Stratigraphy, petrography and major element mineral chemistry of the Wadi Qutabah Layered Mafic Complex, Yemen

by

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Abstract

Little is known about the recently discovered Wadi Qutabah Layered Mafic Intrusion in Yemen. It possesses significant potential for the discovery of economic platinum-group element (PGE) and Ni-Cu-Co mineralization, and is believed to be part of the larger Suwar-Wadi Qutabah Layered Mafic Complex. The intrusion was recently dated as being Neoproterozoic in age (~638.5Ma). The current estimated size of the complex is ~250km^2. Mineralization has been identified in the Suwar area which lies ~30km to the southeast of Wadi Qutabah. Anomalous platinum mineralization was identified in stream sediment samples that run off of the Wadi Qutabah intrusion. Little is known about the stratigraphy, mineralization, layering and geochemistry of the rocks from Wadi Qutabah. Drill cores from 14 drill holes were used to study the stratigraphy, petrography and mineral chemistry of the Wadi Qutabah intrusion. Methods employed were drill core logging, petrographic analysis and mineral grain analyses using the Scanning Electron Microscope (SEM/EDS). Rocks from the Wadi Qutabah intrusion are medium to coarse-grained cumulate norites and gabbros with minor anorthosite, pyroxenite, and localized massive sulphide layers. Correlation of the layering was accomplished in a broad scale as a result of modal and phase layering, stratigraphic position and textural variations. Lithological unit codes were created for the purposes of correlation and identification for this study. Each of the units/layers is host to unique textures, mineralogy and stratigraphic position. They correlate across stratigraphy from drill hole to drill hole, but lateral changes in alteration and thickness are common. Significant changes in chemistry occur at the top of unit 5a (augite norite) which occurs in the middle of the section. The reversal in chemistry towards more primitive compositions up stratigraphy, are the result of injection of new hot primitive magma. Comparison of the mineralogy and chemistry of the Wadi Qutabah intrusion with other layered intrusions indicates that the complex is >2km in thickness and that there are prospective areas for PGE mineral exploration. Discriminant analysis of augite composition suggests that the magmas are derived from within plate tholeiites. A composite stratigraphic column yields a section ~500m thick in the area.

Preface

The work conducted in this thesis is based on the information and drill core provided by Cantex Mine Development Corporation. They had the drill core shipped from Yemen, and presented me the opportunity to work these rocks. This is a significant opportunity to work on a newly discovered layered mafic intrusion with potential for the discovery of an economic mineral deposit. This could not be passed up.

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List of Abbreviations

The following abbreviations are common in the literature and may appear in the thesis. They are most commonly used here for the purposes of drill core logging, petrographic descriptions, and figure and table descriptions.

Act: actinolite
Altd: altered
Altn: alteration (altn)
Amph: amphibole
An: anorthosite (lithology code)
An%: anorthite % of plagioclase
Apat: apatite
Aug: augite
Avg: average
BCON: brecciated contact
BFLT: brecciated fault
Bio: biotite
Ble: bleaching
BRX: breccia
Carb: carbonate/calcite
Chl: chlorite
CON: contact
Cpx: clinopyroxene
Cpy: chalcopyrite
Cr or cr: coarse
DYK: dyke
Epi: epidote
Fcarb: iron carbonate alteration
FLT/Flt: fault
FLZ: fault zone
FN or fn: fine
FOL/Fol: foliation
FRA: fracture
FRZ: fracture zone
Gab: gabbro
GCON: gradational contact
Gra: graphite
Gran: granite
Hbld: hornblende
Hem: hematite
Ilm: ilmenite
Irreg: irregular
LC: lost core/ no recovery
LIN/Lin: lineation
LIP: large igneous province
LMI: layered mafic intrusion
M or m: moderate
Mag: magnetite
Med: medium
MLIN: mineral lineation
Mus: muscovite
NOR: Norite
Opx: orthopyroxene
Ox: oxidation
PAO: Pan-African Orogeny
Pent: pentlandite
PGE: platinum-group element
Pig: pigeonite
Plag: plagioclase
Po: pyrrhotite
ppl: plane polarized light
Py: pyrite
PYR: pyroxenite
Pyrox: pyroxene
Qtz: quartz
REE: rare earth element
Rl: reflected light
Rut: rutile
S or s: strong
SEM: Scanning electron microscope
Ser: sericite
Serp: serpentine
SHR: shear
SHZ: shear zone
Sil: silica
Sulph: sulphide(s)
TCA or tca: to the core axis
VN or vn: vein
VW or vw: very weak
W or w or wk: weak
Xpl: crossed polarized ligh

Glossary

The following terms will be used to describe the rocks in this study. All definitions provided below are with respect to mafic intrusions, since some of these terms also apply to other rock types and geological features of other intrusions, plutons, etc.

Adcumulate: cumulate rock that contains little to no intercumulus material

Adcumulate texture: results from the growth of the cumulus crystals through diffusion of material from the main body of magma. This causes a gradual reduction of the pore liquid leading to a cumulate that is lacking in intercumulus phases. The intercumulus phases represent <7% of the rock. The grain boundaries of cumulus minerals are all in contact with one another, which may be attributed to overgrowth of the cumulus grains. Grain boundary recrystallization may also be seen

Allotriomorphic/xenomorphic: the rock is comprised primarily of anhedral grains (2005, Lapidus, 2003)

Alteromorph: general term used to describe a primary mineral that has undergone alteration or weathering to secondary products of all shapes, sizes and states of preservation (Delvigne, 1998)

Anhedral: poorly developed crystal without recognizable crystal faces.

Anorthosite: rock containing >90% plagioclase

Biotitization: the replacement of pyroxene +/- amphibole by biotite

Carbonitization: Alteration of the minerals by carbonate rich minerals

Chloritization: the replacement of mafic minerals by chlorite

Compaction: reduced pore volume and an increase in packing

Cryptic Layering: not visibly obvious) is a systematic variation in the chemical composition of cumulus minerals with stratigraphic height in the layered sequence

Cumulate: a rock composed of cumulus and intercumulus minerals that crystallized on the floor, roof and walls of a slowly cooled magma body (in this study, of mafic composition).These rocks are the product of fractional crystallization, in-situ crystallization and to a lesser degree additional processes such as gravitational settling. There are three main types of recognized cumulates that were originally proposed by Wager et al., (1960): adcumulate, mesocumulate and orthocumulate (McBirney, 2009, Wadsworth, 1985, Wager *et al.*, 1960)

Cumulus: Initial crystallizing phases that are typically euhedral to subhedral in habit and generally form the main framework of the rock (Philpotts & Ague, 2009, Wager *et al.*, 1960)

Densification: any process or processes that increases the volume of the cumulus phase(s)

Equigranular: the grains that make up the rock are all approximately the same size

Euhedral (idiomorphic): mineral that is fully developed and is bound by crystal faces

Fractional crystallization: the separation of crystals from a melt

Gabbro: phaneritic mafic igneous rock composed of 10-90% plagioclase + pyroxenes +/- olivine

Graphic: a texture referring to the intergrowth of crystals that create angular wedge shaped forms. This texture may be both macro (graphic) and micro-scale (micrographic).

Heteradcumulate: complex adcumulates, whereby the unzoned cumulus crystals are surrounded by unzoned poikilitic crystals that have essentially the same composition

Heteradcumulate texture/poikilitic adcumulate: occurs when the cumulus crystals are poikilitically enclosed in large unzoned crystal(s) of another mineral (subclass of adcumulates). It is important to note that the two minerals may have the same composition

Hypidiomorphic: the rock is comprised primarily of subhedral grains.

Inequigranular: the grains that make up the rock are a variety of sizes

Intercumulus: Mineral(s) that crystallized from the trapped or interstitial liquid within the initial cumulate framework. The minerals are typically anhedral and have unusual habits, and are a later crystallization product of the intrusion (2005, Best, 2011, McBirney, 1984)

Layer: a stratum of rock of some thickness that has similar internal characteristics

Layering: a series of strata, each of some thickness, that are distinguished by their mineral mode, texture and grain size. There are 3 main types of layering recognized in layered intrusions: modal, phase and cryptic layering (McBirney, 1984, Philpotts & Ague, 2009)

Lineation (mineral): linear structural feature of a rock. Minerals are elongate or oriented with the long axis parallel to the flow direction or the direction of elongation (shear). The elongate grains may also show a preferred orientation in the plane of foliation. Another type of lineation is where there is a preferred orientation of elongate grains in the plane of two intersecting planar features, and is this called an intersection lineation (McBirney & Nicolas, 1997)

Magmatic Differentiation: process/processes that cause the composition of the magma to change (such as during partial melting, emplacement, fractionation, mixing, contamination/assimilation, etc.)

Mesocumulate texture: is an intermediary between orthocumulate and adcumulate, and contains subordinate zoning of the cumulus crystals. The intercumulus phases typically represent 7-25% of the cumulate rock. Many grain boundaries between the cumulus minerals are mutual boundaries

Modal Layering: is characterized by a variation in the relative proportion of the constituent minerals

Nesophitic: The plagioclase is large and the pyroxenes are interstitial

Norite: mafic igneous rocks composed of orthopyroxene and plagioclase +/- clinopyroxene +/- olivine

Oikocryst: the host phenocryst in a poikilitic texture

Ophitic: large pyroxene crystals that enclose smaller plagioclase crystals or laths

Orthocumulate: as a cumulate rock composed of essentially one or more cumulus minerals surrounded by a significant percentage of unmodified crystallized intercumulus liquid (material)

Orthocumulate texture: is defined as cumulus crystal phases enclosed by poikilitic minerals that nucleate from the intercumulus liquid. The crystals typically show normal zoning. Orthocumulate texture contains between 25-50% postcumulus minerals (analogous to lightly packed sediments)

Partition coefficient (D): the distribution of a trace element between a mineral and a melt: D=C min/C liq

Platinum group elements (PGEs): Ru (Z: 44), Rh (Z: 45), Pd (Z: 46), Os (Z: 76), Ir (Z: 77), Pt (Z: 78)

Phase Layering: is characterized by the appearance or disappearance of minerals in the crystallization sequence developed in modal layers

Poikilitic: a host phenocryst contains inclusions of other minerals

Postcumulus: involves the crystallization of the intercumulus liquid and may result in the complete crystallization or recrystallization of the intrusion

Pseudomorph: one or more minerals replace another but retaining the original crystals shape of the original mineral

Pyroxenite: Ultramafic rock containing >90% pyroxenes +/- plagioclase+/- hornblende

Seritization: the replacement of the plagioclase by sericite

Subhedral (subidiomorphic): The crystal form is recognizable but is poorly developed, and is partially bound by well-formed crystal faces

Subophitic: Plagioclase crystals/ laths are larger than the pyroxenes and are only partially enclosed

Texture: the physical character or appearance of a fully crystallized rock and the arrangement of all of its components. These may include grain size, shape, crystallinity, configuration and the relationship of the components at both the macroscopic and microscopic level (Higgins, 2011)

Uralitization: the replacement of pyroxene by amphibole

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Chapter 1.0 Introduction

Layered mafic intrusions or basic intrusions have been the subject of numerous studies over nearly a century. These large, slowly cooled mafic bodies are most often associated with layering, cumulate textures and economically significant platinum-group element (PGE) mineralization. The Bushveld Complex, located in South Africa is the largest known and most well recognized of the large layered mafic intrusions. It is of Precambrian age (2.06Ga) has a thickness of 7-9km and an aerial extent of ~65,000km^2 (Eales & Cawthorn, 1996). The Bushveld Complex is also host to the largest known deposits of Cr, V and platinum-group metals (PGMs) in the world (Clarke *et al.*, 2009). Of these, the Bushveld complex is host to ~95% of the known global reserves of platinum group metals (PGMs) (Survey, 2012). Other significant layered intrusions include the Stillwater Complex (Montana), the Noril'sk-Talnakh (Russia), the Great Dyke (Zimbabwe), the Skaergaard Complex (Greenland) and the Lac Des Iles Complex (Ontario), each of which is host to economically significant mineralization. These large mafic intrusions are desirable targets for mineral exploration and a subject of interest for economic geologists.

Cantex Mine Development Corporation recently discovered two previously unknown layered mafic intrusions in northwestern Yemen: the Suwar and Wadi Qutabah layered mafic Complexes. There is potential for these intrusions to host economically significant mineralization (Ni, Cu, Co, Pt-Pd). The Suwar Intrusion lies ~30km to the southeast of the Wadi Qutabah Complex, and is currently known to be 32km in length and 8km in width (Corporation, 2012a). The known extent of the Wadi Qutabah intrusion is 23km^2, with mineralization being traced for more than 19km in outcrop. Mineralization in the Wadi Qutabah Complex is composed of five known sulphide horizons hosted in noritic to gabbroic rocks. Anomalous platinum mineralization was identified in samples/concentrates from drainages that cut the intrusion. The discovery of anomalous platinum suggests that the Wadi Qutabah Intrusion may be host to an undiscovered platinum deposit (Corporation, 2012).

A drill program undertaken in 2007 was completed on the Wadi Qutabah intrusion in hopes of identifying the source of the anomalous platinum. A total of 14 drill holes were completed in 3 areas, for a total of ~1650m of drill core. It is these drill cores from the Wadi Qutabah Layered Mafic Intrusion that are the focus of this study.

There is little information available on the Wadi Qutabah and Suwar intrusions. The information on the region is largely a result of mapping, sampling, drilling and geophysics conducted by geologists from Cantex Mine Development Corporation. The gabbroic complex intrudes Precambrian or late Proterozoic amphibolite-facies paragneisses that are exposed in the south, and overlain by flat lying Phanerozoic sedimentary cover and Permian shales. The intrusion is also cut by a Tertiary diabase dyke that runs near north-south.

Stratigraphy of the Wadi Qutabah intrusion has been mapped on the large scale. It is broken into 3 distinct sequences based on plagioclase and ferromagnesian mineral content. Each of these sequences is also host to sulphide mineralization which is believed to be conformable to the layering. These sulphide rich layers are recognized in the exposed rock as gossans that reflect surface oxidation. Cantex geologists recognized the more leucocratic nature of the rocks up stratigraphy, suggesting that these rocks are more evolved than those seen at the Suwar intrusion (Corporation, 2012, Plank *et al.*, 2007).

The recent study by Greenough *et al*., (2011) is the only published work on the Suwar and Wadi Qutabah intrusions, and the first dates by U-Pb isotope dilution- thermal ionization mass spectrometry (ID-TIMS) published on any rocks from Yemen. Results of the study returned dates of 638.58±0.51Ma for Wadi Qutabah and 638.46± 0.73Ma for Suwar, which are indistinguishable within analytical error, suggesting that these intrusions are coeval/comagmatic or part of the same intrusion. The geochemical results suggest that the magma source of these rocks is plume related, involved melting of Archean subcontinental lithosphere, and that this region experienced an extensional tectonic regime at the end of the Neoproterozoic (Greenough *et al.*, 2011).

Rocks in the Suwar intrusion are olivine rich (Greenough *et al.,* 2011). Olivine cumulates are generally found at the base of large layered mafic intrusions. No olivine was identified in the rocks from the Wadi Qutabah intrusion, which suggests a more evolved magma composition up stratigraphy from which these rocks crystallized. The evidence presented by Greenough *et al.,* (2011) and the more evolved composition of the Wadi Qutabah intrusion compared to the Suwar suggests that they are part of the same intrusion. They will be treated as a single intrusion for the remainder of the text.

The discovery of a large layered mafic intrusion of Neoproterozoic age in Yemen has some important implications for the region. The estimated size of the complex is ~250km^2, which places the intrusion among the largest layered mafic intrusions discovered to date. In the case of layered mafic intrusions, the bigger the better, since the larger size increases the economic potential of the complex, and makes this a desirable target for mineral exploration (Best, 2011, Greenough *et al.*, 2011). The formation of large layered mafic intrusions requires significant volumes of mafic magma be generated as a result of melting in the upper mantle (Mungall, 2005). The most widely accepted genetic origin of these magmas is from mantle plumes and zones of crustal rifting (Bryan & Ernst, 2007, Mungall, 2005). The large volumes of magma and the tectonic setting suggest a close genetic relationship between layered mafic intrusions and large igneous provinces (LIPs) (Mungall, 2005). A plume origin for the Suwar-Wadi Qutabah layered complex was proposed by Greenough *et al.*, (2011). Perhaps the Suwar-Wadi Qutabah Complex is part of a larger system, potentially a new large igneous province.

An important factor in the formation of economically significant Ni, Cu, Co, platinum-group elements (PGEs) mineralization is the high degrees of melting required to generate mafic magmas. The concentrations of compatible elements such as Ni, Cu, Pd and Au increase as sulphide returns or is dissolved in the melt with increasing degrees of partial melting. This leads to the formation of enriched magmas. Economically viable PGE and Ni-Cu-PGE deposits require that processes must operate to concentrate these elements from large volumes of magma into a small volume of rock. The main collectors of these elements are sulphide liquid and chromite (Mungall, 2005).

Layered mafic intrusions are also important for the study of magma chambers. Exposures of these deposits offer unique opportunities to study the evolution of magmas, and the processes and mechanisms involved in crystallization, cooling, magma chamber replenishment, assimilation, and late stage processes such as hydrothermal alteration/metasomatism, and metamorphism (Campbell, 1996, Hunter, 1996, Naslund & McBirney, 1996). One of the pivotal publications on layered intrusions is that of Wager & Brown, (1968) entitled “Layered igneous rocks”. In this publication, the authors present a detailed study of the geology, petrography, mineralogy, textures and geochemistry of the Skaergaard Complex in Eastern Greenland. This critical work describes the features of the intrusion, mechanisms of differentiation and suggests possible fractionation trends of the liquid composition as a result of crystallization (Wager &

Brown, 1968). Even today, the Skaergaard intrusion is the subject of many geological studies, with a number of questions that still remain unanswered.

Cumulate terminology was developed by L.R. Wager, G.M. Brown and W.J. Wadsworth, in their paper entitled "Types of Igneous Cumulates" published in the Journal of Petrology, 1960. The new cumulate terminology was used to describe igneous rocks that formed by crystal accumulation. This was designed to replace the term 'primary precipitate crystal' that was in use up to that time. In the literature, cumulate terminology is synonymous with layered mafic intrusions and the description of the rocks which they contain (Hess, 1989, Holness *et al.*, 2007, Hunter, 1996, Irvine, 1982, Wadsworth, 1985, Wager *et al.*, 1960).

Formation of cumulate textures and layering are the result of processes occurring in the magma chamber during differentiation. Some of these processes include fractional crystallization, new magma injections, mixing, contamination, changes in the intensive parameters (temperature, pressure, and oxygen fugacity), etc. (Hunter, 1996, Naslund & McBirney, 1996, Robb, 2005).

Layering in mafic intrusions consists of sheet like units that are distinctive in their mineralogy, composition and/or textural features (Hess, 1989). Layers vary in thickness, composition, texture, internal structure, shape and/ or form (Irvine, 1982). Layering occurs in a number of different textural and compositional modes, such as in modal layering; which is characterized by a variation in the relative proportion of the constituent minerals. Phase layering is characterized by the appearance or disappearance of minerals in the crystallization sequence developed in modal layers. Cryptic layering (not visibly obvious) is a systematic variation in the chemical composition of cumulus minerals with stratigraphic height in the layered sequence. A rare type called size graded layering shows a smooth and gradual variation in the grain size of cumulate minerals. The regularity of layering may also vary from one location to another, or within the same intrusion. Layering can be rhythmic showing a repetitive sequence of distinctive layers. Rhythmic layering can be microscopic; microrhythmic (on the millimeter-centimeter scale) to macroscopic; macrorhythmic (on the meter scale), or intermittent demonstrating irregular patterns of layering. There are numerous types of layering described in the literature, but the above terms are the most common and widely used (Best, 2011, Hess, 1989, Irvine, 1982, Naslund & McBirney, 1996, Sen, 2001, Wager, 1953).

What we know today about large layered intrusions is a result of studies on a small number of large, ore bearing intrusions, which include: the Bushveld Complex (South Africa), the Stillwater Complex (Montana, USA), the Great Dyke (Zimbabwe), Noril'sk-Talnakh (Russia) and the Skaergaard Intrusion (Greenland). All of these with the exception of the Skaergaard are Precambrian in age (Best, 2011). The discovery of a new large layered mafic intrusion of Neoproterozoic age is an opportunity to study a new and younger magma chamber, and to test models for formation, mixing, magma chamber replenishment and mineralization.

One of the critical pieces of information necessary in the study of these intrusions is an understanding of the stratigraphy. Even a basic understanding of the size, layering and chemical variation is an opportunity to compare with other intrusions to determine stratigraphic position and make predictions on the location of possible mineralization. Mineralogical, textural and chemical variations occur over stratigraphy as a result of the processes and mechanisms that take place in the magma chamber during the cooling and crystallization of the intrusion. Some trends in mineralogy and chemistry are predictable as a result of fractionation and the crystallization of early crystallizing minerals (e.g. olivine). Some of these include a progressive trend of iron enrichment with stratigraphic height (Veksler, 2009), increasing incompatible element concentrations in the residual liquids, and a general trend towards a more evolved or more felsic composition with stratigraphic height (McBirney, 1996).

Knowing stratigraphic position is important in the search for mineral deposits. Economic mineralization is generally found in the stratigraphic centre of large intrusions. There are a few exceptions, where mineralization is found at the base of the intrusion and above the stratigraphic middle, but these are generally sub-economic. There is one significant exception: the Platreef in the Bushveld (Cawthorn, 2005), where the mineralization lies along the floor (at the base) in the northern part of the intrusion (Lee, 1996).

The estimated thickness of the Suwar-Wadi Qutabah Complex is a least 400m (Greenough *et al.*, 2011), in which Suwar is considered near the base and Wadi Qutabah lies up stratigraphy, but where, is the question. The full size and extent of the intrusion is unknown, as a result of erosion and sedimentary cover. Therefore, we can only estimate the size and stratigraphic position of these rocks. Understanding the stratigraphy of the intrusion allows for better estimation of stratigraphic position, and proposing areas for mineral exploration. It is also a starting point in our understanding of magma chamber processes and mechanisms that occurred in this intrusion.

Currently there is little known of the stratigraphy of the Suwar-Wadi Qutabah Complex. The primary objective of this study is to establish a broad scale stratigraphy of the Wadi Qutabah intrusion and to use this stratigraphy to make inferences about stratigraphic position, economic and tectonic significance and suggest possible target areas for mineral exploration.

The 14 drill holes from the 2007 drill program from the Wadi Qutabah mafic intrusion are used for the purposes of correlation, petrographic study and geochemical analysis. Original data and samples were collected during drill core logging; petrographic thin sections were created from selected samples and subsequently studied. The petrographic thin sections were used for major element analyses. The Tescan Mira3 XMU Scanning Electron Microscope (SEM) was used to obtain major element analyses of in-situ mineral grains in petrographic thin sections.

Geology, mineralogy, textures, layering, contact relationships, petrographic study, stratigraphic position and geochemistry are employed to create composite stratigraphic sections of the intrusion. Correlation of the layers, stratigraphy and geochemistry are presented over elevation, and comparisons to other famous intrusions are presented to infer stratigraphic position in the rocks from the Wadi Qutabah Complex. The geochemistry of augite is also used to examine the paleotectonic affinity of the magmas from which the intrusion is derived.

Results of this study are a starting point for any future work on the Suwar-Wadi Qutabah intrusion, and are beneficial for mineral exploration and may contribute to the discovery of a world class mineral deposit.

Chapter 2.0 Geological and Tectonic Setting

2.1 The Arabian Plate

Yemen is located on the Arabian Plate, which is one of the youngest and smallest of the tectonic plates. It formed approximately 25-30million years ago as a result of rifting that lead to the separation of Africa and Arabia, and the formation of the Red Sea and the Gulf of Aden (Johnson, 1998, Stern & Johnson, 2010). The plate is bordered by the Eurasian plate to the north, the Indian plate to the east and the African plate to the south and west. The northern border is a convergent boundary, whereas the border with the African plate is a divergent plate boundary, along the Red Sea Rift (Stern & Johnson, 2010).

2.2 Regional Geology and Tectonic Setting

The geology of Yemen spans from the Achaean to the Cenozoic (Khanbari & Huchon, 2010). The Precambrian basement of Yemen is an important link in the understanding of the assembly of Gondwana during the Pan-African Orogeny ~870-550Ma (Kroner & Stern, 2004, Whitehouse *et al.*, 2001).

The formation of the Arabian-Nubian Shield (ANS) is tied to a supercontinent cycle, and begins with the breakup of Rodinia, and ends with the assembly of east and west Gondwana to form Greater Gondwana. The Juvenile crust of the Arabian-Nubian Shield is believed to have been generated in arc systems that were later accreted to the western margin of Gondwana. Generation and accretion of these arcs and microcontinental terranes occurred from ~870-630Ma, (Li *et al.*, 2008, Stern & Johnson, 2010) and from ~660-620 Ma collisional tectonics along the western margin of Gondwana resulted in continental orogenesis. Following orogenesis, the ANS experienced an extensional regime from ~620-540Ma (Stoeser & Frost, 2006).

The Arabian-Nubian Shield (ANS) refers to the basement of northeast Africa and western Arabia, and is the northern part of the East African Orogen (EAO) (Abdelsalam & Stern, 1996). The Arabian Shield is located in western Saudi Arabia and Yemen, and is comprised of a series of geologically distinct terranes (Fig. 2.1 and 2.2). These comprise three island arc systems (Asir, Hijaz, Midyan) joined by island-arc-island-arc suture zones to the west, and terranes (Afif, Ad Dawadimi (Al Amrar), Ar Rayn) of continental origin separated by an orogenic belt in the East (Stern & Johnson, 2010, Stoeser & Camp, 1985). The Asir terrane is also referred to as the

Asir composite terrane, which contains a number of arc terranes. These include from east to west the Amlah (~720Ma), Tathlith-Malahah (660-700Ma), Al Qarah (715-740Ma), An Nimas (780-850Ma), Bidah (>800Ma) and the Jiddah (760-870? Ma) arc terranes. The Paleoproterozoic Afif terrane is also a composite terrane and is composed of 2-3 ensimatic arc terranes and the Khida terrane which is underlain by continental crust. The Afif composite terrane includes the Khida (740-760Ma) in the south, and the Sawdah (670-695), Saqrah (720~740Ma), and the Siham (680-~715Ma) in the north (Stoeser & Frost, 2006). Some of the terrane boundaries are marked by the presence of ophiolite sequences. These range in age from ~690-870Ma (Stern & Johnson, 2010). Accretion of these terranes through collisional tectonics occurred from 715-630Ma, which resulted in the formation of the Arabian Neocraton (Stoeser & Camp, 1985). The accreted arcs resulted in a series of NNE/NE trending terranes (Whitehouse *et al.*, 2001). Magmatism and intracratonic deformation continued and resulted in the formation of large scale left-lateral fault systems. These systems are responsible for the displacement of the northern part of the Shield ~250km to the northwest, and are part of the Pan-African Orogeny (Stoeser & Camp, 1985).

Age of the arc assemblages of the Arabian Shield shows a progressive younging of terranes eastward (Fig. 2.1).The oldest of the arc terranes is of Neoproterozoic age (>800Ma) located in the west. It is bordered by younger arc terranes to the east and north, with the youngest of these lying farthest to the east (the Ar Ryan Terrane, 620-700Ma) (Stern & Johnson, 2010, Stoeser & Frost, 2006).

The suture zones between these terranes may be significant complex structural features, which locally include ophiolite sequences that represent hundreds of kilometers of displacement. A study of the Nabitah Suture zone in Saudi Arabia revealed that there is significant left lateral displacement with major components of strike-slip movement, which would suggest that there is a component of oblique convergence that played a role in the assembly of the Arabian shield (Quick, 1991). Recognition of these large scale structural features and their direction(s) of movement will be important clues to a more conclusive correlation of the terranes of the Arabian Shield.

Some controversy remains about the igneous rocks that date from 850-750Ma in these terranes. It has been suggested that they represent arc volcanism, while others suggest that they formed as a result of continental extension with contributions from underplating plume magmatism, oceanic plateaus, and arcs related to plume activities (Li *et al.*, 2008).

2.3 Arabian Shield in Yemen

In Yemen, the accreted terranes are from west to east the Asir (continental), Afif? (continental), Abas (continental), Al-Bayda (island arc), Al-Mahfid (continental) and Al-Mukalla (island arc) (Fig. 2.2). Each of these terranes is bordered by a suture zone that is comprised of ductile and brittle deformation (Stoeser & Camp, 1985, Whitehouse *et al.*, 2001). Correlation of the terranes from north to the south is difficult, and hindered by a scarcity of geological and geochronological data. There are also significant changes in the orientation of the terranes and structures from Saudi Arabia in the north to Yemen in the south (Stoeser & Camp, 1985, Windley *et al.*, 1996). Johnson & Stewart, (1996) proposed a correlation of these terranes, but a great deal of uncertainty remains due to the scarcity of data and reliable radiometric dates, as well as the potential for unrecognized faults and structures from the North to the South (Johnson & Stewart, 1996). Additional information is required to verify the correlation with greater certainty (Jackson, 1980).

The Precambrian basement of Yemen is sandwiched between a collection of accreted arc terranes (Whitehouse *et al.*, 2001). U-Pb dates of zircons from gneisses of the Al-Mahfid terrane confirmed the presence of Archean crust (~2.95-2.55Ga) and a minor Archean component in the Abas terrane (~2.6Ga)(Whitehouse *et al.*, 1998).

The Asir and Afif (composite) terranes of Saudi Arabia have been correlated to the northwestern terranes of Yemen (Fig. 2.2). The Nabitah Suture Zone and orogenic belt is believed to be the boundary between the two terranes. Extensive plutonism and high-grade metamorphism is recognized in the Nabitah orogenic belt (Windley *et al.*, 1996). The Asir terrane, located along the western margin of Yemen, is composed of intercalated greenschist facies volcanics, high grade gneisses and sediments. Two episodes of arc magmatism are recognized in this terrane. The Afif terrane is composed of post-orogenic granites, volcanics and sediments that unconformably overlie the crystalline basement (Stoeser & Camp, 1985). In Yemen, the Afif terrane is recognized as orthogneisses intercalated with arc-type volcanics and intruded by undated post-tectonic intrusions (Windley *et al.*, 1996).

The breakup of Gondwana (~180Ma)(Kearey, 2001) led to the formation of large fault systems, and rift basins in the central and interior of Yemen. The orientation of these rift basins appears to reflect acquired Precambrian structural trends (Redfern & Jones, 1995).

The accreted terranes in Yemen are overlain by Phanerozoic sedimentary cover. The cover varies in extent and thickness throughout the Arabian plate and the Arabian Shield. There are abundant exposures of the crystalline basement in the western Arabian Peninsula, but few to the east. This is the result of regional uplift of the western margin of the Arabian plate associated with rifting in the Oligocene-Miocene, associated with emplacement of the Afar plume (Menzies *et al.*, 1997). Regional uplift gave rise to the Yemen highlands, which reach 3660m in elevation (Davison *et al.*, 1994), and rifting resulted in the formation of the Red Sea and the Gulf of Aden, and the separation of Africa and Arabia (Stern & Johnson, 2010).

In the Oligocene-Miocene, magmatism associated with the Afar plume gave rise to the formation of continental flood basalt volcanism in the region of the African-Arabian triple junction. Volcanism resulted in the deposition of ~350 000km^3 of flood basalts and rhyolites (Baker *et al.*, 1998). These subaerial flows in Yemen are known as the Yemen Large Igneous Province or as the Yemen Traps (part of the Yemen volcanic group), and characterize part of the western region of Yemen. The eastern part is characterized by Tertiary deposits of carbonates, shales and sandstone sequences, and thus represents a non-volcanic margin (Khanbari & Huchon, 2010). The western margin of Yemen is characterized by a series of distinct rock types. A simplified list includes the metamorphosed Precambrian basement that is unconformably overlain by Phanerozoic sedimentary cover, which is overlain by the Yemen volcanic group (incl. the Yemen Traps), and intruded by syenitic, granitic and gabbroic bodies (Menzies *et al.*, 2001).

2.4 Geological Setting of the Wadi Qutabah Intrusion

The Wadi Qutabah intrusion is located approximately ~70km northwest of Sana'a, along the border of the states of Hajjah and Amran, in Yemen (Fig. 2.2). The intrusion is a layered noritic-gabbroic complex that intrudes late Proterozoic amphibolite-facies paragneisses, and is unconformably overlain by Phanerozoic sedimentary cover. These include the Akbarah shales (lower Permian), the Kuhlan sandstone (lower Jurassic) and the Amran limestone (lower to middle Jurassic) (Plank *et al.*, 2007). The Wadi Qutabah intrusion is located on the western edge of the Afif/Asir terrane (Greenough *et al.*, 2011, Whitehouse *et al.*, 1998, Whitehouse *et al.*, 2001, Windley *et al.*, 1996). These have been interpreted as accreted arc terranes of the Pan-

African Orogeny (PAO), related to the assembly of Gondwana (Stoeser & Camp, 1985). The basement of the Afif terrane is believed to be continental in origin (~2.4-1.65Ga) (Whitehouse *et al.*, 1998, Whitehouse *et al.*, 2001).

The Wadi Qutabah the intrusion covers an area of $23km^2$ (current known extents), and the sulphide horizons can be traced for more than 19km in the rugged mountainous terrain (Corporation, 2012). The full extent of the intrusion is currently unknown as a result of sedimentary cover, and the significant geographical area that it underlies. Numerous structural events have affected the intrusion. It is cut by large scale faults that have been identified through surface mapping, the extent of which are not fully determined. The direction and the magnitude of movement along these planes are also uncertain (Plank *et al.*, 2007).

A study of aerial photographs, accompanied by field work in the Hajjah district by Heikal, (1989) shows that the structural trends are dominated by faulting, and not folding. The Precambrian rocks in the area have a dominant WNW and NW fracture pattern believed to be related to the Najd fault system (NW-SE wrench faults) of late Proterozoic-Cambrian age (630-560Ma possibly to 530Ma) (Heikal, 1989, Kroner & Stern, 2004, Redfern & Jones, 1995).

Numerous faults and fractures were identified in the drill cores from the Wadi Qutabah Complex, most of which are host to chlorite alteration. They show slickenside surfaces, and locally contain carbonate alteration. Surface mapping by Cantex Mine Development Corporation (Cantex) geologists suggests that there are multiple large scale faults that cut the intrusion at various orientations, but there is a slightly dominant orientation of NNW-SSE, and a series of large scale faults that run NE-SW (Plank *et al.*, 2007).

Geological surface maps compiled by geologists from Cantex show that the noritic-gabbroic complex extends beyond the drilling completed in 2007 (Plank *et al.*, 2007). To verify the extent of the complex, additional mapping and diamond drilling would be required. Where there is extensive sedimentary cover, other methods would be needed such as geophysical surveys.

The rocks used for this study represent a significant geographical area of approximately 5km (E-W) x 4km (N-S). The rocks come from diamond drill cores collected in 2007 with the purpose of identifying any platinum-group element type mineralization.

The Wadi Qutabah layered mafic complex is believed to be part of the ore bearing Suwar intrusion located ~30km to the southeast (Corp., 2011, Greenough *et al.*, 2011). The two localities were recently dated using high-precision U-Pb isotope dilution-thermal ionization mass spectrometry (ID-TIMS) at 638.58±0.51Ma for Wadi Qutabah and 638.46± 0.73Ma for Suwar. These two dates are indistinguishable within analytical error, suggesting that the two localities are part of the same system, and hence the same intrusion (Greenough *et al.*, 2011). Geophysical surveys of the region have identified a number of new targets of considerable size in proximity to the Suwar and the Wadi Qutabah intrusions, suggesting that there may be significant extent to the complex which is not exposed at surface (Corp., 2011).

Evidence presented by Greenough *et al*., (2011) suggests that the Suwar and Wadi Qutabah intrusions are related to plume activity. Mantle plumes generate large volumes of magma and have been attributed to flood basalts, large oceanic plateaus, large dyke swarms, sills and mafic-ultramafic intrusive provinces, such as the Bushveld (Bryan & Ernst, 2007). The significant volumes of magma required for the formation of large layered mafic intrusions, would suggest an increased possibility for the formation of economically significant PGE+/-Ni+/-Cu+/-Co mineralization (Mungall, 2005).

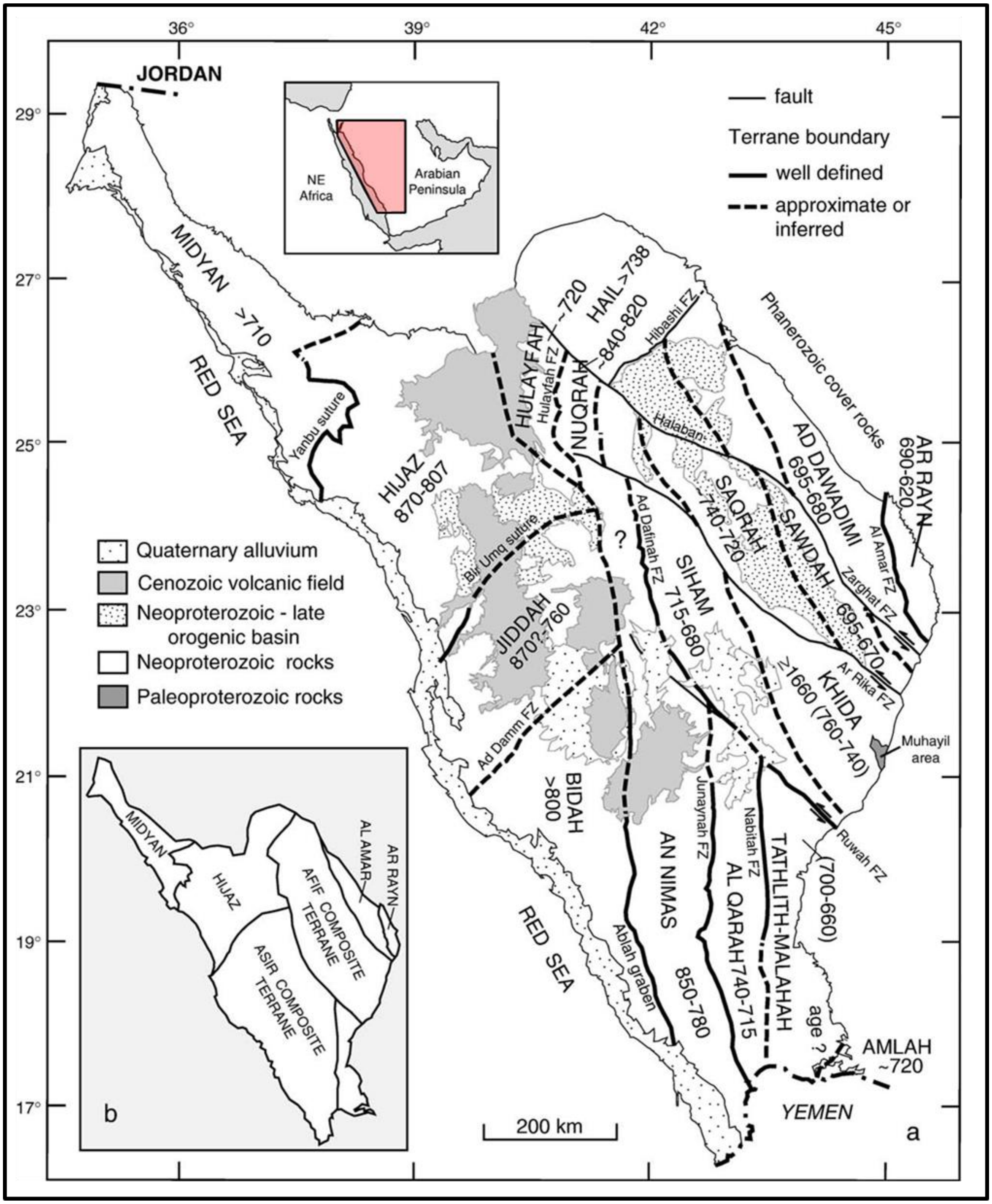


Figure 2.1. Terrane map of the Arabian Shield in Saudi Arabia (a) according to (Stoeser & Frost, 2006), with protolith ages given in million years (Ma), ages in parentheses are younger arc assemblages emplaced into older protoliths. (b) Terranes from the Arabian Shield as defined by (Stoeser & Camp, 1985). Figure modified from Stoeser & Frost, (2006) (Fig 1, p.164).

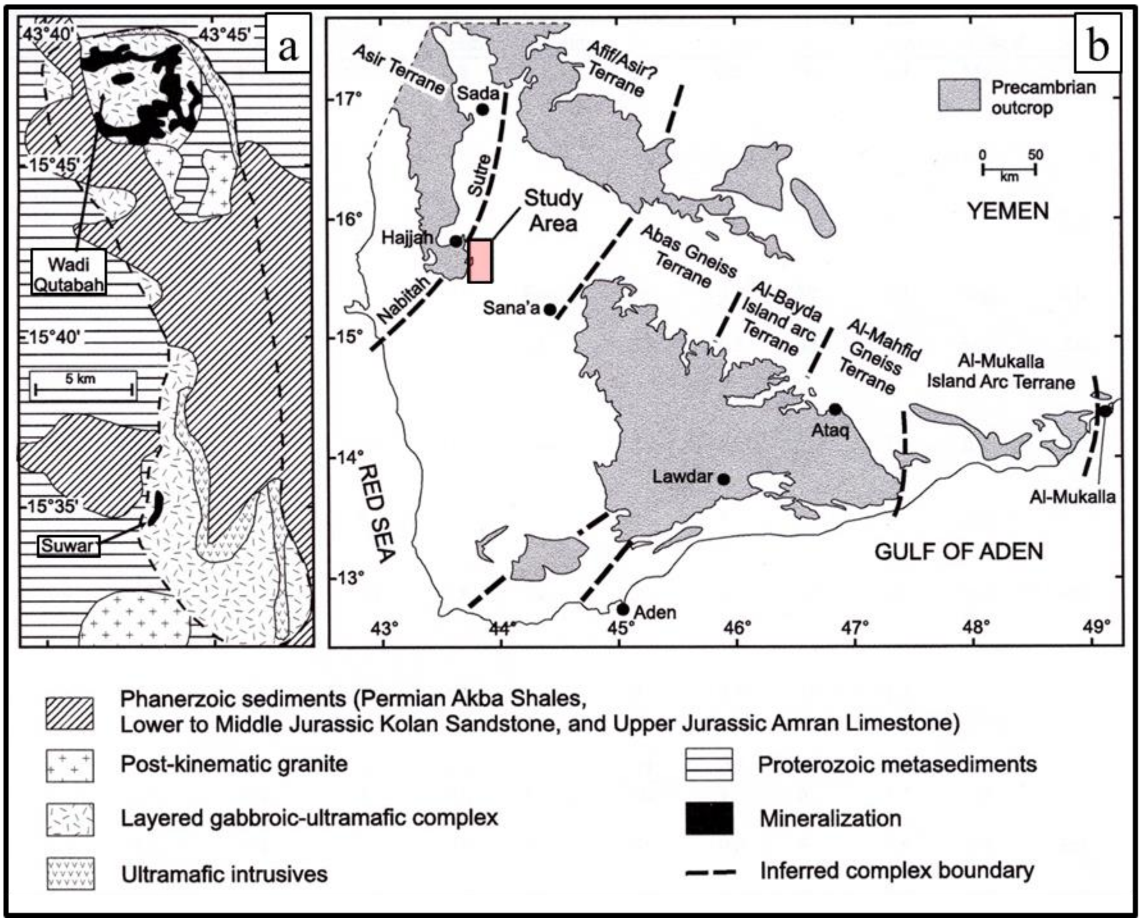


Figure 2.2. Simplified map showing the geology and location of a) the Wadi Qutabah and Suwar intrusions, and b) a map of Yemen with the locations of the Precambrian outcrops and delineation of terranes boundaries. (a) Reproduced from Greenough *et al*., (2011); (b) map modified from Windley *et al*., (1996) with additional information from Whitehouse *et al*., (2001).

Chapter 3.0 Diamond Drill Core

3.1 Diamond Drill Core: The Samples

A total of 14 diamond drill holes were shipped from Yemen to Kelowna for the purpose of this study. The diamond drill holes were completed in 2007, and stored in Yemen until shipped to Canada in 2011. The purpose of the drill program was to follow up on anomalous platinum assays returned from stream sediment samples collected from drainages that cut the Wadi Qutabah Layered Complex, in hopes of identifying the mineralized horizons hosting the platinum bearing phases.

The 2007 drill program consisted of 14 drill holes (Table 3.1) completed in 3 different areas (Fig. 3.1). Holes H-01 to H-06 complete a fence of holes drilled from the northeast towards the southwest in the east of the intrusion. Hole Hp-09 was drilled as a standalone hole, in the western part of the intrusion. Holes Hp-07, Hp-08, Hp-10 to Hp-12 and Hp-12A were drilled in the southwest, and form a fence of holes along a roughly E-W direction. The total length of the drill core is 1648.93m, with 846.39m from the eastern holes, Hp-09 is 130.02m in length and the southwestern holes (or western holes) total 672.52m (Table 3.1 & Fig 3.1).

The drill holes from this project span an area of approximately 5km from East to West, and approximately 4km from North to South, and an elevation of approximately 800m (vertical). The drill holes are all vertical. There is significant variation in the starting elevation of each hole, largely due to the variable topography of the mountainous terrain.

The core size is also variable down hole. Some of the drill holes were started in NQ (5cm diameter core) and then reduced to BQ (3cm diameter core), and some were drilled entirely in BQ, likely due to the quality of the rock being drilled. Drill core diameter impacts sample size. This would be of great concern for a large scale exploration program interested in reliable assay results, but is of little importance here.

One feature that is worth noting for the purposes of exploration and future work on this intrusion is the presence of oxidation in the upper ~28m of drill cores. Oxidation depth is variable, but is most intense in the upper parts, which affects the alteration, presence of sulphides and oxides, as well as the competency of the rock. Oxidation of sulphides is important for surface mapping, since these mineralized horizons are identified as gossans.

3.2 Diamond Drill Core Logging: Procedures

The fourteen diamond drill holes were logged in a secure outdoor storage yard at C.F. Mineral Research Ltd., in Kelowna. Each box of drill core was taped shut prior to leaving Yemen. This added an additional measure of security, and ensured that no core was lost during transport.

Logging was performed outside, and data were recorded directly into a series of spread sheets in Microsoft Excel. Information recorded includes lithology, mineralogy, contact relationships, textures, grain size, structure, mineralization, alteration, veining, RQD and sampling location and numbers. Additional information on lost core, drilling problems, previous sampling and mixed core were also recorded. Finally, photographs of the drill cores were taken using a Kodak handheld 8.0 megapixel camera. These record the contents of each box and sample locations for future reference.

Standard exploration methods were used for sampling. Since this is exploration drill core, only half of the core was used for sampling. Using a synthetic diamond impregnated saw blade the core was cut lengthwise along the core axis into two equal halves. One half remains in the core box and the other half is the sample. The drill core was marked with a red grease pencil at the start and end of the sampled sections. Depth was recorded in the drill log and also written on the drill core. Tags were prepared for each sample and consist of three parts in a book. The initial tag is the sample record, where sample information is recorded such as depth, type of sample, hole number, date and any important notes. The first tag is part of a book, and is stored separately from the drill core, and remains a record of the sampling. The second tag is removed from the book and resides in the box with the remaining drill core (half core) as a record of sampling. The third tag is removed from the book and is placed with the sample in a sample bag, as a record of the sample number and then the bag is sealed.

Sample selection was of great importance to the completion of the project. The focus of the work is to garner a better geological and geochemical understanding of the Wadi Qutabah intrusion, and to provide a correlated stratigraphy of the layering. Samples were selected to thoroughly reflect all of the lithologies, textures and mineralization seen in the 14 diamond drill holes. Some samples were also selected for their stratigraphic position or similarities to samples from previous holes.

Cut samples were stored at C.F. Mineral Research Ltd. until logging of the entire drill core was complete. Secure storage was also arranged at the University (UBCO). The samples were transported directly from C.F. Mineral Research Ltd. to the CFI lab (FIP144), where they were placed in a locked cabinet.

Logging of the diamond drill core was completed in August and September, 2011. Logging took longer than anticipated due to weather (reaching temperatures of 40°C+ in the paved yard) and the challenge of completing the tasks alone ((moving the boxes ~40-60lbs each), logging, cutting, and photographing the drill core and duties at school.

3.3 Diamond Drill Core Logging: Summary

3.3.1 General Features

A summary of the logging conducted on the Wadi Qutabah layered gabbroic complex is presented below. For full drill logs, see appendices B to H.

Logging revealed the presence of multiple lithologies that show variations in texture, grain size, mineralogy, alteration and the presence of numerous faults and fracture zones. Some characteristics are large scale features that would not be noticed on the single drill hole scale. The large geographical area that the drill holes represent provides a significant window into the structure and nature of the lithologies of the intrusion.

The mafic complex consists of a series of cumulate layers composed of norites, gabbros, semi-massive to massive sulphides, anorthosites and pyroxenites of varying thickness, grain size and abundance. There is a general trend towards more felsic compositions with increasing elevation (up stratigraphy). Plagioclase and orthopyroxene are the most common cumulate phases, but can also be intercumulus or post cumulus phases. The pyroxene content is highly variable from <1% up to >50% (visual % from logging). Augite is present but generally intercumulus.

Most lithologies are medium-grained (grains are 1-5mm in length), with weak alteration (carbonate +/- chlorite+/- biotite). Coarse-grained gabbros and norites also occur but they are not as abundant as medium-grained layers. Coarse-grained gabbros and norites locally host massive sulphide and sulphide mineralization and what appear to be small magnetic dykes.

3.3.2 Layering

Layering generally falls into two categories: modal layering and phase layering. Modal layers show distinct changes in the proportion of minerals, such as the modal proportion of plagioclase, which is locally highly variable. Phase layering was also seen but to a lesser extent. Minor size grading was also noted, but it is uncertain if these variations are primary or a result of secondary crystal growth or textural equilibration. Cryptic layering may be present, but this can only be ascertained through analytical methods.

Layers of anorthosite/ leuco norite/leuco gabbro are present in some of the drill holes and reach up to ~8m in thickness, but are typically <1m. Drill hole Hp-09 is unusual. It hosts what appears to be cyclical layering from ~100m to end of hole at 129.76m. The cycles contain repetitive layers of coarse-grained gabbro and anorthosite/leucogabbro. Thus rocks in Hp-09 may represent a different part of the intrusion, perhaps higher in elevation, or they may have formed in an isolated part of the intrusion.

The presence of plagioclase rich layers is a common feature of the norites and gabbros. These are most common in the lithologies in the upper part of the stratigraphy. Plagioclase rich layers or plagioclase segregations (anorthosite to leuco gabbro/norite in composition), vary in thickness, but the grain size is generally similar to the lithologies above and below these layers. The contacts are gradational, and irregular. No distinct pattern or cyclicity was seen from hole to hole with regards to the location or presence of these felsic segregations.

Variations in mineralogy and texture can be seen on the order of a few millimeters to centimeters, to meters. Fine-grained mafic layers or fine-grained mafic segregations were identified in nearly all of the noritic/gabbroic lithologies of the Wadi Qutabah Layered Complex. There does not appear to be any cyclicity or pattern to the presence of the thin fine-grained layers. The fine-grained layers are typically 1-15cm in thickness with some reaching 1m or more. They show gradational contacts, to rare, sharp contacts with the overlying and underlying lithologies. The mineralogy of these fine layers appears to be similar to those of the adjacent geology, but typically host increased fine-grained sulphides (pyrrhotite). The continuity of these fine-grained layers was not ascertained. Although they were recorded in the drill logs, and only the thickest were recorded as separate units. Additional study will be required to determine if these fine grained features are laterally continuous.

The layers or units of the intrusion dip at ~20-30º to the SE. This is an approximation, because the drill core is not oriented. The dip is likely related to a regional tilting event, perhaps associated with Red Sea Rift tectonics (Davison *et al.*, 1994).

3.3.3 Fabric and Structures

Foliation and lineation were noted locally, but these are generally not intense features. The foliation, where present is of weak to moderate intensity, and does not appear to be primary. Lineated plagioclase laths and crystals were oriented with the long axis parallel or sub parallel to the plane of foliation. The development of foliation and lineation appears to be the result of compaction, or late stage processes.

Fractures, faults and alteration identified in the drill cores complicate correlation of the lithologies between drill holes. The fault surfaces are generally host to slickensides composed of chlorite +/- serpentine. The faults generally fall into two categories: those at 20-40° to the core axis (TCA), and those at 50-75° TCA. The fractures and fracture zones typically cut the drill core at ~20ºTCA, but the range is from ~10-30° TCA. There are additional fractures at 40-60° TCA, but these are not as abundant as those at lower angles. The unknown direction and distance of motion on faults also complicates the correlation of stratigraphy. Detailed surface mapping of the intrusion would provide additional constraints on fault movement.

Shear zones generally occur in the upper half of the drill holes, and are locally host to granitic veins/dykes/sills that are strongly deformed and in some cases mylonitic. The shear zones measure ~20-40° TCA, which translates to ~50-70° from horizontal.

3.3.4 Mineralogy

Olivine was not identified in the drill cores from the Wadi Qutabah Complex. This is in stark contrast to the olivine rich cumulates at Suwar (Greenough *et al.*, 2011).

The metallic oxides are important for correlation of the layering. Ilmenite ($FeTiO_3$), the most dominant of the oxides locally reaches ~20-25% (visual %) of the lithology. Locally the ilmenite is magnetic, but this is generally associated with what appear to be sills or possibly dykes that show sharp contacts with the over and underlying lithologies.

Magnetite occurs in seams, veinlets and as fine disseminations, but is a very minor phase. Hematite was also identified, but was typically found in proximity to the collar or within the oxidation zone, or associated with fractures and faults. Hematite, if present was only seen in trace quantities.

Pyrrhotite is the main sulphide phase, but there is minor chalcopyrite and rare pyrite. Pentlandite, a mineral with the highest likely hood of hosting nickel, and PGE mineralization was not seen during the logging process, or was too fine to be observed with only a hand lens (10x magnification). Pyrrhotite appears to be an intercumulus phase, and varies greatly in concentration. Some lithologies contain trace sulphides, whereas others are host to massive sulphide bands or layers. These sulphide layers are present in varying concentration and thickness. The most significant sulphide intervals occur in H-06, Hp-09 and Hp-12 (pyrrhotite and minor chalcopyrite mineralization) with sulphides reaching up to ~65% of the rock.

Graphite was identified typically in association with sulphide rich layers. It forms seams, pods and disseminations. The relationship of graphite to other minerals suggests that it is late and not a primary mineral.

Textures exhibited by the sulphides are magmatic. The sulphides (+/- oxides) occur as bands, seams, layers and disseminations. These may be disrupted and show what appear to be flow structures. The massive sulphide layers appear to be concordant to slightly discordant to the layering. The sulphides may be primary but have been modified by secondary processes, or they may be secondary in origin. The sulphides may also be remobilized, but to what extent is uncertain. Pyrite is present in fractures and small veins indicating that it is a late phase. Down hole from each of these sulphide rich layers is a layer of anorthosite and pyroxenite of variable thickness and grain size, which may or may not host sulphide mineralization. The thickest intersection of these layers is in Hp-09.

3.3.5 Veining

Veining is rare. Only small veins and veinlets were identified, the majority hosting carbonate +/- quartz, and locally minor pyrite mineralization. Rare granitic veins and stringers are also present. In the drill holes furthest to the west (Hp-07, Hp-09, Hp-10, Hp-11, Hp-12, Hp-12A) granitic veins/veinlets were identified, but they were generally strained or sheared.

3.3.6 Intrusives and Granite

An unusual lithological unit in drill hole H-02 appears to be a diabase dyke. Previous mapping in the area identified the presence of a diabase dyke of Tertiary age in the vicinity of H-02. The dyke shares a sharp but irregular, chilled contact with granite. Along the contact it appears that small fragments of the granite are incorporated into the fine-grained dyke (chilled margin). The dyke grades into a medium to coarse-grained diabase downhole and is host to ~15-20% magnetic ilmenite.

Eastern drill holes H-01, H-02, H-02A and H-03 contain more graphic granite/pegmatitic graphic granite than the remaining drill holes. The granite is locally pegmatitic with graphic textures, and is host to small garnets. It appears pristine with little to no alteration, except along small fractures that host minor chlorite and rare epidote. Drill holes H-01 to H-06 (eastern most drill holes) are typically coarser-grained than the remaining holes.

The contacts between the granite and gabbro are sharp, with very thin chilled margins. Chlorite may be present as a thin layer along the contact. The measured angles of these contacts were generally between 40-70º to the core axis (TCA), which is lower than the contacts between the layers, which lie at ~60-70º TCA. The contacts between the gabbros and granite are sharp to irregular, suggesting that the granite may be composed of sills and dykes.

A common feature of the gabbro-granite contact is “bleaching” in the gabbro. It extends from only a few centimeters to up to 2m from the contact and varies in intensity. The true thickness of this effect is unknown due to the irregular nature of the contacts and vertical position of the drill holes.

3.3.7 Alteration

Late stage carbonate alteration may be the result of hydrothermal fluids percolating through the system. It may be related to cooling of the gabbroic intrusion, or to intrusion of the granites in the eastern part of the intrusion. Strong alteration of the gabbros in the eastern most holes indicates that they are in close proximity to the alteration source, thus suggesting a relationship with emplacement of the granitic pluton. Veining is rare, but fractures are abundant, and appear to be the conduits for infiltrating fluids in the system. Fractures are also host to vugs of calcite crystals.

3.3.8 Rock Quality

There are a number of areas where the drill core was lost in the drilling process. This is likely related to the presence of faults and/or strong fracture zones. In these areas the drill core can be "ground-up" with little or no recovery (indicated by a wooden block by the drillers or rubble in the core box) and is recorded in the drill log. RQD or rock quality designation (total length of core pieces >10cm * 100/total length of core run) data was collected from the Wadi Qutabah drill holes (contact the author for RQD data/calculations).

3.3.9 Oxidation

Moderate to strong intensity oxidation associated with surficial weathering penetrates down to ~28m. The intensity and depth varies from hole to hole. Oxidizing fluids also exploited fractures and faults to penetrate deeper into the bedrock. Oxidation is most intense along fractures and faults and reaches the deepest depths of up to 68m in the eastern most holes.

3.3.10 General Comments

During logging, distinct features were identified; including mineralogical, textural, modal and alteration changes suggesting that correlation between the drill holes was possible. Hand drawn strip logs for each of the drill holes, confirmed the presence of correlatable layers.

In summary, the drill cores from the Wadi Qutabah Layered gabbroic complex are host to correlatable layers and lithologies. They are also host to sulphide mineralization and layers with distinct mineralogy, grain size and stratigraphic position. The presence of strong carbonate alteration in the eastern most drill holes suggests that the carbonate bearing fluids may be related to the emplacement of the granitic pluton, and the intrusion is cut by a diabase dyke that was intersected in drill hole H-02.

Table 3.1. Drill hole identification numbers, location coordinates (longitude, latitude and UTM), azimuth, dip and hole length.

Hole_ID	Longitude	Latitude	Elevation (m)	Easting (UTM)	Northing (UTM)	Azimuth	Dip	Depth (m)
H-01	43°44'22.24"E	15°47'34.26"N	1662.7	364991.2	1746426.9	0	-90	114.58
H-02	43°44'4.85"E	15°47'25.55"N	1680.5	364561.0	1746161.1	0	-90	120.91
H-02A	43°44'5.42"E	15°47'21.08"N	1594.2	364488.8	1746024.4	0	-90	58.42
H-03	43°43'58.58"E	15°47'18.99"N	1558.2	364284.5	1745961.4	0	-90	128.5
H-04	43°43'49.32"E	15°47'11.32"N	1467.1	364007.6	1745727.9	0	-90	131.26
H-05	43°43'42.81"E	15°47'4.65"N	1387.7	363812.6	1745523.9	0	-90	101.04
H-06	43°43'36.56"E	15°46'59.27"N	1329.0	363625.7	1745359.5	0	-90	191.68
Hp-07	43°42'11.94"E	15°45'56.10"N	1909.4	361095.6	1743433.6	0	-90	90.31
Hp-08	43°42'11.22"E	15°45'58.51"N	1864.6	361074.8	1743507.4	0	-90	187.84
Hp-09	43°42'3.05"E	15°47'17.98"N	1588.3	360846.9	1745951.6	0	-90	130.02
Hp-10	43°41'58.47"E	15°46'6.24"N	1799.9	360697.0	1743748.0	0	-90	187.14
Hp-11	43°41'44.16"E	15°46'10.45"N	1868.5	360271.1	1743879.2	0	-90	90.45
Hp-12	43°42'20.24"E	15°46'6.11"N	1804.2	361344.3	1743740.0	0	-90	85.81
Hp-12A	43°42'15.69"E	15°46'3.54"N	1829.9	361208.1	1743661.7	0	-90	30.97

Note: Drill hole coordinates were collected by Cantex Mine Development Corporation using a DGPS.

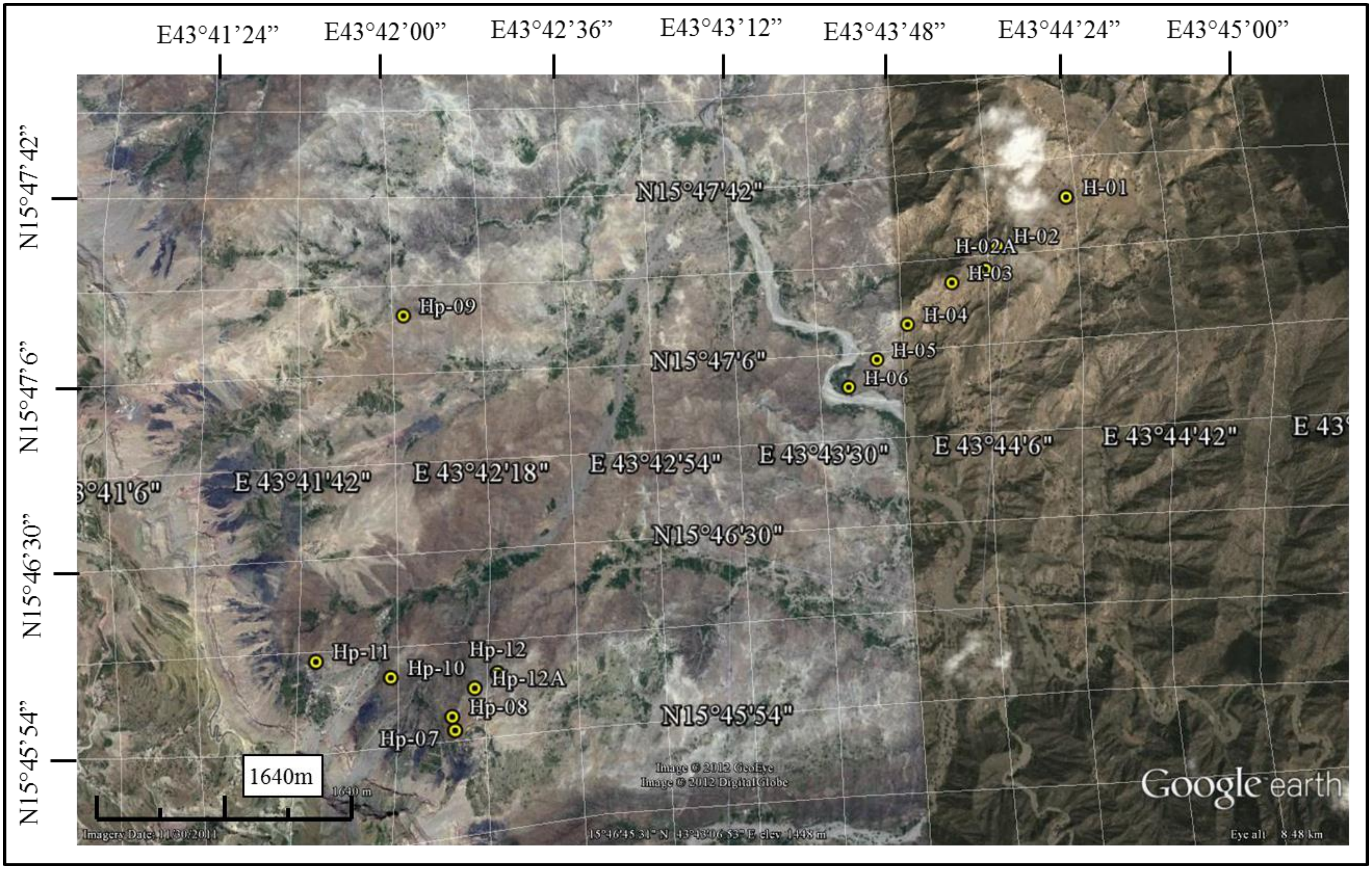


Figure 3.1. Satellite imagery from Google Earth showing the location of the drill holes from the Wadi Qutabah Intrusion, Yemen (Earth, 2012).

Chapter 4.0 Petrography

4.1 Petrography: Sample Selection and Preparation

Samples were selected after creating hand drawn vertical sections from the core logging data in an attempt to correlate the geology based on macroscale and visual characteristics, as well as sample descriptions. The samples were selected to provide broad and thorough coverage of the lithologies in the fourteen diamond drill holes. Thin section blanks were cut at UBC Okanagan using a core saw with a diamond impregnated blade. The unused portion of each sample was retained in the original poly sample bag to prevent contamination and for future use. Only one thin section blank was cut at a time to prevent contamination and mix-ups. Each cut thin section blank was then placed in its own individual bag and labelled with its unique sample number for identification. The cut blank was also marked with the sample number. Once all 52 thin section blanks were cut, bagged and labelled, the samples were sent to Vancouver Petrographics for polished thin section fabrication. An additional 8 polished thin sections were available from a previous study of the Wadi Qutabah and Suwar Complex. Of the 60 thin sections a selected number were used to obtain major element in-situ mineral analyses using the scanning electron microscope (SEM-EDS) (53 samples).

4.2 Petrography: Modal Calculations

Petrographic study of 59 polished thin sections was completed using a Nikon eclipse polarising binocular microscope. The petrographic descriptions include transmitted, polarized and reflected light information, to highlight the importance of the silicate, oxide and sulphide phases. Photomicrographs were taken of each sample under plane polarized light (ppl), crossed polars (xpl) and reflected light (rl) to document the textures and the mineralogy. A Nikon D700 was used for photomicrographs.

Mode estimates were made using a standardized procedure. Five locations on each thin section; four at the corners and one in the middle of the slide were used to estimate the % modal abundance. The cross hairs in the eye piece provided a scale of 100 divisions to measure the mineral content. With 5 locations this equals 500 counts per thin section. There are only 3 samples where the calculation was completed using 10 different locations, which include the 4 corners, the middle, the centre of each of the faces, and a spot just above the bottom centre location, for a total of 1000 counts. A 25x magnification was used for the purposes of these calculations, but in some of the finer grained samples a greater magnification was required (50x or 100x magnification). The length of the 100 divisions at 25x magnification is 3.9mm. At 50x magnification it is 2.0mm, and at 100x the cross hair scale crosses 1.0mm of the sample. Results of the modal calculations appear in Tables 4.1 to 4.3 and rock names in Table 4.4.

4.3 Petrography: General Summary of all Samples

Only a brief overview of the petrography is presented below. A more thorough review is presented in the unit descriptions in Chapter 5.

A number of characteristics are common to most of the thin section samples from the 14 drill holes of the Wadi Qutabah layered intrusion. Most contain plagioclase as a primary cumulus phase (Fig. 4.1), but it is also present locally as an intercumulus phase. Orthopyroxene is the dominant pyroxene and is typically cumulus (Fig. 4.1. d & f) and augite intercumulus (Fig. 4.1. d to f). Augite (+/- pigeonite) are seen commonly as exsolution in the orthopyroxene (Fig. 4.1. e). The orthopyroxenes and augites are host to fine grained exsolution lamellae of Fe-Ti oxides (Fig. 4.1. c). Hornblende is generally either intercumulus, or replaces/overprints the pyroxenes (uralitization) (Fig. 4.1. a to c). Amphibole (hornblende and actinolite) percentages are highest where alteration is most intense. The presence of carbonate bearing fractures and veinlets, suggests that there was a late stage fluid migration or hydrothermal event. The amphiboles may be related to this/these event(s), or there may be multiple episodes of amphibole crystallization (cooling, and late stage).

Ilmenite is the most abundant of the oxides (Tables 4.1. to 4.3.), and is typically an intercumulus phase (Fig. 4.1. a & e), but may also be present as a cumulus phase. The presence of significant modal % ilmenite is a key feature of some lithological units. Ilmenite forms anhedral to subhedral crystals, crystal clusters or fine-grained exsolution lamellae in pyroxenes. In the samples with moderate to strong alteration, ilmenite forms leucoxene/rutile along the fractures and margins of the relict crystals.

The concentration of sulphides (pyrrhotite, chalcopyrite, pyrite and pentlandite) varies greatly from trace (<1%) to >65%, forming massive sulphide layers. Pyrrhotite is the most abundant of the sulphide phases, and is locally host to blebs of chalcopyrite, suggesting they were co-crystallizing phases.

Pyrite is generally found as fracture fill or is a late phase, associated with alteration. Pyrite may also be recrystallized or remobilized.

Pentlandite is rare (<0.1% of sulphides), and was only found as exsolution in the pyrrhotite. Pentlandite appears as small flame like structures that originate along the margin of and extend into the pyrrhotite crystals (Fig. 4.2).

The rocks show pervasive, late, weak to moderate carbonate alteration, and very weak to moderate chlorite (+/-serpentine) alteration. The chlorite and carbonate alteration infiltrates the samples along fractures, faults, lithology contacts and crystal boundaries. There is also a weak sericite alteration of the plagioclase crystals, typically in samples with carbonate alteration. The samples that exhibit the strongest alteration are located in the eastern drill holes (H-01 to H-03) (Fig. 3.1). These holes also contain the most granite, suggesting that the alteration is associated with granite emplacement. Some samples are host to trace amounts of quartz as individual grains or as fracture fill with the carbonates. Thus, the quartz is related to a late stage alteration or metasomatic event.

Biotite is another common but low percentage alteration phase. Similar to the amphiboles it is most common in proximity to carbonate alteration. It is also commonly found adjacent to ilmenite and sulphide phases.

Accessory phases in these samples consist typically of apatite, rutile, and rare zircons. No olivine was seen in any of the samples.

The most commonly observed textures are adcumulate (Fig. 4.1. b), heteradcumulate, poikilitic (Fig. 4.1. f), ophitic and subophitic. The boundaries of the crystals typically exhibit some equilibration (changes in grain boundaries towards a lower-energy configuration), as a result of compaction and the reduction of pore space. Evidence of compaction is also present in commonly bent or kinked plagioclase laths and rarely noted bent orthopyroxenes (Boudreau & McBirney, 1997, Hunter, 1996).

Variation in grain size is common, but the majority of the samples are medium (1-5mm) to coarse-grained (>5mm). Fine-grained samples are less common, but during the logging process thin fine-grained layers were found in most of the larger coarser layers. These fine-grained segregations or fine-grained layers are commonly host to increased sulphide mineralization (pyrrhotite).

There also appears to be a generalized trend towards more leucocratic compositions with increasing elevation in the intrusion.

For full petrographic descriptions see appendix A.

Table 4.1. Modal % composition of the samples from drill holes H-01 to H-05. Plag=plagioclase, Opx=orthopyroxene, Cpx=augite +/- pigeonite, Hbld=hornblende, Act= actinolite, Bio= biotite, Serp=serpentine, Chl=chlorite, Cal/Carb=calcite, Ser=sericite, Apat=apatite, Qtz=quartz, Rut=rutile, Ilm=ilmenite, Po=pyrrhotite, Cpy=chalcopyrite, Py=pyrite, Gra=graphite, Mag=magnetite, Hem=hematite, Op_Uk=opaque (unknown), Bn_Min=brown mineral (unknown), Gn_Min=green mineral (unknown), Scap=scapolite

Hole ID	Sample #	Plag	Opx	Cpx	Hbld	Act	Bio	Serp	Chl	Cal/ Carb	Ser	Apat	Qtz	Rut	Ilm	Po	Cpy	Py	Gra	Mag	Hem	Op_ UK	Bn_ Min	Gn_ min	Scap
H-01	921-01	43.4			13.2	34.4		3.8	3.6		1			0.2		0.4									
H-01	922-01	41.4			1.2	3.8			22.6	21.6	0.6		7.8										0.4		0.6
H-02	924-01	47.6		23.6	2.7		0.7					1.7	1.2	0.2	15.9									6.4	
H-02A	776-01	54.6	5.8		27.2	4.4	1	3.2	1.6					1.2		1									
H-03	778-01	63.2			11.8	14.6	2.2		5		0.2	0.2		0.6		2.2									
H-03	779-01	53.1	11	0.6	14	17.8		0.8			0.3		0.4	1.6		0.4									
H-03	783-01	71.2	3		11.6	3.8			3.6	1.5	1.3	0.4		0.8		2.8									
H-03	790-01	64.8	14.6	5.6	0.8	2.8			0.4							10.4	0.6								
H-03	792-01	64.8	12	7	6	9				0.4	0.2					0.6									
H-04	793-01	72.6	15.4	2	5.2	3.2				0.8	0.2				0.6										
H-04	795-01	85			4.8	1.2			4	1.4	1.2			0.4	1.6	0.4									
H-04	796-01	48.2	13.4	7.4	22.2		3.6								5.2										
H-04	797-01	61.2	14.8	3.3	13.5	1	0.9			0.4	0.3				0.1	4.5									
H-04	798-01	43.4	24	18			0.4								14.2										
H-04	800-01	65.4			25		1.4		1.6	0.6	0.6				0.2	5.2									
H-05	804-01	43.6			17.8	1.6					0.5					27	0.2		6.2			3.1			
H-05	806-01	55.2	10.6	10	7.2		1								15.2	0.8									
H-05	806-02	56.4	15.6	5.4	5.8		2.6								2.6	11.7									
H-05	810-01	81.8			9.2				2.8	1	3.6				1.6										
H-05	812-01	61.6			31.4		0.4								6.6										

Table 4.2. Modal % composition of the samples from drill holes (H-06 to Hp-09). (For mineral code descriptions see Table 4.1)

Hole ID	Sample #	Plag	Opx	Cpx	Hbld	Act	Bio	Serp	Chl	Cal/ Carb	Ser	Apat	Qtz	Rut	Ilm	Po	Cpy	Py	Gra	Mag	Hem	Op_ UK	Bn_ Min	Gn_ min	Scap
H-06	814-01	55.4	11.4	9.6	4	0.3	5.65			1.6			1		11	0.05									
H-06	815-01	59.4	32.8		4.8	0.4	0.4		0.2	0.6	0.2				0.4	0.8									
H-06	827-01	58.6	29	4.2	1.4	0.2	2.2				0.6					2.6	0.4		0.4			0.4			
H-06	829-01	63.2			18.3	6	3				0.6				0.2	8.3						0.4			
H-06	832-01	54.2	15.6	17.8	9.6		1.4			0.4						1									
H-06	835-01	72.6			9.6	9.2	1.6		0.2	1.6					0.6	1.2						3.4			
Hp-07	836-01	52.4	28.4	14.4	1.8		0.2			1.4						1.4									
Hp-07	839-01	57.8	24	2	5.8	4.4	2.8			0.4					0.6	1.6	0.2					0.4			
Hp-07	840-01	66.2	19	7.6	2.4					1.2						3.6									
Hp-07	842-01	79.4			4.6	2.2			3.2	2.6			3.6		1.8	2.6									
Hp-07	843-01	70.8	3	1.4	19.8		1			1.2		0.2			1.8	0.8									
Hp-08	845-01	48	19.6	7.4	7.6		2.2			0		1.8			12							1.4			
Hp-08	848-01	37.2	22.6	20	1.6	12	0.2			1.2		2	0.6		2.6										
Hp-08	851-01	64.2	1.2	23.4	1.8		0.6			4.2		1.4				1.8			1.4						
Hp-08	851-02	49.2	19.8	16.4	0.8					1.4					11.8	0.4						0.2			
Hp-09	906-01	95.2					0.8		0.6	0.4	2.6				0.4										
Hp-09	906-02	1	71.2	0.4	1.6	9									1.4	15.2							0.2		
Hp-09	908-01	0.2	23	33.8	4.6										37.8	0.6									
Hp-09	909-01	60.4			26.4	8.2	1		0.2	1.2	0.6					2									
Hp-09	916-01	87.4		4.6						2.2	5.2				0.2	0.4									

Table 4.3. Modal % composition of the samples from the western drill holes (Hp-10 to Hp-12) and grab sample YEMWQ1. (For code descriptions see Table 4.1)

Hole ID	Sample #	Plag	Opx	Cpx	Hbld	Act	Bio	Serp	Chl	Cal/ Carb	Ser	Apat	Qtz	Rut	Ilm	Po	Cpy	Py	Gra	Mag	Hem	Op_ UK	Bn_ Min	Gn_ min	Scap
Hp-10	876-01	63.6	15.4	7	5.4		0.2			0.8	0.6				2.4	4.6									
Hp-10	877-01	44.3	14.2	9.8	16.6	0	2			1		2.7			6.4							3			
Hp-10	880-01	37.2			46.2	1.4	1.8			0.8		2.8		1.2	7.8			0.2				0.6			
Hp-10	884-01	67	7.2	8	0.8		2.6			0.8	0.2	0.4			11.6	1.4									
Hp-10	890-01	34.8	26.2	21.4	1.2		0.4			0.4					11.2	3.8						0.6			
Hp-10	FX847931	77.6	0.2	2.5	16.1		1.5		0.4	0.7	1														
Hp-10	FX847932	43	19	16.8	9.4		2.6					0.2				9									
Hp-10	FX847933	51.4	14	11.6	0.8		0.6			0.4		0.6			19.4	1.2									
Hp-10	FX847934	49.4	4.6	27	7.4		0.6			1.2					9.6								0.2		
Hp-11	854-01	56.4	0	0	27.2	6	8.2		1		0.4				0.8										
Hp-11	856-01	40.2	2.4	6.4	31				0.6		0.2							6.2	6.4			0.2	6.4		
Hp-11	856-02	50.4	2.8	0.6	26.6				12.4		0.8		0.6		3.8			1.4					0.6		
Hp-11	FX847935	59.2	34.2	5.2	0.6		0.2			0.6															
Hp-11	FX847937	38.2	6.8	0.6	34		4.4								16										
Hp-12	859-01	41.6			48.2		1.4					2.2			4.6						1.4	0.6			
Hp-12	860-01	62	12	6.6	0.8		3.2			3	0.4	0.8			10.6	0.6									
Hp-12	866-01	55			2.8	13.2	1.6				0.2				0	23	2.4						1.8		
Hp-12	874-01	66	8	13.4			3			0.8	1.2				7	0.6									
	YEMWQ1	62.2	31.6	4.9	0.6					0.5					0.2										

Table 4.4. Thin section numbers, rock names and hole IDs from the eastern and western drill holes.

East		
Hole ID	Sample #	Rock Type
H-01	921-01	Hbld Gabbro
H-01	922-01	Hbld Gabbro (altd)
H-02	924-01	Diabase
H-02A	776-01	Hbld Norite
H-03	778-01	Hbld Gabbro
H-03	779-01	Hbld Norite
H-03	783-01	Leuco Hbld Gabbro
H-03	790-01	Norite (Pyrrhotite rich)
H-03	792-01	Aug-Hbld Norite (Leuco)
H-04	793-01	Leuco Hbld-Aug Norite
H-04	795-01	Leuco Gabbro/ Leuco Hbld Gabbro
H-04	796-01	Hbld-Aug Norite
H-04	797-01	Hbld-Aug Norite
H-04	798-01	Aug Norite
H-04	800-01	Leuco Hbld Gabbro
H-05	804-01	Hbld Gabbro (mineralized)
H-05	806-01	Aug-Hbld Norite
H-05	806-02	Aug-Hbld Norite
H-05	810-01	Leuco Hbld Gabbro
H-05	812-01	Hbld Gabbro
H-06	814-01	Aug Norite
H-06	815-01	Hbld Norite
H-06	827-01	Augite Norite
H-06	829-01	Hbld Norite
H-06	832-01	Opx-Hbld Gabbro
H-06	835-01	Leuco Hbld Norite

West		
Hole ID	Sample #	Rock Type
Hp-07	836-01	Aug Norite
Hp-07	839-01	Hbld Aug Norite
Hp-07	840-01	Leuco Aug Norite
Hp-07	842-01	Leuco Hbld Gabbro
Hp-07	843-01	Leuco Hbld Gabbro
Hp-08	845-01	Hbld Aug Norite
Hp-08	848-01	Aug Norite
Hp-08	851-01	Gabbro
Hp-08	851-02	Aug Norite/ gabbronorite
Hp-09	906-01	Anorthosite
Hp-09	906-02	Plag bearing Pyroxenite (mineralized)
Hp-09	908-01	Plag bearing (hbld) Pyroxenite (Ilm rich)
Hp-09	909-01	Hbld Gabbro
Hp-09	916-01	Leuco Gabbro
Hp-10	876-01	Cpx-Hbld Norite
Hp-10	877-01	Hbld-Aug Norite
Hp-10	880-01	Hbld Gabbro
Hp-10	884-01	Leuco Opx Gabbro/Leuco Aug Norite
Hp-10	890-01	Mela Aug Norite
Hp-10	FX847931	leuco Hbld Gabbro
Hp-10	FX847932	Aug-Hbld Norite
Hp-10	FX847933	Aug Norite
Hp-10	FX847934	Opx Hbld Gabbro
Hp-11	854-01	Hbld Gabbro
Hp-11	856-01	Hbld-Opx Gabbro (mineralized)
Hp-11	856-02	Hbld Gabbro
Hp-11	FX847935	Aug Norite
Hp-11	FX847937	Hbld-Aug Norite
Hp-12	859-01	Hbld Gabbro
Hp-12	860-01	Aug Norite
Hp-12	866-01	Hbld Gabbro (mineralized)
Hp-12	874-01	Leuco Opx Gabbro
	YEMWQ1	Aug Norite

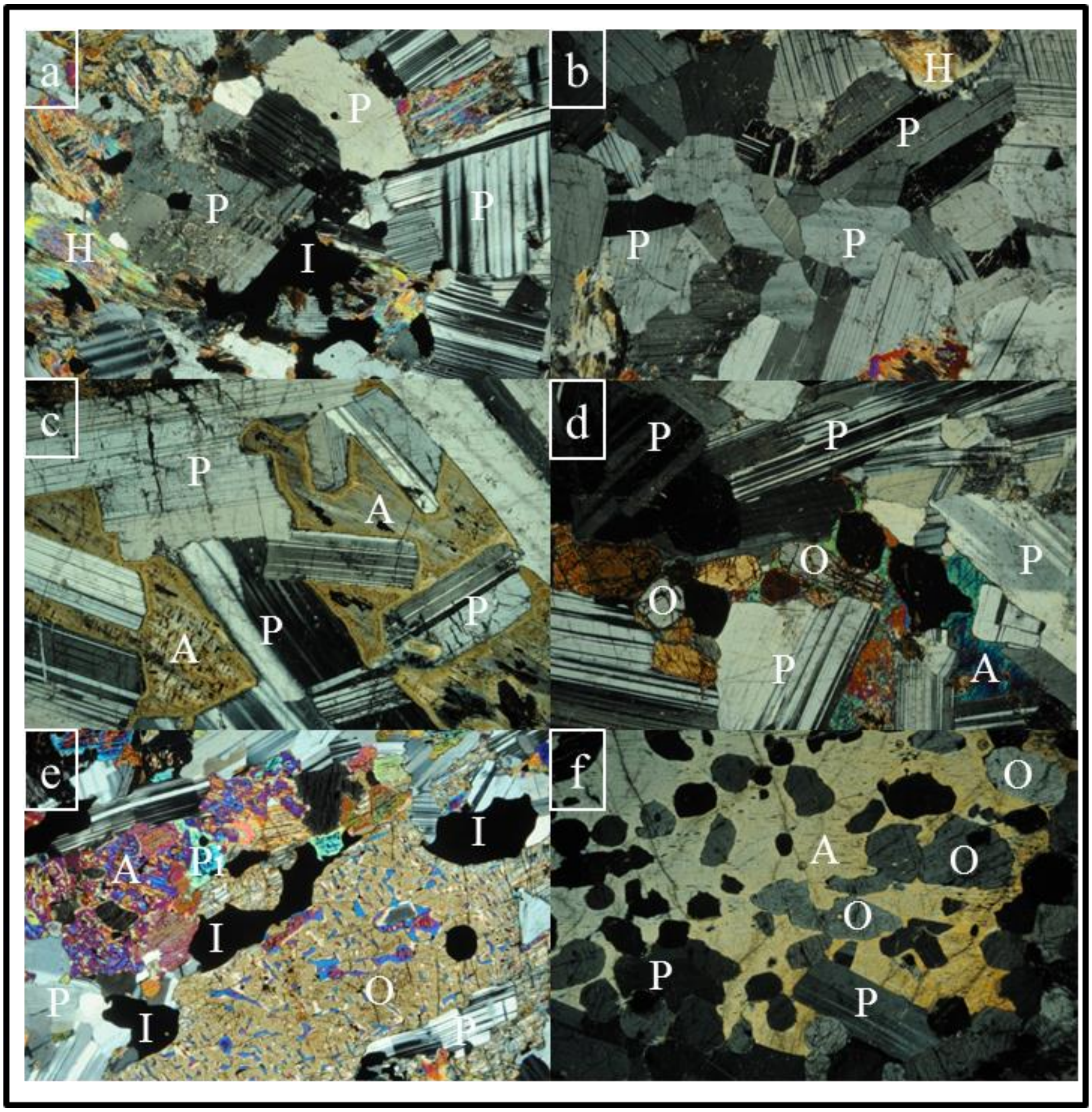


Figure 4.1. Photomicrographs of thin sections from the Wadi Qutabah Intrusion. Each image represents 5.4mm in width and was taken at 25x magnification under crossed polarized light. a) 829-01 shows cumulus plagioclase and intercumulus ilmenite; b) 793-01 shows cumulus plagioclase with adcumulus growth; c) 842-01 shows cumulus plagioclase with intercumulus augite mantled by hornblende, augite is host to fine grained Fe-Ti oxide exsolution lamellae; d) 876-01 shows cumulus plagioclase and orthopyroxene with intercumulus augite; e) 798-01 shows large intercumulus orthopyroxenes, augite, pigeonite and ilmenite, and orthopyroxene is host to exsolution of augite +/- pigeonite; f) 836-01 cumulus plagioclase and orthopyroxene hosted in a large intercumulus augite in poikilitic texture. P=plagioclase, A=augite, O=orthopyroxene, H=hornblende, Pi=pigeonite, I=ilmenite.

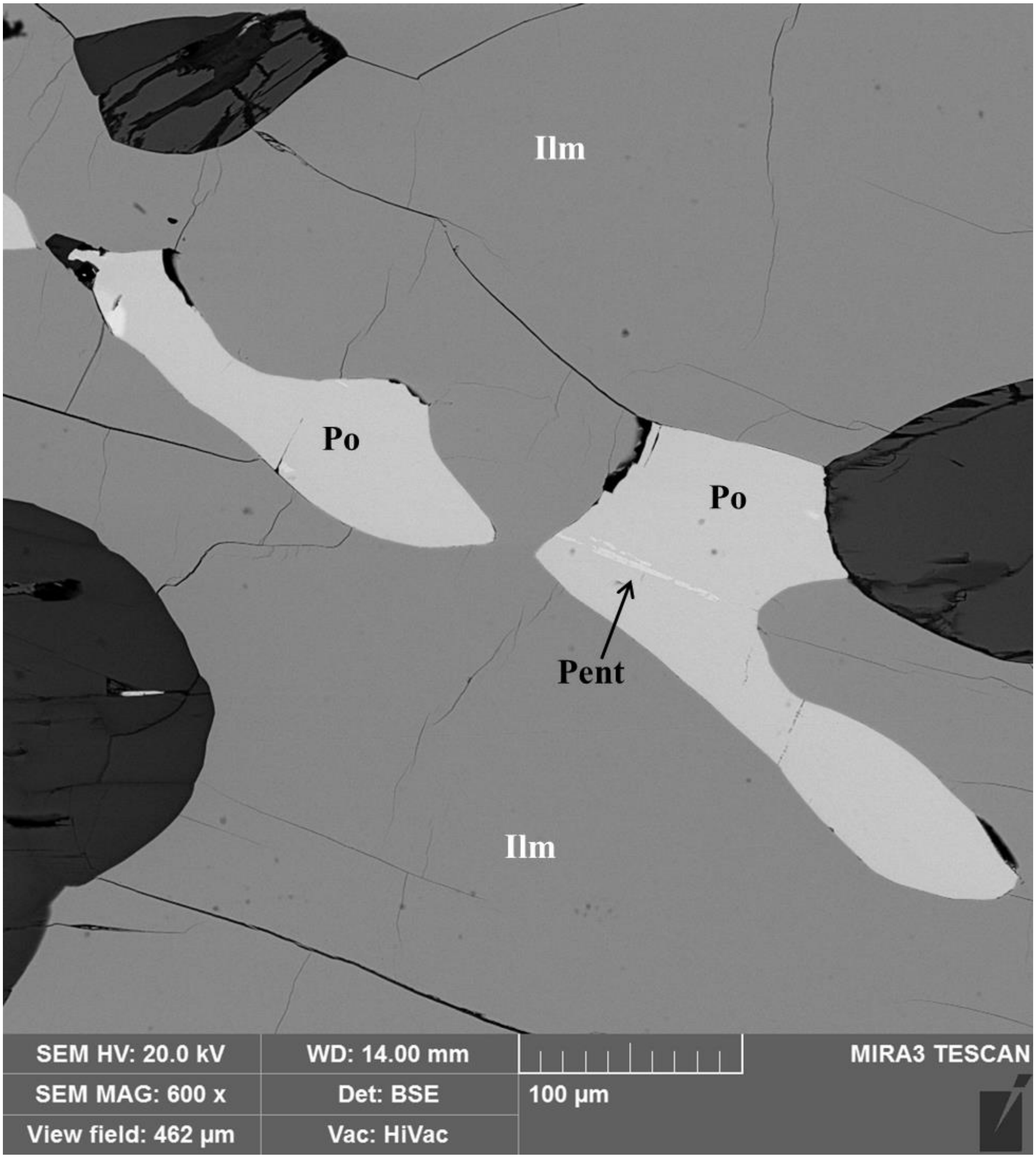


Figure 4.2. Backscatter electron image from the scanning electron microscope (SEM) of pentlandite exsolution in pyrrhotite hosted in ilmenite from sample 796-01. Ilm= ilmenite, Po=pyrrhotite, Pent=pentlandite.

Chapter 5.0 Units, Lithology, Petrology and Stratigraphy

5.1 Elevation and Dip Corrections

To correlate rocks between holes and assemble a composite stratigraphic column, dip corrections were applied to the layers identified during logging. Faulting has displaced unit elevations between holes. To facilitate plotting of geochemical, petrographic and lithologic data relative to height in the intrusion, height has been normalized to the top of a distinctive lithologic layer. Details of the dip and height (elevation) calculations are given below.

Corrections for dip are important because the thickness of layers does not represent true thickness. Dip is not rigorously constrained but foliation measured in drill holes varies from 60-70° to the core axis (TCA), which translates to a dip of 20-30°. A small trigonometric correction applied to all drill holes assuming a dip of 25º: true thickness = apparent thickness x Cos 25º. Figure 5.1, shows a simplified cross-sectional view of the trigonometric correction. Results are given in Tables 5.1 to 5.3.

No corrections for fault off-sets are applied to drill holes in the eastern study area. However difficulties with the correlation between holes H-03 and H-04 suggest that there may be a fault.

Drill holes in the western study area (Hp-07, Hp-08, Hp-09, Hp-10, Hp-11, Hp-12, and Hp-12A) are locally offset by faults. The true offset or direction of movement on these faults is uncertain, but the layers and lithologies in the drill holes provide clues to the direction of movement. Three faults were previously identified in the area by Cantex geologists, that locally offset the stratigraphy (Plank *et al.*, 2007). The top of unit 5a (ilmenite-rich norite) the most consistently present and distinct layer, was used to "normalize" the drill holes relative to hole Hp-08, with corrections as follows, for Hp-10:-3.89m, for Hp-11: -98.57m, for Hp-12: -20.70m. Drill holes Hp-08, Hp-07 and Hp-12A occur in the same fault block, and are not offset by faulting.

Drill hole Hp-09 is a special case, and was drilled in isolation (Fig. 3.1). Logging and thin section information indicates that the bottom of Hp-09 correlates with the upper part of Hp-07. Hp-07 required no corrections for faulting so only an elevation correction is applied to Hp-09 (correction of +365.02m). There is limited data on the area (distance of ~2.5km) between Hp-09 and Hp-07, and previous mapping of the area by Cantex geologists identified a large fault that runs ~NE-SW and dips to the NW (Plank *et al.*, 2007). Thus some uncertainty remains and additional information is required to increase confidence in this correlation.

5.2 Units, Petrography, Lithology and Stratigraphy

Although it will be shown that there are similarities between lithologies and stratigraphy between the eastern and western drill holes, for the purposes of presenting information here they are dealt with separately. A synthesis of information of the drill hole logging and petrography led to simplified and detailed stratigraphic columns for the eastern drill holes and analogous columns for the western drill holes. Different lithologies (e.g. hornblende norite) are given unit numbers (e.g. 10a) in these diagrams. The following pages provide descriptions of the lithological stratigraphic units. A subsequent section correlates units between the eastern and western drill holes.

Descriptions of individual layers are presented below, beginning with the layers identified in the eastern drill holes, at the lowest elevation and moving up stratigraphy. Thicknesses (in meters) in the layer descriptions are those measured from individual drill holes. They are not corrected for dip or faults and therefore represent apparent thickness.

5.2.1 Unit: 10b

Unit 10b is a medium-grained altered cumulate norite (Fig. 5.2 & 5.3) with cumulus plagioclase (~63-72%) averaging 1-2mm but reaching >5mm in length. Plagioclase grains are locally zoned, can be kinked (suggesting compaction) and are weak to moderately lineated. Pyroxenes are largely replaced by amphiboles but relict fine-grained exsolved Fe-Ti oxides help outline original grain shapes and suggest that the rock originally contained cumulus orthopyroxene (~0.5-1.5mm) and subordinate intercumulus augite. Intercumulus ilmenite and sulphides (pyrrhotite and chalcopyrite) comprise $\leq$ 8.5% of the rock. Grain boundaries are sharp linear to irregular and locally serrated (Fig. 5.3). The grain boundary configuration indicates a partially equilibrated geometry. **Textural equilibration** is a change in crystal interfaces (e.g. grain boundaries) towards a lower total surface energy. Textural equilibration may also lead to increased grain size as a result of lower grain boundary curvatures of larger vs. smaller grains. A fully equilibrated geometry has dihedral angles (120°) between phases (Hunter, 1996). Biotite is a common alteration mineral (up to 3%) associated with hornblende.

Unit 10b was only identified in drill hole H-06, which apparently reached the lowest stratigraphic levels in the intrusion (Fig. 5.4). Units 10b and 10a may be part of a cyclical layering sequence, because unit 10a is over and underlain by unit 10b in the lowest elevations. This layer reaches a thickness of ~31m, but the actual thickness is unknown because drilling ended before passing through.

5.2.2 Unit: 10a

Unit 10a is a cumulate hornblende norite (Fig.5.5) with higher percentages of unaltered pyroxenes than unit 10b (Fig.5.3). It is medium-grained and dominanted by cumulus plagioclase and orthopyroxene (Fig. 5.6). Cumulus plagioclase (~54-59%) averages 1-2mm but reaches 4mm in length. It can be kinked (suggesting compaction) and fractured. Orthopyroxene is a cumulus and intercumulus phase (15-32%), and shows minor Fe-Ti oxide exsolution. It is locally poikilitic surrounding cumulus plagioclase. Augite is intercumulus (up to ~18%) and, hornblende (5-10%) is intercumulus or an alteration/replacement product mantling the pyroxenes. Biotite (0.5 to >1%) occurs in association with the hornblende. Sulphides (pyrrhotite and chalcopyrite), ilmenite and graphite are intercumulus phases and comprise (~1% of the rock). Grain boundaries between all of the crystals are sharp linear, irregular to locally serrated, and show a partially equilibrated textural geometry. Some of the plagioclase crystals exhibit an equilibrated geometry. Carbonate and sericite alteration occurs along fractures, with locally weak sericite alteration of the plagioclase.

Unit 10a was only identified in hole H-06, and may be part of a cyclical sequence with 10b. At higher elevations it is underlain by 5c and overlain by 5a, and is host to massive sulphide mineralization (Fig. 5.4). Unit 10a varies in thickness from ~54m in the lowest intersection to ~14m in the stratigraphically highest intersection.

5.2.3 Unit: 5c

Unit 5c is a medium-grained cumulate augite norite (Fig. 5.7). This unit contains cumulus plagioclase and intercumulus orthopyroxene, augite, and minor pyrrhotite, chalcopyrite and ilmenite (Fig. 5.8). Cumulus plagioclase (~59%) averages 1-2mm but reaches 5mm in length.

Plagioclase grains can be kinked and weakly lineated. Both, orthopyroxene (~29%, crystals up to 5mm in length) and augite (~4% up to 5mm in length) show well developed exsolution lamellae of augite and orthopyroxene (respectively) as well as fine-grained Fe-Ti oxide exsolution lamellae. The sulphide (pyrrhotite (~2.5%) and chalcopyrite (~0.5%)) and oxide (ilmenite + graphite) content of this unit is ~3% total with all phases intercumulus to late (trace graphite). Hornblende (~1-2%) and biotite (~2%) form minor alteration phases of the pyroxenes. The textures exhibited by the crystals suggest a partially equilibrated textural geometry. Sericite alteration is weak to moderate in intensity and has the greatest effect on plagioclase.

This unit (5c) was only identified in drill hole H-06 (Fig. 5.4). It is underlain by unit 10b and overlain by unit 10a, and reaches a thickness of ~38m. Unit 5c is cut by a granitic dyke or sill.

5.2.4 Unit: 5a

Unit 5a is a medium-grained cumulate augite (+/- hornblende) norite (Fig. 5.9). This unit contains cumulus and minor intercumulus plagioclase, the most abundant phase, but its content is highly variable (35-67%) (Fig. 5.10). Plagioclase can be zoned, kinked or bent (Fig. 5.11b) (suggesting compaction) and crystals reach up to 7mm in length but average ~2mm. Orthopyroxenes reach up to 5mm but are on average 1-2mm in length and are intercumulus (7-26%), but rare cumulus grains were identified. Orthopyroxene is host to exsolution of augite +/- pigeonite and locally fine exsolution lamellae of Fe-Ti oxides. Augite is intercumulus (8-23%) and exhibits exsolution of orthopyroxene and fine lamellae of Fe-Ti oxides (Fig. 5.11). Ilmenite is intercumulus (+/-cumulus?), the most abundant oxide phase (5-15%, up to 1.5mm in length), and locally magnetic. The high modal abundance of ilmenite is a distinguishing feature of this unit. Sulphides (pyrrhotite and chalcopyrite) are minor intercumulus phases and comprise $\leq$ 4% of the rock. Apatite is a minor accessory phase (<1%). Hornblende is an alteration phase mantling or replacing/overprinting the pyroxenes with varying intensity. Biotite, an alteration phase (<6%), is associated with hornblende. Carbonate alteration is weak to moderate in intensity and is associated with fractures, which are common features.

Fine-grained segregations (see unit 5b below) (Fig. 5.9 a, b, f) are hosted in unit 5a (Fig.5.4). The fine-grained beds/layers are generally a few centimeters in thickness and host fine-grained sulphides (pyrrhotite). Sample 806-02 is an example of this type of fine-grained feature.

Layer 5a reaches a thickness of >101.04m in the eastern holes (Fig. 5.38 & 5.39), and in the west, there is no constraint on the base of the unit, therefore it is >98.54m in thickness (Fig. 5.40 & 5.41). Unit 5a in the eastern holes is underlain by 10a, and overlain by unit 9. In the west, unit 5a is overlain by units 11a and 4. Unit 5a is cut by dykes/ sills of granite, which locally reach 7m in thickness, and it is host to layers of unit 2b (leuco hornblende gabbro) (see below for unit 2b description).

5.2.5 Unit: 5b

Unit 5b is a fine-grained cumulate orthopyroxene (+/- hornblende) gabbro/augite (+/- hornblende) norite (Fig. 5.10 & 5.12 a, f) hosted in unit 5a (Fig. 5.9 & 5.10). Unit 5b is similar in composition to 5a, but generally has higher sulphide content. Plagioclase (~50-56% modal) is a cumulus and intercumulus phase reaching up to 1.2mm in length, averaging 0.4-0.5mm, and it is weakly lineated. The plagioclase grains locally exhibit dihedral angles indicating some textural equilibration. Orthopyroxene and augite are intercumulus phases and the average grain size is <1mm. Hornblende forms an alteration/replacement phase of the pyroxenes (~5-7%). Biotite (≤2%) is also an alteration phase and is associated with hornblende. Fine grained sulphides (pyrrhotite, chalcopyrite) and oxides (ilmenite) are intercumulus phases. Pyrrhotite varies up to 12% and ilmenite from 2.6-9.6%. Trace accessory apatite is disseminated and subhedral to euhedral. Carbonate alteration is weak to moderate in intensity and is associated with fractures. Pyrite occurs in fractures, indicating that it is a late phase, or remobilized.

Unit 5b was identified in all intersections of unit 5a (Fig. 5.38 to 5.41). It is only a few centimeters in thickness (10-30cm) and is readily identifiable by the sharp contrast in grain size and increased opaque phases. Contacts between 5a and 5b show a very thin layer (~1-2mm) of pyroxene.

5.2.6 Unit: 2b

Unit 2b is a medium to coarse-grained cumulate leuco hornblende gabbro (Fig. 5.13). It is composed of cumulus plagioclase (65-82%) averaging 2-5mm but reaching >8mm in length (Fig. 5.14). Plagioclase grains are locally zoned and can be kinked or bent. Grain contacts suggest a partially equilibrated textural geometry. Hornblende is the main mafic phase (9-25%), green to brownish in colour, and appears to be both an intercumulus and alteration/replacement phase of cumulus orthopyroxene and subordinate intercumulus augite, as suggested by relict outlines. Intercumulus sulphides (pyrrhotite, chalcopyrite and trace pentlandite) and oxides (ilmenite) comprise ~1.5-6% or the rock and reach up to 1mm but most are <0.5mm in length. Alteration minerals are chlorite (~2-3%), biotite (<1.4%), calcite (≤1%) and sericite (≤3.6%). Chlorite and biotite are associated with the hornblende, and the sericite represents altered plagioclase. Calcite is a late alteration phase associated with fractures.

This layer varies in thickness up to 0.8m, and is hosted in unit 5a in the eastern holes (Fig. 5.38 & 5.39).

5.2.7 Unit: 9

Unit 9 is a medium-grained cumulate (+/- hornblende, augite) norite (Fig. 5.15). Plagioclase is a cumulus and intercumulus phase (~61-73%) averaging 1-2mm and reaching up to 5mm in length (Fig. 5.16). Plagioclase grain boundaries are smooth, linear to serrated and show a partially to equilibrated textural geometry, with some dihedral angles present. Orthopyroxene is cumulus (12-15%) and the average grain size is ~1-2mm, but it can reach up to 4mm in length. Orthopyroxene may be mantled by augite and/or hornblende, and is locally replaced/altered by other amphiboles. Pyrrhotite (≤10.4%) is the dominant intercumulus opaque phase, with subordinate ilmenite (0.1-0.6%) and chalcopyrite (≤0.6%). Alteration minerals include amphiboles (hornblende (<1 to13.5%), actinolite (1-9%)), biotite (<1%), chlorite (<0.5%), calcite (<1%) and sericite (<0.5%). All are fine-grained (<1mm) except the amphiboles, which reach up to 1.6mm. Biotite is associated with the amphiboles, and chlorite with the amphiboles and the carbonate alteration. Calcite occurs in fractures and sericite is a weak alteration product of the feldspars.

Unit 9 overlies the 5a contact in the eastern drill holes, and is overlain by unit 8 (Fig. 5.38 & 5.39). It is host to a layer of leuco gabbro (see description below for unit 3) and small noritic/gabbroic dykes/sills (see description below for unit 12). Unit 9 is host to fine-grained segregations similar to unit 5b in unit 5a.

5.2.8 Unit: 3

Unit 3 is a medium-grained adcumulate, leuco (+/- hornblende) gabbro (Fig. 5.17). Plagioclase is cumulus (~85%), average crystals are 2mm but reach up to 8mm in length, and can be kinked or bent (Fig. 5.18). Plagioclase grain boundaries suggest a partially equilibrated textural geometry. Hornblende is the most abundant mafic phase and is either an intercumulus phase or an alteration product of primary pyroxenes. Fine Fe-Ti oxide exsolution lamellae in relict pyroxenes are still visible and indicate primary crystal outlines. They suggest that the initial pyroxenes were cumulus orthopyroxene with subordinate intercumulus augite. Hornblende (~4.8%) and actinolite (1.2%) are fine-grained (≤1mm) and locally altered to chlorite (~4%) and biotite (<0.1%). Minor fine-grained (up to 0.5mm) intercumulus pyrrhotite (~0.4%), ilmenite (~1.6%) and rutile (~0.4%) are present. Rutile is an alteration product from ilmenite. Weak sericite alteration (~1.2%) affects the plagioclase, whereas moderate carbonate alteration (~1.4%) is associated with fractures.

Unit 3 is hosted in unit 9 (Fig. 5.38 & 5.39), and is a common feature of unit 9. Unit 3 is generally only a few 10s of cm thick.

5.2.9 Unit: 12

Unit 12 is a fine to medium-grained augite (+/- hornblende) norite/ hornblende (+/- orthopyroxene) gabbro (Fig. 5.19), host to intercumulus, locally magnetic ilmenite (2.6-11%) representing a distinguishing feature of this unit (Fig. 5.20). It contains cumulus plagioclase +/- orthopyroxene, and intercumulus augite, +/- orthopyroxene, +/- plagioclase, +/- hornblende, ilmenite, pyrrhotite and chalcopyrite. Accessory euhedral to subhedral, acicular apatite (~1-3%) is also present. Plagioclase exhibits large (≤ 4mm) euhedral to subhedral laths that can be zoned, and smaller (<1mm) cumulus and intercumulus crystals which total 37-62% of the rock. Orthopyroxene is a cumulus and/or intercumulus phase (13-19%) with subordinate augite as an intercumulus phase (6-10%) and grains are up to 0.7mm in length but average ~0.4mm. Hornblende (<1-48%) is intercumulus and an alteration/replacement product of pyroxenes (Pleochroism from pale brown to dark green). Fine to medium grained (≤2mm) intercumulus sulphides (pyrrhotite, chalcopyrite, pentlandite and minor pyrite (fracture fill)) and oxides (ilmenite) comprise ≤12% of the rock. Ilmenite is locally annealed exhibiting dihedral angles. Pyrite is a late phase, and occurs in fractures. Biotite (1.4-3.6%) is an alteration phase associated with the amphiboles. Carbonate alteration (≤3%) is weak and associated with fractures.

Contacts for this unit are sharp, but no chilled margins were noted. Unit 12 is hosted in unit 11a, 1a (see below for descriptions of units 11a and 1a), and 9 (Fig. 5.38 to 5.41). It varies in thickness from a few 10s of centimeters to >3m in thickness. The stratigraphic position of this unit varies between drill holes suggesting that it is not concordant with layering, and represents a dyke and/or sill.

5.2.10 Unit: 8

Unit 8 is a medium-grained cumulate hornblende gabbro/hornblende norite (Fig. 5.21) with cumulus plagioclase (~53-71%) averaging 2mm but reaching up to 1cm in length (Fig. 5.22). Plagioclase may be zoned, and can be kinked or bent. Contacts between the plagioclase grains are sharp, smooth to serrated suggesting a partially to equilibrated textural geometry. Pyroxenes are largely replaced by amphiboles (hornblende (11-27%) and actinolite (~4-18%), but relict cores remain along with fine-grained exsolution lamellae of Fe-Ti oxides that help outline original grain shapes, and suggest that the rock originally contained cumulus orthopyroxene (up to 2mm) and subordinate intercumulus augite (up to1mm). Minor intercumulus pyrrhotite, chalcopyrite and ilmenite comprise ≤2.8% or the rock. Accessory euhedral to subhedral acicular rutile (0.6-1.6%) and apatite (<0.5%) were also noted. Biotite (~1-2%) is a common alteration phase associated with the amphiboles (fig 25). Chlorite (≤5%) occurs with amphiboles and in fractures. Carbonate alteration (≤1.5%) infiltrates the sample along fractures and sericite alteration (≤1.3%) is associated with the plagioclase.

Unit 8 is host to fine-grained layers (similar to unit 5b in unit 5a) and plagioclase rich layers (or plagioclase segregations; similar to unit 3) that vary in thickness from a few cm to 10s of cm. Unit 8 was identified in the eastern drill holes, and in one western drill hole (Fig. 5.38 to 5.41). It is underlain by unit 9, and is cut by numerous dykes and/or sills of graphic granite. In the western drill hole it is sitting in unit 1a, an augite norite (see below for description of unit 1a). Unit 8 is appears to be overlain by unit 2a (see below) and is cut by a large diabase dyke (see description for unit 13a) (Fig. 5.4). The contact between unit 8 and 2a is inferred, it was not observed in the core as a result of the diabase dyke and granite.

5.2.11 Unit 13a

Unit 13a is a medium-grained diabase dyke (Fig. 5.23). Euhedral to subhedral, zoned lath-shaped plagioclase forms the framework of this sample (Fig. 5.24). Plagioclase grains (~48%) are ~2mm but reach up to 4mm in length, and can be interstitial. Augite (~24%) is interstitial and can be zoned, and reachs up to 1.5mm. Ilmenite (~16%) forms a primary, interstitial, euhedral to subhedral, and locally skeletal mineral. It can exhibit twinning and host rare blebs of pyrite. Interstitial sulphides (pyrrhotite, chalcopyrite, and pyrite) and oxides (ilmenite, rutile and magnetite) comprise ~16% of the rock. Apatite (<2%) is a common accessory phase forming euhedral acicular crystals that average 0.5mm and reach up to 1mm in length. Hornblende (~2.7%) is an interstitial phase and alteration product of augite. Crystals reach 0.25mm in length. Biotite (<1%) and chlorite (<0.1%) are associated with hornblende. Quartz was identified as an interstitial phase (~1.2%), and calcite and sericite were noted but their concentration is very low (<0.1%).

The upper contact of the dyke is sharp and chilled against the granite. It is porphyritic and appears to have incorporated pieces of the granite along the margins. The dyke grades into a medium-grained diabase downhole. The diabase was only intersected in H-02 (Fig. 5.4), and according to regional mapping the dyke runs near N-S (Plank *et al.*, 2007).

5.2.12 Unit: 2a

Unit 2a is a medium to coarse-grained hornblende gabbro (Fig. 5.25) with cumulus plagioclase (41-56%) average 2-5mm and reaching up to 8mm in length (Fig. 5.26). Plagioclase can be zoned, bent or kinked and fractured. Grain boundaries of the plagioclase indicate a partially equilibrated textural geometry. Amphiboles (hornblende and actinolite) are the most abundant mafic phases comprising ≤47.6% of the rock (up to ~0.5mm in length). The amphiboles appear to be replacing primary, cumulus orthopyroxene (based on the outlines of the crystals), but may also be intercumulus phases. Rare intercumulus augite was identified (<0.1%). Sulphides (pyrrhotite, chalcopyrite, pyrite) and oxides (ilmenite) are intercumulus and comprise <1% of the rock. Chlorite (≤22.6%), and lizardite (~3.8%) are common alteration phases associated with the amphiboles, with crystals reaching up to 1.5mm in length. Biotite alteration (≤8.2%) is associated with the amphiboles and crystals reach up to 3.5mm in length. Carbonate alteration (≤21.6%) is moderate to strong and carbonate-quartz veins and fracture fill cut and locally brecciate the unit. Calcite crystals locally reach up to 1.4mm in length. Sericite (≤1%) is a common alteration of plagioclase.

Unit 2a varies in thickness up to ~19m and locally hosts thin bands of sulphide mineralization. In the east, unit 2a is cut by granitic dykes/ sills and may also be cut by unit 13a (diabase dyke) (Fig. 5.4). Unit 2a is interpreted as being underlain by unit 8 in the East. In the west unit 2a is a thin layer that overlies 11a (Fig. 5.41) (See description below for unit 11a) and appears to be a separate layer of similar composition to unit 2a in the east (Fig. 5.42). Therefore, unit 2a could be divided into 2a lower (west) and 2a upper (east).

5.2.13 Unit: 11a

Unit 11a is a medium to coarse-grained (heteradcumulate) augite norite/orthopyroxene gabbro with cumulus plagioclase (+/- orthopyroxene) (Fig. 5.27) and intercumulus augite, orthopyroxene, sulphides, oxides and locally hornblende, which is also present as an alteration phase (Fig. 5.28). Plagioclase (37-66%) averages 3-4mm but reaches 8mm in length. Plagioclase is weakly lineated and the grain boundaries suggest a partially equilibrated textural geometry. Orthopyroxene is both a cumulus and intercumulus phase, reaches up to 6mm in length, and contains fine grained exsolved Fe-Ti oxide lamellae. Orthopyroxene oikocrysts host plagioclase crystals in a poikilitic and ophitic texture. Augite (13-20%) is intercumulus, mantles the orthopyroxenes and forms large oikocrysts (up to 8mm in length) that host orthopyroxene and/or plagioclase in a poikilitic texture. The sulphides (pyrrhotite, chalcopyrite, and pentlandite) and oxides (ilmenite and rutile) are intercumulus phases and comprise 2.6-7.6% of the rock. Hornblende (≤1.6%) is present as a minor intercumulus phase, but is more commonly an alteration phase, and locally mantles pyroxenes. Biotite (≤3%) is a fine to medium-grained alteration phase associated with the hornblende. Carbonate alteration (~1%) is associated with fractures, and there is weak sericite (≤1.2%) alteration of the plagioclase.

Unit 11a overlies unit 5a in the west and appears to correlate with unit 9 in the eastern drill holes (Fig. 5.40 to 5.42).

5.2.14 Unit: 4

Unit 4 is a sulphide bearing medium-grained (+/- orthopyroxene) hornblende gabbro (Fig. 5.29). It contains cumulus plagioclase and pyroxenes (+/- orthopyroxene, +/- augite) and intercumulus pyroxenes (+/- orthopyroxene, +/- augite), plagioclase, hornblende and minor opaque phases (+/- pyrrhotite, ilmenite, and chalcopyrite) (Fig. 5.30). Plagioclase (40-55%) is a cumulus and minor intercumulus phase averaging ~2mm and reaching up to 5mm in length. Crystals can be kinked or bent and grain boundaries suggest a partially equilibrated textural geometry. Only relict cores remain of the pyroxenes (<10%) as a result of alteration/replacement by amphiboles. Hornblende (≤31%) and actinolite (≤13.2%) are fine-grained (<1mm) and present as intercumulus and alteration phases. Sulphides (pyrrhotite (≤23%), chalcopyrite (≤2.4%), pyrite (≤6.2%)), graphite (≤6.4%) and ilmenite (<0.1%) are intercumulus or late phases. Alteration minerals include biotite (≤1.6%) and chlorite (≤12.4%) which are associated with the amphiboles, and minor sericite (≤0.8%) alteration of the plagioclase.

Unit 4 occurs in two stratigraphic positions. The first is in unit 5a (804-01) in the east where it is host to a thin layer of mineralization ~40cm in thickness (Fig. 5.38 & 5.39), and the second is in the west just above the 5a contact , in unit 11a +/- 2a (Fig. 5.40 & 5.41). Unit 4 varies in thickness from 3 to 6m.

5.2.15 Unit: 1a

Unit 1a is a medium to coarse-grained augite (+/- hornblende) norite (Fig. 5.31) with cumulus plagioclase and orthopyroxene and intercumulus augite, ilmenite, pyrrhotite +/- hornblende (Fig. 5.32). Plagioclase (52-66%) averages ~2mm but reaches up to 7mm in length. Grains are locally bent or kinked (Fig. 5.32 (f)), and weakly lineated. Orthopyroxene (15-34%) forms rounded to slightly elongate cumulus crystals that locally exhibit exsolution and reach up to 4mm but average ~1-2mm in length. Augite (2-16.8%) is intercumulus (Fig. 5.32). Large oikocrysts host plagioclase and orthopyroxene in a poikilitic texture. Augite also mantles orthopyroxene. Hornblende (≤9.4%) is a minor intercumulus phase and an alteration/replacement of the pyroxenes. Sulphides (pyrrhotite (≤9%) and chalcopyrite (≤0.2%)) and oxides (ilmenite (≤2.4%) and rutile (<0.1%)) are intercumulus and generally fine-grained (≤1mm). Biotite (≤2.8%) is a late alteration phase associated with the amphiboles. Carbonate alteration (~1%) is weak in intensity and associated with fractures. Sericite alteration (≤0.6%) is weak in intensity and affects the plagioclase.

Unit 1a is host to thin fine-grained layers (similar to unit 5b in unit 5a) that generally host increased pyrrhotite content. Thin plagioclase rich layers are present (similar to unit 3) within unit 1a. Unit 11a shows some similarities to unit 1a (mineralogy, textures, etc.). Unit 1a in the western drill holes is underlain by 11a, and is overlain by 1ab (see below for description) (Fig. 5.40 & 5.41). Units 1a and 1ab appear to be interbedded, and may represent a sequence of cyclical layers. Unit 1a is cut by shear zones, granitic veins/dykes/sills and by gabbroic dykes/sills (unit 12). It is also host to thin bands of sulphide mineralization. If units 1a and 1ab are lumped together, then this combined layer reaches 150m and may be as much as 165m thick.

5.2.16 Unit: 1ab

Unit 1ab is a medium to coarse-grained (leuco) hornblende gabbro (Fig. 5.33) and is similar in texture and composition to unit 1a (Fig. 5.31 & 5.32), but is more intensely altered (Fig. 5.34). Plagioclase (~60-87%) is cumulus and averages ~3-4mm but reaches >8mm in length. Grains can be kinked/bent and grain boundaries indicate a partially equilibrated textural geometry. Orthopyroxene (≤3%) is cumulus, but only relict grains (up to 2.5mm) remain due to replacement/alteration by amphiboles. Fine-grained exsolved Fe-Ti oxide lamellae aid in outlining the primary grain boundaries. Augite (<5%) is intercumulus (up to 3.6mm) but also altered to amphiboles. Hornblende +/- actinolite are the main mafic phases (≤26.4%), and overprint/replace the pyroxenes. Sulphides (pyrrhotite and chalcopyrite) and oxides (ilmenite) are common intercumulus phases and comprise ≤4.4% of the rock. Biotite (≤1%) is a minor alteration phase associated with the amphiboles. Carbonate alteration (≤2.6%) is associated with fractures, and weak sericite alteration (≤5.2%) locally affects the plagioclase.

Unit 1ab is similar to unit 1a, and may be part of a cyclical sequence comprised of alternating units 1a and 1ab. Unit 1ab is overlain by a pyroxenite in Hp-09. Unit 1ab is cut by shear zones, granitic veins/dykes and sills, and thin intersections of unit 12, as well as sulphide mineralization (Fig. 5.40 & 5.41). Unit 8 in the eastern drill holes appears to correspond to units 1a and 1ab in the west.

5.2.17 Unit: 7

Unit 7 is a medium to coarse-grained pyroxenite (Fig. 5.35) with cumulus orthopyroxenes (≤71.2%) averaging 3mm but reaching up to ~1cm in length (Fig. 5.36). Orthopyroxene can show minor exsolution of augite, can be kinked or bent and is commonly fractured (Fig. 5.36). Plagioclase (≤1%), sulphides (pyrrhotite, chalcopyrite, and pentlandite) and oxides (ilmenite and graphite) are intercumulus phases and comprise ≤38.4% of the rock. It is uncertain if the sulphide mineralization is primary, secondary or remobilized (or combination of these). Amphibole (hornblende +/- actinolite) alteration (≤10.6%) of the pyroxenes is common along the margins and locally mantles the grains.

The pyroxenite (unit 7) is underlain by unit 1ab and is overlain by anorthosite (unit 6, see below for description). The most significant intersection of pyroxenite occurs in Hp-09 and has a down hole thickness of ~2.9m (Fig. 5.41).

5.2.18 Unit: 6

Unit 6 is a medium-grained anorthosite (Fig. 5.35 (a) only) with cumulus plagioclase (95.2%) averaging 3mm but reaching >8mm in length (Fig. 5.37). Plagioclase grain boundaries are sharp, irregular to smooth and suggest a partially equilibrated textural geometry and an adcumulate texture. Intercumulus minerals include hornblende (possibly replacing pyroxene?), ilmenite, pyrrhotite, chalcopyrite and pyrite which comprise <0.5% of the rock. Alteration minerals include chlorite, biotite, sericite and calcite, are associated with fractures and hornblende, and comprise <4.5% of the rock.

Unit 6 lies directly below a massive sulphide layer in Hp-09, and is underlain by pyroxenite (unit 7) (Fig. 5.41). Unit 6 has a downhole thickness of 1.28m.

5.3 Correlation

Correlation of the geological units was accomplished using mineralogy, texture, grain size, stratigraphic position and alteration. Elevations used for correlation and in stratigraphic sections are the “corrected” elevations (Tables 5.1 to 5.3). Simplified and detailed stratigraphic columns were created for the eastern drill holes (H-01 to H-06) (Fig. 5.38 & 5.39) and the western drill holes (Hp-07 to Hp-12A) (Fig. 5.40 & 5.41). Stratigraphy from the east and west drill holes appears to overlap, but the thickness of unit 5a in the western drill holes is not constrained because none reached the base of the unit. A complete list of samples and their assigned unit codes appears in Table 5.4.

Faults (Plank *et al.*, 2007), alteration, granite intrusion (eastern holes) complicate correlation between the east and west holes but some layers appear to be thicker in the western area suggesting that they are closer to the centre of the intrusion (Fig. 5.42).

Similar lithologies and sequences of lithologies in the east and west drill holes suggest that the layers identified in the eastern drill holes (layers 9, 8, 3) correlate with units 11a, 1a and 1ab in the western drill holes (Fig. 5.42) (unit 9 + 3 (east) = 11a (west), unit 8 (east)=1a + 1ab (west)). The more leucocratic layers that lie above the 5a contact may represent a shift in crystallization or magma chemistry towards a more leucocratic composition with stratigraphic height.

Intersections of unit 12 show some variation in stratigraphic position from hole to hole (Fig. 5.42). This unit is fine-grained, and the contacts are sharp. It represents a dyke(s) or sill(s) with emplacement structurally or stratigraphically controlled by earlier lithologic layering, fractures and/or faults.

Unit 5a is one of the most recognisable lithological units due to abundant ilmenite. In thin section there are long chain-like clusters of intercumulus pyroxenes (orthopyroxene, augite and pigeonite), exsolution of augite +/- pigeonite in the orthopyroxene, exsolution of orthopyroxene in augite, and fine grained exsolution lamellae of Fe-Ti oxides in both pyroxenes (Fig. 5.10 & 5.11).

Layering observed in the drill holes, is composed of modal and phase layering. Cyclical layering may be present, but additional information is required for this to be confirmed. The layers appear to be laterally continuous, but vary in thickness, grain size and alteration.

As noted above, additional layers were identified in the thickest sequences. It is not clear if these are laterally continuous layers or a result of localized magmatic or post cumulus processes. The thin layers fall into two categories: 1) fine-grained “segregations” or thin layers (~2-10cm) of similar composition to the host layer with increased sulphide content, and 2) plagioclase rich layers that vary in thickness (>5cm). Ascertaining the significance of these features requires additional study.

Figure 5.42 summarizes the compiled stratigraphy of the Wadi Qutabah intrusion and correlates the east and west holes. The top of unit 5a is constrained by multiple intersections in the east and west and is used to correlate the stratigraphy. Thickness of the correlated units varies from east to west. Unit 5a is thicker in the west and unit 9 (east) is thicker than the correlative unit 11a (west). The true thickness of the layers in the east is unknown as a result of the intrusion of numerous granitic dykes and sills which displace the stratigraphy. Some layers are thicker in the west, and others in the east, therefore no definitive conclusions can be made with regards to position (centre or margin) within in the intrusion.

One area of the intrusion that deserves additional attention is the space between Hp-07 and Hp-09 and the area around Hp-09. Hp-09 is host to the thickest intersection of sulphide mineralization, which is underlain by layers of the rare pyroxenite and anorthosite lithologies. Economic mineralization has been identified in other large intrusions in mineralized pyroxenite layers. The Great Dyke in Zimbabwe is host to an example of this type of mineralization, in the Main Sulphide Zone (MSZ). The sulphide phases that carry the platinum group metals (PGMs) are pyrrhotite and chalcopyrite (Oberthur & Melcher, 2005), which are the most common sulphide phases of the Wadi Qutabah intrusion.

An assembly of all information (Fig. 5.42) indicates that ~500m (true thickness) of the intrusions stratigraphy was sampled by drilling in an area ~5km (E-W) x4km (N-S). This provides important information for future exploration, mapping and work on the intrusion.

Table 5.1. Calculated true thickness for the eastern samples and drill holes: H-01 to H-05 for a dip of 25°.

Hole ID	Thin Section #	From	To	Hole Length (m)	**True "from"**	**True from elev**	**True "to"**	**True to elev**	**True Collar**	**True EOH**	**True Length**	Unit Code
H-01	921-01	30	30.3	114.58	27.19	1479.69	27.46	1479.42	1506.88	1403.03	103.84	2a
H-01	922-01	81.59	81.92	114.58	73.95	1432.93	74.24	1432.63	1506.88	1403.03	103.84	2a
H-02	924-01	95.33	95.65	120.91	86.40	1436.63	86.69	1436.34	1523.03	1413.45	109.58	13a
H-02A	776-01	46.9	47.4	58.42	42.51	1402.33	42.96	1401.88	1444.83	1391.89	52.95	8
H-03	778-01	20.63	21.12	128.50	18.70	1393.53	19.14	1393.08	1412.22	1295.76	116.46	8
H-03	779-01	38.28	38.75	128.50	34.69	1377.53	35.12	1377.10	1412.22	1295.76	116.46	8
H-03	783-01	93.8	94.3	128.50	85.01	1327.21	85.46	1326.76	1412.22	1295.76	116.46	8
H-03	790-01	123.64	124.2	128.50	112.06	1300.17	112.56	1299.66	1412.22	1295.76	116.46	9
H-03	792-01	128.1	128.5	128.50	116.10	1296.13	116.46	1295.76	1412.22	1295.76	116.46	9
H-04	793-01	17.77	18.12	131.26	16.11	1313.52	16.42	1313.21	1329.63	1210.67	118.96	9
H-04	795-01	40.02	40.35	131.26	36.27	1293.36	36.57	1293.06	1329.63	1210.67	118.96	3
H-04	796-01	52.12	52.5	131.26	47.24	1282.39	47.58	1282.05	1329.63	1210.67	118.96	12
H-04	797-01	79.03	79.48	131.26	71.63	1258.00	72.03	1257.60	1329.63	1210.67	118.96	9
H-04	798-01	96.9	97.34	131.26	87.82	1241.81	88.22	1241.41	1329.63	1210.67	118.96	5a
H-04	800-01	123.8	124.1	131.26	112.20	1217.43	112.50	1217.13	1329.63	1210.67	118.96	2b
H-05	804-01	36.08	36.43	101.04	32.70	1225.03	33.02	1224.71	1257.73	1166.15	91.57	4
H-05	806-01	52.27	52.79	101.04	47.37	1210.35	47.84	1209.88	1257.73	1166.15	91.57	5a
H-05	806-02	52.67	52.72	101.04	47.74	1209.99	47.78	1209.94	1257.73	1166.15	91.57	5b
H-05	810-01	88.89	89.2	101.04	80.56	1177.16	80.84	1176.88	1257.73	1166.15	91.57	2b
H-05	812-01	99.29	99.7	101.04	89.99	1167.74	90.36	1167.37	1257.73	1166.15	91.57	5a

Table 5.2. Calculated true thickness for samples and drill holes: H-06 and Hp-07 to Hp-09 for a dip of 25°.

Hole ID	Thin Section #	From	To	Hole Length (m)	**True "from"**	**True from elev**	**True "to"**	**True to elev**	**True Collar**	**True EOH**	**True Length**	Unit Code
H-06	814-01	17.06	17.46	191.68	15.46	1189.04	15.82	1188.68	1204.50	1030.78	173.72	5a
H-06	815-01	42.97	43.42	191.68	38.94	1165.56	39.35	1165.15	1204.50	1030.78	173.72	10a
H-06	827-01	62.78	63.3	191.68	56.90	1147.60	57.37	1147.13	1204.50	1030.78	173.72	5c
H-06	829-01	96.8	97.3	191.68	87.73	1116.77	88.18	1116.32	1204.50	1030.78	173.72	10b
H-06	832-01	137	137.5	191.68	124.16	1080.34	124.58	1079.92	1204.50	1030.78	173.72	10a
H-06	835-01	188.6	189	191.68	170.93	1033.57	171.29	1033.21	1204.50	1030.78	173.72	10b
Hp-07	836-01	27.46	27.82	90.31	24.89	1705.61	25.21	1705.28	1730.50	1648.65	81.85	1a
Hp-07	839-01	51	51.32	90.31	46.22	1684.28	46.51	1683.99	1730.50	1648.65	81.85	1a
Hp-07	840-01	69	69.5	90.31	62.54	1667.96	62.99	1667.51	1730.50	1648.65	81.85	1a
Hp-07	842-01	87.61	87.94	90.31	79.40	1651.10	79.70	1650.80	1730.50	1648.65	81.85	1ab
Hp-08	843-01	19.91	20.29	187.84	18.04	1671.88	18.39	1671.54	1689.93	1519.69	170.24	1ab
Hp-08	845-01	81.47	81.9	187.84	73.84	1616.09	74.23	1615.70	1689.93	1519.69	170.24	12
Hp-08	848-01	139.6	140.1	187.84	126.52	1563.41	126.97	1562.95	1689.93	1519.69	170.24	11a
Hp-08	851-01	171.26	171.3	187.84	155.21	1534.71	155.26	1534.67	1689.93	1519.69	170.24	5a
Hp-08	851-02	171.54	171.6	187.84	155.47	1534.46	155.51	1534.41	1689.93	1519.69	170.24	5a
Hp-09	906-01	24.28	24.33	130.02	22.01	1748.29	22.05	1748.24	1770.29	1652.46	117.84	6
Hp-09	906-02	24.69	24.74	130.02	22.38	1747.92	22.42	1747.87	1770.29	1652.46	117.84	7
Hp-09	908-01	25.6	25.93	130.02	23.20	1747.09	23.50	1746.79	1770.29	1652.46	117.84	7
Hp-09	909-01	32.17	32.49	130.02	29.16	1741.14	29.45	1740.85	1770.29	1652.46	117.84	1ab
Hp-09	916-01	101.8	102.1	130.02	92.26	1678.03	92.57	1677.72	1770.29	1652.46	117.84	1ab

Table 5.3. Calculated true thickness for samples and drill holes: Hp-10 to Hp-12 for a dip of 25°.

Hole ID	Thin Section #	From	To	Hole Length (m)	**True "from"**	**True from elev**	**True "to"**	**True to elev**	**True Collar**	**True EOH**	**True Length**	Unit Code
Hp-10	FX847931	14.36	29.02	187.14	13.01	1614.69	26.30	1601.40	1627.70	1458.09	169.61	8
Hp-10	FX847932	32.17	32.27	187.14	29.16	1598.54	29.25	1598.45	1627.70	1458.09	169.61	1a
Hp-10	876-01	35.16	35.52	187.14	31.87	1595.83	32.19	1595.51	1627.70	1458.09	169.61	1a
Hp-10	877-01	45.04	45.26	187.14	40.82	1586.88	41.02	1586.68	1627.70	1458.09	169.61	12
Hp-10	880-01	68.1	68.4	187.14	61.72	1565.98	61.99	1565.71	1627.70	1458.09	169.61	12
Hp-10	FX847933	107.15	107.3	187.14	97.11	1530.59	97.20	1530.50	1627.70	1458.09	169.61	5a
Hp-10	884-01	139.15	139.5	187.14	126.11	1501.59	126.43	1501.27	1627.70	1458.09	169.61	5a
Hp-10	890-01	178.78	179.1	187.14	162.03	1465.67	162.35	1465.35	1627.70	1458.09	169.61	5a
Hp-10	FX847934	183.05	183.2	187.14	165.90	1461.80	166.04	1461.66	1627.70	1458.09	169.61	5b
Hp-11	FX847935	17.65	17.73	90.45	16.00	1588.06	16.07	1587.99	1604.05	1522.08	81.98	1a
Hp-11	854-01	32.5	32.87	90.45	29.46	1574.60	29.79	1574.26	1604.05	1522.08	81.98	2a
Hp-11	856-01	62.32	62.66	90.45	56.48	1547.57	56.79	1547.26	1604.05	1522.08	81.98	4
Hp-11	856-02	62.61	62.66	90.45	56.74	1547.31	56.79	1547.26	1604.05	1522.08	81.98	4
Hp-11	FX847937	85.03	85.14	90.45	77.06	1526.99	77.16	1526.89	1604.05	1522.08	81.98	5a
Hp-12	859-01	21.81	22.23	85.81	19.77	1596.65	20.15	1596.27	1616.42	1538.65	77.77	12
Hp-12	860-01	29.83	30.22	85.81	27.04	1589.38	27.39	1589.03	1616.42	1538.65	77.77	12
Hp-12	866-01	63.27	63.71	85.81	57.34	1559.08	57.74	1558.68	1616.42	1538.65	77.77	4
Hp-12	874-01	78.45	78.89	85.81	71.10	1545.32	71.50	1544.92	1616.42	1538.65	77.77	11a

Table 5.4. List of the thin section samples with their assigned lithological unit codes for the eastern and western drill holes.

Hole_ID	Thin Section #	Unit Code	Location	Hole_ID	Thin Section #	Unit Code	Location
H-01	921-01	2a	East	Hp-07	842-01	1ab	West
H-01	922-01	2a	East	Hp-08	843-01	1ab	West
H-02	924-01	13a	East	Hp-08	845-01	12	West
H-02A	776-01	8	East	Hp-08	848-01	11a	West
H-03	778-01	8	East	Hp-08	851-01	5a	West
H-03	779-01	8	East	Hp-08	851-02	5a	West
H-03	783-01	8	East	Hp-09	906-01	6	West
H-03	790-01	9	East	Hp-09	906-02	7	West
H-03	792-01	9	East	Hp-09	908-01	7	West
H-04	793-01	9	East	Hp-09	909-01	1ab	West
H-04	795-01	3	East	Hp-09	916-01	1ab	West
H-04	796-01	12	East	Hp-10	FX847931	8	West
H-04	797-01	9	East	Hp-10	FX847932	1a	West
H-04	798-01	5a	East	Hp-10	876-01	1a	West
H-04	800-01	2b	East	Hp-10	877-01	12	West
H-05	804-01	4	East	Hp-10	880-01	12	West
H-05	806-01	5a	East	Hp-10	FX847933	5a	West
H-05	806-02	5b	East	Hp-10	884-01	5a	West
H-05	810-01	2b	East	Hp-10	890-01	5a	West
H-05	812-01	5a	East	Hp-10	FX847934	5b	West
H-06	814-01	5a	East	Hp-11	FX847935	1a	West
H-06	815-01	10a	East	Hp-11	854-01	2a	West
H-06	827-01	5c	East	Hp-11	856-01	4	West
H-06	829-01	10b	East	Hp-11	856-02	4	West
H-06	832-01	10a	East	Hp-11	FX847937	5a	West
H-06	835-01	10b	East	Hp-12	859-01	12	West
Hp-07	836-01	1a	West	Hp-12	860-01	12	West
Hp-07	839-01	1a	West	Hp-12	866-01	4	West
Hp-07	840-01	1a	West	Hp-12	874-01	11a	West

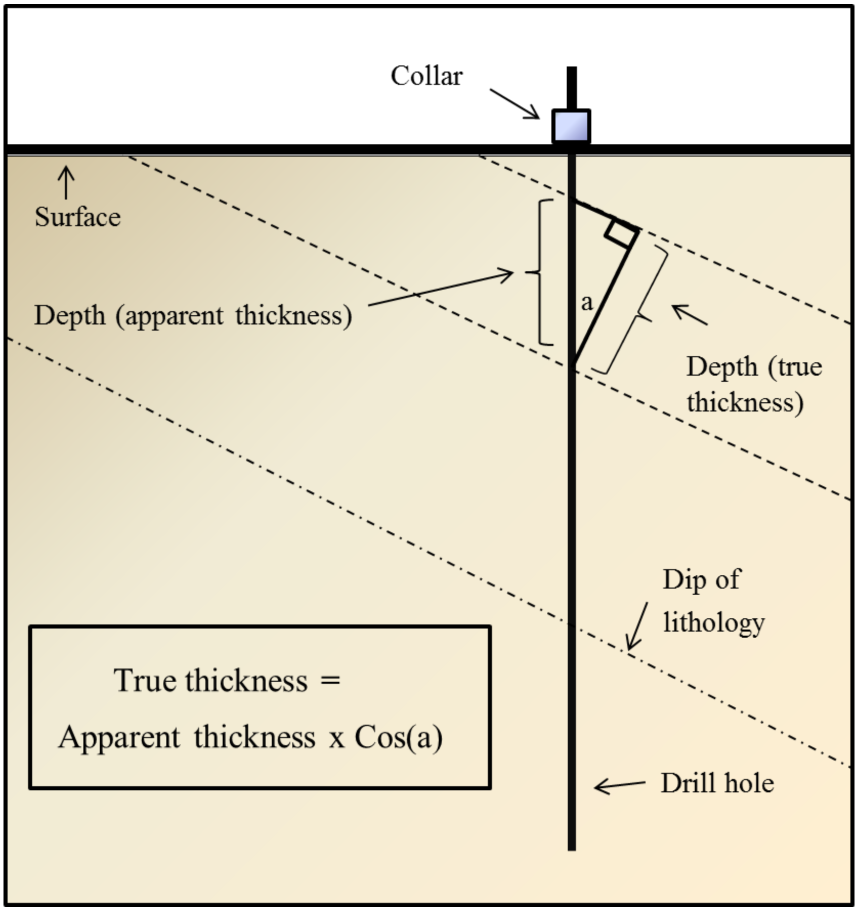


Figure 5.1. A simplified cross-sectional view of the relationship between a drill hole and the lithologies/stratigraphy, at a dip of 25º.

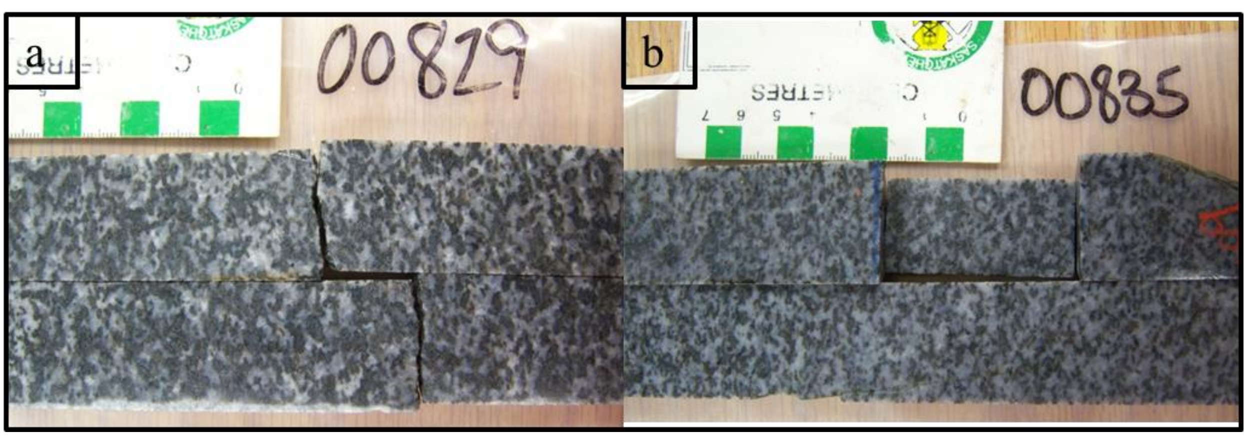


Figure 5.2. Photographs of samples a) 829 and b) 835 from unit 10b. Sample 829 lies stratigraphically higher than 835 and each is from a separate intersection of unit 10b. (Scale is in cm)

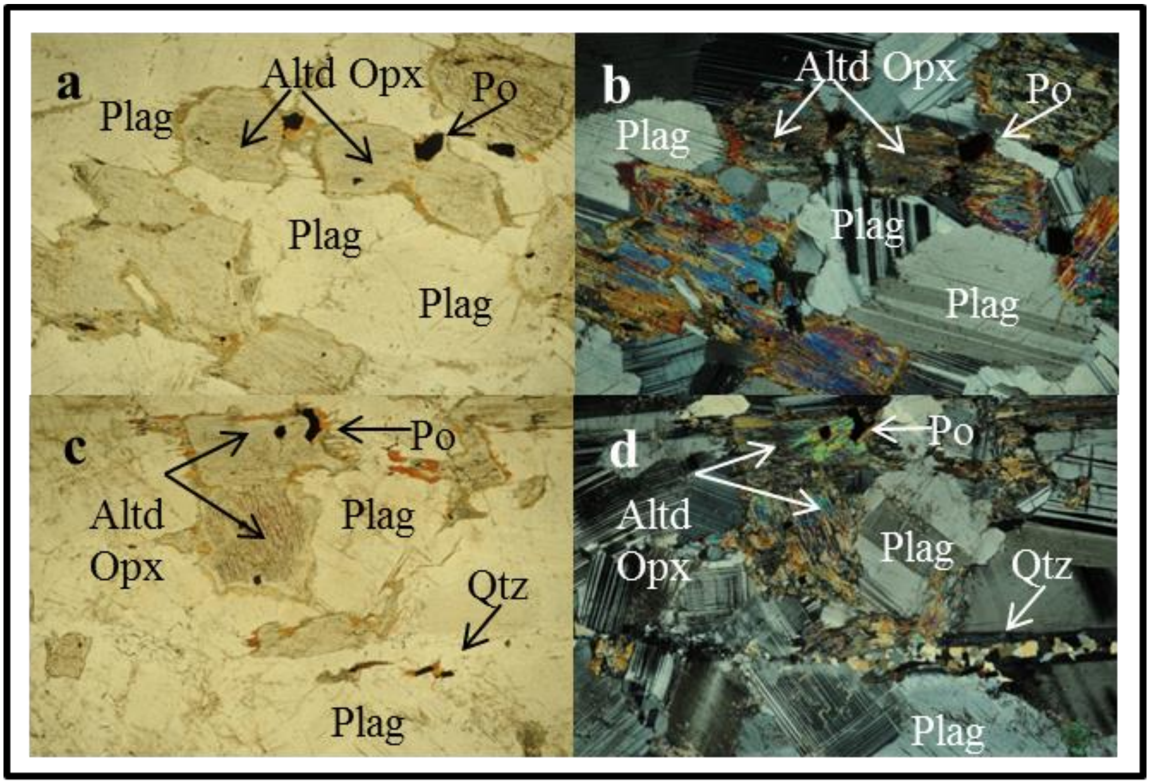


Figure 5.3. Photomicrographs of 829-01 and 835-01 from unit 10b, (width of view 5.4mm, 25x magnification); a) 829-01 under plane polarized light (ppl) showing uralitized cumulate orthopyroxenes with cumulus and intercumulus plagioclase. Plagioclase exhibits irregular to serrated grain boundaries; b) same location as (a) under crossed polarized light (xpl); c) 835-01 under ppl showing uralitized cumulate orthopyroxenes and cumulate plagioclase cut by a thin quartz veinlet; d) same location as (c) under xpl. Grain boundaries between the plagioclase are linear to irregular, and the crystals are locally fractured. Plag=plagioclase, Altd Opx= altered orthopyroxene, Po= pyrrhotite and Qtz= quartz.

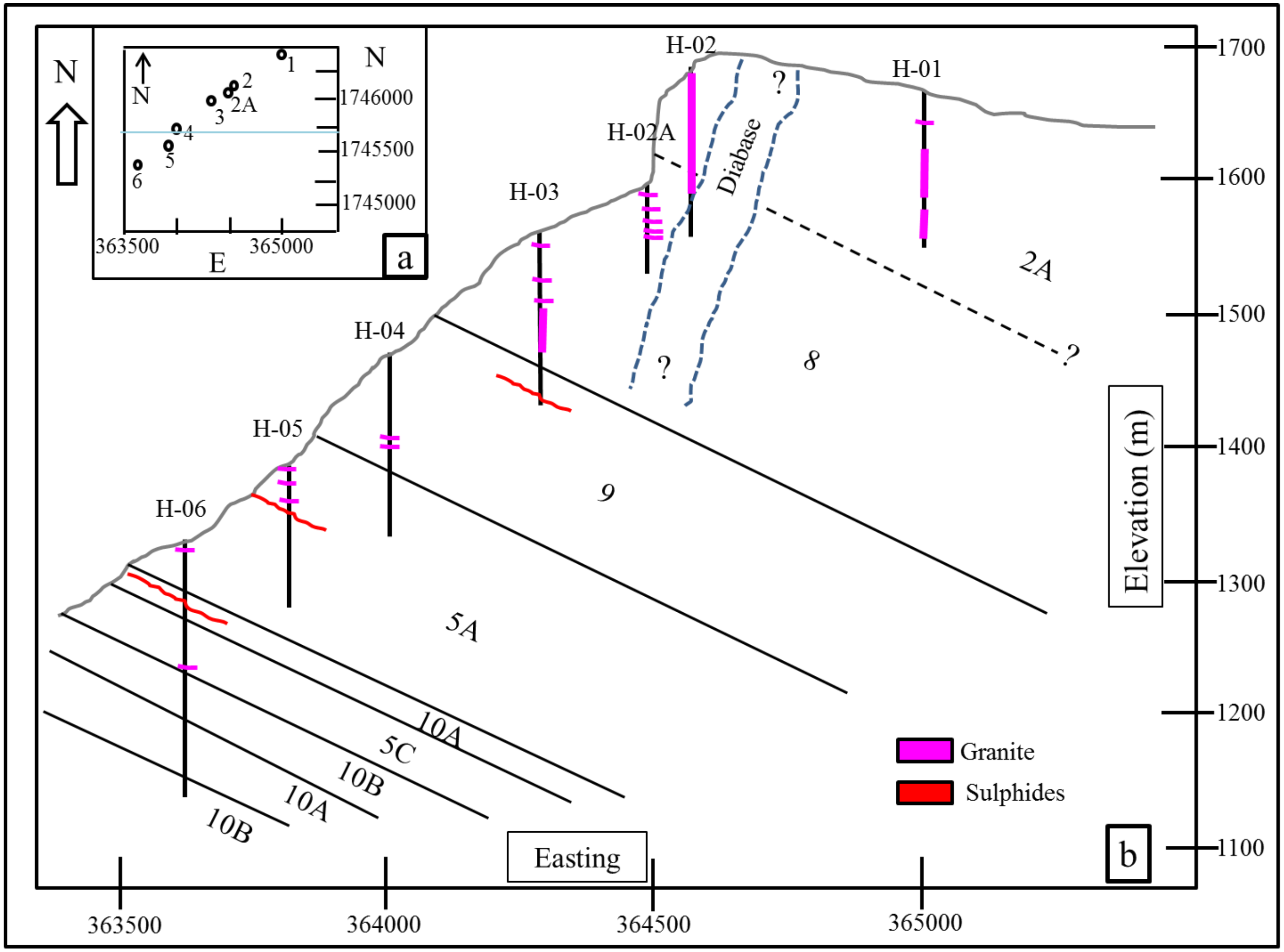


Figure 5.4. Plan view (a) of the eastern drill holes, and b) a vertical section (W-E), looking north of the eastern drill holes (H-01 to H-06) cutting a simplified view of the major lithological layers (unit codes provided).

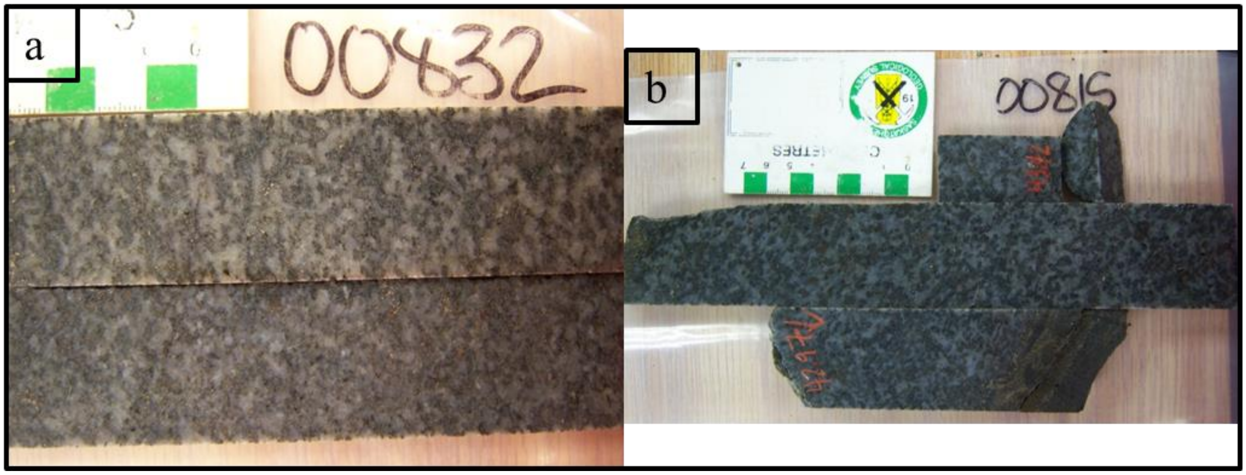


Figure 5.5. Photographs of samples a) 832 and b) 815 from unit 10a. Sample 832 is from the lower intersection and 815 from the stratigraphically higher intersection of unit 10a. (Scale is in cm)

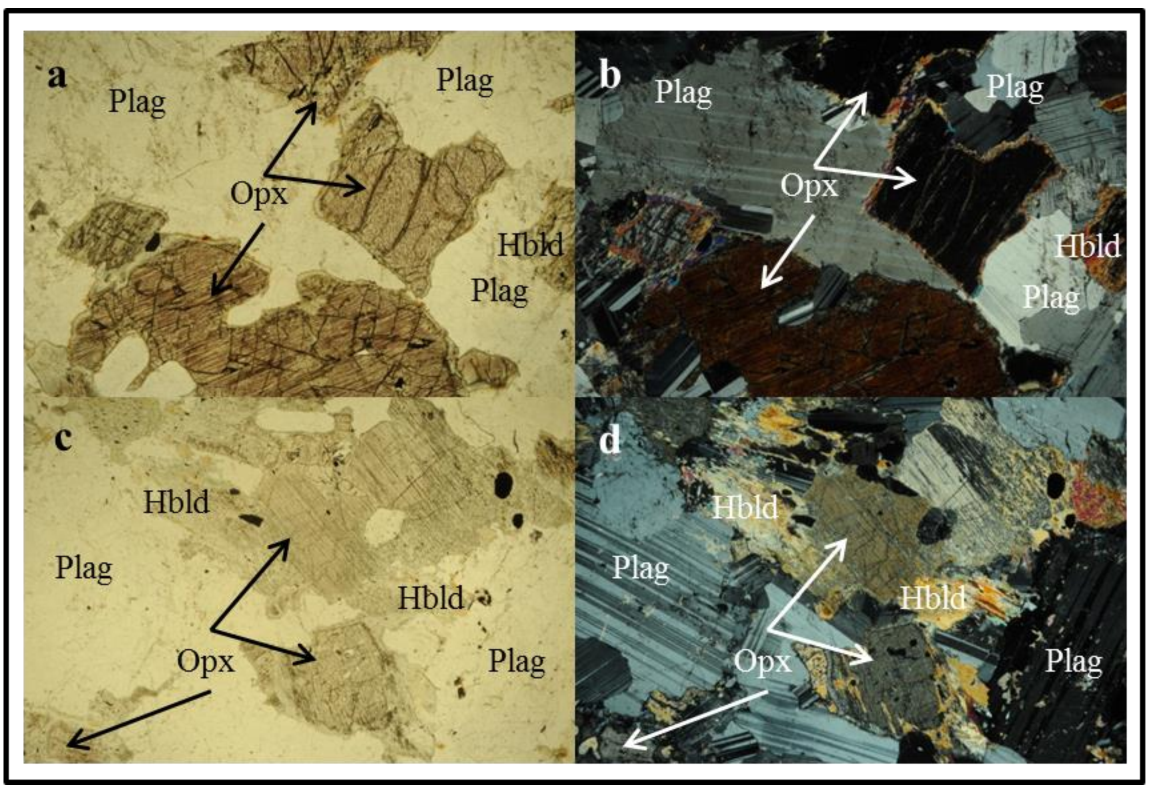


Figure 5.6. Photomicrographs of 815-01(hornblende norite) and 832-01 (orthopyroxene hornblende gabbro) from unit 10a. a) 815-01 under plane polarized light (ppl) showing cumulus plagioclase and orthopyroxene with sharp grain boundaries and minor mantling by hornblende of the pyroxenes; b) same location as (a) under crossed polarized light (xpl) with sharp linear to

irregular grain boundaries; c) 832-01 under ppl, showing cumulus plagioclase and orthopyroxenes with hornblende alteration; d) same location as (c) under xpl showing the intensity of the amphibole alteration of the pyroxenes. Grain boundaries between the plagioclases are sharp and irregular. Plag=plagioclase, Opx= orthopyroxene, Hbld= hornblende. All have a field of view of 5.4mm in width.

Figure 5.7. Photograph of sample 827 from unit 5c. (Scale is in centimeters.)

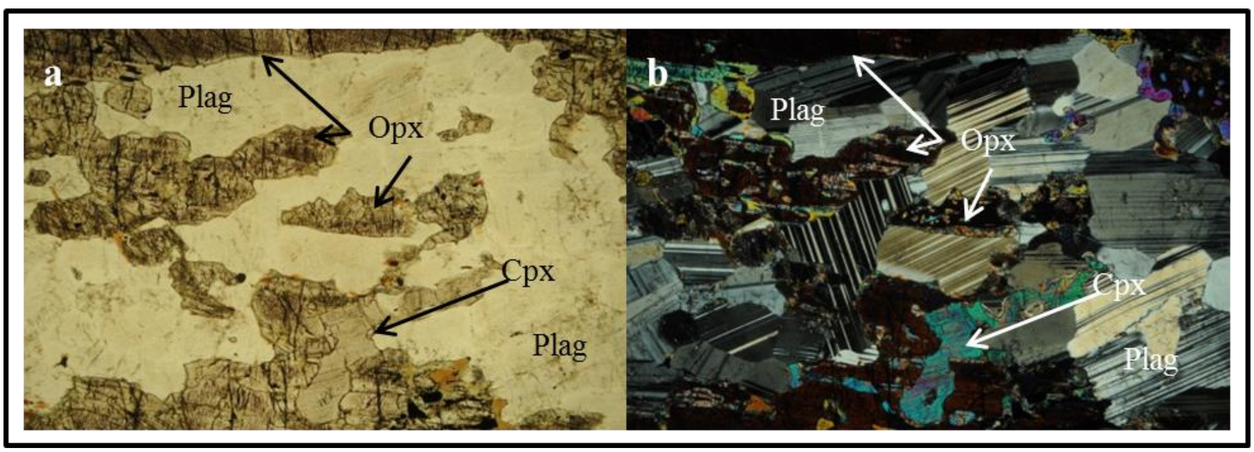


Figure 5.8. Photomicrographs of 827-01(augite norite) from unit 5c; a) 827-01 under plane polarized light showing intercumulus orthopyroxene and clinopyroxene hosted in cumulus plagioclase; b) same location as (a) under crossed polarized light. Exsolution of clinopyroxene in the orthopyroxenes is clearly visible, and the partially equilibrated grain boundaries are irregular to linear. Plag=plagioclase, Opx= orthopyroxene, Cpx= clinopyroxene. All have a field of view of 5.4mm in width.


a
00851
b
00851
c
00890
d
00884
e
00814
f
g
00812
h

Figure 5.9. Photographs of samples a) 851, fine-grained, b) 851, medium-grained, c) 890, d) 884, e) 814, f) 806 contains both fine and medium-grained norite; g) 812, and h) 798 from unit 5a. (Scale is in cm)

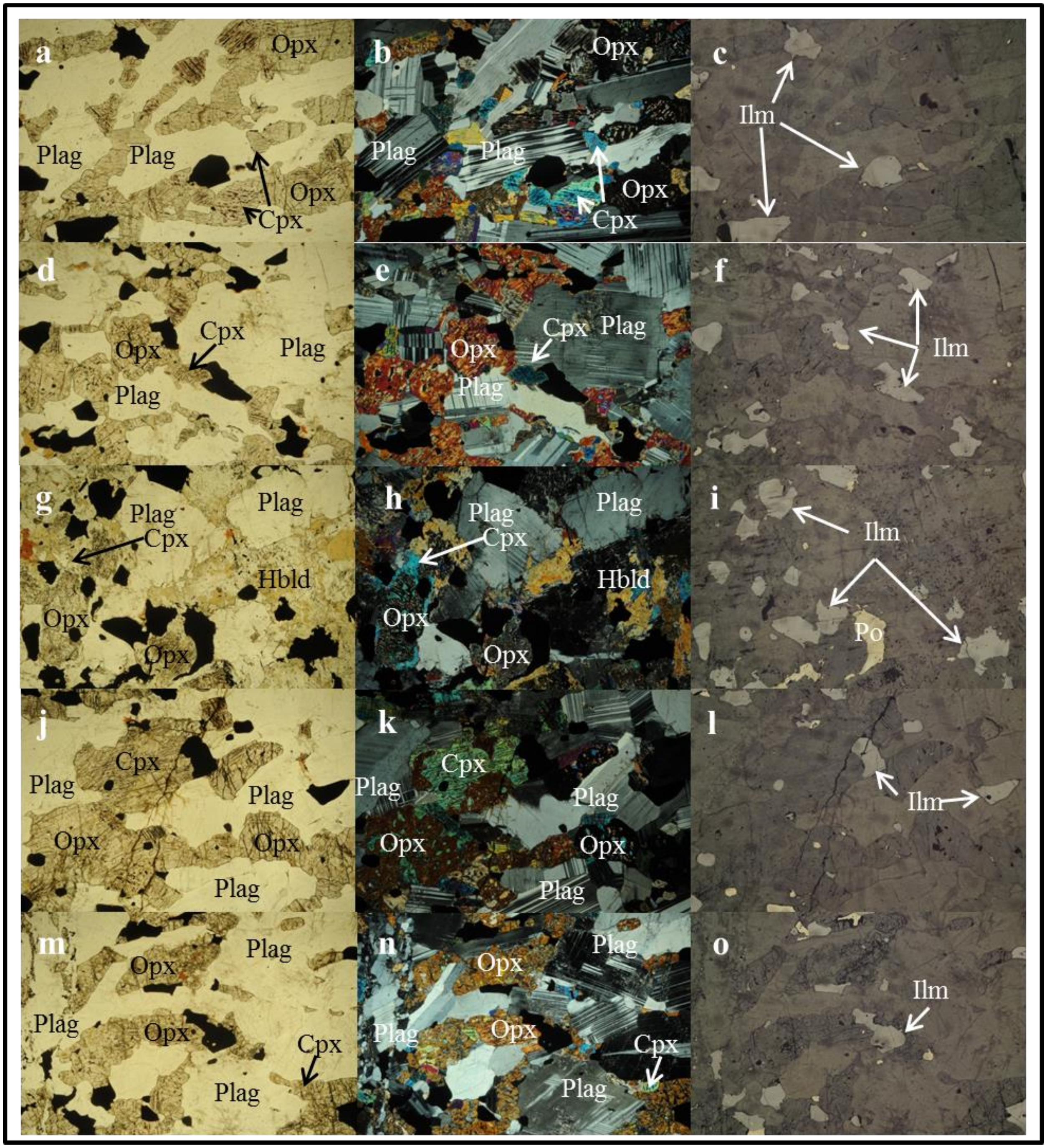
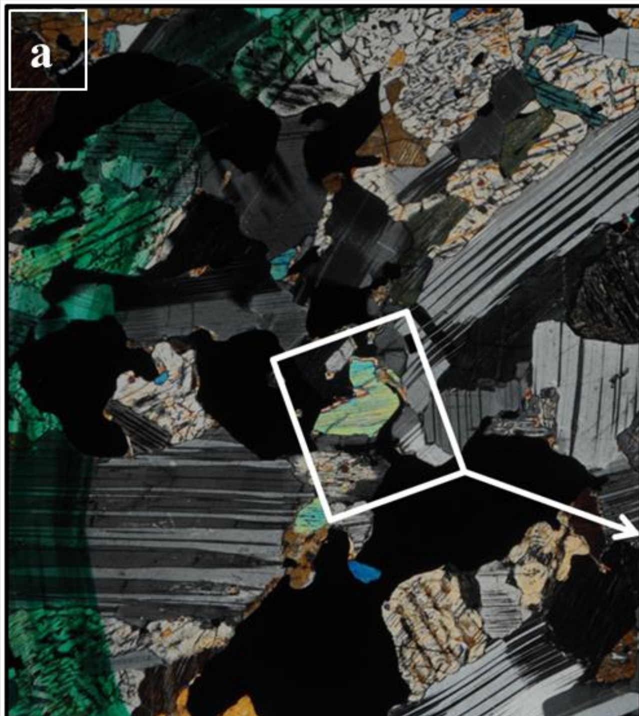
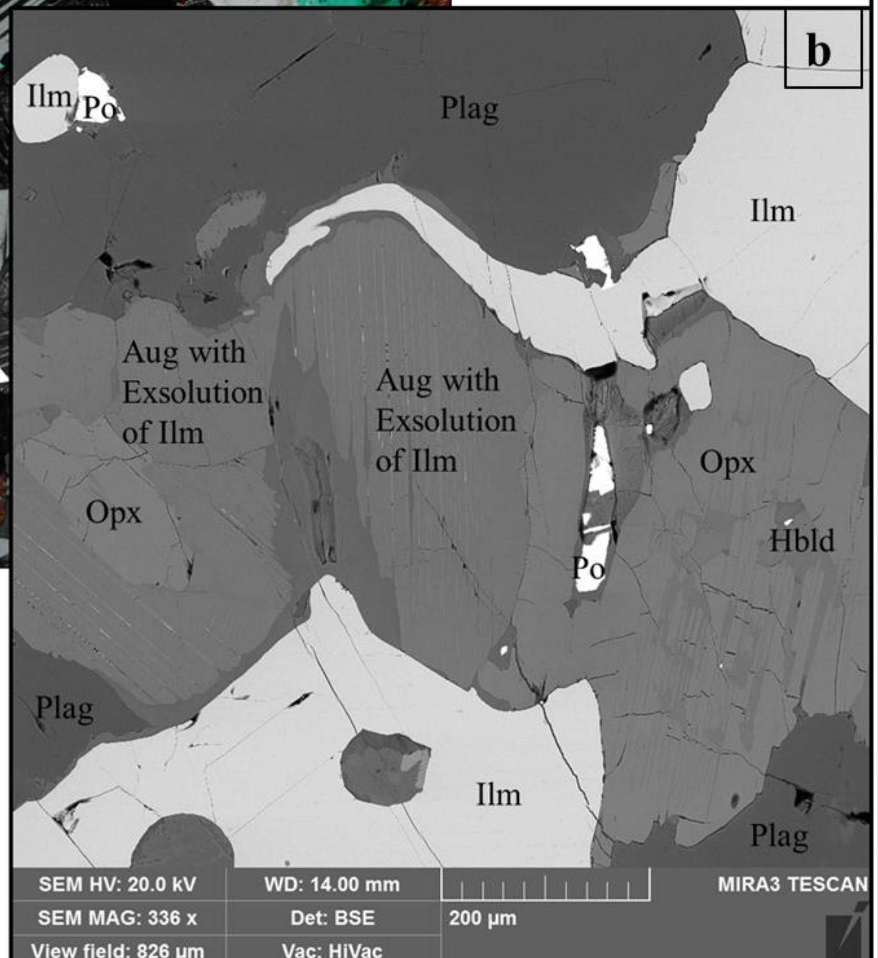


Figure 5.10. Photomicrographs of 798-01(augite norite), 814-01 (augite norite), FX847937 (hornblende augite norite), 851-02 (augite norite), 884-01 (leuco orthopyroxene gabbro/leuco augite norite) from unit 5a. a) 798-01 under plane polarized light (ppl) showing intercumulus pyroxenes and the relationship of the pyroxenes to plagioclase; b) same location as (a) under crossed polarized light (xpl); Note the presence of kinked plagioclase and exsolution in the pyroxenes, c) same location as (a) & (b) under reflected light (rl) showing ilmenite; d) sample 814-01 under ppl showing intercumulus pyroxenes and cumulus plagioclase; e) same location as (d) under xpl; exsolution in the pyroxenes is a common texture, and the grain contacts show a partially equilibrated texture; f) same location as (d) & (e) under rl with numerous ilmenite crystals; g) FX847937 under ppl showing hornblende alteration of the pyroxenes, h) FX847937 under xpl with exsolution textures in the pyroxenes visible; i) FX847937 under rl with abundant ilmenite and minor pyrrhotite; j) 851-02 under ppl with slightly coarser intercumulus pyroxenes and cumulus plagioclase compared to (a) ; k) 851-02 under xpl is host to exsolution textures in the pyroxenes and partially equilibrated textural geometry; l) 851-02 under rl showing intercumulus ilmenite; m) 884-01 under ppl showing cumulus plagioclase and intercumulus pyroxenes and opaques; n) 884-01 under xpl showing exsolution of augite in orthopyroxene and relationships of mineral grains; o) 884-01 under rl showing intercumulus ilmenite. Plag=plagioclase, Opx= orthopyroxene, Cpx= clinopyroxene, Hbld= hornblende, Ilm=ilmenite, Po=pyrrhotite. All have a field of view of 5.4mm in width.





798-01 under crossed polarized light at 25x magnification (width of photomicrograph is 5.4mm) (above). The outline indicates the location of the SEM backscatter electron image (right).

Figure 5.11. Photomicrograph of 798-01 (a) under crossed polars (width of view is 5.4mm) and a selected area outlined in white where the high resolution BSE image; (b) was taken showing fine-grained exsolution of Fe-Ti oxides in the pyroxenes. Ilm=ilmenite, Plag=plagioclase, Aug=augite, Opx=orthopyroxene, Hbld=hornblende, Po=pyrrhotite.

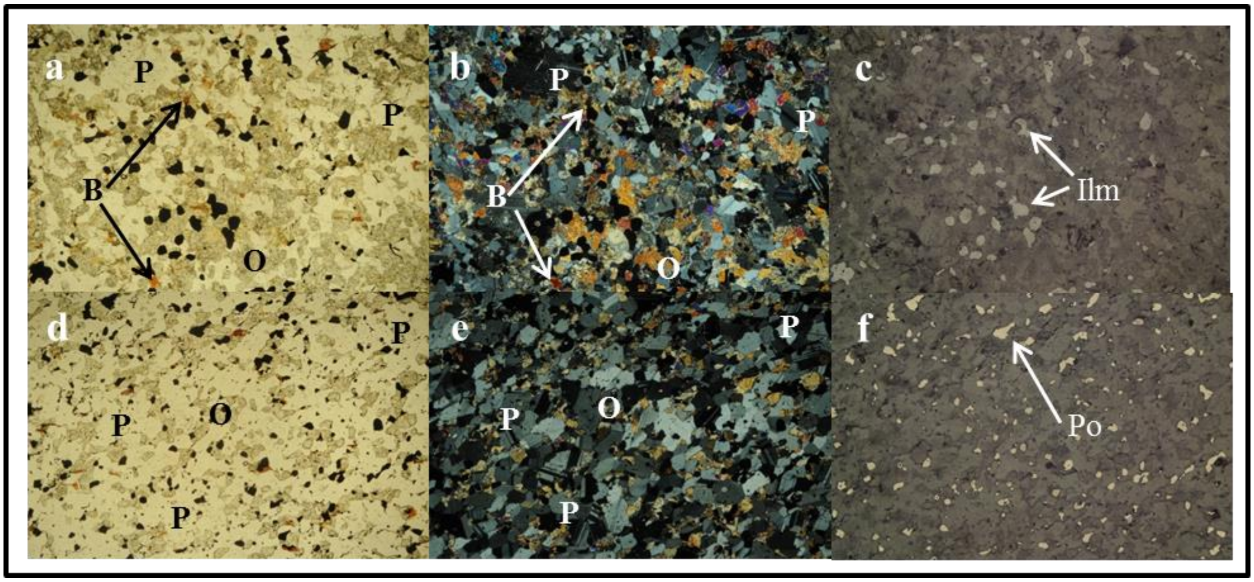


Figure 5.12. Photomicrographs of FX847934 (orthopyroxene hornblende gabbro) and 806-02 (augite hornblende norite) from unit 5b. a) FX847934 under ppl showing cumulus and intercumulus plagioclase with intercumulus pyroxenes and ilmenite; b) same location as (a) under xpl; c) same location as (a) & (b) under reflected light(rl) showing abundant ilmenite; d) 806-02 (augite norite) under ppl showing cumulus and intercumulus plagioclase with intercumulus pyroxenes; e) same location as (d) under xpl; f) same location as (d) & (e) under rl with numerous pyrrhotite crystals. P=plagioclase, O= orthopyroxene, B= biotite, Ilm = ilmenite, Po= pyrrhotite, ppl= plane polarized light, xpl= crossed polarized light, rl= reflected light. All photos 5.4mm wide.

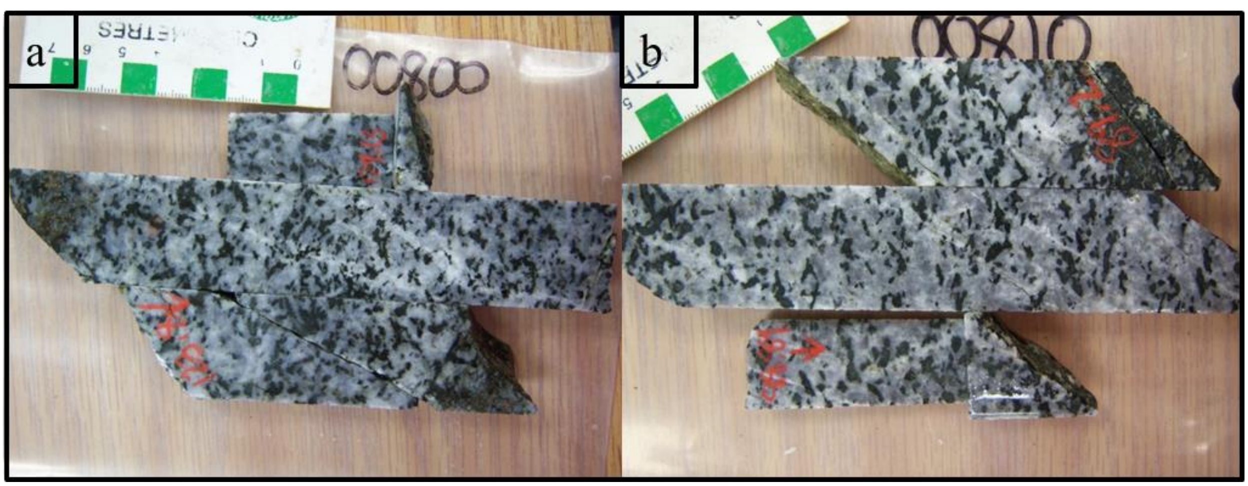


Figure 5.13. Photographs of samples a) 800 and b) 810 from unit 2b. (Scale is in centimeters.)

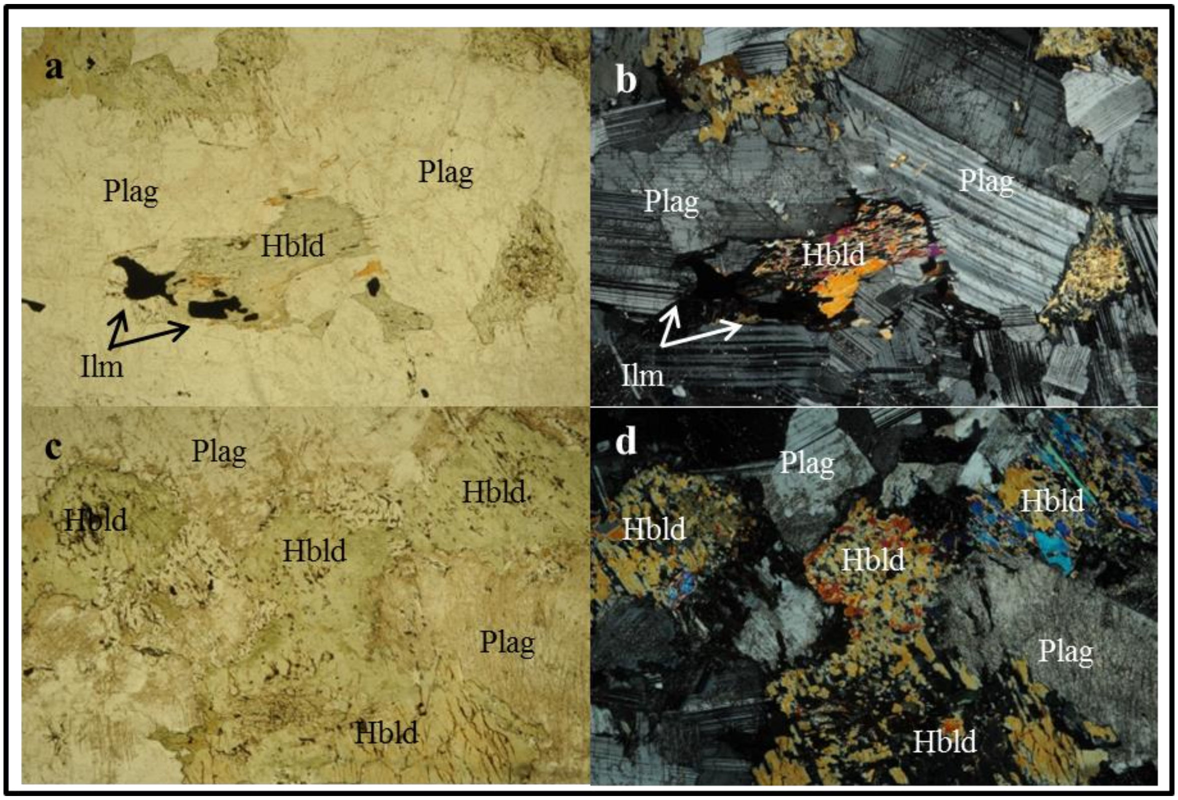


Figure 5.14. Photomicrographs of thin sections 800-01 (leuco hornblende gabbro) and 810-01 (leuco hornblende gabbro) from unit 2b (fields of view 5.4mm wide), a) 800-01 under plane polarized light (ppl), showing pale green hornblende and medium-grained cumulus plagioclase; b) same location as (a) under crossed polars (xpl) were plagioclase is exhibiting a partially equilibrated textural geometry; c) 810-01 taken under ppl showing abundant hornblende and sericite altered plagioclase; d) same location as (c) under xpl, and plagioclase grains exhibiting a partially equilibrated geometry. Plag=plagioclase, Hbld= hornblende, Ilm= ilmenite.

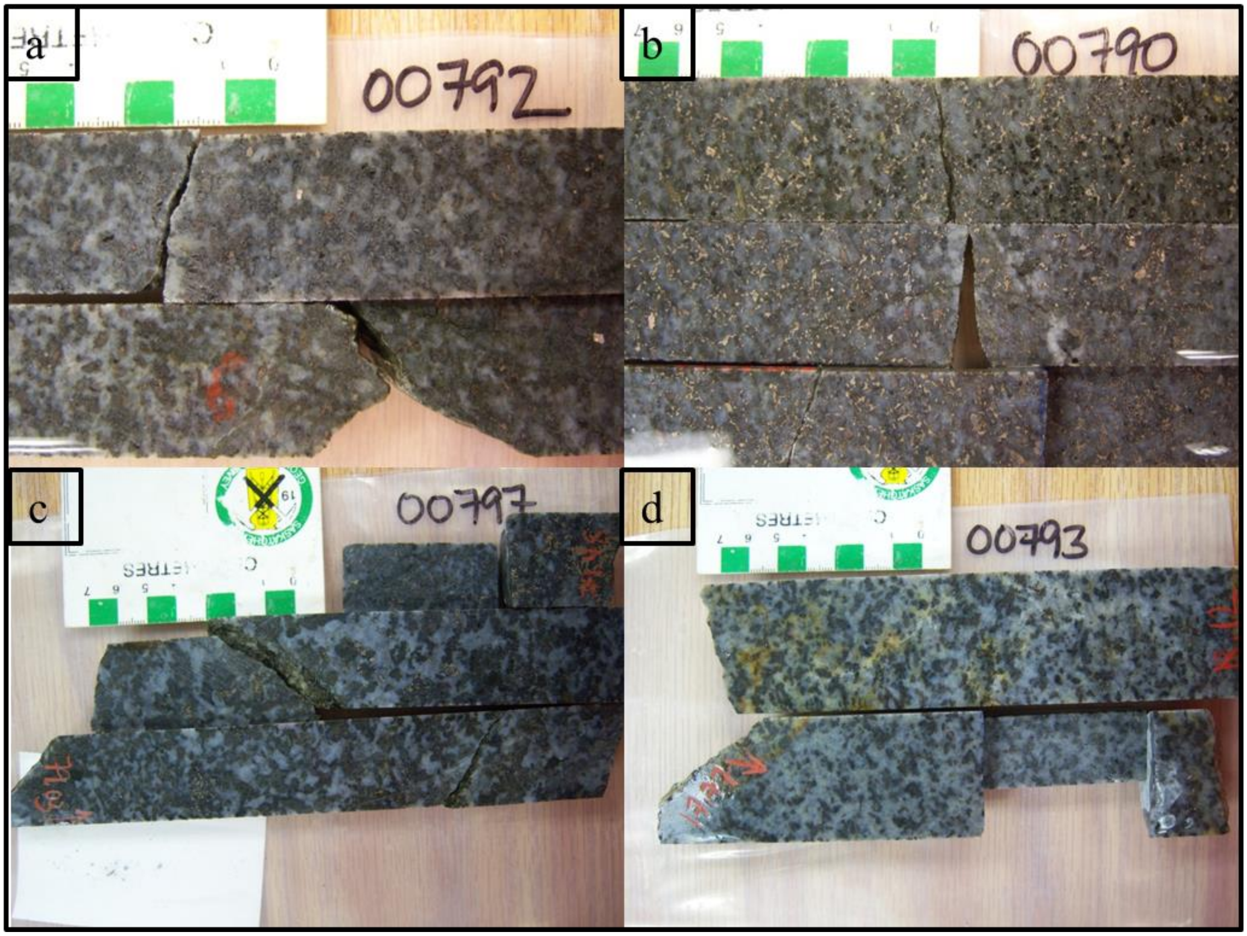


Figure 5.15. Photographs of samples a) 792, b) 790, mineralized (pyrrhotite), c) 797, and d) 793 from unit 9. (Scale is in centimeters.)

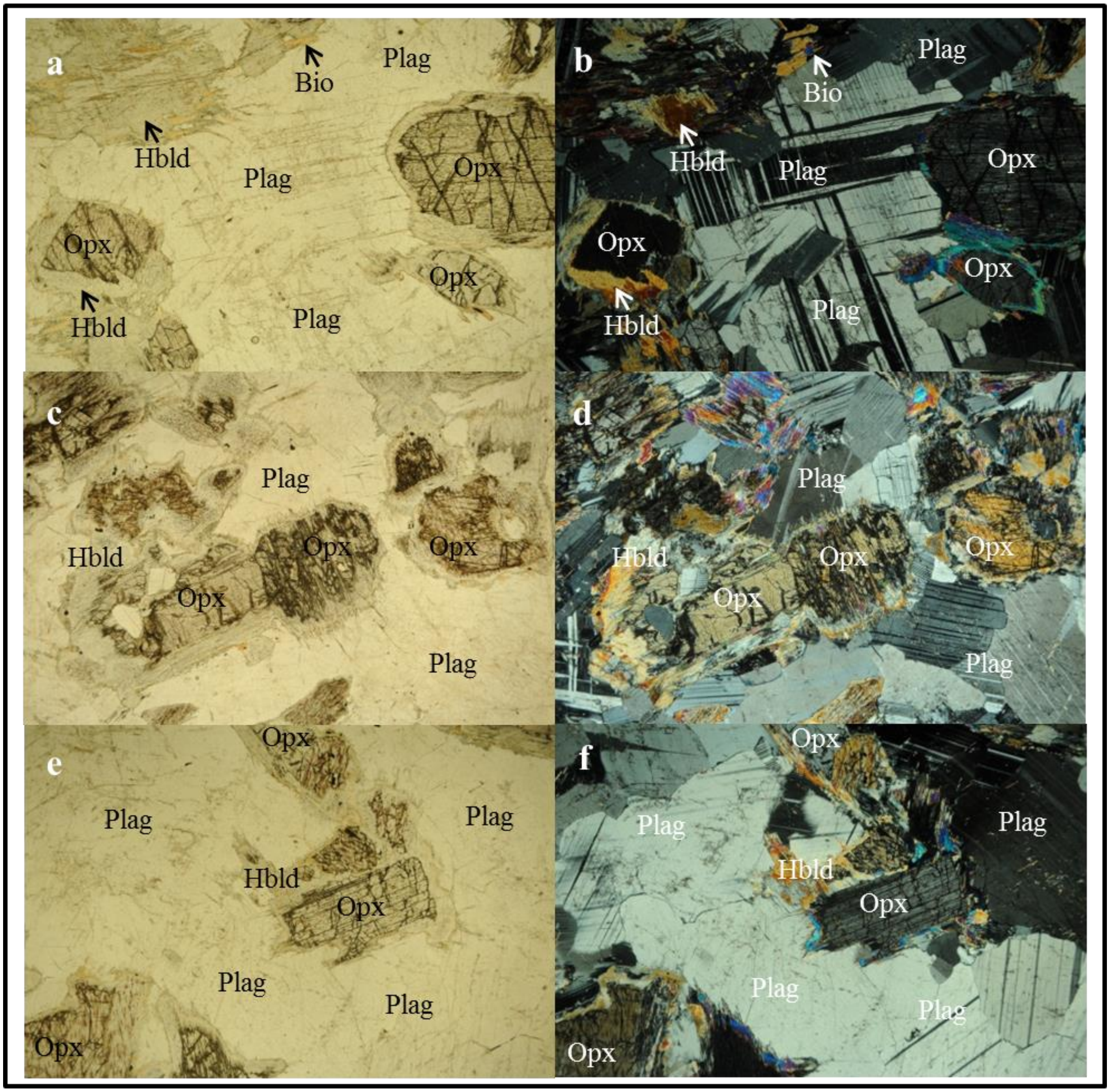


Figure 5.16. Photomicrographs of 792-01 (hornblende augite norite), 797-01 (hornblende augite norite) and 793-01 (leuco hornblende augite norite) from unit 9. a) 792-01 under plane polarized light (ppl) showing cumulus orthopyroxene mantled by hornblende and minor augite, with cumulus and intercumulus plagioclase; b) same location as (a) under crossed polars (xpl); c) 797-01 under ppl showing cumulus orthopyroxene mantled and altered by hornblende, with cumulus plagioclase; d) same location as (c) under xpl, plagioclase showing partially equilibrated textural geometry; e) 793-01 under ppl showing cumulus orthopyroxene and plagioclase; f) same location as (e) under xpl with orthopyroxene mantled and altered by hornblende and large cumulus plagioclase grains. Plag=plagioclase, Hbld= hornblende, Opx= orthopyroxene, Bio=biotite. All photomicrographs 5.4mm wide.

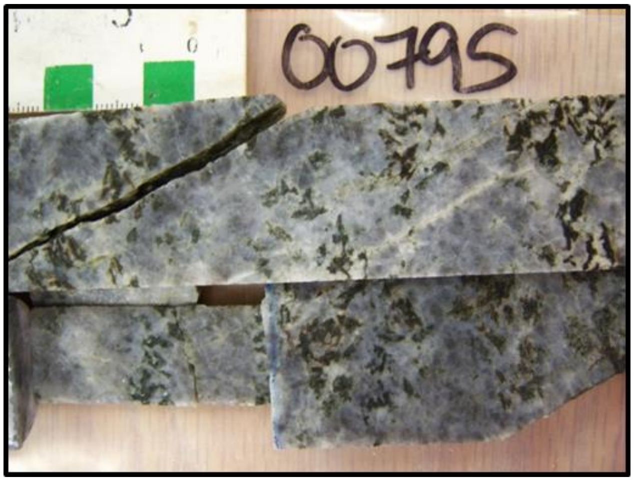


Figure 5.17. Photograph of sample 795 from unit 3. (Scale in centimeters)

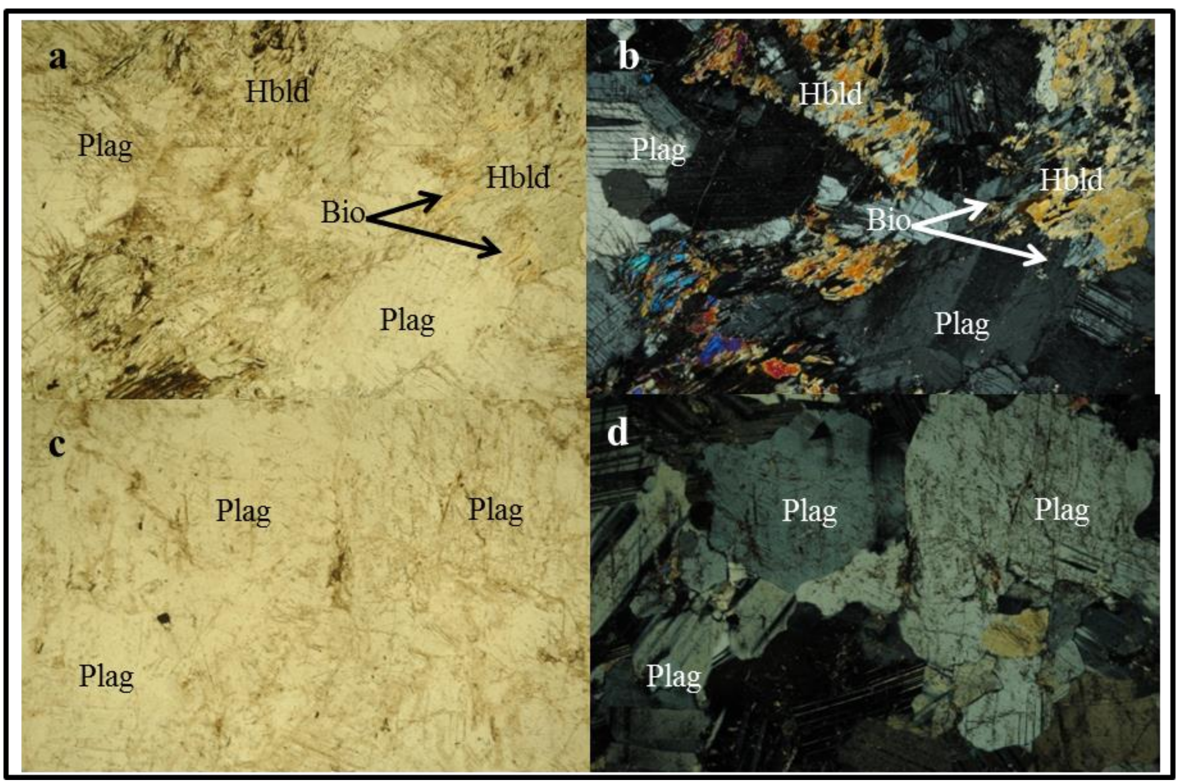


Figure 5.18. Photomicrographs of 795-01 (leuco gabbro/leuco hornblende gabbro) from unit 3. (5.4mm wide) a) under plane polarized light (ppl) showing large anhedral hornblende and cumulus plagioclase; b) same location as (a) under crossed polars (xpl); c) under ppl; d) same location as (c) under xpl showing weak to moderately altered plagioclase. Plag=plagioclase, Hbld= hornblende, Bio=biotite.

Figure 5.19. Photographs of samples a) 859, b) 845, c) 860, d) 877, e) 796 and f) 880 from unit 12. (Scale in centimeters.)

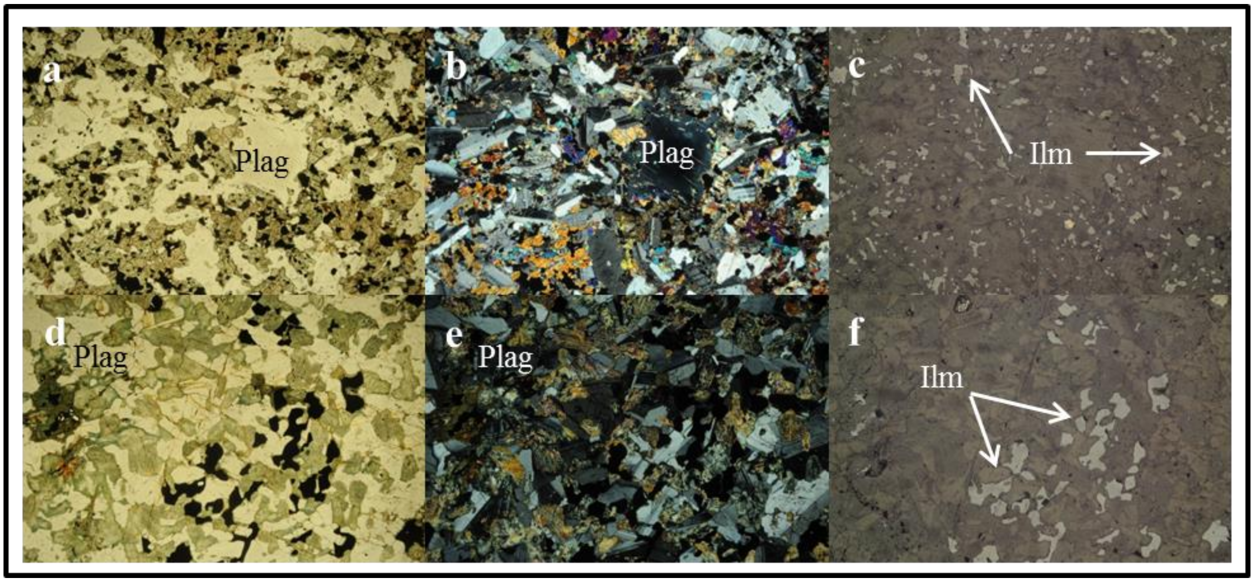


Figure 5.20. Photomicrographs of thin sections 877-01 (hornblende augite norite) and 859-01 (hornblende gabbro) from unit 12, a) 877-01 under plane polarized light (ppl) showing fine to medium-grained cumulus plagioclase (+/-opx) and intercumulus orthopyroxene and augite with weak hornblende and biotite alteration; b) same location as (a) under crossed polars (xpl) orthopyroxene showing exsolution of augite; c) same location as (a) & (b), under reflected light (rl), showing abundant intercumulus ilmenite; d) 859-01 under ppl showing uralitized pyroxenes and cumulus and intercumulus plagioclase; e) same location as (d) under xpl; f) same location as (d) & (e) under rl, showing abundant intercumulus ilmenite. Plag= plagioclase, Ilm=ilmenite. All photos 5.4mm wide.

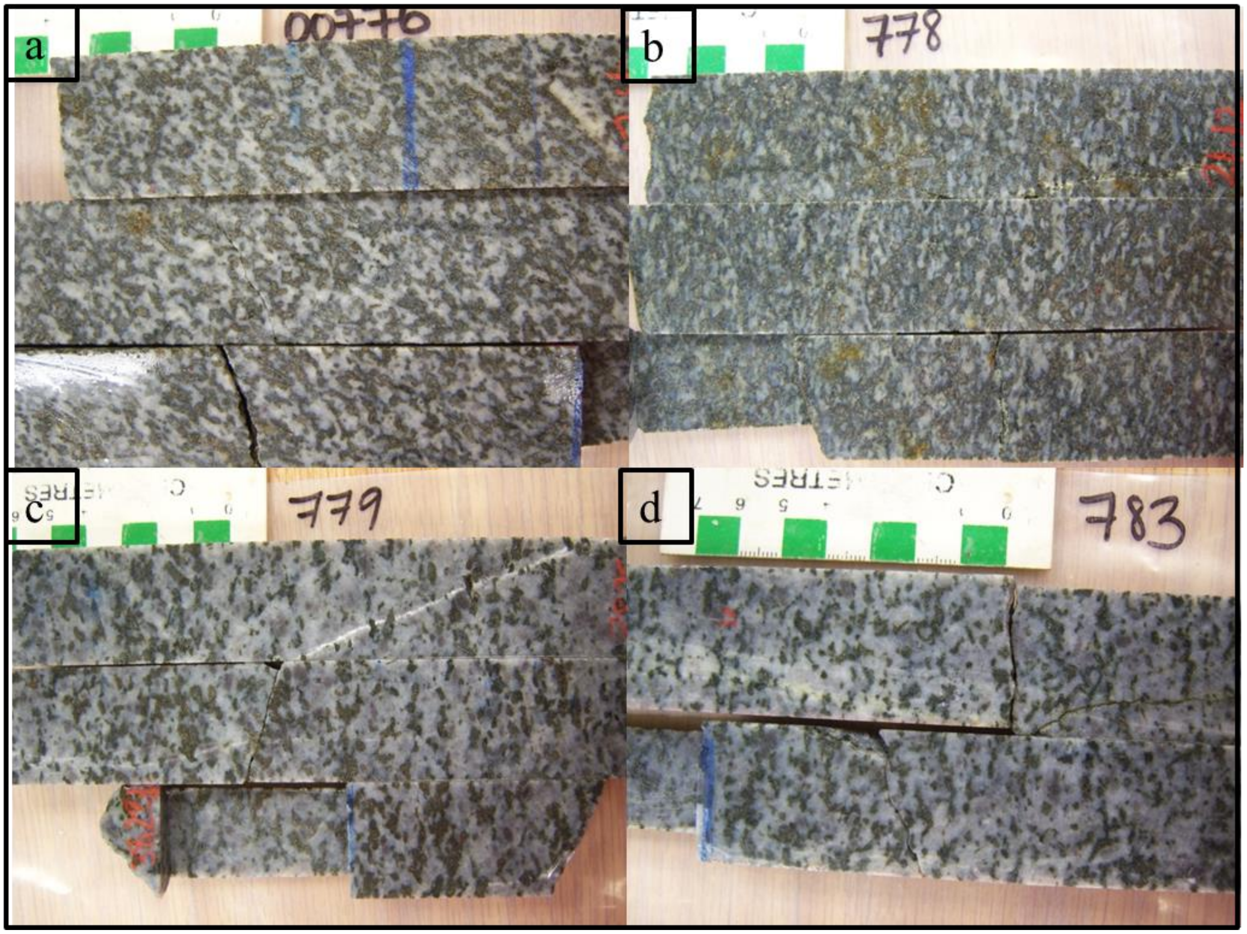


Figure 5.21. Photographs of samples a) 776, b) 778, c) 779 and d) 783 from unit 8. (Scale in cm.)

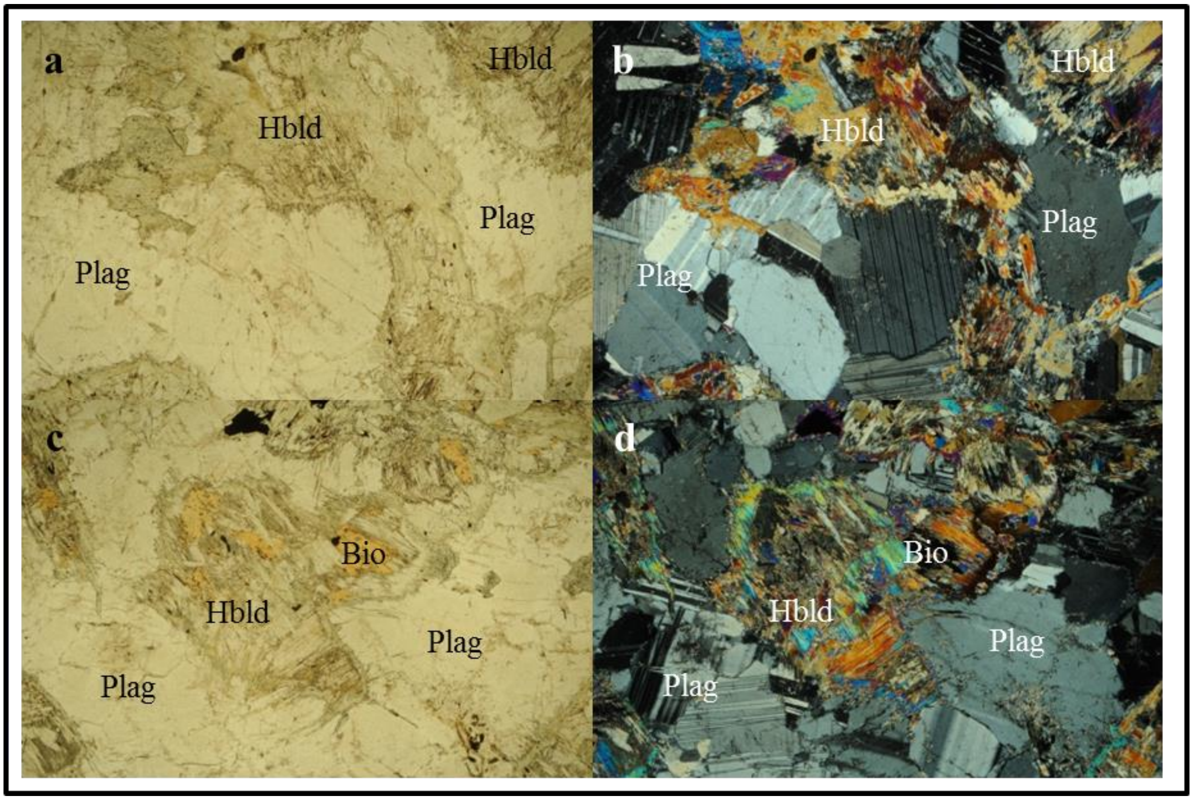


Figure 5.22. Photomicrographs of thin sections 776-01 (hornblende norite) and 778-01 (hornblende gabbro) from unit 8, (fields of view 5.4mm in wide), a) 776-01 under plane polarized light (ppl) showing cumulus plagioclase and hornblende-altered pyroxene alteromorphs; b) same location as (a) under crossed polars (xpl), plagioclase grain boundaries indicate a partially equilibrated to equilibrated textural geometry; c) 778-01 under ppl showing hornblende and biotite alteration of pyroxenes; d) same location as (c) under xpl. Plag=plagioclase, Hbld=hornblende, Bio=biotite.

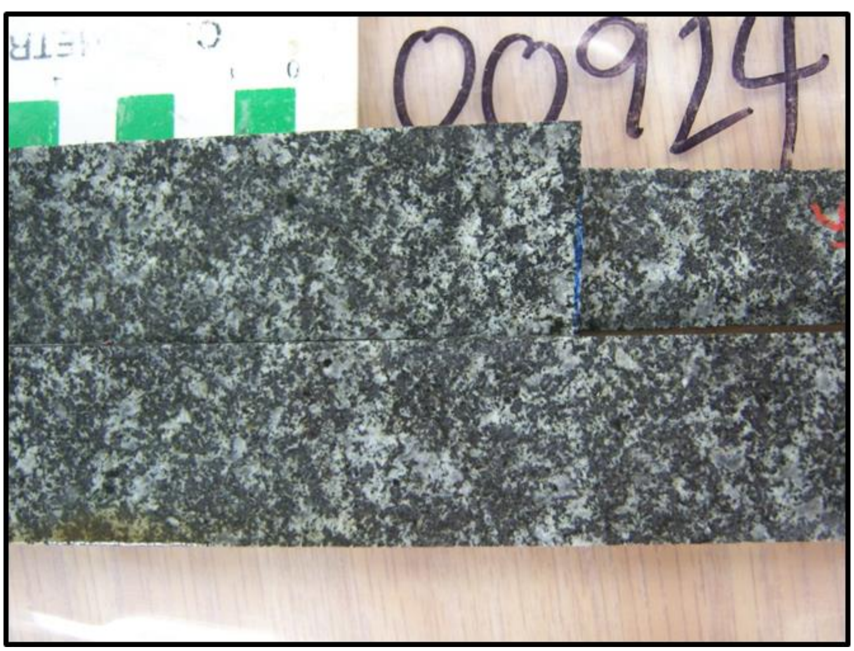


Figure 5.23. Photograph of sample 924, a diabase dyke. Scale in centimeters (cm).

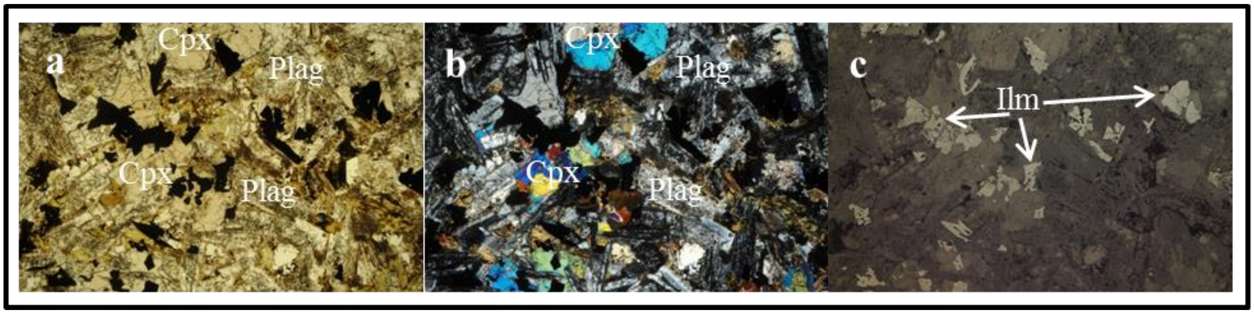


Figure 5.24. Photomicrographs of thin section 924-01 from unit 13a (diabase): a) 924-01 under plane polarized light, (fields of view 5.4mm wide) showing altered and zoned plagioclase and augite with euhedral-subhedral to skeletal ilmenite; b) same location as (a) under crossed polars, showing zoned plagioclase and augite; c) same location as (a) & (b), under reflected light showing the various shapes of ilmenite. Plag=plagioclase, Cpx= augite, Ilm=ilmenite.

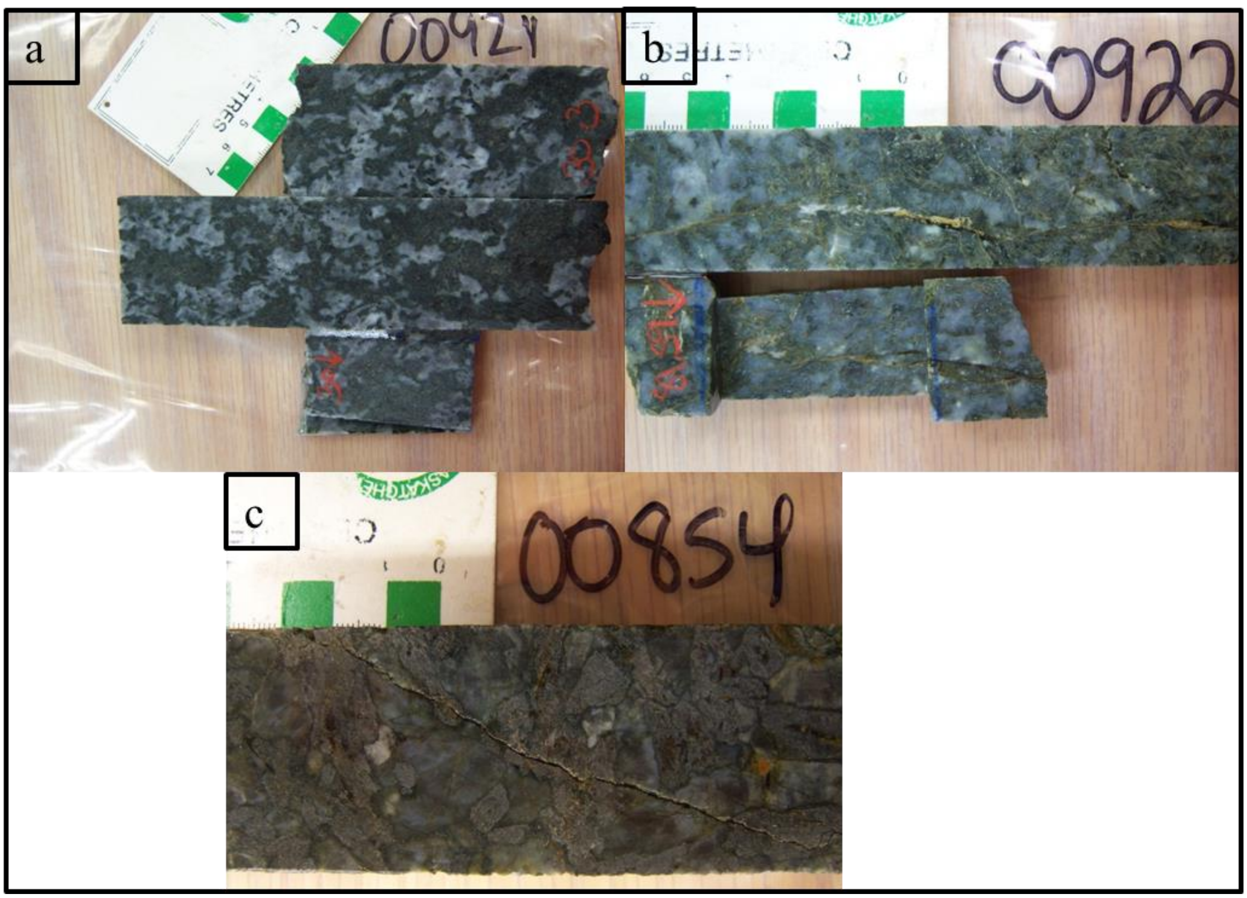


Figure 5.25. Photographs of samples a) 921, b) 922 and c) 854 from unit 2a. Samples 921 and 922 are from the eastern holes and 854 (coarse-grained) is from the west. Scale in centimeters.

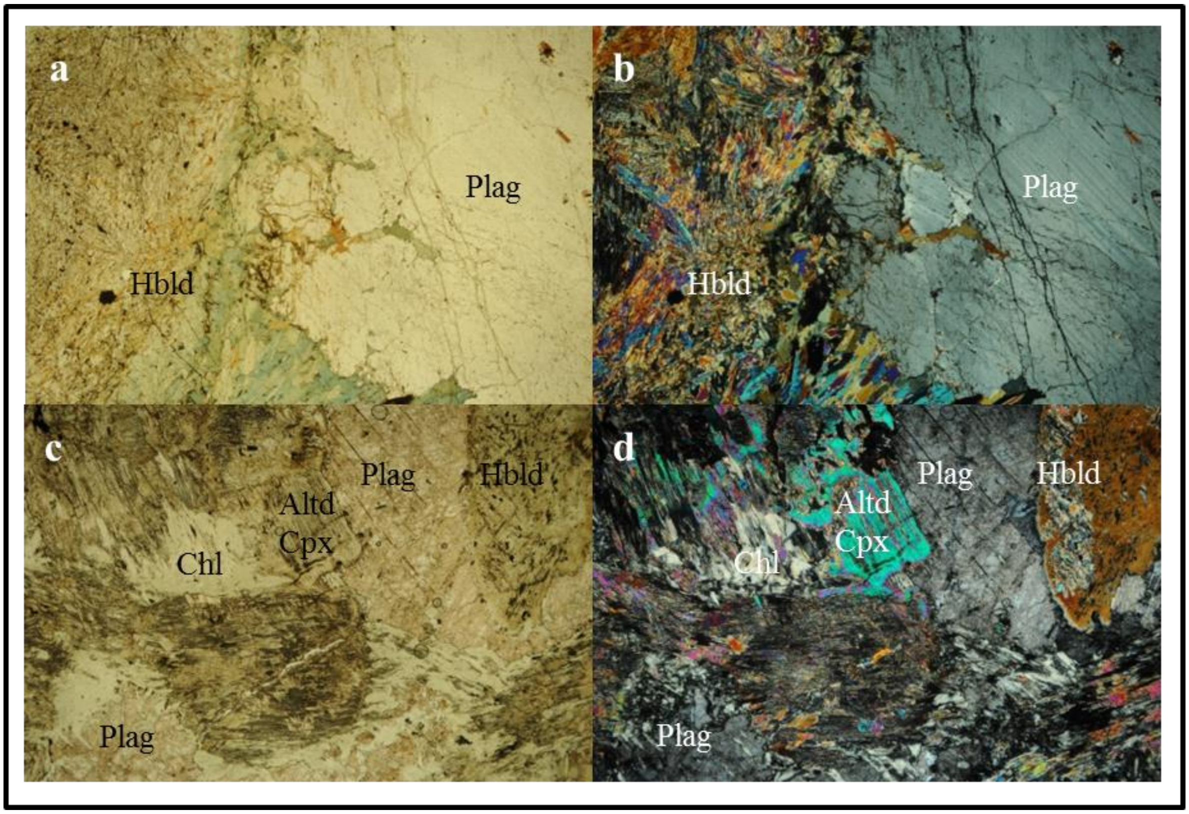


Figure 5.26. Photomicrographs of 854-01(hornblende gabbro), 921-01(hornblende gabbro) from unit 2a, fields of view 5.4mm wide: a) 854-01 under plane polarized light (ppl) showing coarse-grained cumulus plagioclase and hornblende (possibly altered cumulus orthopyroxene); b) same location as (a) under crossed polars (xpl); c) 921-01 under ppl, showing moderate to strong hornblende and chlorite alteration. Plagioclase is also altered by sericite giving it a dusted appearance; d) same location as (c) under xpl. Plag= plagioclase, Hbld= hornblende, Altd Cpx= altered augite, Chl= chlorite.

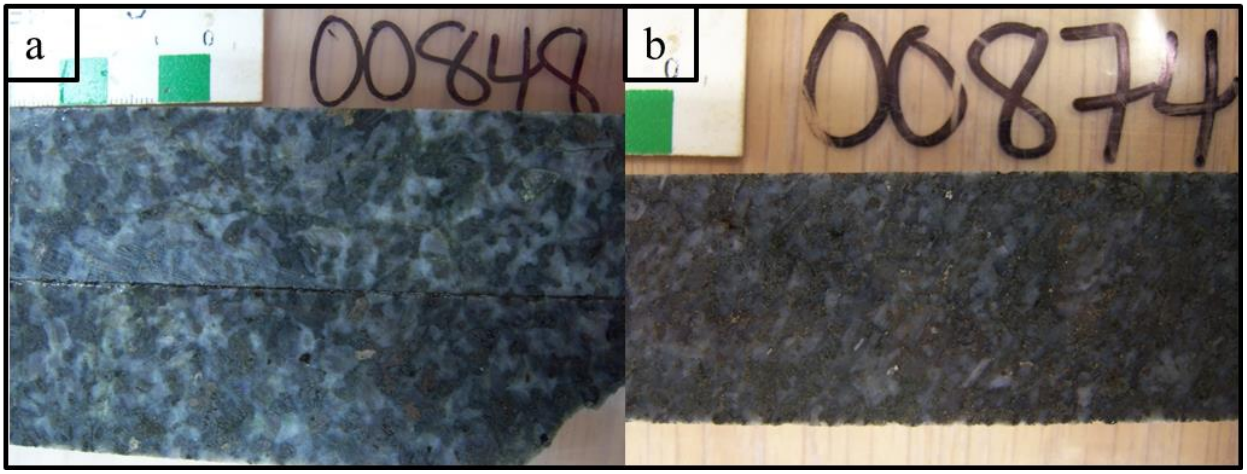


Figure 5.27. Photographs of samples a) 848 and b) 874 from unit 11a. Sample 874 contains a higher concentration of oxides and sulphides relative to 848. Scale in cm.

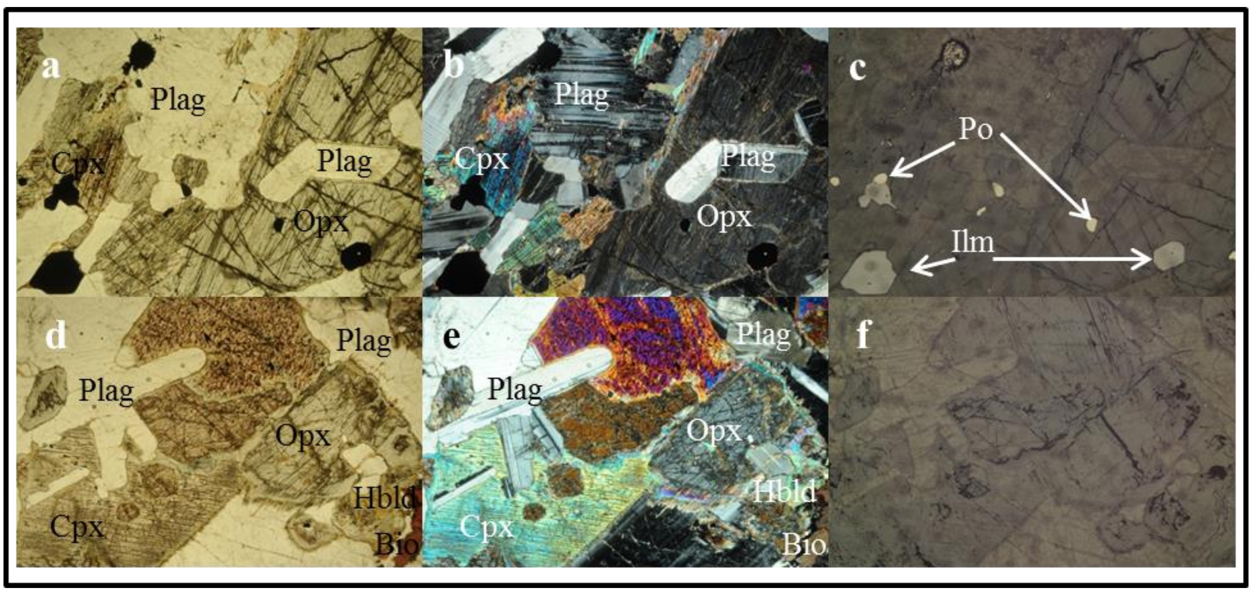


Figure 5.28. Photomicrographs of 874-01 (leuco orthopyroxene gabbro) and 848-01 (augite norite) from unit 11a; (fields of view 5.4mm in width) a) 874-01 under plane polarized light (ppl) showing poikilitic orthopyroxene oikocrysts and intercumulus augite with cumulus plagioclase; b) same location as (a) under crossed polars (xpl) showing the variation in plagioclase crystal size; c) same location as (a) & (b), under reflected light (rl) showing ilmenite and pyrrhotite as intercumulus phases; d) sample 848-01 under ppl, showing small cumulus orthopyroxenes and large intercumulus augite and orthopyroxene with lath shaped plagioclase; e) same location as (d) under xpl showing poikilitic textures; f) same location as (d) & (e) under rl with no opaque phases. Plag=plagioclase, Hbld= hornblende, Opx=orthopyroxene, Cpx=augite, Bio=biotite, Ilm=ilmenite, Po=pyrrhotite.

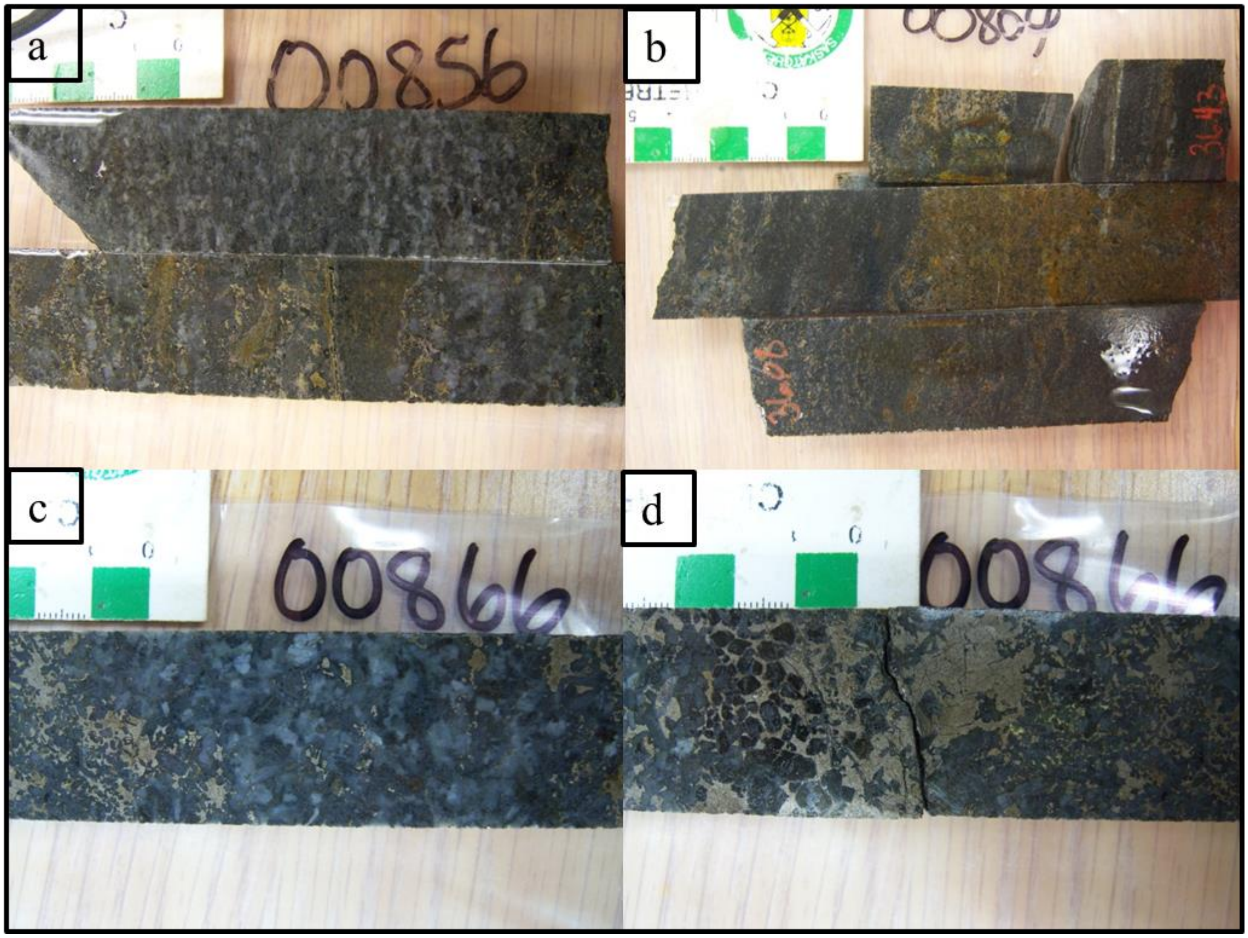


Figure 5.29. Photographs of samples a) 856, b) 804 and c) & d) 866 from unit 4. Samples 856 and 804 are fine and medium-grained gabbros that are mineralized. Sample 866 is medium to coarse-grained and host to pyrrhotite and chalcopyrite mineralization. The scale is in centimeters.

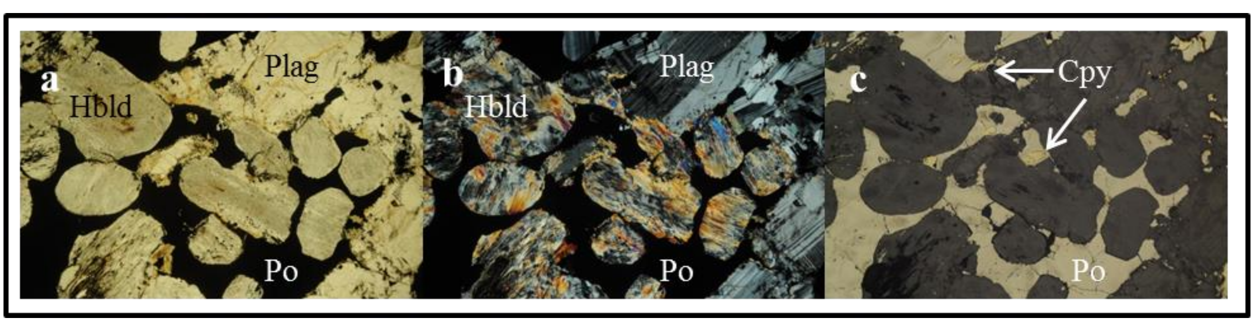


Figure 5.30. Photomicrographs of 866-01 (hornblende gabbro) ~25% (modal) sulphides from unit 4, a) 866-01 under plane polarized light showing the intercumulus nature of the sulphides; b) same location as (a) under crossed polars, cumulus plagioclase surrounds the intercumulus sulphides that encircle the amphibole altered pyroxenes; c) same location as (a) & (b) under reflected light showing intercumulus pyrrhotite and chalcopyrite. Plag=plagioclase, Hbld= hornblende, Po=pyrrhotite, Cpy= chalcopyrite. All photographs 5.4mm wide.

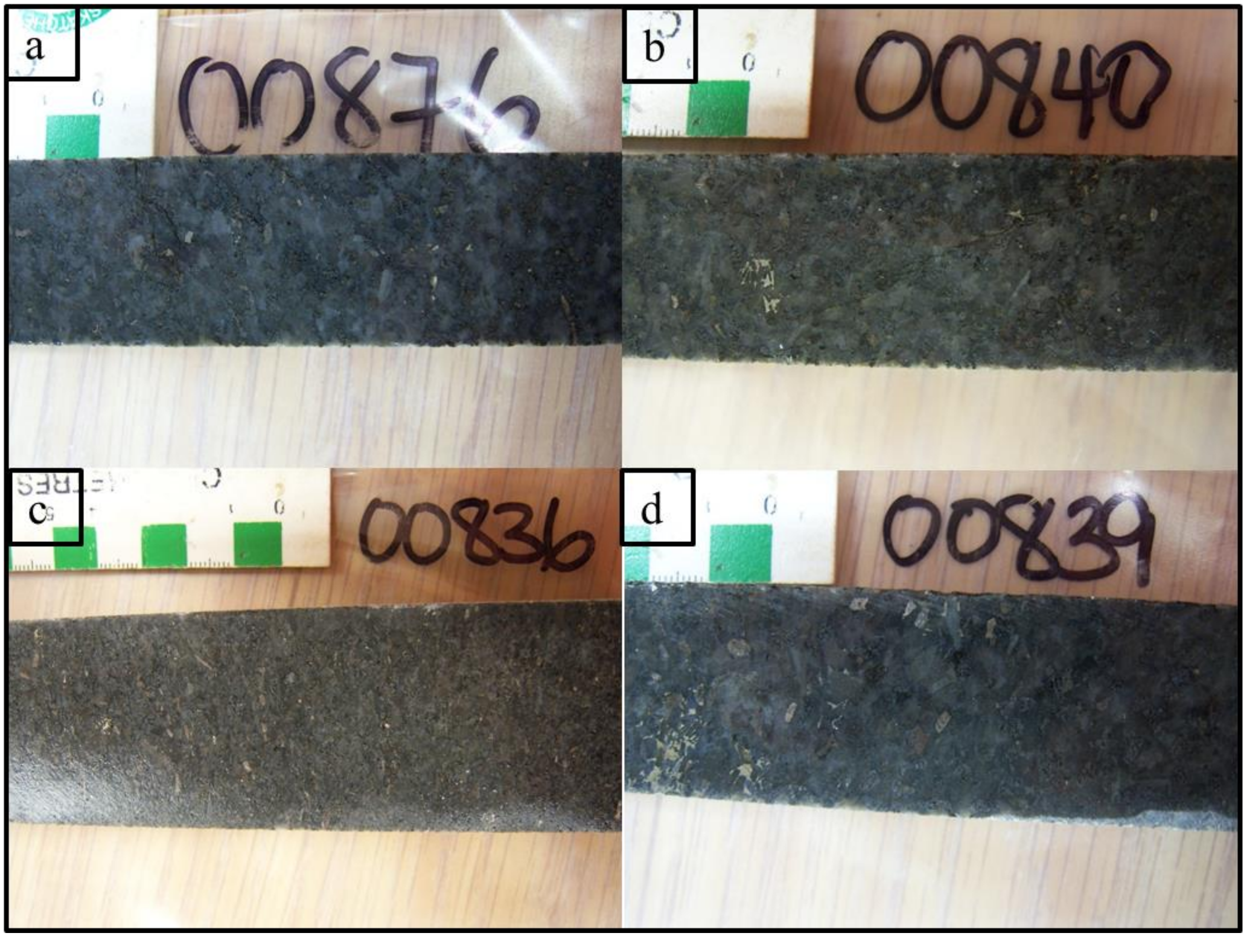


Figure 5.31. Photographs of samples a) 876, b) 840, c) 836 and d) 839 from unit 1a. Scale in cm.

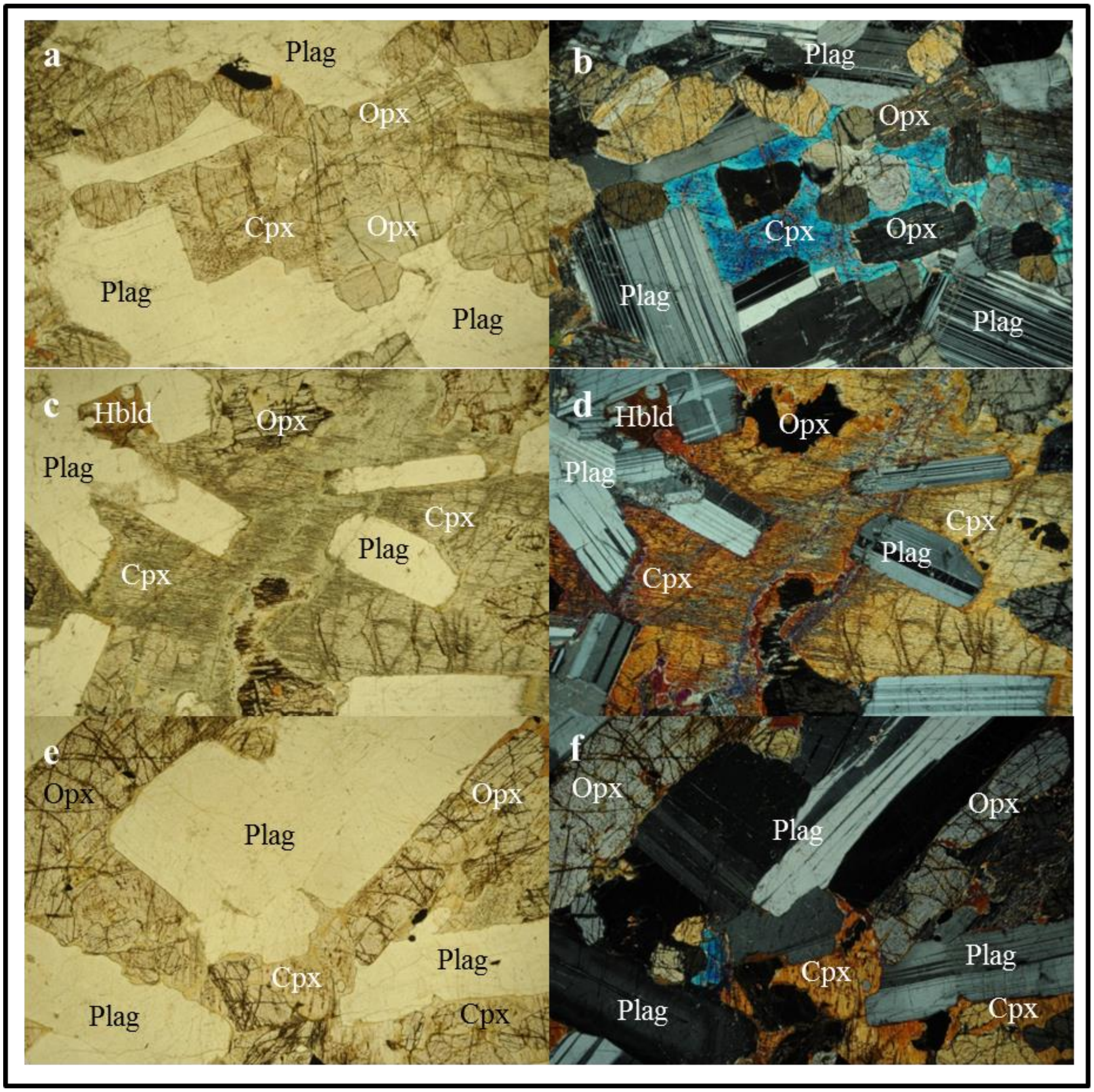


Figure 5.32. Photomicrographs of 836-01 (augite norite), 839-01 (hornblende-augite norite) and FX847935 (augite norite) from unit 1a, (fields of view 5.4mm wide), a) 836-01 under plane polarized light (ppl) showing cumulus orthopyroxene and plagioclase and intercumulus augite; b) same location as (a) under crossed polars (xpl); c) 839-01 under ppl showing a large augite oikocryst in a poikilitic texture, hosting plagioclase laths and orthopyroxenes; d) same location as (c) under xpl, a late fracture cuts augite and plagioclase and is host to minor hornblende alteration; e) FX847935 under ppl showing large cumulus plagioclase and orthopyroxene with intercumulus augite, and f) FX847935 at same location as (e) under xpl, note the kinked plagioclase at the bottom right. Plag=plagioclase, Opx=orthopyroxene, Cpx=augite, Hbld=hornblende

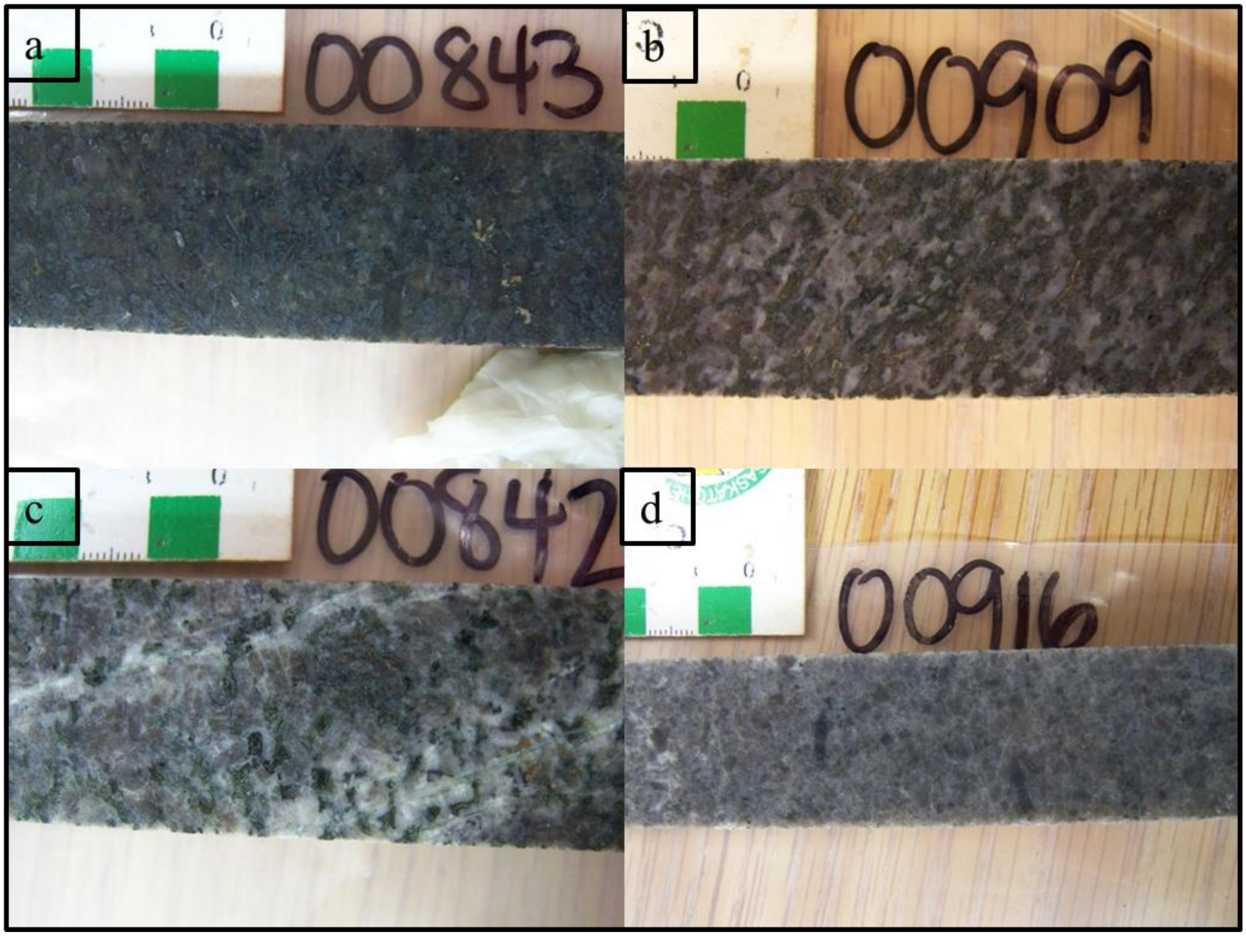


Figure 5.33. Photographs of samples a) 843, b) 909, c) 842 and d) 916 from unit 1ab. This unit shows significant variation in plagioclase content as seen in (a) to (d). Scale is in cm.

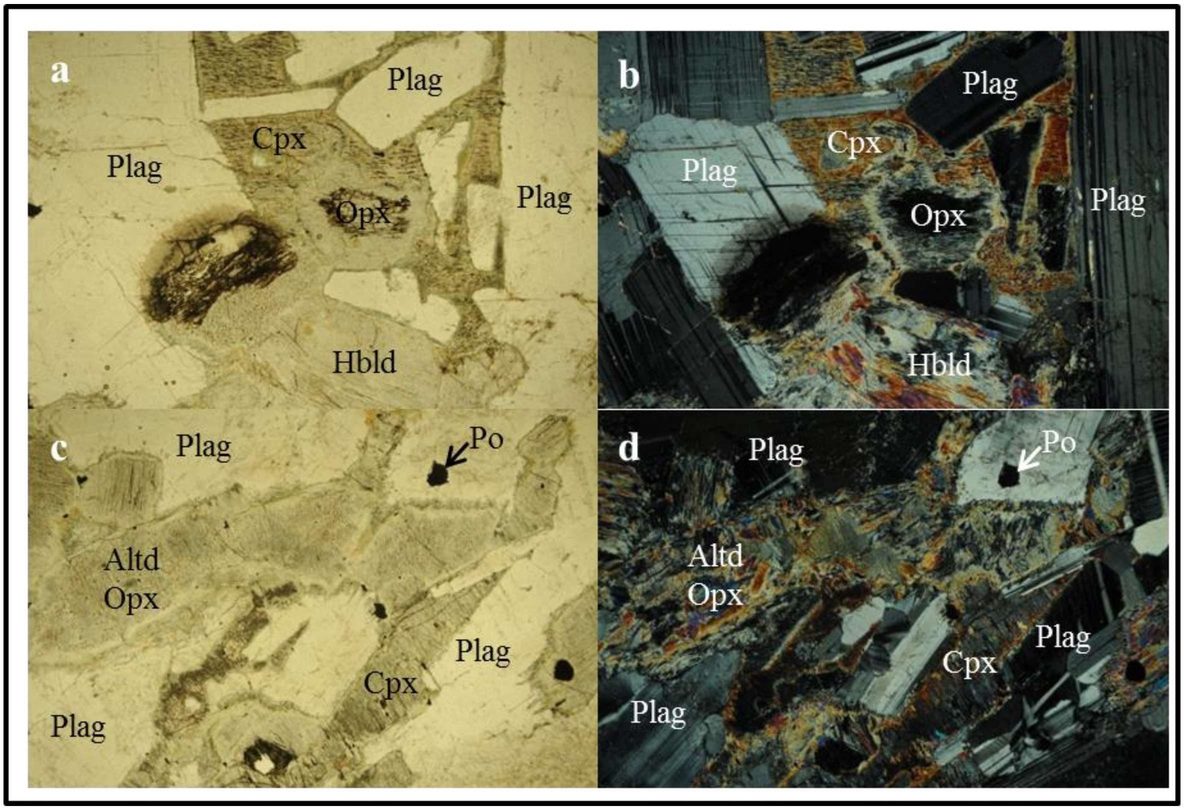


Figure 5.34. Photomicrographs of 843-01 (leuco hornblende gabbro) and 909-01 (hornblende gabbro) from unit 1ab. (fields of view 5.4mm wide) a) 843-01 under plane polarized light (ppl) showing coarse cumulus plagioclase with altered intercumulus augite and cumulus orthopyroxene; b) same location as (a) under crossed polars (xpl) altered pyroxenes in cumulus plagioclase; c) 909-01 under ppl, showing altered cumulus orthopyroxene and intercumulus augite with cumulus plagioclase; d) same location as (c) under xpl. Plag=plagioclase, Opx=orthopyroxene, Cpx=augite, Hbld=hornblende, Altd=altered, Po=pyrrhotite.

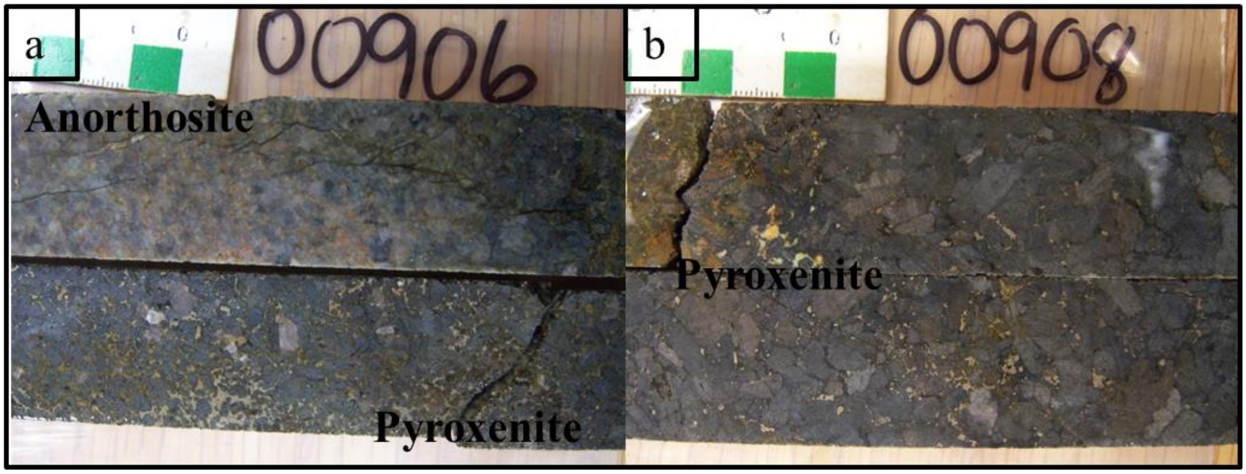


Figure 5.35. Photographs of samples a) 906 and b) 908 from units 6 and 7. The top of sample 906 is composed of anorthosite (top row in (a)), and the bottom is pyroxenite. Sample 908 (b) is composed of medium to coarse-grained pyroxenite. The scale is in cm.

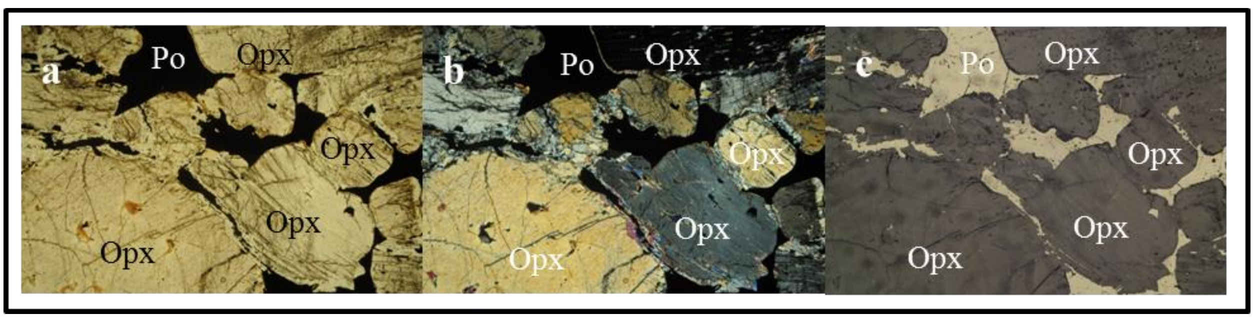


Figure 5.36. Photomicrographs of 906-02 (plagioclase bearing pyroxenite) from unit 7. (Fields of view 5.4mm wide) a) 906-02 under plane polarized light (ppl); b) same location as (a) under crossed polars (xpl), abundant intercumulus sulphides (pyrrhotite and minor chalcopyrite). Note the bent or deformed orthopyroxene; c) same location as (a) & (b), under reflected light (rl), showing pyrrhotite mineralization. Opx= orthopyroxene, Po= pyrrhotite.

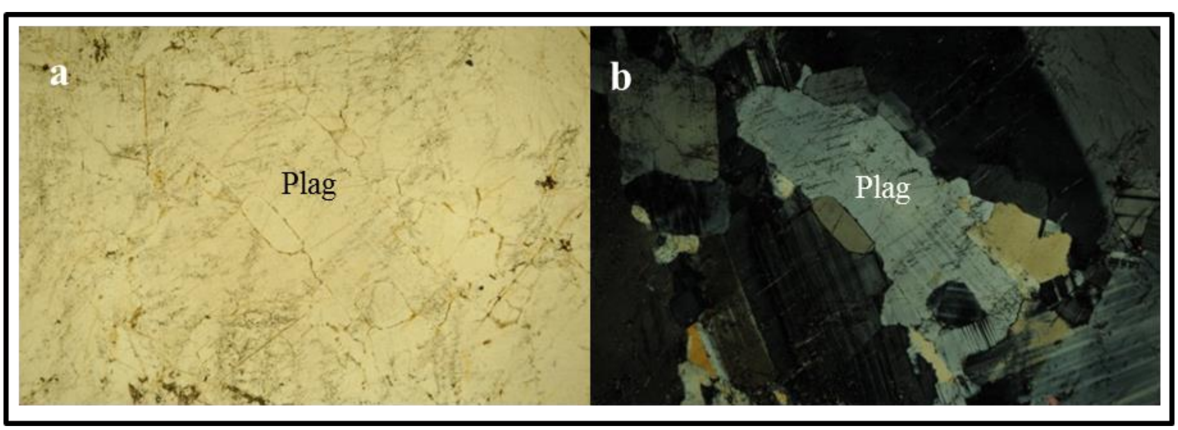


Figure 5.37. Photomicrographs of 906-01 (anorthosite) from unit 6, (fields of view 5.4mm wide) a) 906-01 under plane polarized light, composed of cumulus plagioclase; b) same location as (a) under crossed polars showing variation in grain size and the partially equilibrated textural geometry. Plag=plagioclase.

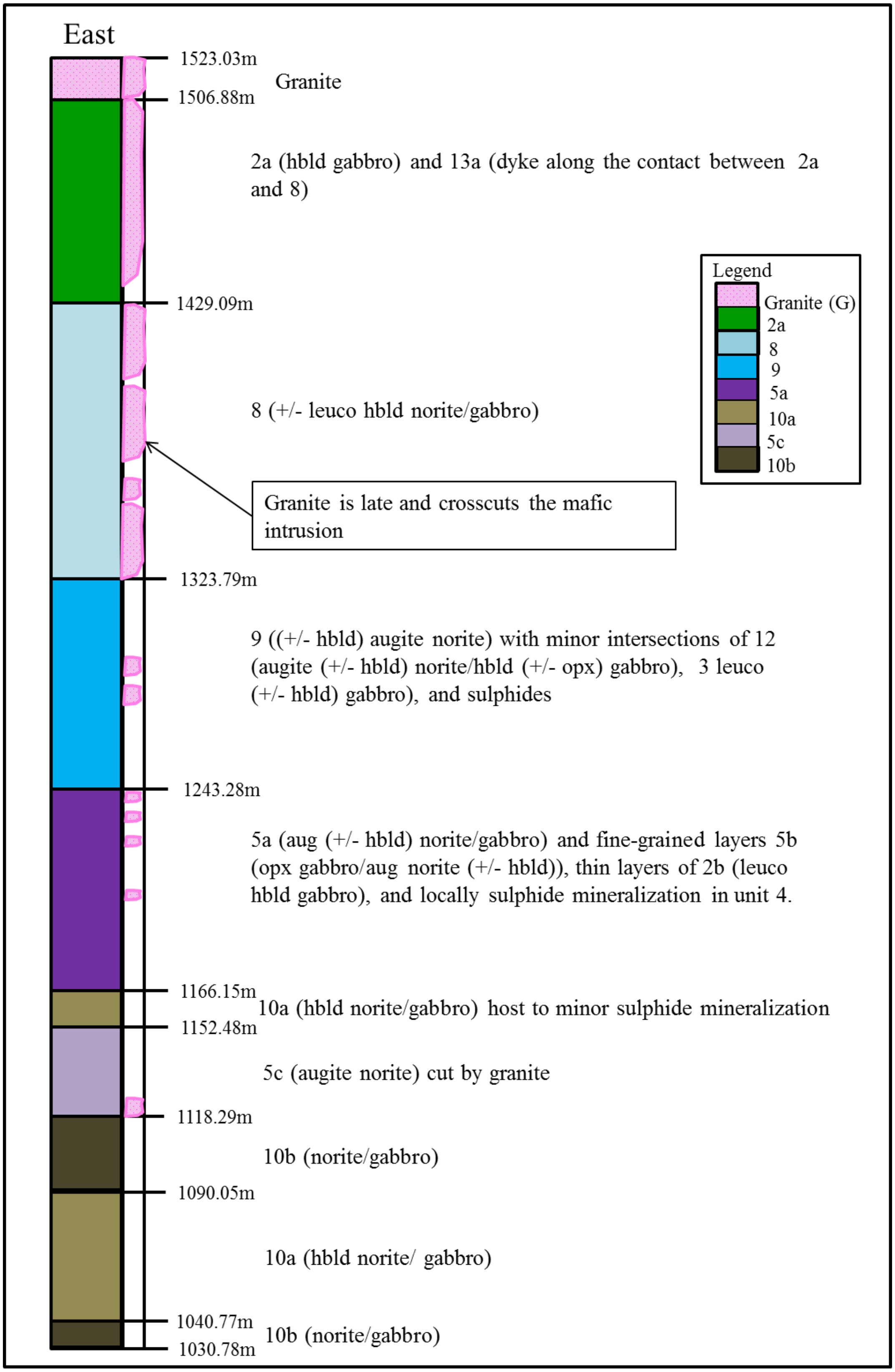


Figure 5.38. A simplified stratigraphic column created from a compilation of the lithologies of the eastern drill holes (H-01 to H-06) from the Wadi Qutabah Layered Mafic Complex.

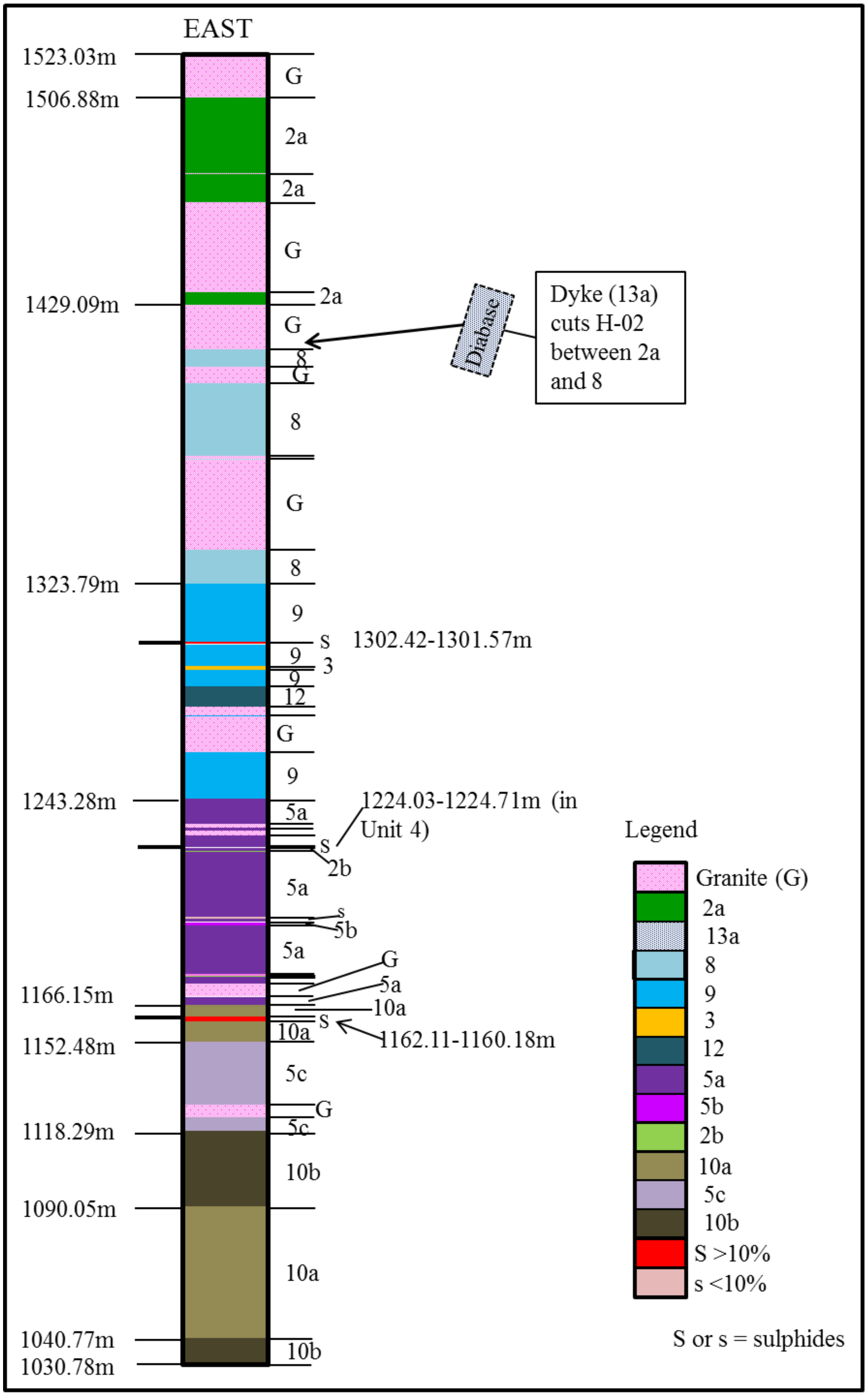


Figure 5.39. A detailed stratigraphic column created from a compilation of the lithologies of the eastern drill holes (H-01 to H-06) from the Wadi Qutabah Layered Mafic Complex.

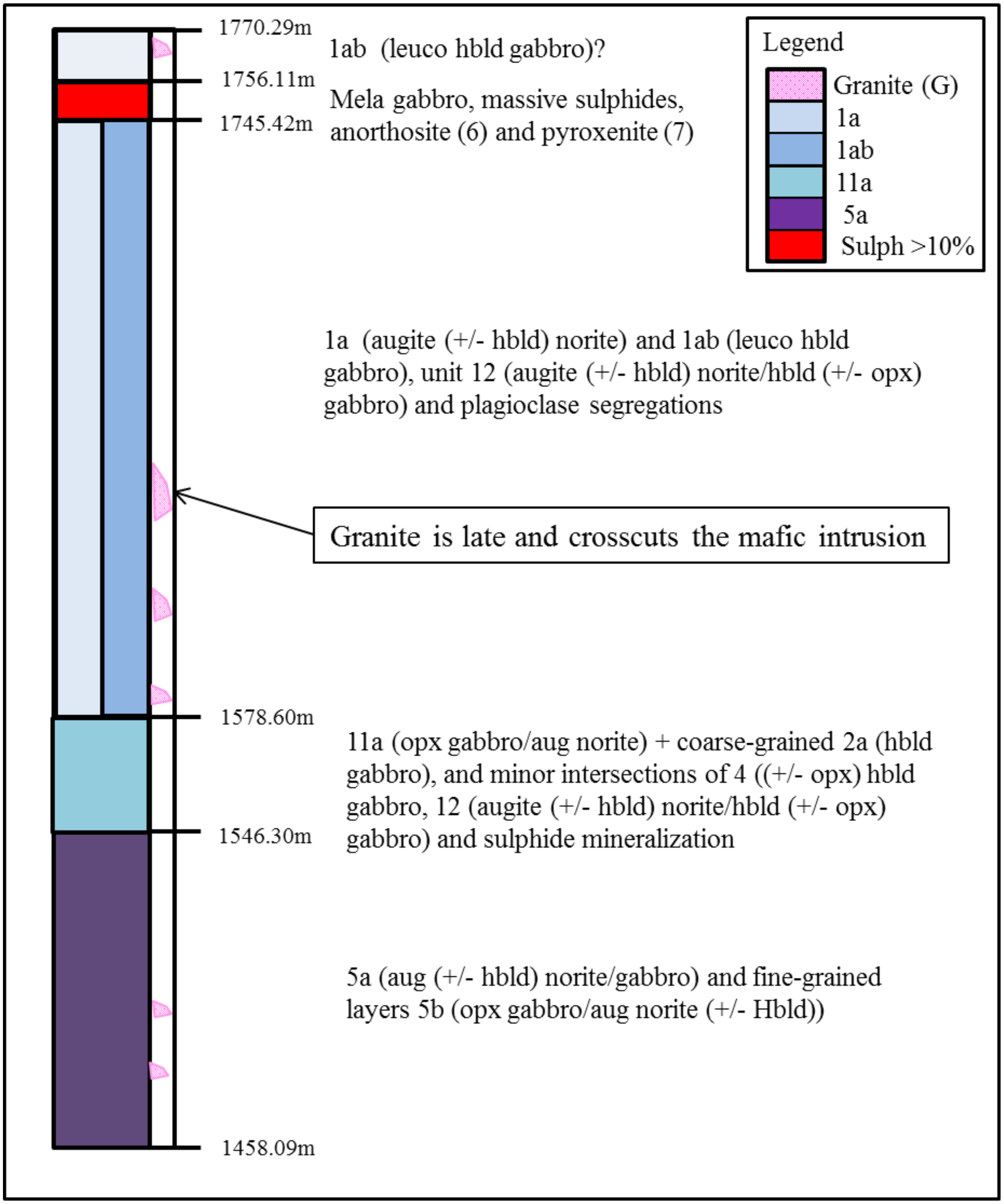


Figure 5.40. A simplified stratigraphic column created from a compilation of the lithologies of the western drill holes (Hp-07 to Hp-12A) from the Wadi Qutabah Layered Mafic Complex.

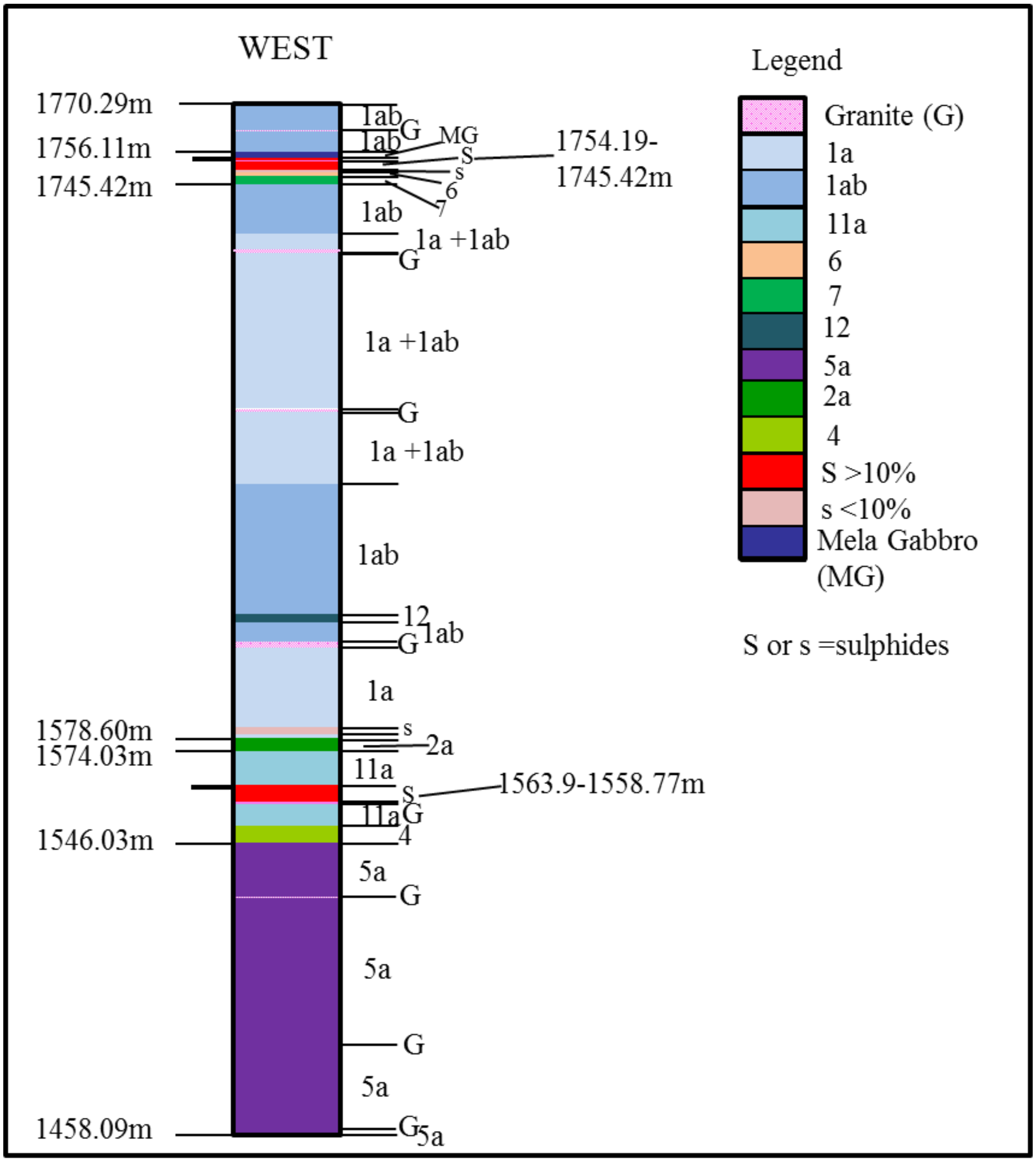
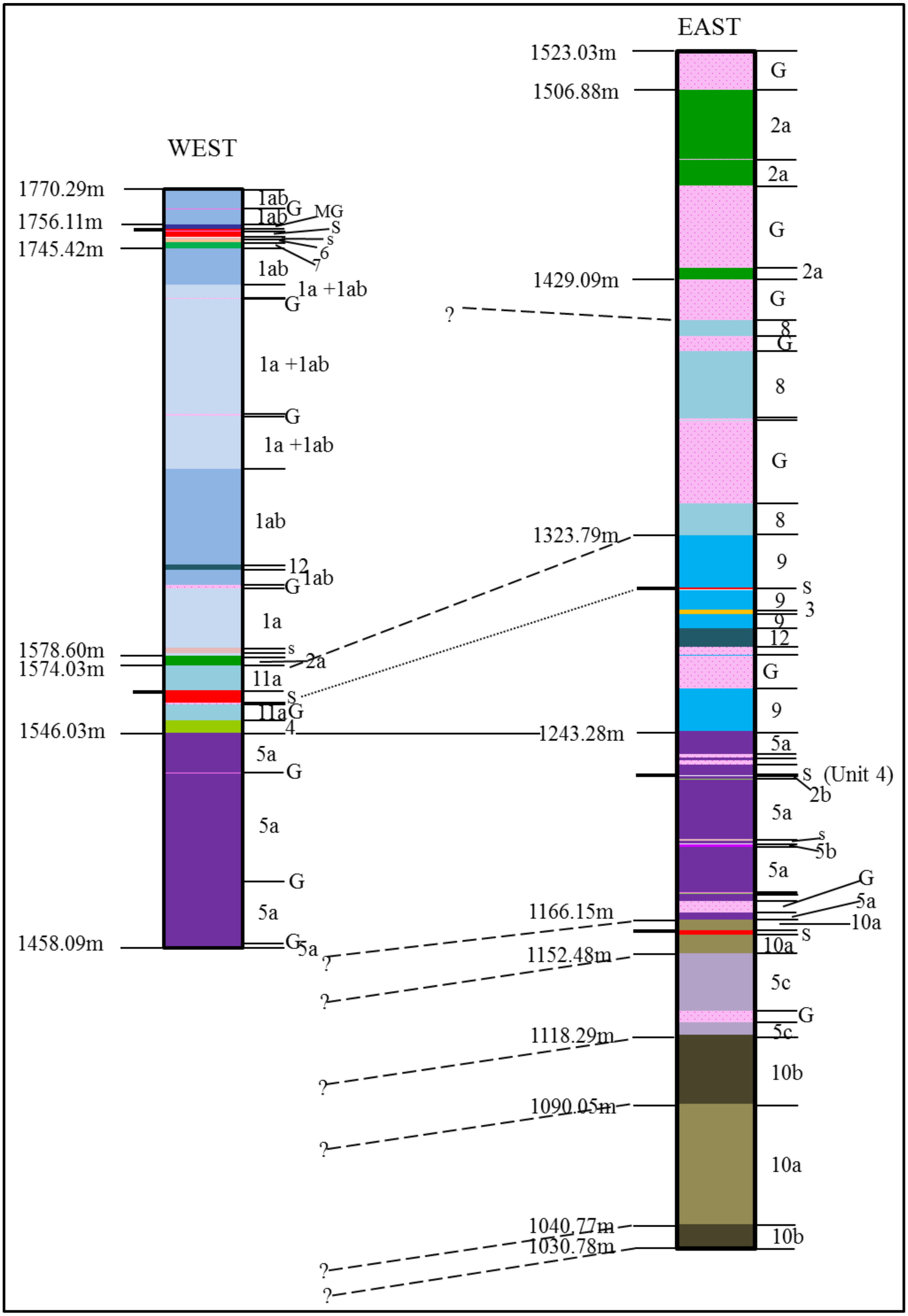


Figure 5.41. Detailed stratigraphic column created from a compilation of the lithologies of the western drill holes (Hp-07 to Hp-12A) from the Wadi Qutabah Layered Mafic Complex.



WEST
EAST
1770.29m
1756.11m
1745.42m
1578.60m
1574.03m
1546.03m
1458.09m
1523.03m
1506.88m
1429.09m
1323.79m
1243.28m
1166.15m
1152.48m
1118.29m
1090.05m
1040.77m
1030.78m
1ab
G
MG
S
s
6
7
1a +1ab
1a
12
2a
11a
4
5a
G
8
9
3
(Unit 4)
2b
5b
10a
5c
10b
?

Figure 5.42. Simplified correlation of the detailed stratigraphic columns from the east and west drill holes of the Wadi Qutabah Layered Mafic Complex.

Chapter 6.0 Analytical Procedures and Results

6.1 Scanning Electron Microscope (SEM)

A Tescan Mira3 XMU Scanning Electron Microscope (SEM) and Oxford Aztec X-max EDS system with a 80 mm^2 silicon drift detector were used for the analysis of minerals in 53 thin sections. Processing of the SEM data was completed using Oxford Aztec software. The SEM is part of the Fipke lab for trace element research (Filter) located in the Fipke building, at UBC Okanagan in Kelowna, B.C.

In preparation for analysis the thin sections were carbon coated at C.F. Mineral Research Ltd. Thickness of the coating is ~200Å.

Prior to carbon coating, mineral grains were circled and numbered using a permanent marker. Photographs were taken of each circle in plane polarized light (ppl), under crossed polars (xpl) and using reflected light (rl) for reference during analysis.

Analysis involved collection in EDS mode and acquisition of high-resolution images in back-scatter mode (example: Fig.4.2), with a few completed in secondary electron mode. High resolution images and location identifiers are available for each of the analyses. A beam energy of 20keV was used.

Each sample contained ≤ 7 minerals for SEM/EDS analysis including plagioclase, augite, orthopyroxene, hornblende, ilmenite, pyrrhotite, and apatite. Attempts were made to analyse the cores of the grains. Some of these 7 minerals were primarily analyzed (1 analysis in a sample) to confirm identity but plagioclase, orthopyroxene, augite and ilmenite were multiply analysed to determine average composition. The goal is to use major element mineral analyses to correlate samples/units between holes and confirm or dispel the correlation suggested by logging and petrographic data. Minerals such as apatite were not multiply analyzed because of low abundance. Similarly, sulphides, despite their potential economic importance were not multiply analyzed because of the small grain sizes in most units and the absence of PGE-bearing pentlandite. Lastly, limited information was acquired on amphibole compositions because amphiboles form intercumulus, post-cumulus and alteration phases making them of limited utility for correlating units.

Unadjusted totals are affected by magnification so all analyses were normalized to 100% yielding near identical analyses regardless of magnification. Normalization prevents using the analysis total for quality control but stoichiometry provides a rigorous constraint. All mineral analyses have cation totals ≤0.75% (plagioclase are ≤0.325%, pyroxenes +0.75%/-0.5% and ilmenite ≤0.5%) of the ideal total. The stoichiometry for each mineral is based on a number of oxygens yielding acceptable cation totals. Stoichiometry of plagioclase is based on 32 oxygens, yeilding cation totals of 19.935 to 20.065. The stoichiometry of augite, orthopyroxene and ilmenite are based on 6 oxygens, and yield acceptable cation totals of 3.98 to 4.03 for the pyroxenes and 3.98 to 4.02 for ilmenite.

A total of ~1700 analyses were completed using the SEM/EDS. Over 1000 analyses were completed on plagioclase, augite, orthopyroxene and ilmenite. Analyses with cation totals greater or less than the accepted values (above) were rejected.

6.2 SEM Results

Averaged major element analyses for plagioclase, augite, pigeonite, orthopyroxene and ilmenite appear in Tables 6.1 to 6.10 and are plotted in Figures 6.1 to 6.8 as concentrations (wt% oxide) over elevation (m). Correlation diagrams for plagioclase, augite and orthopyroxene can be found in Figures 6.9 to 6.11

6.2.1 Data Trends

Ignoring the dyke/sill samples, plots of chemical parameters versus height (m) show that for both western and eastern samples there is a significant “burp” in plagioclase, orthopyroxene and augite compositions (eg. SiO_2, Al_2O_3, FeO, MgO and TiO_2) above unit 5a (Fig. 6.1 to 6.7). Minerals become more mafic (eg. SiO_2 in plagioclase goes down, Al_2O_3 goes up; the MgO content of pyroxenes goes up). Ilmenite data show more scatter (Fig. 6.8). The anorthite (An) content of plagioclase and the enstatite (En) content of pyroxenes (Fig. 6.3 & 6.6 respectively) confirm these breaks in chemistry.

The sections above and below the top of 5a show modest gradual changes in mineral composition with height. This is best illustrated in the eastern drill holes. For example the An content of plagioclase and the En content of pyroxenes show a gradual decline (Fig. 6.3 to 6.6).

Plots of element oxide versus CaO/(CaO +Na2O) for plagioclase (Fig. 6.9) and MgO/(MgO+FeO) for the pyroxenes (Fig. 6.10 & 6.11) show that samples from above the 5a contact in both the eastern and western sections have similar mineral compositions. The same is true of mineral samples from below 5a.

Table 6.1. Analyses of plagioclase crystals by SEM/EDS from drill holes H-01 to H-05 from the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg Na_2O	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg K_2O	Avg CaO	Avg TiO_2	Avg FeO	# of analyses
H-01	30	30.05	921-01	5.59		28.77	54.82		10.82			2
H-01	81.61	81.66	922-01	8.93	0.51	23.69	63.05	0.96	3.22		0.37	5
H-02	95.6	95.65	924-01	4.59		29.31	53.05	0.20	12.17		0.68	2
H-02A	47.04	47.09	776-01	5.10		29.31	54.24		11.36			3
H-03	27.67	27.62	778-01	4.96		29.66	53.64	0.31	11.65			3
H-03	38.28	38.33	779-01	4.99		29.54	53.68		11.79			2
H-03	93.8	93.85	783-01	5.02		29.59	53.81		11.59			6
H-03	123.76	123.81	790-01	4.86		29.59	53.63	0.23	11.73		0.23	12
H-03	128.31	128.36	792-01	5.07		29.43	53.80		11.69			3
H-04	17.86	17.91	793-01	4.85		29.71	53.51	0.21	11.84			15
H-04	40.06	40.11	795-01	5.09		29.33	53.97		11.60			3
H-04	52.45	52.5	796-01	6.00		28.04	56.05	0.19	9.79			5
H-04	79.39	79.44	797-01	5.22	0.27	29.21	54.34	0.31	11.05			5
H-04	97.24	97.29	798-01	5.93		27.68	56.36	0.29	9.74			19
H-04	124.08	124.13	800-01	5.92		28.18	55.80		10.10			6
H-05	36.34	36.39	804-01	6.37		27.53	56.69	0.14	9.32		0.18	6
H-05	52.32	52.37	806-01	6.27		27.18	57.06	0.27	9.22			9
H-05	52.67	52.72	806-02	6.30		27.33	56.97	0.16	9.23		0.19	4
H-05	88.89	88.94	810-01	6.33		27.60	56.56	0.17	9.47			4
H-05	99.29	99.34	812-01	6.15		27.86	56.22		9.77			3

Table 6.2. Analyses of plagioclase crystals by SEM/EDS from drill holes H-06, Hp-07 to Hp-09 from the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole_ID	From	To	Sample#	Avg Na_2O	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg K_2O	Avg CaO	Avg TiO_2	Avg FeO	# of analyses
H-06	17.41	17.46	814-01	5.99		27.66	56.33	0.25	9.69		0.30	14
H-06	43.37	43.42	815-01	6.07		27.92	56.22		9.79			6
H-06	63.22	63.27	827-01	5.81		27.80	56.10	0.33	9.96			3
H-06	97.25	97.3	829-01	6.14		28.05	55.96		9.84			3
H-06	137	137.05	832-01	5.84		28.06	55.89	0.15	10.09		0.22	11
H-06	188.91	188.96	835-01	5.51		28.72	54.88		10.82		0.24	6
Hp-07	27.77	27.82	836-01	5.07		28.93	54.41	0.25	11.33			3
Hp-07	51.02	51.07	839-01	5.10		29.09	54.26	0.24	11.35		0.33	12
Hp-07	69.4	69.45	840-01	4.98		29.36	53.69	0.18	11.64		0.23	3
Hp-07	87.64	87.69	842-01	4.91		29.42	53.80	0.17	11.69			2
Hp-08	20.1	20.15	843-01	5.01		29.30	53.88	0.16	11.68		0.26	6
Hp-08	81.85	81.9	845-01	5.61		28.27	55.38	0.30	10.30		0.20	9
Hp-08	139.72	139.77	848-01	5.16		28.92	54.47	0.27	11.21			12
Hp-08	171.54	171.59	851-02	5.87		27.73	56.15	0.33	9.89		0.31	9
Hp-09	24.69	24.74	906-01	5.58		28.66	55.09		10.67			6
Hp-09	24.69	24.74	906-02	6.04		28.40	55.25		10.02		0.30	2
Hp-09	32.2	32.25	909-01	5.33		29.03	54.52		11.12			3
Hp-09	101.9	101.95	916-01	5.31		28.50	55.06	0.28	10.85			3

Table 6.3. Analyses of plagioclase crystals by SEM/EDS from drill holes Hp-10 to Hp-12 from the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole_ID	From	To	Sample#	Avg Na_2O	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg K_2O	Avg CaO	Avg TiO_2	Avg FeO	# of analyses
Hp-10	14.36	29.02	FX847931	5.23		29.21	54.24		11.33			6
Hp-10	35.42	35.47	876-01	4.92		29.30	53.97	0.29	11.46		0.28	9
Hp-10	45.04	45.09	877-01	6.53		27.06	57.29	0.18	8.82		0.26	9
Hp-10	68.2	68.25	880-01	6.79		26.68	57.77		8.55		0.34	3
Hp-10	139.15	139.2	884-01	5.91		27.66	56.25	0.34	9.75		0.40	13
Hp-10	178.78	178.83	890-01	6.08		27.46	56.56	0.28	9.55		0.22	3
Hp-10	183.05	183.2	FX847934	5.93		27.86	56.04	0.21	9.97			3
Hp-11	17.65	17.73	FX847935	5.08	0.09	28.90	54.44	0.27	11.16		0.43	8
Hp-11	32.58	32.63	854-01	6.84		26.54	58.17	0.16	8.29			2
Hp-11	62.5	62.55	856-01	5.90		27.97	55.95		10.12		0.20	3
Hp-11	85.03	85.14	FX847937	6.10		27.78	56.25	0.15	9.63		0.21	5
Hp-12	22.18	22.23	859-01	6.11		27.94	55.97		9.87		0.18	3
Hp-12	30.12	30.17	860-01	5.78		27.90	55.86	0.28	9.96	0.25	0.43	5
Hp-12	63.34	63.39	866-01	5.02		29.42	53.91		11.65			3
Hp-12	78.52	78.57	874-01	5.93		27.92	55.97	0.21	9.99			8

Table 6.4. Analyses of orthopyroxenes by SEM/EDS from the eastern drill holes of the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg CaO	Avg TiO_2	Avg V_2O_3	Avg MnO	Avg FeO	# of analyses
H-03	123.76	123.81	790-01	25.11	2.05	52.88	1.85	0.44		0.37	17.30	8
H-03	128.31	128.36	792-01	25.30	2.16	53.04	1.57	0.19		0.41	17.45	3
H-04	17.86	17.91	793-01	24.67	2.13	52.51	1.39	0.40		0.41	18.56	14
H-04	52.45	52.5	796-01	19.61	1.51	50.95	1.15	0.28		0.49	25.99	6
H-04	79.39	79.44	797-01	24.44	1.98	52.59	1.04	0.45		0.42	19.08	6
H-04	97.24	97.29	798-01	21.95	0.95	52.34	0.84	0.21		0.52	23.43	16
H-05	52.32	52.37	806-01	20.89	1.06	51.75	1.59	0.26		0.58	24.00	2
H-05	52.67	52.72	806-02	20.42	1.13	51.59	1.21	0.32		0.58	24.74	6
H-06	17.41	17.46	814-01	21.36	1.11	52.03	1.03	0.27	0.24	0.56	23.80	8
H-06	43.37	43.42	815-01	21.97	1.21	51.92	1.91	0.57		0.46	21.94	9
H-06	63.22	63.27	827-01	21.30	1.19	51.88	1.82	0.46		0.53	22.82	3
H-06	137	137.05	832-01	21.79	1.25	52.00	1.91	0.58		0.50	21.97	12

Table 6.5. Analyses of orthopyroxene by SEM/EDS from western drill holes of the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg CaO	Avg TiO_2	Avg V_2O_3	Avg MnO	Avg FeO	# of analyses
Hp-07	27.77	27.82	836-01	24.47	1.81	52.75	1.22	0.26		0.45	19.04	3
Hp-07	51.02	51.07	839-01	23.96	1.81	52.58	1.71	0.36		0.40	19.26	10
Hp-07	69.4	69.45	840-01	23.03	1.54	52.20	1.83	0.36		0.49	20.71	3
Hp-08	20.1	20.15	843-01	23.33	1.62	52.14	1.42	0.39		0.43	20.66	3
Hp-08	81.85	81.9	845-01	19.13	1.17	51.33	0.69	0.24		0.59	27.03	6
Hp-08	139.72	139.77	848-01	23.86	1.86	52.42	1.85	0.54		0.42	19.11	8
Hp-08	171.54	171.59	851-02	19.40	1.02	51.24	1.05	0.28		0.60	26.41	3
Hp-09	24.69	24.74	906-02	23.14	1.30	52.27	1.52	0.44		0.46	20.87	4
Hp-09	101.9	101.95	916-01	19.33	1.40	51.06	1.09	0.30	0.19	0.55	26.21	3
Hp-10	35.42	35.47	876-01	23.25	1.97	52.10	1.74	0.44		0.44	20.14	13
Hp-10	45.04	45.09	877-01	13.30	1.08	49.01	1.23	0.28		0.76	34.46	12
Hp-10	139.15	139.2	884-01	19.65	0.90	51.57	1.32	0.32	0.20	0.54	25.67	7
Hp-10	178.78	178.83	890-01	19.76	0.99	51.31	1.73	0.43	0.21	0.60	25.11	3
Hp-10	183.05	183.2	FX847934	19.75	0.99	51.55	1.09	0.27	0.24	0.61	25.79	6
Hp-11	17.65	17.73	FX847935	21.73	1.70	51.80	1.65	0.46		0.48	22.28	9
Hp-11	85.03	85.14	FX847937	20.27	0.87	51.67	1.92	0.40		0.58	24.26	2
Hp-12	30.12	30.17	860-01	16.92	1.06	50.41	1.09	0.24		0.60	29.67	6
Hp-12	63.34	63.39	866-01	24.02	1.88	52.64	2.03	0.40		0.41	18.61	3
Hp-12	78.52	78.57	874-01	22.31	1.35	52.11	2.16	0.65		0.46	20.96	2

Table 6.6. Analyses of pigeonite by SEM/EDS from the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg CaO	Avg TiO_2	Avg V_2O_3	Avg MnO	Avg FeO	# of Analyses
H-04	97.24	97.29	798-01	20.08	1.18	52.21	4.91	0.27		0.49	21.14	7
H-05	52.32	52.37	806-01	19.75	1.27	52.37	5.44	0.36	0.23	0.51	20.52	7
H-06	17.41	17.46	814-01	20.14	1.27	52.32	5.34	0.29		0.44	20.46	5
H-06	137	137.05	832-01	21.56	1.32	51.76	2.50	0.81		0.54	21.50	1
Hp-07	51.02	51.07	839-01	22.98	1.73	52.57	4.27	0.31		0.31	17.83	1
Hp-08	139.72	139.77	848-01	23.71	1.93	53.13	2.72	0.31			18.20	1
Hp-10	35.42	35.47	876-01	20.53	2.07	52.17	6.23	0.33		0.33	18.33	1
Hp-10	139.15	139.2	884-01	19.09	1.70	51.13	2.91	0.37		0.64	24.18	1
Hp-11	85.03	85.14	FX847937	19.27	1.15	53.22	5.62	0.21		0.52	20.02	1
Hp-12	78.52	78.57	874-01	21.81	1.65	52.36	2.53	0.55		0.42	20.69	1

Table 6.7. Analyses of augite by SEM/EDS from the eastern drill holes of the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg Na_2O	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg CaO	Avg TiO_2	Avg V_2O_3	Avg Cr_2O_3	Avg MnO	Avg FeO	# of Analyses
H-02	95.6	95.65	924-01	0.36	15.67	2.61	50.90	19.58	1.22			0.31	9.41	6
H-03	27.67	27.62	778-01	1.27	16.44	10.28	50.30	12.02	0.54		0.25		9.03	2
H-03	123.76	123.81	790-01	0.36	15.52	3.64	51.30	20.61	1.26		0.28	0.27	7.14	11
H-04	17.86	17.91	793-01	0.38	14.67	3.40	51.38	20.63	0.99		0.27	0.27	8.48	11
H-04	52.45	52.5	796-01	0.38	14.37	3.17	50.74	18.11	1.42			0.24	11.57	3
H-04	79.39	79.44	797-01	0.32	15.26	3.53	51.76	21.61	1.15				6.35	3
H-04	97.24	97.29	798-01	0.34	14.97	1.88	51.91	19.34	0.63	0.26		0.32	10.95	32
H-05	52.32	52.37	806-01	0.29	14.94	2.00	51.25	17.58	1.01	0.26		0.36	12.88	12
H-06	17.41	17.46	814-01	0.36	15.28	2.01	51.65	18.21	0.93	0.28		0.31	11.58	17
H-06	63.22	63.27	827-01	0.37	13.96	2.09	51.72	21.21	0.59	0.28		0.31	9.85	6
H-06	137	137.05	832-01	0.37	14.83	2.27	52.18	19.24	0.79			0.30	10.13	9

Table 6.8. Analyses of augite by SEM/EDS from the western drill holes of the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg Na_2O	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg K_2O	Avg CaO	Avg TiO_2	Avg V_2O_3	Avg Cr_2O_3	Avg MnO	Avg FeO	# of Analyses
Hp-07	27.77	27.82	836-01	0.49	15.18	3.07	51.00		19.74	1.16		0.24	0.23	9.21	3
Hp-07	51.02	51.07	839-01	0.47	16.01	4.49	51.42	0.52	17.23	0.86			0.31	9.23	9
Hp-07	69.4	69.45	840-01	0.34	14.19	2.77	51.57		22.48	0.64			0.27	7.95	6
Hp-07	87.64	87.69	842-01	0.35	13.58	3.19	51.23		21.80	0.64		0.24	0.29	8.95	3
Hp-08	20.1	20.15	843-01	0.34	15.43	2.98	51.96		18.96	0.84		0.26	0.29	9.45	5
Hp-08	81.85	81.9	845-01	0.39	12.94	2.17	51.36		21.90	0.33			0.32	10.82	3
Hp-08	139.72	139.77	848-01	0.40	14.84	3.21	51.25		19.07	1.00			0.41	10.20	9
Hp-08	171.54	171.59	851-02	0.33	13.87	1.76	51.65		20.89	0.53			0.34	10.85	6
Hp-09	32.2	32.25	909-01	0.34	14.47	2.60	52.13		21.56	0.66				8.25	3
Hp-09	101.9	101.95	916-01	0.39	12.71	2.77	50.58		20.31	0.56	0.22		0.34	12.30	6
Hp-10	35.42	35.47	876-01	0.42	15.26	3.26	50.91		18.69	0.96			0.27	10.48	8
Hp-10	45.04	45.09	877-01	0.43	10.36	1.88	50.59		19.98	0.33			0.43	16.59	12
Hp-10	139.15	139.2	884-01	0.44	14.09	2.03	51.87	0.19	19.52	0.61	0.33		0.31	11.67	11
Hp-10	178.78	178.83	890-01	0.38	13.51	1.70	51.57		20.32	0.52			0.33	11.86	2
Hp-10	183.05	183.2	FX847934	0.33	13.83	1.71	51.76		20.95	0.55	0.26		0.34	10.88	6
Hp-11	17.65	17.73	FX847935	0.45	14.11	2.60	51.55		20.47	0.67			0.30	10.15	9
Hp-11	85.03	85.14	FX847937	0.25	13.92	1.78	51.97		20.49	0.70			0.33	11.08	3
Hp-12	30.12	30.17	860-01	0.41	12.29	2.13	50.97		19.69	0.45			0.36	13.97	6
Hp-12	78.52	78.57	874-01	0.35	15.09	2.27	51.78		19.14	0.64	0.26		0.25	10.42	3

Table 6.9. Analyses of ilmenite by SEM/EDS from the eastern drill holes of the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg CaO	Avg TiO_2	Avg V_2O_3	Avg MnO	Avg FeO	# of analyses
H-01	30	30.05	921-01			0.26	0.22	52.54	0.62	4.01	42.67	2
H-01	81.61	81.66	922-01			0.23	0.19	52.79	0.74	4.80	41.70	4
H-03	38.28	38.33	779-01					53.40		1.28	45.32	1
H-03	93.8	93.85	783-01			0.20		52.70	0.68	0.92	45.78	3
H-03	128.31	128.36	792-01			0.32		52.39	0.70	2.27	45.00	3
H-04	17.86	17.91	793-01	1.23		0.31	0.27	52.46	0.55	1.04	45.39	6
H-04	40.06	40.11	795-01		0.22	0.30		52.57	0.64	3.38	43.65	6
H-04	52.45	52.5	796-01	1.19		0.24		52.83	0.78	0.57	44.83	6
H-04	79.39	79.44	797-01	0.85		0.23		52.89	0.46	0.69	45.28	3
H-04	97.24	97.29	798-01	2.16		0.29	0.53	52.91	0.94	0.58	43.33	15
H-04	124.08	124.13	800-01			0.57	0.29	52.56	0.67	1.77	44.88	3
H-05	36.34	36.39	804-01					52.43	0.61	4.28	42.68	3
H-05	52.32	52.37	806-01	1.10	0.22	0.44	0.21	52.49	0.78	0.68	44.62	8
H-05	52.67	52.72	806-02		0.36	0.73	0.19	51.77	0.51	1.77	45.37	3
H-05	88.89	88.94	810-01			0.21		52.71	0.56	1.64	44.96	3
H-05	99.29	99.34	812-01					52.72	0.69	0.94	45.65	3
H-06	17.41	17.46	814-01	1.48		0.45	0.22	52.55	0.85	0.66	44.23	9
H-06	97.25	97.3	829-01					52.54	0.53	2.34	44.59	3
H-06	137	137.05	832-01	1.09		0.44		51.64	0.73	0.79	45.31	4
H-06	188.91	188.96	835-01			0.25		52.78	0.62	0.80	45.68	2

Table 6.10. Analyses of ilmenite by SEM/EDS from the western drill holes of the Wadi Qutabah Layered Mafic Intrusion. Results presented are average weight% of the oxides.

Hole ID	From	To	Sample#	Avg MgO	Avg Al_2O_3	Avg SiO_2	Avg CaO	Avg TiO_2	Avg V_2O_3	Avg MnO	Avg FeO	# of analyses
Hp-07	51.02	51.07	839-01	0.66		0.20		52.28	0.85	0.65	45.94	8
Hp-07	69.4	69.45	840-01				0.13	52.38	0.67	1.29	45.58	3
Hp-07	87.64	87.69	842-01			0.21		52.76	0.73	2.02	44.66	3
Hp-08	20.1	20.15	843-01	0.64		0.31	0.20	52.52	0.73	0.81	45.96	6
Hp-08	81.85	81.9	845-01			0.25		52.19	0.66	1.25	45.65	3
Hp-08	139.72	139.77	848-01			0.25		52.44	0.64	1.48	45.48	9
Hp-08	171.54	171.59	851-02	1.71		0.21		52.74	0.94	0.61	43.90	6
Hp-09	24.69	24.74	906-01			0.23		52.07	0.56	1.43	45.86	3
Hp-09	24.69	24.74	906-02	0.81		0.24		52.79	0.63	3.62	42.20	3
Hp-09	32.2	32.25	909-01				0.15	52.45	0.69	1.71	45.09	3
Hp-09	101.9	101.95	916-01		0.38	0.58	0.29	52.47	0.69	1.55	45.23	6
Hp-10	14.36	29.02	FX847931			0.73	0.33	52.13	0.44	2.11	44.63	3
Hp-10	35.42	35.47	876-01			0.19		52.77	0.71	1.43	45.41	6
Hp-10	45.04	45.09	877-01			0.77		51.19	0.58	0.68	47.59	6
Hp-10	68.2	68.25	880-01			0.39		52.20	0.68	1.08	46.36	3
Hp-10	139.15	139.2	884-01	0.77		0.25	0.18	52.33	0.99	0.68	45.43	11
Hp-10	178.78	178.83	890-01	1.24		0.27		52.31	1.01	0.59	45.14	3
Hp-10	183.05	183.2	FX847934					52.80	0.85	0.70	46.00	2
Hp-11	17.65	17.73	FX847935	1.24		0.25		53.45	0.61	0.61	44.72	7
Hp-11	32.58	32.63	854-01			0.28		52.27	0.58	3.29	44.06	3
Hp-11	62.5	62.55	856-01			0.22		52.61	0.57	2.23	44.71	3
Hp-11	85.03	85.14	FX847937	0.71		0.61		51.57	0.75	0.74	45.94	2
Hp-12	30.12	30.17	860-01			0.38	0.15	51.79	0.75	0.70	46.65	3
Hp-12	78.52	78.57	874-01	1.79		0.25		52.96	1.03	0.66	43.48	6

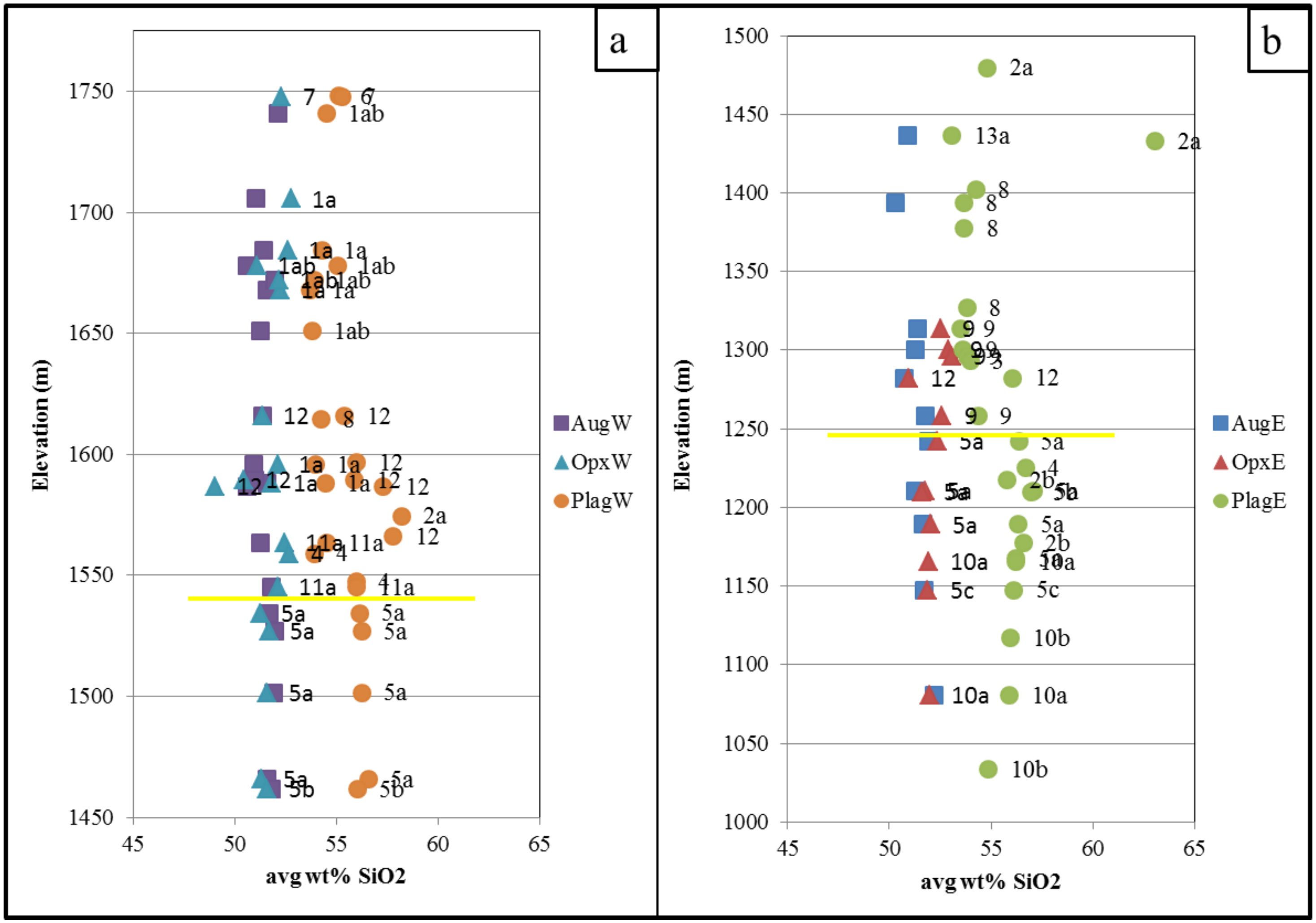


Figure 6.1. Variation of SiO_2 (avg wt. %) in augite, orthopyroxene and plagioclase versus elevation (m) for the western (a) and eastern (b) samples. The unit codes are displayed, and the horizontal lines (yellow) indicate the top of unit 5a. The dykes/sills (units 12 and 13a) are also included.

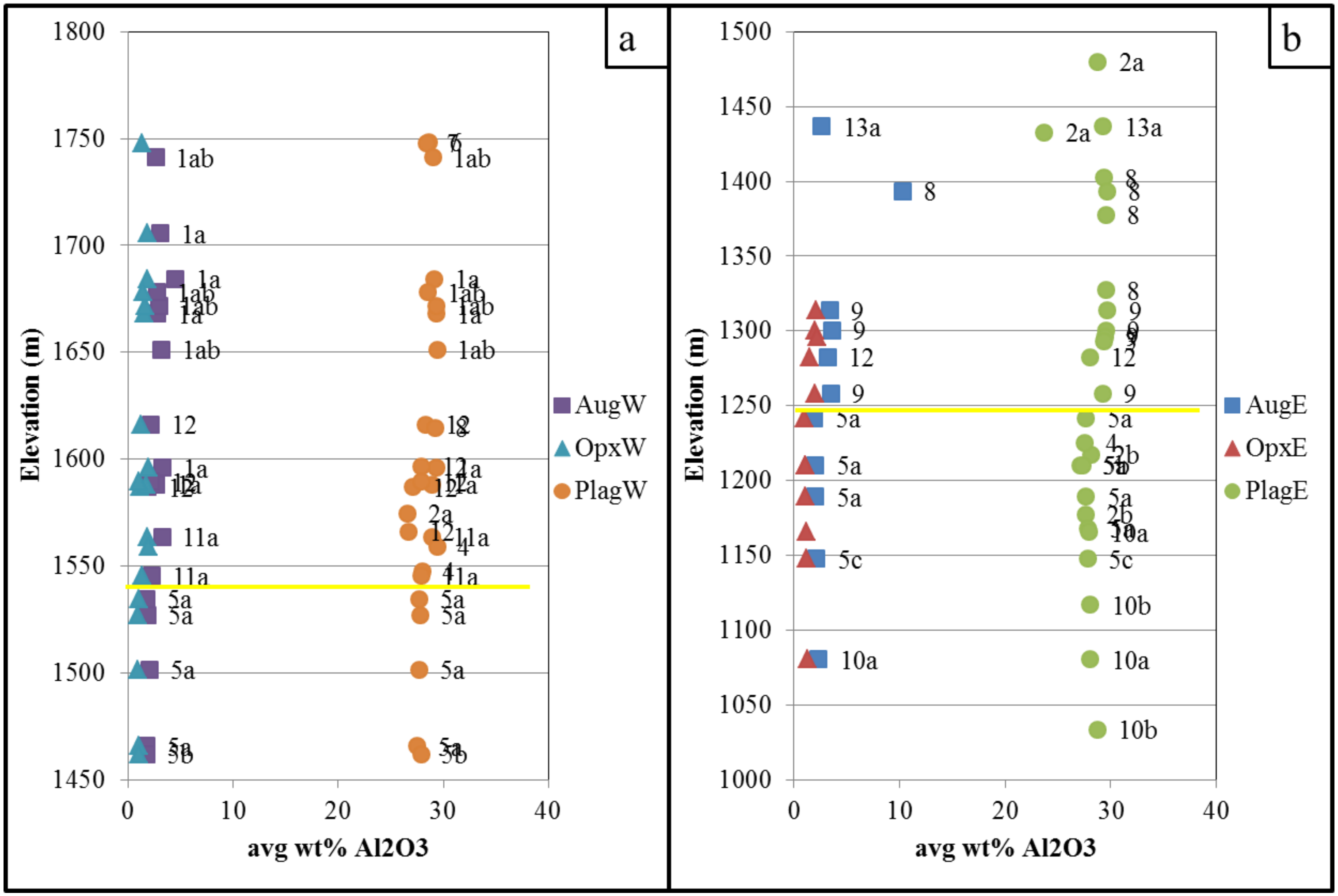


Figure 6.2. Variation of Al_2O_3 (avg wt. %) in augite, orthopyroxene and plagioclase versus elevation (m) for the western (a) and eastern (b) samples. The numbers displayed are the unit codes and horizontal lines (yellow) indicate the top of unit 5a. The dykes/sills (unit 12 and 13a) are also included.

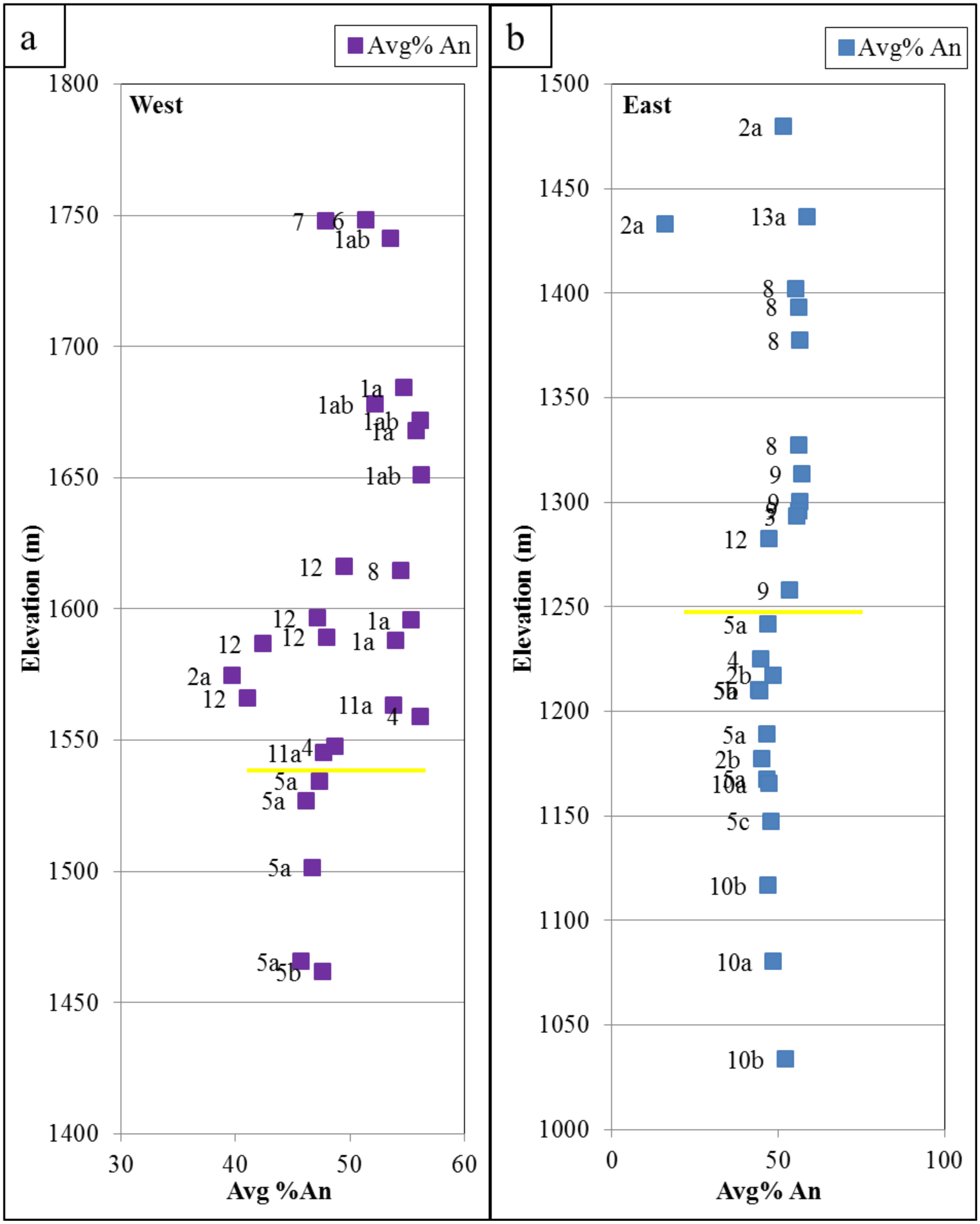


Figure 6.3. Variation of anorthite content (An%) in plagioclase from the western (a) and eastern (b) samples versus elevation (m). An % of plagioclase mimics the trend exhibited by CaO and Al_2O_3 for both the east and west samples. An% shows a marked increase above unit 5a (indicated by horizontal yellow lines). The lower An% of plagioclase in unit 12 is consistent with the unit being a sill or dyke.

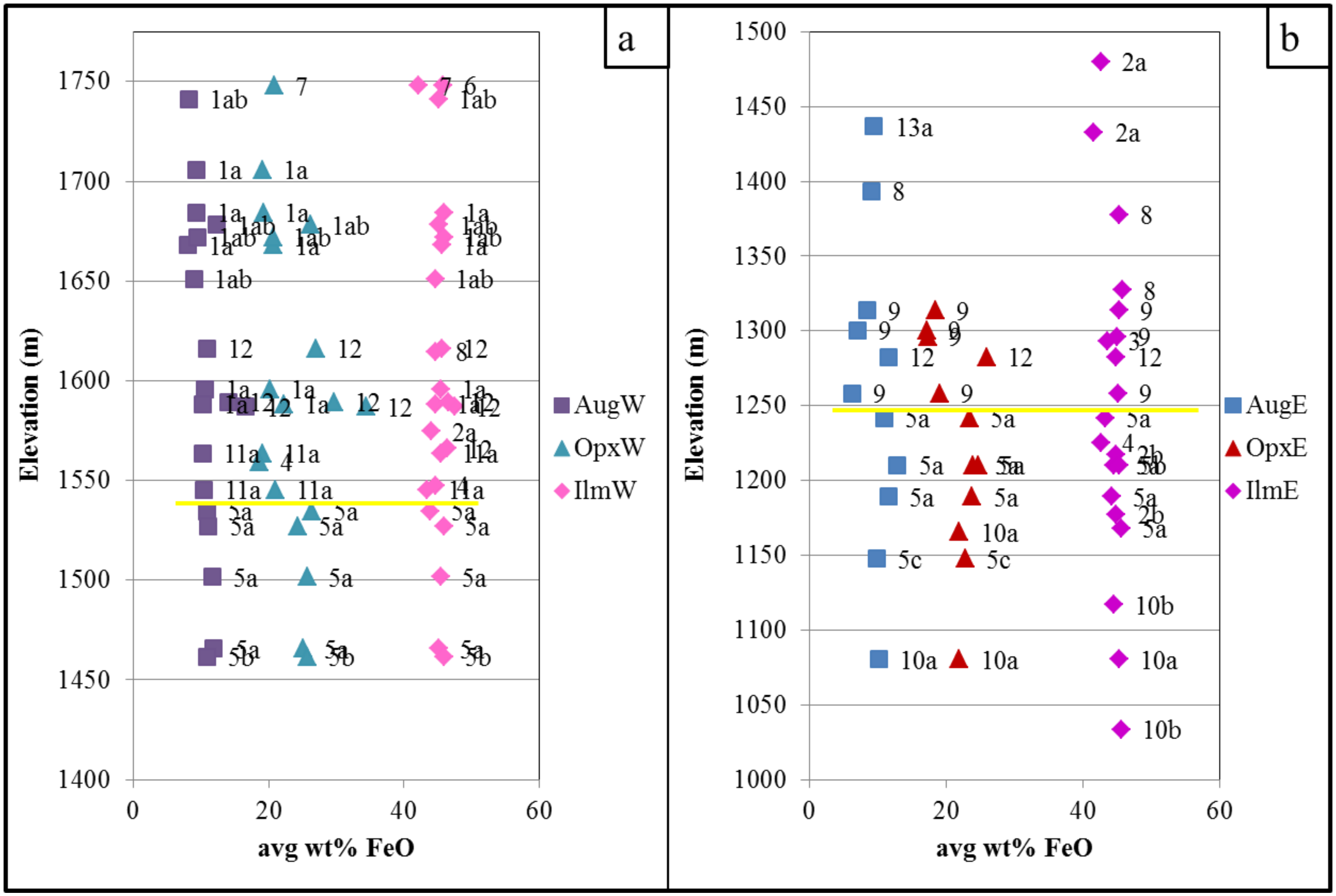


Figure 6.4. Variation of FeO (avg wt. %) in augite, orthopyroxene and ilmenite versus elevation (m) from the western (a) and eastern (b) samples. The numbers displayed are the unit codes and the horizontal lines (yellow) indicate the top of unit 5a. The dykes/sills (units 12 and 13a) are also included.

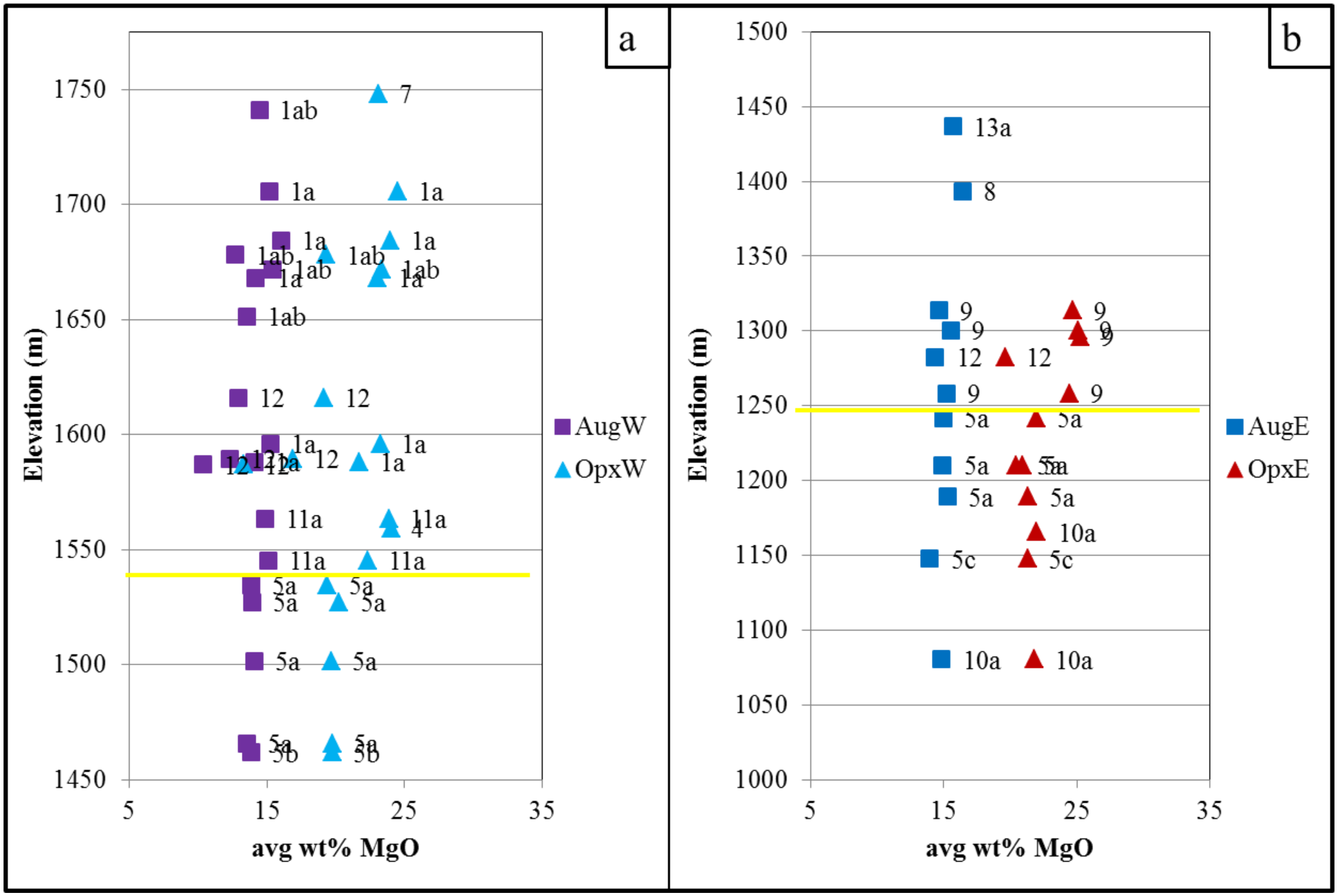


Figure 6.5. Variation of MgO (avg wt. %) in augite and orthopyroxene versus elevation (m) for the western (a) and eastern (b) samples. The numbers displayed are the unit codes and the horizontal lines (yellow) indicate the top of unit 5a. The dykes/sills (units 12 and 13a) are also included.

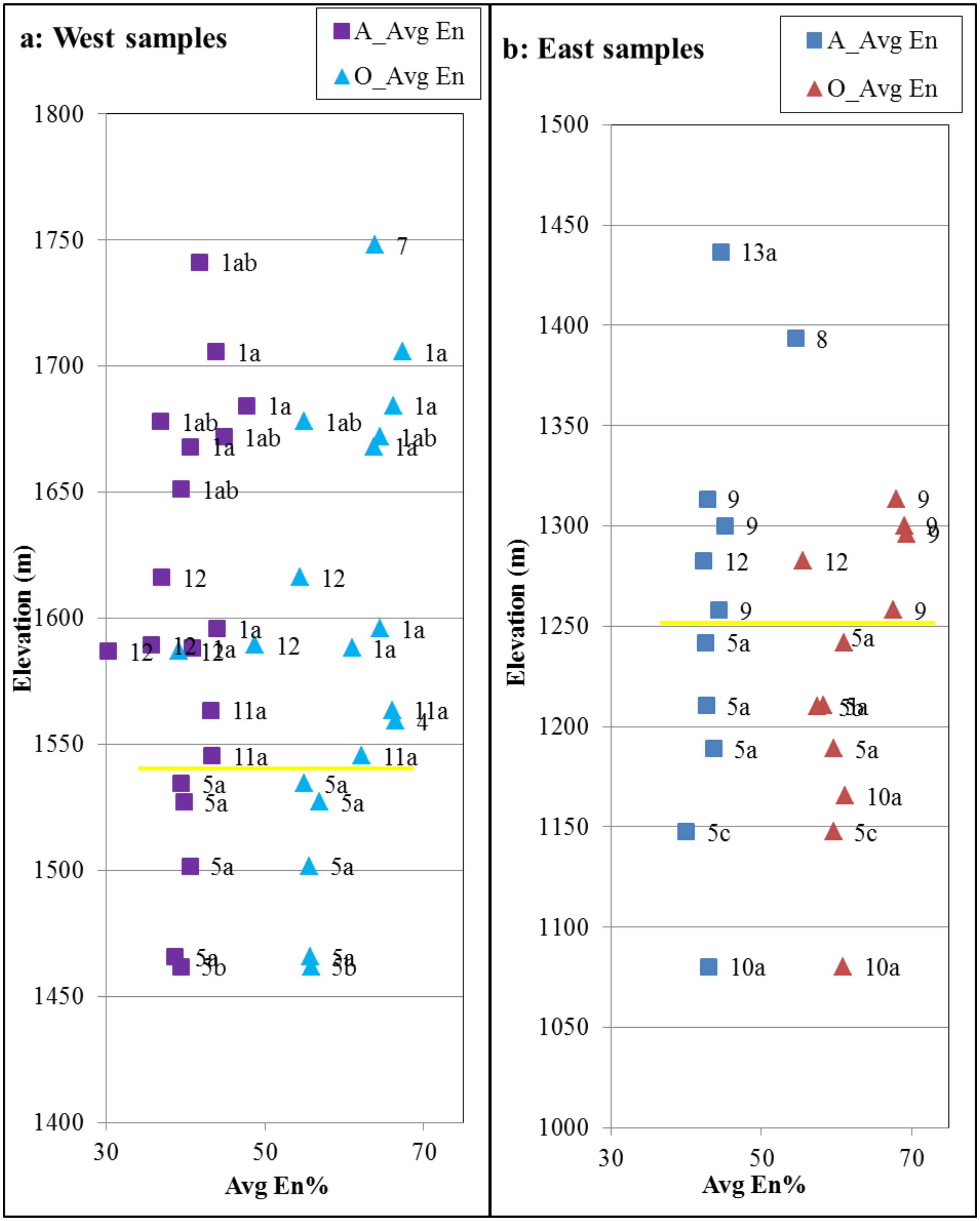


Figure 6.6. Diagrams showing variation in enstatite content (En%) versus elevation (m) in augite and orthopyroxene from the western (a) and eastern (b) samples. Numerical unit codes are displayed and horizontal lines (yellow) indicates the top of unit 5a. The dykes/sills (units 12 and 13a) are also included. En% calculated using cation proportions, where En%=Mg/(Ca+Mg+∑Fe)*100, where ∑Fe= Fe+Mn.

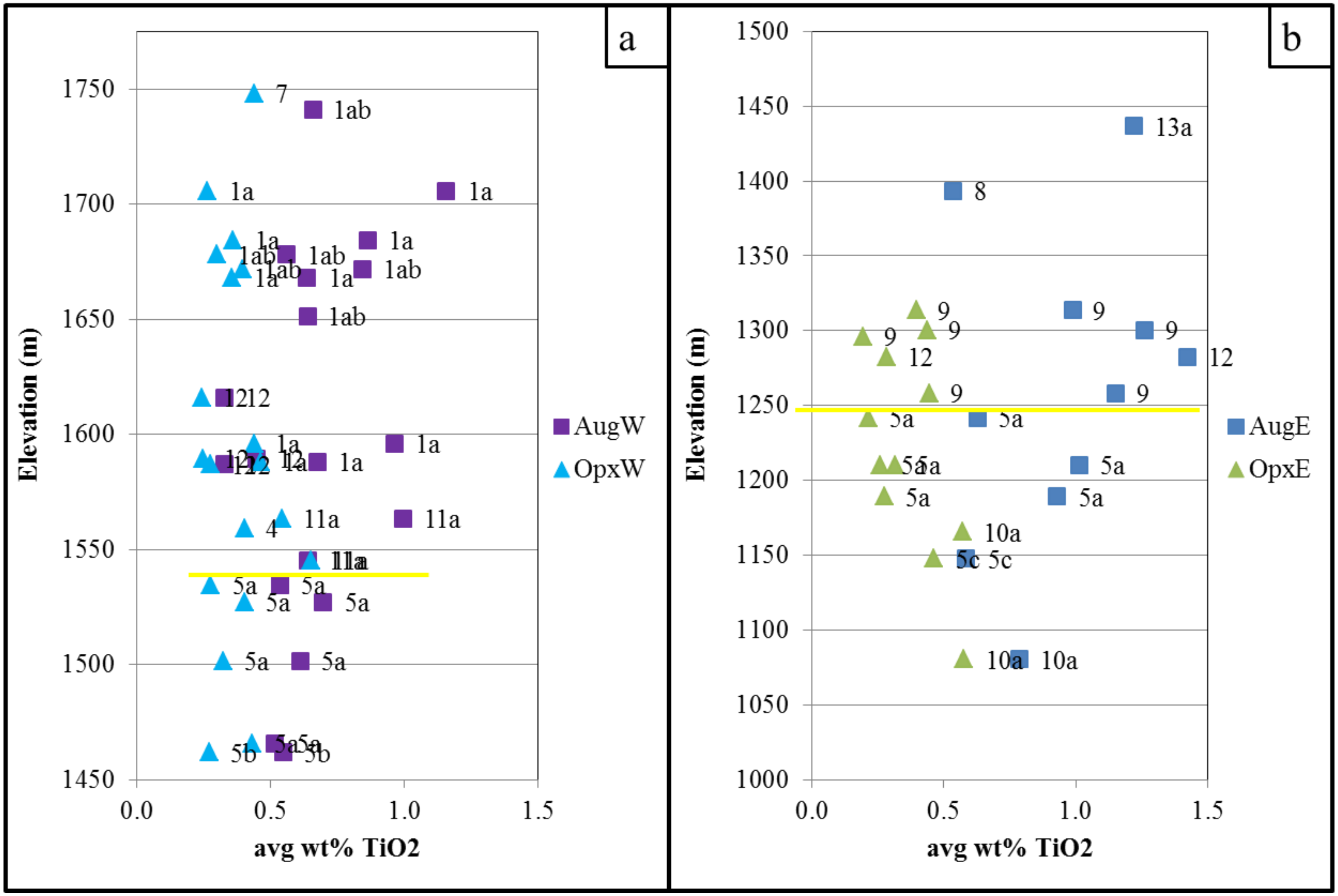


Figure 6.7. Diagrams showing the variation of TiO_2 (avg wt. %) in augite and orthopyroxene versus elevation (m) for the western (a) and eastern (b) samples. The numbers displayed are the unit codes and the horizontal lines (yellow) indicate the top of unit 5a. The dykes/sills (units 12 and 13a) are also included.

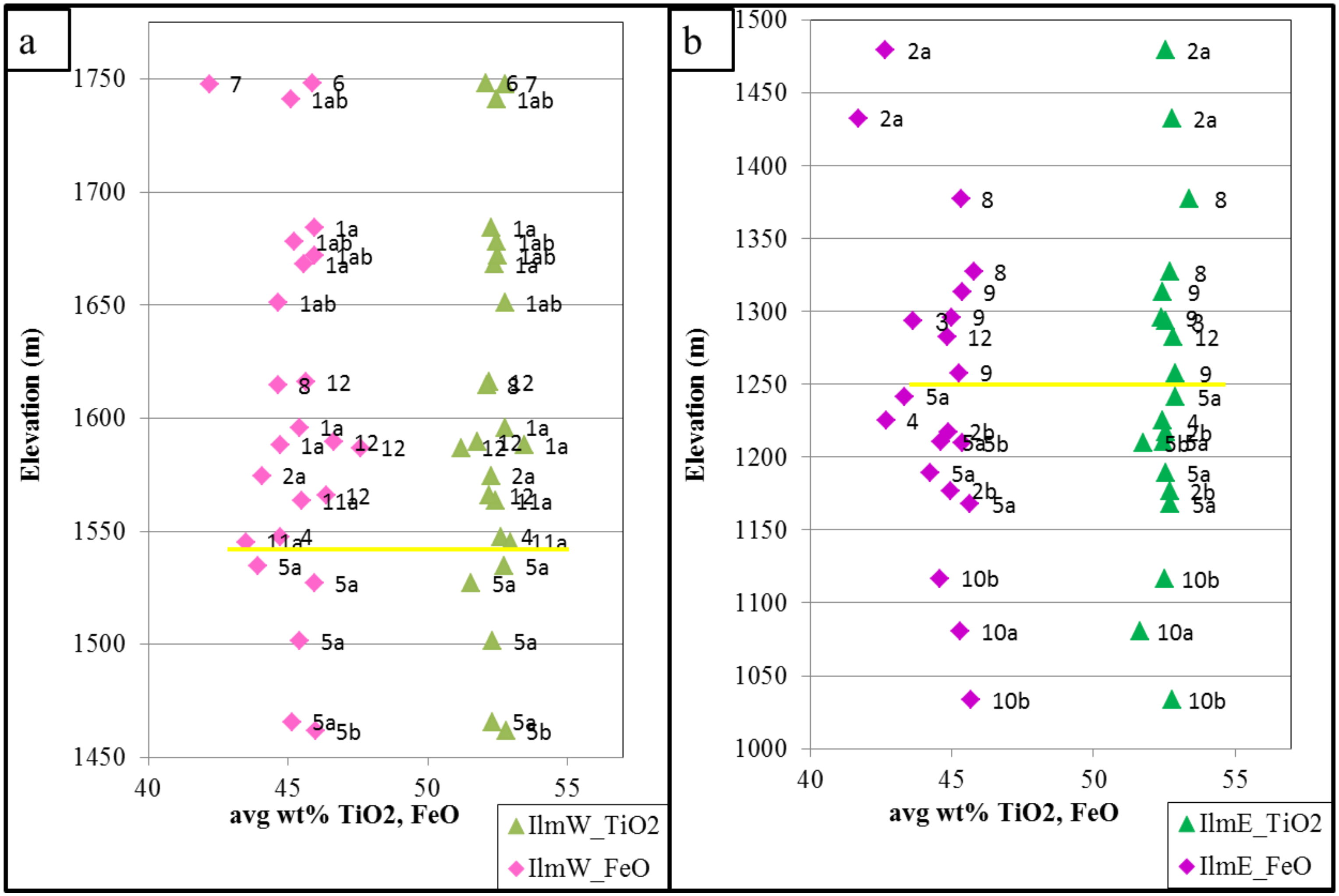


Figure 6.8. Diagrams showing the variation of TiO_2 and FeO (avg wt. %) in ilmenite versus elevation (m) for the western (a) and eastern (b) samples. The numbers displayed are the unit codes and the horizontal lines (yellow) indicate the top of unit 5a. The dykes/sills (units 12 and 13a) are also included.

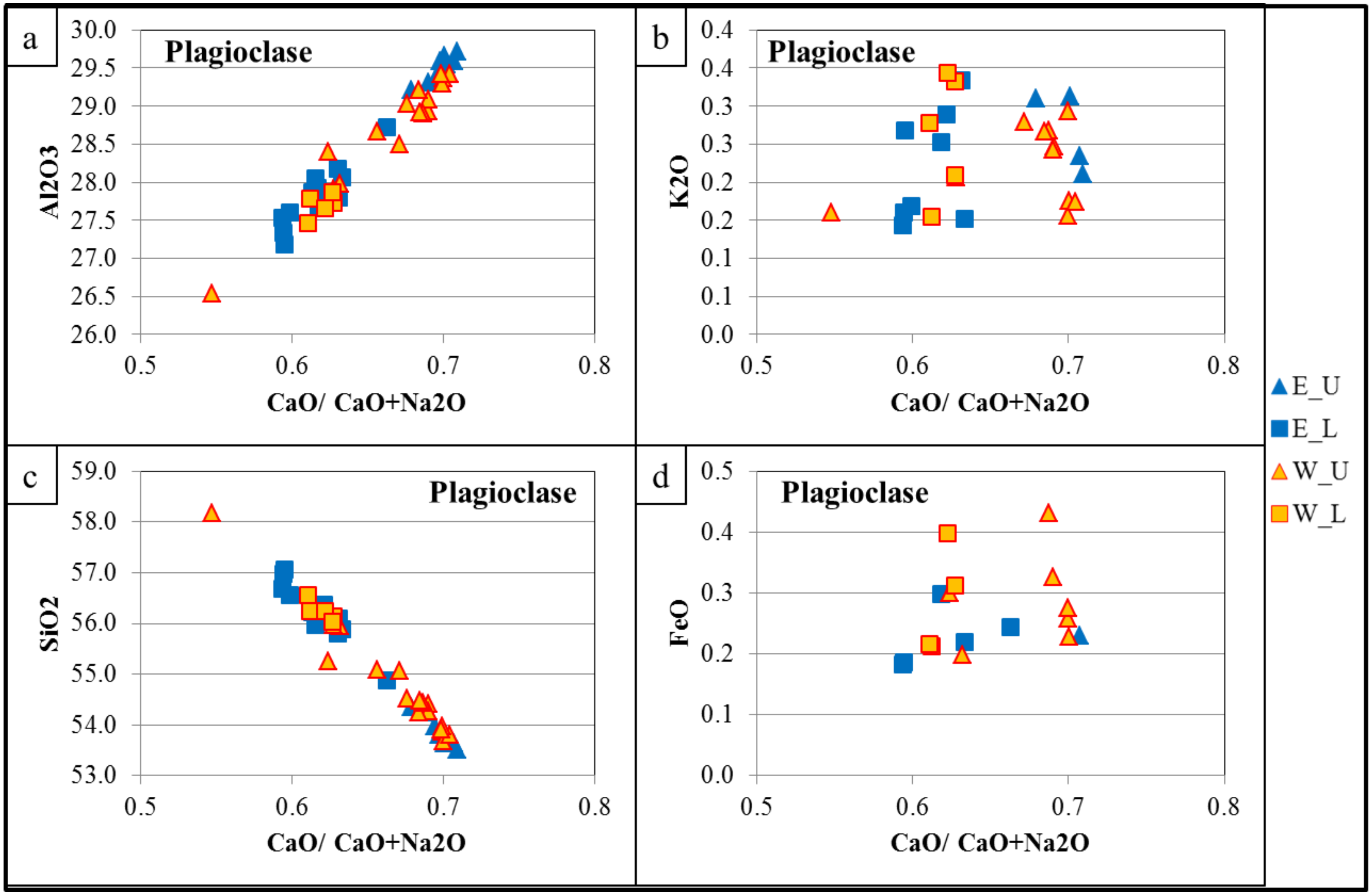


Figure 6.9. Correlation diagrams of a) Al_2O_3, b) K_2O, c) SiO_2, and d) FeO vs. CaO/ ($CaO+Na_2O$) in plagioclase. The triangles are for the samples above the unit 5a upper contact (U for upper) and the squares are for samples below the 5a contact (L =lower). E=east and W=west.

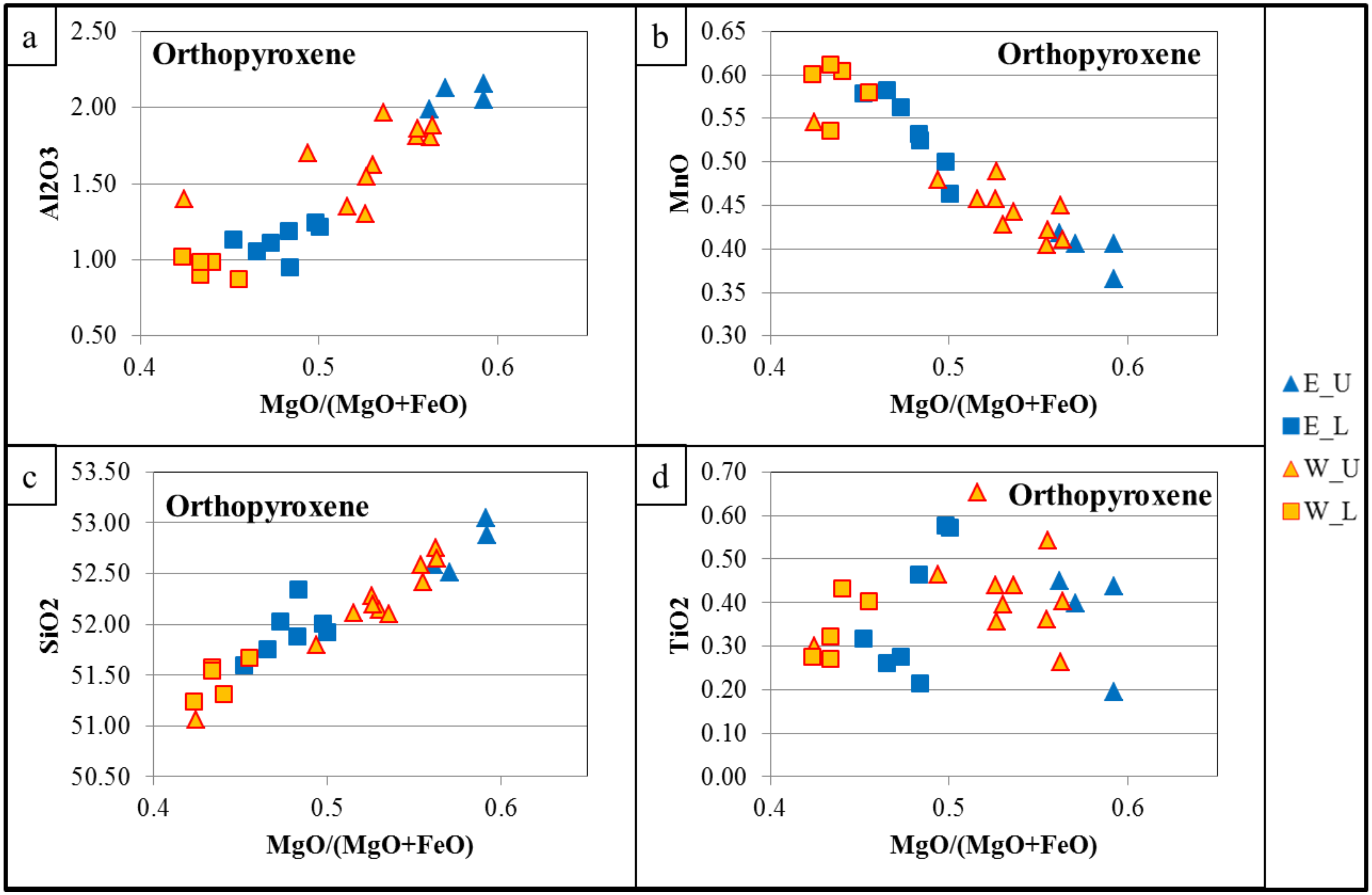


Figure 6.10. Correlation diagrams of a) Al_2O_3, b) MnO, c) SiO_2, and d) TiO_2 vs. MgO/(MgO+FeO) in orthopyroxene. The triangles are for the samples above the unit 5a upper contact (U for upper) and the squares are for samples below the 5a contact (L =lower). E=east and W=west.

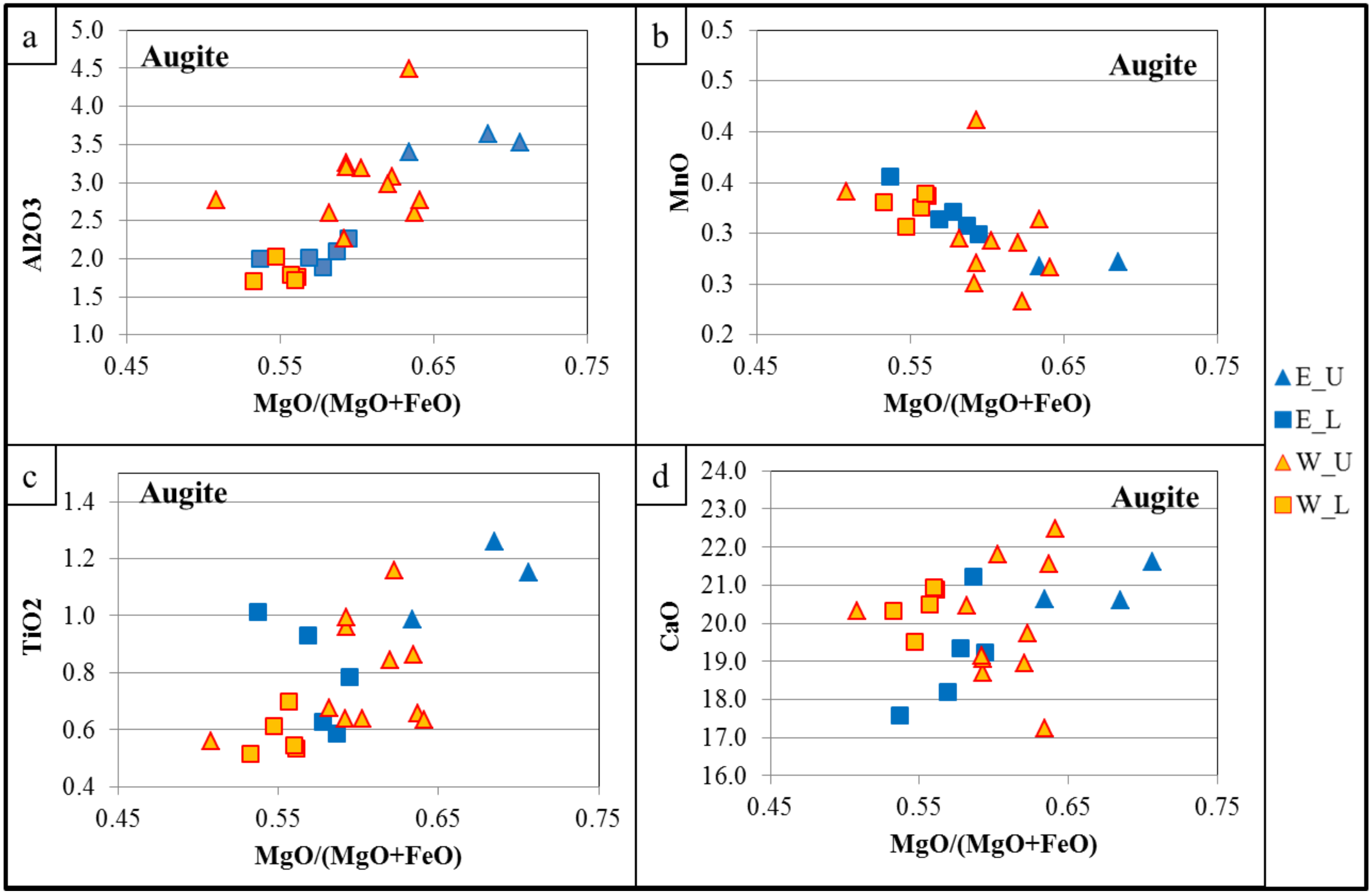


Figure 6.11. Correlation diagrams of a) Al_2O_3, b) MnO, c) TiO_2, and d) CaO vs. MgO/(MgO+FeO) in augite. The triangles are for the samples above the unit 5a upper contact (U for upper) and the squares are for samples below the 5a contact (L =lower). E=east and W=west.

Chapter 7.0 Discussion

7.1 SEM

Mineral analyses by SEM revealed some significant major element changes in the stratigraphy of the Wadi Qutabah layered mafic intrusion. These changes are in part related to the progressive crystallization of minerals, whereas others may be the result of injection of hot more primitive magma. Alteration may also affect the composition of minerals by the addition or removal of elements by hydrothermal fluids.

Plagioclase shows clearly defined positive correlations between Al_2O_3 (Fig. 6.9 a) and $CaO/CaO+Na_2O$ and a negative correlation of SiO_2 with $CaO/CaO+Na_2O$ (Fig. 6.9 c). There is a distinct separation in composition of the plagioclases that lie above (triangles) and below (squares) the 5a contact. This relationship indicates that as CaO increases, so does Al_2O_3, and as Na_2O increases so does SiO_2. The relationship of K_2O and FeO to $CaO/(CaO+Na_2O)$ is not as clear, but there is a weak positive correlation (Fig. 6.9 b & d).

Orthopyroxene shows positive correlations with SiO_2 (Fig. 6.10 c) and Al_2O_3 (Fig. 6.10 a) over MgO/(MgO+FeO) and a negative correlation with MnO (Fig. 6.10 b). TiO_2 shows scatter, but there is a weak positive correlation (Fig. 6.10 d). There are distinct separations between the samples that lie above (triangles) and below (squares) the 5a contact.

Correlation diagrams for augite (Fig. 6.11 a to d) show positive correlations between Al_2O_3, TiO_2 and CaO with MgO/(MgO+FeO) and negative with MnO. There are clearly defined variations in the samples that lie above the 5a contact (triangles) and those below (squares). Where there is a positive correlation, the samples that lie below the 5a contact contain a lower abundance of the oxides (Al_2O_3, TiO_2, CaO and MgO). The samples that lie above the 5a contact contain higher concentrations of oxides. The negative correlation with MnO indicates that MnO decreases as MgO increases.

The sample showing the most anomalous feldspar composition is 922-01 which is part of unit 2a in eastern drill hole H-01. H-01 is located farthest to the east (Fig. 3.1) and host to large intersections of granite (Fig. 5.4). Sample 922-01 has suffered the most intense carbonate (+amphibole, chlorite) alteration of any of the samples. Hydrothermal fluids may be responsible for enrichment in silica (Si) (Fig. 6.1) and sodium (Na) of the plagioclase leading to higher albite content and lower An% in sample 922-01 (unit 2a)(Fig. 6.3) (Rollinson, 1993).

SiO_2 in plagioclase shows a distinct trend of increasing concentration in the samples from the lowest elevations (in the east) until reaching the top of unit 5a, where there is a dramatic decrease. This pattern is repeated in the western drill holes, but it is not as dramatic. A decrease in SiO_2 in plagioclase from layers 2b, 4, 9, 8, 11a, 1a and 1ab corresponds to a shift in magma chemistry (Fig. 6.1). Plagioclase composition increases in CaO and decreases in Na_2O, which is a shift towards higher anorthite ($CaAl_2Si_2O_8$) content (Fig. 6.3). This reflects the coupled substitution of $Ca^{2+}Al^{3+}=Na^{+}Si^{4}$. When Al goes up so does Ca with accompanying decreases in Na and Si. This change in composition is opposite of what is expected, since the more evolved composition (lower An%) should lie stratigraphically higher in the intrusion. This reversal in composition beginning at the top of unit 5a suggests that an event such as magma recharge, of hot more primitive magma may be responsible for this change in chemistry (Philpotts & Ague, 2009).

SiO_2 variation in the pyroxenes (Fig. 6.1) show similar contents below the top of unit 5a, but above 5a SiO_2 tends to be higher in orthopyroxene compared to augite. This change appears more pronounced in the eastern holes.

Aluminum (Al_2O_3) in plagioclase (Fig. 6.2) mirrors the trend exhibited by SiO_2 (Fig. 6.1). There is a decrease in Al_2O_3 above the 5a upper contact. This trend is likely a result of crystallization of plagioclase with increasing An% (Fig. 6.3), since plagioclase generally represents >40modal% of each of the layers (units) and is the main cumulus phase. There is a slight increase in Al_2O_3 in the pyroxenes above the 5a upper contact (Fig. 6.2).

FeO content of orthopyroxene, and to some extent augite decreases above unit 5a (Fig. 6.4) with a complimentary increase in MgO above 5a (Fig. 6.5). Similarly, the enstatite content (En%) increases but the result is more pronounced in orthopyroxene (Fig. 6.6).

Unit 12 (noritic/gabbroic) dykes/ sills exhibit distinct compositional variations relative to the host units (layers). They contain plagioclase with higher SiO_2 (Fig. 6.1) and lower An% (Fig. 6.3), and pyroxenes with lower MgO (Fig. 6.5) and En% (Fig. 6.6), and higher FeO (Fig. 6.4). This indicates a more evolved composition relative to the host units. The dykes contain up to

~11% modal ilmenite, again suggesting a more evolved composition. In drill core unit 12 shows sharp contacts with the overlying and underlying layers and does not correlate well between layers, suggesting that it may be structurally and/or stratigraphically controlled.

Unit 5a (including 5b) contains ~10-15modal% ilmenite which likely affected the concentration of iron and titanium in the system as well as the oxygen fugacity (Wilson *et al.*, 1996). There is a decrease in FeO (Fig. 6.4) in units 9, 11a, 4, 1a and 1b, which overlie unit 5a. The change in FeO may be the result of ilmenite removal or possibly the result of injection of a more primitive hot magma.

The enstatite (En%) (Fig. 6.6) content of the pyroxenes mimics the patterns exhibited by MgO concentration (Fig. 6.5). They increase above the 5a contact in both the east and west drill holes. Augite shows little increase in the eastern samples compared to the west. Samples from the west show a slight increase, and unit 12 (dykes/sills) shows scatter. Higher En% is a result of the crystallization of minerals rich in MgO and at higher temperatures (Philpotts & Ague, 2009). An increase in En% up elevation might indicate injection of new hot more primitive magma leading to more Mg-rich compositions of the ferromagnesian minerals.

Ilmenite shows no clear TiO_2 compositional changes with height or clear change above unit 5a (Fig. 6.8) despite the fact that it is what makes 5a distinctive. FeO in ilmenite (Fig. 6.8) decreases in the upper part of unit 5a (including unit 4) then returns to a similar FeO content above 5a as below.

TiO_2 content in the pyroxenes (Fig. 6.7) shows significant scatter. Augite is enriched in TiO_2 relative to orthopyroxene, a result of partitioning of titanium into augite (Philpotts & Ague, 2009).

Semi-massive and massive sulphide layers are hosted in units 11a, 4,10a, 9, 5a and in Hp-09 above unit 6 (anorthosite) (Fig. 5.38 to 5.42). The Sulphides and oxides that make up these layers are pyrrhotite, minor chalcopyrite, ilmenite, thin irregular seams and pods of graphite and trace exsolution of pentlandite in the pyrrhotite. The sulphides exhibit magmatic textures that are locally disrupted. No crosscutting relationships were observed, with the exception of rare thin carbonate veinlets hosting pyrite mineralization. This implies that the pyrite is secondary or has been remobilized. Rare annealed textures were observed in the opaque phases, suggesting some recrystallization. It is not clear if the sulphides have been remobilized or are secondary phases as a result of the formation of a separate sulphide liquid either through sulphur saturation or the upward migration of fluids. Magma injections can also trigger the formation of sulphide rich liquids by the addition of dissolved sulphur into the system. Sulphide rich layers may affect the distribution of the siderophile and chalcophile elements as a result of partitioning of these elements into the sulphide and Fe-rich phases (Mungall, 2005, Mungall & Naldrett, 2008, Philpotts & Ague, 2009).

SEM analyses of the Wadi Qutabah layered mafic intrusion indicate that changes in major element chemistry are controlled by the composition of the crystallizing phases (below the 5a contact), alteration (east) and likely injection of more primitive hot magma near the upper contact of 5a. The crystallizing phases are a reflection of the conditions of crystallization, such as liquid composition, intensive parameters (pressure, temperature, fO_2) and undergo the effects of convection, new injections of magma, country rock assimilation and evolution of the liquid through crystallization. Chemical variations toward more primitive compositions above unit 5a suggest input of a more primitive and hot magma, with sufficient mixing or magma stratification to affect the major element chemistries and the phases being crystallized ((Best, 2011, Hatton & Von Gruenewaldt, 1990, Philpotts & Ague, 2009).

Chemical reversals are common features of layered mafic intrusions. Injection of more primitive magma may lead to the crystallization of minerals with more primitive compositions, or may trigger the formation of monomineralic or near monomineralic layers (e.g. plagioclase rich layers or dunite) (Best, 2011, Philpotts & Ague, 2009). Injection of new magma has been recorded in the mineral chemistry and in changes in the strontium (Sr) isotopic ratios ($^{87}Sr/^{86}Sr$) in large intrusions such as the Bushveld Complex (South Africa)(Eales & Cawthorn, 1996), the Stillwater Complex (Montana)(McCallum, 1996), the Rum Intrusion (Scotland) (Emeleus *et al.*, 1996) and the Muskox Intrusion (Northwest Territories)(Philpotts & Ague, 2009) to name a few. Changes in the initial $^{87}Sr/^{86}Sr$ ratios is indisputable evidence of multiple magma injections and an active and open system of replenishment (Hatton & Von Gruenewaldt, 1990). Perhaps the plagioclase rich layers (eg. 2b, 9, 11a and plagioclase segregations) in the Wadi Qutabah intrusion are evidence of new magma input.

More primitive compositions above unit 5a indicate that there is cryptic layering within the intrusion, from the top of unit 5a, up stratigraphy towards units 6 and 7.

7.2 Comparison to other Layered Mafic Intrusions

Tholeiitic layered mafic intrusions show progressive fractionation trends towards more felsic compositions and Fe-enrichment with elevation (Best, 2011, Hall & Hughes, 1990). This feature suggests that estimation of stratigraphic position may be determined as a result of mineral chemistry. Mineral samples from the Wadi Qutabah layered mafic intrusion show chemical variation up through the stratigraphy. Plagioclase decreases from An 52 in unit 10b to An44 in unit 4, then increases to ~An47 at the top of unit 5a. There is a significant shift above 5a to ~An53 up to ~An55-57 to the bottom of 2a (altered plagioclase) in the eastern holes. In the west An% remains low into unit 4, where it increases up stratigraphy to An54-56 (Fig. 6.3). En% in orthopyroxene varies from ~61 in the lowest layers and then decreases to 57-58 in units 5a/5b, and then increases up stratigraphy to En 69 (Fig. 6.6). Variation in augite composition shows similar trends to the plagioclase and orthopyroxene, with decreases in En% in unit 5a, and then an increase up stratigraphy.

Thickness of the correlated stratigraphy represents ~500m of true thickness of the intrusion, over an area of ~5km (E-W) x 4km (N-S). Consider the lower part of the intrusion from unit10a to 4 , a thickness of~184m, where An% of plagioclase and En% of orthopyroxene decrease from ~An49 to An44 (Fig. 6.3) and En61 to En58 (Fig. 6.6). Above unit 4 (in 5a) both the An content of plagioclase and En content of orthopyroxene show sharp increases to An47 and En 61, and then increase even further above the 5a contact to An54 and En 68 respectively. The An% of plagioclase continues to increase up stratigraphy from An54 to 55-56 at the top of unit 8 over a thickness of ~186m, and En% increases from 67 to 69 at the top if unit 9 over 80.51m. If we assume that the rate of change of An% and En% over height is related to intrusion thickness, we can guess at the thickness of the Suwar-Wadi Qutabah intrusion. A summary of these compositional changes over the lower 184m is as follows: An% changes (decrease) by 5 and En% changes (decrease) by 3. Mineral compositions change very little over the 184m interval and through comparison with the rate of change in the Bushveld and Skaergaard intrusions, this suggests that the Wadi Qutabah intrusion is >2km in thickness and perhaps closer to 4.5km in thickness (average of the results). This comparison was accomplished through a simple calculation comparing the known intrusion to the unknown to determine a crude calculation for thickness based on changes in mineral composition. The calculation is as follows, where we solve for x: (a/b)/c = (d/x)/f, where a= the vertical thickness of the section examined where change occurs (known intrusion), b= total thickness of the intrusion (known intrusion), c= change in An% or En% (known intrusion), d=thickness of the vertical section used (intrusion of unknown thickness), x= unknown thickness of intrusion, f= change in An% or En% (intrusion of unknown thickness).

Thickness of the Suwar-Wadi Qutabah Compex was also estimated using regression analysis. The composition of plagioclase was examined from multiple large intrusions to determine an equation for the estimation of thickness based on the rate of change of anorthite (An) in plagioclase. The equation is T (km) =0.019294*MAN+1.55293, where MAN is the meters per 1 An unit in plagiolcase. The correlation coefficient for this equation is 0.93037 and P= 0.002366, indicating a highly significant correlation. The standard error of estimate is ±0.901304km. Results of this calculation suggest that the Suwar-Wadi Qutabah complex is ~2.3km in thickness (Fig. 7.1).

Mineral compositions, when compared to the Bushveld and the Skaergaard intrusions (Fig. 7.2) suggest that the rocks from the Wadi Qutabah intrusion lie towards the middle or upper part of the intrusion.

If we consider that the distance between Suwar and Wadi Qutabah is ~30km and the thickness of the intrusion is >2km, with a width of ~7km (Greenough *et al.*, 2011) then the intrusion represents a surface area >210km^2 (minimum) and a volume of >420km^3(minimum). If Wadi Qutabah lies towards the central part of the intrusion, then this may be a significant underestimation of the volume of the intrusion. This implies that there remains a large part of the intrusion that is undiscovered.

The considerable size of the Suwar-Wadi Qutabah Complex ranks it among the largest known intrusions in the world. For example the Rhum Intrusion (Scotland) is 115km^2 and >2km thick, the Skaergaard Intrusion (Greenland) is 55km^2 >3.5km thick and the Stillwater Intrusion (Montana) is 440km^2 and ~7km thick (Best, 2011).

In the search for PGE mineralization, we can compare the elevation of known mineralization in other layered mafic intrusions to the possible stratigraphic position of the Wadi Qutabah intrusion. The Skaergaard intrusion (~3km thick) is host to the Platinova Reef (hosted in ilmenite-rich ferrogabbro (Nielsen *et al.*, 2005)) which lies near the Middle Zone-Upper Zone contact at ~1.5km elevation. This is stratigraphically high in the intrusion, compared to the Bushveld (total ~8-9km in thickness), where the main chromite layers and the Merensky Reef lie at ~1.5 and 2.5km in elevation (Fig. 7.2) (Nielsen *et al.*, 2005, Philpotts & Ague, 2009). If the Wadi Qutabah rocks lie towards the middle of the intrusion then the area with the highest probability of hosting Bushveld-like PGE mineralization is to the south towards Suwar, perhaps half way between the two localities. There is also potential in the rocks to the north (NNW) of Wadi Qutabah to host mineralization, similar to the Platinova Reef in the Skaergaard. In fact the An content of the Platinova Reef is ~An46 and is similar to that seen in the Wadi Qutabah section studied here.

The discovery of a compositional reversal at the top of unit 5a is likely the result of magma replenishment or injection of hot and more primitive magma into the intrusion. Magma replenishment events are common occurrences in layered mafic intrusions (Philpotts & Ague, 2009), and have been attributed to the formation of monomineralic and near monomineralic layers (Philpotts & Ague, 2009). In the Bushveld, magma injections have been modeled for the origin of the Merensky Reef and the UG2 chromitite layer, which contain significant PGE mineralization (Robb, 2005).

The large size and active replenishment of the intrusion, suggest that the Suwar-Wadi Qutabah complex is a desirable exploration target for PGE +/- Ni, Cu, Co mineralization.

7.3 Tectonic Setting

Geochemical characteristics of volcanic rocks have been used to identify and fingerprint magma source characteristics. Minerals such as augite also provide a method of discriminating magmatic affinity, since augite composition varies as a result of liquid composition (Nisbet & Pearce, 1977, Rollinson, 1993).

Nisbet & Pearce, (1977) used augite compositions to discriminate between 4 tectonic settings; within plate alkalic basalts (WPA), volcanic arc basalts (VAB), ocean floor basalts

(OFB) and within plate tholeiities (WPT). This was accomplished using variations in major element chemistry and discriminant analysis (Nisbet & Pearce, 1977). This diagram does not have a unique field where only WPT augites plot.

Wadi Qutabah augites are plotted according to Nisbet & Pearce, (1977) in Figure 7.3. Augites from the east and west samples plot within VAB/OFB and WPT/OFB fields, suggesting that they are within plate tholeiites, but it does not rule out arc magmatism. Clearly the intrusion could not have formed from an ocean floor basaltic magma. Position of the points in Figure 7.3, are similar to those for WPT from the original diagram in Nisbet & Pearce, (1977).

Caution is required when using the results from discriminant analysis. Nisbet & Pearce, (1977) noted that 38% of the VAB and 50% of WPT clinopyroxenes were misclassified. The authors obtained an average success rate of ~70% for all of the classifications, suggesting that the results are not always conclusive (Nisbet & Pearce, 1977). Other limitations of the Nisbet & Pearce diagrams are that they used a relatively small number of analyses (329) for their discriminant analysis. The within plate tholeiites (WPT) had the fewest number of analyses and the lowest number of correct assigned magma types. Perhaps, different elements are more appropriate to define tectonic setting (Leterrier *et al.*, 1982).

The ternary TiO_2-MnO-Na_2O diagram is also employed for discrimination of tectonic setting according to augite composition (Fig 7.4) (Nisbet & Pearce, 1977). Augites from the Wadi Qutabah intrusion plot in the "all" field (Fig. 7.4). This result is similar to the original results obtained by Nisbet & Pearce, (1977) for WPT. The authors noted that there is significant overlap in the diagram, but that certain magam types plot effectively within their designated fields. The WPT magmas do not have a unique field on this diagram, whereas OFB and WPA plot in more distinct areas.

Whole rock geochemical evidence presented by Greenough *et al.*, (2011) for the Suwar-Wadi Qutabah intrusion suggests that the parent magma was within plate tholeiite (WPT) of plume origin, with contributions from the Archean subcontinental lithosphere (Greenough *et al.*, 2011). Results of the discriminant analysis (Fig. 7.3) suggest that if 50% of the WPT analysis are misclassified (Nisbet & Pearce, 1977) then the magmas from which the Wadi Qutabah Intrusion crystallized are likely within plate tholeiites, which is in agreement with the conclusions of Greenough *et al.*, (2011).

Layered mafic intrusions have been attributed to a number of genetic origins. The most widely accepted is that they are associated with mantle plumes and crustal rifting. This would seem most likely due to the large volumes of magma required to form these intrusions (Bryan & Ernst, 2007, Mungall, 2005). Large igneous provinces (LIPs), and their magmatic activity are generally found in intraplate settings, away from the plate margins (Bryan & Ernst, 2007). The significant size of the Suwar-Wadi Qutabah Complex requires a productive source of mafic magma for formation. The conclusions drawn by Greenough *et al*., (2011), of a plume origin in an extensional setting would provide an ideal location for the formation of a large layered intrusion. Results of discriminant analyses of augite composition are in agreement with the within plate setting and a tholeiitic magma composition.

Based on available augite-based discrimination diagrams the augite analyses presented here are in agreement with the results from Greenough *et al.*, (2011).

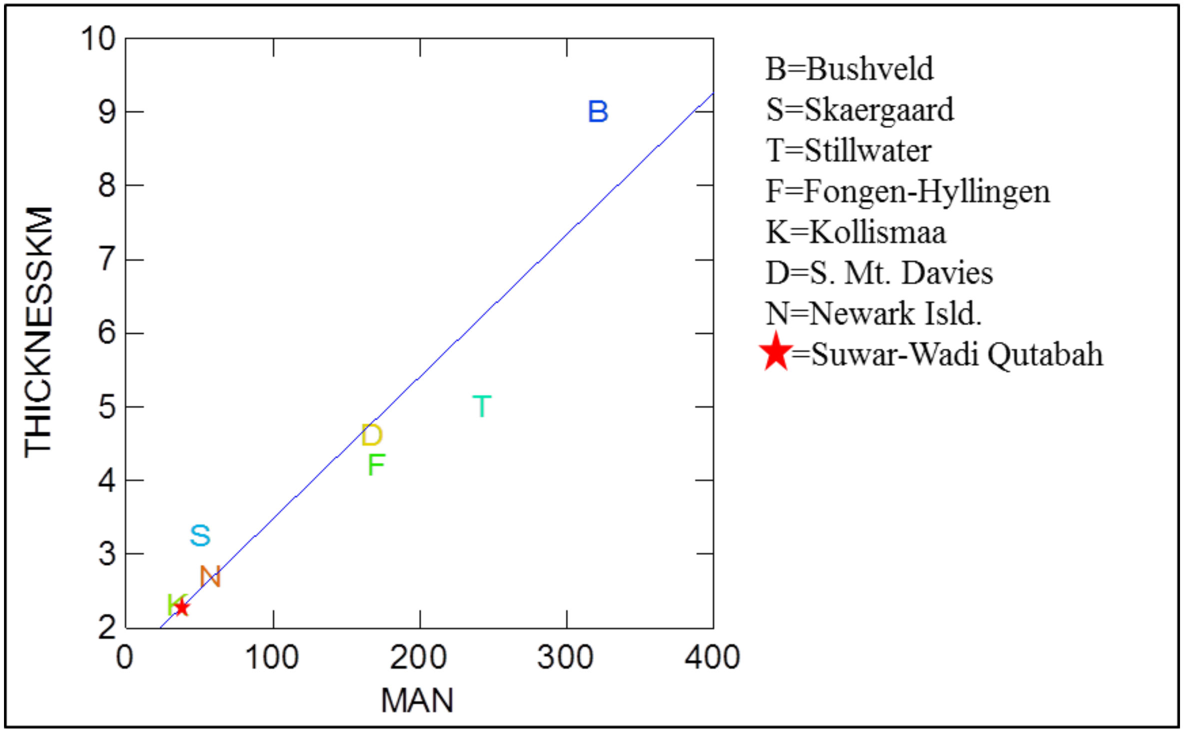


Figure 7.1. Plot of MAN (meters per 1 unit of anorthite in plagioclase) versus thickness of the intrusion (km). The regression line is indicated on the plot.

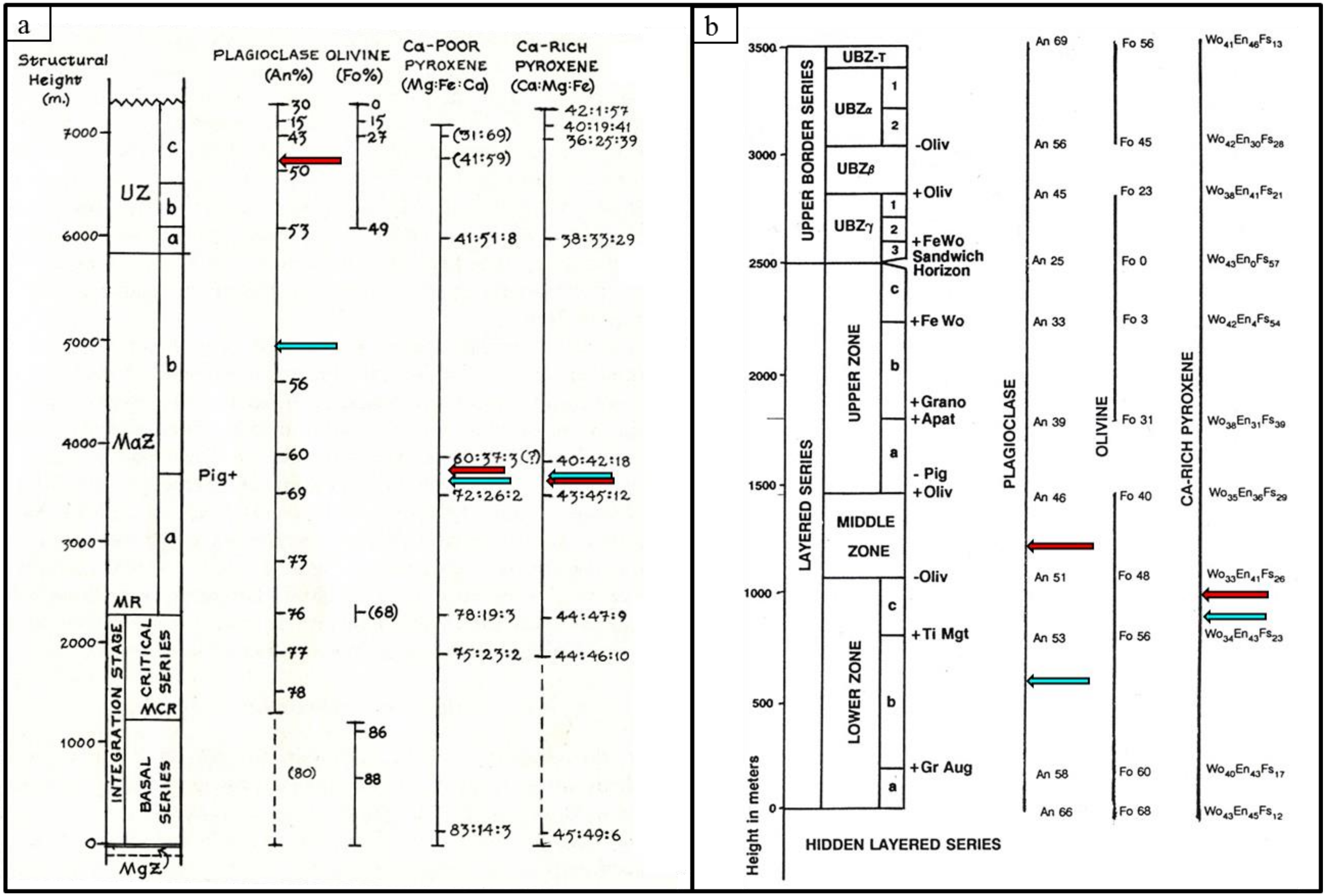

a
Structural Height (m.)
PLAGIOCLASE (An%)
OLIVINE (Fo%)
Ca-POOR PYROXENE (Mg:Fe:Ca)
Ca-RICH PYROXENE (Ca:Mg:Fe)
UZ
MaZ
MR
INTEGRATION STAGE
CRITICAL SERIES
MCR
BASAL SERIES
MgZ
Pig+
b
UPPER BORDER SERIES
UBZ-τ
UBZα
UBZβ
UBZγ
LAYERED SERIES
UPPER ZONE
MIDDLE ZONE
LOWER ZONE
HIDDEN LAYERED SERIES
Height in meters
-Oliv
+Oliv
+FeWo
Sandwich Horizon
+Fe Wo
+Grano
+Apat
- Pig
+Oliv
-Oliv
+Ti Mgt
+Gr Aug
PLAGIOCLASE
OLIVINE
CA-RICH PYROXENE

Figure 7.2. Stratigraphic sections through the Bushveld (a) (McBirney, 1984) (modified from figure 6-9, p. 193) and the Skaergaard intrusion (b) (McBirney, 1996) (modified from figure 4, p.153), showing stratigraphic positions of similar mineral compositions to the plagioclase, augite and orthopyroxenes from the lower part (red arrows) and the upper part (green arrows) of the Wadi Qutabah Intrusion.

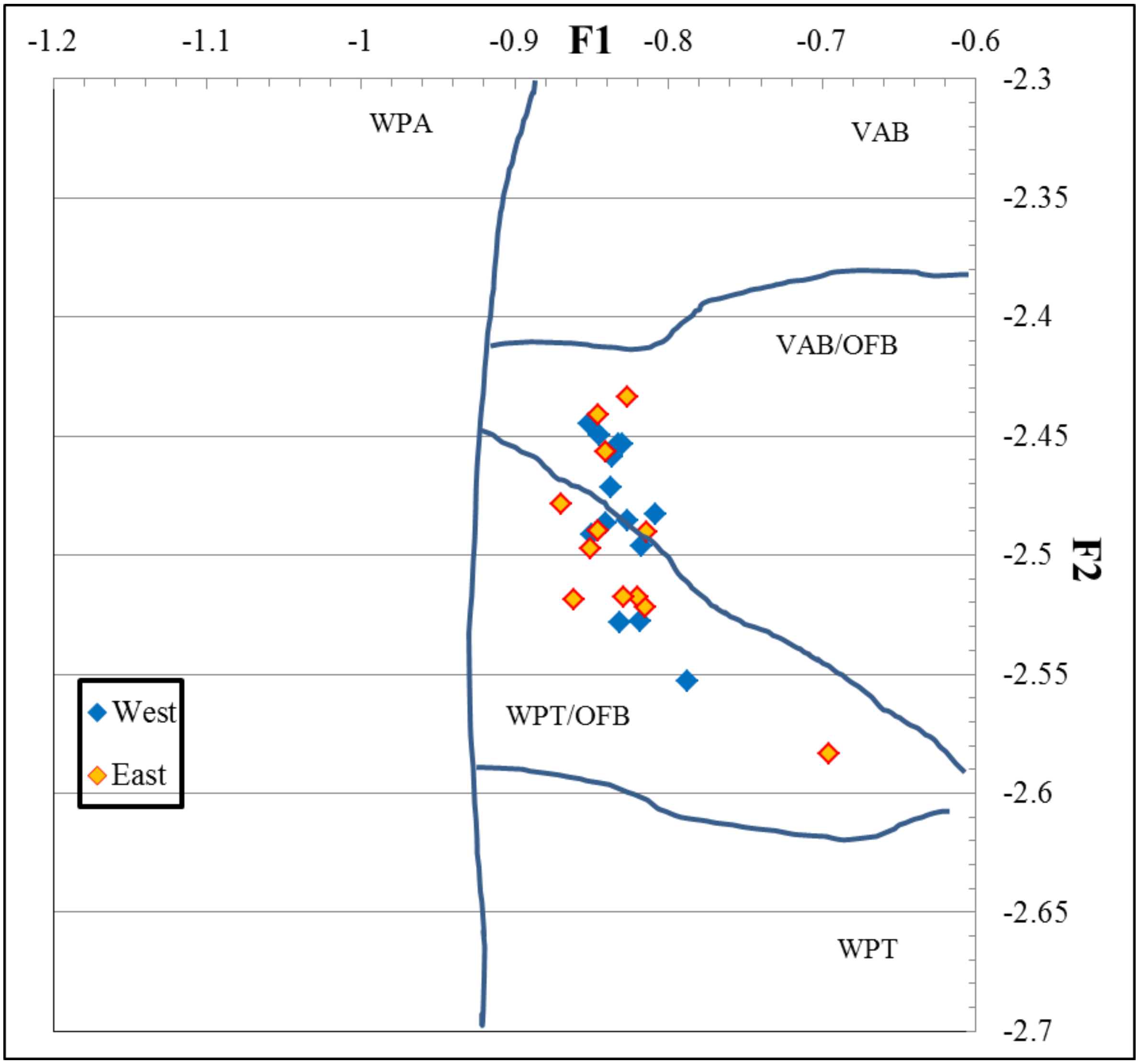


Figure 7.3. Plot of discriminant functions F1 vs. F2 of augite composition according to (Nisbet & Pearce, 1977) to determine magma types: within plate alkalic basalts (WPA), volcanic arc basalts (VAB), ocean floor basalts(OFB) and within plate tholeiitic basalts (WPT). Lines are hand drawn by eye according to the divisions created by Nisbet & Pearce, (1977).

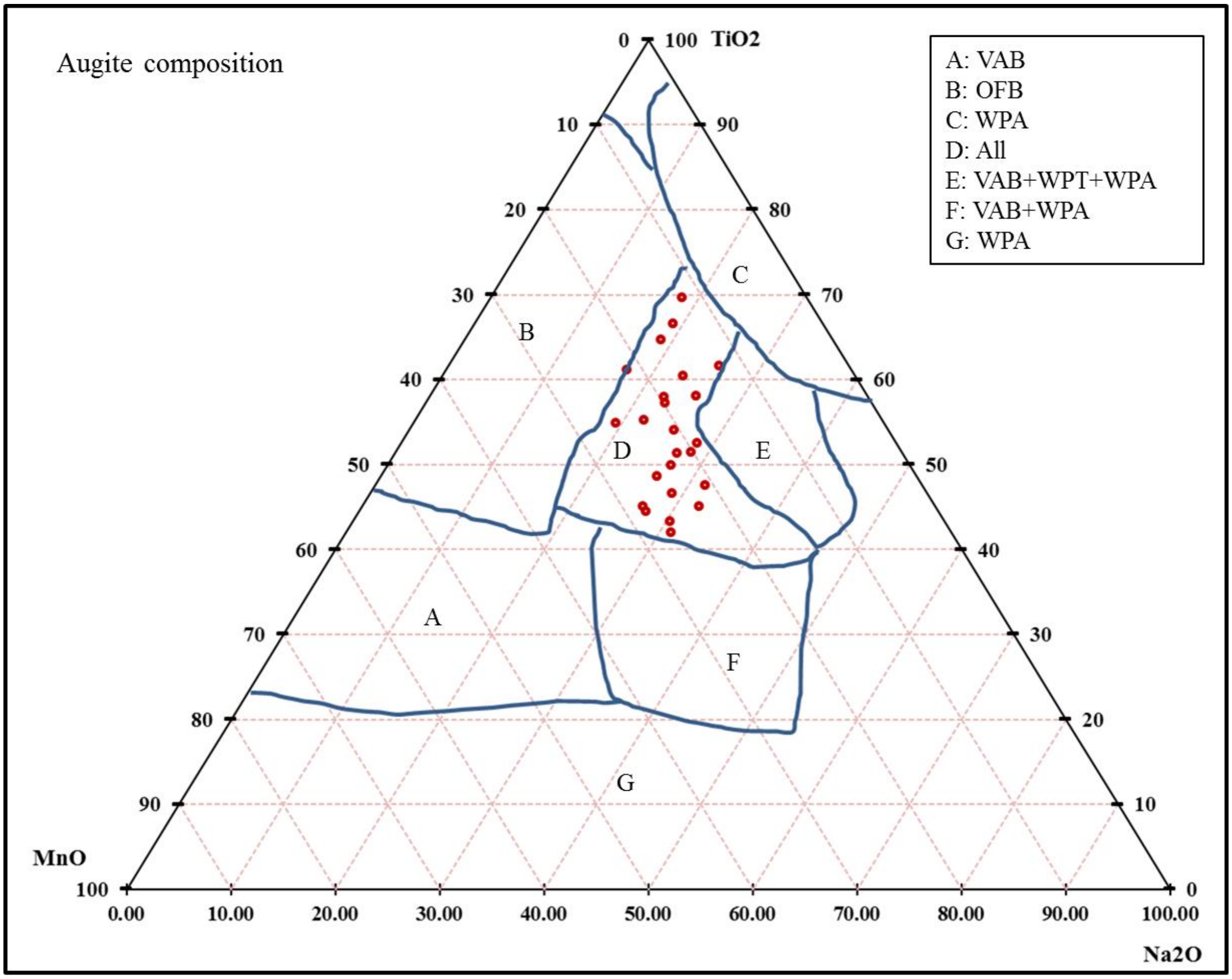


Figure 7.4. Ternary diagram TiO_2-MnO-Na_2O for discrimination of magma type by augite composition (Nisbet & Pearce, 1977).

Chapter 8.0 Conclusions

Drill cores from the Wadi Qutabah layered mafic intrusion correlate on a broad scale between drill holes and represent a thickness of ~500m in the intrusion. Layering appears to be laterally extensive, but varies in thickness and is most commonly modal and phase type layering, with unconfirmed cyclical layering.

Mineralogy shows a general trend towards a more evolved composition with stratigraphic height, but the major element mineral chemistry indicates a trend towards more primitive compositions above unit 5a, with stratigraphic height. This led to the conclusion that the intrusion experienced a magma recharge event after formation of unit 5a, with sufficient mixing or stratification to modify the composition of the crystallizing phases.

Discriminant analysis diagrams using augite compositions suggests that the magmas from which the Wadi Qutabah rocks crystallized was a within plate tholeiite. These results are in agreement with the conclusions of Greenough *et al.*, (2011), who determined a within plate plume origin in an extensional regime for the formation of the Suwar-Wadi Qutabah Complex (Greenough *et al.*, 2011).

When compared to other layered mafic intrusions, the stratigraphic position of Wadi Qutabah rocks lies towards the centre or middle of the intrusion, and has a thickness of >2km. Stratigraphic position is of interrest in the search for PGE mineralization, since economic PGE mineralization in other large intrusions is generally located in the lower 1/3 to 1/2 of most intrusions. Stratigraphic position of the Wadi Qutabah rocks suggests that there are multiple areas of interest in the search for PGE mineralization. These areas lie: 1) close to half-way between Suwar and Wadi Qutabah, and 2) just to the north of Wadi Qutabah.

Results of this study contribute to the overall knowledge of the Wadi Qutabah layered mafic intrusion and the Suwar-Wadi Qutabah Complex. The broad scale correlation of the stratigraphy provides a foundation for future exploration, drilling, mapping, geophysics and academic research. The major element mineral geochemistry suggests that the Complex experienced a magma recharge event, leading to the crystallization of more primitive mineral compositions above unit 5a.

The goal of this study was create a broad correlation of the stratigraphy, descriptions of the geology, petrography and examination of the major element geochemistry of the Wadi Qutabah intrusion. There are a number of questions that remain unanswered such as: 1) where is the PGE mineralization, 2) significance of the fine grained layers and plagioclase rich layers, 3) are there multiple magma recharge events?, 4) is there cyclical layering, 5) what is in the area between Hp-07 and Hp-09, 6) significance of the faults and direction of movement, etc.

The Wadi Qutabah-Suwar Complex offers many opportunities to advance our limited understanding of the region and of this newly discovered large layered mafic complex. Future studies or work on this intrusion will add to the body of knowledge on layered mafic intrusions, contribute to the limited information available on the region, and may lead to the discovery of a world class economic mineral deposit.

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Appendices

Appendix A. Petrography of the Wadi Qutabah Samples

A.1 Petrographic Thin Section Descriptions

The descriptions are grouped according to their designated unit codes.

A.1.1 Unit 1a

This unit also includes samples FX847932, FX847935 and YEMWQ1. Samples descriptions are provided in Greenough, *et al* (2011).

A.1.1.1 Hole ID: Hp-07 Sample#: 00836-01

From (m): 27.77, **To** (m): 27.82

Rock type: Cpx (augite) Norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene, hornblende, biotite, rutile, ilmenite, pyrrhotite, chalcopyrite, opaques (unknown composition), chlorite, calcite, sericite, apatite, pentlandite

Main description: This cumulate sample is orthopyroxene rich. The orthopyroxenes are granular to elongate and are subhedral to anhedral, cumulus crystals, and are locally host to minor exsolution. The plagioclase is also a cumulus and locally intercumulus phase. Some of the plagioclase laths are enclosed by a series of chains of pyroxenes (ophitic to subophitic). These phases appear to have crystallized at approximately the same time. Locally, large intercumulus, poikilitic augite enclose plagioclase and orthopyroxenes (ophitic). The chains of pyroxenes form a weak fabric. A weak lineation of the pyroxenes along with the plagioclase crystals, are parallel to layering. The sulphides and oxides are also intercumulus phases. The crystals are anhedral and occupy the intercumulus space (between pyroxenes and locally pyroxenes and plagioclase). The most dominant of the opaques is pyrrhotite, but the largest opaque crystals are the ilmenite. There is a weak carbonate alteration that is exploiting fractures and contacts. Biotite, chlorite and hornblende are generally associated with the carbonate alteration. The contacts between the crystals are sharp, to angular, irregular, and smooth. The arrangement of crystals and the nature of their contacts suggest that this sample is texturally unequilibrated to locally partially equilibrated.

Plagioclase: Cumulus and minor intercumulus phase, anhedral to locally euhedral crystals and laths, weak lineation parallel to layering, weak carbonate alteration and locally trace sericite alteration, rare poikilitically enclosed crystals (ophitic), to locally subophitic. The plagioclase in this sample contains very few of the acicular needles that have been so abundant in the other samples from holes H-01 to H-06. Crystal up to 4mm in length, but most are ~2mm. (~50-55%)

Orthopyroxene: Granular to elongate cumulate crystals, which locally form chains and are parallel to the layering. Crystals are anhedral to subhedral, up to 4mm in length, but most are 1mm in length. Typically host to thin exsolution lamellae of Fe-Ti-oxides, and locally exsolution of what appears to be augite (too small to resolve). Crystals are typically cut by numerous fractures, and are locally have thin rims of hornblende +/- biotite. Replacement by hornblende is locally present. (~30%)

Clinopyroxene (augite): Large intercumulus, poikilitic crystals, host to plagioclase and orthopyroxene crystals. Large poikilitic crystal >5mm in length. (~10-15%)

Hornblende: Hornblende may be both an intercumulus and late phase. Hornblende is present as alteration of the pyroxenes (uralitization), thin rims of the pyroxenes, exploiting fractures and is most abundant where the carbonate alteration is most intense. Secondary phase? (~2-3%)

Biotite: Alteration phase, associated with the hornblende and the carbonate alteration, irregular distribution, fibrous crystals up to 0.5mm in length. (<1-1%)

Chlorite: Associated with the carbonate alteration, thin fibrous crystals as alteration of the mafic phases. Minor phase (<1%)

Calcite : Main alteration phase of the plagioclase, secondary mineral, exploiting fractures, crystal contacts and defects, irregular distribution. (~2%)

Sericite: Minor alteration phase of the plagioclase, exploiting fractures and contacts to infiltrate the sample. Fine grained crystals. (tr)

Apatite: Rare acicular, euhedral crystals, up to 0.06mm in length, generally hosted in the plagioclase. (tr)

Rutile: Minor phase that is locally present with the ilmenite (ilmenite breaking down to form rutile/ leucoxene?). (tr)

Ilmenite: Intercumulus phase, anhedral, sharp but smooth contacts, typically fractured, crystals up to 2mm in length, but most are much smaller. (<1%)

Pyrrhotite: Intercumulus phase, anhedral, crystals up to 0.5mm in length, contacts are sharp but weakly jagged, weakly pitted and locally hosts thin exsolution of pentlandite? Generally adjacent to chalcopyrite and they share mutual grain boundaries. (1%)

Chalcopyrite: Associated with the pyrrhotite, and present as an intercumulus phase. (tr)

Opaques (unknown Composition): Minor phase, generally associated with the oxide and sulphides phases, typically surrounding or adjacent to those grains. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

A.1.1.2 Hole ID: Hp-07 Sample#: 00839-01

From (m): 51.02, **To** (m): 51.07

Rock type: Hornblende Augite Norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene, hornblende (+/- actinolite), biotite, calcite, chlorite (+/- serpentine), ilmenite, Pyrrhotite, chalcopyrite, (opaques unknown composition)

Main description: Allotriomorphic to hypidiomorphic, medium grained norite. The plagioclase is primarily a cumulus phase and forms the main framework of the sample along with cumulus orthopyroxene. Locally large poikilitic augite encloses plagioclase and orthopyroxenes (ophitic to subophitic texture). The plagioclase crystals are subhedral to anhedral, some are lath shaped, but do not show a clearly defined orientation. The pyroxenes are granular to elongate, subhedral to anhedral to poikilitic (ophitic).The orthopyroxenes are a cumulus phase and the augite is an intercumulus phase. The contacts between the crystals are sharp but irregular. There are a number of fractures that cut the rock; these appear to be sources of altering fluids. Carbonate alteration appears to be exploiting the fractures, as well as the crystal boundaries to infiltrate the sample. Alteration minerals such as chlorite and biotite as well as the presence of hornblende are most abundant in proximity to these fractures. Locally sulphides (Po) also fill these fractures suggesting that some of the sulphides have been remobilized or are secondary phases. The primary pyroxenes are rimmed or show a coronal texture by hornblende +/- actinolite +/- biotite, which are no longer restricted to the primary crystal boundaries and locally form crystals entering into the plagioclase. Majority of the pyroxenes are fractured, these fractures are locally sources of ingress of alteration in the pyroxenes. There is minor exsolution of augite seen in the orthopyroxenes locally. The opaque phases appear to be intercumulus, and ilmenite forms large crystals, whereas pyrrhotite typically forms small clusters of crystals. The contacts between the crystals are sharp, to angular, irregular, and smooth. The arrangement of crystals and the nature of their contacts suggest that this sample is texturally unequilibrated to locally partially equilibrated. The presence of bent or kinked crystals would suggest that this sample has undergone some densification and compaction.

Plagioclase: Cumulus phase, anhedral to locally euhedral crystals and laths, no clearly defined orientation to the crystals. Weak carbonate alteration locally, rare poikilitically enclosed crystals (ophitic texture), plagioclase in this sample contains fewer of the acicular needles that have been so abundant in the other samples from holes H-01 to H-06. Plagioclase crystals reach up to 6mm in length, but most are ~3mm. A small number of crystals are kinked, and some are cut by the fractures. There is minor intercumulus plagioclase present. (35-45%)

Orthopyroxene: Granular to elongate crystals that are anhedral to subhedral, up to 4mm in length, but most are 1-2mm in length. Typically host to thin exsolution lamellae of Fe-Ti-oxides, and locally exsolution of what appears to be augite (too small to resolve composition). Crystals are cut by numerous fractures, and are locally have thin rims (coronal texture) of hornblende +/- biotite. Replacement/overprinting by hornblende is locally present (uralitization), which is most abundant in proximity to the fractures (sources of altering fluids).

Clinopyroxene (augite): Large poikilitic intercumulus crystals and locally present as exsolution in the orthopyroxenes. Large poikilitic crystal >8mm in length that encloses orthopyroxenes, and plagioclase laths (ophitic texture). Typically cut by numerous fractures, locally being altered by hornblende +/- actinolite and biotite+/- carbonate. This is generally most intense in proximity to the fractures.

Hornblende: Alteration of the pyroxenes, thin rims (coronal texture), exploiting fractures, and present within the pyroxenes. Hornblende is most abundant where the alteration is most intense, in proximity to the fractures. What appear to be intercumulus crystals of hornblende are also present, anhedral (rare). (5-7%)

Actinolite: Minor phase, associated with the hornblende, alteration of the pyroxenes, fibrous needles.

Biotite: Alteration phase, associated with the hornblende, and the carbonate alteration, irregular distribution, up to 0.8mm in length. Typically present as fibrous, anhedral to subhedral crystals. (2-3%)

Serpentine: May not be present, difficult to distinguish from the chlorite (fine grained). (tr)

Chlorite: Associated with the carbonate and biotite alteration, thin fibrous radiating crystals, alteration of the mafic phases. Minor phase (<1%)

Calcite: Present as alteration of the plagioclase, secondary mineral, exploiting fractures, crystal contacts and crystal defects, irregular distribution. Fine grained aggregates, small crystals and fracture fill. (~2%)

Ilmenite: Intercumulus phase, anhedral, sharp but smooth irregular contacts, typically fractured, crystals up to 2.6mm in length. Also present as elongate exsolution lamellae within the pyroxenes. (~1%)

Pyrrhotite: Intercumulus phase, anhedral, crystals up to 1.6mm in length, contacts are sharp but weakly jagged, weakly pitted and typically fractured. Present as intercumulus phase and as fracture fill, suggesting that either it is remobilized or is a secondary phase. Locally host to chalcopyrite blebs (trapped in the pyrrhotite). (1%)

Chalcopyrite: Rare bleb that is trapped in the pyrrhotite. (tr)

Opaques (unknown Composition): Minor phase, associated with the oxide and sulphide phases, typically surrounding or partially surrounding the crystals present, fracture fill also with the pyrrhotite. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

A.1.1.3 Hole ID: Hp-07 Sample#: 00840-01

From (m): 69.4, **To** (m): 69.45

Rock type: Leuco Cpx (augite) Norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene, hornblende, biotite, calcite, sericite, ilmenite, pyrrhotite, chalcopyrite, apatite, and opaques of unknown composition

Main description: Similar to sample 839-01. (Compared to 00839-01 this sample has a lineation, and there are more intercumulus phases, the primary crystals appear to be plagioclase + orthopyroxene and there is a secondary growth crystallizing from the intercumulus liquid of Cpx, hornblende, ilmenite and pyrrhotite. This sample is medium grained.) The cumulus orthopyroxenes are granular to elongate and then generally surrounded by poikilitic augite (+/- hornblende due to alteration) crystallizing from the intercumulus liquid. The orthopyroxenes are subhedral to anhedral. The cumulus plagioclase crystals are subhedral to anhedral, some are lath shaped (subhedral to euhedral), and weakly show a defined orientation (weak lineation). The contacts between the crystals are sharp but irregular to rounded. Most of the orthopyroxenes are rimmed (coronal texture), alteration is weak, but increases from weak to moderate locally in proximity to fractures which appear to be sources of carbonate bearing fluids. Calcite +/- sericite alteration is weak and most abundant in the plagioclase, exploiting fractures and crystal contacts and boundaries. Hornblende appears to be both an intercumulus an alteration phase. Crystallization of hornblende may be due to prolonged crystallization or alteration associated with the carbonate, sericite and biotite. (This sample shows some similarities to 00839-01, but this sample has weaker alteration intensity) The contacts between the crystals are sharp, to angular, irregular, and smooth to locally serrated. The arrangement of crystals and the nature of their contacts suggest that this sample is texturally unequilibrated to locally partially equilibrated. The presence of bent or kinked crystals would suggest that this sample has undergone some densification and compaction.

Plagioclase: Primary cumulus phase, forms the main framework of the sample, crystals are anhedral to locally euhedral to lath shaped, weakly defined lineation, weak carbonate +/- sericite alteration locally, rare poikilitically enclosed crystals (ophitic texture). Host to many acicular needles. Crystal up to 5mm in length, but most are ~2-3mm. A small number of crystals are kinked, and some are cut by the fractures. Contacts between the crystals are sharp but irregular and locally are almost rounded. There appears to be a minor quantity of intercumulus plagioclase present locally. (50-55%)

Orthopyroxene: Granular to elongate crystals that are anhedral to subhedral and up to 4mm in length, but most are 1-2mm in length. Typically host to thin exsolution lamellae of Fe-Ti-oxides, and locally exsolution of what appears to be augite+/-pigeonite? (too small to resolve). Crystals are typically cut by numerous fractures, and locally have thin rims (coronal texture) of +/-Cpx +/- hbld+/- biotite.

Clinopyroxene (augite): Large poikilitic crystals present, intercumulus phase and present as exsolution in the orthopyroxene. Poikilitic augite locally encompasses other orthopyroxenes and plagioclase (ophitic texture). Generally cut by numerous fractures. Locally weak alteration of the augite by hornblende +/- biotite.

Hornblende: Present as and intercumulus phase, and as replacement/alteration/overprinting of the pyroxenes, thin rims (coronal texture), exploiting fractures, and present as crystals. Typically brownish in colour, but locally green hornblende (ppl). Locally weakly biotite altered. (~5%)

Biotite: Late alteration phase, associated with the hornblende and carbonate alteration, irregular distribution, up to 1.2mm in length. The crystals are generally fibrous and anhedral to subhedral, are reddish brown in colour and highly pleochroic under plane polarized light. Locally associated with the ilmenite. (~1%)

Calcite: Main alteration phase of the plagioclase, secondary mineral, exploiting fractures, crystal contacts and crystal defects, irregular distribution. Fine grained aggregates, small crystals and fracture fill. (1%)

Apatite: Minor accessory phase. (tr)

Ilmenite: Intercumulus phase, anhedral, sharp but smooth irregular contacts, typically fractured, crystals up to 2.5mm in length. Also present as elongate exsolution lamellae within the pyroxenes. (<1%)

Pyrrhotite: Intercumulus phase, anhedral, crystals up to 4mm in length, contacts are sharp but weakly jagged, typically fractured. Locally host to chalcopyrite blebs (trapped in the pyrrhotite) along the margins of the pyrrhotite, but some of the blebs are contained within the pyrrhotite crystals. Pyrrhotite is also present as fracture fill, suggesting that there has been some remobilization or that there may be a secondary emplacement associated with the formation of the fractures. (2-3%)

Chalcopyrite: Blebs of chalcopyrite are associated with the pyrrhotite and share mutual boundaries. Blebs are anhedral and reach up to 0.4mm in length, also present as fracture fill, suggesting that there is either remobilization or a secondary emplacement of chalcopyrite. (tr)

Opaques (unknown Composition): Minor phase, generally associated with the oxide and sulphides phases, typically surrounding or partially surrounding the crystals present. Composition of these opaque phases is unknown (do not reflect light and are opaque under ppl and xpl). Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

A.1.1.4 Hole ID: Hp-10 Sample#: 00876-01

From (m): 35.42, **To** (m): 35.47

Rock type: Cpx Hbld Norite

Minerals Present: Plagioclase, orthopyroxenes, clinopyroxene (augite), hornblende, biotite, calcite, sericite, chlorite, pyrrhotite, ilmenite, chalcopyrite and opaques of unknown composition, pentlandite

Main description: Allotriomorphic to hypidiomorphic medium grained norite. The plagioclase forms the main framework of the sample, and is weakly lineated parallel to the layering. The crystals are rare euhedral to subhedral to anhedral and some are lath shaped. There is a significant variation in crystal size of the plagioclase crystals. The orthopyroxenes are granular to elongate and the augite is anhedral and locally poikilitic. The pyroxenes are typically rimmed by hornblende. There is a weak carbonate and sericite alteration that is exploiting fractures and contacts to infiltrate the sample. There is a weak biotite alteration of the mafic phases. Minor oxide (ilmenite) and sulphides (pyrrhotite, chalcopyrite) are intercumulus phases. Cumulate sample, heteradcumulate locally. The contacts between grains are sharp, smooth to irregular. Packing of the minerals would suggest that there has been some densification, and likely compaction. The presence of bent and kinked crystals would support that statement. The sample exhibits a partially equilibrated textural geometry.

Plagioclase: Plagioclase is a cumulus phase, and there is minor intercumulus plagioclase. Crystals are subhedral to anhedral (rare euhedral), some are lath shaped. There is a weak lineation of the plagioclase crystals parallel to layering. Crystals range in size up to 7mm in length, but most are 2-3mm in length. Contacts are sharp, but irregular to rounded. The plagioclase crystals form the main framework of the sample. Locally extinction of the crystals is irregular, and some of the crystals are bent or kinked. Plagioclase is the most abundant phase of this sample. (~60-65%)

Orthopyroxene: Cumulus phase that is comprised of granular to slightly elongate crystals, that are anhedral to subhedral to rarely euhedral. There is a weak carbonatization and weak uralitization of the pyroxenes locally. Orthopyroxene crystals are typically fractured and are locally host to partial rims of hornblende. The crystals are typically 1-2mm in length. (Main cumulus mafic phase) (~15-20%)

Clinopyroxene (augite): Cpx is locally present as an intercumulus poikilitic phase, enclosing orthopyroxene crystals and rarely plagioclase. The augite is typically fractured and locally hosts partial rims of hornblende. The intercumulus crystals reach up to 4mm in length. (~5-10%)

Hornblende: Hornblende may be both an intercumulus and alteration phase. Present as rims, and locally as crystals. Hornblende is present as alteration/replacement of the pyroxenes (uralitization) and is most abundant where the alteration is most intense (carbonate and sericite). Rare crystals reaching up to 0.8mm in length. (~5-8%)

Biotite: Fibrous crystals that are subhedral to anhedral, reddish-brown and highly pleochroic under ppl. Found typically in proximity to the oxides/sulphide phases, and hornblende. Crystals reaching up to 0.8mm in length locally present. Also present as elongate fibrous crystals that appear to grow outwards from the mafic phases into the plagioclase. (<1-1%)

Chlorite: Minor alteration phase associated with the carbonate alteration. Found as fracture fill, and locally as small patches of fibrous crystals adjacent to the mafics or hosted in the plagioclase. (<1% -tr)

Calcite: Main alteration phase, exploiting fractures, crystal contacts and boundaries. Patchy alteration, overall a weak intensity alteration. Minor pods of calcite crystals, but also present as fracture fill. (~1-2%)

Sericite: Weak sericitization of the plagioclase. Associated with the carbonate alteration, locally small fibrous crystals present. Patchy and irregular distribution of the alteration. (<1-1%)

Ilmenite: Anhedral intercumulus phase, crystals reaching up to 2.1mm in length. Contacts are sharp, and irregular. Locally shares mutual grain boundaries with pyrrhotite. (1-3%)

Pyrrhotite: Main sulphide phase, intercumulus, sharp contacts that are irregular to jagged, weakly pitted and fractured. Poikilitic (chalcopyrite), host to minor exsolution of what appears to be pentlandite? (The crystals are too small to resolve the composition). Crystals reaching up to 3mm in length. (~3-5%)

Chalcopyrite: Anhedral blebs and poikilitically enclosed blebs. Found in association with pyrrhotite. They share mutual grain boundaries. The chalcopyrite crystals reach up to 0.3mm in length. (tr-<1%)

Pentlandite: Exsolution from pyrrhotite? (tr)

Opaques (unknown Composition): Present adjacent to or in close proximity to the oxide and sulphide phases. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.2 Unit 1ab

A.1.2.1 Hole ID: Hp-07 Sample#: 00842-01

From (m): 87.64, **To** (m): 87.69

Rock type: Leuco Hornblende Gabbro

Minerals Present: Plagioclase, clinopyroxene, orthopyroxene, hornblende, actinolite, chlorite, calcite, sericite, ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition, quartz, pentlandite

Main description: Allotriomorphic to hypidiomorphic, medium to coarse grained leuco gabbro. Somewhat similar to 840-01 but is host to fewer orthopyroxenes and increased augite. This sample is cut by numerous fractures. There is a weak to moderate carbonate alteration. The carbonates are exploiting fractures, crystal contacts, boundaries and crystal defects. Chlorite is also a common alteration mineral in this sample and typically fills fractures in the plagioclase. A thin veinlet of quartz+ carbonate is also present, with alteration most intense in proximity to this veinlet. There is a very weak lineation of the plagioclase laths, which make up the main cumulate framework. The plagioclase crystals vary in size with some reaching >8mm in length. The cumulate orthopyroxenes (rare) appears as relics only, and intercumulus augite are typically altered or rimmed by amphiboles. Augite is the more abundant of the pyroxenes, and is locally host to Fe-Ti oxide exsolution. The oxides and sulphides are also intercumulus phases, and are typically rimmed by +/- chlorite+/- hornblende. The packing arrangement of the crystals would suggest that the sample has undergone densification and compaction, and the presence of kinked or bent plagioclase crystals is evidence of that. The contacts between the grains are sharp, smooth and irregular. This sample demonstrates a partially equilibrated geometry and densified crystal packing. The crystals likely underwent adcumulus growth or overgrowth to reduce the pore space and produce the arrangement seen today.

Plagioclase: Cumulus phase, anhedral to subhedral to rarely euhedral crystals and laths, weakly defined orientation (weak lineation of the crystals). Patchy weak to moderate carbonate +/-sericite alteration, rare poikilitically enclosed crystals. Host to many acicular needles (unknown composition). Plagioclase crystals vary in size with some >8mm in length, but most are ~4mm. A small number of crystals are kinked or bent suggesting compaction?, and some are cut by fractures. Contacts between the crystals are sharp but irregular and locally are almost rounded. Fracturing of the plagioclase is common with chlorite locally filling those fractures+/-carbonate. There appears to be a very minor amount of intercumulus plagioclase locally. These form anhedral crystals between the larger cumulus plagioclase crystals. (50-55%)

Orthopyroxene: Rare relic crystals, moderate to strongly altered by carbonate and amphiboles, and are typically surrounded by hornblende (uralitization). Most of the primary orthopyroxenes has been replaced by amphiboles. Crystals reach up to 3mm (that are still recognizable) in length, and exsolution textures of Fe-Ti oxides are still visible. (<1 to 1%)

Clinopyroxene (augite): Relic crystals that are locally weak to moderately altered, generally only the cores of crystals remain, with coronal textures of hornblende. These appear to have been intercumulus phases and are anhedral, but some of the primary textures are still visible. Locally host to Fe-Ti oxide exsolution lamellae. Augite crystals reach up to 4mm in length. (5%)

Hornblende: Main mafic phase, replacement/ alteration/ overprinting of the pyroxenes (uralitization), and locally as rims surrounding the remaining crystals. Locally poikilitic (replacement of poikilitic pyroxenes). (~15%)

Actinolite: Very fine, fibrous amphiboles, associated with the hornblende. Replacing/altering the pyroxenes.

Chlorite: Common alteration phase, fibrous crystals that fill fractures in the plagioclase and are present as alteration of the hornblende. Crystals up to 0.2mm in length. (5%)

Calcite: Main alteration phase of the plagioclase, secondary mineral, exploiting fractures, crystal contacts and crystal defects, irregular distribution. Fine grained aggregates, small crystals and fracture fill. Also present as fill in the quartz-carbonate veinlets. (3-5%)

Quartz: Anhedral crystals, sharp contacts, late phase associated with carbonate as part of a thin quartz-carbonate veinlet and fracture fill. (tr)

Ilmenite: Intercumulus phase, anhedral, locally the ilmenite is breaking down to form other opaque phases (rutile). Locally host to small blebs of pyrrhotite. Contacts are sharp to irregular, attributed to the decomposition of the crystals along fractures and contacts. Crystals reach up to 2.7mm in length. (2%)

Pyrrhotite: Intercumulus phase, anhedral, crystals up to 2.7mm in length, contacts are sharp but weakly jagged, typically fractured. Locally host to chalcopyrite blebs (trapped in the pyrrhotite) along the margins of the pyrrhotite, but some of the blebs are contained within the pyrrhotite. Pyrrhotite is also host to exsolution of another sulphide phase (pentlandite) that look like small flame like structures along the margins of the crystals. The pyrrhotite and chalcopyrite are present in close proximity to the quartz-carbonate veinlets, and are surrounded by silicates and carbonates, suggesting that these may be secondary phases. There are also long thin crystals present within the pyroxenes, that are generally surrounded by other opaque phases of unknown composition. (1%)

Chalcopyrite: Blebs of chalcopyrite are associated with the pyrrhotite and share mutual boundaries, blebs are anhedral and reach up to 0.2mm in length. (tr)

Pentlandite: Pentlandite is present only as exsolution in the pyrrhotite, and appear as small flame like structures along the margins of the crystals. (tr)

Opaques (unknown Composition): Opaque phases present in the pyroxenes, generally associated with the pyrrhotite. Some of these may also be the product of replacement of one mafic phase for another (leaving some excess Fe or Mg, etc.) Some are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

Brown Mineral: Alteration at the cores of the mafic phases is locally composed of a brownish coloured semi-opaque phase, and is locally associated with actinolite and chlorite. Alteration similar to this is seen in 00922-01 as well. Composition is uncertain. (~1%)

A.1.2.2 Hole ID: Hp-08 Sample#: 00843-01

From (m): 20.1, **To** (m): 20.15

Rock type: Leuco Hornblende Gabbro

Minerals Present: Plagioclase, orthopyroxene, augite (cpx), hornblende, biotite, calcite, actinolite, ilmenite, pyrrhotite, chalcopyrite, pyrite, opaques of unknown composition, and a brownish coloured mineral that appears to be an alteration product of the mafics (perhaps a carbonate?), apatite, pentlandite, and zircon

Main description: Similar to 00842-01 but this sample contains more cumulate orthopyroxene and less intercumulus augite, and is also similar to 840-01. Plagioclase forms the main framework of this sample along with what were cumulate orthopyroxenes that are granular in texture. Intercumulus phases of augite + ilmenite are also present. The amphiboles appear to be a later phase since they overprint/replace the pyroxenes (uralitization) and are present as rims of the mafic crystals. These rims are no longer restricted to the primary crystal boundaries and have grown into the plagioclase. Accessory phases of apatite and zircon are also present and can typically be found intercumulus to the plagioclase. The carbonate alteration is a later phase, is weak, and appears to have infiltrated the sample along contacts, boundaries and fractures.

The packing arrangement of the crystals would suggest that the sample has undergone densification and compaction. The contacts between the grains are sharp, smooth and irregular. This sample demonstrates a partially equilibrated geometry and densified crystal packing. The crystals likely underwent adcumulus growth or overgrowth to reduce the pore space and produce the arrangement seen today. Alteration is locally skewing the contacts.

Plagioclase: The plagioclase crystals are >8mm in length locally, but there is significant variation in crystal size from <1mm to >8mm with most being ~ 4mm in length. The cumulus crystals are subhedral to anhedral and typically show sharp to irregular contacts. These contacts are locally hosts to carbonate alteration. The plagioclase crystals are locally host to many acicular needles that locally show a weak lineation within each of the crystals. The plagioclase crystals form the main framework for the cumulate, and are locally poikilitically enclosed within the pyroxenes/amphiboles. There also appears to be minor intercumulus plagioclase locally. (An 50-60) (>50%)

Orthopyroxene: There are very few primary cumulate crystals that remain. What remains are the cores of the pyroxene alteromorphs. These are generally fractured and altered. The boundaries of the original cumulate crystals are still familiar (granular to slightly elongate), but are now largely replaced/overprinted by amphiboles. Exsolution lamellae of Fe and Fe-Ti oxides are locally still visible (forming a linear pattern in the samples.)

Clinopyroxene (augite): The augite is an intercumulus phase that is largely replaced/overprinted by amphiboles. The intercumulus augite is poikilitic hosting crystals of orthopyroxene and plagioclase (ophitic texture).

Hornblende: Hornblende is present as anhedral to subhedral crystals, as replacement or overprinting the pyroxenes and also as rims. The rims locally have a granular texture and the crystals are not confined to the primary crystal boundaries, so that granular subhedral crystals of hornblende are growing in to the plagioclase. Typically green to brownish in colour under ppl (pleochroic). They are locally poikilitic, and are most abundant in proximity to the most intense carbonate alteration. Fe-Ti oxide exsolution lamellae are visible locally in the overprinted/replaced pyroxenes by the hornblende. Generally associated with pyroxenes, biotite, actinolite and carbonate alteration. (~10%)

Actinolite: Generally associated with the pyroxenes, hornblende and biotite, typically forming clusters of fibrous crystals that locally penetrate into the plagioclase. Crystals are present at multiple orientations and look almost wispy to feathery in texture. Generally, colourless to very pale green in colour under plane polarized light. (~5%)

Biotite: Alteration associated with the carbonate alteration +/- hornblende and is generally found as clusters of fibrous anhedral to subhedral crystals. These may have Fe-Ti-oxides+/- sulphides along their margins. Locally found as alteration of the pyroxenes/mafic minerals. (~1-3%)

Calcite: Alteration phase locally found exploiting fractures, crystal boundaries and contacts. Generally fine grained anhedral crystals, and rarely as small pockets of calcite. Alteration appears to affect the mafic phases more readily.

Sericite: Minor alteration phase of the plagioclase. Fine grained crystals and dustings associated with the carbonate. (tr)

Apatite: Accessory phase. The crystals are subhedral to euhedral and are disseminated, but most are found in the plagioclase. (tr)

Rutile: Rare accessory phase, subhedral crystals up to 0.075mm in length. (tr)

Ilmenite: Ilmenite is the most abundant of the opaque phases. Anhedral crystals, intercumulus phase, sharp contacts that are almost rounded, most of the crystals are fractured. (<1 to ~1%)

Pyrrhotite: Anhedral crystals that have sharp but angular to jagged contacts, typically has chalcopyrite associated with it as anhedral blebs along the margins of the crystals, and they share mutual contacts. Pyrrhotite locally shows exsolution lamellae of pentlandite. The pyrrhotite is also found as elongate crystals as fracture fill, suggesting that there may be a secondary emplacement of pyrrhotite or that there may be some remobilization. (<1%)

Chalcopyrite: Associated with the pyrrhotite, generally sharing mutual boundaries, with anhedral crystals (blebs) up to 0.1mm in length. Shares sharp irregular contact with the silicates. (tr)

Pentlandite: Exsolution of pyrrhotite? (tr)

Zircon: Accessory phase that is disseminated and locally appears to be an intercumulus phase. Colourless to very pale green and very high relief under plane polarized light. (tr-rare)

Opaques (unknown Composition): Associated with the sulphides and oxides, also present as thin exsolution lamellae and small pods of opaques hosted in the mafic phases. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1-2%)

Brownish coloured semi-opaque phase: Present locally at the cores of the mafic crystals, and appears to be composed of fine grained crystals that are brownish to yellowish-brown in colour. Possibly a carbonate phase? Locally associated with fractures. Has a slight fibrous to granular texture. (~1-2%)

A.1.2.3 Hole ID: Hp-09 Sample#: 00909-01

From (m): 32.2, **To** (m): 32.25

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, hornblende, actinolite, calcite, sericite, biotite, chlorite (+/- serpentine), ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition, quartz, apatite

Main description: The main framework of this cumulate sample is composed of plagioclase. These crystals are largely lath shaped, but most are subhedral to anhedral. The plagioclase crystals are lineated parallel to the layering. The mafic phases are largely replaced by amphiboles (uralitized). The amphiboles are locally overprinting the primary cumulus and intercumulus pyroxenes. The exsolution textures from the orthopyroxenes are locally visible. The amphiboles are no longer restricted to the primary crystal boundaries, and locally enter the plagioclase. There is a weak to moderate carbonatization of the sample, as well as a weak sericitization. The alteration is exploiting the minor fractures that cut through the sample, as well as taking advantage of contacts and boundaries. There are minor opaque phases and they are intercumulus. The contacts between the grains are generally overwhelmed by the alteration minerals and the additional growth of amphiboles across the primary crystal contacts. The contacts are generally irregular sharp, and locally exploited by alteration minerals. The crystals show a partially to unequilibrated textural geometry.

Plagioclase: Forms the main framework of the sample. The crystals are subhedral (locally euhedral) to anhedral and locally are lath shaped. There is a lineation of the plagioclase laths parallel to the layering of the sample. Weak to moderate carbonatization, and weak sericitization, the carbonate is typically exploiting the fractures and crystal boundaries and contacts to infiltrate the sample. Crystals reach up to up to 6mm in length, but most are ~3-4mm in length. Irregular extinction of the crystals suggests either chemical zoning or that the crystals are strained. Some of the crystals show subtle deformation or bending, suggesting that this may be the result of compaction. Contacts between the crystals are sharp but typically irregular. The plagioclase crystals are host to minor fine grained acicular needles (much less than holes H-01 to H-06). Cumulus phase +/- intercumulus plagioclase. (~60-65%)

Orthopyroxene: Only remnants of the primary crystals remain. These are typically at the cores of the original mafic crystals. Some of the exsolution of the Fe-Ti oxides remain and are overprinted by the amphiboles. Orthopyroxene appears to have been a cumulus phase +/- intercumulus.

Clinopyroxene (augite): Only remnants of the primary crystals remain. These are typically at the cores of the original mafic crystals. The primary crystals are overprinted by amphiboles (hbld and actinolite). Clinopyroxene (augite) appears to have been an intercumulus phase. (Uncertain due to strong alteration of the primary crystals).

Hornblende: The main mafic phase present as alteration/ replacement that is overprinting the primary pyroxenes, typically associated with actinolite. Pale green to pale brown under ppl, and highly pleochroic. The crystals are typically anhedral, but some of the crystals on the margins of the larger mafic crystals are subhedral. These crystals are no longer restricted to the primary crystal boundaries and locally enter the plagioclase. The crystals are present at various orientations. Some of the primary exsolution of Fe-Ti oxides in the pyroxenes are still visible, even with the alteration. (~25-30%)

Actinolite: One of the main mafic phases. Overprinting the primary pyroxenes, typically associated with hornblende. Generally colourless to pale green in ppl. The crystals are anhedral to subhedral. Generally the actinolite forms fibrous to amalgamations of acicular crystals. These crystals are no longer restricted to the primary crystal boundaries and locally enter the plagioclase. There is no defined orientation of the crystals (all random orientations). (~5-10%)

Biotite: Reddish-brown in colour under ppl, fibrous to flaky crystals with clearly defined basal cleavage. The crystals are anhedral to subhedral, and are typically found associated with the carbonate alteration. Also found along the margins of the mafic crystals with the hornblende +/- actinolite. These crystals appear to grow outwards from the mafics into the plagioclase. Generally also found in close proximity to the oxide and sulphide phases. (~1-2%)

Chlorite: Alteration phase found in association with the carbonates. Present along the margins of the mafic crystals and within fractures in the plagioclase. Fibrous in texture, composed of radiating crystals, locally anomalous blue interference colours under xpl. Minor alteration phase, with rare crystals reaching up to 0.1mm in length. (<1%)

Calcite: Carbonatization of the plagioclase and mafics, locally fracture fill and associated with silica. Weak to moderate intensity carbonate alteration that is unevenly distributed throughout the sample. The carbonates appear to be the catalyst for some of the alteration.

Sericite: Alteration of the plagioclase, typically associated with the carbonates. Disseminated and unevenly distributed, exploiting fractures and contacts to propagate.

Apatite: Minor accessory phase. Crystals are euhedral to subhedral, <0.1mm in length, and are typically found hosted in the plagioclase. (tr)

Quartz: Fracture fill, with the carbonates. Minor phase. (tr)

Ilmenite: Anhedral, irregular crystals that are generally found along the margins of the mafic crystals and as thin exsolution lamellae of the former pyroxenes. Crystals reach up to 0.4mm in length. (<1%)

Pyrrhotite: Anhedral, irregular crystals. Up to 1.4mm in length, most specks are up to 0.2mm and the contacts are sharp but irregular to jagged. Found typically along the margins of the mafic grains. (<1%)

Chalcopyrite: Rare speck of chalcopyrite, very fine grained and generally in proximity to pyrrhotite. (tr)

Opaques (unknown Composition): These are likely oxides/sulphides that do not cut though the surface of the slide. These are typically found adjacent to the sulphides/oxides, but there are also additional disseminated opaques that are likely oxides or sulphides that are not exposed at the surface of the polished thin section. (<1%)

A.1.2.4 Hole ID: Hp-09 Sample#: 00916-01

From (m): 101.9, **To** (m): 101.95

Rock type: Anorthosite (to Leuco gabbro)

Minerals Present: Plagioclase, calcite, sericite, chlorite, hornblende, orthopyroxene, clinopyroxene (augite), biotite, apatite (tr), ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition.

Main description: Allotriomorphic to hypidiomorphic medium to coarse grained anorthosite to Leuco gabbro. The plagioclase crystals show sharp but irregular to rounded crystal contacts. There is a weak to moderate intensity carbonate and sericite alteration. Alteration is patchy and is most intense in proximity to fractures. There are rare intercumulus pyroxenes that are locally rimmed by hornblende. The sulphides and oxides are found along the margins of the plagioclase and mafic crystals as well as trapped within the plagioclase. This would suggest that the oxide and sulphide phases are co-exiting phases with the plagioclase and may also be intercumulus phases. Cumulate sample (adcumulate). The packing of the mineral grains is tight and they share sharp, rounded, smooth to serrated crystal contacts. These are locally exploited my alteration minerals. The arrangement of the crystals shows a partially equilibrated textural geometry.

Plagioclase: Main silicate (high modal %) phase present in this sample. There is a significant variation in crystal size with crystals reaching up to >8mm in length, but most of the crystals are ~2-3mm in length. Most of the crystals are subhedral to anhedral. Some show irregular extinction, which is likely a result of compositional variations or deformation. Rare kinked crystals. The contacts between the plagioclase crystals are sharp, but irregular to rounded. No visible lineation. The plagiolcase suffers from weak to moderate intensity carbonate and sericite alteration. The plagioclase crystals are locally cut by fractures, these appear to be exploited by alteration minerals/fluids. Crystal contacts are also sources of altering fluids. (One crystal tested ~An60) The plagioclase crystals form a patchwork of anhedral crystals that appear to have suffered from adcumulus growth. Uncertain if there are any intercumulus plagioclases. (>90%)

Orthopyroxene: Very minor cumulus to intercumulus phase. Crystals are anhedral and locally rimmed by hornblende and more rarely are poikilitically enclosed in clinopyroxene. Orthopyroxenes are typically fractured, and have a granular to slightly elongate shape. One of the orthopyroxene crystals appears to be a cumulate and is hosted in intercumulus augite. (tr)

Clinopyroxene (augite): Intercumulus phase, typically found rimmed by hornblende. Contacts are blurred by the hornblende, locally uralitized. Locally host to what appears to be a cumulus orthopyroxene crystal. (~1%)

Hornblende: Minor phase, mainly present as rims and replacement of the pyroxenes (uralitization). Secondary phase? (<1%)

Biotite: Minor alteration phase, typically found adjacent to the Fe-Ti oxides +/- hornblende. Reddish-brown in colour and highly pleochroic under plane polarized light. Crystals are fibrous, subhedral to anhedral and reach up to 0.3mm in length. (tr)

Chlorite: Alteration phase, pale green and pleochroic in ppl, anomalous blues in xpl. Present as fibrous crystals that form aggregates of fibrous crystals. Typically found with the calcite and sericite. (minor phase) (tr)

Calcite: Alteration phase that is unevenly distributed typically found with sericite and is exploiting fractures and crystal contacts and boundaries. There is an overall weak to moderate intensity alteration. Locally pods of calcite present. (~3-4%)

Sericite: Alteration phase that is unevenly distributed typically found with calcite and exploiting fractures and crystal contacts and boundaries. Weak to moderate intensity alteration. Some large crystals can be found reaching up to 0.5mm in length. (3-5%)

Apatite: Rare accessory phase. Crystals are subhedral to euhedral. (tr)

Ilmenite: Anhedral crystals. Generally, present along the margins of cumulate plagioclase, and adjacent to the intercumulus pyroxenes. Contacts are sharp. Intercumulus phase, with crystals reaching up to 0.8mm. (<1%)

Pyrrhotite: Anhedral crystals that are intercumulus and poikilitically enclosed in the plagioclase. Contacts are sharp but irregular to jagged, the crystals are highly pitted. Rare crystals that reach up to 2.2mm in length. (<1%)

Chalcopyrite: Rare anhedral crystals, typically found with the pyrrhotite and share mutual boundaries. Rare disseminated crystal. (tr)

Opaques (unknown Composition): Opaques of unknown composition are present locally, they do not reflect light and are opaque under ppl and xpl. Minor phase. Generally found adjacent to, or surrounding the sulphides and oxides. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

A.1.3 Unit 2a

A.1.3.1 Hole ID: H-01 Sample#: 00921-01

From (m): 30, **To** (m): 30.05

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, serpentine, chlorite, actinolite, hornblende, sericite, Pyrrhotite, chalcopyrite, ilmenite, rutile, quartz, opaques of unknown composition, relic Opx and Cpx

Main description: Medium to coarse grained, allotriomorphic cumulate with moderate to strong carbonate/sericite/amphibole/chlorite (+/-serpentine) alteration. Typically subophitic to nesophitic. Plagioclase is one of the main components of this sample and is sericitized and weakly carbonatized. There is a strong uralitization of what appears to have been primary pyroxenes by the amphiboles. The pyroxene alteromorphs appear to be cumulate and intercumulus phases (likely cumulus orthopyroxene and intercumulus augite). The sulphide and oxide phases appear to be intercumulus, but are locally breaking down, likely as a result of the alteration of the sample. The mafic phases make up >50% of the sample (hornblende+ actinolite +chlorite +serpentine=~50-60% of the sample) Contacts between the grains are generally skewed by the alteration and fractures. Where they are still visible they are sharp, and irregular. The arrangement of those minerals, suggests that the sample demonstrates a partially equilibrated geometry.

Plagioclase: Plagioclase is sericitized and carbonatized (weak to moderate altn). This gives the crystals an almost mottled appearance, but the twinning is still clearly visible. Crystals are anhedral to subhedral, and contacts are sharp but irregular to locally jagged. Alteration is locally exploiting the contacts. Some of the crystals show irregular extinction (no visible zoning), and some are kinked or bent. Fractures cut some of the plagioclase crystals. Few crystals reach up to 8mm in length, most are 4-5mm in length. Plagioclase is also host to thin bands and pods of serpentine +/- chlorite alteration, which cut along the margins of the crystals and exploit fractures. (~40-50%)

Orthopyroxene and Augite: Relics of orthopyroxene are still present as exsolution lamellae of Fe-Ti oxides in the former cumulate phases. Relic augite appears to have been an intercumulus phase and is strongly altered/replaced by amphiboles. These crystals would have been coarse grained.

Hornblende: Pale brown to pale green under ppl, replacing the pyroxenes (primary exsolution of Fe-Ti oxides is still visible) (uralitized), locally poikilitic. No defined orientation to the crystals, and occur at various orientations. Typically found with actinolite. Locally altered by chlorite +/-serpentine.

Actinolite: Fibrous to acicular crystals replacing pyroxenes (uralitization). The actinolite crystals are locally oriented in similar directions and are somewhat restricted to the primary crystal boundaries of the pyroxenes. Typically found with hornblende. Generally found at the cores of the now mafic aggregates.

Serpentine (lizardite): Colourless to pale green in ppl, forms fibrous intergrowths that show a prominent basal or flaky cleavage. Typically found along the boundaries/contacts and as thin crystals in the plagioclase and along the margins and cores of the mafic phases. Crystals up to 0.2mm in length locally present. The serpentine generally shows a wavy extinction, and is locally kinked. Chlorite and serpentine show similar characteristics.

Chlorite: Associated with the serpentine. (see description above)

Calcite: Moderate alteration phase, that appears as a brownish coloured opaque mineral that may be a Fe- or Mg carbonate? Present as a dusting over most of the sample. Late phase.

Sericite: Weak to moderate alteration phase, primarily of the plagioclase (sericitization). Found as fine grained disseminated crystals and up to 0.025mm in length.

Quartz: Rare anhedral crystals, secondary phase associated with fractures (fracture fill). (tr)

Rutile: Accessory phase, generally associated with the sulphides and oxides (ilmenite). Anhedral crystals that locally share mutual grain boundaries with ilmenite, and occasionally contain small blebs of trapped pyrrhotite within the crystals. (tr)

Ilmenite: Irregular distribution, locally associated with the sulphide phases and is present as thin exsolution lamellae in the relic pyroxenes. Locally the crystals are breaking down (forming leucoxene/rutile). Anhedral crystals up to 0.15mm in length. (tr)

Pyrrhotite: Small irregular disseminated anhedral crystals (intercumulus phase). Thin blebs also present within the mafic phases. Some of the crystals appear to be breaking down and are skeletal. Crystals up to 0.5mm in length. (~1%)

Chalcopyrite: Small irregular anhedral crystals that are found sharing mutual boundaries with pyrrhotite, and crystals reach up to 0.07mm in length. (tr)

Opaques (unknown Composition): Opaques of unknown composition locally associated with the oxide and sulphide phases. These do not reflect light and are black to dark brown in colour under ppl and are black under xpl. It is likely that these are sulphides and oxides that are contained within the 30μm thickness of the slide and are not cut by the surface of the polished section. (<1%)

A.1.3.2 Hole ID: H-01 Sample#: 00922-01

From (m): 81.61, **To** (m): 81.66

Rock type: Altered Hornblende Gabbro

Minerals Present: Plagioclase, chlorite (+/-serpentine), actinolite, hornblende, pyrrhotite, pyrite, ilmenite, rutile, calcite, scapolite, quartz, opaques of unknown composition, brown coloured mineral (unknown composition), and rare augite.

Main description: Chloritized and carbonatized hornblende gabbro (to Leuco gabbro), that is allotriomorphic to hypidiomorphic. The primary plagioclase is pervasively carbonatized and is weakly chloritized. Contacts between the plagioclase crystals are skewed by the strong alteration. The sample is cut by a number of quartz-carbonate veinlets and fractures. These are presently filled with calcite and quartz, and the margins of the fractures and veinlets host a brown coloured fine grained mineral. This brownish-coloured mineral is abundant and is present along the margins of all of the fractures and veinlets. Chlorite alteration is also hosted in the fractures and locally in the veinlets. Chlorite is also present as an alteration phase of the mafics (cores of the crystals), and is found filling fractures in the plagioclase. The plagioclase is locally brecciated by the fractures and veinlets. The amphiboles (hornblende and actinolite) are anhedral to subhedral to euhedral crystals replacing what appear to have been primary pyroxenes. These crystals are also surrounded by the brownish coloured minerals and chlorite. There also appears to be a few crystals of scapolite (uncertain) hosted in the altered plagioclase, and is found in association with the chlorite. The sulphides and oxides represent a very minor proportion of the sample (small modal %, <1%) and are anhedral. One small intercumulus augite was identified, suggesting that there were cumulus or intercumulus pyroxenes present. This sample shows a number of similarities with 921-01, but this sample contains fewer mafic minerals and is host to stronger alteration intensities. Contacts between the grains are generally skewed by the alteration, fractures and breccia.

Plagioclase: Plagioclase is comprised of clusters of subhedral to anhedral sericitized, carbonatized and chloritized crystals. Twinning is still visible, but is generally skewed by the strong alteration and the crystals have a mottled appearance due to the alteration. Crystals reach up to 4mm in length, but most are 2mm or less in length. Kinking is common. Crystals are typically surrounded by a brownish coloured mineral (likely a carbonate (Fe or Mg?). Some of the plagioclase crystals are cut by fractures and veinlets, resulting in a fine grained breccia texture, and the fractures and veinlets are filled with carbonate, chlorite +/- serpentine, quartz. The plagioclase appears to be the main primary phase.

Hornblende: Subhedral to locally euhedral crystals. Cleavage is clearly visible in some of the crystals, and some of the crystals reach up to 0.4mm in length. These are likely the result of uralitization of any primary pyroxenes, or there is a secondary growth of amphiboles. Typically found with the actinolite.

Actinolite: Anhedral to subhedral, to locally euhedral crystals that are fibrous to acicular and are typically found with the hornblende, chlorite and the brown mineral (carbonate?). Uncertain if the actinolite is replacing any primary pyroxenes. Rare twinned crystals. These are also cut by some of the fractures, suggesting that fracturing of the sample is a recent event.

Serpentine: Fibrous crystals and radiating clusters of crystals, generally found with chlorite.

Chlorite: One of the main alteration phases. Chlorite is present as fibrous crystals, radiating fibrous clusters and bands of chlorite alteration. Contacts are sharp to gradational. Chlorite is present in fractures in the plagioclase and is also replacing the mafic phases. Crystals reach up to 1.5mm in length.

Calcite/ Carbonate: Main alteration phase. Calcite/carbonate alteration is strong in this sample. Calcite is present as a pervasive alteration of the plagioclase which gives the plagioclase a light pinkish colour and looks dirty under ppl. Veinlets that cut the sample are composed of quartz-carbonate fill. The fractures are also sources of carbonate alteration that cut the sample. Calcite crystals reach up to 1.4mm in length. The carbonate alteration cuts all of the phases and is likely the result of a late event.

Sericite: Weak sericitization of the plagioclase. Fine grained disseminated alteration that appears to be related to the carbonate alteration. Rare crystals up to 0.1mm in length. (~1%)

Quartz: Related to the veining and is associated with the carbonate. Crystals are irregular and anhedral, with rare crystals that reach up to 0.4mm in length. There is calcite, the brown mineral and chlorite found with the quartz locally. Late addition to sample and is likely related to the late carbonatization. (~2%)

Ilmenite: Very minor phase, anhedral, and fractured crystals that are breaking down to form leucoxene/rutile? Host to small blebs of pyrrhotite. Crystals reach up to 0.3mmin length. (tr)

Pyrrhotite: Anhedral crystals, disseminated and locally trapped blebs in the ilmenite. (tr)

Chalcopyrite: Small anhedral blebs, associated with pyrrhotite, or as blebs trapped within the pyrrhotite. All crystals seen are up to 0.07mm in length. (tr)

Pyrite: Anhedral crystals, found hosted in the calcite filled veinlets (late sulphide phase). (tr)

Opaques (unknown Composition): There are also opaque phases of unknown composition. These are generally associated with the sulphides and oxides and are likely additional crystals of sulphides and oxides that are hosted within the thickness of the slide but are not cut by the surface of the polished section. (tr)

Brown Mineral: There is a strong presence of a brown coloured mineral that is associated with the calcite veining. It is present flanking the veinlets and as fracture fill, and appears to be an alteration phase. The brown mineral does not change characteristics from ppl to xpl and does not reflect light. The mineral is generally fine grained and may be a fine grained High Fe or Mg carbonate, or may be ferruginous weathering.

Scapolite: High relief, colourless to pale green with sharp contacts under ppl. Anhedral to subhedral crystals that are weakly fractured. Hosted in plagioclase and associated with the quartz+/- chlorite. The scapolite has a light bluish-violet colouration under xpl. Crystals reach up to 0.2mm in length. (~1%)

A.1.3.3 Hole ID: Hp-11 Sample#: 00854-01

From (m): 32.58, **To** (m): 32.63

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, hornblende (+/- actinolite), biotite, remnants of Opx and augite (Cpx), chlorite, sericite, pyrrhotite, ilmenite, chalcopyrite, quartz and opaques of unknown composition, accessory phase with radiation halo that is pseudo-hexagonal.

Main description: Very coarse grained sample exhibiting strongly uralitization. The primary pyroxenes are replaced/altered by amphiboles. Some of the primary exsolution textures are still visible. Rare remnants of the pyroxenes remain, and it appears that orthopyroxene was a cumulus phase. The plagioclase is weakly sericitized, but is cut by numerous fractures that are locally bearing sericite, silica, biotite and chlorite. Most of the plagioclase crystals show irregular extinction and the contacts are exploited by the alteration. The amphiboles have replaced the pyroxenes from the outside in, and there is no distinct orientation to the hornblende crystals. Patches of quartz crystals are present associated with the fractures (fracture fill). (adcumulate (to mesocumulate)) The sample is tightly packed, and the arrangement of the crystals would suggest that there has been some densification. The contacts between the crystals are sharp, irregular, fractures, and serrated. The sample texturally shows a partially equilibrated to unequilibrated geometry. The contacts are also skewed by alteration minerals and the growth of additional minerals across the contacts.

Plagioclase: Anhedral crystals, weak sericitization and cut by numerous fractures. The contacts are exploited by alteration minerals. Irregular extinction, the large crystals are zoned or have suffered from compaction. Fine grained plagioclase along the margins of the larger crystals. These crystals are coarse grained, and appear to have some adcumulus growth.

Orthopyroxene: Rare remnants of the orthopyroxene crystals are still present. Locally the cores of some of the crystals remain and are locally overprinted by actinolite. One of the larger crystals still has a core of orthopyroxene that has a fibrous appearance. The exsolution lamellae of Fe-Ti oxides are still visible. The outline of the coarse mafic crystals would suggest that the primary crystals were cumulus phases.

Clinopyroxene (augite): Rare remnants of the augite are still present, though most are recrystallized or replaced. The augite appears to have been an intercumulus phase. The composition of the crystals replacing the augite, are too fine to resolve.

Hornblende: Green hornblende (pale green to bluish-green in colour under ppl), replacing the primary pyroxenes. Crystals do not have a defined orientation. Crystals are typically anhedral to subhedral, and are rarely twinned. The margins of the large mafic grains are composed of elongate granular hornblende crystals and cores of the mafics are both hornblende and actinolite crystals +/- biotite alteration. The centres of the large pyroxene alteromorphs typically have a fibrous texture. Rare remnants of the primary crystals remain. Locally exsolution of Fe-Ti oxides from the orthopyroxene is still visible due to overprinting.

Actinolite: Replacing the primary pyroxenes. Crystals do not have a defined orientation, but they do appear to have grown from the outside towards the inside of the large crystals. Crystals are typically anhedral to subhedral, and are rarely twinned. The margins of the large mafic grains are composed of elongate granular hornblende crystals and centre of the mafics are both hornblende and actinolite crystals +/- biotite alteration. The cores of the large replaced pyroxenes typically have a fibrous texture. Only rare remnants of the primary crystals remain. Locally exsolution of Fe-Ti oxides from the orthopyroxene is still visible due to overprinting by the amphiboles.

Biotite: Anhedral to subhedral crystals reach up to 3.5mm in length. Associated with the fractures and appears to be an alteration phase of the amphiboles/pyroxenes. Locally crystals are deformed (bent). Some of the crystals have ilmenite present along their margins (exsolution?). (~2-4%)

Chlorite: Alteration phase, fracture fill, fibrous in texture, pale green under ppl, locally anomalous blue interference colours. (~1%)

Sericite: Alteration phase of the plagioclase and is exploiting the abundant fractures that cut this sample. Weak sericite alteration.

Quartz: Anhedral crystals, associated with the fractures as fracture fill, and also pods of crystals present locally that show irregular and rounded contacts. Late phase. (tr)

Ilmenite: Main oxide phase (<1%). Anhedral crystals, found as thin exsolution lamellae from the primary pyroxenes and as anhedral crystals along the margins of the biotite (exsolution?). Rare crystals up to 0.4mm in length. (<1%)

Pyrrhotite: Main sulphide phase, anhedral blebs, intercumulus and fracture fill. Late stage remobilization? The crystals are weakly pitted, contacts are sharp but irregular. Small anhedral blebs also found within the replaced mafics as space filling? Rare crystals up to 1mm in length. (<1-1%)

Chalcopyrite: Minor sulphide phase. Anhedral blebs, generally found adjacent to or in proximity to the pyrrhotite. Rare single bleb trapped in the mafics. Anhedral crystals up to 0.04mm in length. (tr)

Opaques (unknown Composition): Generally found in proximity to or adjacent to the oxides/sulphides. Locally disseminated pods. Likely that these are oxide or sulphide phases that are not cut by the surface of the slide. These pods are anhedral and may be composed of fine grained aggregates of crystals.

Unknown Accessory phase: Accessory phase showing clearly defined radiation haloes. Hosted in the mafics (hornblende), and locally in the biotite crystals. Crystals up to 0.4mm in length, subhedral to locally euhedral, yellowish-brown in colour and very high relief. (tr)

A.1.4 Unit 2b

A.1.4.1 Hole ID: H-04 Sample#: 00800-01

From (m): 124.08, **To** (m): 124.13

Rock type: Leuco Hornblende Gabbro

Minerals Present: Plagioclase, hornblende, calcite, sericite, chlorite (+/-serpentine), biotite, pyrrhotite, chalcopyrite, ilmenite, opaques of unknown composition, relic opx?.

Main description: Allotriomorphic to hypidiomorphic medium grained leuco-gabbro. Plagioclase is the most abundant mineral in the sample, and is locally zoned. The mafics likely originated as orthopyroxenes (determined from crude remaining crystal outlines), but are now strongly uralitized and composed of multiple amphibole crystals at various orientations. Hornblende also appears to be present as a intercumulus phase. It is also possible that this sample did not contain any pyroxenes, only amphiboles, which would make this sample unique, but the crude outlines of primary crystals would suggest that the amphiboles are a later phase. The mafics are in turn biotite and chlorite altered. There is a weak to moderate intensity carbonate alteration that is exploiting fractures and contacts to infiltrate the sample, and a weak sericitization of the plagioclase. The oxide and sulphides appear to be coexisting phases and are intercumulus to the plagioclase. The contacts between the grains show a partially equilibrated geometry. The contacts are smooth to serrated, and all of the pore space is occupied with intercumulus phases, or now alteration minerals.

Plagioclase: Plagioclase is the most abundant phase and shows significant variation in crystal sizes. Crystals up to >4mm in length but most are between 0.5-2mm in length. Crystals are anhedral to subhedral to rare euhedral crystals. Contacts are sharp, irregular to locally rounded. Rare zoning of some of the crystals, but irregular extinction is common. Typically larger lath shaped crystals are surrounded by much smaller anhedral plagioclase crystals. Weak to moderate carbonate alteration locally and very weak sericitization. Locally crystals poikilitically enclosed by hornblende. There is minor chlorite alteration along fractures locally. The plagioclase is both a cumulus and intercumulus phase. (~65%)

Orthopyroxene: Crude outlines of primary crystals and what appears to be exsolution textures of ilmenite. Strongly uralitized.

Hornblende: Main mafic phase. Irregular, anhedral to subhedral crystals that are pale green to brownish in colour. Crystals at various orientations form large amalgamations that show an almost woven texture. Open spaces appear to be filled with plagioclase (difficult to resolve the composition locally). Locally the hornblende is poikilitic. Contacts are sharp. Intercumulus and replacement/alteration crystals up to 2mm but most are 0.5-1mm. (~15-20%)

Biotite: Alteration phase, associated with the chlorite and carbonate. Long fibrous crystals up to 1.4mm in length, and are subhedral to anhedral. Found along the margins and at the cores of the mafic aggregates.

Chlorite: Colourless to pale green under ppl, fibrous crystals that typically form long crystals and aggregates. Associated with the carbonate, and is exploiting fractures and crystal contacts and boundaries. Crystals up to 0.5mm in length. Biotite and chlorite locally share mutual boundaries. (<5%)

Calcite: Secondary alteration that is exploiting fractures, crystal contacts and boundaries. Forming fine grained crystals and small pods up to 0.6mm in length. Crystals are anhedral. (<5%)

Sericite: Fine grained alteration of the plagioclase. Crystals up to 0.1mm.

Ilmenite: Irregular, anhedral crystals up to 0.8mm in length. Typically the crystals are fractured and locally host small anhedral blebs of pyrrhotite and chalcopyrite. Locally twinned.

Also present as fine grained exsolution lamella and crystals hosted in the hornblende. The ilmenite, pyrrhotite and chalcopyrite appear to have been coexisting phases. (<0.5%)

Pyrrhotite: Anhedral crystals up to 1mm in length, typically associated with the mafic phases. (<1%)

Chalcopyrite: Anhedral crystals up to 0.1mm sharing mutual grain boundaries with pyrrhotite. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.4.2 Hole ID: H-05 Sample#: 00810-01

From (m): 88.89, **To** (m): 88.94

Rock type: Leuco Hornblende Gabbro

Minerals Present: Plagioclase, hornblende, biotite, sericite, calcite, chlorite, ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition, quartz, pentlandite

Main description: Similar to 00800-01, but this sample has a weaker alteration of the mafic phases and a stronger alteration of the plagioclase. Plagioclase is the main silicate phase and is moderately sericitized and carbonatized. There is a significant variation in the size of the plagioclase crystals with some exceeding 8mm in length, but most are 1-3mm in length. The plagioclase crystals are anhedral to subhedral and share sharp but irregular to rounded contacts. Hornblende is main mafic phase and appears to be replacing primary pyroxenes?. These crystals are weakly chlorite and biotite altered. There are numerous hornblende crystals at various orientations that make up what appear to be individual large mafic crystals on the macroscale. These hornblende crystals are not restricted to the primary crystal boundaries and are anhedral to locally euhedral. There is a late stage fracturing of the sample, these fractures crosscut all phases and appear to be the sources of the carbonate, quartz and sericite. Some of these fractures reach up to 0.05mm in width. The opaque phases are intercumulus and are composed of ilmenite and pyrrhotite. This sample is medium grained, but contains some large crystals. The crystals are tightly packed, but the contacts are sharp, smooth and irregular. This sample shows a partially equilibrated geometry, that has undergone densification and likely some compaction.

Plagioclase: Main silicate phase, crystals are anhedral to subhedral and reach up to 8mm in length. Contacts are sharp but rounded. Crystals are locally kinked and show irregular extinction (related to compaction?). There is a significant variation in crystal size (crystals reaching >8mm in length) with the larger crystals typically surrounded by numerous smaller crystals. There is a weak to moderate sericitization, and carbonatization of the plagioclase, with the alteration exploiting fractures and contacts. The alteration appears as a pale brownish coloured dusting on the crystals. The crystals are host to fine grained acicular crystals of actinolite?? These are too small to resolve their composition. The plagioclase appears to be both a cumulus and intercumulus phase, and is generally subhedral to anhedral. (~60-65%)

Pyroxenes (Ortho and Clinopyroxenes): None visible. Appears to have been cumulus orthopyroxene, based on the shape of the grains.

Hornblende: Main mafic phase that is pale green to greenish brown in colour (ppl). Crystals are anhedral to locally euhedral. Numerous crystals at various orientations make up what appears to be individual large crystals on the macroscale. These are locally chlorite altered. Crystals reaching up to 4mm in length, but most are 0.8mm in length or less. Locally crystals are cut by small fractures. The hornblende is an intercumulus and alteration phase likely replacing primary pyroxenes. The crystals are no longer restricted to the primary crystal boundaries and are entering the plagioclase. (~15-20%)

Biotite: Alteration phase of the hornblende and associated with the chlorite. Crystals up to 0.4mm in length, fibrous, anhedral to subhedral. (~1%)

Chlorite: Fibrous crystals, anhedral to subhedral. Locally alteration of the hornblende and associated with the calcite and biotite. Crystals up to 0.6mm in length.

Calcite: Late alteration phase that is exploiting fractures and contacts, and is locally a space filling phase. (~5-10%)

Sericite: Fine grained alteration of the plagioclase, rare crystals up to 0.2mm in length. Fibrous crystals that appear as a fine dusting on the plagioclase.

Quartz: Fracture fill, associated with the carbonate. Very minor, late phase.

Ilmenite: Anhedral crystals that are breaking down along the margins of the crystals to form what appears to be rutile or leucoxene. Crystals are typically fractured. Some of the fractures host small blebs of pyrrhotite. Intercumulus phase. (<1%)

Pyrrhotite: Anhedral crystals up to 1mm in length. Locally host to thin flames of exsolution of pentlandite. Intercumulus phase. (~1%)

Chalcopyrite: Anhedral blebs sharing mutual boundaries with pyrrhotite. Crystals reaching up to 0.15mm in length. Intercumulus phase. (tr)

Pentlandite: Exsolution that appears as flames originating from the exterior of the pyrrhotite crystals. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (<1%)

A.1.5 Unit 3

A.1.5.1 Hole ID: H-04 Sample#: 00795-01

From (m): 40.06, **To** (m): 40.11

Rock type: Leuco Hbld Gabbro (Leuco Gabbro)

Minerals Present: Plagioclase, hornblende, actinolite, serpentine, chlorite, biotite, sericite, calcite, quartz, pyrrhotite, chalcopyrite, ilmenite, rutile, opaques (unknown composition), pentlandite

Main description: Allotriomorphic to hypidiomorphic, medium grained leuco-gabbro. This sample is cut by numerous fractures and a very small veinlet that is host to quartz-carbonate fill. There is a weak to moderate intensity carbonate, sericite and chlorite alteration. Plagioclase is the dominant mineral in this sample. The plagioclase crystals are of various sizes including some that are >5mm in length, but most of the crystals exhibit an irregular sharp with rounded contacts. What may have been primary pyroxenes are now strongly uralitized. Hornblende may also be an intercumulus phase. The amphiboles are also weakly altered by biotite and chlorite. Minor intercumulus sulphides (later phase?) and oxides (ilmenite+ rutile) are present that are locally breaking down, likely as a result of inequilibrium. The boundaries between the crystals in this sample are smooth, but rounded and show a partially equilibrated geometry. The kinking and bent crystals are likely a result of densification and compaction. This sample is largely an adcumulate.

Plagioclase: Main phase is comprised of anhedral to subhedral crystals (lath shaped to stubby). Crystals locally show irregular extinction and kinking, but there is no distinct zoning, suggesting these are strain or compaction induced. There is a great diversity in crystal sizes, with crystals reaching up to 8mm in length, but most are ~2mm. Contacts are sharp but irregular to rounded, and the crystals are suffering from a weak to moderate intensity carbonate and sericite alteration that is exploiting the fractures and contacts/crystals boundaries. There appears to be both cumulus and intercumulus crystals present. (single crystal= An50) (~80%)

Orthopyroxene: Only the primary exsolution textures of this mineral remain. Replaced by the amphiboles.

Clinopyroxene (augite): Uncertain if there were any present. All of the primary mafic minerals are strongly uralitized.

Hornblende: Pale green under ppl. Anhedral to subhedral crystals that are replacing/overprinting the pyroxene alteromorphs and may also be an intercumulus phase. The crystals are most prominent along the margins and locally are suffering from biotite and chlorite alteration. There is a variety of crystal sizes with some reaching up to 1mm in length. Generally found associated with actinolite. The crystals are no longer restricted to the primary crystal boundaries and are entering the plagioclase. (~10-15%)

Actinolite: Acicular to fibrous crystals, associated with the hornblende. Rare twinned crystals. (See hornblende description).

Biotite: Reddish-brown in ppl. Crystals reach up to 0.45mm in length, long fibrous to scaly crystals. Typically found as an alteration phase of the amphiboles. Chlorite also found with the biotite locally.

Serpentine: May be minor serpentine associated with the chlorite. (See chlorite description)

Chlorite: Small fine grained fibrous crystals to aggregates of fibrous crystals that are colourless to pale green in colour (ppl), and are hosted in fractures in the plagioclase and are associated with the carbonate and sericite alteration. Crystals reach up to 0.4mm in length. Late alteration phase. (+/- serpentine)

Calcite: Weak to locally moderate intensity alteration. Exploiting contacts/boundaries and fractures. Calcite is a late fracture fill, space filling, alteration phase.

Sericite: Weak intensity alteration of the plagioclase. Exploiting contacts/boundaries and fractures to enter the plagioclase. Fine grained but with crystals reaching up to 0.2mm in length. Associated with the calcite/carbonate, late alteration phase.

Quartz: Anhedral crystals associated with a small veinlet composed of calcite and quartz. (tr)

Rutile: Subhedral to euhedral crystals, locally corona of the ilmenite. Rutile is also found surrounded by pyrrhotite and chalcopyrite. Individual crystals are locally present, up to 0.4mm in length. (tr)

Ilmenite: Anhedral crystals, locally these are breaking down to form rutile. It is common to see only skeletal ilmenite remaining. Crystals up to 0.5mm in length. The ilmenite is also host to small blebs of pyrrhotite, suggesting that these two phases co-existed. Intercumulus to the plagioclase. (<1%)

Pyrrhotite: Anhedral irregular crystals up to 0.17mm in length. Some of the crystals are associated with and some are trapped in the ilmenite. Disseminated pyrrhotite crystals are locally showing some exsolution textures that look like flames entering the crystal from the outer edge. These are likely composed of pentlandite, but they are too small to resolve. Intercumulus to the plagioclase. (<1%)

Chalcopyrite: Small anhedral blebs associated with the pyrrhotite and sharing mutual grain boundaries. (tr)

Pentlandite: Exsolution of the pyrrhotite. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (<1%)

A.1.6 Unit 4

A.1.6.1 Hole ID: Hp-12 Sample#: 00866-01

From (m): 63.34, **To** (m): 63.39

Rock type: Sulphide rich hornblende Gabbro

Minerals Present: Plagioclase, pyrrhotite, chalcopyrite, hornblende +/- actinolite, biotite, relic ortho (and clinopyroxenes?), sericite, ilmenite, opaques of unknown composition and a brownish mineral, apatite

Main description: The sulphides (pyrrhotite + chalcopyrite) comprise a significant part of this sample and fill a large % of the interstitial space between the plagioclase and mafics. The sulphides appear to be an intercumulus phase, with additional sulphide emplacement/ remobilization or recrystallization. The plagioclase crystals are typically lath shaped, and are subhedral to anhedral to locally euhedral. They are host to numerous fractures and are also host to fine grained patchy disseminated irregular bands of sulphides, as well as a very weak sericitization locally. Some of the individual crystals are enclosed by sulphides and others still maintain contacts with other plagioclases as well as former pyroxenes. Most of the pyroxenes are uralitized by amphiboles, but some still retain their primary cores (orthopyroxene). There appear to be both cumulus and intercumulus pyroxenes present. The cores that remain are highly fractured. The cores are surrounded and cut along the fractures by a brown coloured mineral (fine grained) of unknown composition. Exsolution lamellae from the pyroxenes are still clearly visible. There are numerous fractures that cut the sample, which cut all phases present and are filled with a brown coloured mineral that is locally fibrous in texture, and fills the fractures in open space filling texture. The sulphides (pyrrhotite and chalcopyrite) are anhedral and form long interconnected pods of irregular sulphide crystals that surround some of the silicates. The distribution of the sulphides is irregular and they locally appear to be replacing some of the silicate phases (mainly plagioclase). The sulphides fill the interstitial space, fractures and are also highly fractured. The sulphides locally hide the contacts between the primary grains, but the few contacts that are visible would suggest that the sample has suffered from some densification and reduction of pore volume. The contacts between grains are sharp, irregular and locally serrated and skewed by sulphides or alteration minerals. The sample exhibits a partially equilibrated geometry.

Plagioclase: Plagioclase crystals are subhedral to anhedral to euhedral, and reach up to 5mm in length. Most of the crystals are ~2-2.5mm in length. There is significant variation in crystal sizes in this sample. There are much finer grained plagioclase crystals present that appears to be related to fracturing and may represent breccia fragments. This is difficult to determine since the sulphides have skewed the textures and overprinted and filled any of the open spaces. A significant number of the plagioclase crystals have very irregular extinction and are weakly zoned. Some crystals show obvious deformation and are bent or kinked (possibly deformation attributed to compaction?). Contacts between the crystals are sharp, but irregular. Some of the minerals are entering the plagioclase and are overtaking their primary crystal boundaries. The plagioclase is also locally host to acicular needles, but this is minor in comparison to the plagioclases from holes H-01 to H-06. Cumulus phase ,with a minor intercumulus component.

Orthopyroxene: Only remnant core of orthopyroxene remain. Most of the pyroxenes have suffered from strong uralitization. The crystals are now replaced with fibrous crystals, radiating at various angles. They are colourless and only overprint the primary textures. These are typically fractured and the fractures are host to a brownish coloured mineral. The brownish coloured mineral is replacing the pyroxenes radiating outwards from the fractures. Exsolution lamellae of Fe-Ti oxides are still visible in the pyroxene alteromorphs locally. The primary crystals were granular to elongate and appear to have been cumulus phases (+/- intercumulus orthopyroxene??) The contacts are skewed by the presence of the sulphides, which locally envelop the crystals. The amphiboles and biotite that are replacing the pyroxenes are not restricted to the primary crystal boundaries and locally enter the plagioclase.

Clinopyroxene (augite): Uncertain if any augite was present, or if any remain. The uralitization is strong, and there are only remnants of the primary crystals that remain (mostly all orthopyroxene). Augite was an intercumulus phase, which has suffered from a strong uralitization/alteration.

Hornblende: Along with actinolite is replacing the pyroxenes. The hornblende is pale brownish in colour (ppl) and is irregularly distributed. Crystals are anhedral and vary greatly in size. Hornblende is generally most abundant in proximity to the fractures (likely as a source of altering fluids). Some larger hornblende crystals are up to 0.8mm in length. Typically found as rims and crystals replacing the pyroxenes and associated with actinolite.

Actinolite: Replacing the pyroxenes, associated with the hornblende. Crystals are fibrous, and locally form radiating clusters, are colourless (ppl).

Biotite: Alteration phase, generally found adjacent to the sulphides +/- hornblende. The biotite is irregularly distributed and is generally found along fractures or in proximity to the fractures. Crystals are fibrous and are subhedral. (~1%)

Sericite: Weak alteration phase of the plagioclase that is exploiting the fractures in the plagioclase.

Apatite: Rare accessory phase. Only a couple of acicular crystals were found, all hosted in the plagioclase. (tr)

Ilmenite: Very minor phase. Rare anhedral crystals found sharing mutual boundaries with pyrrhotite. Also present as fine grained exsolution lamellae in the pyroxenes. Also found along the margins of the biotite locally as fine grained anhedral crystals. (<1%)

Pyrrhotite: Main sulphide phase. The crystals are anhedral, irregular shape and size, and are typically fractured and have sharp to jagged and irregular contacts. Locally the sulphides appear to be breaking apart and losing fragments. Some of the pyrrhotite crystals show irregular extinction patterns which suggests that these crystals are slightly deformed (bent) and there is no evidence of annealing. There as numerous fine-grained bands/pods of sulphides cutting the plagioclase. These are typically along fractures. The pyrrhotite and chalcopyrite share mutual grain boundaries and appear to be co-existing phases. Pyrrhotite is also present as fracture fill along with chalcopyrite. The pyrrhotite and chalcopyrite are likely intercumulus phases, and may have suffered from either a second episode of crystallization or some remobilization. (~30-35%)

Chalcopyrite: Chalcopyrite is typically found sharing mutual boundaries with pyrrhotite, or as individual crystals. These are anhedral and, irregularly distributed. Some of the chalcopyrite forms fine grained pods and clusters that cut into the plagioclase. Anhedral pods of chalcopyrite are also enclosed within the pyrrhotite. Contacts between the pyrrhotite and the chalcopyrite are sharp and irregular. Where the chalcopyrite is in contact with the silicates it has jagged contacts and crystals are entering into the silicates. The chalcopyrite has taken advantage of the fibrous nature of the uralitized pyroxenes and locally forms thin bands in these crystals. The largest crystal of chalcopyrite found is 1.6mm in length. Chalcopyrite is also present as fracture fill along with the pyrrhotite. Again, suggesting that these were co-existing phases. (~5%)

Opaques (unknown Composition): The opaques are likely additional sulphides (pyrrhotite and chalcopyrite) that are present within the thickness of the slide and are not cut by the surface of the polished section. The opaques are located adjacent to or in close proximity to the sulphides, and the textures of these phases are similar to that exhibited by the sulphides.

Brown mineral: There may be one or two unidentified brown minerals present in this sample. There is a brown coloured mineral that is present as fracture fill, and is locally fibrous in texture but it's colour and properties do not change from ppl to xpl and it does not reflect light. The mineral fills the fractures that cut through the plagioclase and locally rims the sulphides/plagioclase and the mafics. It also fills the fractures that cut the sulphides. The brown mineral is also present as replacement of the pyroxenes through the fractures at the cores of the original crystals. The replacement begins along the fractures then radiates outwards. This mineral is also found as rims along some of the sulphides. A similar phase has been seen in numerous other samples. (~5%)

A.1.6.2 Hole ID: Hp-11 Sample#: 00856-01

From (m): 62.5, **To** (m): 62.55

Rock type: Hornblende-Orthopyroxene Gabbro (mineralized)

Minerals Present: Plagioclase, hornblende (+/- actinolite), chlorite, remnant Opx and Cpx, sericite, apatite, pyrite, graphite, pyrrhotite, chalcopyrite, ilmenite, opaques of unknown composition, magnetite and a yellowish-brown to reddish-brown phase of unknown composition.

Main description: The sulphides locally overwhelm the textures in this sample. This sample appears to have originated as a cumulate, but the texture is somewhat hidden by the presence of what appear to be late sulphides (pyrite). The pyroxenes were granular in texture and the plagioclase forms anhedral to subhedral, to rare euhedral lath shaped crystals that exhibit a very weak lineation. The pyrite appears to be a secondary phase that has replaced the intercumulus minerals, since it locally fills fractures in what appears to be altered primary or cumulus pyroxenes. It appears that the pyrrhotite and chalcopyrite crystallized prior to the pyrite, and are minor phases. The graphite also appears to be a secondary phase, or is easily remobilized, since it can be found in fractures and as open space filling. The pyroxenes are altered and now have a fibrous texture and are no longer single crystals. The exsolution from the pyroxenes is still visible, suggesting that the majority of the cumulus pyroxenes were clinopyroxene, likely augite. Uncertain if any orthopyroxene is present due to the uralitization and current textures of these crystals. There is a weak sericite alteration of the plagioclase, and locally some of the crystals are bent/deformed (ductile), suggesting that this sample may have suffered from compaction. There is a strong presence of an unidentified mineral that is brownish (red/yellow) in colour and appears to have a strong relationship with the sulphides/oxides. Perhaps a late oxide phases that is associated with the emplacement of the pyrite? The contacts between the grains are sharp, and irregular, but the packing of the crystals would suggest that the sample has suffered from some densification and compaction. The presence of bent or deformed plagioclase suggests that this occurred slowly, allowing for ductile deformation of the grains, rather than brittle deformation. The sample shows a partially equilibrated textural geometry.

Plagioclase: Anhedral to subhedral crystals that are cut by numerous fractures and are weak to moderately altered, and locally deformed. Some of the crystals are bent. Most of the crystals show irregular extinction (likely a result of chemical inequilibrium or strain). There are crystals up to 5mm in length, but most are ~2mm in length. Contacts between the crystals are exploited by alteration minerals and sulphides +/- graphite. Very weak lineation of the lath shaped crystals. (~40%)

Orthopyroxene: Minor phase. There are only what appear to be remnant cumulate orthopyroxene crystals present (+/- intercumulus opx?). What were granular shaped crystals now comprise numerous crystals that are fibrous to wispy in texture. The crystals are at various orientations, but the exsolution textures of the primary pyroxenes are still visible. These crystals are also uralitized. Orthopyroxene appears to be a very minor cumulus phase.

Clinopyroxene (augite): There is only what appear to be remnant cumulus augite crystals present and minor intercumulus augite. What were granular shaped crystals now comprise numerous crystals that are fibrous to wispy to granular in shape. The crystals are at various orientations, but the exsolution textures of the primary pyroxenes are still visible. These crystals are also uralitized.

Hornblende: There are crystals of hornblende, as well as hornblende replacing the pyroxenes (uralitized). Reddish-brown to greenish-brown in colour (ppl), crystals are anhedral and their distribution is also irregular. Also present as rims around the pyroxene alteromorphs that appear to grow outwards into the plagioclase.

Actinolite: Replacing the pyroxenes, fibrous in appearance, colourless to pale green under ppl. Typically found with hornblende.

Chlorite: Alteration phase, fibrous crystals, associated with fractures in the plagioclase as well as within the mafics. Chlorite is pale green to pale yellowish-green in colour. There are seams and pods of alteration, with irregular distribution.

Sericite: There is a weak to moderate sericitization of the plagioclase comprised of fine grained crystals that are exploiting the fractures and contacts. Fine grained dusting locally.

Apatite: Apatite is a rare accessory phase. The crystals are subhedral to euhedral and disseminated. (tr)

Ilmenite: Ilmenite appears to be an intercumulus phase, and is comprised of anhedral crystals that are locally associated with, or cut by the graphite. Crystals have sharp irregular contacts. Some of the contacts appear to almost be breaking off into the surrounding silicates (like droplets of water). Ilmenite is also present as fine grained exsolution lamellae in what appears to have been cumulus pyroxenes, forming elongate thin crystals. These are locally lineated. (<1%)

Pyrrhotite: Pyrrhotite is comprised of anhedral crystals. The individual crystals and blebs are trapped within the pyrite and sharing mutual grain boundaries with the pyrite and chalcopyrite locally. There are crystals up to 0.7mm in length present locally, that are locally weakly fractured. The pyrrhotite appears to be an intercumulus phase, but I am uncertain if there is a secondary emplacement or remobilization of the pyrrhotite. Textures would suggest that the pyrrhotite and chalcopyrite are intercumulus phases and that the pyrite is a late phase or secondary phase. (~1%)

Chalcopyrite: Minor sulphide phase, found sharing mutual grain boundaries with pyrrhotite and pyrite. Rare crystals are trapped within the pyrite. Chalcopyrite crystals reaching up to 0.09mm in length, and are anhedral blebs with sharp contacts with other sulphides and the silicates. (<1%)

Pyrite: Pyrite is the main sulphide phase in this sample. The crystals are anhedral to subhedral, and show fracture fill and space filling textures. The pyrite appears to have replaced or overprinted the intercumulus space between the pyroxenes and plagioclase. The contacts are sharp, irregular to locally jagged. Some of the crystals have formed partial euhedral faces, and others are skeletal. There is a strong association of the brownish coloured mineral mentioned below with the pyrite. They are typically found adjacent to each other, or the pyrite +/- graphite may be rimmed by this mineral. Pyrite crystals reach up to 4mm in length. Pyrite is also locally host to small anhedral blebs of pyrrhotite and locally shares boundaries with the pyrrhotite and minor chalcopyrite. The pyrite appears to be a late phase. Uncertain if there is any remobilization of the pyrite. (~10%+)

Graphite: Graphite is comprised of anhedral to subhedral crystals that are elongate (look like tree branches). Some of the crystals are deformed, such as being curved or bent. The graphite is locally present as fracture fill, and space filling. It is associated with the pyrite, which appears to be a secondary phase. Locally the graphite is growing into the silicate phases in the sample (not restricted to the intercumulus space.) (5-7%)

Magnetite: Rare anhedral crystals, located adjacent to sulphides (pyrite). Crystals up to 0.02mm in length. (tr)

Opaques (unknown composition): Associated with the sulphides and oxides. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

Brownish-yellow/brownish-red mineral: Abundant phase associated with the fractures and the sulphides/oxides. Fine grained, reddish-brown to yellowish-brown in colour, fracture fill, pods and patches adjacent to the sulphides/oxides. Not an opaque phase. Does not change character from ppl to xpl. Present as fracture fill, open space filling and fine grained aggregates. Uncertain of composition. (~5-10%)

A.1.6.3 Hole ID: Hp-11 Sample#: 00856-02

From (m): 62.61, **To** (m): 62.66

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, chlorite, hornblende, sericite, remnant Opx and Cpx, graphite, pyrite, chalcopyrite, pyrrhotite, ilmenite, opaques of unknown composition and a brownish-yellowish mineral similar to that seen in 00856-01, and quartz.

Main description: The sample shows numerous similarities to 00776-01, 00779-01, 00783-01, 00793-01, 00829-01, 00839-01, but is generally coarser grained, and has a stronger intensity alteration, as well as a stronger presence of graphite and pyrite. Plagioclase is the most abundant silicate mineral present and forms somewhat of a framework. The plagioclase crystals are anhedral to subhedral and rarely euhedral, and the contacts are sharp but irregular. They are locally deformed and show irregular extinction. The contacts are typically exploited by alteration phases and opaque phases. The pyroxenes are uralitized and locally some of the cores of the crystals remain. Exsolution of Fe- Ti oxides in the pyroxenes are still clearly visible. The orthopyroxenes appear to be a cumulus phase (+/- intercumulus phase?) and the augite an intercumulus phase. The pyroxenes are locally poikilitic (enclosing pyroxenes and plagioclase as well as ilmenite). Replacement/alteration of the pyroxenes by amphiboles is common, as well as by chlorite, especially where the pyroxenes are cut by fractures. The sample is cut by numerous fractures that are host to chlorite alteration +/- quartz. This sample also shows some similarities to 840-01, 842-01 and 843-01. The packing of the crystals would indicate that there has been some reduction in pore volume, suggesting that the sample has suffered from densification and compaction. The contacts between the crystals are sharp, and irregular. The sample shows a partially equilibrated geometry.

Plagioclase: Subhedral to anhedral crystals that are locally lath shaped. Crystals up to 4mm in length are locally present. There is a significant variety of sizes present (4mm or less), most are 2mm in length. Some are kinked/bent, and some show irregular extinction, which may be a result of compaction? The plagioclase forms the main framework of the sample and appears to be a cumulate phase. Contacts are sharp but irregular. There is a weak intensity sericite alteration, and the plagioclase crystals are cut by numerous fractures. These fractures are filled with chlorite and an unknown brownish coloured mineral locally. The plagioclase is also host to numerous fine grained acicular needles that locally have a weak lineation. The needles are too small to resolve their composition.

Orthopyroxene: Remnant fragments of orthopyroxene are present locally. Some of the exsolution textures of the Fe-Ti oxides are still visible. The orthopyroxene appears to have originated as a cumulus phase. The crystals are granular to slightly elongate and are now strongly altered, and uralitized. Uncertain if there is intercumulus orthopyroxene present due to alteration. Crystals reach up to 6mm in length and are strongly uralitized, and locally chloritized.

Clinopyroxene (augite): Remnant fragments of augite are present locally. Some of the exsolution textures are still visible. The augite appears to have originated as both a cumulus and intercumulus phase, and is locally poikilitic. The crystals are anhedral to subhedral and reach up to 8mm in length. The crystals are strongly uralitized, and locally chloritized.

Hornblende: Replacing the pyroxenes (uralitized) and forms numerous granular anhedral to subhedral crystals that replace and rim the pyroxene alteromorphs. The hornblende is not restricted to the initial crystal boundaries of the pyroxenes and locally is encroaching into the plagioclase. Chlorite locally associated with the hornblende. (Main alteration phase of the pyroxenes, and is the most abundant mafic phase now present in this sample.) (20-30%)

Biotite: Minor alteration phase, typically found adjacent to the oxides phases, fibrous radiating crystals. (tr)

Chlorite: One of the main alteration phases in this sample, and is present as fracture fill, alteration of the mafics, and locally found filling fractures and contacts in the plagioclase. Typically fibrous to radiating textured crystals that are pale green in ppl and locally anomalous blues under xpl. (~5-7%)

Sericite: Weak to moderate intensity alteration of the plagioclase that is exploiting fractures and contacts. Appears as a fine dusting on the plagioclase crystals. (~3%)

Quartz: Small anhedral crystals associated with the fractures, filling open space and fractures. (<1%)

Ilmenite: Main oxide phase. Anhedral crystals typically found with the mafics as larger crystals, and locally as thin exsolution lamellae. Locally the ilmenite is breaking down to form leucoxene/rutile? Crystals up to 1.4mm in length. (~1-2%)

Pyrrhotite: Anhedral crystals that are weakly fractured and generally found with the graphite. Pyrrhotite is a minor sulphide phase, with crystals reaching up to 0.4mm in length. The contacts between crystals are sharp and irregular. (tr)

Chalcopyrite: Minor sulphide phase, anhedral crystals, associated with the fractures. Contacts are sharp, locally fine grained blebs. (<1%)

Pyrite: Main sulphide phase, pyrite is present as fracture fill and space filling crystals that are anhedral to subhedral and locally skeletal. There is a decreased presence of pyrite in this sample, compared to 856-01 which is cut from the same piece of drill core. (~1%)

Graphite: Anhedral radiating crystals, branchlike crystals and locally anhedral pods. Appears to be a later phase, possibly associated with the emplacement of pyrite. (~1-2%)

Opaques (unknown Composition): Typically found in proximity to the opaques as rims and surrounding the crystals. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1%)

Brownish Mineral: Fine grained aggregates? Brownish coloured mineral that does not change character under ppl or xpl. Typically found with the opaque phases, but also as fracture fill and what appears to be alteration of the mafics. (~5-7%)

A.1.6.4 Hole ID: H-05 Sample#: 00804-01

From (m): 36.34, **To** (m): 36.39

Rock type: Mineralized Hornblende Gabbro

Minerals Present: Plagioclase, hornblende (+/- actinolite), chlorite, biotite, sericite, calcite, pyrrhotite, chalcopyrite, ilmenite, graphite, opaques (unknown composition).

Main description: Sulphide rich sample. The sulphides appear to be an intercumulus phase with a secondary episode of growth, possibly some remobilization. The silicates are poikilitically enclosed by the pyrrhotite locally. Plagioclase is the most abundant silicate phase, and appears to be a cumulus and intercumulus phase. The initial mafic minerals (pyroxenes) are replaced by amphiboles. There is a weak intensity carbonate +/- sericite alteration locally. Graphite is also present and appears to be an intercumulus and late phase. The contacts of the grains are sharp, and smooth. The crystals show a texturally equilibrated to partially equilibrated geometry and there has been a significant reduction in the pore volume, leading to densification of the sample. This would suggest that this sample has undergone densification and compaction. A pattern seen in this sample is typical of some of the other sulphide rich samples seen from this intrusion, consisting of layers of: fine grained gabbro, strongly uralitized pyroxenes and sulphides, coarse plagioclase, sulphides, finer grained plagioclase with sulphides and pyroxenes showing a weak layering/ lineation.

Plagioclase: Anhedral, crystals up to 3.5mm in length but most are 0.5mm in length. Contacts are sharp, irregular to rounded, and are sources of alteration. Some of the crystals exhibit irregular extinction (possibly a result of compaction?). The plagioclase is host to numerous acicular needles of unknown composition (too small to resolve). Plagioclase is a cumulus and intercumulus phase? (~25%)

Orthopyroxene: Only exsolution textures remain. Strongly uralitized.

Clinopyroxene (augite): None visible. May have been present, but is now strongly uralitized.

Hornblende: Irregular, anhedral to subhedral crystals that are pale green to brownish in colour. Crystals at various orientations form large aggregates replacing what is likely primary orthopyroxene. Crystals up to 2.5mm but most are 0.5mm in length. Locally weak biotite and chlorite alteration. (~20%)

Actinolite: Alteration of primary pyroxenes. Crystals are fibrous, anhedral to subhedral. Associated with the hornblende.

Biotite: Alteration phase, associated with the chlorite and hornblende. Fibrous crystals up to 0.4mm in length, and are subhedral to anhedral. Also found adjacent to the opaque phases.

Chlorite: Colourless to pale green under ppl, fibrous crystals and aggregates. Crystals up to 0.8mm in length. Dominant alteration phase of the amphiboles.

Calcite: Secondary alteration that is exploiting fractures, crystal contacts and boundaries. Forming fine grained crystals and small pods up to 0.3mm in length. Crystals are anhedral.

Sericite: Fine grained alteration of the plagioclase that is exploiting fractures and contacts. Appears as a fine grained dusting of the plagioclase.

Ilmenite: Anhedral crystals, associated with the pyrrhotite and locally shares mutual grain boundaries with pyrrhotite. Crystals up to 0.2mm in length. Locally found with the biotite (exsolution??) (<1%)

Pyrrhotite: Main sulphide phase and most abundant phase in this sample. Anhedral crystals that surround the silicate phases. The crystals are cut by numerous fractures and are host to tiny pits. Numerous interconnected crystals with rare dihedral angles are locally host to graphite crystals as well as anhedral blebs of chalcopyrite. Contacts with the silicates are sharp and irregular, locally small fragments of the pyrrhotite are breaking off. The pyrrhotite forms large interconnected crystals that crosscut the slide (2.4cm in width). The crystals appear to be intercumulus phases. (>25%)

Chalcopyrite: Anhedral crystals, sharing mutual boundaries with the pyrrhotite and some of the blebs are trapped in the pyrrhotite, suggesting that these were co-crystallizing phases. Crystals up to 0.2mm in length. (<1%)

Graphite: Flaky, soft, scaly to dendritic crystals that are locally hosted in the pyrrhotite and cut the silicates. Crystals up to 0.4mm in length, but most are 0.2mm in length. Secondary phase?? The presence of graphite trapped in the pyrrhotite suggests that it is a coexisting phase with the pyrrhotite and chalcopyrite. (~5-8%)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.7 Unit 5a

Samples FX847933 and FX847937 described in Greenough, et al (2011) are part of this unit, including the samples below.

A.1.7.1 Hole ID: H-04 Sample#: 00798-01

From (m): 97.24, **To** (m): 97.29

Rock type: Augite Norite

Minerals Present: Plagioclase, orthopyroxene, augite (cpx), pigeonite, hornblende, biotite, sericite, pyrrhotite, chalcopyrite, ilmenite, rutile, apatite, pentlandite, opaques of unknown composition.

Main description: This is the least altered sample from the samples collected from the Wadi Qutabah Layered gabbroic Complex. It also exhibits some of the most abundant exsolution textures. The plagioclase crystals (laths) are lineated parallel to the layering. The mafic phases (pyroxenes) are also weakly oriented parallel to the layering direction. The pyroxenes are intercumulus phases that show abundant exsolution textures and are anhedral to subhedral. The sulphides and oxides are intercumulus and cumulus phases to the plagioclase and are typically associated with the mafic phases. Ilmenite is the main opaque phase, and is a distinguishing feature of this unit. There is a weak alteration in this sample. This sample exhibits both texturally equilibrated and partially equilibrated geometry. The feldspars locally show common triple junctions, which reduces the pore space and increases the density and packing of the crystals. The crystals also demonstrate a partially equilibrated texture, with the rounded and smooth contacts. The presence of kinked or bent crystals is likely a result of compaction or densification.

Plagioclase: Subhedral to anhedral plagioclase laths show a weak to moderate lineation with the layering. Contacts are sharp, irregular to rounded. Plagioclase is the most abundant phase of this sample, and is typically nesophitic to locally ophitic. Host to numerous acicular fine grained needles. Some of the crystals are kinked and some show irregular extinction (related to compaction?) Most of the plagioclase crystals appear to be cumulus phases, with minor intercumulus crystals. (Single crystal= An53) (~45-50%)

Orthopyroxene: Irregular and anhedral crystals that are locally poikilitic (enclosing plagioclase and other pyroxenes locally) and show abundant exsolution textures. Exsolution of augite and pigeonite, and locally fine exsolution lamellae of ilmenite are hosted in the orthopyroxene. The orthopyroxenes and clinopyroxenes form chain like crystals that are parallel to sub parallel to the lineation of the plagioclase. Crystals up to 4.5mm in length, but most are 0.4-1mm in length. (35-40%)

Clinopyroxene (augite): Irregular and anhedral to granular to poikilitic crystals (enclosing plagioclase and other pyroxenes locally) and locally showing minor exsolution. Augite is also present as an exsolution phase hosted in the orthopyroxenes. Crystals up to 2mm in length, but most are 0.5-1mm in length.

Pigeonite: Exsolution phase hosted in the orthopyroxene, and locally as an intercumulus phase.

Hornblende: Weak uralitization of the primary pyroxenes. Hornblende is most abundant where the alteration is most intense (carbonate/sericite). Contacts are sharp to gradational, weak biotite alteration. Locally Oxides remain as part of the replacement process. Crystals up to 1.4mm in length but most are <1mm. (<1-1%)

Biotite: Alteration of the pyroxenes and amphibole, rare crystals up to 0.3mm in length. Also locally found adjacent to the oxides phases.

Calcite: There is a weak intensity calcite alteration that is exploiting fractures and contacts. Where carbonate alteration is most intense, typically the uralitization and biotitization is also most intense.

Sericite: Weak intensity alteration of the plagioclase. Fine grained crystals that are exploiting the fractures and crystal contacts/ boundaries. Appears as a fine grained dusting on the plagioclase. (<1%)

Apatite: Rare accessory phase. Acicular crystals, typically hosted in the plagioclase. (tr)

Ilmenite: Main opaque phase, that seems to be a distinguishing feature of this unit. Irregular, anhedral crystals that are locally twinned. The larger crystals are composed of a number amalgamated crystals that locally show minor annealing with dihedral angles. Host to small blebs of pyrrhotite and chalcopyrite suggesting that they were co-crystallizing phases. Single crystals up to 1.6mm but clusters can reach up to 3.3mm. Cumulus to intercumulus phase. (~15%)

Pyrrhotite: Irregular, anhedral crystals up to 0.4mm in length. Small blebs locally hosted in the ilmenite crystals. Some of the crystals show exsolution of what appear to be pentlandite.

The pyrrhotite is typically found bordering or hosted in the mafic phases (pyroxenes). Intercumulus phase. (~1%)

Chalcopyrite: Anhedral crystals that are typically found with the pyrrhotite, crystal up to 0.05mm in length. (tr)

Pentlandite: Exsolution that looks like flames along the margins of the pyrrhotite. (tr)

Magnetite: A single small anhedral bleb of magnetite found with pyrrhotite and ilmenite.(tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.7.2 Hole ID: H-05 Sample#: 00806-01

From (m): 52.32, **To** (m): 52.37

Rock type: augite hornblende norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite + pigeonite), hornblende, biotite, sericite, calcite, ilmenite, pyrrhotite, graphite, chalcopyrite, pyrite, opaques (unknown composition), pentlandite, zircon?

Main description: Similar to 00798-01, but with increased intensity alteration, coarser grained than 00806-02.The plagioclase crystals are the most abundant phase of the sample and are lineated parallel to the layering. Some of the plagioclase crystals are weakly zoned. The pyroxenes are intercumulus phases that show exsolution textures and are anhedral to subhedral to locally poikilitic. The sulphides and oxides are intercumulus phases to the plagioclase and are typically associated with the mafics. Ilmenite is the most abundant of the opaque phases, and there is a minor presence of graphite, which appears to be a secondary phase. This is a weakly altered, allotriomorphic to hypidiomorphic medium grained norite. The geometry of the crystals would suggest that the sample has undergone densification, and likely some compaction. The presence of kinked or bent crystals would support that hypothesis. The contacts between the grains are sharp, smooth but typically irregular. Some of the plagioclase crystals show a texturally equilibrated geometry, but the contacts between other grains suggest a partially equilibrated geometry.

Plagioclase: Plagioclase is the most abundant phase of this sample. The crystals are both cumulus and intercumulus. The crystals are anhedral to subhedral, to rare euhedral plagioclase laths that show a weak to moderate lineation with the layering direction. There is a significant variation in crystals sizes with laths reaching up to 7mm, but most are 2mm or less in length. Contacts are sharp, irregular to rounded. Plagioclase is typically nesophitic to locally ophitic. Some of the crystals show irregular extinction. Plagioclase is suffering from a weak carbonate and sericite alteration. (~50%)

Orthopyroxene: Anhedral crystals, exsolution textures, locally poikilitic/ophitic (enclosing augite and plagioclase). Exsolution of augite and pigeonite present, and locally fine exsolution lamellae of ilmenite. Crystals up to 4mm in length, but most are 1-2mm in length. Intercumulus phase. Weakly uralitized locally. (~25-30%)

Clinopyroxene (augite): Anhedral to granular to poikilitic/rims crystals and locally showing exsolution textures. Also present as exsolution in the orthopyroxenes. Crystals up to 4mm in length, but most are 1-2mm in length. Intercumulus phase. Locally weakly uralitized.

Pigeonite: Exsolution phase hosted in the orthopyroxenes.

Hornblende: Anhedral crystals, typically pale brown to pale green in colour (ppl).Present as rims and uralitization of the pyroxenes. Crystals up to 1.2mm in length with sharp to locally gradational contacts.

Biotite: Alteration mineral of the pyroxenes and amphiboles, rare anhedral to subhedral fibrous crystals, up to 0.2mm in length. Also locally found adjacent to the oxides phases. (~1-2%)

Calcite: Weak intensity calcite alteration that is exploiting fractures/contacts and fractures. (<1%)

Sericite: Weak intensity alteration of the plagioclase. Fine grained crystals that are exploiting the fractures and crystal contacts/ boundaries. Appears as a fine grained dusting of the plagioclase. (<1%)

Zircon: Only a single crystal found. Zircon? Too small to resolve. (tr)

Ilmenite: Main opaque phase. Irregular, anhedral crystals. Contacts are typically sharp to slightly rounded. Locally host to small blebs of pyrrhotite. Typically associated with the mafic phases. Also present as fine grained exsolution lamellae. Intercumulus phase. (~10-15%)

Pyrrhotite: Irregular, anhedral crystals up to 0.8mm in length. Associated with the graphite, ilmenite and chalcopyrite. Some of the crystals show exsolution of what appear to be pentlandite? Pyrrhotite locally is host to blebs of chalcopyrite and is itself hosted in ilmenite locally, suggesting that these are co-crystallizing phases. Intercumulus phase. (~1-2%)

Chalcopyrite: Anhedral crystals that are typically found with the pyrrhotite, crystal up to 0.15mm in length. (tr)

Pyrite: Subhedral to anhedral crystals trapped in the pyrrhotite and locally found along the margins of the pyrrhotite. Crystals up to 0.07mm in length. (tr)

Graphite: Irregular, anhedral crystals that form large clusters up to 6mm in length. Graphite is hosted in the mafic phases, and locally small blebs of pyrrhotite and crystals of ilmenite are hosted in the graphite. Patchy distribution. (~2-3%)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1-2%)

A.1.7.3 Hole ID: H-05 Sample#: 00806-02

From (m): 52.67, **To** (m): 52.72

Rock type: Augite Hornblende norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite+ pigeonite), hornblende, biotite, sericite, calcite, ilmenite, pyrrhotite, graphite, chalcopyrite, pyrite, apatite, opaques (unknown composition)

Main description: Cut from the same sample as 00806-01 but the focus of this sample is on the fine grained segregations that are common to these rocks. This sample contains both coarser and a fine grained norite. The fine grained segregation represents approx. 2/3 to 3/4 of the polished thin section, the remainder is similar to that seen in 00806-01. The coarser section of the sample is similar to 00798-01 but with increased alteration intensity. The plagioclase crystals are the most abundant phase of the sample and are lineated parallel to the layering. The pyroxenes are intercumulus phases that show exsolution textures and are anhedral to subhedral to locally poikilitic. The majority of the pyroxenes in the fine grained segregation are orthopyroxenes. The sulphides and oxides are intercumulus phases to the plagioclase and are typically associated with the mafic phases. There is a weak alteration, and the sample is allotriomorphic to hypidiomorphic, medium grained augite-hornblende norite. The contact between the coarser and finer grained norite is sharp and there is a thin band of augite along the contact.

Within the fine grained segregation the average crystal size is approx. 0.2-0.3mm in length. The crystals are granular and anhedral to locally subhedral with minor poikilitic pyroxenes and rare crystals that show fine grained exsolution lamellae. There is a weak biotite alteration and weak uralitization. The crystals are weakly elongate parallel to the layering direction.

The geometry of the crystals would suggest that the sample has undergone densification, and likely some compaction. The presence of kinked or bent crystals would support that hypothesis. The contacts between the grains are sharp, smooth but typically irregular. Some of the plagioclase crystals show a texturally equilibrated geometry, but the contacts between other grains suggest a partially equilibrated geometry. The packing of the crystals is tight, with locally present triple junction contacts.

Plagioclase: In the finer grained norite the pyroxene crystals are anhedral to subhedral and reach up to 1.2mm, but most are 0.4-0.5mm in length. Contacts are sharp, but rounded and there is a very weak lineation of the crystals parallel to the layering direction. Weak sericite and carbonate alteration. The crystals appear to be largely intercumulus phases, but some of these may also be cumulus crystals. In the medium grained gabbro: anhedral to subhedral, to rare euhedral plagioclase laths that show a weak to moderate lineation with the layering direction. There is a significant variation in crystals sizes with laths reaching up to 7mm, but most are 2mm or less in length. Contacts are sharp, irregular to rounded. Plagioclase is typically nesophitic to locally ophitic. Some of the crystals show irregular extinction. There is a weak carbonate and sericite alteration. Within the coarser norite, the plagioclase appears to be both cumulus and intercumulus phases. (~55-60%)

Orthopyroxene: In the fine grained norite, the orthopyroxene is granular, anhedral, locally poikilitic, locally weakly altered (biotite) and locally being replaced (uralitized). In the medium grained gabbro the crystals are Anhedral and are locally poikilitic/ophitic (enclosing Augite and plagioclase). Host to exsolution of augite, and locally fine exsolution lamellae of ilmenite. Crystals up to 4.2mm in length, but most are 1-2mm in length. Intercumulus phase. Weakly uralitized locally. (~25-30%)

Clinopyroxene (augite): In the fine grained gabbro the clinopyroxene is granular, anhedral to subhedral, locally weakly altered (biotite) and locally being replaced (uralitized). In the medium grained gabbro the crystals are anhedral to granular to poikilitic/rims crystals and locally showing exsolution textures. Also present as exsolution in the orthopyroxenes. Crystals up to 4mm in length, but most are 1-2mm in length. Intercumulus phase, locally weakly uralitized.

Hornblende: In the fine grained segregation, the hornblende is anhedral, up to 0.6mm in length. Locally replacing the pyroxenes and weak biotite alteration. In the medium-grained gabbro the crystals are anhedral, typically pale brown to pale green in colour (ppl). The hornblende is present as uralitization of the primary pyroxenes and as rims around the pyroxenes. Crystals up to 1.2mm in length. Contacts are sharp to locally gradational.

Actinolite: May be minor actinolite associated with the hornblende locally.

Biotite: Alteration mineral of the pyroxenes and amphiboles, rare anhedral to subhedral fibrous crystals up to 0.4mm in length. Can also be found adjacent to some of the oxide and sulphide phases.

Calcite: Weak intensity calcite alteration that is exploiting fractures/contacts and fractures.

Sericite: Weak intensity alteration of the plagioclase. Fine grained crystals that are exploiting the fractures and crystal contacts/ boundaries. Present as a fine grained dusting on the plagioclase. The sericite alteration is more intense in the coarser grained gabbro.

Apatite: Accessory phase. Small subhedral to euhedral acicular crystals, 0.01 to 0.05mm in length. (tr)

Ilmenite: In the fine grained segregation the ilmenite represents a minor percentage of the opaque phases (~1%). Crystals are anhedral and up to 0.4mm in length. Ilmenite is locally host to small blebs of pyrrhotite, and shares mutual boundaries with pyrrhotite and chalcopyrite. In the coarser grained gabbro the ilmenite is the main opaque phase. Irregular, anhedral crystals. Contacts are typically sharp to slightly rounded. Locally host to small blebs of pyrrhotite. Typically associated with the mafic phases. Also present as fine grained exsolution lamellae. Intercumulus phases.

Pyrrhotite: Most abundant sulphide phase and opaque phase in the fine grained segregation (~5-7%), composed of anhedral blebs, intercumulus, crystals up to 0.4mm in length but most are 0.1mm. They share mutual crystal boundaries with chalcopyrite and ilmenite. Rare blebs of pyrrhotite are encapsulated in the ilmenite. In the coarser gabbro the crystals are irregular, anhedral crystals up to 0.8mm in length. Associated with the graphite, ilmenite and chalcopyrite. Pyrrhotite locally is host to blebs of chalcopyrite and is itself hosted in ilmenite locally. Approx. 2% pyrrhotite in the coarser grained gabbro. Intercumulus phase.

Chalcopyrite: Anhedral crystals that are typically found with the pyrrhotite or enclosed in the pyrrhotite. (tr)

Pyrite: Anhedral crystals trapped in the pyrrhotite and locally in fractures in the ilmenite. Only seen in the coarser grained gabbro, none seen in the fine grained segregation.

Graphite: Irregular, anhedral crystals that form dendritic needle like crystals. Most abundant in the coarser grained gabbro. None seen in the fine grained segregation.

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~5%)

A.1.7.4 Hole ID: H-05 Sample#: 00812-01

From (m): 99.29, **To** (m): 99.34

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, hornblende (+/- actinolite), biotite, sericite, calcite, ilmenite, pyrrhotite, augite, orthopyroxene, opaques (unknown composition)

Main description: Similar to 00798-01, but this sample has a more intense alteration. This is an allotriomorphic to hypidiomorphic medium grained gabbro. There is a weak lineation of the plagioclase and mafic phases parallel to layering. The plagioclase is the main silicate phase and most abundant phase of the sample. The hornblende crystals appear to be the product of strong uralitization of what was likely, primary pyroxenes. Locally exsolution textures are still visible, and some rare orthopyroxene and augite crystals remain. The replaced pyroxenes are now composed of numerous hornblende crystals at various orientations, and no longer respect the primary crystal boundaries and enter the plagioclase. There is a weak sericite and carbonate alteration as well as biotite locally. Ilmenite and pyrrhotite are both present and are intercumulus, co-crystallizing phases. This sample has undergone densification and there is a significant reduction in pore space. The contacts between the crystals are sharp, smooth, and irregular. The plagioclase crystals are locally kinked or bent suggesting that densification and compaction have affected this sample. The crystals show a partially equilibrated geometry.

Plagioclase: Anhedral to subhedral crystals that show significant variability in size up to >4mm, but most are ~1-2mm in length. Contacts are irregular, sharp but typically rounded. Crystals are lineated. Crystals are locally kinked, and some exhibit irregular extinction and zoning. The plagioclase is also host to fine grained acicular needles (unknown composition) that are too small to resolve. Weak carbonate +/- sericite alteration that is associated with fractures.

Plagioclase is the most abundant phase present in this sample and is both a cumulus and intercumulus phase. (~45-50%)

Orthopyroxene: Rare crystals remain, but most are strongly uralitized. Locally exsolution textures are still visible.

Clinopyroxene (augite): Rare crystals remain, but most are strongly uralitized.

Hornblende: Main mafic phase, replacing what appears to have been primary pyroxenes. Locally exsolution lamellae are visible in what appears to have been orthopyroxene. There are numerous hornblende crystals at various orientations making up what appear to be individual large crystals on the macroscale. The crystals are no longer restricted to the primary crystal boundaries and are locally entering the plagioclase. Crystals up to 2mm but most of them are 0.2-0.5mm in length. May be minor actinolite associated with the hornblende. (~30-35%)

Actinolite: Minor alteration phase associated with the hornblende.

Biotite: Anhedral to subhedral fibrous crystals up to 0.4mm in length. Typically found in proximity to ilmenite and hornblende. (~2-3%)

Calcite: Weak intensity alteration that is exploiting fractures and contacts. (<1%)

Sericite: Weak intensity alteration of the plagioclase, and is exploiting fractures and contacts. (<1%)

Ilmenite: Anhedral crystals up to 1.8mm in length. Main opaque phase, intercumulus, typically associated with the mafic phases and as fine grained exsolution lamellae. Locally exsolution in the ilmenite of rutile? Leucoxene? Ilmenite is also locally host to blebs of pyrrhotite and shares mutual boundaries with pyrrhotite. Likely co-crystallizing phases. (~10-15%)

Pyrrhotite: Anhedral crystals and blebs, sharing mutual boundaries with, and locally trapped in the ilmenite, and is associated with the mafic phases. (intercumulus phase) (~1%)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.7.5 Hole ID: H-06 Sample#: 00814-01

From (m): 17.41, **To** (m): 17.46

Rock type: Augite Norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite), pigeonite, hornblende, biotite, calcite +/- sericite, quartz, apatite, ilmenite, pyrrhotite, chalcopyrite, exsolving mineral in the pyrrhotite, opaques (unknown composition), pentlandite

Main description: Similar to 00798-01, but with more biotite alteration and a noted increase in apatite. Allotriomorphic to hypidiomorphic medium-grained norite. Generally the crystals are weak to moderately aligned parallel to the layering. The larger plagioclase laths are aligned parallel to layering. The plagioclase is one of the most abundant phases, and is both a cumulus and intercumulus phase. The mafic minerals (orthopyroxene, clinopyroxene, pigeonite and hornblende), form granular to large poikilitic crystals that are anhedral, and pods of interconnected crystals, likely as a result of crystallizing from the intercumulus liquid. The orthopyroxene is cumulus to intercumulus phase that hosts exsolution of augite locally. The opaque phases are also intercumulus to the plagioclase and are anhedral, most are associated with the mafic phases. This sample is cut by a number of small fractures that are locally filled with silica (qtz), carbonate and biotite. The plagioclase crystals vary in size up to 5mm, but most are ~1mm in length. The mafic crystals reach up to 5mm, but most are ~1mm in length, and typically form amalgamations of crystals that are parallel to the layering. Apatite is an accessory phase, and is disseminated (typically subhedral to euhedral). The contacts between the grains are sharp, smooth and irregular to locally serrated, and show a partially equilibrated geometry. The presence of kinked or bent crystals would suggest that the sample has undergone both densification and likely some compaction.

Plagioclase: Crystals up to 5mm, but most are ~1-2mm, typically the crystals are anhedral to subhedral, and have rounded but sharp contacts. Some of the crystals are zoned, exhibit irregular extinction and some are bent or kinked (related to compaction?). The plagioclase is locally weakly altered by carbonate +/- sericite, this is generally in the vicinity of the fractures. Plagioclase is also host to numerous acicular needles of actinolite? These crystals are at various orientations within the plagioclase, and are too small to resolve their composition. Both a cumulus and intercumulus phase, some of the plagioclase appear to have crystallized at a similar time as the pyroxenes.

Orthopyroxene: Cumulus to intercumulus phase, typically showing exsolution of augite, and is locally altered by amphiboles (hbld +/- actinolite) (uralitized). Crystals are anhedral to subhedral locally, some are poikilitic locally enclosing plagioclase, augite and other crystals of Opx and locally ilmenite and pyrrhotite. Crystals up to 5mm locally but most are ~1-2mm.

Augite (Cpx): Present as exsolution within the Opx, and locally as individual crystals. Crystals are anhedral and also exhibit exsolution. Typically, forming clusters of pyroxenes that are found between layers of plagioclase crystals, and parallel to layering. Crystals up to 1mm, most are ~0.5mm.

Hornblende: Replacement or alteration of the pyroxenes (uralitization). Rarely present as thin rims surrounding parts of the pyroxenes, generally more abundant in those regions of the rock that are more intensely altered. (carbonate). (pale green to brownish in colour, pleochroic under ppl)

Actinolite: Fine acicular needles, typically associated with hornblende and locally with the carbonate alteration. These may be the needles that are trapped in the plagioclase.

Biotite: Alteration mineral that is generally associated with the ilmenite +/- pyrrhotite, typically adjacent to or in close proximity to. Crystals range from fine grained fibrous crystals, up to large crystals of 2.1mm in length. The biotite is also host to fine grained exsolution of ilmenite parallel to the cleavage. There appears to be two generations of biotite present.

Calcite: Alteration mineral, typically exploiting fractures and contacts, affecting the plagioclase and the pyroxenes, typically forming fine grained aggregates, and is associated with biotite. Generally fine grained.

Sericite: Alteration phase of the plagioclase. Exploiting fractures and contacts. Associated with the calcite.

Apatite: Rare accessory phase. Associated with the veinlets and hosted in the plagioclase and quartz, crystals are subhedral to euhedral. (<1%)

Quartz: Fracture or vein fill, rare crystals up to 1.4mm in length, most are irregular and show undulatory extinction, generally associated with other alteration minerals such as biotite and locally calcite. Locally hosting crystals of apatite.

Ilmenite: Most abundant of the opaques. Anhedral crystals that typically have mutual grain boundaries and rare dihedral angles. Most of the crystals are fractured, or show minor pitting. Some of the ilmenite crystals poikilitically enclose blebs of pyrrhotite suggesting that they are co-existing phases. Locally ilmenite also present as exsolution within the biotite and very fine grained crystals within the pyroxenes. Crystals up to 1.6mm in length. Intercumulus Phase.

Pyrrhotite: Main sulphide phase, generally showing mutual boundaries with the ilmenite. Locally blebs trapped within the ilmenite crystals. Anhedral, irregular, intercumulus phase, blebs up to 0.6mm. Locally poikilitically enclosing small blebs of chalcopyrite. Some of the pyrrhotite is showing exsolution lamellae along the margins, possibly pentlandite?

Chalcopyrite: Small blebs, typically associated with pyrrhotite or as blebs tapped within the Po. All crystals seen are <0.1mm.

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1%)

A.1.7.6 Hole ID: Hp-08 Sample#: 00851-01

From (m): 171.26, **To** (m): 171.31

Rock type: Gabbro

Minerals Present: Plagioclase, orthopyroxene (rare), clinopyroxene (augite), biotite, hornblende, calcite, apatite, ilmenite, graphite, pyrrhotite, chalcopyrite, pyrite, opaques (composition?)

Main description: This sample contains both fine grained and coarser gabbro. The contact between the two is composed of granular pyroxenes that form a barrier between the fine and medium grained gabbros. The fine grained gabbro is composed of granular to slightly elongate crystals that are lineated and parallel with the layering. The fine grained gabbro (fine grained segregation or fine grained layer?) appears to from one of possibly a number of size graded layers. This layer is approx. 1.25cm in thickness down the thin section. The crystals are anhedral. Some of the pyroxenes are poikilitic and contain almost rounded holes of plagioclase (ophitic texture). There is a weak carbonatization in proximity to the contact with the coarser grained gabbro. Weak uralitization and weak biotitization are most intense where the carbonatization is most intense. Abundant sulphides/oxides, graphite and opaques hosted in the fine grained layer. These are also anhedral and appear to be intercumulus phases as well. The crystals in both parts of the sample are allotriomorphic to hypidiomorphic, fine grained gabbro (average crystal size ~0.3mm). The sample is tightly packed, and the arrangement of the crystals would suggest that there has been some densification. The contacts between the crystals are sharp and smooth. The sample texturally shows a partially equilibrated geometry.

The coarser grained gabbro is composed of cumulus plagioclase and pyroxenes (mostly augite). There is a very weak lineation of the plagioclase laths. There is a weak to locally moderate carbonatization that is exploiting fractures, contacts/crystal boundaries to infiltrate the sample. The pyroxenes are primarily cumulus phases with rare intercumulus crystals. Some of the granular pyroxenes are hosted in poikilitic plagioclase crystals showing nesophitic texture. Very minor intercumulus pyroxenes are anhedral and angular. The sulphides/oxides are intercumulus to late phases. The ilmenite forms intercumulus anhedral and angular crystals trapped between the plagioclase crystals. The pyrrhotite and chalcopyrite also appear to be intercumulus phases, but some appears to either have been remobilized or there is a secondary episode of sulphide emplacement. The graphite appears to be a late addition to the sample and is exploiting the fractures and is generally found with the calcite and carbonate alteration. Minor pyrite mineralization is a late addition and appears to be related to the carbonate alteration, and likely crystallized from the carbonate bearing fluids or a late sulphide emplacement. The crystals in both parts of the sample are allotriomorphic to hypidiomorphic, medium grained gabbro (average crystal size ~1-1.5mm). The sample is tightly packed, and the arrangement of the crystals would suggest that there has been some densification. The contacts between the crystals are sharp and smooth to serrated. The sample texturally shows a partially equilibrated geometry.

Plagioclase: The plagioclase in the fine grained gabbro is anhedral, almost granular to slightly elongate in shape. The contacts are sharp, irregular to rounded. Some of the plagioclase crystals share dihedral angles between the plagioclase and pyroxenes which are common. Irregular distribution of weak carbonatization. The plagioclase in the coarser gabbro is subhedral to anhedral and appears to be both cumulus and intercumulus. Some of the crystals are locally poikilitic (enclosing pyroxenes) showing nesophitic texture.

Orthopyroxene: Orthopyroxene is a very minor component of this sample. Most of the pyroxenes are augite. Finer grained gabbro: crystals are anhedral and are slightly elongate. Most of the crystals are ~0.3mm in length and form part of a weakly size graded layer. Coarser gabbro: orthopyroxenes are granular to slightly elongate anhedral crystals that are locally yellowish in colour. Cleavage planes are prominent that locally host Fe-Ti oxide exsolution lamellae.

Clinopyroxene (augite): Finer grained gabbro: crystals are anhedral and are elongate to poikilitic, up to 0.9mm in length. Most of the crystals are ~0.3mm in length. The crystals are slightly elongate parallel to the layering. Along the contact between the two distinct grain sized layers the augite crystals form somewhat of a barrier of solid interconnected crystals. Coarser gabbro: crystals are granular to slightly elongate anhedral crystals. Cleavage planes are prominent, and locally show Fe-Ti oxide exsolution in some crystals. Crystals range up to 2.2mm in length. These are locally weak to moderately uralitized and weakly carbonatized.

Hornblende: Uralitizing the pyroxenes. The intensity of replacement/alteration is highly variable and appears to be related to the intensity and proximity to the carbonate alteration that is infiltrating the sample. The hornblende is a pale brownish colour (ppl). Patchy replacement of the pyroxenes. (~2%)

Biotite: Alteration mineral, late phase, and is generally found in close proximity to, or adjacent to the carbonate alteration, the hornblende and Fe-Ti bearing oxides. The biotite is a strong reddish-brown and is highly pleochroic in ppl. Anhedral to subhedral fibrous crystals that locally reach up to 0.8mm in length. Biotite is present in both the coarser and finer grained gabbro. There is a slight increase in biotite alteration in the coarser gabbro, likely associated with the increased carbonate alteration. (~1%)

Calcite: Carbonate alteration is infiltrating this sample along fractures, crystal boundaries and crystal contacts. The alteration is patchy. Locally anhedral pods of calcite are present. Carbonate is not restricted to the plagioclase, and therefore cuts the mafic phases, which locally appears to be related to the uralitization of the pyroxenes, as well as the biotitization.

Apatite: Very minor accessory phase, crystals are subhedral to euhedral, acicular and up to 0.12mm in length. Majority of the crystals found are within the fine grained segregation. (<1%)

Ilmenite: Crystals are anhedral, sharp contacts, locally weakly fractured. The ilmenite is more abundant in the coarser gabbro, where it is present as intercumulus crystals as well as fine grained elongate exsolution lamellae. Rare crystals reaching up to 1.6mm in length. Locally ilmenite is found sharing mutual grain boundaries with graphite, pyrrhotite and pyrite and poikilitically encloses graphite and pyrrhotite. Ilmenite is also present in the finer grained gabbro where it generally shares mutual grain boundaries with the pyrrhotite and is also anhedral and somewhat granular in shape similar to the plagioclase and the pyroxenes. (~1-2%)

Pyrrhotite: In the finer grained gabbro the pyrrhotite is the main opaque phase, the crystals are anhedral and disseminated throughout. The contacts of these crystals are sharp and irregular to jagged. Most of the crystals are located at the triple junctions of crystals or are intercumulus. The pyrrhotite may share mutual grain boundaries with chalcopyrite, ilmenite, graphite as well as locally with pyrite. In the coarser grained gabbro the pyrrhotite is an intercumulus phase. There also appears to be either a secondary emplacement of pyrrhotite or a remobilization of the pyrrhotite. The crystals are anhedral and have sharp to irregular contacts and locally share mutual grain boundaries with pyrite, ilmenite, pyrite and chalcopyrite. Locally the pyrrhotite is poikilitic and encloses crystals of graphite. Crystals up to 1.6mm in length. (~5-8%)

Chalcopyrite: Minor sulphide phase that is generally found adjacent to or in proximity to the pyrrhotite. Largest anhedral bleb is 0.2mm in length and is poikilitically enclosed in the pyrrhotite. (tr)

Pyrite: The pyrite appears to be a secondary sulphide that is anhedral to subhedral and forms large clusters or pods of crystals that share mutual grain boundaries with pyrrhotite, graphite and rarely ilmenite locally. The crystals have irregular and jagged to angular contacts. Generally found in proximity to fractures. (<1%)

Graphite: Graphite crystals are fibrous to dendritic and appear to be a later addition to the sample. The crystals are related to fractures and locally cut and overlie the plagioclase and pyroxenes. There appears to be a slight relationship between the graphite and carbonate alteration (concurrent??). Graphite crystals are found both in the coarser and finer grained gabbro in similar textures and relationships.The coarser grained gabbro is host to much coarser grained graphite with crystals reaching 1.6mm in length. The graphite has the appearance of tree branches that are locally interconnected. (~2-3%)

Zircon: Possibly 1 anhedral zircon found hosted in plagioclase with an odd shaped radiation halo. Crystal measures 0.09mm in length.

Opaques (unknown Composition): There are numerous pods of opaque phases which are likely sulphides, oxides and graphite that are not cut by the surface of the slide and are hosted in the thickness of the sample. These are most abundant in the finer grained gabbro. Generally found adjacent to or surrounding the sulphides/oxides/graphite or are pods that are disseminated. (~1-2%)

A.1.7.7 Hole ID: Hp-08 Sample#: 00851-02

From (m): 171.54, **To** (m): 171.59

Rock type: Augite Norite (Gabbronorite) (similar quantities of orthopyroxene and clinopyroxene)

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite), biotite, hornblende, calcite, quartz, ilmenite (locally breaking down and forming leucoxene), graphite, pyrrhotite, chalcopyrite, opaques of unknown composition, apatite.

Main description: Cut from the same sample as 00851-01, and is similar to the coarser part of 851-01, but overall is much more similar to 798-01 and is host to more orthopyroxene than 851-01. Plagioclase forms the main framework of the cumulate. The pyroxenes are intercumulus phases and locally show exsolution textures, which are not as prominent as in 798-01. Some of the intercumulus pyroxenes are poikilitic. The pyroxenes form long chains of crystals that are parallel to the layering and lineation of the plagioclase. Ilmenite is abundant and is the main opaque phase. Ilmenite appears to have crystallized with pyrrhotite, since the ilmenite is locally poikilitic and enclosing anhedral blebs of pyrrhotite. There are a number of small fractures that cut through this sample. These appear to be where carbonate bearing fluids have infiltrated the sample. There is a weak carbonate and biotite alteration. The sample is tightly packed, and the arrangement of the crystals would suggest that there has been some densification. The contacts between the crystals are sharp and smooth, and locally serrated or irregular. The sample texturally shows a partially equilibrated geometry. Some of the smaller plagioclase crystals are more strongly equilibrated and show smooth sharp contacts with clearly visible triple junctions.

Plagioclase: Plagioclase is the most abundant cumulate phase, forming the framework of the sample. (Intercumulus plagioclase?, if so, there is only a very minor component of this sample.) Weak lineation, subhedral crystals to lath shaped that are up to 4mm in length, but most are 2-2.5mm in length. Crystal contacts are sharp, irregular to rounded. Crystals typically show irregular extinction, which is likely a result of weak zoning. Weak carbonate alteration of the plagioclase (patchy). The crystals are also host to numerous acicular needles of uncertain composition, since they are too small to resolve their composition. Plagioclase is locally fractured. These fractures and contacts are locally exploited by carbonate bearing fluids. (>50%)

Orthopyroxene: Anhedral, intercumulus, associated with augite, forming long chains of crystals that are parallel to the layering and lineation of the plagioclase. Crystals are up to >5mm in length and are locally poikilitic and show exsolution of clinopyroxene locally. Locally weak biotite and carbonate alteration. Granular anhedral sulphides and oxides also associated with the pyroxenes. Contacts are sharp but typically irregular. Locally cut by small fractures. (~15-20%)

Clinopyroxene (augite): Anhedral, intercumulus, associated with orthopyroxene, forming long chains of crystals that are parallel to the layering and lineation of the plagioclase. Crystals are up to 4mm in length and are locally poikilitic. Locally weak biotite and carbonate alteration. Granular anhedral sulphides and oxides also associated with the pyroxenes. Sharp but irregular contacts, locally cut by small fractures. (~15-20%)

Hornblende: Minor mafic phase, crystals and alteration of the pyroxenes (uralitization), typically is brownish in colour and pleochroic under ppl, anhedral, +/-biotite +/- carbonate alteration locally associated with this phase. Crystals up to 0.4mm in length. (~1%)

Biotite: Alteration phase, secondary, typically found in proximity to the oxide and sulphide phases as well as with the hornblende. Deep reddish-brown in colour, and highly pleochroic under ppl, fibrous crystals that are anhedral to subhedral, almost flaky, clearly visible basal cleavage locally. Crystals up to 0.5mm in length. These crystals are not restricted to the primary crystal boundaries and enter the plagioclase and replace the mafics (amphiboles/pyroxenes).

Calcite: Secondary alteration phase, infiltrating the sample along fractures, crystal contacts and boundaries. Present as a fine grained dusting locally, and as small patchy alteration. The alteration is also affecting the mafic phases and the development of amphiboles and biotite, and breaking down of the pyroxenes. Overall there is a weak carbonate alteration (intensity).

Apatite: Minor accessory phase, disseminated subhedral to anhedral crystals that are typically found hosted in the plagioclase. (tr)

Quartz: Rare crystals that appear to be associated with the fractures, anhedral, typically found with the carbonate alteration. (tr)

Rutile: Leucoxene found in trace quantities due to the breakdown of ilmenite locally.

Ilmenite: Main oxide phase, anhedral irregular blebs that are disseminated and appear to be intercumulus phase. Crystals are locally fractured, and locally share mutual grain boundaries with pyrrhotite. The ilmenite is also host to blebs of pyrrhotite, suggesting that they are co-existing phases. Crystals up to 1.6mm in length. The ilmenite is locally breaking down and forming leucoxene? (rutile). Contacts are sharp and rounded to weakly jagged. Locally annealed crystals with triple junction contacts. (~10-15%)

Pyrrhotite: Main sulphide phase, crystals are anhedral, sharp to jagged contacts, locally share mutual grain boundaries with the ilmenite +/- chalcopyrite. Intercumulus phase, crystals up to 0.6mm in length. (~1-2%)

Chalcopyrite: Very minor sulphide phase, generally found with the pyrrhotite or locally as anhedral crystals, contacts are sharp with pyrrhotite, and sharp to weakly jagged with the silicates. Crystals up to 0.04mm in length. (tr)

Graphite: Rare dendritic and fibrous crystals that are up to 0.2mm in length. (<1%)

Opaques (unknown Composition): Typically found adjacent to the oxides and sulphide phases and range in thickness. These are opaque in ppl and do not reflect light, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1%)

A.1.7.8 Hole ID: Hp-10 Sample#: 00884-01

From (m): 139.15, **To** (m): 139.2

Rock type: (Leuco) Augite Norite/ Orthopyroxene gabbro

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite +/- pigeonite), biotite, hornblende, calcite, ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition, apatite, chlorite

Main description: Similar to 00798-01 (coarser than), 00806-01, 00814-01(more altered) and 00851-02. Medium to coarse grained sample. Plagioclase forms the main framework. The pyroxenes are intercumulus phases, and locally exhibit exsolution textures. Some of the intercumulus pyroxenes are poikilitic. Exsolution textures are also common in the pyroxenes. The pyroxenes form long chains of crystals that are parallel to the layering and lineation of the plagioclase. Ilmenite is abundant and is the main opaque phase present. There are a number of small fractures that cut through this sample, these appear to be sources of carbonate bearing fluids. There is a weak carbonate and biotite alteration of this sample. There is a large fracture with a weak breccia that is ~1.2mm in thickness present cutting the sample. (Smaller crystals within the fracture zone) Cumulate. The contacts between the mineral grains are sharp, smooth, to serrated or irregular. The packing is tight and shows a partially equilibrated textural geometry.

Plagioclase: Anhedral to subhedral, to euhedral crystals that form the main framework of the sample and from a weak lineation. The crystals reach up to 5mm in length, but most are 2-3mm in length. Crystal contacts are sharp, but typically irregular to rounded. Weak carbonate alteration of the plagioclase is present locally. The crystals are also host to numerous acicular needles. Uncertain what mineral these are since they are too small to resolve their composition. The plagioclase is a cumulus phase, but there also appears to be a minor intercumulus phase. (>50%)

Orthopyroxene: Anhedral, intercumulus, associated with augite, crystals reach up to >8mm in length and are locally poikilitic (oikocryst) and local show exsolution of augite (+/- pigeonite) locally. Locally weak biotite and carbonate alteration or replacement by hornblende (uralitization). Granular anhedral sulphides and oxides also associated with the pyroxenes. Contacts are sharp but typically irregular. Locally cut by small fractures.

Clinopyroxene (augite): Anhedral, intercumulus phase, associated with the orthopyroxenes. Crystals reach up to 5mm in length and are locally poikilitic (oikocryst). Locally weak biotite and carbonate alteration, to weak replacement by hornblende. Granular anhedral sulphides and oxides also associated with the pyroxenes. Sharp but irregular contacts. Locally cut by small fractures. Pigeonite is also found locally with the intercumulus pyroxenes, but is a minor phase in this sample.

Hornblende: Minor mafic phase that is present as anhedral crystals and alteration of the pyroxenes (uralitization). Hornblende is typically brownish in colour and pleochroic under ppl. Biotite +/- carbonate alteration locally associated with this phase. Crystals up to 0.8mm in length. (~1%)

Biotite: Alteration phase, secondary, typically found in proximity to the oxide and sulphide phases as well as with the hornblende. Deep reddish-brown in colour and highly pleochroic under ppl. Fibrous crystals that are anhedral to subhedral, almost flaky, with a clearly visible basal cleavage locally. Crystals up to 0.5mm in length are present. These crystals are not restricted to the primary crystal boundaries and therefore enter the plagioclase and replace the mafics. (2-4%)

Chlorite: Minor alteration phase found with the carbonate alteration and hosted in the plagioclase. Colourless to pale green, fibrous and radiating crystals (ppl) with locally anomalous blues under xpl. (tr-<1%)

Calcite: Alteration phase. Secondary phase, entering along fractures and crystals contacts and boundaries. Present as a fine grained dusting locally and as small patchy alteration. The alteration is also affecting the mafic phases as alteration and the development of amphiboles and biotite, and breaking down of the pyroxenes. Overall there is a weak carbonate alteration (intensity). (~1-2%)

Sericite: Minor alteration phase of the plagioclase, typically found associated with the carbonate alteration as well as the fractures. (tr)

Apatite: Minor accessory phase, disseminated subhedral to euhedral crystals that are typically found hosted in the plagioclase. (tr)

Ilmenite: Main oxide phase, anhedral irregular blebs that are disseminated and appear to be intercumulus phases. Crystals are locally fractured, and locally share mutual grain boundaries with pyrrhotite. The ilmenite is host to blebs of pyrrhotite, suggesting that they are co-existing phases. Crystals reach up to 2.2mm in length, the contacts are sharp and rounded to irregular. Locally annealed crystals with triple junction contacts are present. (~10-15%)

Pyrrhotite: Main sulphide phase, crystals are anhedral, sharp to jagged contacts, locally shared mutual grain boundaries with the ilmenite +/- chalcopyrite. Intercumulus phase, crystals up to 0.6mm in length. ~1-2%

Chalcopyrite: Minor sulphide phase, generally found with the pyrrhotite or locally as anhedral crystals, contact are sharp with pyrrhotite, and sharp to weakly jagged with the silicates. Crystals reach up to 0.01mm in length. (tr)

Opaques (unknown Composition): Typically found adjacent to the oxides and sulphide phases and range in thickness. These are opaque in ppl and do not reflect light. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1-2%)

A.1.7.9 Hole ID: Hp-10 Sample#: 00890-01

From (m): 178.78, **To** (m): 178.83

Rock type: Mela augite Norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite+/-pigeonite), hornblende, biotite, calcite, ilmenite, pyrrhotite, chalcopyrite, graphite and opaques of unknown composition, apatite.

Main description: Similar to 00798-01, 00806-01, 00851-01 and 00884-01 but is coarser grained and contains more sulphides, coarser oxides and larger poikilitic orthopyroxenes (>1cm in length). This sample is most similar to 884-01 but contains a greater quantity of pyroxenes (larger modal %) and is coarser grained. Cumulate sample. Large poikilitic orthopyroxenes comprise a significant percentage of this sample. The plagioclase crystals form a lineation that is parallel to layering. The pyroxenes locally show exsolution textures and poikilitically enclose plagioclase (ophitic texture). The sulphide and oxide phases are abundant and are intercumulus phases. There is a very weak carbonate alteration locally, as well as minor biotite alteration. Hornblende is a minor phase, locally the pyroxenes are weakly uralitized. The packing of the mineral grains is tight, and the contacts are sharp, smooth, to serrated. The sample shows a partially to locally equilibrated textural geometry. The tight packing the mineral grains and the presence of bent or kinked plagioclase crystals would suggest that the sample has undergone densification and likely compaction.

Plagioclase: Lineated, crystals are anhedral to subhedral to euhedral, and the contacts between the plagioclase are typically sharp but irregular. Weak carbonate alteration that is exploiting any fractures and locally the crystal boundaries. Locally poikilitically enclosed in the pyroxenes (ophitic texture). Host to fine grained acicular needles, these locally have a very distinct orientation within the plagioclase. Crystals up to 4mm in length, most of the plagioclase crystals are 2-2.5mm in length. The plagioclase is a cumulus phase, but is also present as an intercumulus phase. Rare crystals exhibit unusual extinction patterns, or are weakly bent, suggesting deformation related to compaction or densification. (30-40%)

Orthopyroxene: Orthopyroxene is present as individual crystals and large poikilitic cumulates. Some of the poikilitic crystals are >1cm in length. The crystals are anhedral, with sharp irregular to rounded contacts. Weak carbonate alteration locally. Exsolution of Fe-Ti oxides and locally of augite is locally present. The orthopyroxenes are an intercumulus phase. (~20-30%)

Clinopyroxene (augite): Individual and large poikilitic intercumulus crystals. Crystals reach up to >1cm in length. The crystals are anhedral, with sharp irregular to rounded contacts. Weak carbonate alteration locally. Intercumulus phase, associated with the orthopyroxenes and oxide/sulphide phases. (~20-25%)

Hornblende: Minor phase. Locally replacing/ altering the pyroxenes generally in proximity to the carbonate alteration. Irregular distribution, anhedral crystals, rare crystal up to 0.8mm in length. (~1-3%)

Biotite: Weak alteration phase, generally found associated with the carbonate alteration and in proximity to or adjacent to the oxides/sulphides. The crystals are fibrous and anhedral to subhedral. Biotite is reddish-brown and highly pleochroic in ppl, rare crystals up to 0.9mm in length. (<1%)

Calcite: Weak alteration phase. Typically exploiting fractures, crystal contacts and margins. Patchy alteration, locally small pods of calcite crystals are present. Overall a weak intensity alteration. The alteration affects both the plagioclase and the pyroxenes, and appears to be a driving force behind the presence of hornblende and biotite alteration within this sample. (<1-1%)

Apatite: Accessory phase. Subhedral to euhedral disseminated crystals that are hosted in the pyroxenes as well as the plagioclase locally. (tr)

Ilmenite: The main oxide phase. Crystals are anhedral, intercumulus, locally poikilitic hosted blebs of pyrrhotite. Ilmenite shares mutual grain boundaries with pyrrhotite, and rarely with chalcopyrite. Weakly annealed with triple junction contacts present locally. Rare crystals up to 4.5mm in length, but most are 0.5mm in length. Crystals are weakly fractured. Contacts are sharp with other oxides/sulphides as well as with the silicates. (~10-15%)

Pyrrhotite: Main sulphide phase, anhedral, intercumulus, locally blebs trapped in the ilmenite crystals. Contacts with the oxides/sulphides are sharp. Contacts with the silicates are sharp but irregular to jagged. Locally some of the crystal of pyrrhotite appear to be weakly digested or are breaking down. Rare crystals up to 1.2mm in length, but most are ~0.5mm in length. (~5%)

Chalcopyrite: Minor sulphide phase. Typically found with the pyrrhotite as small anhedral blebs trapped along the margins, or within the pyrrhotite crystals. These may reach up to 0.16mm in length. (<1%)

Graphite: Minor phase, crystals are irregular and typically long and thin, forming what almost look like tree branches. Also present as anhedral pods locally. (tr)

Opaques (unknown Composition): These are typically found with associated with the oxide and sulphide phases either surrounding the crystals or adjacent to them. These may be sulphides and oxides present within the 30micron this slides that are not cut by the surface of the slide.

A.1.8 Unit 5b

Sample FX847934 described in Greenough *et al*., (2011) is part of this unit.

A.1.8.1 Hole ID: H-05 Sample#: 00806-02

From (m): 52.67, **To** (m): 52.72

Rock type: Augite Hornblende norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite+ pigeonite), hornblende, biotite, sericite, calcite, ilmenite, pyrrhotite, graphite, chalcopyrite, pyrite, apatite, opaques (unknown composition)

Main description: Cut from the same sample as 00806-01 but the focus of this sample is on the fine-grained segregations that are common to these rocks. This sample contains both coarser and a fine-grained norite. The fine-grained segregation represents approx. 2/3 to 3/4 of the polished section, the remainder is similar to that seen in 00806-01. The coarser section of the sample is similar to 00798-01 but with increased alteration intensity. The plagioclase crystals are the most abundant phase of the sample and are lineated parallel to the layering. The pyroxenes are intercumulus phases that show exsolution textures and are anhedral to subhedral to locally poikilitic. The majority of the pyroxenes in the fine grained segregation are orthopyroxenes. The sulphides and oxides are intercumulus phases to the plagioclase and are typically associated with the mafic phases. There is a weak alteration, and the sample is allotriomorphic to hypidiomorphic, medium-grained augite-hornblende norite. The contact between the coarser and finer grained norite is sharp and there is a thin band of augite along the contact. Within the fine grained segregation the average crystal size is approx. 0.2-0.3mm in length. The crystals are granular and anhedral to locally subhedral with minor poikilitic pyroxenes and rare crystals that show fine grained exsolution lamellae. There is a weak biotite alteration and weak uralitization. The crystals are weakly elongate parallel to the layering direction. The geometry of the crystals would suggest that the sample has undergone densification, and likely some compaction. The presence of kinked or bent crystals would support that hypothesis. The contacts between the grains are sharp, smooth but typically irregular. Some of the plagioclase crystals show a texturally equilibrated geometry, but the contacts between other grains suggest a partially equilibrated geometry. The packing of the crystals is tight, with locally present triple junction contacts.

Plagioclase: In the finer grained norite the pyroxene crystals are anhedral to subhedral and reach up to 1.2mm, but most are 0.4-0.5mm in length. Contacts are sharp, but rounded and there is a very weak lineation of the crystals parallel to the layering direction. Weak sericite and carbonate alteration. The crystals appear to be largely intercumulus phases, but some of these may also be cumulus crystals. In the medium-grained gabbro: Anhedral to subhedral, to rare euhedral plagioclase laths that show a weak to moderate lineation with the layering direction. There is a significant variation in crystals sizes with laths reaching up to 7mm, but most are 2mm or less in length. Contacts are sharp, irregular to rounded. Plagioclase is typically nesophitic to locally ophitic. Some of the crystals show irregular extinction. There is a weak carbonate and sericite alteration. Within the coarser norite, the plagioclase appears to be both cumulus and intercumulus phases. (~55-60%)

Orthopyroxene: In the fine-grained norite, the orthopyroxene is granular, anhedral, locally poikilitic, locally weakly altered (biotite) and locally being replaced (uralitized). In the medium grained gabbro the crystals are Anhedral and are locally poikilitic/ophitic (enclosing Augite and plagioclase). Host to exsolution of augite, and locally fine exsolution lamellae of ilmenite. Crystals up to 4.2mm in length, but most are 1-2mm in length. Intercumulus phase. Weak uralitization locally. (~25-30%)

Clinopyroxene (augite): In the fine-grained norite the clinopyroxene is granular, anhedral to subhedral, locally weakly altered (biotite) and locally being replaced (uralitized). In the medium grained norite the crystals are anhedral to granular to poikilitic/rims crystals and locally showing exsolution textures. Also present as exsolution in the orthopyroxenes. Crystals up to 4mm in length, but most are 1-2mm in length. Intercumulus phase, locally weakly uralitized.

Hornblende: In the fine-grained segregation, the hornblende is anhedral, up to 0.6mm in length. Locally replacing the pyroxenes and weak biotite alteration. In the medium grained gabbro the crystals are anhedral, typically pale brown to pale green in colour (ppl). The hornblende is present as uralitization of the primary pyroxenes and as rims around the pyroxenes. Crystals up to 1.2mm in length. Contacts are sharp to locally gradational.

Actinolite: May be minor actinolite associated with the hornblende locally.

Biotite: Alteration mineral of the pyroxenes and amphiboles, rare anhedral to subhedral fibrous crystals up to 0.4mm in length. Can also be found adjacent to some of the oxide and sulphide phases.

Calcite: Weak intensity calcite alteration that is exploiting fractures/contacts and fractures.

Sericite: Weak intensity alteration of the plagioclase. Fine grained crystals that are exploiting the fractures and crystal contacts/ boundaries. Appears as a fine grained dusting of the plagioclase. The sericite alteration is more intense in the coarser grained norite.

Apatite: Accessory phase. Small subhedral to euhedral acicular crystals, 0.01 to 0.05mm in length. (tr)

Ilmenite: In the fine grained segregation the ilmenite represents a minor percentage of the opaque phases (~1%). Crystals are anhedral and up to 0.4mm in length. Ilmenite is locally host to small blebs of pyrrhotite, and shares mutual boundaries with pyrrhotite and chalcopyrite. In the coarser grained gabbro the ilmenite is the main opaque phase. Irregular, anhedral crystals. Contacts are typically sharp to slightly rounded. Locally host to small blebs of pyrrhotite. Typically associated with the mafic phases. Also present as fine grained exsolution lamellae. Intercumulus phases.

Pyrrhotite: Most abundant sulphide phase and opaque phase in the fine grained segregation (~5-7%), composed of anhedral blebs, intercumulus, crystals up to 0.4mm in length but most are 0.1mm. They share mutual crystal boundaries with chalcopyrite and ilmenite. Rare blebs of pyrrhotite are encapsulated in the ilmenite. In the coarser norite the crystals are irregular, anhedral crystals up to 0.8mm in length. Associated with the graphite, ilmenite and chalcopyrite. Pyrrhotite locally is host to blebs of chalcopyrite and is itself hosted in ilmenite locally. Approx. 2% pyrrhotite in the coarser grained norite. Intercumulus phase.

Chalcopyrite: Anhedral crystals that are typically found with the pyrrhotite or enclosed in the pyrrhotite. (tr)

Pyrite: Anhedral crystals trapped in the pyrrhotite and locally in fractures in the ilmenite. Only seen in the coarser grained norite, none in the fine grained section.

Graphite: Irregular, anhedral crystals that form dendritic needle like crystals. Most abundant in the coarser grained norite. None seen in the fine grained segregation.

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~5%)

A.1.9 Unit 5c

A.1.9.1 Hole ID: H-06 Sample#: 00827-01

From (m): 63.22, **To** (m): 63.27

Rock type: Cpx (augite) Norite

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite), hornblende, biotite, actinolite, apatite, sericite, chlorite (tr), pyrrhotite, ilmenite, chalcopyrite, greenish coloured alteration mineral (possibly amphibole?), quartz

Main description: Cumulate, allotriomorphic to hypidiomorphic, medium-grained norite. Plagioclase is the most abundant phase of the sample. The plagioclase crystals are anhedral to subhedral, weakly lineated and are weakly sericitized. Host to numerous acicular needles of actinolite? Locally these needles have a defined orientation, but this does not correspond to the crystal structure of the plagioclase. The contacts between plagioclase crystals are sharp, but are typically rounded to angular. The pyroxenes are the main mafic phases and generally form long chains of crystal with the same crystallographic orientation, some of these are poikilitic. Most of the orthopyroxenes display exsolution of augite, which look almost like worm bore holes. The pyroxenes may also display a common brownish coloured almost box like exsolution texture, which is fine ilmenite. The pyroxenes are locally weakly altered by hornblende, minor actinolite and weak biotite. Alteration by hornblende is typically present along fractures and the outer margins of the crystals. The sulphides are anhedral and appear to intercumulus phases, but are generally associated with the mafics. The ilmenite is present as thin exsolution lamellae in the pyroxenes, and as individual anhedral crystals, typically found in proximity to the mafic phases. Pyrrhotite and chalcopyrite are also present but in very minor quantities. The tight packing arrangement of the crystals would suggest that the sample has undergone densification and compaction. The presence of kinked or bent plagioclase crystals would support that statement. The crystals demonstrate a partially equilibrated geometry, and show sharp, smooth to irregular contacts.

Plagioclase: Anhedral to subhedral crystals, locally lath shaped. There is a weak lineation of the plagioclase crystals that parallel to layering. Crystals range in size up to 5mm in length, but most are 1-2mm in length. Locally ophitic, in poikilitic textured pyroxenes. Weak sericite alteration, host to numerous of acicular needles of actinolite?, these needles have a very specific orientation locally that does not correspond to the plagioclase crystal structure. Rare crystals are kinked. The plagioclase crystals appear to be both cumulus and intercumulus phases, with some of the crystals present prior to the crystallization of the pyroxenes, but these are not euhedral and are typically blocky, or subhedral to anhedral. (45-55%)

Orthopyroxene: One of the main mafic phases, typically anhedral, poikilitic, host to exsolution of augite. Crystals >5mm locally present. Locally alteration by hornblende and minor actinolite, may be rimed by clinopyroxene +/- actinolite and biotite. The intercumulus orthopyroxene crystals form long chains that are parallel to the layering and parallel to the plagioclase lineation. Host to opaque phases as exsolution (ilmenite), and blebs of sulphides and anhedral crystals of ilmenite as well as the unknown opaque phases. There appears to be rare cumulate orthopyroxene crystals that are rounded. (20%)

Clinopyroxene (augite): Other main mafic phase, crystals up to 5mm in length, anhedral to subhedral, associated with the Opx and Hbld, also part of long chains of crystals that appear to be intercumulus and are parallel to the layering. Alteration of this phase by hornblende and biotite is weak. Locally poikilitic (plagioclase). Host to opaque phases as fine exsolution lamellae, blebs of sulphides, and anhedral crystals of ilmenite. Also present as exsolution in the orthopyroxenes. (~10-15%)

Hornblende: Alteration of the pyroxenes, anhedral, locally forming new crystals. Biotite may be associated with the hornblende. Crystals up to 0.8mm in length, but is most abundant in proximity to the fractures which may be sources of fluids. (brownish and highly pleochroic in ppl) Locally present as a fine-grained rim surrounding the pyroxenes, crystals may not be restricted to the primary crystal boundaries, crystals are entering into the plagioclase. Associated with actinolite. (~5%)

Actinolite: Thin needles, locally entering the plagioclase, and present as rims. Also appears as alteration (fracture fill), secondary phase? (<5%)

Biotite: Alteration phase, brownish red in colour, highly pleochoric, typically associated with the hornblende, and the oxide and sulphide phases, also alteration of the pyroxenes. Crystals up to 0.7mm in length, appears to be most abundant in proximity to fractures (sources of fluids?). Biotite crystals are fibrous in appearance and locally appear to grow from the mafic phases into the plag. (<5%)

Chlorite: Alteration phase, fracture fill, appears to be associated with actinolite. Pale green in colour, and primarily associated with the fractures in the plagioclase. Minor phase (tr)

Sericite: Alteration of the plagioclase, weak to locally moderate, appears as a fine brownish coloured dusting on the plagioclase, the alteration appears to exploit the fractures and contacts of the plagioclase crystals to propagate. (~5%)

Apatite: Accessory phase that is acicular, euhedral to subhedral and is typically hosted in the plagioclase. Rare crystals up to 0.09mm in length. (tr)

Quartz: Fracture fill, composed of small anhedral crystals. A fracture runs down the length of the slide and appears to be the source of the alteration (fluids). Small patchwork of crystals with washed out contacts. (~1%)

Ilmenite: Anhedral, irregular crystals. Contacts are typically rounded but sharp. Thin elongate crystals are present within the mafic phases as exsolution, and locally larger crystals up to 0.3mm in length are associated with the pyrrhotite (mutual grain boundaries) and associated with the mafic phases. (<1%)

Pyrrhotite: Anhedral, contacts are irregular, jagged, to locally appearing to be weakly digested. Main opaque phase typically surrounded by some unknown opaque phase (halo), anhedral crystals that typically show common mutual grain boundaries. Rare crystals up to 1.7mm in length, but most are <0.4mm. The larger crystals are pitted. These anhedral crystals are likely intercumulus phases. Locally host small blebs of chalcopyrite (completely enclosed), or is associated with small blebs along the margins of the crystals. Pyrrhotite is also present as fine grained irregular to almost skeletal crystals that are hosted in the mafic phases but appear to be related to the fracturing, and may be secondary sulphides. (1-2%)

Chalcopyrite: Small anhedral blebs, that are associated with the pyrrhotite. These may be small blebs along the margins of the pyrrhotite or may be trapped blebs within the pyrrhotite. Rare crystals reaching up to 0.16mm in length. (tr)

Graphite: Small anhedral blobs of graphite, to locally fibrous looking crystals (resembling the branches of a tree, up to 0.35mm in length, distribution is irregular , but the graphite seems to be associated with fractures and may be a secondary phase (uncertain). (<1%)

Opaques (unknown Composition): These typically are associated with the sulphide and oxide phases as incomplete rims to halos, or may be disseminated. These do not reflect light under RL, and under ppl appear black. Some of these phases are very fine grained and appear to be composed of aggregates of crystals. These are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1 to 2%)

Green alteration mineral: There is a greenish coloured alteration mineral found in the plagioclase and as fracture fill. Similar mineral is present in sample 00924-01 from hole H-02. Possibly an amphibole? Too fine-grained to resolve the composition.

A.1.10 Unit 6

A.1.10.1 Hole ID: Hp-09 Sample#: 00906-01

From (m): 24.28, **To** (m): 24.33

Rock type: Anorthosite

Minerals Present: Plagioclase, biotite, calcite, sericite, chlorite, quartz, hornblende, ilmenite, pyrrhotite, chalcopyrite, magnetite, opaques of unknown composition.

Main description: Composed primarily of plagioclase crystals that share sharp, but irregular to rounded crystal boundaries. There is a weak to moderate intensity carbonate and sericite alteration. The sample is cut by numerous fractures that are host to a brownish-reddish coloured mineral and carbonates. Minor chlorite alteration is also present locally. There are rare intercumulus spaces that were filled with hornblende +/-carbonate. Sulphides and oxides are also present, and are a very minor phase found along the contacts of the plagioclase crystals. These are intercumulus phases. There is a significant crystal size variation within this sample. The sample shows tight packing of the mineral grains. The contacts between the grains are sharp, irregular, serrated and locally skewed by alteration minerals, and fractures. The sample shows a partially equilibrated textural geometry. Adcumulate.

Plagioclase: Main silicate, forming the framework of this sample. There is a significant variation in crystal sizes with crystals reaching up to >8mm in length, but most of the crystals are ~3mm in length. The crystals typically show irregular extinction, which is likely a result of compositional variations. The contacts between the plagioclase crystals are sharp, but irregular to rounded. No visible crystal lineation. Weak to moderate intensity carbonate and sericite alteration. The plagioclase crystals are locally cut by fractures, these appear to be exploited by alteration minerals/fluids. Crystal contacts are also sources of altering fluids. There appears to be both cumulus and intercumulus plagioclase present, and some of these may have suffered from adcumulus growth. (>90%)

Hornblende: Minor phase, intercumulus crystal is host to hornblende that may be a secondary or replacement phase? Pleochroic pale green in colour under ppl, anhedral and patchy. Associated with carbonate, biotite and chlorite that have replaced what may have been primary intercumulus pyroxene (Augite?)? (<1%)

Biotite: Alteration phase associated with the fractures and crystal contacts, typically found with calcite, sericite and chlorite. Uneven distribution, the crystals are fibrous and anhedral. (1-2%)

Chlorite: Alteration phase, pale green and pleochroic in ppl, anomalous blues in xpl. Present as fibrous crystals that form aggregates, and locally can be found with biotite. Some of the crystals reach up to 0.4mm in length. (<1%)

Calcite: Alteration phase that is unevenly distributed, and typically found with sericite and exploiting fractures and crystal contacts and boundaries. Weak intensity alteration (<1%)

Sericite: Alteration phase that is unevenly distributed typically found with calcite and exploiting fractures and crystal contacts and boundaries. Weak to moderate intensity alteration locally. Some large crystals can be found reaching up to 0.4mm in length. (~2-4%)

Quartz: Rare quartz crystal that is generally found in very close proximity to the fractures. Anhedral crystals. (tr)

Ilmenite: Irregular anhedral ilmenite crystals that are locally breaking down to form leucoxene. This is a very minor phase present in this sample. Rare crystals up to 0.2mm. Intercumulus phase. (tr)

Pyrrhotite: Rare crystal up to 0.1mm in length, anhedral, sharp to jagged contacts and locally associated with the pyrite. (tr)

Chalcopyrite: Rare anhedral crystals, disseminated. (only one small bleb seen) (tr)

Pyrite: Subhedral to anhedral crystal that are disseminated, and up to 0.06mm in length, and are locally found hosted in the plagioclase. Also found with pyrrhotite locally sharing mutual grain boundaries. (tr)

Magnetite: Rare crystal that is associated with the silicates filling fractures/ or replacing what may have been mafics. Up to 0.09mm in length. (tr)

Opaques (unknown Composition): Opaques of unknown composition are present locally, they do not reflect light and are opaque under ppl and xpl. Minor phase. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

A.1.11 Unit 7

A.1.11.1 Hole ID: Hp-09 Sample#: 00906-02

From (m): 24.69, **To** (m): 24.74

Rock type: Mineralized plagioclase bearing pyroxenite

Minerals Present: Orthopyroxene, (+/-augite), actinolite, hornblende, biotite, pyrrhotite, ilmenite, chalcopyrite, graphite, pentlandite, opaques of unknown composition, greenish-brownish coloured mineral similar to that seen in 00924-01, plagioclase

Main description: The pyroxenite is composed of granular to slightly elongate cumulus orthopyroxenes that are weakly altered by amphiboles. The pyroxenes vary in size and are locally bent or kinked, and fractures are common. Rare exsolution of augite is locally present. The intercumulus space is filled with sulphides (mainly pyrrhotite), minor oxides and rare plagioclase crystals. Cumulate sample. The presence of bent or kinked pyroxenes suggests that the sample has undergone densification and/ or compaction resulting in deformation of the mineral grains. The contacts between the grains are skewed by alteration minerals and sulphides.

Plagioclase: Very minor phase, crystals are anhedral, twinning is locally visible, contacts are sharp to irregular and there are other phases that are invading the plagioclase locally. (tr)

Orthopyroxene: Granular to weakly elongate cumulus crystals,and is the main mafic phase. These are locally suffering from alteration/replacement by amphiboles (actinolite and hornblende) along the margins and between the crystals. There are crystals that reach up to 7mm in length, but most are ~3mm in length. There are some bent or kinked crystals locally present. The orthopyroxenes locally exhibit very weak exsolution. These small pods of exsolution are locally altered by amphiboles+/- biotite. Very rare pod of exsolution that appears to be augite. (60-75%)

Clinopyroxene (augite): Appears to only be present as exsolution in the orthopyroxenes.

Hornblende: Secondary phase, that is locally altering the orthopyroxenes (uralitization). The hornblende is generally brownish in colour, and pleochroic under ppl, forming anhedral crystals that vary greatly in shape and size. Locally associated with actinolite. (~2-3%)

Actinolite: Fibrous crystals, that is colourless in ppl. Found along the margins of the pyroxenes as radiating crystals. Generally found in close proximity to the sulphides and oxides as well. Hornblende may also be present with the actinolite locally. No distinct orientation to the crystals. (~5-10%)

Biotite: Minor phase that is generally found with the actinolite, and along the margins of the pyroxenes. Rare crystals reach up to 0.3mm in length and are reddish-brown and pleochroic under ppl. (tr)

Ilmenite: Ilmenite is the most abundant oxide phase. It is found typically sharing mutual grain boundaries with pyrrhotite. Also found as anhedral crystals hosted in the alteration zone (where the amphiboles are replacing the pyroxenes). Sharp contacts with the silicates, and with the pyrrhotite. Crystals reach up to 0.5mm in length and are an intercumulus or late phase. (<1%)

Pyrrhotite: Main sulphide, intercumulus phase, found between the pyroxenes. Crystals show minor annealing (dihedral angles present), locally shares mutual grain boundaries with ilmenite and chalcopyrite and what appears to be one bleb of pentlandite. The crystals are typically pitted and weakly fractured. Contacts are sharp to weakly jagged. The pyrrhotite is also present as blebs, or trails of anhedral crystals between the pyroxenes and amphiboles. Crystals are mostly interconnected, and therefore vary greatly in length, some crystals reach up to 4mm in length. (~15%)

Chalcopyrite: Generally found sharing mutual grain boundaries with the pyrrhotite or trapped in the pyrrhotite crystals. Anhedral blebs up to 0.2mm in length. (tr)

Graphite: Minor phase, dendritic crystals, they look almost like tree branches, typically found in the alteration zone (altn from pyroxenes to amphiboles). (tr)

Pentlandite: Anhedral bleb (only one seen), associated with the pyrrhotite. (tr)

Opaques (unknown Composition): Opaques are typically found adjacent to the sulphides and oxides, these vary in thickness and distribution. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1-3%)

Brownish-green mineral: Mineral is brownish green under ppl and is not pleochroic, fibrous texture, fine grained, locally alteration phase. Similar to mineral from 00924-01. Possibly an amphibole? (<1-1%)

A.1.11.2 Hole ID: Hp-09 Sample#: 00908-01

From (m): 25.88, **To** (m): 25.93

Rock type: Plagioclase bearing (hornblende) pyroxenite

Minerals Present: Orthopyroxene, Clinopyroxene (augite+/- pigeonite?), hornblende, plagioclase, calcite, biotite, ilmenite, pyrrhotite, hematite, chalcopyrite, pentlandite, opaques of unknown composition, and a yellowish-greenish coloured mineral as fracture fill (silicate), quartz, zircon?

Main description: This is one of the most unusual samples collected from the Wadi Qutabah layered gabbroic complex. The pyroxenes are granular to slightly elongate, anhedral to subhedral and surrounded by oxides and sulphides. The pyroxenes vary in size and show a very weak lineation parallel to layering. Locally the pyroxenes are being altered by hornblende (uralitization) and minor carbonate and biotite alteration. The space between some of the larger crystals is filled with small anhedral crystals of pyroxenes, plagioclase, hornblende and ilmenite. Locally the larger crystals are rimmed by a series of hornblende crystals. The remainder of the slide is composed of ilmenite, hematite, pyrrhotite, chalcopyrite +/- pentlandite that fills most of the space between the pyroxenes. It is uncertain if these oxides and sulphides are a secondary phase or are primary. It should be noted that in the regions between larger pyroxene crystals, there is a mosaic of finer grain crystals, where it is not uncommon to find myrmekitic textures exhibited by ilmenite hosted in the silicates. There are also very prominent exsolution of Fe-Ti oxides (ilmenite) within the pyroxenes. Locally along the margins of the pyroxenes is a crosshatched pattern of thin oxides. The pyroxenes are exhibit strong exsolution textures of other pyroxenes locally. The pyroxene crystals appear to be both cumulus and locally intercumulus phases. There are a number of fractures that cut the sample, these are late phases, since they cross cut all phases. The presence of bent pyroxenes would suggest that the sample has suffered from some form of deformation, or possibly densification or compaction. The arrangement of the crystals would indicate a partially equilibrated textural geometry.

Plagioclase: The plagioclase is typically found in the interstitial space between the larger pyroxenes. These are anhedral and may locally be part of the mosaic of finer grained crystals that are located between the larger pyroxene cumulates. Twinning is locally visible in the plagioclase crystals. Contacts are sharp but irregular. Extinction is irregular. Locally poikilitically enclosed by hornblende. Minor phase. (~1%)

Orthopyroxene: Granular to elongate anhedral to subhedral crystals that are locally fractured (fracture is filled with the yellowish mineral described below). Host to thin exsolution lamellae of Fe-Ti oxides that form a linear pattern in the crystals. Locally found as exsolution in the Cpx, and also hosts minor exsolution of orthopyroxene +/-Cpx locally. Locally alteration by amphiboles occurs along the margins of the crystals (uralitization) and forms almost a ring around the crystals. Rare bent or kinked crystals. There are crystals that reach up to >5mm in length.

Augite: Granular to elongate, anhedral crystals, that locally host exsolution of Fe-Ti oxides +/- orthopyroxene. The crystals are locally fractured (fracture is filled with the yellowish mineral described below). Alteration of the pyroxenes is occurring along the margins of the crystals. Crystals up to >5mm in length.

Pigeonite: There also appears to be inverted pigeonite present as exsolution (too small to resolve composition).

Hornblende: Alteration or replacement phase of the pyroxenes (uralitization). Anhedral crystals, that form fine grained rims, and granular almost mosaic type of crystal clusters found between the larger pyroxenes. Locally poikilitic. Typically occupies the space between the pyroxenes and oxides/sulphides. Varies greatly in size and locally exploits the fractures (likely as a result of fluid infiltration). Brownish to brownish-green under ppl. (~5-7%)

Biotite: Minor alteration phase. Typically found with the carbonate, hornblende and Fe-Ti oxides. Fibrous crystals that are subhedral to anhedral, reddish-brown in colour and highly pleochroic under ppl. (tr)

Calcite: Minor alteration phase, locally small patches of carbonate alteration. Typically associated with the fractures. The quartz and hornblende are found typically in proximity to this alteration. Rare crystals up to 0.5mm in length. (<1%)

Quartz: Very minor phase, rare anhedral crystals found with the silicates. Associated with fractures. (tr)

Ilmenite: Main oxide phase. Anhedral crystals that fill the spaces between the pyroxenes. Locally fractured and shares mutual grain boundaries with hematite, pyrrhotite and locally chalcopyrite. Also present as fine exsolution lamellae in the pyroxenes and as fine grained pods of crystals in myrmekitic texture. Contacts with the ilmenite are sharp to rounded. There is weak annealing of the crystals with triple junctions visible. Appears to be an intercumulus phase. Uncertain if there is a secondary emplacement of ilmenite in this sample or a remobilization of ilmenite. (~25-35%)

Pyrrhotite: Main sulphide phase. Anhedral crystals that are typically host to blebs of chalcopyrite and locally exsolution of pentlandite? Shares sharp mutual grain boundaries with ilmenite. Crystals up to 0.4mm in length. (~1%)

Chalcopyrite: Anhedral blebs that are generally found adjacent to, or hosted in the pyrrhotite. The crystals are typically thin and elongate as they cut through the pyrrhotite. (<1%)

Pentlandite: Pentlandite is exsolving from the pyrrhotite. These appear as irregular and anhedral patches at the cores of the crystals, and locally exsolving from the margin and moving towards the centre of the pyrrhotite crystals. (tr)

Hematite: Larger anhedral crystals found with the ilmenite. Irregular contacts that appear to be breaking down. The contacts between the hematite and silicates are jagged and irregular. Crystals reach up to 4mm in length. (<1%)

Zircon: Appears to be a single Zircon hosted in an altered pyroxene. Crystal is 0.1mm in length. (high relief, and strong birefringence) (tr)

Opaques (unknown Composition): Opaques of unknown composition are littered throughout the sample. These are likely fine grained Fe-Ti oxides/sulphides that are hosted in the thickness of the slide and that do not penetrate the surface. (These include opaques adjacent to the sulphides/oxides and exsolution lamellae). (~2-4%)

Yellowish to greenish mineral: This mineral is yellowish to yellow-greenish in colour and is locally pleochroic, present as fracture fill and locally small crystals present. Has a weakly fibrous texture. Similar to that seen in 00906-02 and 00924-01. Possibly an amphibole or amphibole + biotite? Has 2nd to 3rd order interference colours (under xpl). (~1%)

A.1.12 Unit 8

Sample FX847931 also belongs to this unit and is described in Greenough, et al (2011).

A.1.12.1 Hole ID: H-02A Sample#: 00776-01

From (m): 47.04, **To** (m): 47.09

Rock type: Hornblende norite

Minerals Present: Plagioclase, hornblende, actinolite, serpentine+/- chlorite, biotite, sericite+/- calcite, orthopyroxene, rutile, pyrrhotite, chalcopyrite, opaques of unknown composition

Main description: This sample is allotriomorphic to hypidiomorphic and is a medium-grained norite. Plagioclase crystals are anhedral to subhedral and do not show any lineation or alignment, some of the crystals are kinked and are the main cumulate phase. It appears that the orthopyroxene was a cumulus phase and the clinopyroxene (augite) an intercumulus phase, but these are both strongly uralitized. Remnants of granular to rounded and elongate crystals remain of what appears to have been the cumulate orthopyroxenes. Hornblende represents the main mafic phases in the sample with only relic and minor fragments of the primary pyroxene crystals remaining. Exsolution lamellae are still locally visible in the amphiboles that are replacing/ overprinting the pyroxenes. The primary crystal boundaries are no longer respected and the amphiboles are growing into the plagioclase crystals. The pyroxene alteromorphs now consist of many amphibole crystals at various orientations. There is a weak intensity chloritization+/- serpentinization, biotitization and sericitization. Each of the alteration phases is exploiting fractures, crystal contacts and boundaries. The opaque phases are typically found hosted in the mafic alteromorphs, including locally euhedral rutile crystals. The contacts between the crystals show an equilibrated to partially equilibrated geometry. There are multiple triple junction contacts between the plagioclase crystals, but the alteration and growth of amphiboles has skewed the contacts between the plagioclase and mafics.

Plagioclase: Plagioclase forms the main framework of the sample and is the most abundant cumulate + intercumulus plagioclase. Crystals are up to 4mm in length but most are 2mm, typically anhedral to subhedral, irregular crystals with sharp but rounded contacts. Contacts between plagioclase crystals are generally sharp, but may also be exploited by the alteration minerals. Most crystals display albite twins, with few displaying Carlsbad twinning. Glide twins were also seen. Some of the crystals are kinked. The plagioclase crystals are also host to thousands of fine grained acicular needles which are too small to resolve their composition. There is a weak sericitization and carbonatization of the crystals. There is no distinct lineation of the plagioclase in this sample. One crystal tested= ~An55 (~45-50%)

Orthopyroxene: Only small relic cores remain at the centre of few of the pyroxene alteromorphs, and are strongly uralitized. The orthopyroxenes appear to have been a cumulus phase.

Clinopyroxene (augite): There are no visible remnants of clinopyroxene present due to the strong uralitization. The clinopyroxene appears to have been an intercumulus phase, and was anhedral.

Hornblende: Replacing what appears to be cumulus and intercumulus pyroxene crystals (uralitization). Numerous hornblende crystals at various orientations (+ actinolite) form mafic aggregates that on the macroscale appear as single large crystal. Some of the crystals are subhedral but most are anhedral. The crystals are no longer restricted to the primary crystal boundaries and locally enter the plagioclase crystals that surround the mafics. Hornblende is a late phase, but some of the crystals appear to be intercumulus.

Actinolite: These are radiating to acicular to fibrous and scaly crystals that are replacing/overprinting the pyroxenes. Typically found at the cores of the pyroxene alteromorphs and surrounded by crystals of hornblende. The hornblende forms an outline of crystals along the margins of the pyroxene alteromorphs. Locally chlorite+/-serpentine alteration and biotite alteration associated with this phase.

Biotite: A weak alteration phase that is reddish-brown in colour under ppl. Fibrous crystals associated with the amphiboles and the chlorite/serpentine alteration.

Serpentine: Irregular crystals present along the margins, boundaries and at the cores of the mafic aggregates and locally along the boundaries of the plagioclase crystals. Rare crystals reaching up to 0.9mm in length. (Lizardite +/- chlorite)

Chlorite: Minor chlorite associated with the serpentine. Weak alteration phase.

Sericite: Weak intensity sericitization of the plagioclase. Alteration is exploiting contacts, crystals boundaries and fractures to infiltrate the plagioclase. Rare crystals up to 0.1mm in length. Crystals are fibrous, but typically very fine grained.

Rutile: Accessory phase that is yellowish-brown to greenish in colour, none to weak pleochroism under plane polarized light. The crystals are typically elongate and anhedral to locally euhedral. Few of the crystals are cut so that they are visible under reflected light. Also present as thin exsolution lamellae. Largest crystals up to 0.7mm in length. Most of the crystals are found hosted in the mafics. (<1%)

Pyrrhotite: Anhedral, rounded crystals that are disseminated and typically hosted in the mafics. Crystals up to 0.2mm in size. (<1%)

Chalcopyrite: Small bleb of chalcopyrite found with the pyrrhotite. They share sharp contacts. (tr)

Opaques (unknown Composition): Opaques that do not reflect light are typically found adjacent to or surrounding the existing oxide and sulphides phases. These are likely additional sulphides/oxides that hosted within the thickness of the sample and are not cut by the surface of the polished section. (<1%)

A.1.12.2 Hole ID: H-03 Sample#: 00778-01

From (m): 27.67, **To** (m): 27.72

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, hornblende, actinolite, chlorite +/-serpentine, biotite, sericite+/- calcite, orthopyroxene, (augite?), apatite, rutile, pyrrhotite, chalcopyrite, opaques of unknown composition

Main description: Similar to 00776-01, but this sample has a more intense alteration. Medium-grained allotriomorphic to hypidiomorphic cumulate gabbro. Plagioclase forms the main framework along with large pyroxene alteromorphs that are now uralitized. The primary pyroxenes appear to have been cumulate phases, with what appears to be minor intercumulus phases. These likely represent primary cumulate orthopyroxenes and rare intercumulus clinopyroxene. The amphiboles are somewhat restricted to the primary crystal boundaries, but are locally exceeding those and are entering into the plagioclase. On the macroscale, what appear to be individual large crystals are composed of many smaller amphibole crystals at various orientations. There are very rare relic crystals of orthopyroxenes (+/- clinopyroxene?) present locally. These are typically surrounded by either hornblende +/- actinolite. Apatite is an accessory phase and is locally disseminated, and hosted in the plagioclase. The rutile is generally associated with the mafic phases and may reach up to 0.4mm in length. There is a weak intensity irregularly distributed biotite and chlorite (+/- serpentine) and sericite alteration. The opaques are more abundant than in 776, and there is a small band of sulphide (pyrrhotite) mineralization along with trace ilmenite. The contacts show a partially equilibrated geometry, with smooth to locally serrated edges.

Plagioclase: Crystals reach up to 4mm, but most are 1-1.5mm in length. The crystals are generally anhedral to subhedral, and form irregular crystals with sharp but rounded contacts. Contacts between plagioclase crystals are locally exploited by the alteration minerals. Plagioclase is a cumulate + intercumulus phase that forms the main framework of the sample. The plagioclase crystals are also host to thousands of fine grained acicular needles of an unknown mineral (too small to resolve). There is a weak sericitization of the plagioclase that is exploiting transverse cracks and sub parallel transverse cracks in the crystals. There is a weak lineation of the plagioclase crystals. Some of the plagioclase crystals are trapped in the mafic phases and are in ophitic texture, were as others are locally poikilitic and host mafic phases. (~35-40%)

Orthopyroxene: The primary pyroxenes are largely uralitized, but locally parts of the original crystals remain (relic fragments). The orthopyroxenes appear to have been cumulus phases.

Clinopyroxene (augite): Uncertain if any is present due to the strong presence of amphiboles. A primary intercumulus phase?

Hornblende: Replacing what appears to be primary pyroxene crystals (uralitization). Numerous hornblende + actinolite crystals at various orientations form mafic aggregates that on the macroscale appear to form individual large crystals. The crystals are subhedral to anhedral but locally euhedral crystals are present. The hornblende is pale green to pale brownish in ppl and locally show distinct cleavage. Generally found along the margins of the pyroxene alteromorphs with the crystals no longer respecting the primary crystal boundaries, and are entering the plagioclase. Appears to be a late phase, uncertain if any of these crystals are intercumulus. (~40-45%)

Actinolite: Radiating to fibrous, to elongate crystals that are pale green to colourless in ppl, and reach up to 1.7mm in length. Actinolite is also replacing the primary pyroxenes and can be found with hornblende. The crystals do not respect the primary crystal boundaries, so the actinolite crystals are entering the plagioclase.

Biotite: Subhedral to anhedral fibrous crystals associated with the amphiboles. Locally found at the cores of the mafic alteromorphs with amphiboles +/- pyroxene relics. Contacts are typically gradational. (<5%)

Chlorite: Fibrous crystals located along fractures and along margins of the mafic alteromorphs. Pale green to colourless in ppl. (+/- minor serpentine) (5-10%)

Sericite: There is a weak intensity sericitization of the plagioclase. Fine grained alteration exploiting the transverse and sub parallel cracks in the plagioclase, as well as the contacts and crystal boundaries. Forms a light dusting on the plagioclase.

Apatite: Rare accessory phase, acicular subhedral to euhedral crystals that are typically hosted in the plagioclase. A rare cross section of the mineral is locally visible. Up to 0.08mm in length. (tr)

Rutile: Yellow-brown in colour under ppl. Small anhedral to euhedral crystals that are generally hosted in the mafics. Crystals reach up to 0.4mm in length. (<1%)

Pyrrhotite: The main sulphide phase. Irregular anhedral crystals concentrated in a thin band. The sulphides are intercumulus. The pyrrhotite is locally host to blebs of chalcopyrite and shares mutual boundaries with chalcopyrite. Pyrrhotite crystals reached up to 1.5mm in length. (5-10%)

Chalcopyrite: Small blebs, typically associated with pyrrhotite or as blebs tapped within the Po. All crystals seen are <0.1mm (up to 0.07mm). (tr)

Opaques (unknown Composition): There are opaques phases of unknown composition present. These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides or oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~1-2%)

A.1.12.3 Hole ID: H-03 Sample#: 00779-01

From (m): 38.28, **To** (m): 38.33

Rock type: Hornblende Norite

Minerals Present: Plagioclase, hornblende, orthopyroxene, (augite?), actinolite, chlorite (+/- serpentine), biotite, rutile, apatite, sericite, quartz, pyrrhotite, opaques of unknown composition.

Main description: Allotriomorphic to hypidiomorphic medium-grained norite, similar to 776-01. Cumulus + intercumulus plagioclase form the main framework of the sample along with cumulate orthopyroxene, which is now largely overprinted by amphiboles. There is a weak lineation and weak sericitization of the plagioclase. The contacts of the plagioclase crystals are rounded but typically sharp. It appears that some of the crystals have gown at the expense of others. The mafic minerals are largely replaced by amphiboles (uralitization). Minor primary pyroxenes remain. Numerous amphibole crystals make up the larger pyroxene alteromorphs. These are weak to moderately altered by chlorite and biotite. Minor accessory phases are present, and are typically hosted in the mafics. This sample is cut by small fractures that are locally host to silica infill. The fractures are likely the source of the late altering fluids. There is trace opaques that are typically hosted in the mafic phases and appear to be late a rare late phase of pyrrhotite crystals that are hosted in the plagioclase that may be remobilized or a late phase of crystallization. The contacts between the crystals show a partially equilibrated to locally texturally equilibrated geometry. There are multiple triple junctions present with smooth contacts. Locally the contacts are serrated, but some of that appears to be the result of alteration.

Plagioclase: Anhedral to subhedral cumulate + intercumulus crystals. Contacts are sharp, irregular to locally rounded. Weak sericitization of the plagioclase, along transverse cracks and crystal contacts and boundaries. Weak lineation. Some of the crystals are kinked, and some show irregular extinction, suggesting that the crystals are strained or have undergone some compaction. Crystals reach up to 6mm in length but most are 2mm in length. Plagioclase is also host to numerous fine grained acicular needles (unresolved composition). (~65%)

Orthopyroxene: Crystals are anhedral, and host to numerous fractures. The orthopyroxene is a cumulus phase, and is uralitized. Along these fractures is a dark brownish coloured mineral (composition?). The orthopyroxene (bronzite) is a minor phase. (<1%)

Clinopyroxene (augite)?: Uncertain if there is any clinopyroxenes present in this sample. Some altered regions appear to have been an intercumulus phase of augite, but these are strongly uralitized.

Hornblende: Numerous subhedral crystals form the outline of the pyroxene alteromorphs and locally the cores. The crystals may not all have the same orientation. The amphiboles are replacing/overprinting the pyroxenes. The crystals no longer respect the primary crystal boundaries and locally enter the plagioclase. (~25%)

Actinolite: Acicular crystals to elongate lath shaped crystals. Found with the hornblende. The actinolite crystals no longer respect the primary crystal boundaries of the plagioclase/pyroxenes, and the actinolite crystals are entering the plagioclase. Rare twinned crystals. Chlorite +/- serpentine is locally associated with the mafics.

Biotite: Minor alteration phase associated with the mafics. Secondary or late crystallization.

Serpentine: Minor alteration phase that is fibrous with prominent cleavages and is associated with the chlorite.

Chlorite: Fibrous crystals found in the cores of the mafic alteromorphs (formerly orthopyroxene) and locally the crystals appear to be space filling. Biotite and serpentine may also be present with the chlorite. Late phase.

Sericite: Fine-grained alteration of the plagioclase, which looks like a dusting on the plagioclase. Rare crystals up to 0.03mm in length (small fibrous crystals).

Apatite: Disseminated accessory phase. The crystals are subhedral to euhedral and are hosted in the plagioclase and the mafics. (tr)

Quartz: Small crystals related to fracturing. Crystals are anhedral and up to 0.25mm in length, as fracture fill. Quartz is also present at the core of some of the mafic alteromorphs. (~1%)

Rutile: Subhedral to euhedral (acicular) up to 0.2mm in length. Intercumulus phase, generally hosted in the mafics. Brown-yellow in colour under ppl. (tr)

Pyrrhotite: Anhedral crystals up to 0.1mm in length that from small clusters of crystals, and are hosted in the mafics. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides or oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

A.1.12.4 Hole ID: H-03 Sample #: 00783-01

From (m): 123.76, **To** (m): 123.81

Rock type: Leuco Hornblende Gabbro

Minerals Present: Plagioclase, orthopyroxene, hornblende, serpentine +/- chlorite, actinolite, sericite, pyrrhotite, chalcopyrite, ilmenite, rutile, calcite, apatite and opaques of unknown composition

Main description: Similar to 00779-01. Plagioclase forms the main framework of the sample. Some of the plagioclase crystals are very large (>5mm in length) and are very weakly lineated. This may also be a result of compression, rather than primary magmatic lineation. The plagioclase crystals show a great diversity of sizes and crystal shapes along with sharp but irregular contacts. An allotriomorphic to hypidiomorphic medium-grained gabbro, with weak intensity sericitization and carbonatization and strong uralitization. The primary alteromorphs (orthopyroxene) are strongly altered/overprinted by amphiboles. Each of the mafic alteromorphs are now composed of many amphibole crystals at various orientations, and are no longer restricted to the primary crystal boundaries and are growing into the plagioclase. The opaque phases are minor (~1%) with the majority being ilmenite with minor pyrrhotite that is typically found associated with the mafic phases. Ilmenite appears to be an intercumulus phase and is Anhedral with sharp and irregular contacts. The pyrrhotite appears to be a later phase or may be remobilized? The contacts between the crystals show a partially equilibrated to locally texturally equilibrated geometry. There are multiple triple junctions present with smooth contacts. Locally the contacts are serrated, but some of that appears to be the result of alteration. The plagioclase crystals exhibit locally texturally equilibrated geometries.

Plagioclase: Crystals are anhedral to subhedral, to locally euhedral and reach up to 1cm in length, but most are 2mm in length. The contacts between the crystals are sharp but rounded and irregular, likely resulting from adcumulus growth. The plagioclase forms that main framework of the rock and show a very weak lineation. The plagioclase is a cumulus + intercumulus phase. There is a weak intensity carbonate and sericite alteration that is exploiting transverse cracks and contacts and crystals boundaries. The plagioclase is also host to numerous acicular needles (too small to resolve their composition). Sulphides and alteration minerals are present in the intercumulus space. Plagioclase composition is approx. An52- 55. (~65%)

Orthopyroxene: High Mg orthopyroxene (bronzite to hypersthene), anhedral crystals that form the relic cores of the primary mafic crystals suffering from uralitization. Contacts are sharp to locally skewed. Minor phase. (~1-2%)

Hornblende: Anhedral to subhedral crystals, commonly forming rims around the pyroxene alteromorphs. Crystals up to 0.8mm in length and is host to accessory rutile. Together with actinolite, the amphiboles are replacing and overprinting the pyroxenes. (20-25%)

Actinolite: Acicular needles and fibrous radiating crystals in the cores and along the margins of the pyroxene alteromorphs. Associated with the hornblende. Chlorite+/- serpentine may be found in the cores of the primary crystals (alteration phases, late stage).

Serpentine: Possibly a very small amount present with the chlorite.

Chlorite: Alteration phase of the mafics, and found as fracture fill in the plagioclase. Crystals are fibrous to radiating and locally replace the cores of the mafic alteromorphs. (minor serpentine may also be present, gradational contacts)

Calcite: Minor alteration phase. Exploiting the contacts, crystal boundaries and transverse fractures in the plagioclase. Very weak carbonatization. This is a late addition to the rock. (tr)

Sericite: Weak alteration phase. Exploiting the contacts, crystal boundaries and transverse fractures in the plagioclase. Crystals are very fine grained. This is a late addition to the rock. (~1%)

Apatite: Euhedral to subhedral acicular crystals. Minor accessory phase. (tr)

Rutile: Yellow-brownish in colour, small crystals that are subhedral to euhedral, typically hosted in the mafic minerals. Rare crystal that share mutual boundaries with the sulphides (pyrrhotite) Crystals up to 0.4mm in length. (<1%)

Ilmenite: Anhedral crystals with sharp contacts. Some of the crystals are almost rounded. Crystals reaching up to 1.2mm in length. Typically the ilmenite is hosted in the mafic phases, but may also be found intercumulus to the plagioclase. <1%

Pyrrhotite: Crystals are anhedral and locally rounded to sub rounded, disseminated and reach up to 0.5mm in length. Locally shares mutual boundaries with chalcopyrite, and rutile. (intercumulus phase or late addition?) (<1%)

Chalcopyrite: small anhedral crystals found in proximity to or sharing mutual boundaries with pyrrhotite. Crystal reaching up to 0.1mm in length. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

A.1.13 Unit 9

A.1.13.1 Hole ID: H-03 Sample#: 00790-01

From (m): 123.76, **To** (m): 123.81

Rock type: Norite (pyrrhotite rich)

Minerals Present: Plagioclase, orthopyroxene, augite, hornblende, biotite, actinolite, sericite, calcite, chlorite, pyrrhotite, chalcopyrite, ilmenite, zoisite/clinozoisite?, opaques (unknown composition)

Main description: Medium-grained allotriomorphic to hypidiomorphic norite. Plagioclase forms the main framework for this sample along with granular to slightly elongate shaped orthopyroxenes. Some of the plagioclase crystals are bent or kinked suggesting possible compaction. There are also a variety of crystal sizes, with rare large lath shaped crystals. The majority of the plagioclase crystals are 1-2mm in length and show sharp but irregular contact. The plagioclase is both a cumulus and intercumulus phase. The orthopyroxene crystals are granular to slightly elongate. The pyroxenes are locally rimmed by augite+/- amphiboles. The augite is an intercumulus phases and locally poikilitic. The sulphides are intercumulus and appear to have crystallized later as an intercumulus phase. The sericitization and carbonatization is likely related to a late event. The contacts between the crystals show a partially equilibrated geometry. The contacts are smooth to locally serrated.

Plagioclase: Anhedral to subhedral crystals that reach up to 5mm in length. The plagioclase crystals show a significant variation of crystal sizes, with the largest at 5mm, but most are 1-2mm in length. There is a weak lineation of the plagioclase crystals parallel to the layering direction. The crystals are short and tabular to lath shaped with sharp and irregular to rounded contacts. Some of the crystals exhibit irregular extinction (suggesting zoning or strain deformation) and some are kinked or bent, suggesting compaction. There is a very weak sericitization and carbonatization of the plagioclase. This alteration is exploiting contacts and fractures to infiltrate the sample. The plagioclase crystals are also host to numerous acicular needles (these are too small to resolve their composition). Contacts with the mafic minerals (silicates) are irregular and locally those crystals are entering the plagioclase. The oxide/sulphides also show irregular contacts with the plagioclase, appearing as though some of these opaque phases are breaking off into the plagioclase. The plagioclase is both a cumulus and intercumulus phase, and is the most abundant phase of the sample. (50-55%)

Orthopyroxene: Granular, subhedral to anhedral, cumulus mineral, cut by numerous fractures, crystals reaching up to 1mm in length. Fractures are point sources of infiltration of alteration/replacement minerals (amphiboles). Locally rimmed by hornblende+/- actinolite. Cleavage is clearly visible in some of the crystals. (~25%)

Clinopyroxene (augite): Intercumulus phase, anhedral, cut by numerous fractures which are exploited by alteration/replacement phases. Large poikilitic crystals reaching up to 5mm in length. Rimmed by hornblende locally. (~5-10%)

Hornblende: Present as rims surrounding the pyroxenes and as minor alteration of the pyroxenes (uralitization). Crystals are anhedral.

Actinolite: Present as rims surrounding the pyroxenes and as minor alteration of the pyroxenes (uralitization). Crystals are fibrous to acicular, subhedral.

Biotite: Reddish-brown in colour (ppl), fibrous crystals that are irregularly distributed and are subhedral to anhedral. Typically found in proximity to or adjacent to the opaques and the mafic phases. Minor alteration phase.

Chlorite: Very minor alteration phase associated with the carbonate alteration. Small fibrous crystals filling fractures that cut the plagioclase. (tr)

Calcite: Weak intensity alteration. Exploiting contacts/boundaries and fractures to enter the sample. (<1%)

Sericite: Weak intensity alteration. Exploiting contacts/boundaries and fractures to enter the plagioclase. Fine grained crystals. (<1%)

Ilmenite: Anhedral crystals that are typically found in close association with the sulphides (pyrrhotite and chalcopyrite). Crystals are rounded and share mutual boundaries with pyrrhotite locally. Minor phase, irregular distribution. (tr)

Pyrrhotite: Main sulphide phase. Anhedral crystals, sharp to irregular contacts that are locally being weakly digested/breaking down. Pyrrhotite is also locally host to small blebs of chalcopyrite suggesting that these are co-existing phases. The larger pyrrhotite crystals are typically composed of multiple amalgamated crystals, these may reach up to 4mm in length. (~20%)

Chalcopyrite: Anhedral crystals to irregular blebs trapped in the pyrrhotite. Crystals up to 0.4mm in length. Irregular distribution of chalcopyrite. (<1%)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~3%)

Zoisite/clinozoisite?: Very small high relief mineral that is colourless under ppl, and anomalous pale blues under xpl. Found adjacent to a number small sulphide crystals, hosted in the plagioclase. (tr)

A.1.13.2 Hole ID: H-03 Sample#: 00792-01

From (m): 128.31, **To** (m): 128.36

Rock type: Augite Hornblende Norite/ Leuco Augite Hornblende Norite

Minerals Present: Plagioclase, orthopyroxene, augite, hornblende, biotite, actinolite, sericite, calcite, chlorite, pyrrhotite, chalcopyrite, ilmenite, opaques (unknown composition)

Main description: Similar to 00790-01 but has a stronger intensity alteration and increased amphibole presence. The plagioclase crystals form the main framework and are the most abundant phase of the sample. The laths and truncated laths are very weakly lineated, and weakly sericitized and carbonatized. The orthopyroxenes crystals from chain like crystals between the framework of plagioclase crystals that are both cumulus and intercumulus phases. The cumulus orthopyroxene are locally rimmed by mafic phases (hornblende/Cpx) and are locally uralitized (crystals are at various orientations replacing the primary pyroxenes). These orthopyroxene alteromorphs are also strongly fractured. Biotite alteration is commonly present along the margins of the mafic minerals (pyroxenes/amphiboles). There is a minor presence of oxide and sulphide phases, and appear to be intercumulus. There may be some remobilization of the pyrrhotite. The contacts between the crystals show a partially equilibrated geometry, with locally present triple junctions. The contacts are smooth to irregular and locally serrated.

Plagioclase: Plagioclase forms the main framework of the sample. The plagioclase forms both cumulus and intercumulus crystals. The crystals are subhedral to anhedral and reach up to 4mm in length. These crystals are host to numerous acicular fine-grained needles of unknown composition (too small to resolve). Most of the crystals exhibit irregular extinction but do not appear to be zoned. There is a significant variation in crystal sizes. The larger crystals reach up to 4mm in length and are generally surrounded by much small crystals with sharp but irregular to rounded contacts. There is a weak sericitization and carbonatization that is exploiting crystal contacts/boundaries and transverse fractures in the plagioclase. (>50%)

Orthopyroxene: Subhedral to anhedral crystals that are granular to elongate in shape. Typically fractured and rimmed by additional mafic minerals (amphiboles/or augite). Rare, poikilitic crystals. Crystals present up to 2mm in length. Fine grained exsolution lamellae present in some of the crystals. (~30%)

Clinopyroxene (augite): Subhedral to anhedral crystals that are an intercumulus phase. Locally rimming orthopyroxene. Rare poikilitic crystals. Crystals reaching up to 3mm in length.

Hornblende: Anhedral crystals reaching up to 1.6mm in length. Present as rims around the pyroxenes and locally as crystals. Cleavage is clearly visible in some crystals. Locally small fractures are host to biotite alteration. The hornblende appears to be a later phase, after the pyroxenes. Uncertain if any of the hornblende is an intercumulus phase.

Actinolite: Acicular to fibrous crystals associated with the hornblende that rims the pyroxenes. These crystals no longer respect the primary crystal boundaries and enter the plagioclase. Rare large crystals present that reach up to 1.2mm in length.

Biotite: Anhedral to subhedral fibrous crystals up to 0.8mm in length that are typically found adjacent to or within the mafic minerals (pyroxenes/amphiboles). Secondary alteration phase?

Chlorite: Rare alteration phase. Fine grained fibrous crystals. (tr)

Calcite: Weak intensity alteration. Exploiting contacts/boundaries and fractures. Crystals reaching up to 0.1mm in length. Late alteration phase. (tr)

Sericite: Weak intensity alteration. Exploiting contacts/boundaries and fractures to enter the plagioclase. Fine grained crystals, associated with the calcite/carbonate. (<1%)

Ilmenite: Rounded anhedral crystals, up to 0.1mm in length. Also present as fine grained exsolution lamellae in the orthopyroxene. Appears to be a cumulus phase (concurrent with the plagioclase and orthopyroxene.) (<1%)

Pyrrhotite: Irregular anhedral crystals up to 0.5mm in length, these crystals appear to be weakly digested (breaking down) and share irregular contacts. Locally shares mutual boundaries with chalcopyrite. (<1%)

Chalcopyrite: Small anhedral crystals associated with the pyrrhotite, up to 0.025mm in length. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and is likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.13.3 Hole ID: H-04 Sample#: 00793-01

From (m): 17.86, **To** (m): 17.91

Rock type: Leuco hornblende augite norite/ hornblend-augite-norite

Minerals Present: Plagioclase, Orthopyroxene, augite, hornblende, biotite, actinolite, sericite, calcite, pyrrhotite, chalcopyrite, ilmenite, pentlandite, opaques (unknown composition), apatite

Main description: Similar to 00792-01 and 00790-01. Medium-grained allotriomorphic to hypidiomorphic leuco-norite/norite. Plagioclase is the most abundant phase of the sample and is very weakly lineated. The plagioclase crystals are both cumulus and intercumulus phases. Cumulate orthopyroxene are also present and rimmed by amphiboles and augite locally. Augite is an intercumulus phase and is locally being replaced/ overprinted by the hornblende. Only the cores of the pyroxenes remain due to the uralitization. The pyroxenes are fractured, providing a simple means of alteration and replacement. The amphiboles are present as rims and crystals replacing/overprinting the pyroxenes. These crystals do not respect the primary crystal boundaries of the pyroxenes and locally enter the plagioclase. There is a weak to moderate intensity carbonatization and sericitization locally. There is a weak biotitization locally. Minor quantities of opaque phases are generally found with the mafic minerals. The opaques appear to be intercumulus phases. The sample displays a texturally equilibrated to partially equilibrated geometry. The contacts between the plagioclase crystals are typically smooth and locally show triple junction contacts, but are also locally irregular. Some of the crystals are bent or kinked which may be a result of compaction of densification.

Plagioclase: Plagioclase is the most abundant phase of the sample. Crystals are subhedral to anhedral and reach up to 4.5mm in length, but the average size is approx. 1.5mm in length. These crystals are host to numerous acicular fine-grained needles of unknown composition. Contacts are irregular but sharp to rounded. There is a very weak lineation. A weak sericitization and carbonatization is exploiting the crystal contacts/boundaries and transverse fractures in the plagioclase. Plagioclase ~ An50. (~60%)

Orthopyroxene: Orthopyroxenes are subhedral to anhedral crystals that are typically surrounded/rimmed by amphiboles +/- augite, showing a weak to moderate uralitization. Granular to slightly elongate shaped crystals. The orthopyroxenes are cumulus crystals. Crystals are generally fractured. Locally sulphides are hosted in these fractures. Crystals reach up to 2.5mm in length. They are host to fine exsolution lamellae. (10%)

Clinopyroxene (augite): Subhedral to anhedral crystals that typically surround/rim orthopyroxenes. Crystals reaching up to 2mm in length. Weakly to moderately uralitized. Appears to be intercumulus phase. Locally host to minor exsolution. (5-10%)

Hornblende: Anhedral crystals reaching up to 1.6mm in length. Present as rims around the pyroxenes and locally as crystals. Associated with actinolite. The amphiboles are not respecting the primary crystal contacts and are locally entering the plagioclase. (20-25%)

Actinolite: Acicular to fibrous crystals associated with the hornblende that rims the pyroxenes. These crystals no longer respect the primary crystal boundaries and enter the plagioclase.

Biotite: Anhedral to subhedral, fibrous crystals up to 0.2mm in length, that are typically found adjacent to the amphiboles. Biotite is reddish-brown in colour. Secondary alteration phase?

Calcite: Weak to locally moderate intensity alteration that is exploiting contacts/boundaries and fractures. Calcite is fracture fill with crystals reaching up to 0.5mm in length. Late alteration phase.

Sericite: Weak intensity alteration of the plagioclase. Exploiting contacts/boundaries and fractures to enter the plagioclase. Fine grained but with crystals reaching up to 0.15mm in length. Late alteration phase.

Apatite: Trace accessory phase. Crystals are subhedral to euhedral and typically hosted in the plagioclase. (tr)

Ilmenite: Rounded, anhedral crystals, up to 0.2mm in length. Appears to be associated with the pyrrhotite, locally they share mutual boundaries. Most of the ilmenite is hosted in the mafic phases. (<1%)

Pyrrhotite: Irregular anhedral crystals up to 1mm in length, these crystals appear to be weakly digested (breaking down) and show irregular contacts. Exsolution or alteration of the pyrrhotite from along the margins appears to be composed of pentlandite (but these regions are too small to resolve). Locally small fine grained pyrrhotite present within fractures in the pyroxenes, these are likely remobilized or a secondary episode of mineralization. (<1%)

Chalcopyrite: Small anhedral crystals associated with the pyrrhotite, up to 0.02mm in length. Rare bleb hosted in the pyrrhotite suggesting these are coexisting phases. (tr)

Pentlandite: Pyrrhotite is host to fine grained exsolution that appears to be pentlandite. These are too small to resolve the composition. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.13.4 Hole ID: H-04 Sample#: 00797-01

From (m): 79.39, **To** (m): 79.44

Rock type: Hornblende-Augite Norite

Minerals Present: Plagioclase, orthopyroxene, augite (cpx), hornblende, actinolite, biotite, sericite, calcite, chlorite (+/- serpentine), pyrrhotite, chalcopyrite, ilmenite, graphite, opaques (unknown composition), brown mineral.

Main description: Allotriomorphic to hypidiomorphic medium to locally coarse-grained norite. Plagioclase is the most abundant phase of this sample, and is both a cumulus and intercumulus phase. The orthopyroxenes are suffering from strong uralitization and only the cores of the crystals remain. Some of the orthopyroxene crystals are poikilitic and host crystals of plagioclase, suggesting that they co-crystallized. Augite is an intercumulus phase. Amphiboles rim and locally replace the pyroxenes. The plagioclase is weakly sericitized and carbonatized. Biotite alteration is weak to moderate in intensity, and there is a very weak chlorite alteration. The average crystal size is approx. 3.5-4mm. The smaller plagioclase crystals show a more texturally equilibrated geometry, but the overall geometry is that of a partially equilibrated sample. The contacts are smooth to rounded, and locally serrated. The alteration locally skews the contacts.

Plagioclase: Anhedral to subhedral, rare euhedral crystals with sharp but irregular to rounded contacts. Lath shaped crystals up to 5mm in length but most are 2mm. The plagioclase is both a cumulus and intercumulus phase. The plagioclase crystals are the most abundant phase. Some of the crystals are bent, some are kinked and some show irregular extinction (related to deformation, compaction?). Weak sericite and carbonate alteration, that exploits fractures and contacts. The plagioclase crystals are host to numerous acicular needles of unknown composition (these do not appear to have a specific orientation). (~50%)

Orthopyroxene: Anhedral to subhedral crystals up to 4.2mm in length. Exhibiting fine-grained exsolution lamellae. Most of the crystals are fractured, and uralitized. The amphiboles are overprinting the primary textures of the pyroxenes, including the exsolution lamellae. Locally poikilitic crystals. Typically only the cores of the primary crystals remain. Cumulus phase (+/- intercumulus opx?). (15%)

Clinopyroxene (augite): Anhedral to crystals up to 3mm in length. Most of the crystals are fractured, and uralitized. The amphiboles are overprinting the primary textures of the pyroxenes. Intercumulus phase. (~5%)

Hornblende: Replacement of the primary pyroxenes as rims, and along the fractures that cut the crystals. Crystals of hornblende are also present and these are anhedral to subhedral. Overprinting some of the exsolution textures from the pyroxenes. Crystals up to 1.4mm in length. The amphiboles are not restricted to the primary crystal boundaries, and enter the plagioclase. Weak biotite and chlorite alteration that is most intense in proximity to the carbonate alteration. (20-25%)

Actinolite: Associated with the hornblende, see description for hornblende.

Biotite: Fibrous to flaky crystals that are subhedral and reach up to 0.4mm in length. Alteration phase of the amphiboles. (<5%)

Chlorite: Fibrous crystals that are locally kinked, up to 0.3mm in length. Associated with the plagioclase, amphiboles and carbonate alteration. (<1%)

Calcite: Weak intensity carbonate alteration. The calcite is exploiting the fractures and contacts to infiltrate the sample. Pods of calcite alteration reaching up to 0.4mm in length.

Sericite: Weak alteration of the plagioclase that is exploiting the contacts and fractures. (tr)

Ilmenite: Anhedral crystal up to 0.4mm in length. Typically associated with the mafic phases, and locally as exsolution lamellae. Intercumulus phase? (tr)

Pyrrhotite: Anhedral crystals, sharing mutual grain boundaries with chalcopyrite, and rare blebs of pyrrhotite hosted in the chalcopyrite. Crystals up to 2.3mm in length. No annealing seen (no dihedral angles). Intercumulus phase. Coexisting phase with chalcopyrite. (~2%)

Chalcopyrite: Anhedral crystals, sharing mutual boundaries with pyrrhotite and locally hosting small blebs of pyrrhotite. Crystals up to 2mm in length. Intercumulus phase. (<1%)

Graphite: Anhedral masses of graphite. Irregular distribution. Crystals up to 0.3mm in length. Late phase? (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (<1%)

Brownish-mineral: There is a semi-opaque, fine-grained phase that is present along the fractures at the cores of the pyroxenes. Uncertain if this is an iron rich alteration phase?? (~5%)

A.1.14 Unit 10a

A.1.14.1 Hole ID: H-06 Sample#: 00815-01

From (m): 43.37, **To** (m): 43.42

Rock type: Hornblende Norite

Minerals Present: Plagioclase, orthopyroxene (bronzite), biotite, hornblende (+/- actinolite), calcite, sericite, chlorite, pyrrhotite, ilmenite, chalcopyrite, graphite, opaques (unknown composition)

Main description: Coarse-grained, allotriomorphic to hypidiomorphic norite. Plagioclase is an abundant phase, and is both cumulus and intercumulus. Orthopyroxene is a cumulus and minor intercumulus phase, and is locally poikilitic. Typically, the orthopyroxenes are rimmed by hornblende (+/- actinolite). These crystals generally form a thin rim of fibrous to acicular crystals around the orthopyroxene. Some enter the plagioclase and no longer respect the primary crystal boundaries. Biotite is locally associated with these rims. There are a number of small fractures that cross cut the sample, these are sources of alteration minerals and water ingress. Typically calcite and sericite are associated with these fractures and in proximity to these structures. Alteration of the plagioclase is also occurring along crystal contacts and fractures. Alteration of the mafic phases is also more intense in proximity to these fractures, where carbonate, biotite and hornblende are replacing the orthopyroxene. The pyroxenes are themselves fractured and these fractures are the loci of alteration. The opaque phases (pyrrhotite, trace chalcopyrite and rare ilmenite) are associated with the mafics and appear to be intercumulus phases (all are irregular and anhedral). The contacts, and the arrangement of the crystals in this sample demonstrate a partially equilibrated geometry. The contacts are smooth, sharp, irregular to locally serrated. Only a small number of the smaller plagioclase crystals demonstrate a more texturally equilibrated geometry. The sample is tightly packed and has likely suffered from densification and compaction.

Plagioclase: Main silicate phase. Cumulus + intercumulus plagioclase, crystals are anhedral and irregular, and show irregular but sharp contacts. Minor zoning present. Host to numerous acicular needles of actinolite? Some crystals are kinked or bent, and some show irregular extinction (almost undulatory), suggesting some compaction. Crystals up to 4mm in length but most are 2mm. Alteration varies from very weak to moderate locally (carbonate+/-sericite).

Orthopyroxene: The main cumulus and rare intercumulus mafic phase, up to 4mm in length, typically poikilitic, hosting oxides, plagioclase and locally minor exsolution. Crystals are anhedral and are generally rimmed by amphiboles. Host to numerous fractures that are also points of alteration. Altered by amphiboles and biotite. (>15%)

Augite: None seen

Hornblende: Main alteration mineral of the orthopyroxenes (uralitization), and as a rim surrounding the orthopyroxenes. Rare twining of the crystals, associated with actinolite, pyroxenes, biotite and opaque phases. Crystals up to 0.98mm in length, generally reddish brown to pale green and pleochroic in ppl. Locally the crystals no longer respect the primary crystal boundaries and enter the plagioclase.

Actinolite: Acicular needles and fibrous crystals that are associated with the hornblende and locally enter the plagioclase. Crystals of various lengths, but none appear to exceed 0.5mm.

Biotite: Alteration mineral, generally associated with hornblende, actinolite, opaques, chlorite and the carbonates. This appears to be a secondary phase. Fibrous crystals, with well defined basal cleavage, reddish brown in ppl and highly pleochroic, crystals reaching 0.6mm

Chlorite: Minor alteration phase, associated with the carbonates and is altering the mafic phases (hornblende and the pyroxenes) and the margins/contacts and locally along fractures.

Calcite: Alteration mineral, exploiting fractures, contact and boundaries. Small patches of calcite present up to 0.2mm in length, these are space filling. Also present as a fine dusting in the plagioclase, and typically associated with sericite.

Sericite: Alteration mineral of the plagioclase and associated with the calcite. Exploiting fractures and contacts.

Ilmenite: Main oxide phase, most are associated with the mafic phases, intercumulus crystals, anhedral. Also present as fine exsolution. Crystals up to 0.4mm in length. (minor phase)

Pyrrhotite: Anhedral, irregular blebs, appear to be intercumulus phases. Contacts are sharp but some of the crystals appear to be weakly digested (jagged contacts), some crystals are enclosed within the mafic phases. Crystals up to 1mm in length but most are between 0.1 and 0.5mm. Locally shares mutual boundaries with ilmenite, and rare chalcopyrite blebs in contact with the pyrrhotite. Minor phase.

Chalcopyrite: (very rare) small blebs attached to the pyrrhotite crystals, mutual grain boundaries. Crystals up to 0.1mm. (tr)

Graphite: Rare graphite crystals, fibrous and irregular flaky crystals. Crystals look like branches from a tree. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (<1%)

A.1.14.2 Hole ID: H-06 Sample#: 00832-01

From (m): 137, **To** (m): 137.05

Rock type: Opx Hornblende Gabbro

Minerals Present: Plagioclase, orthopyroxene, clinopyroxene (augite), hornblende, calcite, biotite, chlorite, pyrrhotite, ilmenite, chalcopyrite, graphite, quartz (fracture fill), opaques (unknown composition)

Main description: Some similarities to 00793-01 and 00797-01. Cumulate sample. Plagioclase is the most abundant phase of the sample and is weakly lineated parallel to the layering. The cumulus orthopyroxene is typically fractured and locally host exsolution of Fe-Ti oxides. The pyroxenes are locally uralitized and are typically rimmed by hornblende. Where the pyroxenes have been replaced by the amphiboles some of the exsolution of the oxides are still visible (overprinted). There is a weak intensity biotite alteration of the mafic phases. The pyroxenes are anhedral and are granular to locally poikilitic. There are small fractures that cut the sample and are filled with carbonate and silica. Minor opaque phases present comprising pyrrhotite, ilmenite, chalcopyrite and graphite. The packing arrangement of the crystals would suggest that the sample has undergone densification and compaction, and the presence of kinked or bent plagioclase crystals is evidence of that. The contacts between the grains are sharp, smooth and irregular to serrated. This sample demonstrates a partially equilibrated geometry and densified crystal packing.

Plagioclase: Most abundant phase. The crystals are weakly aligned parallel to the layering. Lath shaped crystals reaching up to 4.25mm in length, most are 1-2mm. Plagioclase is typically anhedral to subhedral. Some of the crystals are kinked or bent, suggesting compaction. Crystal contacts are sharp but irregular and locally rounded, larger laths are typically surrounded by numerous smaller plagioclase crystals forming a network. Plagioclase is also host to thousands of acicular needles that are too fine to resolve their composition. The plagioclase is weakly carbonatized locally. The calcite appears to be exploiting fractures, crystal boundaries and contacts. The plagioclase appears to be mostly a cumulus phase, but is also present as an intercumulus phase.

Orthopyroxene: Cumulus phase that is elongate to rounded to almost blade like, locally hosting exsolution of thin opaques that are all lineated (ilmenite??), also locally hosting exsolution of augite. The orthopyroxene typically forms clusters of crystals. Locally orthopyroxene is poikilitic. Typically rimmed by hornblende+/- actinolite+/- biotite. The amphiboles are replacing the pyroxenes, and locally taking advantage of the fractures in the pyroxenes. Crystals up to 2.4mm but most are ~1mm in length.

Clinopyroxene (augite): Anhedral crystals that are typically fractured, and host a brownish coloured exsolution that is angular in shape, typically associated with the Opx or may occur as exsolution. Appears to be an intercumulus phase, locally being replaced by the amphiboles (hornblende+/- actinolite), and is typically rimmed by the amphiboles. Augite is locally poikilitic and is rarely twinned. Crystals up to 3mm, but most are ~1mm in length.

Hornblende: An alteration/replacement phase of the pyroxenes. Hornblende is present as rims and as individual anhedral to subhedral crystals, and is locally twinned. Hornblende is also exploiting fractures in the pyroxenes as a means of replacement (uralitization).

Actinolite: Actinolite is typically associated with the hornblende, as rims and replacement of the pyroxenes.

Biotite: Alteration phase, most abundant in proximity to fractures, is reddish brown in colour (ppl), and is locally replacing the hornblende, its presence is patchy and unevenly distributed, rare crystals up to 0.7mm in length, most are subhedral to anhedral, fibrous crystals and crystal clusters. (~5%)

Chlorite: Very minor alteration phase (tr), that appears as fibrous crystals associated with the carbonate alteration, along fractures and the margins of the mafic phases. (tr)

Calcite: Alteration phase that is exploiting that fractures, crystal boundaries and crystal defects, most abundant alteration phase of the plagioclase. Small pods and irregular patchy alteration. (1-2%)

Ilmenite: Anhedral, sharp contacts, irregular and rounded, present as individual crystals that appear to have been intercumulus phases and locally as thin elongate exsolution in the pyroxenes. Rare crystal up to 0.6mm in length. (<1%)

Pyrrhotite: Main opaque phase, anhedral crystals, intercumulus, sharp jagged contacts, but not as severe as 00827-01, typically crystals are fractured and reach up 1.3mm in length. The pyrrhotite is generally associated with the mafic phases.

Chalcopyrite: Anhedral blebs, generally sharing mutual grain boundaries with pyrrhotite, some of the chalcopyrite is trapped in crystals of pyrrhotite. Crystals up to 0.1mm in length.

Graphite: Anhedral masses, irregular distribution. (tr)

Opaques (unknown Composition): There are generally thin haloes or incomplete haloes of opaques of unknown composition surrounding each of large sulphide and oxide grains. These do not reflect light and appear black under ppl and xpl. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.15 Unit 10b

A.1.15.1 Hole ID: H-06 Sample#: 00829-01

From (m): 97.25, **To** (m): 97.3

Rock type: Altered Hornblende Norite

Minerals Present: Plagioclase, hornblende (+/- actinolite), Opx and Cpx, biotite, sericite, pyrrhotite, ilmenite, chalcopyrite, opaques (unknown composition)

Main description: Similar to 793-01, except that this sample has greater presence of amphiboles and stronger alteration, and increased amount of opaque phases (pyrrhotite). This sample appears to be an altered version of sample # 832-01. This is an allotriomorphic to hypidiomorphic, medium-grained hornblende rich norite (now a gabbro). Plagioclase is the most abundant phase in this sample. There is a weak lineation of the plagioclase parallel to the layering. Strong uralitization, only outlines, exsolution and rare cores of the primary crystals remain. Any original cores are typically rimmed by amphiboles. Oxides and sulphides appear to be intercumulus phases. Ilmenite is also present as exsolution. The packing arrangement of the crystals would suggest that the sample has undergone densification and compaction, and the presence of kinked or bent plagioclase crystal would agree with that. The contacts between the grains are sharp, irregular and serrated. This sample is host to an unequilibrated to partially equilibrated geometry.

Plagioclase: Up to 4mm, most 1-2mm in length, anhedral to subhedral, sharp but rounded contacts, weak to moderate alteration (sericite) that is exploiting fractures, crystal contacts and crystal defects, locally carbonate alteration also present. The plagioclase crystals exhibit a weak orientation of the plagioclase parallel to layering. There is a significant variation in crystal size and shape locally, some of the crystals are kinked, and rare crystals show irregular extinction. Host to numerous acicular needles (actinolite??), locally these crystals appear to follow a preferred orientation. The plagioclase appears to be mostly a cumulus phase, with some intercumulus crystals.

Orthopyroxene: Replaced by amphiboles (strong uralitization), locally exsolution of Fe-Ti oxides are still visible. Rare cores present. May have been a primary cumulus phase.

Clinopyroxene (augite): Replaced by amphiboles. Locally exsolution and primary grain outlines are still visible. Rare core of a primary crystal present and is rimmed by amphiboles.

Hornblende: Main mafic phase. Strong uralitization of the pyroxenes, now what appears to be individual crystals on the macroscale are composed of many crystals of hornblende +/- actinolite at various orientations on the microscale. Crystals are anhedral to subhedral, and are not restricted to the original boundaries of the primary crystals. These now enter the plagioclase, and extend outside of those boundaries. Overprinted the exsolution of the primary pyroxenes.

Actinolite: One of the main mafic phases, replacing the pyroxenes. Now what appears to be individual large crystals on the macroscale are many crystals of hornblende +/- actinolite at various orientations that make up these crystals. Most are fibrous in texture. Crystals are not restricted to the original boundaries of the primary crystals. These now enter the plagioclase, and extend outside of those boundaries.

Biotite: Alteration phase, typically fibrous and forms short stubby or long fibrous crystals that are reddish-brown and highly pleochroic in ppl. Biotite is generally associated with the hornblende and with the sulphide and oxides (sources of Fe). Some of these crystals appear to radiate from the sulphides, and reach up to 1.2mm in length. The crystals are subhedral to anhedral.

Chlorite: Trace amount of chlorite associated with the carbonate and sericite alteration along fractures, as well as with the biotite.

Calcite: Very minor alteration phase that is associated with fractures and crystals boundaries/contacts. Small pods of calcite. (tr)

Sericite: Weak alteration of the plagioclase, locally associated with carbonate, typically exploiting the crystal boundaries/contacts, fractures and crystals defects.

Ilmenite: Main oxide phase, associated with the pyrrhotite, but also present as thin elongate exsolution and small crystals trapped in the mafic phases. Crystals up to 1.2mm in length, but that is rare most anhedral crystals are 0.1mm or less. Contacts are generally sharp to jagged, and may be weakly fractured. (tr)

Pyrrhotite: Main opaque phase, anhedral, irregular, jagged and contacts, except with chalcopyrite and ilmenite which show mutual grain boundaries. Pyrrhotite is typically pitted, and crystals reach up to 2mm in length, no annealing seen, sulphides appear to be intercumulus phases (anhedral) and appear to have crystallized around or between other crystals (gangue).

Chalcopyrite: Minor sulphide phase (tr)

Opaques (unknown Composition): Typically associated with the sulphides and oxides, generally appear to be composed of fine grained aggregates, and do not reflect light, but are black under ppl. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.15.2 Hole ID: H-06 Sample#: 00835-01

From (m): 188.91, **To** (m): 188.96

Rock type: Altered leuco hornblende norite

Minerals Present: Plagioclase, calcite, biotite, hornblende (+/- actinolite), quartz, pyrrhotite, chalcopyrite, ilmenite, apatite, augite, relic orthopyroxene?, opaques (unknown composition), pentlandite

Main description: This sample is similar to 00829-01, but has higher intensity alteration. This is an allotriomorphic to hypidiomorphic, medium-grained cumulate norite to leuco norite (now altered and more gabbroic in composition due to the amphiboles). The minerals are aligned parallel with the layering, showing a weak to moderate lineation. Weak to moderate carbonate alteration, numerous small fractures cut this sample and appear to be sources of altering fluids (carbonates). Alteration minerals have developed as a result of the fluid infiltration (biotite, chlorite, +/- amphiboles). The primary cumulate pyroxenes (orthopyroxenes) appear to be replaced or overprinted by the amphiboles (uralitization). Rare augite crystals remain as an intercumulus phase. Exsolution lamellae and primary textures of the pyroxenes are still visible locally. The amphiboles along with the biotite alteration are no longer restricted to the primary crystal boundaries and enter the plagioclase. Plagioclase appears to have formed the main cumulate framework along with orthopyroxenes. The plagioclase shows a slight variation in crystal size, suggesting that some of the plagioclase crystals may have been primary crystals from the magma. There also appears to be very minor intercumulus plagioclase locally. The opaques appear to be intercumulus phases, locally some of the opaques are found within the mafic crystals suggesting that they crystallized at the same time. There is minor pyrrhotite and ilmenite present. The packing arrangement of the crystals would suggest that the sample has undergone densification and compaction, and the presence of kinked or bent plagioclase crystals is evidence of that. The contacts between the grains are sharp, smooth and irregular to serrated. This sample demonstrates a partially equilibrated geometry and densified crystal packing. The crystals likely underwent adcumulus growth or overgrowth to reduce the pore space and produce the arrangement seen today.

Plagioclase: Main cumulate phase, and forms that main framework of the rock along with orthopyroxene, weak lineation of the plagioclase parallel to the layering, weak to locally moderate carbonatization, locally crystals are kinked. Crystals show abundant albite twinning and less common Carlsbad and pericline twinning, glide twins also present. The crystals are anhedral to subhedral and generally show sharp and irregular to rounded contacts. There are a couple of anhedral crystals that appear to be intercumulus phases (uncertain). There is a variation in crystal size, with some plagioclase reaching >5mm in length, but most are 1-2mm. (Single crystal = An48)

Orthopyroxene: Remnant Opx appears as the cores of some of the mafic grains, the linear exsolution lamellae are clearly visible. They appear to have been replaced or overprinted by amphiboles, and show an almost fibrous texture and oblique extinction. Some of the primary exsolution is still visible. The orthopyroxene appears to have originated as a cumulate phase of subhedral granular to slightly elongate crystals.

Clinopyroxene (augite): Some of the primary textures are still present, but augite is largely altered or replaced. Augite appears to have been an intercumulus phase, associated with the orthopyroxenes.

Hornblende: Later phase, currently replacing/overprinting the pyroxenes. Present as rims and replacing the primary crystals, typically associated with actinolite (uralitization). There are numerous amphibole crystals that now form what appear to have been large pyroxene crystals. The hornblende is locally altered by biotite along the margins and is exploiting any fractures or what may have been exsolution lamellae. Crystals are anhedral to subhedral, rarely twinned, and have irregular orientations. These appear to be intergrown with actinolite locally. Typically the crystals are not restricted to the original grain boundaries of the pyroxenes and entre the plagioclase.

Actinolite: Replacement of the pyroxenes as rims and replacing/overprinting the primary crystals, typically associated with hornblende, and the two minerals may be intergrown. Generally the crystals are not restricted to the original grain boundaries of the pyroxenes and now extend into the plagioclase.

Biotite: Alteration phase, typically found along the margins of the mafic "clusters", these fibrous crystals now extend into the plagioclase and are not restricted by crystal boundaries. Biotite is also found along fractures and in proximity to the Fe-sulphides and Fe-oxides. Rare crystals up to 0.8mm in length.

Serpentine: May also be minor serpentine with the chlorite?? Too fine to resolve the composition.

Chlorite: Minor alteration phase associated with the fractures. The chlorite is locally replacing the amphiboles/pyroxenes that are cut by the thin fractures, and is associated with carbonate and silica. The crystals are fibrous and locally radiate outwards, up to 0.4mm in length. (~1%)

Calcite: Calcite is the main alteration phase of the plagioclase, and appears to exploit the fractures, crystal boundaries and contacts as well as any crystal defects. Patchy alteration, that is weak to moderate in intensity locally.

Apatite: Minor accessory phase

Quartz: Fracture fill of thin fracture that runs across the slide, forming a patchwork of small crystals. Small irregular quartz crystals are also present along the margins of the main crystals (locally). Later phase.

Ilmenite: Irregular, anhedral crystals, typically elongate, and present as exsolution lamellae within the mafic crystals (formerly pyroxenes: orthopyroxene). Crystal contacts are generally sharp, smooth to almost rounded. Typically the ilmenite is associated with the mafics, and is an intercumulus phase. (<1%)

Pyrrhotite: Main opaque phase, anhedral crystals, sharp irregular to jagged contacts, locally sharing mutual grain boundaries with the chalcopyrite. Rarely hosting blebs of other sulphides. Locally one crystal hosting what appears to be pentlandite? Typically sulphides are associated with the mafic phases, generally present as blebs and locally as thin irregular straw like crystals up to 0.8mm in length. These also appear to be intercumulus phases, but there may be some later effects on the crystals to form such jagged contacts. (~1%)

Chalcopyrite: Small blebs associated with the pyrrhotite. (tr)

Opaques (unknown Composition): Opaques generally found with the sulphides and oxides as either a rim or partial rims, they vary in thickness. They do not reflect light and appear opaque under ppl and xpl. Often found with the pyrrhotite. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.16 Unit 11a

A.1.16.1 Hole ID: Hp-08 Sample#: 00848-01

From (m): 139.72, **To** (m): 139.77

Rock type: Cpx (augite) Norite

Minerals Present: Plagioclase, orthopyroxene, augite (cpx), hornblende, actinolite, biotite, calcite, quartz, chlorite, apatite, ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition, and a brownish coloured mineral/alteration of the mafics, pentlandite

Main description: Textures are similar to 845-01, 840-01, 842-01 and 843-01 except that this sample is much coarser and shows a weaker alteration. The sample is coarse-grained and a cumulate norite, with cumulus plagioclase + orthopyroxene forming the main framework of the sample. Intercumulus augite is locally poikilitic, and encloses minor plagioclase. There is a weak carbonatization of the sample, with the carbonate exploiting the fractures and contacts to infiltrate the sample. Alteration/replacement of the pyroxenes by hornblende and biotite is most abundant along the rims/margins of the pyroxene crystals and in proximity to carbonate alteration. Most the crystals are fractured (especially the orthopyroxene crystals), which also allows for the accelerated alteration of the crystals. The sulphide and oxide phases are intercumulus and are locally breaking down. The ilmenite is breaking down to form leucoxene (rutile), and the pyrrhotite is locally exhibiting thin exsolution lamellae of pentlandite. This sample is coarse grained with the average crystal size >5mm in length. The sample is tightly packed, and the arrangement of the crystals would suggest that there has been some densification. The contacts between the crystals are sharp and irregular to smooth, and are locally filled with alteration minerals. The sample texturally shows a partially equilibrated geometry.

Plagioclase: Plagioclase forms the main framework of the cumulate. The crystals reach up to >8mm in length, most are anhedral to subhedral and show irregular extinction and a weak zoning. The plagioclase is cut by numerous fractures that are sources of carbonate bearing fluids. Carbonate alteration of the plagioclase is weak to moderate in intensity. Contacts between the plagioclase crystals are sharp but irregular, and appear to have been exploited by altering fluids. There are many acicular crystals hosted in the plagioclase, but not as much as seen in holes H-01 to H-06. The plagioclase is also host to pods of calcite and small aggregates of chlorite alteration. The plagioclase is locally enclosed poikilitically within the pyroxenes (ophitic texture). No visible defined orientation to the plagioclase crystals. The hornblende and biotite that rim the mafics are not restricted by the crystal boundaries and are growing into the plagioclase crystals. (>50%)

Orthopyroxene: Crystals up to 4.5mm in length, most have rims of +/-hornblende+/-biotite. The crystals are typically fractured and host fine exsolution lamellae of what appears to be Fe-Ti oxides, these form a simple lineation aligned with the crystal structure. The orthopyroxenes are also host to thin exsolution lamellae of Cpx (or possibly pigeonite (too small to resolve)). The orthopyroxenes are suffering from replacement/alteration/overprinting by amphiboles locally (uralitization).

Clinopyroxene (augite): Crystals are anhedral, intercumulus, up to 8mm in length, locally poikilitic and typically fractured. Augite is also present as fine-grained rims locally, but is typically rimmed by hornblende +/- biotite. Augite is locally being altered/replaced/overprinted by hornblende +/- biotite+/- carbonate, along the margins and through the fractures that cut the crystals.

Hornblende: Present as rims on the pyroxenes, alteration/overprinting/replacement of the pyroxenes and locally as small pods that have infiltrated the pyroxenes. Anhedral crystals that range from pale brownish to pale green in colour under ppl. The rims are no longer restricted to the original crystal boundaries, the hornblende+/- biotite locally forms clusters of crystals that grow outwards and into the plagioclase. (2-3%)

Actinolite: Fibrous accumulations that are locally replacing or overprinting the pyroxenes, typically associated with hornblende and biotite. Generally found along the margins of the crystals. Colourless to very pale green in ppl. (1-2%)

Biotite: Alteration phase, typically found with the carbonate alteration, and as an alteration phase of the mafics. Reddish brown and highly pleochroic under ppl. Also found adjacent to the oxides and sulphide phases and may host acicular crystals that are opaque but do not reflect light (no set orientation to the crystals, so likely not a form of exsolution or overprinting.) Crystals are typically fibrous and show a prominent basal cleavage. (1-3%)

Chlorite: Alteration associated with biotite and is locally hosts thin bands of calcite. Also found as irregular pods of fibrous looking crystals hosted in the plagioclase adjacent to calcite alteration. (tr)

Calcite: Alteration phase locally found exploiting fractures, crystal boundaries and contacts. Generally found as fine grained anhedral crystals, and small pods of calcite. Biotite, chlorite and quartz appear to be more abundant in proximity to the calcite. (<1%)

Apatite: Very minor accessory phase, subhedral crystals up to 0.3mm in length, found in association with the mafics. (tr)

Quartz: Small anhedral crystals that appear to originate along fractures and fill spaces. Typically found with the carbonate alteration. Late phase? (<1%)

Rutile: Leucoxene, alteration/breakdown product of the ilmenite. (tr)

Ilmenite: Anhedral crystals, intercumulus, crystals are locally breaking down to form what appears to be leucoxene (or rutile). Contacts are sharp and irregular to rounded. The crystals are locally weakly fractured. There appears to be two main populations of ilmenite: large intercumulus crystals and locally as exsolution lamellae within the pyroxenes (opx). Rare crystals up to 2.7mm in length. (~1%)

Pyrrhotite: Anhedral crystals that have sharp but angular to jagged contacts, generally chalcopyrite associated with it. The pyrrhotite is locally showing exsolution lamellae of pentlandite, which are most prominent along the margins of the crystals. Pyrrhotite crystals up to 0.7mm in length. (tr)

Chalcopyrite: Associated with the pyrrhotite, sharing mutual grain boundaries. Crystals up to 0.1mm in length, that form anhedral blebs, with sharp irregular to smooth contacts with the silicates and sulphides. (tr)

Pentlandite: Exsolution of pentlandite from the pyrrhotite that look like irregular flame like structures originating along the margins of the pyrrhotite crystals. (tr)

Opaques (unknown Composition): Associated with the sulphides and oxides, typically as irregular and incomplete rims. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (tr)

Brownish coloured semi-opaque phase: Fine grained, brownish coloured mineral that is semi-opaque, found along the fractures of the pyroxenes and locally as alteration of the mafic phases. Possibly a carbonate phase? Or iron rich alteration mineral? Too fine grained to resolve the composition.

A.1.16.2 Hole ID: Hp-12 Sample#: 00874-01

From (m): 78.52, **To** (m): 78.57

Rock type: Leuco Opx Gabbro

Minerals Present: Plagioclase, orthopyroxene, augite (+/- pigeonite), biotite, hornblende, calcite, sericite, ilmenite, pyrrhotite, chalcopyrite, graphite, opaques (unknown composition), zircon?

Main description: Similar mineralogically to 00798-01, but texturally different and but much coarser-grained and with a stronger intensity alteration. This sample is composed of lineated cumulus plagioclases which are anhedral to subhedral, to euhedral with intercumulus pyroxenes + oxides/sulphides. Weak to locally moderate uralitization of the pyroxenes by hornblende, but this appears to be related to the late stage carbonatization and sericitization infiltrating the sample along fractures, contacts and boundaries. Some of the plagioclase crystals are zoned. The sulphides and oxides are also intercumulus phases and appear to have crystallized at approximately the same time as the pyroxenes (opx and Cpx). Rare ophitic to subophitic pyroxenes. The ilmenite is host to blebs of pyrrhotite in a poikilitic texture, and it is also suffering from exsolution or is breaking down to form leucoxene? The contacts between grains are sharp, and irregular to serrated. The packing of the minerals would suggest that there has been some densification, and likely compaction. The sample exhibits a partially equilibrated to unequilibrated geometry.

Plagioclase: Forms the main framework of the sample, cumulus phase (and minor intercumulus plagioclase crystals) Significant variability in crystal size up to 8mm in length, with the average crystal size ~3-4mm. Most crystals are anhedral to subhedral to euhedral to lath shaped. The larger crystals are typically lath shaped. Irregular extinction and zoning present in some of the crystals. Contacts are sharp but irregular and are locally exploited by alteration minerals. There is a weak carbonatization and sericitization of the plagioclase. The lath shaped crystals are lineated and are parallel to the layering direction.

Orthopyroxene: One of the main mafic phases. Intercumulus phase, crystals are anhedral to subhedral, some are poikilitic and locally host exsolution of the Fe-Ti oxides +/- Cpx. Locally uralitized and weakly altered by biotite and carbonate. Orthopyroxene crystals reach up to 6mm in length. The orthopyroxene are generally larger than the clinopyroxenes, but there is slightly more augite present than orthopyroxenes.

Clinopyroxene (augite): One of the main mafic phases. Intercumulus phase, crystals are anhedral, and some are poikilitic. Locally uralitized and weakly altered by biotite and carbonate. Crystals reach up to 4mm in length. The Cpx/Augite is also locally present as thin rims around the orthopyroxenes. (There appears to be very minor amount of pigeonite present as intercumulus crystals locally. (tr)

Hornblende: Weak intensity uralitization of the pyroxenes locally, by brown coloured hornblende. The crystals are anhedral, patchy and have an irregular distribution. Appears to be associated with the carbonate +/- biotite.

Biotite: Alteration phase typically found adjacent to, or in close proximity to sulphides/oxides +/-hornblende+/- carbonate alteration. Patchy and irregular distribution. Crystals are anhedral to subhedral, and reach up to 1.6mm in length. Biotite appears to be a secondary phase related to late stage alteration.

Calcite: Weak intensity carbonate alteration of the sample with irregular or patchy distribution. The calcite is exploiting the fractures, crystal contacts and boundaries. Calcite is also present as fracture fill and small anhedral pods. Late phase. (~2%)

Sericite: Weak intensity sericite alteration of the plagioclase that is exploiting fractures, and crystal contacts. Late phase. (~1%)

Ilmenite: Intercumulus phase, main metallic oxide phase. Appears to have crystallized at approximately the same time as the pyroxenes, some of the crystals are poikilitically enclosed in the pyroxenes and others are surrounded by the pyroxenes. The ilmenite is also poikilitic and locally hosts blebs of pyrrhotite. The ilmenite crystals are typically fractured and are locally host to exsolution of Fe/Ti minerals. Some of the ilmenite is also breaking down to form leucoxene/rutile? Twinning is common. Rare annealing and dihedral angles (120deg). Also present as thin exsolution lamellae in the pyroxenes. (10-15%)

Pyrrhotite: Main sulphide phase comprised of anhedral crystals that are locally poikilitically enclosed in the ilmenite, and also share mutual boundaries with the ilmenite. Minor chalcopyrite found adjacent to the pyrrhotite. Crystals reaching >1mm in length (most are ~0.25-0.5mm in length). Intercumulus phase. (~2-3%)

Chalcopyrite: Rare anhedral crystals, found adjacent to the pyrrhotite and sharing mutual crystal contacts that are sharp but rounded. Up to 0.08mm in length. (tr)

Graphite: Very minor phase, anhedral crystals that are dendritic, and reach up to 0.2mm in length. Does not appear to be primary. Late phase or related to the fracturing? (tr)

Zircon: A single zircon crystal found that is 0.1mm in length and hosted in the plagioclase with high relief and high birefringence. Possibly a zircon? (tr)

Opaques (unknown Composition): These are generally found adjacent to/or in proximity to the oxides and sulphides. These are likely additional sulphides/oxide phases that do not cut the surface of the thin section. Some of the opaques may also be the breakdown products of the oxides/sulphides. (~1%)

A.1.17 Unit 12

A.1.17.1 Hole ID: H-04 Sample#: 00796-01

From (m): 52.45, **To** (m): 52.5

Rock type: hornblende-augite-norite to hbld-opx-gabbro (similar quantities of both orthopyroxene and augite)

Minerals Present: Plagioclase, orthopyroxene, augite (Cpx), hornblende (+/-actinolite), biotite, apatite, pyrrhotite, chalcopyrite, ilmenite, opaques of unknown composition, pentlandite

Main description: Fine-grained allotriomorphic norite/gabbro (approximately the same quantity of orthopyroxene and augite). There is a weak to moderate lineation that is parallel to the layering. The crystals are all approximately the same size (0.3-0.6mm), but the plagioclase crystals are slightly larger than the mafics. The orthopyroxenes appears to be a cumulus phase and the augite is intercumulus +/- minor cumulus crystals. The pyroxenes form long chains of crystals that are parallel to sub-parallel to the layering. The pyroxenes are locally uralitized and there is a weak to moderate biotite alteration of the sample. Weak carbonate alteration that is exploiting the fractures and crystal boundaries and contacts in the sample. Has a granular appearance. The crystal contacts are smooth to rounded, and show a partially equilibrated geometry.

Plagioclase: Anhedral to subhedral, weak lineation, sharp irregular contacts. Rare crystals up to 4mm in length but most are 0.3-0.6mm in length. The plagioclase crystals are generally slightly larger than the mafic phases. Irregular extinction (due to strain or compositional zoning). Weak intensity carbonate alteration (irregular distribution). The plagioclase crystals appear to be both cumulus and intercumulus phases. (One crystal An45) (~45-50%)

Orthopyroxene: Anhedral, granular to slightly elongate crystals that are weakly lineated parallel to the layering. Crystals up to 0.7mm in length but most are ~0.3-0.5mm in length. Contacts are sharp and irregular. The crystals are cut by numerous fractures and locally are weakly to moderately uralitized, and weakly biotized. (~40% pyroxenes total)

Clinopyroxene (augite): Anhedral, granular to slightly elongate crystals, that are locally rimmed by amphiboles and weakly uralitized. Crystals up to 0.7mm in length but most are 0.3-0.5mm in length. Weakly lineated parallel to the layering. Crystals are locally fractured.

Hornblende: Present as rims surrounding the pyroxenes (mantles), as individual crystals and replacement of the pyroxenes (uralitization). There appears to be a minor component of intercumulus hornblende. Weak biotite alteration, minor actinolite associated with the hornblende. Crystal up to 0.5mm in length. The hornblende is also host to small minerals with radiation haloes. These minerals are too small to resolve their composition (possibly small zircons?).

Actinolite: Anhedral to subhedral crystals, associated with the hornblende, uralitizing the pyroxenes.Weak biotite alteration.

Biotite: Reddish-brown coloured biotite (ppl), late alteration phase, anhedral to subhedral crystals up to 0.4mm in length. Fibrous to scaly crystals with irregular distribution.

Calcite: Weak intensity carbonate alteration. The calcite is exploiting the fractures and contacts to infiltrate the sample. (~1-2%)

Apatite: Subhedral to euhedral acicular crystals up to 0.05mm in length. Typically hosted in the plagioclase.

Ilmenite: Anhedral to rounded crystals, with sharp contacts, up to 2mm in length. Shares mutual boundaries with pyrrhotite, locally some of the ilmenite is annealed showing dihedral angles (3 at 120deg). Opaque phases surrounding some of the ilmenite crystals. Host to blebs of pyrrhotite (coexisting phases?)(~10-15%)

Pyrrhotite: Anhedral irregular crystals up to 0.2mm in length. Shares mutual boundaries with ilmenite, and chalcopyrite. Locally small rounded blebs of pyrrhotite in the ilmenite. The pyrrhotite is also host to small flame like structures that appear to be exsolution of pentlandite (too small to resolve). (~1%)

Chalcopyrite: Small anhedral crystals that locally share mutual boundaries with pyrrhotite and ilmenite. Crystals up to 0.01mm in length. (tr)

Pentlandite: Small flame like exsolution of pentlandite in the pyrrhotite. (tr)

Opaques (unknown Composition): These are typically found in proximity to, or surrounding the oxide or sulphide phases, and are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.17.2 Hole ID: Hp-08 Sample#: 00845-01

From (m): 81.85, **To** (m): 81.9

Rock type: Hornblende-Augite Norite

Minerals Present: Plagioclase, orthopyroxene, augite (cpx), hornblende, apatite, biotite, calcite, ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition, pentlandite

Main description: Allotriomorphic to hypidiomorphic, fine-grained hornblende-augite norite. Plagioclase forms the main framework of the sample. The crystals are lath shaped and show a very weak lineation. There is a significant variation in plagioclase crystal size from 0.5mm up to ~2.7mm in length, with the largest of the crystals typically exhibiting zoning. The pyroxenes are granular to elongate, and form long chains of crystals surrounding the plagioclase (subophitic to nesophitic locally). The orthopyroxenes are generally the larger of the pyroxene crystals, and appear to be both cumulus and intercumulus phases. The augite appears to be an intercumulus phase with rare cumulus crystals. Locally large poikilitic hornblende crystals are present (look like snowflakes) and are host to plagioclase, opaques and rarely pyroxene crystals. The oxide and sulphide phases are also granular and anhedral, and are typically found adjacent to the pyroxenes. There is a weak carbonate alteration, and a strong presence of accessory apatite which is disseminated throughout the sample. (In hand sample, this rock is magnetic and may be a late intrusive? The ilmenite is likely the magnetic phase in this sample. It is also possible that the pyrrhotite is also magnetic.) The sample is tightly packed, and the arrangement of the crystals would suggest that there has been some densification of the norite. The contacts between the crystals are sharp, irregular and smooth. The sample shows a partially equilibrated geometry.

Plagioclase: Plagioclase crystals of various sizes are present, the largest of the crystals are zoned, these appear to be the oldest and likely the first cumulates present, these can range up to ~2.7mm in length. There is a weak lineation of the plagioclase laths and these form the main framework of the sample. Most of the plagioclase crystals are anhedral to subhedral. Contacts are sharp but typically irregular. The plagioclase is generally host to numerous acicular crystals of apatite. Most of the plagioclase crystals are approx. 0.6mm in length, but range from 0.4-2.7mm in length. The plagioclase crystals are cumulus phases, and there appears to be a very minor component of intercumulus plagioclase. (>50%)

Orthopyroxene: Granular to slightly elongate crystals, anhedral, up to 0.8mm in length, but most are ~0.25mm in size. The orthopyroxene is typically associated with augite and these crystals form long chains that surround and locally are hosted in the plagioclase. Appear to be a cumulus to intercumulus phase.

Clinopyroxene (augite): Granular to slightly elongate crystals, anhedral, up to 0.9mm in length, but most are ~0.2-0.3mm in size. The orthopyroxene is typically associated with augite, and these crystals form long chains that surround and locally are hosted in the plagioclase. Appear intercumulus phase (+/- rare cumulus crystals).

Hornblende: Poikilitic crystals that are brownish green in ppl, typically hosting crystals of plagioclase, pyroxenes and minor apatite. Weak biotite alteration locally. Crystals are anhedral and reach up to 1.5mm in length. Irregular distribution, the poikilitic crystals look almost like snowflakes. Intercumulus phase.

Biotite: Weak alteration phase, typically found adjacent to FeTi-oxides and opaques of unknown composition. Locally very weak alteration of the hornblende. Generally found in proximity to the carbonate alteration. (~1%)

Calcite: Very minor alteration phase, exploiting fractures and contacts. Fine-grained crystals of calcite, locally altering the pyroxenes and plagioclase. (<1%)

Apatite: The crystals are subhedral to euhedral, disseminated, but most are found in the plagioclase. Apatite is the most abundant accessory phase. (~2-3%)

Ilmenite: Anhedral crystals, intercumulus phase, sharp contacts that are almost rounded. Generally biotite and opaques of unknown composition can be found with the ilmenite. Pyrrhotite locally shares mutual boundaries with the ilmenite. Crystals up to 0.2mm in length. Rare poikilitically enclosed ilmenite within the hornblende. (2-4%)

Pyrrhotite: Anhedral crystals, intercumulus phase, sharp to irregular to jagged contacts. Locally shares mutual grain boundaries with ilmenite and chalcopyrite. Some crystals host exsolution lamellae of pentlandite?? Crystals up to 0.1mm in length. (<1%)

Chalcopyrite: Associated with the pyrrhotite, generally showing mutual grain boundaries, up to 0.02mm in length. Anhedral blebs, with sharp contacts. (tr)

Opaques (unknown Composition): Associated with the sulphides and oxides. Present as small pods of opaques hosted in the mafic phases as well. These are likely Fe or Fe-Ti oxides/sulphides. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~2%)

A.1.17.3 Hole ID: Hp-10 Sample#: 00877-01

From (m): 45.04, **To** (m): 45.09

Rock type: Hornblende-augite Norite

Minerals Present: Plagioclase, orthopyroxene, augite (cpx), hornblende, apatite, biotite, calcite, ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition, (+/-actinolite)

Main description: This is a fine-grained cumulate norite. The plagioclase forms the main framework of the sample. The lath shaped crystals define a very weak mineral lineation. The pyroxenes are granular and form long chains of crystals surrounding the plagioclase (subophitic to ophitic texture). There is a weak carbonate alteration that is locally exploiting the minor fractures that cut through the sample. The pyroxenes are locally suffering from minor carbonate alteration, but mainly from uralitization. Weak biotite alteration is also present. Apatite is abundant in this sample and can be found hosted in the plagioclase as well as in the mafics. The crystals are acicular and anhedral to subhedral to rarely euhedral. (Similar to 00845-01, coarser that 00845 with more intense alteration, more pyroxenes and less amphiboles). The contacts between the crystals in this sample are sharp and irregular. The minerals are tightly packed, and there is a weak lineation of the plagioclase laths. The arrangement of the crystals shows a partially equilibrated to unequilibrated textural geometry.

Plagioclase: Plagioclase crystals of various sizes are present and can range up to 2.7mm in length, but most of the crystals are approx. 1-2mm in length. Some of the crystals are zoned. Most of the plagioclase crystals are anhedral to subhedral with rare euhedral crystals. There is a very weak mineral lineation within this sample. The lath shaped crystals form the main framework of the sample. Contacts are sharp but typically irregular. The plagioclase is generally host to many acicular crystals of apatite. These are the most common accessory phase in this sample. Locally the plagioclase suffers from a weak carbonatization. Plagioclase is present as both a cumulus and intercumulus phase. (~50%)

Orthopyroxene: Granular to slightly elongate crystals to locally poikilitic, anhedral to subhedral crystals that reach up to 2mm in length, but most are ~0.4-0.6mm in length. The orthopyroxenes appears to be both a cumulus ad intercumulus phase (mostly cumulus). They typically form conglomerates of crystals with intercumulus augite (+/- oxides/sulphides) between the larger plagioclase laths. Some of the orthopyroxene crystals exhibit exsolution of Fe-Ti-oxides and rarely exsolution of augite.

Clinopyroxene (augite): Intercumulus, poikilitic crystals that are anhedral and reach up to 1.6mm in length, but most are ~0.4-0.6mm in length. The orthopyroxene is typically associated with augite, and these crystals form long chains that surround and locally are hosted in the plagioclase. Augite is also suffering from uralitization locally.

Hornblende: Alteration of the pyroxenes (uralitization) that is green in colour (ppl), patchy, locally associated with the carbonate alteration +/- biotite. The crystals are anhedral. One of the main alteration phases of the pyroxenes. (~2-4%)

Actinolite: Anhedral to subhedral crystals, altering the pyroxenes, and is associated with the carbonate alteration and the hornblende. Fibrous in texture to radiating colourless crystals (ppl). (~1-2%)

Biotite: Dark brownish-red in colour (ppl), anhedral to subhedral crystals, alteration phase (secondary), associated with the hornblende+/- actinolite and carbonates. Fibrous crystals. (~2-3%)

Calcite: Weak alteration phase, exploiting fractures and contacts. Fine grained crystals of calcite, locally altering the pyroxenes and plagioclase. Biotite typically found in proximity to the carbonate alteration as well as the hornblende and actinolite. (~2%)

Apatite: The crystals are subhedral to euhedral, and are disseminated, but most are found in the plagioclase. Apatite is the most abundant accessory phase. (~2-3%)

Ilmenite: Anhedral crystals, intercumulus phase, sharp contacts that are irregular to rounded. Opaques of unknown composition can be found adjacent to or sharing mutual boundaries with the ilmenite. Pyrrhotite locally shares mutual boundaries with the ilmenite and is locally enclosed within the ilmenite. Crystals up to 0.6mm in length. (10-15%)

Pyrrhotite: Anhedral crystals, intercumulus phase, sharp to irregular, to locally jagged contacts. Locally shares mutual grain boundaries with ilmenite and chalcopyrite. Minor pyrrhotite that is poikilitically enclosed within the ilmenite. Crystals up to 0.25mm in length. (~1%)

Chalcopyrite: Rare crystals. They share mutual grain boundaries with pyrrhotite. Anhedral blebs up to 0.02mm in length. (tr)

Opaques (unknown Composition): Associated with the sulphides and oxides. Adjacent to or surrounding these phases. Some are also present as exsolution lamellae in the pyroxenes. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~2%)

A.1.17.4 Hole ID: Hp-10 Sample#: 00880-01

From (m): 68.2, **To** (m): 68.25

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, Hornblende, actinolite, biotite, apatite, calcite, ilmenite, pyrite, pyrrhotite, chalcopyrite and opaques of unknown composition, rutile?

Main description: There is significant amphibole in this sample. This sample is similar to 00877-01 but with a much stronger amphibole presence and less carbonate alteration. There are also some similarities between this sample and 859-01, but this sample is finer-grained. The plagioclase crystals are sitting in a sea of interconnected amphiboles and accessory apatite. The amphiboles are encroaching on the plagioclase and are not restricted to the primary crystal boundaries. There is minor biotite alteration locally. There is also a strong presence of ilmenite and minor pyrrhotite. Pyrite appears to be a secondary phase and is present as fracture fill, and locally as clusters of subhedral crystals in proximity to the fractures. There are a number of fractures that cut this sample. These fractures are locally carbonate bearing. Alteration is most intense adjacent to these fractures. It is important to note that the very green to greenish-blue amphiboles are not present where there is carbonate alteration (in proximity to the carbonate bearing fractures). This sample likely originated with either cumulus or intercumulus pyroxenes, but what are now completely replaced by amphiboles. The crystals were likely both orthopyroxenes and augite. The original crystal boundaries are no longer visible. Cumulate sample. The geometry of the contacts between the grains are skewed by the additional growth of amphiboles into the plagioclase. The few contacts between plagioclase crystals would suggest that this sample is partially equilibrated and has suffered from some densification and likely compaction as well.

Plagioclase: Plagioclase crystals of various sizes are present and range up to 2.5mm in length, but most of the crystals are approx. 0.5-1mm in length. Some of the crystals are zoned. Most of the plagioclase crystals are anhedral to subhedral, and lath shaped. There is a very weak mineral lineation within this sample. Contacts are sharp but typically irregular. The plagioclase is typically host to many acicular crystals of apatite, which are the most common accessory phase in this sample. The amphiboles are encroaching on the plagioclase (they are growing into the plag). There is a weak carbonatization locally. The plagioclase appears to be both a cumulus and intercumulus phase locally. The larger zoned, crystals are likely cumulus phases. (~40%)

Pyroxenes: No visible remnants of primary pyroxenes remain, other than faint outlines of primary crystals and what appears to be exsolution textures. Uncertain if there were any primary cumulus or intercumulus pyroxenes (orthopyroxene and augite).

Hornblende: Anhedral crystals and alteration of the pyroxenes?(uralitized). Varies from strong green-blue to green to pale green in colour (ppl). The very strongly green coloured hornblende is not present in proximity to the carbonate alteration. Only the very pale green to greenish-brown hornblende is present in proximity to the carbonate alteration and carbonate bearing fractures. Appears to have overprinted and replaced primary pyroxenes. The colouration of the amphiboles is most intense along the margins of the crystals. Hornblende is the main mafic phase. (~40-50% (incl. act))

Actinolite: Actinolite is composed of anhedral to subhedral crystals that are fibrous in texture, to radiating colourless to pale green crystals (ppl). Typically found at the cores of the mafics. Associated with hornblende.

Biotite: Dark brownish-red in colour (ppl), anhedral to subhedral fibrous crystals. Alteration phase (secondary), associated with the hornblende+/- actinolite and the fractures.

Calcite: Alteration phase that is exploiting fractures and contacts to infiltrate the sample. The alteration typically extends approx. 2-3mm out from the fractures. Patchy alteration with locally small irregular pods of carbonate alteration. Clearly affects the mineralogy present in the sample, since there is a distinct change in the amphiboles in close proximity to the carbonate bearing fractures.

Apatite: The crystals are subhedral to euhedral and typically acicular, disseminated, and found in the mafics and in the plagioclase. It is the most abundant accessory phase. Crystals up to 0.26mm in length. (2-4%)

Rutile?: Brownish coloured high relief mineral, anhedral crystals that are typically found hosted in the mafics and locally adjacent to the ilmenite and the opaque phases. Uncertain if this is rutile or some other accessory phase. There are minor radiation haloes surrounding these phases. (~0.5-1%)

Ilmenite: Anhedral crystals, intercumulus phase, sharp contacts that are irregular and rounded. Opaques of unknown composition can be found adjacent to or sharing mutual boundaries with the ilmenite. Pyrrhotite locally shares mutual boundaries with the ilmenite and is locally enclosed within the ilmenite. Crystals up to 0.6mm in length. The ilmenite can be found hosted in the mafics. (~10-15%)

Pyrrhotite: Anhedral crystals, intercumulus phase, sharp to irregular to locally jagged contacts. Locally shares mutual grain boundaries with ilmenite and chalcopyrite. Minor pyrrhotite that is poikilitically enclosed within the ilmenite. Crystals up to 0.2mm in length. (~1%)

Chalcopyrite: Rare crystals. They share mutual grain boundaries with pyrrhotite. Anhedral blebs up to 0.02mm in length. (tr)

Pyrite: Fracture fill and locally small clusters of anhedral to subhedral crystals. Appears to be a secondary phase. Some of the crystals are partially skeletal. Individual crystals up to 0.2mm. Sharp and irregular to jagged contacts. (~1%)

Opaques (unknown Composition): Associated with the sulphides and oxides, and are adjacent to or surrounding these phases. They also appear locally as large irregular pods. Some are also present as exsolution lamellae in the pyroxenes. These are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~5-7%)

A.1.17.5 Hole ID: Hp-12 Sample#: 00859-01

From (m): 22.18, **To** (m): 22.23

Rock type: Hornblende Gabbro

Minerals Present: Plagioclase, hornblende, biotite, apatite, quartz, remnant opx and cpx, ilmenite, pyrite brownish-red semi-opaque mineral of uncertain composition (hematite?), opaques of unknown composition.

Main description: Some similarities to 00845-01, 00877-01, 00880-01, but this sample is coarser grained and has a stronger intensity alteration than 00877-01, and is most similar to 00880-01. This sample also shows some similarities to 860-01, but this sample is more intensely altered. Plagioclase is one of the main components of this sample and the crystals vary greatly in size. There is a very weak lineation of the larger plagioclase crystals, but there is a clearly defined layering within the sample. This sample is almost granular in texture, and some of the crystals appear to have been cumulus phases. Some of these crystals are likely pyroxenes, and these are now strongly uralitized by green amphiboles (hornblende). Some of the crystals appear to be intercumulus phases, and are anhedral in shape. The intercumulus crystals appear to be pyroxenes and hornblende. The amphibole crystals are not restricted to the primary crystal boundaries, and are anhedral and have slightly rounded contacts. Anhedral poikilitic hornblende crystals are also locally present. The oxides are anhedral and appear to be intercumulus phases (ilmenite +/- hematite?). There is a weak biotite presence, typically found in proximity to the oxide phases. Apatite is the main accessory phase, and these crystals are disseminated throughout the sample. A small fracture filled with quartz cuts through part of the sample. The sample is tightly packed and the crystals exhibit a partially equilibrated geometry. The contacts are sharp, smooth to irregular and are locally skewed by alteration minerals.

Plagioclase: The plagioclase crystals vary greatly in size, up to 4mm but most are ~0.8mm in length. The crystals are anhedral to subhedral to locally euhedral and some are zoned. The largest crystals show irregular extinction and are typically cut by numerous fractures. There is a weak alteration along the fractures (biotite, hornblende). The plagioclase crystals are also host to numerous acicular needles that are locally lineated. There appears to be a very weak lineation of the plagioclase crystals. Contacts are sharp, but typically irregular. The plagioclase crystals appear to be one of the main cumulus phases, but may also represent a small component of the intercumulus material. (~40-45%)

Orthopyroxene: Uncertain if orthopyroxene was present in this sample. The shape of the crystals and the textures that remain would suggest that there were cumulus +/- intercumulus orthopyroxenes present that are now strongly altered by green amphiboles. Only the exsolution of the Fe-Ti oxides remain. (original content??%)

Clinopyroxene (augite): Uncertain if there was any augite present in this sample, due to the strong uralitization. Augite may have been present as an intercumulus phase. (original content??%)

Hornblende: Hornblende is the main mafic phase, and is green to brownish-green in colour. The hornblende replaced/overprinted what appear to have been primary pyroxenes. These now form long irregular chains of crystals. The crystals are anhedral, and are locally poikilitic, and locally suffer from a weak biotite alteration. The majority of the crystals are approx. 0.5mm in length, and the crystals are no longer restricted to the primary crystal boundaries and extend outwards into the surrounding crystals. Locally the hornblende is cut by fractures that appear to be filled with hematite. Some of the hornblende crystals may be intercumulus phases, suggesting that there may be multiple generations of amphiboles present. (~40-50%)

Biotite: Alteration phase found with the hornblende, and generally in close proximity to the Fe-Ti bearing oxides. Biotite is present as fibrous crystals that are anhedral to subhedral and are highly pleochroic and are red-brown under ppl.

Apatite: Apatite is the main accessory phase in this sample. Crystals are subhedral to euhedral and are typically acicular in shape, and reach up to 1mm in length. These can be found hosted in the plagioclase as well as the hornblende, and locally form small clusters of crystals. (~2-3%)

Quartz: The quartz present in this sample is from a small veinlet. The crystals are anhedral and their contacts are irregular and rounded. The width of the veinlet is up to 0.8mm.

Ilmenite: Ilmenite is the main oxide phase. The crystals are anhedral, and appear to be intercumulus phases. Weakly fractured and locally have a reddish-brown coloured mineral associated with them (appears to be hematite). Opaques of unknown composition are also found adjacent to the ilmenite. Contacts with ilmenite are sharp and irregular. The crystals are weakly fractured. Some are poikilitically enclosed by hornblende. Ilmenite is also present as fine grained elongate exsolution lamellae from the primary pyroxenes. Intercumulus crystals up to 0.8mm in length, and there is an irregular distribution of crystals. (~5-10%)

Pyrite: One small anhedral crystal remnant forming a skeletal outline that appears to be related to the fracturing of the sample. (space filling). (tr)

Hematite: Likely the reddish-brown mineral that is associated with fractures and the ilmenite. These clusters are composed of very fine grained crystals that have a very weak reflectance and are a greyish-blue, but under XRL are strong deep red to red brown colour. Present as fine grained clusters and as fracture fill. The presence of hematite would suggest that oxidizing fluids have penetrated the sample, likely through the fractures. (~5-7%)

Opaques (unknown Composition): There are opaques adjacent to, and that locally surround some of the ilmenite crystals. These are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

A.1.17.6 Hole ID: Hp-12 Sample#: 00860-01

From (m): 30.12, **To** (m): 30.17

Rock type: Augite-Norite

Minerals Present: Plagioclase, orthopyroxene, augite (cpx), hornblende, apatite, biotite, calcite, sericite, ilmenite, pyrrhotite, chalcopyrite, opaques of unknown composition

Main description: Similar to 00845-01 but this sample (00860-01) is much coarser. Allotriomorphic to hypidiomorphic, fine to medium-grained norite. Plagioclase is one of the main components of the sample, and the crystals form a weak lineation. The pyroxenes form interconnected chains of granular to elongate crystals, locally exhibiting exsolution textures and are aligned sub parallel to parallel to the layering. The pyroxenes locally surround the plagioclase crystals (subophitic to ophitic texture). There is a weak uralitization of the pyroxenes locally. Biotite and carbonate alteration is more abundant, but the distribution is irregular. Sulphides and oxides appear to be intercumulus phases. Apatite is the main accessory phase. The sample is tightly packed and the crystals exhibit a partially equilibrated geometry. The contacts are sharp, smooth to irregular and are locally skewed by alteration minerals.

Plagioclase: Plagioclase crystals of various sizes are present ranging up to 4mm in length. Most show irregular extinction and are zoned. The plagioclase crystals form the main framework of the sample and appear to be cumulus phases that have suffered from adcumulus growth. There also appears to be a component of intercumulus plagioclase in this sample. Most of the plagioclase crystals are anhedral to subhedral (rare euhedral) and form a weak lineation. Some are lath shaped. Contacts are sharp but typically irregular. The plagioclase is typically host to many acicular crystals of apatite: the most common accessory phase in this sample. The plagioclase crystals are also fractured and weakly carbonatized. Some of the crystals are host to acicular needles that are aligned with the crystal structure of the plagioclase, uncertain of their composition (too small to resolve). (>50%)

Orthopyroxene: Orthopyroxene is the most abundant of the mafic phases. The crystals are granular to slightly elongate, anhedral to subhedral, up to 1.8mm in length, but most are ~0.5mm in length. The orthopyroxene is typically associated with augite, and these crystals form long chains/clusters that surround the plagioclase crystals. Orthopyroxene is a cumulus phase, and locally shows exsolution of augite. Typically the crystals are fractured and may be suffering from weak carbonatization. Locally weak biotite alteration and weak uralitization is also present.

Clinopyroxene (augite): Augite forms anhedral crystals that can be found with the orthopyroxenes forming chain-like clusters of crystals between the plagioclase crystals. Crystals are generally ~0.5mm in length. Augite is found mainly as an intercumulus phase, and is locally fractured and may be suffering from weak carbonatization, weak biotite alteration +/- weak uralitization locally.

Hornblende: Hornblende is greenish-brown in ppl, anhedral crystals, and is locally replacing the pyroxenes. Weak biotite alteration locally, these crystals reach up to 0.7mm in length. Irregular distribution.

Biotite: Reddish-brown in colour, highly pleochroic under ppl, alteration phase with irregular distribution, but generally found in close proximity to adjacent to hornblende and the oxides/sulphide phases. Most abundant where there is carbonate alteration.

Calcite: Alteration phase, exploiting fractures and contacts. Fine grained crystals of calcite, locally altering the pyroxenes and plagioclase. Biotite typically found in proximity to the carbonate alteration. (2%)

Sericite: Minor alteration phase of the plagioclase (sericitization) that is exploiting fractures and contacts to infiltrate the plagioclase. (<1%)

Apatite: The crystals are subhedral to euhedral and are disseminated, but most are found in the plagioclase. Most abundant silicate accessory phase. (1%)

Ilmenite: Anhedral crystals, intercumulus phase, sharp contacts that are almost rounded. Generally biotite and opaques can be found with the ilmenite. Pyrrhotite locally shares mutual boundaries with the ilmenite. Crystals reach up to 0.4mm in length. Locally ilmenite is poikilitic enclosing blebs of pyrrhotite. (~7%)

Pyrrhotite: Anhedral crystals, intercumulus phase, sharp to irregular contacts. Locally shares mutual grain boundaries with ilmenite and chalcopyrite. Crystals up to 0.4mm in length. (~1%)

Chalcopyrite: Associated with the pyrrhotite, generally showing mutual grain boundaries, up to 0.07mm in length. Anhedral blebs, with sharp contacts. (tr)

Opaques (unknown Composition): Associated with the sulphides and oxides. Present as small pods of opaques hosted in the mafic phases as well. These are likely Fe or Fe-Ti minerals. Some of these are likely additional sulphides/oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section. (~2%)

A.1.18 Unit 13a

A.1.18.1 Hole ID: H-02 Sample#: 00924-01

From (m): 95.6, **To** (m): 95.65

Rock type: Diabase

Minerals Present: Plagioclase, clinopyroxene (augite), hornblende, actinolite, biotite, calcite, sericite, apatite, quartz, ilmenite, pyrite, chalcopyrite, magnetite, opaque phase (unknown composition), greenish-mineral (unknown composition), rutile?, orthopyroxene?

Main description: Hypidiomorphic, medium-grained diabase. Lath shaped plagioclase form the main framework of this sample. The laths are euhedral to subhedral and are typically zoned. No preferred orientation to the laths. The augite and amphiboles appear to be space filling phases and are anhedral to subhedral. There is a weak uralitization of the pyroxenes, which is typically most intense where there is carbonate alteration. Weak intensity carbonate, sericite, biotite and chlorite alteration is present but is irregular in its distribution. There is a significant presence of apatite in this sample. The crystals are disseminated and are subhedral to euhedral, and hosted in all of the silicate phases. Ilmenite is the main opaque phase and appears to be an early phase. The crystals are anhedral to subhedral to locally skeletal. There is an unidentified mineral present (likely an amphibole) that green to greenish-brown in colour and is composed of fibrous to radiating crystals that are replacing the primary minerals and is present as a space filling phase. It appears to be a secondary mineral. The numerous zoned crystals within this sample suggest that the minerals crystallized in an evolving magma. This sample is one of the more unusual samples collected. From the drill core, textures and contacts of this unit, it appears to be a dyke.

Plagioclase: Laths that are subhedral to euhedral, zoned and vary in size up to 4mm in length, but most are ~2mm. The laths form a network of crystals at various orientations, and no visible lineation. Some of the crystals are cut by transverse and sub parallel-transverse fractures. There are many fine grained acicular needles hosted in the plagioclase crystals (too small to resolve the composition). Weak sericitization and carbonatization that is exploiting the fractures and contacts/boundaries of the crystals. There is also a fine-grained brownish mineral that is also taking advantage of these fractures in the plagioclase. Contacts are sharp to skewed by alteration.

Locally the plagioclase laths crosscut the pyroxenes. There appears to be both laths and interstitial plagioclase locally. (>50%)

Orthopyroxene: Uncertain if there is any present. Only augite seen.

Clinopyroxene (augite): Anhedral crystals, early to interstitial. Generally found with additional mafic phases in small clusters of anhedral crystals. Crystals reaching up to 1.5mm in length. Some of the crystals are rimmed by hornblende or are suffering from a weak uralitization. The contacts with the Cpx are sharp but irregular. Some of the crystals are zoned. Main mafic phase. (~25%)

Hornblende: Anhedral to subhedral crystals, locally cleavage is visible. Generally found in clusters of mafic minerals with the pyroxenes. Locally forming rims around the pyroxenes, and weak uralitization of the pyroxenes locally, which appears to be related to the presence of carbonates. Crystals reach up to 0.25mm in length. Possibly an interstitial phase + alteration phase. (2-5%)

Actinolite: Fibrous to acicular needles that are locally replacing the pyroxenes. Minor phase.

Biotite: Minor alteration phase of the mafic minerals. Typically found as distinct crystals that are anhedral to subhedral and reach up to 0.4mm in length. Late phase, possibly secondary mineral. (<5%)

Calcite: Late phase, alteration mineral exploiting fractures to infiltrate the sample. There appears to be a relationship between the carbonate alteration and the increased presence of amphiboles and apatite.

Sericite: Fine grained alteration phase of the plagioclase. Weak intensity alteration, and is irregularly distributed. The sericite is also exploiting the fractures and crystal contacts to infiltrate the sample.

Apatite: There are a significant number of subhedral to euhedral crystals of apatite present in this sample. Acicular crystals reaching up to 1mm in length are present and crosscut multiple phases (plagioclase, pyroxenes and amphiboles). There are also anhedral crystals that are found associated with the fractures and reach up to 0.5mm in length. (>5%)

Quartz: Anhedral to subhedral interstitial crystals. Appears to be space filling? (~1%)

Rutile: Small high relief mineral hosted in the mafics and associated with opaques. Rare (tr)

Ilmenite: Main oxide, crystals are anhedral to subhedral to euhedral, and some are skeletal, most are subhedral. Locally twinned, contacts are sharp and angular to locally rounded. Crystals reaching up to 1mm in length. Primary to interstitial crystals. Rare blebs of pyrite hosted in the ilmenite crystals. (10-15%)

Chalcopyrite: Rare anhedral crystal up to 0.05mm in length. (tr)

Pyrite: Anhedral to skeletal crystals, irregular shaped with rounded to angular contacts. Interstitial crystals up to 1.5mm in length. Rare grains of pyrite hosted in the ilmenite. Pyrite is also present as thin incomplete rims around ilmenite crystals. Suggesting some remobilization? (~1%)

Magnetite: Anhedral to subhedral to skeletal crystals that are exsolving ilmenite. Crystals are twinned and reach up to 0.2mm in length. (tr)

Opaques (unknown Composition): There are opaques phases of unknown composition present. These are typically found in proximity to, or surrounding the oxide or sulphide phases. These are likely additional sulphides or oxides that are hosted within the thickness of the sample and are not cut by the surface of the polished section.

Greenish Mineral: Mineral of unknown composition. Green to greenish-brown in colour, weakly pleochroic under ppl, fibrous to radiating crystals that are locally filling fractures and replacing the primary minerals. Locally cut by apatite crystals, and shares mutual boundaries with biotite. Possibly an amphibole?? (~5-8%)

Appendix B. Logging: Collar Data (all drill holes)

Hole ID	UTM E	UTM N	Elev (m)	Azi	Dip	Length (m)	Core Size	Notes
H-01	364991.24	1746426.95	1662.66	0	-90	114.58	0-31.55 (5cm); 31.55-114.58 (3cm)	Wadi Qutabah Drill core; Suspect that the hole was drilled in feet, and both feet and meters are on the blocks; Logged at C F Mineral Research in their secure yard.
H-02	364561.05	1746161.11	1680.48	0	-90	120.91	0- 9m (5cm); 9-120.91m (3cm)	Wadi Qutabah drill core
H-02A	364488.76	1746024.40	1594.20	0	-90	58.42	0-13m (5cm); 13-58.42m (3cm)	Logged at C F Mineral Research in their secure yard
H-03	364284.47	1745961.41	1558.22	0	-90	128.5	5cm from 0-8.55m; 8.55 to EOH (3cm)	Wadi Qutabah drill core logged at C F Mineral Research in their secure storage yard outside.
H-04	364007.57	1745727.93	1467.08	0	-90	131.26	0-20.11 (5cm); 20.11-EOH (3cm)	Wadi Qutabah drill core logged at C F Mineral Research in their secure storage yard outside.
H-05	363812.59	1745523.94	1387.75	0	-90	101.04	0-4.3m (5cm); 4.3-101.04m (3cm)	Wadi Qutabah Drill core; Typically sulphides associated with plagioclase segregations or bands of increased plagioclase
H-06	363625.74	1745359.48	1329.02	0	-90	191.68	0-78.5m (5cm); 78.5-EOH (3cm)	Bands of massive sulphides from ~45-50m
Hp-07	361095.62	1743433.61	1909.39	0	-90	90.31	0-29.35 (5cm); 29.35-90.31 (3cm)	Upper part of the hole to ~26m is broken up, fractured and faulted, oxidized to ~24.3m.

Hole ID	UTM E	UTM N	Elev (m)	Azi	Dip	Length (m)	Core Size	Notes
Hp-08	361074.82	1743507.39	1864.63	0	-90	187.84	3cm diam	Entire hole was drilled in 3cm diam core. Upper portion of the hole there is lots of lost core, little recovery, From: 86.9-95.56m: Sheared gabbro/granite and med-grained foliated/altered gabbro, series of mixed intervals. From: 86.9-87.26m Shr+ alt LGab, 87.26-88.07m med gr wk foln altd gab, 88.07-88.38m shr + alt LGab, 88.38-88.77m med gr mod foln mod altd gab, 88.77-89.17m shr + alt LGAB, 89.17-89.4m altd med-coarse gr gab; 89.4-90.31m SHR+altn LGAB, 90.31-90.44m med gr strong biotite altd gab; 90.44-92.02m SHR+ altn LGAB, 92.02- 92.56m med gr altd gab, 92.56-95.56m shr + altn LGAB; alteration within these units varies from moderate to strong locally, biotite is most abundant; shears and foliation is at 10- 40deg TCA, all the units are white to green-grey to grey-violet in colour; from 89.4m downhole in the sheared units the pyroxenes are no longer visible (composition resembles that of a diorite); lower contact is sharp.
Hp-09	360846.95	1745951.65	1588.29	0	-90	130.02	0-8.6m (5cm diam); 8.6-eoh (3cm diam)	sulphide zone from 17.77-~22.28m; Actual EOH at 129.76

Hole ID	UTM E	UTM N	Elev (m)	Azi	Dip	Length (m)	Core Size	Notes
Hp-10	360696.98	1743747.99	1799.86	0	-90	187.14	5cm 0-~15.2m; 15.2-187.14 (3cm diam)	Part of this hole is previously sampled from: ~14.19-29m; small section quartered from ~14.6-14.7m; previous sampling from 75.44-87m; sample numbers: (These numbers may be FX847934…..); FX847034 from 75.44-74.67m is quartered; FX847035; FX847036; FX847037; FX847038; FX847039; FX847040; FX847041 massive pyrrhotite (small section from 82.15-82.2m is quartered); FX847042; FX847043; FX847044; FX847045 (pyrite rich + graphite); FX847046; FX847047; 48?; Sample previously cut from 183.05-183.2m (only 1/2 core remains)
Hp-11	360271.07	1743879.15	1868.45	0	-90	90.45	5cm from 0-34.8m; 34.8-90.45m is 3cm diam	Oxidation depth approx. 25.5m; previous sampling from 17.68-17.76 (no sample #); from 40.9 to 52m (only 1/2 core remains); sample numbers: FX-847049; FX-847050; FX-847051; FX-847052; FX-847053; FX-847054; FX-847055; FX-847056; FX-847057; FX-847058; FX-847059; FX-847061; FX-847062; FX-847063; FX-847064; FX-847065; also sampled from 85-85.1m (no sample #, just marked 6)
Hp-12	361344.29	1743739.99	1804.22	0	-90	85.81	5cm from 0-29m; 3cm diam from ~29m To EOH	massive to semi-massive mineralization present in this hole
Hp-12A	361208.14	1743661.68	1829.87	0	-90	30.97	0-30.97m (5cm diam)	Short hole; A lot of lost core/ ground up; only taking sample of the granite, rest is too oxidized

Appendix C. Logging: Lithology (all drill holes)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-01	OVB	0	2.01		OVB	Overburden; no recovery
H-01	GAB	2.01	3.53	med-cr	2a	Med to coarse-grained gabbro; granular feel (likely due to weathering), weak weathering, weak oxidation, ~50-60%plagioclase, biotite alteration that is irregular in its distribution (5-7%)patchy, speckled white and dark grey in colour, with minor brown patches (biotite and oxidation), massive, no foliation, very weak alignment of the feldspars locally, appears to be primarily pyroxenes (35%) and minor amphiboles (5%), trace sulphides/oxides that are oxidized, minor fractures at random orientations
H-01	LC	3.53	5.05		LC	LOST CORE / appears to be ground up
H-01	GAB	5.05	5.15	med-cr	2a	Similar to unit above (2.01-3.53m). Med to coarse grained gabbro; granular feel, weak weathering, weak oxidation, ~50-60% plagioclase, biotite alteration that is irregular in its distribution, speckled white and dark grey in colour, with minor brown patches (biotite), ground bits of core, increasing amounts of coarse grained gabbro; Contact with coarse grained gabbro is sharp at 50deg to CA; crystals are irregular and are subhedral to anhedral, slightly rounded contacts between grains; cumulates.
H-01	GAB	5.15	6.8	cr	2a	Coarse grained gabbro; White and dark green in colour, cut by a series of faults at 20deg to CA, faults contain slickensides+/- graphite+ altered carbonates+/- epidote (weakly veined fault with vein 2cm in thickness, qtz-carb vn); slight preferred orientation of the plagioclase crystals at ~40deg to CA, locally up to 1cm in length, ~55-65%plagioclase, weak altn, phaneritic, sharp upper (50deg) and lower contacts (30deg); appear to be grain size variations of the same unit; cumulates.
H-01	GAB	6.8	7.66	med-cr	2a	Med to coarse grained gabbro; upper contact/transition is sharp, white and dark grey-black speckled in colour, contains ~1% unknown oxide (dark black, shiny to vitreous luster, H ~5-7,not magnetic, Ilmenite??), core is broken up, fractures are weakly oxidized, locally what appear to be ductile structures with mineral lineation and preferred orientation of the crystals, avg grains are subhedral
H-01	GAB	7.66	7.9	fn-med	2a	Fine to med grained gabbro, very weak foliation ~50deg to CA, ~5% mystery oxide (ilmenite?); series of fractures at 40deg to CA, weakly oxidized fractures, ~50-60% plagioclase, upper contact is weakly gradational to sharp at 60deg to CA (transition from coarse to fine grained); lower contact is similar to upper at ~60deg to CA; appears to be similar overall composition to units above and below.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-01	GAB	7.9	8.1	cr	2a	Coarse grained gabbro; grains are euhedral to subhedral; transitional upper contact; sharp lower contact 60 deg to CA(between similar lithologies of different grain size); ~1% dark black oxide (ilmenite?); ~65% plagioclase; very weak altn (oxidation). No veins; very weak foliation at 60deg to CA; white to dark green- grey in colour (more white); cumulate
H-01	GAB	8.1	9	fn-med	2a	fine-med grained gabbro; can still distinguish some of the grain boundaries; sharp upper and transitional lower contacts; grey-green in colour; <1% mystery oxide; cut by small vein at 8.4-8.41m, minor oxide associated with the qtz-carb-plag vein; fractured, fractures are file with iron carbonate that is locally weakly oxidized; in proximity to the lower contact the plagioclase crystals are feathery.
H-01	GAB	9	11.4	med-cr	2a	med to Coarse to very coarse grained gabbro; significant grain size variations; some mafic segregations (up to 5cm in size); ~55-65% plagioclase; subhedral to euhedral crystals; ~1% oxides and sulphides; lower contact is sharp; unit is cut by a fracture that parallel the CA; fracture is weakly oxidized; very weak foliation locally ~50deg, no veining; very minor alteration (oxidation + minor biotite); cumulate.
H-01	GAB	11.4	16.26	fn	2a	Fine grained gabbro with coarse grained segregations (up to 25cm in length); brittle; broken up; fractures are weakly oxidized along their surfaces, locally surfaces host to carbonates (iron carbonate); white to dark- green-grey in colour; locally what appear to be veins at 40deg to CA (from 13.9-14 and from 14.83-15m); ~1% oxides; fault at 13.75-13.77m that is weakly healed, gradational lower contact into coarse grained gabbro. From 14.83-15m appear to be composed of ~80-90% feldspars, possibly a single layer or vein? white in colour; sharp contacts; ~1% oxides; ~5-10% mafic minerals; minor oxidation.
H-01	GAB	16.26	19.04	med-cr	2a	Med to Coarse grained gabbro; cumulates; oxidation along the fractures and faults is weak to moderate; no preferred orientation of the crystals visible; crystals are subhedral to locally euhedral; grain size varies throughout the unit; lower contact just after small quartz vein; numerous fractures and faults render this interval very brittle; largely composed of plagioclase (55-65%) and what appear to be pyroxenes and minor amphiboles (both =35-40%); minor mystery oxide (ilmenite, not magnetic; metallic luster; h ~5, late stage mineral?)
H-01	GAB	19.04	23.94	med	8+2a?	Gabbro, variable grain size from fine to very coarse locally; subhedral to locally euhedral crystals, rare crystals up to 3cm in size; massive, no preferred orientations; weak oxidation; fractures are oxidized, ~1-4% ilmenite? (metallic oxide) which forms irregular blebs and spots that are angular in shape (filling gaps?); plagioclase ~50-65%, from 23.34-23.94m numerous fractures and faults (some healed); speckled white and dark green-grey in colour; lower contact is at fault and quartz vein. Cumulates

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-01	FLT	23.94	23.95		FLT	faulted contact between gabbro and quartz vein; rubble and minor gouge present, at ~40deg to CA
H-01	GRAN	23.95	24.27	cr	GRAN	Granitic vein (granite); White quartz-feldspar+/-minor carbonate vein with minor sericite (clear to light green in colour) and a pink mineral, euhedral to subhedral, hexagonal to rounded, H~6, possibly garnets? Sharp contacts; weakly oxidized; minor oxide (<1%); appears to be vein associated with pluton, granitic composition (pluton in proximity??, must be later than intrusion due to crosscutting)
H-01	GAB	24.27	25.2	cr	2a	coarse grained gabbro, cumulate, ~65% plagioclase; white to dark green-grey in colour; very weak apparent preferred orientation of the plagioclase crystals; fault present; decreasing oxidation of the core; ~1% ilmenite.
H-01	LC	25.2	25.89		LC	LOST CORE / ground up (occurred between 25-26.89m) only minor rubble recovered
H-01	GAB	25.89	31.28	cr	2a	Coarse grained gabbro; 50-65% plagioclase; locally segregations of plag that are almost 100% plag (rare up to 10cm); light grey to greenish grey in colour; cumulate textures; after ~26.4 little oxidation (that appear to be oxidation depth in this hole); crystals are subhedral to locally euhedral in shape and are up to 2cm in size; texturally this unit is slightly different that those previous due to the weak foliation or preferred orientation of the crystals; the quality of the core is higher (higher RQD); locally very coarse grained, a couple of questionable sections that may be veins (28.6-28.8m); locally small bands of what appear to be either ductile deformation or flow, which is indicated by weak foliation at 50deg to CA;
H-01	GRAN	31.28	31.8	cr	GRAN	Granitic vein (granite), similar to vn from 23.95-24.27m; white in colour; composed of qtz-feldspars-garnets; sericite and is weakly oxidized. Sharp upper and lower contacts; coarse grained; lower contact at 40 deg TCA; picture taken of lower contact.
H-01	GAB	31.8	43.65	cr	2a	Coarse grained gabbro; crystals locally up to 3cm in size; cumulates; significant percentage of plagioclase (65-70%) remainder likely augite and minor hornblende; grain size varies from <1cm to ~3cm; crystals are euhedral to subhedral ; small vein of granitic composition from 35.36-35.4m (~1%); from 36.4-41m numerous faults (locally gouge faults) and fractures; most of the fractures in the unit are host to minor carbonates; grey to green-grey in colour (plagioclase is grey to bluish-grey in colour; and the pyroxenes and amphibole are dark green to green-grey in colour); this unit is similar in appearance to the previous coarse grained gabbro above; ~1% oxides and sulphides (ilmenite, and trace pyrrhotite, chalcopyrite and pyrite); locally very weak alignment of the crystals at 50-60degTCA; sharp lower contact at 60degTCA.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-01	GRAN	43.65	80.44	cr	GRAN	Granite-granodiorite; ~25-50% qtz (remainder is white coloured feldspars); ~1-3% sulphides and oxides (pyrite, hematite); unit is white to light pink in colour; med to coarse grained; ~1-2% garnets that are euhedral, pink in colour and <1cm in size; fractures are oxidized and the sulphides are locally oxidized giving the core a brownish to yellowish colouration; brittle; no veins seen; numerous fractures most at 40-50Deg TCA; sharp upper contact; Grain size varies through the unit from coarse grained to pegmatitic to granophyric locally (phaneritic); coarsest from 64-66m; locally muscovite present in small books; locally small patches of light green coloured mica (sericite to muscovite); sharp lower contact at 80.44m at 50deg TCA; unit is relatively pristine.
H-01	GAB	80.44	83.84	cr	2a	Gabbro, coarse grained; dark green and dark bluish-grey in colour; altered; sharp upper and faulted lower contacts; unit is brittle and broken up due to fractures and faults; Weak to moderate alteration (locally strong); cut by small qtz-carb veinlets; cumulate (~50-65% plag and remainder is pyroxenes and amphiboles); this unit may be a block that was incorporated into the "pluton".
H-01	LC	83.84	84.3		LC	Ground up core
H-01	GAB	84.3	84.72	cr	2a	Gabbro, coarse grained; dark green and dark bluish-grey in colour; altered; unit is brittle and broken up due to fractures and faults; Weak to moderate alteration (locally strong); cut by small qtz-carb veinlets; cumulate (~50-65% plag and remainder is pyroxenes and amphiboles); this unit may be a block that was incorporated into the "pluton", appears to be single gabbro from 80.44-85.83 with some ground up due to faulting.
H-01	LC	84.72	85.3		LC	Ground up, likely due to faults
H-01	GAB	85.3	85.83	cr	2a	Gabbro, coarse grained; dark green and dark bluish-grey in colour; altered; faulted lower contact; unit is brittle and broken up due to fractures and faults; Weak to moderate alteration (locally strong); cut by small qtz-carb veinlets; cumulate (~50-65% plag and remainder is pyroxenes and amphiboles); this unit may be a block that was incorporated into the "pluton"; minor gouge present locally.
H-01	GRAN	85.83	114.58	cr	GRAN	Granite (to granodiorite); ~25-50% qtz (remainder is white coloured feldspars); ~1-2% sulphides that are present as fine grained fracture fill and locally as med grained euhedral crystal clusters; rare oxides; unit is white in colour; med to coarse grained; <1 to locally1% garnets that are euhedral, pink in colour and <1cm in size; graphic texture (intergrowth of the qtz and feldspars); strong textures; similar to unit from 43.65-80.44m; upper contact is faulted and weakly brecciated; locally light green granular in appearance sericite alteration +/- chlorite; locally the sulphides are weakly oxidized and are staining the core; no veining; most of the fractures seen in the core are drilling induced. relatively pristine rock; EOH at 114.58m
H-02	OVB	0	2.04		OVB	Overburden/ no recovery

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-02	LC	2.04	2.9		LC	Ground up/ no recovery
H-02	GRAN	2.9	3.56		GRAN	Very weathered; crumbly; granitic in composition; poor recovery; weathered and altered quartz, feldspars and minor mica (biotite and muscovite); light grey in colour; minor oxidation locally; only appears to be one rock type.
H-02	LC	3.56	5		LC	Lost core/ ground up; likely due to weathering of the surface rocks; and possibly faults
H-02	GRAN	5	5.14		GRAN	Rubble and what appears to be fault gouge; weathered rock; poorly consolidated (fall apart easily); light brownish-grey to white in colour; composed of granitic material;
H-02	GRAN	5.14	85.99	cr	GRAN	Granite (to granodiorite); med to coarse grained (locally pegmatitic); white to orangey pink and rarely grey in colour(orangey pink attributed to oxidation along fractures; numerous fractures that are filled with mica (muscovite +/- biotite +/- chlorite) dark green to brownish to grey in colour; minor garnets (<1%) that are euhedral to subhedral and disseminated, locally present in small clusters; at ~10-12m the unit is very coarse grained and is host to graphic textures (intergrowth of qtz and feldspar) and coarse biotite and very coarse feldspars; very coarse from 23-24.1m; coarse from 31.2-32m; grain size is highly variable throughout the unit ranging from med to very coarse grained within a short vertical distance (<10cm); the linear shaped flecks of biotite+/-chlorite appear to be randomly oriented to approx. 19m (may represent stress and strain orientations applied to the pluton?); after 19m the orientation of these biotite/chlorite/muscovite filled fractures have a very weak preferred orientation between 50-70deg TCA; fracture orientation varies typically from 20-60deg TCA; locally books of muscovite present, typically in association with the very coarse grained sections; overall unit is relatively pristine; little to no alteration and no veining (except from 74.4-76.5m where there is a weak to moderate alteration (silica, chlorite, magnetite) and minor fractures);unit is composed of qtz ~25-45%, ~5-10% micas; <1 -1% garnets, and minor amphiboles (<1%) and remainder is feldspars (Very few K-spars); At 83.3-83.33m is what appears to be a large amphibole or mafic segregation/possibly a clast or fragment? (contacts are sharp, no chilled margins); upper contact appears to be faulted; lower contact is sharp at 25deg TCA.
H-02	GAB-P	85.99	89.56	fn	13a	Mafic (fn to med gr porphyritic gabbro); Porphyritic (feldspar +/- qtz) that are subhedral to euhedral; dark grey to black in colour; fine to locally med grained (aphanitic); chilled upper contact; this unit appears to be secondary to the pluton due to the nature of the contact (points entering the pluton and what appears to be fragments of the pluton are incorporated into the volcanics); fine grained pyrite along fractures (<1%); no veining; highly magnetic (>10% magnetite); gradational into coarser grained gabbro; crystals are subhedral to euhedral; lower contact is arbitrary since there is a gradational transition from fn to med-coarse grained (could be large chilled margin)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-02	GAB	89.56	107.83	med	13a	Gabbro, med to coarse grained; locally feldspar porphyritic; felty feldspars; highly magnetic >10% magnetite; ~1-2% sulphides (Pyrite, chalcopyrite); speckled appearance; black and white in colour; rare coarse euhedral crystals of amphiboles up to 1cm in size; no veins; massive; no foliation; grades into more mafic gabbro at 103.66-104.15m (no more felted feldspars, becomes darker in appearance, grains size is similar) then returns to black and white speckled gabbro at 104-104.15m; crystals are euhedral to subhedral; transitions are gradational; lower contact is gradational.
H-02	GAB	107.83	116.66	med	13a	Gabbro; med to coarse grained; similar to unit above, but slight increase in mafic content and is darker in colour; highly magnetic; feldspars are randomly oriented; no foliation or lineation; massive; grey to dark green-grey in colour; 1-3% disseminated sulphides; no veining; locally porphyritic amphiboles up to 1cm in size; crystals are euhedral to subhedral; ~50-60% feldspars; lower contact is also gradational.
H-02	GAB	116.66	120.91	med	13a	Med to Coarse grained gabbro, locally porphyritic (feldspars that are locally zoned); no foliation; small carb+/- qtz veinlets locally; massive; white and dark green-grey speckled in colour; locally plagioclase is felty in texture; highly magnetic; similar to unit from 85.99; numerous fractures cut this interval; decrease in grain size from 120 to 120.91m (fine to med grained at EOH)
H-02A	OVB	0	1.7		OVB	Overburden, no recovery
H-02A	GAB	1.7	5.19	cr	8/2a	Coarse grained gabbro; ~50-60% plagioclase (grey in colour) +40-50% pyroxenes (med-dark green) and rare amphiboles; crystals are subhedral to euhedral; rare crystals up to 1cm in size; majority 5mm in size; very weak alignment of the crystals at ~70 deg TCA; this unit is oxidized and is cut by numerous fractures that appear to have had water ingress and show oxidation giving the core a brownish colouration; cumulate; no sulphides visible; <1% oxides; no veining; alteration is largely due to oxidation and weathering; not magnetic; lower contact is gradational, but there is a sharp appearance in the quantity of amphiboles.
H-02A	GAB	5.19	5.89	cr	8/2a	Gabbro (Amphibole rich Gabbro? or altered pyroxenes?), coarse grained (similar to unit above except increase in amphiboles); ~15-20% amphiboles or pyroxenes that are disseminated, subhedral to euhedral and are very weakly aligned at ~60deg TCA; ~50-60% plagioclase (grey in colour); grey with black speckles in colour; cut by a number of oxidized fractures; upper and lower contacts are gradational with abrupt changes in mineralogy; no veining; no visible sulphides; trace oxides.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-02A	GAB	5.89	6.26	cr	8/2a	Gabbro; similar to unit from 1.7-5.19m; coarse grained; grey to light green-grey in colour; cut by oxidized fractures and small fault; plagioclase (grey) ~50-60% and pyroxenes ~40% (green to green-grey); no veining; no visible sulphides; not magnetic; minor oxides (possibly oxidized sulphides?); gradational contacts with sharp changes in mineralogy.
H-02A	GAB	6.26	7.69	cr	8/2a	Gabbro (Amphibole rich Gabbro? or altered pyroxenes?); coarse grained; cut by numerous oxidized fractures and small faults; has a granular feel due to weathering and oxidation; gradational contacts with sharp transitions in mineralogy; amphiboles or pyroxenes are subhedral to locally euhedral in shape (15-20%); plagioclase is abundant (~50-60%); no veining; no visible sulphides; trace oxides; no veining; very weak alignment of the amphiboles at 60deg TCA; has a spotted or speckled appearance; similar to unit from 5.19-5.89m.
H-02A	GAB	7.69	10.95	cr	8/2a	Gabbro; similar to unit from 1.7-5.19m and from 5.89-6.26m; coarse grained; grey to light green-grey in colour; cut by oxidized fractures and small faults; plagioclase (grey) ~50-60% and pyroxenes ~40% (green to green-grey); no veining; no visible sulphides; not magnetic; cumulate; quality of the core deteriorates at the lower contact with the plutonic rocks; sharp lower contact at 50deg TCA.
H-02A	GRAN	10.95	11.65	cr	GRAN	Granite; coarse grained; graphic texture (intergrowths of feldspars and quartz); white to light pinky orange in colour; oxidation along fractures; abundant fractures; ~5-7% muscovite; <1% hematite (small disseminated blebs and crystals); sharp upper contact and sharp lower contact.
H-02A	GAB	11.65	12.46	cr	8	Coarse grained Gabbro; thin slice caught between granitic rocks; weak to mod altered and oxidized; likely the contacts between these units are sights of water ingress and are also sites of movement (slickensides).Composed of ~45-50%plag (white to light grey) and 40-45%pyroxenes and amphiboles (dark green-grey); broken up core; sharp upper and lower contacts at shallow angles TCA.
H-02A	GRAN	12.46	18.94	cr	GRAN	Granite: coarse grained; white to orangey pink in colour; oxidation associated with the fractures; locally hematite along fractures and locally as blebs; locally disseminated and small clusters of euhedral pink to maroon coloured garnets (up to 2mm in size); granophyric textures locally; locally fractures host muscovite books (coarse grained); muscovite is also present as small disseminated books that are grey to light-greenish-grey in colour; no veining; sharp lower contact.
H-02A	LC	18.94	19.26		LC	Lost Core/ according to the blocks there is core missing; only found one ground end, this may be a driller block error, but I have no way to determine that.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-02A	GAB	19.26	20.35	cr	8	Gabbro; coarse grained; ~50-60% plag; remainder augite +/- amphiboles; no veining; trace sulphides and oxides; minor oxidation associated with fracture that cut the unit; very weak preferred orientation of the crystals at 55deg TCA; similar to units from 7.69-10.95; white and dark green in colour; brownish colouration in proximity to some fractures; sharp upper and lower contacts at granitic units.
H-02A	LC	20.35	20.62		LC	Lost Core/ according to the blocks there is core missing; only found a few very weakly ground ends, this may be a driller block error, but I have no way to determine that.
H-02A	GRAN	20.62	21.87	cr	GRAN	Small band of coarse grained granite; white to light pinky-orange in colour; sharp upper and lower contacts; garnetiferous (small euhedral disseminated and clusters of maroon coloured garnets); tr oxides; no veining; no foliation; cut by small fractures that are weakly oxidized; locally coarse grained muscovite.
H-02A	GAB	21.87	24.55	med-cr	8	Gabbro; med to coarse grained; ~50-60% plag; remainder augite +/- amphiboles; no veining; trace sulphides and oxides; minor oxidation associated with fracture that cut the unit; crystals are subhedral to euhedral; random orientation of the crystals; similar to units from 7.69-10.95 and from 19.26-20.35m; white and dark green in colour; brownish colouration in proximity to some fractures; sharp upper and lower contacts at granitic units.
H-02A	GRAN	24.55	24.72	cr	GRAN	Small band of white to orangey coloured granite; coarse grained; sharp contacts; small fragment of gabbro within this interval from 21.66-21.69m, similar to units from 20.62-21.87 and from 12.46-18.94m
H-02A	GAB	24.72	24.82	cr	8	Gabbro; coarse grained; ~50-60% plag (grey); remainder augite +/- amphiboles (dark green-dark green-grey); no veining; trace sulphides and oxides; minor oxidation associated with fracture that cut the unit; very weak preferred orientation of the crystals at 55deg TCA; similar to units from 7.69-10.95; white and dark green in colour; brownish colouration in proximity to some fractures; sharp upper and lower contacts at granitic units; this unit appears to be in more pristine condition that the previous gabbro.
H-02A	GRAN	24.82	27.5	cr	GRAN	Granite; coarse grained; garnetiferous; white to orangey-pink in colour (attributed to oxidation); garnets are small but euhedral and locally form small clusters and bands that are garnet rich, maroon to pink in colour, up to 3mm in size, rare large clusters; ~1% oxides and sulphides that are disseminated and present as fracture fill; locally small blebs; no veining; locally graphic texture; at 26.33-26.38 there is a fragment of the gabbro incorporated into the granite.
H-02A	LC	27.5	27.8		LC	Cave in in hole; from the small amount of core that remains there appears to have been a fault of breccia fault that ma be the cause of the cave in.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-02A	GRAN	27.8	36.84	cr	GRAN	Granite; coarse grained; ~25-40% qtz; mostly feldspars; garnetiferous (up to 1%); white to orangey-brown in colour (attributed to oxidation associated with fractures and faults); garnets are small but euhedral and locally form small clusters and bands that are garnet rich, maroon to pink in colour, up to 3mm in size, rare large clusters; ~1% oxides and sulphides that are disseminated and present as fracture fill; locally small blebs; no veining; graphic texture; sharp lower contact.
H-02A	GAB	36.84	38.7	med-cr	8	Gabbro; med to coarse grained; similar to gabbro from 21.87-24.55m; plagioclase is grey in colour (~50-65%); augite+/- hornblende (~35-40%) that are dark green to dark green-grey in colour; crystals are subhedral to euhedral and up to 5mm in size; very weak preferred orientation of the pyroxenes and amphiboles at 50 deg TCA; not magnetic; sharp upper and lower contacts.
H-02A	GRAN	38.7	42.54	cr	GRAN	Granite; coarse grained; graphic texture; locally pegmatitic; ~25-40% qtz; >50% feldspars; garnetiferous (up to 1%); white to orangey-brown in colour (attributed to oxidation associated with fractures and faults)(iron staining); garnets are small but euhedral and locally form small clusters and bands that are garnet rich, maroon to pink in colour, up to 3mm in size, rare large clusters; ~1% oxides and sulphides that are disseminated and present as fracture fill; locally small blebs; no veining; sharp lower contact.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-02A	GAB	42.54	58.42	med-cr	8	Gabbro; med to cr gr; similar to gab from 21.87-24.55m; plag is grey in colour (~50-65%); aug (+/- hbld) (~35-40%) that are dark green to dark green-grey in colour; crystals are subhedral to euhedral and up to 5mm in size; v wk preferred orientation of the pyrox and amph at 50 deg TCA; weak (what appears to be) bioe altn; there are what appear to be small vnlts locally but upon closer inspection appear to be feld segregations; not magnetic; sharp upper contact; at 44m there is a sight transition from wkly altd gab to gab with milky grey plage (slight washed out appearance) the pyrox have a greenish brown colouration and are flaky (may also be primary centre pyrox and rims of amphiboles?) vwk preferred orientation of 50-60 deg TCA and increasing amounts of sulph mineralization (<1 to 1%); at ~43.4m there are small fragments of the gran, likely that the hole cut a small sliver of the unit (core is broken up) only 5 or 6 cm of the granitic material there is wk altn associated with the granitic fragment and small fractures; at 49.45 there is another slight transition to a wkly altd gab due to wk veining frac and minor flts then at 50.58m we return to the milky plag with pyrox and rare amph that are med to cr gr and the pyrox and amph have a wk altn that makes them light yellow-brownish-green in colour, increasing sulph, locally small bands of sulph up to 15% (semi-massive bands of 1-2cm); at 57m to EOH there are bands of sulph up to 25% (2-4cm, semi-massive) and numerous flts and frac as well as wk to mod altn; from 57-58.42m there is approx. 5-7% sulph; the plag is white to very light grey in colour, the pyrox and amph standout very well (strong contrasting colours), flt surfaces are coated in a dark green mineral (serp?Chl?); slickensides; EOH at 58.42m (Wish that this hole had continued, this would have been a great opportunity for sampling mineralization)
H-03	OVB	0	0.9		OVB	Overburden/ no recovery; appears to may have been weathered gabbro (likely no sedimentary cover)
H-03	GAB	0.9	5.86	med	8	Gabbro; med to coarse grained; crystal grains are 3-7mm in size; strongly weathered; crumbly; oxidized which gives the core a brownish-orange colouration locally; light grey with dark speckles; composed of plagioclase (light grey in colour, ~60%) and pyroxenes (~25-30%) (also appears to be Cpy and Opx (bronzite?)); oxidation and Fe-staining is more intense along fractures (likely due to water infiltration); no preferred orientation of the crystals; crystals are subhedral to locally euhedral; almost equigranular;
H-03	LC	5.86	6.58		LC	lost core/ ground up/ only minor sand recovered
H-03	GAB	6.58	7.19	med	8	Strongly weathered and possibly faulted gabbro; only rubble and sand recovered (poor recovery); between 6.58 and 7m what appears to be gouge recovered; likely same unit as gabbro above (from 0.9-5.86m); sharp lower contact at granite.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-03	GRAN	7.19	13.82	cr	GRAN	Granite; Coarse grained (locally med grained); grain size is highly variable; graphic textured; garnetiferous (garnets are maroon to pinky in colour; subhedral to euhedral up to 7mm in size; disseminated and present as small clusters); muscovite fine to coarse grained books locally; unit is white to pink to orangey-brown in colour; Fe-oxidation present along fractures and as Fe-staining of the granite; minor oxidized sulphides present along fracture planes (<1% sulphides); most of the fractures and any joints are at 30, 50 and 70 deg TCA; sharp upper and lower contacts; locally graphic texture is pegmatitic.
H-03	GAB	13.82	14.28	med	8	Gabbro; med to coarse grained; crystal grains are 3-7mm in size; light grey-white with dark green spots; composed of plagioclase (light grey in colour, ~60%) and pyroxenes (~30-35%); weak altn (actinolite); crystals are subhedral to locally euhedral; very weak preferred orientation of the crystals at 70deg TCA; crystals are weakly zoned (pyroxenes); minor Fe-oxidation along ay fractures (still in upper oxidation zone); no visible sulphides (likely oxidized if present); no veining; cumulate
H-03	LC	14.28	14.93		LC	lost core/ ground-up/ no recovery
H-03	GAB	14.93	20.29	med	8	Gabbro; med to coarse grained; crystal grains are 3-7mm in size; light grey with dark green spotted; composed of plagioclase (light grey in colour, ~60%) and pyroxenes (~30-35%); crystals are subhedral to locally euhedral; very weak preferred orientation of the crystals at 70deg TCA; Fe-oxidation (Fe-staining) along fractures and faults (still in upper oxidation zone) weak to moderate in intensity; weak altn (weak zoning of the pyroxenes); <1% sulphides (oxidized) that are disseminated; lower contact is arbitrary (at the end of the significant oxidation zone; better quality core.
H-03	GAB	20.29	33.53	med	8	Gabbro; med to locally coarse grained; grains are generally 3-4mm in size (down hole the grain size increases slightly to avg of ~4-5mm); plagioclase is light grey in colour and has a milky appearance; pyroxenes are dark green grey in colour (weakly zoned, uncertain if crystals are altered (actinolite +/- biotite) or if they are composed of pyroxenes and amphibole rims?); crystals are subhedral to locally euhedral; increasing sulphide content (pyrrhotite, chalcopyrite and sphalerite) up to 4%; very weak mineral lineation of the augite at ~65-70deg TCA; rare thin what appear to be plagioclase segregations that are host sulphide mineralization (~1-2% of these), no sharp boundaries (not veins); fracture set at 20deg TCA (surfaces are oxidized and host minor carbonates); at 28.34-28.42m there is a reverse foliated section (pictures taken) at 60deg TCA (small weak shear), fine grained, hosts ~1-2% sulphides biotite and amphiboles; sharp lower contact, alteration from 33.45-33.53m associated with the vein (very weak foliation as well).

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-03	GRAN	33.53	33.75	cr	GRAN	Granite; Coarse grained; garnetiferous (small mm scale garnets that are disseminated and present along small concentrated bands); white in colour; abundant muscovite (~10%) that is coarse grained, light green-yellowish in colour; sharp upper and lower contacts
H-03	GAB	33.75	44.2	med	8	Gabbro; med to coarse grained (plagioclase is coarse grained, crystals are grey to grey-violet in colour, milky, some appear to be weakly zoned; comprise ~60-65% of the unit); pyroxenes are med to coarse grained avg crystals are 4-5mm in size, crystals are subhedral to euhedral and are dark green to dark green-buff in colour (some of crystals are zoned), pyroxenes become darker green down hole; unit is grey in colour; sharp upper (alteration zone adjacent to the vein from 33.75-33.82m, cooked gabbro) and lower contacts; at 40.13-40.17 and 43.64-43.68m there is a small vein of granite (garnetiferous+ biotite), contacts are skewed; fracture and fault surfaces host serpentine; what appears to be small veinlets locally (feldspar segregations); similar to gabbro from 20.29-33.53m; <1% sulphides.
H-03	GRAN	44.2	45.32	cr	GRAN	Granite; coarse grained; graphic texture; white in colour; garnet bearing (small mm sized garnets); sharp upper and lower contacts; linear fractures filled with biotite (~5-7%), minor muscovite disseminated; no visible sulphides; no veining.
H-03	GAB	45.32	45.64	cr	8	Gabbro; coarse grained; similar to unit from 33.75-44.2m. Plagioclase is grey in colour (locally violet hue), coarse, ~65% plag; pyroxenes are dark green in colour, med grained, ~20-25% subhedral to euhedral, biotite rims on the crystals; <1% sulphides; sharp upper and lower contacts; small band of ductile deformation at 45.58-45.65m at 50deg TCA.
H-03	GRAN	45.64	47.89	cr	GRAN	Graphic textured coarse granite; locally pegmatitic; garnetiferous (<1%); white in colour; locally fractures filled with biotite; minor muscovite; sharp upper and lower contacts; similar to unit from 44.2-45.32m
H-03	GAB	47.89	48.24	cr	8	Gabbro; coarse plagioclase (grey in colour; ~65%); pyroxenes and amphiboles are med grained (dark green, subhedral to locally euhedral, locally rims of biotite and actinolite, ~20-25%); sharp upper and lower contacts, similar to gabbro from 45.32-45.64m
H-03	GRAN	48.24	83.3	cr	GRAN	Graphic textured coarse granite; locally pegmatitic; garnetiferous (<1%, small 1mm in size, disseminated and locally present in small clusters and bands); white in colour; locally fractures filled with biotite; minor muscovite; sharp upper and lower contacts; fractures are locally oxidized and there is Fe-staining; similar to unit from 44.2-45.32m and from 45.64-47.89m; <1% sulphides (pyrite that is disseminated and present along fracture planes); locally crystal up to 10cm; from ~67-74m there is strong biotite that is locally present as sheets (long black lines on the core) that are generally oriented at 50-70 Deg TCA); down hole increasing muscovite and decreasing biotite; sharp lower contact at 83.3m

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-03	GAB	83.3	97.57	med-cr	8	Gabbro; sharp upper contact; med to coarse grained; white to dark grey to grey with violet hue with dark green spots in colour; plagioclase is dark grey to grey with violet hue in colour, almost milky and have a slight washed out appearance; coarse grained; avg grain size ~6mm, plagioclase crystal appear to be zoned with darker centres and lighter coloured rims, plagioclase ~60-80% of the rock; pyroxenes are dark green in colour and range in size from 3-7mm (med grained), locally zoned; disseminated sulphides (pyrrhotite, chalcopyrite and what appears to be minor sphalerite or possibly rutile?, pyrite is also present in proximity to the veins and faults, also one speck of a black oxide, possibly ilmenite or magnetite?), <1-1% sulphides; there is a weak preferred orientation of the pyroxenes at 70 deg TCA; alteration zones associated with faults, fractures and small veins that are granitic in composition; fault surfaces are serpentinized (dark green in colour) and may host slickenside surfaces; the core is smooth (feels like silicified core); locally associated with the pyroxenes there are small specks of buff colour material (rutile?); at 92m there is a small shear, above the shear appears to be a feldspar segregation or bleaching effects associated with this structure; lower contact is abrupt at a transition in texture and mineralogy, there is no distinct linear contact visible.
H-03	GAB	97.57	101.4	med-cr	9	Gabbro; med to cr gr; plagioclase is light grey to grey in colour; distinct grains boundaries are difficult to distinguish, ~50-60% plagioclase, becomes zoned down hole; pyroxenes are dark green to greenish-grey in colour, locally zoned (amphibole rims?), subhedral to locally euhedral, Pyroxenes are ~3-6mm in size, ~25%,rare disseminated amphiboles; sulphides and oxides are disseminated, this unit is weakly magnetic (<1% magnetite), disseminated magnetite crystals and intercumulus magnetite; disseminated pyrrhotite and chalcopyrite and minor pyrite locally (~1% sulphides); most of the fracture are serpentinized and host minor carbonates; the core has a more rough feel compared to previous unit (almost washed out appearance); arbitrary lower contact, gradational into more plagioclase rich and faulted/fractured gabbro.
H-03	GAB	101.4	103.13	cr	9	Gabbro; coarse grained; plagioclase ~65%, the crystals are grey to grey-violet in colour; the pyroxenes are dark green in colour; subhedral, up to 6mm in size, avg ~3mm; unit is grey-violet with dark green speckles in colour; unit is cut by numerous faults, fractures and small shears; fluid infiltration along fractures has lead to some alteration in proximity to these structures; (serpentine+/-minor carbonate), sulphide mineralization <1% (pyrrhotite, chalcopyrite, magnetite and minor pyrite), from 103.13-103.3m there is little to no recovery due to fault (lost core)
H-03	LC	103.13	103.3		LC	lost core due to fault and fracture zone, little recovery

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-03	GAB	103.3	121.16	cr	9	Gabbro; coarse grained; plagioclase content varies significantly throughout this interval from 65-80%, the crystals are grey to dark grey-violet in colour; the pyroxenes are dark green in colour; subhedral, up to 6mm in size, avg ~3mm; unit is grey-violet with dark green speckles in colour; unit is cut by numerous faults, fractures and small shears; fluid infiltration along fractures has lead to some alteration in proximity to these structures; (serpentine+/-minor carbonate), sulphide mineralization is up to 1% (pyrrhotite, chalcopyrite, magnetite and minor pyrite), from 103.13-103.3m there is little to no recovery due to fault (lost core); at 114.1-114.17m there is a small band of med grained gabbro (similar in composition to units above and below, but finer grained and slight increase in pyroxene content); locally weakly magnetic (<1% magnetite);at 118.63-118.7m is white in colour, host to bronzite (opx) and appears to be a plagioclase layer/leucogabbro layer (sharp contacts/transitions); transition towards the lower contact shows and increase in the sulphide content up to 15% and an increase in the pyroxene content and their size (up to 7mm, and 25-30%); the lower contact is host to bands of what appear to be plagioclase segregations or bands of strong plagioclase(late stage veins? No sharp or distinct contacts with these sections), these host mineralization and pyroxenes (within these bands the pyroxenes are brown in colour and are coarse grained; lower contact is fine grained and is host to semi-massive pyrrhotite mineralization; contact with next unit is at the appearance of what seems to be Opx crystals and strong pyrrhotite mineralization; no sharp defined line as contact, more a gradational transition.
H-03	GAB	121.16	122.09	med	Sulph	Gabbro; med grained; transitional upper contact, sharp lower contact; ~25% sulphide mineralization, pyrrhotite is present as semi massive bands, disseminated and as intercumulus minerals, pyrrhotite is magnetic; <1% chalcopyrite which is fine grained and disseminated, typically associated with the pyrrhotite, plagioclase is grey in colour ~50% and unit is host to abundant pyroxenes (green-grey to almost black in colour) (opx and Cpx) ~25% that are subhedral to euhedral.
H-03	GAB	122.09	122.45	fn	9	Gabbro, fine grained, sharp upper and lower contacts (faults); similar in composition to units above and below, but finer grained, ~5-7% sulphides (pyrrhotite) and minor pyrite along the fault and fracture planes; no foliation or mineral lineation; weak serpentine alteration;
H-03	NOR	122.45	122.68	cr	9	Norite/ leucogabbro (plagioclase segregation?); White to grey in colour; coarse grained; plagioclase ~70%; host to coarse gr bronzite(opx) that are subhedral to euhedral and Cpx that are subhedral to euhedral; locally pyroxenes encompass plagioclase laths and sulphides; disseminated magnetite or ilmenite (weakly magnetic); ~1-3% sulphides and oxides; sharp upper contact and short gradational lower contact into mela-gabbro.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-03	NOR	122.68	124.7	med	9	Gabbro/Norite, ~45-50% plagioclase; ~40-45% pyroxenes (Opx and Cpy), pyroxenes are subhedral to euhedral and are dark green to dark brown in colour, the bronzite has an iridescent brown colouration; sulphide content varies from 7-10%, primarily pyrrhotite which is present as irregular and angular shaped blebs and pods (infill of pore spaces?); lower contact is at a fault; unit is dark grey in colour; patchy lighter coloured what appear to be plagioclase segregations; weakly gradational upper contact into faulted lower contact.
H-03	GAB	124.7	124.86	med	9	Gabbro, med grained; ~50%plag and ~40% pyroxenes; ~10% sulphides(pyrrhotite, tr Cpy) and oxides (tr magnetite); sulphides form irregular patches of angular and irregular shaped sulphides (appear to be space filling); upper contact is at a fault and lower contact is weakly gradational (short distance); dark grey to dark green-brownish-grey in colour; unit is cut by small plagioclase rich veinlets that do not have sharp contact (the contact blend together), suggesting syn-genetic veins; pyroxenes are subhedral to locally euhedral and are locally zoned (Cpy centre and Opx rims?) very weak preferred orientation of the crystals at 60deg TCA.
H-03	GAB	124.86	128.5	med	9	Gabbro; MED to coarse grained; unit begins in white coloured plagioclase and bronzite rich leuco-gabbro/norite and grades down hole into darker grey opx-gabbro; the pyroxenes crystals are med to coarse grained (3-7mm) and are subhedral to euhedral, some of the crystals are zoned (lighter centre with darker rims); there are a number of colour variations in this unit from white to dark grey (attributed to plagioclase content (layers or alteration?); but overall contains ~55-65% plagioclase, ~30-45% pyroxenes; some sections the OPX crystals appear more prominent, sulphide mineralization decreases after ~125m from ~7% to ~1%; faults and fractures are serpentinized; black coloured fn gr disseminated oxide associated with these white coloured zones (~1%); weak preferred orientation of the crystal at 60-70deg TCA; EOH in OPX rich gabbro
H-04	OVB	0	2.74		OVB	only small pebbles recovered from the overburden, fragments of fine grained gabbro and granite, uncertain if there is a thin highly weathered granitic unit above, or if this is part of the weathered overburden and may have been transported to this location.
H-04	GAB	2.74	3.64	med	9	Gabbro; strong weathering; granular feel; breaking down into sands and clays; oxidized; faulted and fractured; Med grained locally coarse crystals (avg grain size is 3mm); crystals are subhedral to euhedral; cumulates; weak preferred orientation of the crystals at 75deg TCA; plagioclase is light grey in colour and forms ~55-60% of the unit; pyroxenes are dark green-grey in colour and are locally weakly zoned, ~20%; (~5% is OPX) lower contact at lost core.
H-04	LC	3.64	3.83		LC	Lost core; ground up?; poor recovery

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	GAB	3.83	5.59	med-cr	9	Gabbro; weak to moderate weathering, granular feel, cut by numerous fractures, weak to moderately oxidized; appears similar to unit from 2.74-3.64 with reduced weathering; plagioclase is light grey in colour; pyroxenes are dark green-dark green-grey in colour, subhedral to euhedral crystals that are up to 7mm in size, avg grain size is 4-5mm; med to locally coarse grained, Opx present ~5% of pyroxenes; unit is cut by a number of faults and fractures, Fe-oxides are present and there are stained haloes surrounding the crystals (not magnetic), ilmenite? dark black; no veining; alteration is associated with weathering from surface; lower contact is abrupt (but there is not a distinct linear contact, it is weakly gradational over 1cm)
H-04	GAB	5.59	5.87	fn	9	Gabbro, fine grained, buff to brownish-grey in colour; appears to be fine grained irregular mineral banding; granular texture (almost as if recrystallized); pyroxenes are light green-brown to brownish in colour; ~1mm or less in size, equigranular; plagioclase is also fine grained and comprises ~40-50% of the interval; pyroxenes are ~45-50% of the interval; contacts are abrupt; but not sharp defined linear contacts.
H-04	GAB	5.87	12.43	med-cr	9	Gabbro, med to coarse grained; plagioclase is coarse grained; crystals up to 10mm (avg ~6mm), crystals are light grey to grey in colour, and locally have darker coloured centres, form approx. 55-60% of the unit; pyroxenes are green-grey to dark green to brownish in colour and are subhedral (to euhedral), ~25-30% (up to 8mm, avg size ~4mm); slight colour variations in the unit may be attributed to the faults and fractures; weak oxidation, weak serpentinization associated with fractures and faults; <1% opx; weak preferred orientation of the pyroxenes at ~80deg TCA; minor oxides (<1%) that locally have fee-oxidation stained halo surrounding them; cumulates; upper contact is abrupt and lower contact is faulted.
H-04	GAB	12.43	19.7	med-cr	9	Gabbro, med to coarse grained; plagioclase is coarse grained; crystals up to 10mm (avg ~6mm), crystals are light grey to grey in colour, and locally have darker coloured centres, form approx. 55-60% of the unit; pyroxenes are green-grey to dark green to brown in colour and are subhedral to euhedral, ~25-30% (up to 8mm, avg size ~4mm), some of pyroxenes appear flaky and are likely weakly altered; slight colour variations in the unit may be attributed to the faults and fractures; weak oxidation, weak serpentinization associated with fractures and faults; Opx varies from 15% to 2%;biotite alteration is weak, locally small books present, appear to be main alteration mineral of the pyroxenes; weak preferred orientation of the pyroxenes at ~75-80deg TCA; minor oxides (<1%) that locally have fee-oxidation stained halo surrounding them; tr sulphides (Pyrrhotite, small irregular blebs; cumulates; upper contact is faulted; lower contact is gradational into OPX poor gabbro.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	GAB	19.7	22.43	med-cr	9	Gabbro, similar to unit above but with fewer OPX crystals. Core has a almost siliceous appearance and feel, plagioclase is light to dark grey, locally has very weak violet hue; pyroxenes are dark green to light brownish in colour, subhedral to locally euhedral, some of pyroxenes appear flaky and are likely weakly altered; tr sulphides; very weak preferred orientation of the crystals at 70deg TCA; a number of fractures cut the core near parallel TCA; lower contact is gradational into more OPX rich gabbro.
H-04	GAB	22.43	25.5	med-cr	9	Gabbro; similar to unit from 12.43-19.7m; this interval is host to what appear to be plagioclase segregations or layers of plagioclase rich material that are up to 10cm in length; colour variation in this interval is highly variable; plagioclase is from dark grey to white in colour and comprises 60-85% of the core; plag is coarse grained; the pyroxenes are dark green to dark brown to greyish-green in colour and are subhedral to locally euhedral and are medium grained; numerous fracture and faults cut this interval; tr sulphides; lower contact is gradational over a few centimeters and at fracture set.
H-04	GAB	25.5	26.1	fn	Sulph	Gabbro, fine grained, mineralized, similar to unit seen in H-03; dark grey in colour; patchy plagioclase (sections that are more plagioclase rich); ~5-7%sulphides (Pyrrhotite, pyrite, chalcopyrite) that are disseminated and present as irregular pods of sulphides; fractured and faulted upper and lower contacts; lower contact is gradational into coarser gabbro.
H-04	GAB	26.1	27.06	med	9	Gabbro, med grained (to coarse grained); mineralized (~3-4% pyrrhotite, chalcopyrite and pyrite); Bronzite ~7%; pyroxenes are subhedral to euhedral and are dark brown to greenish-grey in colour, some of pyroxenes appear flaky and are likely weakly altered; plagioclase is grey in colour; cut by numerous fracture ; small white coloured band hosting large subhedral to euhedral bronzite at 26.6m; lower contact at a fault.
H-04	GAB	27.06	28.4	med	9	Gabbro; faulted and fractured; weak alteration; numerous plagioclase segregations (white in colour); black oxide present (<1%) as disseminated blebs; no visible OPX; some of the pyroxenes are zoned; unit is med grained; tr sulphides; broken up; lower contact at a fracture.
H-04	GAB	28.4	29.67	med	9	Gabbro, similar to unit from 26.1-27.06m; med grained gabbro (locally coarse); plagioclase ~65% grey in colour; pyroxenes ~25-30% that are dark brown to dark green-brownish in colour; <1% sulphides (Pyrrhotite, chalcopyrite); gradational lower contact into OPX poor gabbro.
H-04	GAB	29.67	30.9	med-cr	9	Gabbro, med-coarse grained; pyroxenes are dark brownish-green in colour and are up to 7mm in length, avg is ~4-5mm, plagioclase is grey to dark grey with violet hue in colour; and are coarse; interval is highly fractured and faulted; weak alteration; no visible sulphides; there appears to be a weak preferred orientation of the crystals at 80deg TCA; lower contact is gradational into OPX rich gabbro

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	GAB	30.9	31.37	med-cr	9	Gabbro, OPX rich, med-coarse grained; plagioclase is ~65% of unit, pyroxenes are dark brown to black to light greenish-grey in colour, crystals up to 1cm in size, avg ~4-5mm and are subhedral to locally euhedral, some of pyroxenes appear flaky and are likely weakly altered; weak biotite alteration; <1% sulphides; upper and lower contacts are gradational (appearance and disappearance of a mineral)
H-04	GAB	31.37	33.46	med-cr	9	Gabbro, med-coarse grained; pyroxenes are light brownish-green in colour and are up to 7mm in length, avg is ~4-5mm, plagioclase is light grey to dark grey with violet hue in colour; and are coarse; interval is cut by numerous fractures and faults; weak alteration; disseminated and small blebs of sulphides locally (<1%); there appears to be a weak preferred orientation of the crystals at ~80deg TCA; from 32.8-33m plagioclase makes up ~85% of the interval; lower contact is gradational into OPX rich gabbro (are these transitions due to alteration?)
H-04	GAB	33.46	34.6	med-cr	9	Gabbro, OPX rich, med-coarse grained; plagioclase is ~65% of unit, pyroxenes are dark brown to black to light greenish-grey in colour, crystals up to 7mm in size, avg ~4mm and are subhedral to locally euhedral, some of pyroxenes appear flaky and are likely weakly altered; weak biotite alteration; ~1% sulphides; upper and lower contacts are gradational (uncertain if this is attributed to alteration); numerous faults and fractures cut this interval; it is also important to note the what appear to be vein like bands of white coloured plagioclase, plagioclase segregations? they are typically 10cm in width, leucogabbro?
H-04	GAB	34.6	39.82	med-cr	9	Gabbro, med-coarse grained; pyroxenes are light brownish-green to dark green in colour and are up to 7mm in length, avg is ~4mm, plagioclase is white to light grey to dark grey with violet hue in colour and are coarse; interval is cut by numerous fractures and faults and shear zones (uncertain if there is significant movement along these structures); weak to mod alteration, carbonates associated with the fractures and faults (nice crystalline, brittle) at 38.6-38.85m; disseminated and small blebs of sulphides ~1-2% (Pyrrhotite and Tr Cpy and minor Pyrite along the fracture planes; there appears to be a weak preferred orientation of the crystals at ~80deg TCA; lower contact is abrupt (gradational over 2-3cm) into nearly 100% plagioclase.
H-04	AN-LGAB	39.82	41.45	cr	3	Anorthosite-Gabbro; high percentage of plagioclase (70-95%), content decreases down hole; from ~40-40.7m is has a weakly brecciated texture; large up to 3cm crystals and smaller<1cm crystals; pyroxenes up to 20%, plagioclase is dark grey-violet in colour; fractures are filled with carbonate and serpentine, slight discolouration along the planes, increase in pyroxene content with depth, pyroxenes are grey-green in colour and are anhedral to subhedral and have a wispy appearance, possibly 2 generations of pyroxenes, rare crystals are dark green and euhedral, <1% sulphides that are disseminated; unit is comprised of coarse plagioclase and med-coarse grained plag and pyroxenes (overall coarse gr); lower contact is fractured and faulted.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	GAB	41.45	44.62	med-cr	9	Gabbro, med to coarse grained, plagioclase if light grey to dark grey in colour and is med to coarse grained ~60-65%; pyroxenes are light green-grey to dark grey to dark brown in colour and are subhedral to euhedral ~20%, some relic pyroxene grains; ~2-3% sulphides (pyrrhotite, chalcopyrite and pyrite) also rare metallic oxides that is black to violet in colour fn gr and typically associated with the plagioclase segregations that are white in colour; Pyrrhotite is locally magnetic and occurs and space filling or interstitial material, anhedral and fine grained blebs; very weak preferred orientation of the pyroxenes at 70deg TCA; lower contact is irregular but sharp
H-04	GAB	44.62	44.7	fn	9	Gabbro (banded, fn gr), fine grained; light brown to grey in colour, weak alternating coloured bands, ~1% disseminated sulphides (Po and Cpy); ~50% pyroxenes and 50% plagioclase, upper and lower contact are sharp but irregular; bands are at ~80deg TCA;
H-04	GAB	44.7	44.81	med	9	Gabbro, med grained (to coarse grained); plagioclase is light grey to grey in colour ~65% and pyroxenes are light grey-green to dark green in colour and are subhedral ~25%;some of pyroxenes appear flaky and are likely weakly altered, upper contact is irregular but sharp and lower contact is sharp; ~3% sulphides (Po and Cpy); these are irregular fn grained, disseminated and present as pods, intercumulus minerals.
H-04	GAB	44.81	48.08	med-cr	9	Gabbro, (opx +/- amphibole bearing) med to coarse grained; plagioclase is light to dark grey in colour and comprises ~60% of the unit, pyroxenes are light green-grey to dark green to dark brownish in colour, subhedral to locally euhedral; there is a weak preferred orientation of the crystals at 70 deg TCA; some relic pyroxenes; ~3-5% sulphides (pyrrhotite, chalcopyrite, pyrite and rare oxide); from 44.81-44.88 there is a band of brownish red fn gr minerals (biotite?) and from 45.06-45.15m there are additional fn grained bands of this mineral; from 46.85-47.3m there is an increase in plagioclase up to 75% the transition is gradational, pyroxenes and sulphides comprise the remainder of the rock; at 47.3m the unit transitions back into Opx bearing gabbro; at 47.95-48.08m is another band of what appears to be plagioclase segregations which are cut by a number of small fractures and faults; lower contact is sharp.
H-04	GAB	48.08	56.44	fn	12	Gabbro, fine grained, weakly magnetic, ilmo-magnetite is present as disseminated fn to med grained crystals and pods, up to 10%, crystal are black with violet hue in colour; <1% veining; cut by numerous fractures and faults; strong deformation approaching the lower contact from 56.3-56.44m; unit is almost equigranular, plagioclase is almost bluish in colour (labradorite), ~50%plag and ~45% pyroxenes, massive (no foliation or visible preferred orientation of the crystals); dark grey in colour; ~1% fn gr disseminated sulphides (Pyrrhotite, chalcopyrite and pyrite); lower contact is sharp, upper contact has a small alteration halo which may be attributed to the "vein" at the upper contact, unit may be a late part of the intrusion?

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	GRAN	56.44	60.33	cr	GRAN	Granite, graphic texture, coarse grained to pegmatitic, largest feldspars up to 8cm and qtz up to 10cm, garnetiferous, garnets are locally concentrated in small bands and disseminated, minor muscovite present as books and locally as small thin crystals; unit is white to milky in colour; upper and lower contacts are sharp
H-04	GAB	60.33	60.87	cr	9	Gabbro, uncertain if fragment or if the contacts between the two units are irregular, coarse grained, plagioclase is grey in colour (~50%), pyroxenes are dark green to brownish in colour (~35%); appears to be biotite alteration halo of the pyroxenes in the gabbro, only the middle to the unit is biotite alteration free, slight preferred orientation of the pyroxenes at 60deg TCA; sharp upper and lower contacts;<1% sulphides and oxides (magnetite, Cpy, Po)
H-04	GRAN	60.87	75.83	cr	GRAN	Granite, graphic texture, coarse grained to pegmatitic, garnetiferous, garnets are locally concentrated in small bands or pods and disseminated (pink coloured garnet pod at ~62m composed of fn gr euhedral garnets, minor muscovite and biotite; upper and lower contacts are sharp; from 62.04-62.16m is biotite rich band of granitic composition and garnet bearing, also contains ~1% pyrite, sharp contact at 50 (upper) and 60 (lower)Deg TCA, also this interval is well foliated at 40deg TCA; unit is white in colour to milky, minor fee-oxide staining associated with some of the fractures; sharp lower contact; from 72.7 to 75.83 fractures are filled with carbonates, core is brittle.
H-04	GAB	75.83	76.5	med	9	Gabbro, med grained; sharp upper contact with granite; weak Fe-carb alteration along the contact and ~35cm into the unit; composed of ~60-65% grey plagioclase that is med to coarse gr (avg gr size ~6mm) and pyroxenes that are dark green-grey in colour and are subhedral (anhedral), wispy in appearance almost flaky in texture (altered) (~25-30%) (avg gr size ~3-4mm); plagioclase segregation at 76.17-76.31m composed almost entirely of plagioclase; ~1-2% intercumulus sulphides (pyrrhotite and tr chalcopyrite); sharp lower contact at fault and fracture zone.
H-04	GAB-FLT	76.5	76.6	fn	9	Fault zone, numerous fractures and some small faulted blocks of plagioclase rich gabbro, fn to med grained, dark brown in colour, Fe-carbonate along the fractures and fault surfaces, slickensides, core is brittle and broken up, ~2% sulphides (Po and Cpy, that are disseminated and present as small blebs; sharp lower and upper contacts.
H-04	GAB	76.6	77.2	cr	9	Gabbro, coarse grained, sharp upper faulted contact and sharp lower faulted and veined contact; plagioclase is white to grey to grey with violet hue in colour; pyroxenes are up to 2cm in size and are dark to light green in colour, some have relic texture and wispy appearance, some appear to be weakly replaced with actinolite, crystals are subhedral to rare euhedral, ~1% sulphides (Po and Py), has that washed out milky plagioclase and smooth core, similar to previous holes and unit above from 19.7-22.43m; from 77.12-77.2m is faulted and altered, plagioclase is white and pyroxenes are dark green almost black in colour.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	VN	77.2	77.32	cr	GRAN	Vein composed of quartz and plagioclase (possibly a vein from the granitic unit above); light grey-clear to white in colour; sharp upper and lower contacts; fractured, fractures are filled with fee-carbonate and Pyrite (<1%); tr biotite.
H-04	GAB	77.32	91.91	cr	9	Gabbro, locally variations in gr size from med-coarse to very coarse with some pyroxene crystals >2cm, unit is also host to bands of massive to semi-massive sulphides; abundant fractures and faults which also appear to be sources of fluids and alteration, uncertain of severity of the displacement along the faults; plagioclase crystals are coarse grained and reach up to 3cm in size, they are white to light grey to dark grey in colour; locally small plagioclase segregations up to 4cm in thickness are present and host ~85% plagioclase, typically minor biotite alteration associated with these zones; pyroxenes (cpx and opx are med to coarse grained, crystals are subhedral (rare euhedral); green-grey to dark green to iridescent brown to black in colour, some of the crystals are poikilitic (contain sulphides or other pyroxenes); sulphides are intercumulus and form irregular and angular blebs and pods to semi-massive to massive bands, also present as fracture fill, primary sulphide is pyrrhotite; from 80.12-80.36m ~20% sulphides, from 82.83-82.95m ~25-30% sulphides; from 82.95-83.12m ~10% sulphides; from 77.32-81.09m is med-coarse gr; from 81.09-82.60m very coarse grained; from 82.6-82.83m is med-coarse gr; from 82.83-83m is fn-med gr; from 83-87.4m med-coarse gr (coarse); 87.4-88.23m very coarse; from 88.23-88.69m med-coarse with plagioclase segregations (white in colour and bands similar to those seen in previous holes; from 88.69-89.3m is very coarse grained; from 89.3-89.58m is med-coarse gr; from 89.58-89.74 is similar to small band seen in previous hole that is brownish-red in colour and appears to be strong biotite alteration; 89.74-90.43m is med-coarse gr; 90.43-90.9 is fine to med grained; 90.9-91.91 is a series of plagioclase segregations and med-coarse grained gabbro; lower contact is fractured and faulted.
H-04	GAB	91.91	95.28	med	9	Gabbro, med grained, cut by numerous fractures and faults, weak alteration locally; plagioclase is ~40-50% of unit and pyroxenes are ~40-45%, ~1-2% fine gr disseminated and irregular blebs of sulphides (pyrrhotite, chalcopyrite, pyrite and mystery light grey metallic sulphide (cobaltite or Pt-mineral?)), also bands of pyrrhotite; unit is dark green-grey in colour; some plagioclase segregations locally up to 6cm in thickness; from 91.91-93m is faulted and broken up with strong slickenside surfaces and is serpentinized; 93-94.79 is med gr gabbro with ~1% sulphides; 94.74-94.79-94.86 is plag segregation band; 94.86-94.88m is band of ~80% pyrrhotite; 94.88-95.28m if fractured and faulted med gr gabbro with biotite and serpentine altn; lower contact is sharp at fault.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	GAB	95.28	103.15	fn-med	5a	Gabbro, weakly magnetic; fn-med grained (med grained), equigranular; strong presence of what appears to be ilmo-magnetite (weakly magnetic) ~20%, crystals are disseminated, black to black with violet hue; fn to med gr; <1% sulphides (pyrrhotite, chalcopyrite and rare pyrite; fractures and faults are serpentinized and locally host fee-carbonate; pyroxenes are dark green to green-grey to brown in colour; subhedral, ~35-40%, plagioclase is grey in colour and comprises ~45% of the unit; there is a weak preferred orientation of the grains at 60deg TCA; at 100.4-100.6 unit is coarse grained, cut by faults and serpentinized; from 100.6-102.2m the unit is granular in texture and is altered; from 102.82-103.15m there is little to no ilmo-magnetite present; lower contact is at plagioclase segregation.
H-04	AN-LGAB	103.15	103.68	med	2b	Anorthosite-Gabbro (leucogabbro); plagioclase up to 90%, med gr, ~1-2% sulphides (Po, Py and tr Cpy), pyroxenes (light to dark green, anhedral to subhedral, wispy) and minor biotite altn; contacts are gradational; rare oxides (ilmenite?); unit is grey in colour.
H-04	GAB	103.68	121.68	med	5a	Gabbro, med gr, gradational upper contact; ~50-60% plagioclase that is grey to bluish (labradorite) in colour are med-coarse gr; pyroxenes (cpx and opx) are dark green to light green to brown in colour and are subhedral; ~1% sulphides and oxides (ilmenite) increasing with depth; the silvery metallic mineral is locally present as disseminated crystals and small aggregates (tr) from 104.32-104.35m comprises ~1-2% of the unit as fn gr seams; fractures and faults are locally serpentinized and generally host slickenside surfaces; very weak preferred orientation of the pyroxenes at 60deg TCA, similar to unit from 95.28-103.15m; there is a variation in the ilmenite content from <1% up to 20%; rare band of magnetite one at 118.17-118.19m; locally weak plagioclase segregations, these appear to occur at transitions in sulphide contact or randomly; small strange band of fn gr gabbro at 111.37-111.38m, increased sulphides above and below this thin band; vein at 109.19-109.25m; lower contact is sharp at grain size change.
H-04	AN-LGAB	121.68	122.48	cr	2b	Anorthosite-Gabbro (Leucogabbro), coarse grained, sharp upper and lower contacts at significant grain size changes, plagioclase is ~70-75% of the unit, plagioclase is light grey to light-grey-violet in colour; pyroxenes are dark green and are anhedral to subhedral; ~1-2% ilmenite, <1% sulphides; very weak preferred orientation of the feldspars at ~50deg TCA; cut by a number of fractures that are serpentinized, most at 40-70deg TCA; plagioclase segregation?
H-04	GAB	122.48	123.43	med	5a	Gabbro, similar to unit from 103.68-121.68m, med gr, plagioclase is white to light grey in colour ~35%, pyroxenes ~50%,~10-15% ilmenite (weakly magnetic); there is a weak preferred orientation of the pyroxenes at 50-60deg TCA; pyroxenes are dark green in colour; ~1% sulphides (Po, Cpy); lower contact is sharp gr size change over 1-2cm.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-04	AN-LGAB	123.43	124.13	cr	2b	Anorthosite-Gabbro (leucogabbro), coarse gr, similar to unit from 121.68-122.48m, contacts are sharp grain size changes; ~70-75% plagioclase; pyroxenes are dark green in colour; ~1-2% sulphides; wk biotite alteration; light grey in colour; <1% ilmenite.
H-04	GAB	124.13	131.26	med	5a	Gabbro, similar to unit 103.68-121.68m, some slight variations in the plagioclase content through-out the unit and the ilmenite concentration changes from 7-20% , numerous plagioclase segregation veins are present that typically cut the core at 15-50deg TCA, they are white in colour and generally host biotite alteration; they are not distinct veins since their contacts are skewed; due to the variation in plagioclase content the content of pyroxenes also changes from 30-45%; pyroxenes are dark green to light green to greenish grey in colour, they are typically anhedral to subhedral and in proximity to the plagioclase segregation veins they are weakly biotite altered (~1-2% of interval); ~1-2% sulphides with the exception of a small band from 127.52-127.61m that contains semi-massive pyrrhotite (~25-30%); unit is cut by a number of fractures and faults that are serpentinized; EOH at 131.26m
H-05	OVB	0	1.21	med	OVB	Overburden, uncertain if this is in bedrock, since the core is broken up. Composed of med grained gabbro, weathered and oxidized.
H-05	GRAN	1.21	8.23	cr	GRAN	Granite, coarse grained; graphic texture, garnet bearing, muscovite and biotite, cut by numerous brittle fractures, oxidized and Fe-staining present, is white to orangey in colour; upper contact ~1.21m between gabbro and granite, lower contact is broken up at ~8.23m (likely was sharp); Possibly lost core between 6.55 and 8.07m (~only1.16m recovered, lost ~36cm, uncertain where core was lost); granite is similar to that seen in all previous holes (H-01 to H-04)
H-05	GAB	8.23	13.4	fn	5b	Gabbro, poor recovery only 1.8m recovered (3.37m of LC within this interval), small pieces and rubble recovered, all pieces are of gabbro, that is fine-med grained, weathered and oxidized, slight variation in plagioclase content from 50-80%, ilmenite (black vitreous luster, small disseminated, anhedral, choncoidal fracture, mineral, not magnetic) ~10-15% locally; pyroxenes are oxidized and are anhedral to subhedral; granular feel to the core, light grey in colour; no sulphides visible (likely all oxidized). Lower contact is at well consolidated core. (poor recovery, some lost core (3.37m))

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-05	GAB	13.4	22.93	med	5a	Gabbro, med gr, similar to unit from H-04 from 103.68-121.68m; locally fine grained bands present (from 15.24-15.26m, 17.74-17.88m) there is sulphides and oxides associated with these bands; weakly magnetic; Plag ~50-60%, Pyroxenes ~light to dark green and anhedral; ilmenite is abundant ~10-20% + sulphides (pyrite, silvery mineral, Pyrrhotite and rare Cpy) ~2%; mystery mineral is silvery metallic, present as disseminated crystals aggregates and dendrites to locally present as seams and semi-massive fn gr pods; there is a weak mineral lineation of the ilmenite at 70deg TCA; unit is cut by a number of fractures and small faults (these are sources of oxidation and potential water ingress); from 18.74m to 22.93m there are a number of plagioclase segregation veins and there is a slight increase in grain size, small coarse gr plagioclase rich band from 21.89-21.97m; from 19-19.25m is a coarse and fn gr band that has a granular appearance and appears to be weakly foliated; lower contact is sharp at change in grain size.
H-05	GAB	22.93	23.38	fn	5b	Gabbro, fine grained; sharp upper and lower contacts; foliated, cut by plagioclase segregation veins which have an alteration halo surrounding them + biotite alteration; mineralized and magnetic (~ magnetite, ilmenite, pyrite, pyrrhotite, chalcopyrite are present as disseminated crystals and as bands and fn gr seams) ~15% sulph+oxides; unit is foliated and locally the pyrite and present as seams that parallel the foliation; unit is dark grey to dark grey-brownish in colour; plagioclase segregation veins are composed of plagioclase +biotite+ minor sulphides.
H-05	GAB	23.38	26.45	med	5a	Gabbro, med gr, similar to unit from H-04 from 103.68-121.68m; and H-05 from 13.4-22.93m, slightly coarser grained and slight decrease in ilmenite (~7-10%) content; sulphides ~1-2%; plagioclase is almost bluish locally (labradorite); coarser grained and increased plagioclase from 23.78-23.92 and fine grained band from 25.1-25.2m; in proximity to the lower contact there is strong biotite alteration from 26.22-26.45; sharp lower contact.
H-05	GRAN	26.45	27.19	cr	GRAN	Granite, coarse grained; sharp upper contact; biotite alteration present as well as seams that are biotite rich; similar to unit below from 27.63-27.88m; lower contact at lost core.
H-05	LC	27.19	27.63		LC	Lost core, strong biotite alteration, likely small fragment of gabbro
H-05	GRAN	27.63	27.88	cr	GRAN	Granite, coarse gr, locally graphic texture; white to orangey in colour due to oxidation staining; lower contact broken up but was likely sharp.
H-05	GAB	27.88	29.26	med	5a	Gabbro, med gr; locally biotite alteration (from 28.6-29.26m); mineralized and minor carbonate alteration (halos around the ilmenite crystals); ~2-4% sulphides (pyrite, Po); slight variation in gr size from med-coarse at top to med grained down hole; slight foliation at 70deg TCA; unit is dark green-grey to brown in colour; sharp lower contact.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-05	GRAN	29.26	31.43	cr	GRAN	Granite; coarse gr; graphic texture; locally appears to be additional contacts with strong biotite altered gabbro (these are near parallel TCA; suggesting that we may be near the pluton/gabbro contact) (ex from 30.06-30.22m contact at 10deg TCA); white in colour; similar to previous granitic units; sharp lower contact.
H-05	GAB	31.43	36.08	med	5a	Gabbro, med grained; upper contact is sharp and is biotite altered, strong biotite alteration to 31.74m; plagioclase is light to med grey ~50%; pyroxenes are dark green in colour and anhedral to subhedral (weak biotite altn) ~40%, ilmenite and sulphides ~7-10% (disseminated); weak preferred orientation of the pyroxenes at 75deg TCA; similar to unit from 13.4-22.93m; dark grey in colour; when dry has a speckled appearance; cumulate; weakly magnetic; lower contact is abrupt at gr size and mineralogy change; locally small plagioclase segregation veins up to 3cm in width (one at 32.62 and 32.75m and 33.3m); silvery sulphide? is locally present <1% (disseminated) (graphite?).
H-05	GAB-M	36.08	36.43	fn-med	Sulph	Gabbro, fn-med gr, mineralized, contains ~60% sulphides and oxides (Pyrrhotite, chalcopyrite, magnetite, silvery sulphide and tr pyrite +/- ilmenite); the sulphides are present as intercumulus material surrounding the plagioclase which are subhedral to euhedral and med gr and the pyroxenes that are anhedral to subhedral, sulphides fn gr and anhedral to subhedral, ilmenite is disseminated and fn gr, upper contact is gradational at gr size change and increase in sulphides and lower contact is abrupt, return to unit similar to that from 31.43-36.08m
H-05	GAB	36.43	37.39	med	5a	Gabbro, med gr, dark grey in colour, speckled appearance (dry), disseminated ilmenite ~10-15%, sulphides are disseminated and present as fn gr pods and intercumulus material (pyrrhotite, silvery metallic mineral, tr Cpy); plagioclase is bluish-grey in colour, med gr, ~50%, pyroxenes are dark green to buff in colour and are locally altered, anhedral to subhedral ~30%, cumulate, sulphides typically appear to be late or are crystallized from intercumulus material; lower contact at plagioclase segregation, contact is gradational from 37.35-37.39m.
H-05	AN-LGAB	37.39	37.82	med	2b?	Plagioclase segregation, Anorthosite-Gabbro (leucogabbro), ~85-90% plagioclase, ~10% pyroxenes that are dark green to brownish in colour and are zoned, <1% disseminated sulphides; plagioclase is white to greyish-violet in colour; gradational upper contact and abrupt lower contact.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-05	GAB	37.82	65.42	med	5a	Gabbro, med gr, similar to unit from 31.43-36.08m, disseminated ilmenite ~7-10%, unit is very weakly magnetic; sulphides are disseminated and locally present as fn gr pods or as semi-massive bands (main sulphides are pyrrhotite, silvery mineral (locally this may be magnetite (not always magnetic)), pyrite and Cpy) + ilmenite and magnetite; a number of plagioclase segregation veins and small bands are present locally and typically are sources of biotite alteration; plagioclase is white to grey to bluish in colour (labradorite) ~55-60% (the labradorite is irregularly distributed, higher content in upper portion of interval); pyroxenes are dark green to buff-green in colour and are anhedral to subhedral (~30%); small band of fn gr gabbro at 42.53-42.6m and 52.63-52.7m and 54.5-54.72m with increased sulphides; locally where there is an increase in plagioclase content there is sulphides associated with these zones or in close proximity (example from 41.75-41.88m); rare magnetite seams (49.66m); plagioclase segregation vns are present locally and typically host biotite alteration and are coarse grained; may also host coarse pyroxenes +/- amphiboles; slight increase in gr size down hole from ~60-65.42m; lower contact at fn gr and mineralized section.
H-05	GAB	65.42	66.2	fn-med	5a	Gabbro, mineralized; fn-med gr; similar to unit from 36.08-36.43m; sulphides and oxides are abundant and comprise >40% of the interval; these are present as fn gr bands and seams, disseminated and intercumulus minerals; upper and lower contacts are gradational and at significant transitions in gr size and mineral content; unit is dark green-grey to copper-metallic silvery-black in colour; gr size of the plagioclase and pyroxenes within the interval is variable, but there are patches that appear to be similar to the unit above.
H-05	GAB	66.2	66.85	med	5a	Gabbro, med gr, similar to unit from 37.82-65.42m, fine grained section from 66.48-66.62m; in med gr section ilmenite ~10%, ~1-2% sulphides; plagioclase is light grey in colour ~50% of the interval, pyroxenes are dark green to light buff-green in colour and are locally weakly biotite altered, anhedral to subhedral; weak preferred orientation of the pyroxenes at 70deg TCA; lower contact is sharp at gr size change.
H-05	GAB	66.85	68.04	fine	5b	Gabbro, fn-med gr, equigranular; <1% ilmenite; ~50% plagioclase and ~40-45% pyroxenes; dark grey in colour; upper and lower contacts are sharp at significant gr size and mineralogy changes; weak preferred orientation of the pyroxenes at75deg TCA.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-05	GAB	68.04	88.33	med	5a	Gabbro, med gr, similar to unit from 31.43-36.08m, disseminated ilmenite ~10%, unit is very weakly magnetic to approx. 74m then not magnetic; locally fn gr bands of magnetite and seams of magnetite; sulphides are typically disseminated or form small irregular pods (intercumulus); plag is light to dark grey in colour ~50-65% of the unit; pyroxenes are dark green- to buff in colour and are anhedral to subhedral and are typically altered or rimed (locally zoned); weak biotite alteration locally; between 81.26-83.25m the unit is altered and here is a small shear zone at 81.32-81.39m; at 81.55-81.58m is a small sheared band that is biotite altered similar to that seen in previous holes; granitic vein that are garnet bearing from 82.98-83.04m; increasing fractures down hole from 83m; lower contact is sharp at granitic vein/dyke.
H-05	GRAN	88.33	88.73	cr	GRAN	Graphic textured granite, med-coarse gr; sharp upper and lower contacts at 65deg TCA; white in colour; biotite present (black lines up to 2-3cm in length that cut the core at various angles); similar to granite seen in previous holes.
H-05	GAB	88.73	88.89	med	5a	Gabbro, med gr, trapped between granite and plagioclase segregation; unit is dark green in colour; pyroxenes are dark green, anhedral, ~40-45%; plagioclase is light grey ~50%; ilmenite is disseminated ~7%; locally a fn white rim of carbonate? surrounding the ilmenite; sharp upper and abrupt lower contact.
H-05	AN-LGAB	88.89	89.2	cr	2b	Anorthosite-Gabbro (leucogabbro); plagioclase segregation, coarse gr, plagioclase ~75% and are coarse gr, light grey to grey with violet hue in colour; pyroxenes are dark green in colour, anhedral to subhedral, <1% sulphides and oxides (ilmenite, pyrrhotite); and weak biotite and serpentine altn; upper and lower contacts are abrupt to weakly gradational over 1-2cm.
H-05	GAB	89.2	92	med	5a	Gabbro, med gr, similar to gabbro from 68.04-88.33m, weakly magnetic; disseminated ilmenite ~10%; pyroxenes are dark green to brownish in colour and are anhedral to subhedral ~35%; plagioclase is light grey to grey-violet to bluish in colour; <1% plagioclase segregation veins; ~1-2% sulphides (pyrrhotite, pyrite, chalcopyrite); from 91.58-91.78m is a band of fn gr gabbro with veins at the centre of this short interval, dark grey, increased sulphides (~7-10%), associated with the veins appear to be small shears/faults, contacts to this fn gr section are abrupt; lower contact is sharp at granite.
H-05	GRAN	92	97.3	cr	GRAN	Graphic textured granite; coarse gr; similar to granite seen in previous drill holes; garnet bearing; garnet s are typically fn to med gr and are present in clusters of euhedral to subhedral crystals and along fracture planes; biotite and muscovite also present; white in colour; numerous fractures cut the granite (brittle structures); sharp upper and lower contacts.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-05	GAB	97.3	101.04	med	5a	Gabbro, similar to unit from 68.04-88.33m; med gr; dark grey in colour; disseminated ilmenite ~10%; pyroxenes (cpx and opx) are light to dark green in colour anhedral to subhedral ~35-40%; plagioclase is light grey to med grey ~50%; sulphides ~1-2%, locally small bands of increased sulphides; fn gr band from 98.42-98.51m where there is an increase in sulphides and oxides (pyrrhotite + magnetite + Cpy) ~40%; very weak biotite and serpentine altn locally; fractures are serpentinized; appears to be tr rutile; EOH at 101.04m
H-06	LC	0	1.3		LC	no recovery
H-06	OVB	1.3	1.64		OVB	strongly weathered overburden and fragment of bedrock; upper contact of gabbro ~1.64m; core is oxidized, altered, and granular/crumbly, it is breaking down.
H-06	GAB	1.64	4.89	med	5a	Gabbro, medium gr, ilmenite rich ~10%; granular feel, oxidized, altered; cut by numerous fractures and small faults; plagioclase ~50%, pyroxenes are altered and anhedral; unit is white-green with Fe-staining (orangey-brown) in colour; no sulphides visible (likely oxidized); not magnetic; sharp lower contact (similar to ilmenite rich unit seen in H-05).
H-06	GRAN	4.89	7.67	cr	GRAN	Granite, coarse gr, graphic texture, similar to that seen in all previous holes; garnet bearing; biotite bearing; granite is also cut by numerous fractures and is brittle and crumbly locally; sharp upper and lower contacts.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-06	GAB	7.67	40.48	med	5a	Gabbro, fine-med gr; crystals are avg 1-2mm in size; equigranular; this unit is similar to that seen in H-04 and H-05 (increasing labradorite with depth); plagi is light grey to grey (to bluish) in colour ~55%; pyrox are buff to greenish-buff to dark brown (iridescent) in colour and are anhedral (altered) (to rare subhedral) (Cpx and Opx); ilm is disseminated ~10%, ~1-2% disseminated sulphides (Po, Cpy, Py); there are abundant oxidized fractures from 7.67-9.17m; at 10.21-10.5m there is a band of fn gr sulph and oxides including graphite ~50-70% sulphides and oxides, also altered, maroon coloured mineral ~5-7% if the interval appears to be garnet or possibly spinel?; from 10.5-10.58m is band of alteration likely as a result of hydrothermal fluids; at 12.41-12.46 is a small band of fn gr gabbro and increased pyrrhotite mineralization and decrease in ilmenite; at 13.23-13.24m there is a thin band of ~90% graphite; at 13.62- 13.88m small bands of fn gr gabbro with increased Po and decrease in ilmenite; at 18.95-19.05m is band of strong sulphides (~75%) Po + graphite?; from 21.64-24.26m the core is cut by a series of fractures and faults at 10-20deg TCA, altn associated with these; locally bronzy-maroon coloured biotite present associated with plagioclase segregation veins; at 24.26-24.33m there is a band of sulphides ~75% Pyrrhotite +~2-3% ilmenite+ ~1% pyrite; additional plagioclase segregation veins down hole from 21- 32m which host bronze-maroon coloured bio that is locally being altered to muscovite (buff coloured mica), the grain size increases slightly in proximity to these segregation veins; abundant fractures and faults from ~21m to 38.23m that are typically at 10-30deg TCA and are host to serpentine +/- pyrite+/- carbonate; lower contact is gradational into coarser and more plag rich gabbro.
H-06	GAB	40.48	45.36	med-cr	10a	Gabbro, med-coarse gr, grain size increases with depth from med to coarse at ~44m, bronzite rich to ~44m then appears to be altered; plagioclase ~55-65%, which increases locally from 44-45.36m up to 70%, pyroxenes and amphiboles are dark brown to iridescent in colour to 44m then are brownish-green to buff-green in colour and are rimmed by amphiboles? (darker in colour), anhedral to locally subhedral, intercumulus crystals; tr ilmenite; <1% sulphides; biotite alteration increasing towards the lower contact; small band of sulphides at 43.05-43.1m~75% sulphides; lower contact is abrupt at grain size and mineralogy change.
H-06	GAB-M	45.36	45.8	fn	Sulph	Gabbro, fn gr, Mineralized, bands of semi-massive sulphides (primary sulphide is pyrrhotite) ~50-60% sulphides in unit; biotite alteration is moderate to locally strong, biotite is brown to maroon in colour and is fn to med gr; upper contact is abrupt and lower contact is sharp; banding is irregular suggesting deformation or fluid movement prior to consolidation; plagioclase is fn gr and grey in colour.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-06	AN-LGAB	45.8	45.96	cr	10a	Anorthosite-Gabbro, plagioclase segregation? with sharp upper and lower contacts; has a weak brecciated appearance (breccia), biotite alteration of the pyroxenes, ~85% plagioclase; ~2-3% pyrrhotite (fracture fill); white-grey in colour.
H-06	GAB	45.96	46.77	med-cr	10a	Gabbro, med-coarse gr (plag is coarse, pyroxenes are med-coarse, avg gr size ~4-6mm); plagioclase is white to light grey in colour ~50%; pyroxenes are dark green to brownish in colour and are biotite altered, anhedral to subhedral; ~1% sulphides; lower contact is abrupt.
H-06	AN-M	46.77	48.9	fn	Sulph	Sulphide rich, what appears to be anorthosite, Semi-massive to massive bands of sulphide mineralization hosted in fn gr plagioclase rich zone with moderate biotite alteration; main sulphide is pyrrhotite which is magnetic, minor pyrite present along fractures and tr Cpy, ~60-70% sulphides; upper contact is abrupt and lower contact is sharp, banding is typically at 50-70deg TCA.
H-06	GAB	48.9	50.73	med	10a	Gabbro, med gr, ~55% plag that is light to med grey, pyroxenes are grey-green to buff-green to dark green in colour and are anhedral to subhedral; very weak biotite alteration, ~1% disseminated sulphides and oxides (pyrrhotite + ilmenite); lower contact is gradational into strong alteration.
H-06	GAB-ALT	50.73	52.26	fn	10a	Altered Gabbro??, unit is fn to locally med gr, is green-grey to purple to purple-pink in colour; product of altn??, ~2-3% sulphides (disseminated and locally present as small irregular and fn gr pods and as fracture fill; DYKE? from 52.02-52.12 there appears to be a small dyke??, contacts are irregular but sharp, possibly intruded while still crystallizing, it is fn gr, dark grey to black in colour and is host to a metallic mineral that is not magnetic and is present as seams, dull metallic grey; lower contact is sharp at distinct change.
H-06	GAB	52.26	56.95	med	10a	Gabbro, (opx rich) med gr, grey in colour; plagioclase ~50-55%, pyroxenes (Cpx and Opx) are dark green to green-buff to brownish green in colour; slight preferred orientation of the pyroxenes at ~80deg TCA; ~1% disseminated sulphides and minor ilmenite, small bands of fn gr gabbro locally that are up to 3cm in with and typically host increased sulphides; serpentine associated with fractures +/- pyrite; very weak serpentine altn locally; lower contact is gradational.
H-06	GAB	56.95	57.4	cr	?2b?	An-Gab (coarse) Gabbro, coarse gr, plagioclase rich ~70%, which is white to light grey in colour; pyroxenes are med-coarse gr, and are dark green to green-grey in colour , anhedral to subhedral (altd appearance); fractures are serpentinized; upper and lower contacts are weakly gradational over 2cm.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-06	GAB	57.4	83.35	med	5c	Gabbro, med gr, Opx rich (bronzite), plag is grey to slightly bluish in colour ~55-60%; pyroxenes are brown to greenish-brown to dark brownish-iridescent in colour, subhedral (rare euhedral), pyroxene content increases slightly down hole, ~up to 2% sulphides that are disseminated and locally present in small bands or fn gr bands; rare speck of ilmenite; fractures and faults are serpentinized; equigranular ; band of fn gr gabbro from 66.79-66.87m; locally small plagioclase segregation veins that typically have biotite altn associated with them; coarse gr band of gabbro at 69.47-69.52m; granitic vein at 71.71-71.73m (garnet bearing); lower contact is sharp at granite.
H-06	GRAN	83.35	88.58	cr	GRAN	Granite, coarse gr to pegmatitic, graphic texture, similar to that seen in all previous holes; white in colour; garnet bearing; biotite present as long thin books that look like black lines cutting the granite (large up to 3cm in length); muscovite also present; sharp upper and lower contacts.
H-06	GAB	88.58	95.12	med	5c	Gabbro, similar to that from 57.4-83.35m, OPX rich (bronzite), when dry has a black speckled appearance, grey in colour; ~1% sulphides; ~50-60% plagioclase, pyroxenes are brown in colour ~35% and are subhedral to locally euhedral; lower contact is gradational, change in mineralogy.
H-06	GAB	95.12	98.38	med	10b	Gabbro, med gr, plagioclase is white to very light grey almost milky in colour, pyroxenes are green to green-grey in colour, bronzite is still present but only ~1-2%; pyrrhotite ~1%, this interval may be due to altn, the pyroxenes appear to be zoned, small band of gabbro with increased OPX from 95.86-96.02m; upper and lower contacts are gradational (similar in texture to unit above from 88.58-95.12m), this core has a almost siliceous appearance.
H-06	GAB	98.38	122.24	med	10b	Gabbro, (opx rich) med grained, similar to unit from 88.58-95.12m, plag is light grey to grey in colour ~55%; pyroxenes are brownish-bronze to green-brown to locally dark green in colour, subhedral, ~35%, intercumulus minerals; ~1-2% sulphides (increased sulphides from 112.5 to 121m); small bands of fn gr gabbro host increased sulphides such as from 99.13-99.18m; very weak biotite altn locally; upper contact is gradational, slight increase in plagioclase from 110.54 down hole from ~55 to 60-65% and slight increase in grain size; from 112.5m there are increases in pyroxene content and sulphide content to ~3-5% sulphides and slight decrease in gr size; from 121-121.55m is a series of plagioclase rich bands that are up to 95% plagioclase over 3-4cm; lower contact is abrupt at gr size change.
H-06	GAB	122.24	122.59	fn-med	10b	Gabbro, fn to med gr (avg gr size 1-2mm); upper and lower contacts are abrupt changes in grain size, pyroxenes are dark green in colour (~35-40%),~1% bronzite; plagioclase ~50% is light to med grey, small plagioclase segregation veins present up to 1cm in width ~7% of interval; no sulphides seen.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
H-06	GAB	122.59	126.28	med	10b	Gabbro, med gr, plagioclase is white to light grey in colour ~50%, pyroxenes are dark green in colour, anhedral to subhedral and locally are weakly altered by biotite; rare bronzite; ~2-3% sulphides; from 123.74-123.88m is fn gr and plagioclase and biotite rich (plag segregation vein?) interval is host to plagioclase rich band from 125.49-125.72m and increase in gr size; fn gr band from 126.07-126.11m that is host to increased sulphides; lower contact is gradational into bronzite rich gabbro.
H-06	GAB	126.28	180.66	med	10a	Gabbro, med gr, Opx rich (bronzite); similar to unit from 88.58-95.12m; plagioclase is light grey to grey to light-yellowish-grey to bluish-grey in colour ~55-60% (locally appears to be labradorite), pyroxenes are brown to green-grey in colour and are anhedral to subhedral (rare euhedral), intercumulus crystals ~35% (bronzite 5-25%); locally slight gr size increase over 3-6cm; fractures are serpentinized; ~1-2% sulphides, small bands with increased sulphides locally (up to 30%); slight preferred orientation of the pyroxenes at 70deg TCA; weak altn associated with the fractures and faults; at 156.09-156.29m is coarse gabbro with up to 70% plagioclase and 20% bronzite + biotite altn (gradational upper and lower contacts); at 157.32-157.67m is pyroxene rich ~45-50% (gradational upper and lower contacts); fine grained gabbro at 159.85-159.88m and at 161.24-161.33m; small coarse gr plagioclase segregation from 164.32-164.38m; from 170.62-170.9 is coarse grained gabbro; patchy very weak to weak biotite and serpentine alteration, generally more intense in proximity to fractures/faults and plagioclase segregations; upper contact is gradational, lower contact appears to be an alteration contact (sharp at a vein).
H-06	GAB	180.66	182.53	med	10b	Gabbro, med gr, ~50-55% plag that is light grey to milky white in colour, pyroxenes are dark green to green-grey in colour, anhedral to subhedral, ~40%, intercumulus crystals, weak biotite altn, minor bronzite <3%, there appears to be a slight preferred orientation of the pyroxene crystals at ~70deg TCA; similar textures to unit above; sulphides are intercumulus minerals ~1-2%; veins (granitic composition) present at 180.66-180.68m and 181.75-181.82m; contacts are gradational
H-06	GAB	182.53	183.18	med	10b	Gabbro, med gr, similar to unit from 126.28-180.66m, OPX rich; small band, with gradational contacts (upper and lower); plagioclase is bluish in colour (labradorite) ~55-60%; pyroxenes are dark brown to buff-brown to brown-grey in colour ~40%, anhedral to subhedral; ~1-3% sulphides.
H-06	GAB	183.18	191.62	med	10b	Gabbro, med gr, gradational upper contact; plagioclase is white to light grey to grey in colour ~50-55%; pyroxenes are dark green to buff-green in colour; anhedral to subhedral~40%; there is a weak preferred orientation of the crystals at 75-80deg TCA; ~2% sulphides; weak patchy biotite altn; EOH at 191.62m
Hp-07	OVB	0	1.95		OVB	No recovery

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-07	GAB	1.95	3.4	med	1a?	Gabbro, med grained; strongly oxidized, broken up and is crumbly, granular feel; brownish-orange in colour; any sulphides that may have been present appear to have been oxidized; cut by numerous fractures and faults; plagioclase forms laths that are subhedral to euhedral ~50-60% of the unit; pyroxenes (Cpx and Opx (bronzite)) are both present and are dark green to brown in colour ~35-40%, lower contact is an approximation due to the broken up core, appears to have been a sharp contact at approx. 30deg TCA.
Hp-07	GAB	3.4	3.44	fn	1a?	Gabbro/ lamprophyre, fine grained, dyke???; equigranular; cut by numerous fractures that are oxidized with hematite staining; core is all broken up, upper contact appears to be sharp, lower contact??; ~0.5-1% sulphides (pyrrhotite) suggesting that this is a later feature; late stage dyke??
Hp-07	LC	3.44	3.96		LC	Lost core, uncertain if this is the location since the core is all broken up, likely most between 3.44 and 4m there is approx. 52cm of lost core.
Hp-07	GAB	3.96	4.57	fn	1a?	Gabbro/ lamprophyre, fine grained, dyke???; equigranular; cut by numerous fractures that are oxidized with hematite staining; core is all broken up, upper contact appears to be sharp, lower contact??; ~0.5-1% sulphides (pyrrhotite) suggesting that this is a later feature; late stage dyke??
Hp-07	GAB	4.57	5.75	med	1a/1ab	Gabbro, med grained; strongly oxidized+ iron oxide staining, upper part of interval to ~5m is granular in feel and is crumbly; altered from ~5-5.75m (plag forms laths that are euhedral to subhedral and appear to have a slight preferred orientation at 70deg TCA), cut by numerous fractures and faults; lower contact is irregular and sharp at qtz vein.
Hp-07	VN	5.75	6.05		GRAN	Quartz + plag veins, ~75% veining; veins are white in colour; primarily qtz and minor plag; contacts appear to be irregular but sharp, core is broken up
Hp-07	GAB	6.05	8.36	med	1a/1ab	Gabbro, med grained (from 6.05-6.5m is med-coarse gr); altered; locally small bands of fine grained altered gabbro (bands of altn similar to altn in H-06 below the sulphide zone); unit is oxidized + iron oxide staining; cut by numerous fractures; there is a small qtz vn at 6.65m that is similar to those from 5.75-6.05m; unit is green-grey-brownish-orange in colour; lower contact??
Hp-07	LC	8.36	8.91		LC	Lost core, ground up?? Between 8.01-9.54m is 55cm of lost core
Hp-07	GAB	8.91	16.22	cr	1a/1ab	Gabbro, coarse to med grained; large euhedral to subhedral plagioclase laths; oxidized; cut by numerous fractures and faults these are likely sources of water ingress; any sulphides that may have been present are oxidized, has a granular feel; appears to be both cpx and opx (bronzite)present; rare sections of competent core show coarse grained cumulate textures of plagioclase and bronzite; from 13.33-13.37m is a thin band of what appears to be oxidized sulphides; lower contact at lost core
Hp-07	LC	16.22	16.91		LC	Lost core, ground up?, likely as a result of faulting between 15.63-17.16m.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-07	GAB	16.91	17.16	med	1a/1ab	Gabbro, strongly oxidized, brittle, crumbly, faulted, gouge present; med-coarse grained; crystals are subhedral to euhedral; brown in colour; contacts appear to be faults/lost core; similar to unit from 8.91-16.22m
Hp-07	LC	17.16	17.3		LC	Lost core
Hp-07	GAB	17.3	18.68	fn	1a/1ab	Gabbro?? Strongly altered and oxidized, broken up, fractured and faulted; appears to be a coarse grained segregation from 18.6-18.68m of coarse grained gabbro. Unit is orangey-brown in colour, abundant slickenside surfaces, fracture and fault zone.
Hp-07	LC	18.68	18.8		LC	Lost Core, ground up? Fault?
Hp-07	GAB	18.8	19.63	fn	1a/1ab	Gabbro, fine grained, oxidized, cut by numerous fractures and faults; similar to unit from 17.3-18.68m, orangey-brown in colour.
Hp-07	LC	19.63	19.85		LC	Lost Core, ground up? Fault?
Hp-07	GAB	19.85	20.2	fn	1a/1ab	Gabbro, fine grained, oxidized, cut by numerous fractures and faults; similar to unit from 17.3-18.68m, orangey-brown in colour.
Hp-07	LC	20.2	20.5		LC	Lost Core, ground up? Fault?
Hp-07	GAB	20.5	21.53	fn	1a/1ab	Gabbro, fine-med grained; grey to brownish-orange in colour; fractured and faulted, oxidized; gouge present between 20.5-21.15m; equigranular; sharp lower contact at fault.
Hp-07	GAB	21.53	24.26	med	1a	Gabbro; med grained; sharp upper and lower contacts; unit has a granular feel attributed to the oxidation and altn of the unit; plagioclase is grey in colour and is subhedral to euhedral, pyroxenes (Cpx (subhedral) and Opx (subhedral to euhedral)(bronzite)) are both present and are dark green to black to dark brown in colour; cut by numerous fractures and faults which are oxidized; Most of the sulphides have been oxidized or weathered, <1% sulphides remain (primarily pyrrhotite); grey to orangey-brown in colour
Hp-07	GAB	24.26	25.24	fn	1a	Gabbro, fine grained (written on the core is Hp7 G3); sharp upper contact and short gradational lower contact, cut by a series of fractures so the core is broken up; equigranular, <1% disseminated sulphides; pyroxenes are light green-grey in colour; unit is grey in colour.
Hp-07	GAB	25.24	28.13	med-cr	1a	Gabbro, medium to coarse grained (written on the core at 26.7 is HP7 G4); from 25.24-26m the core is broken up (fractures); unit is altered to ~27.8m; plagioclase forms long laths that are subhedral to euhedral in shape and are light grey in colour ~50-55% (this decreases to ~40% from 27.5-28.13m), pyroxenes (Cpx and Opx (bronzite)) are both present, the bronzite is typically subhedral to euhedral and is iridescent brown in colour, locally pyroxenes are altered; there is a slight preferred orientation of the crystals at 70deg TCA; sulphides are present as seams and intercumulus minerals, disseminated and thin semi-massive to massive bands; disseminated ilmenite locally present; lower contact is sharp at gr size change.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-07	GAB	28.13	28.64	fn-med	1a	Gabbro, fine to med grained (avg gr size is 1-2mm), similar to unit from above, but smaller grain size, sharp upper and lower contacts; Cpx and Opx present ~40%, plagioclase is light grey ~50%, sulphides are disseminated and present as seams; light grey in colour, wk altn of pyroxenes.
Hp-07	GAB	28.64	39.65	med-cr	1a	Gabbro, med-coarse grained (opx rich), avg crystal size is 4-6mm (at 28.87m written on the core is G6 and at 30.75 is PH-7-G7 and 32.9m is PH-7-8), plagioclase forms laths that are subhedral to euhedral ~ 50%; pyroxenes ~45%, opx is iridescent brownish-pink in colour and are typically subhedral to euhedral and is abundant, intercumulus crystals (poikilitic); there is a preferred orientation to the crystals at ~70deg TCA; sulphides are present as thin bands and pods (intercumulus), locally small semi-massive to massive bands (over 2-4cm), patchy sulphides; crystals are more euhedral after 29.35m to ~32m; transition from 5cm to 3cm diam core at 29.35m; core is brownish-grey in colour; from 32.3m down to 39.65m there are a number of small transitions and zones of alteration (possibly thin layers?); there are also a number of fractures and faults that are serpentinized; at 33.75-33.94m is altered plagioclase segregation; at 34.57-34.75m is fn gr gabbro; at 35.5-35.62 is fn gr gabbro; from ~36.2-39.65m the pyroxenes are dark brown to black in colour which is likely the result of serpentine altn (crystals are euhedral to subhedral, no cleavage visible, may also be amphiboles??); lower contact is gradational.
Hp-07	GAB	39.65	44.45	med	1a	Gabbro, similar to unit above but with decreased Opx content, also appears to be altered where the gabbro appears to have been silicified and the pyroxenes have an almost milky translucent appearance (seen in previous holes); patches of Opx rich gabbro still present in this interval, the loss/altn may be attributed to an alteration of the gabbro, numerous fractures cut the unit and may be a source of fluids; plagioclase varies from milky white to dark grey in colour and comprises ~55-65% of the unit, the pyroxenes are green-grey to dark green to brown to black in colour; sulphides are present as thin bands and pods of intercumulus minerals ~1% (small bands of semi-massive to massive sulphides also present), sulphides are patchy (not a uniform distribution); upper and lower contacts are gradational (suggesting that this may be a product of altn)
Hp-07	GAB	44.45	55.63	med	1a	Gabbro, med gr, similar to unit from 28.64-39.65m, Opx rich, crystals are subhedral to euhedral; plagioclase is grey in colour ~60-65%, pyroxenes are brown to green-grey in colour and are subhedral to euhedral ~30%; sulphides are present as pods and bands (semi-massive to massive), their distribution is irregular , ~2-3%; dark grey in colour; at 51-52m crystals are euhedral (and is very similar to unit above from 29.35-~32m); cut by a number of fractures and small faults that are typically serpentinized; lower contact is gradational.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-07	GAB	55.63	58	med	1a	Gabbro, med grained, gradational upper contact and sharp lower contact; plagioclase is grey to violet grey in colour ~55-65%; pyroxenes are green-grey to dark green in colour ~30%; core is almost siliceous in appearance; is this a result of alteration associated with the Granite below?; unit is cut by thin stringer of granitic material; sulphides are present as pods and semi-massive bands (irregular distribution); unit is dark grey in colour; at 56.5m HP7.G9 is written on the core)
Hp-07	GRAN	58	58.87	cr	GRAN	Granite, coarse grained; graphic texture, white to light pink in colour; host to muscovite altn along contacts and coarse books, pyrite mineralization associated with fractures ~1%; sharp upper and lower contacts.
Hp-07	GAB	58.87	64.33	med	1a	Gabbro, med grained, similar to unit from 55.63-58m (altn halo surrounding the granite?); sharp upper contact, gradational lower contact; plagioclase is grey to violet-pink-grey in colour ~55-60%, plagioclase has a siliceous appearance; pyroxenes are green-grey to green to brownish-green in colour and are anhedral to subhedral ~30%, locally pyroxenes are rimmed; alteration of the unit is strongest in proximity to the granite; serpentine associated with the fractures; sulphides ~1-2% are unevenly distributed; unit is grey to green-grey in colour.
Hp-07	GAB	64.33	72.96	med	1a	Gabbro, med grained, gradational upper contact, Opx rich (bronzite), similar to unit from 44.45-55.63m; plagioclase forms euhedral laths that are grey to bluish-grey in colour; wk preferred orientation at ~70deg tca ~60%; pyroxenes are brown to dark brown-green in colour and are subhedral to euhedral ~30%; there is a decrease in pyroxenes from 72-72.96m and the plagioclase is grey to violet in colour; disseminated ilmenite <1%; sulphides are irregularly distributed but are typically present as thin bands or pods of intercumulus material, pyrrhotite is the dominant sulphide; gradational lower contact; (note: from 65.72-67.45m core is mixed up)
Hp-07	GAB	72.96	76.42	med	1a	Gabbro, med grained, similar to unit from 55.63-58m; plagioclase is grey to violet-pink-grey in colour ~55-60%, plagioclase has a siliceous appearance; pyroxenes are green-grey to green to brownish-green in colour and are anhedral to subhedral to locally euhedral ~30%; this unit is similar to that above from 64.33-72.96m except there is a significant decrease in Opx down to <5%; sulphides ~1-2% are unevenly distributed; <1%disseminated ilmenite; upper and lower contacts are gradational
Hp-07	GAB	76.42	82.61	med	1a	Gabbro, med grained, similar to unit from 64.33-72.96m, Opx rich (bronzite); decrease in pyroxene content towards the lower contact, gradational lower contact; plagioclase is grey to bluish-grey to violet-pink-grey in colour ~60-65%; pyroxenes are brown to dark brown-green in colour and are subhedral to euhedral ~20-25%; disseminated ilmenite <1%; sulphides are irregularly distributed but are typically present as thin bands or pods of intercumulus material, pyrrhotite is the dominant sulphide, appears speckled due to the dark coloured pyroxenes.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-07	LGAB	82.61	88.78	med	1ab	Leuco-Gabbro, med-coarse grained; plagioclase is abundant and is white to grey to violet-pink-grey in colour, ~65-75%, plag is coarse grained, laths that are subhedral to euhedral; pyroxenes are dark green to light green-grey in colour and are intercumulus to the plag ~10-20%; sulphides and oxides are also intercumulus crystals, ilmenite + pyrrhotite +/- Cpy, Py; numerous fractures cut the unit typically at shallow angles; also small veins/shears present at 83.4-83.42 and 85.41-85.45m that are composed of plagioclase +/- qtz; lower contact at lost core?? there are some ground bits at 88.78m suggesting that if there was any lost core that it was around this depth.
Hp-07	LC	88.78	89.08		LC	ground up core, no recovery, uncertain if there is this much lost core, run may have been short???
Hp-07	LGAB	89.08	90.31	med	1ab	Leuco-Gabbro, med-coarse grained; similar to unit from 82.61-88.78m; plagioclase is abundant and is white to grey to violet-pink-grey in colour, ~65-75%, plag is coarse grained, laths that are subhedral to euhedral; pyroxenes are dark green to light green-grey in colour and are intercumulus to the plagioclase, ~25%; increasing pyroxenes down hole; sulphides and oxides (ilmenite) are intercumulus to the plagioclase (~1-2%); some of the sulphides are beginning to oxidize and stain the core, fractures at shallow angles TCA; EOH at 90.31m.
Hp-08	LC	0	1.92		LC	No recovery
Hp-08	OVB	1.92	11.36		OVB	Poorly consolidated gabbro, weathered, oxidized, crumbly, a lot of lost core, between 1.92 and 11.36m there is only 85cm of bits of core recovered, likely this is bedrock, but is highly weathered.
Hp-08	GAB	11.36	17.12	med	1ab	Gabbro, oxidized, weathered, fractured and faulted, weathering and oxidation is patchy and appears to be associated with fractures and faults; med grained, (opx rich) similar to unit from 44.45-55.63m and from 64.33-72.96 and from 76.42-82.61m in hole Hp-07, unit varies in colour from orangey pink to dark grey; unit is bronzite rich; Pyroxenes are dark green-black to dark brown-iridescent and are subhedral to euhedral ~35%; plagioclase is white to grey to pinkish to violet in colour and is med-coarse grained, plag is typically subhedral to euhedral forming laths ~50-60%; the crystals in this unit are quite euhedral; cumulates; <1-1% ilmenite; <1% sulphides due largely to the oxidation and weathering; lower contact is at transition from fractured and faulted gabbro to more fresh and consolidated bedrock.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-08	GAB	17.12	30	med	1ab	Gabbro, med grained;OPX-rich; similar to unit from 44.45-55.63m and from 64.33-72.96 and from 76.42-82.61m in hole Hp-07 (unit likely correlates with Hp-07); euhedral crystals that have a weak preferred orientation at 70deg TCA; plagioclase laths are up to 1cm in length and are locally twinned, plag is grey to white to brownish-maroon in colour and comprises 55-65% of the core, plagioclase cumulate crystals form the framework, the pyroxenes, ilmenite and sulphides are the intercumulus minerals; pyroxenes (Cpx and Opx, including bronzite) are green grey to dark green to brown to brown-black, pyroxenes are locally altered ~20-30%, sulphides and ilmenite are intercumulus to the plag ad therefore form small angular blebs locally ~1-2% oxides + sulphides (patchy sulphide distribution); there is a gradual decrease in pyroxenes down hole (from 30% to ~15%); unit is dark grey with brownish hue in colour, core is smooth (almost silicified); lower contact is gradational.
Hp-08	LGAB	30	35.49	med	1ab	Leuco-gabbro? Altered Gabbro, similar to that seen in Hp-07 from 82.61-88.78m and from 89.08-90.31m (these two likely correlate); medium grained; plagioclase rich ~70-75%, which is white to violet to violet-pink in colour; the pyroxenes are dark green to green-grey in colour and are intercumulus to the plag, the pyroxenes are locally zoned (rimmed by amphiboles?); sulphides and oxides are also intercumulus to the plagioclase ~1-2% including ilmenite; altn associated with fractures and bleaching the core (plag become white and the pyroxenes are dark green); from 34-35.49m is altered (bleached) and cut by numerous fractures, faults and shear zones; lower contact is sharp at strong serpentine and pyrite altn; from 35.3-35.44m the core is vuggy, the plagioclase are breaking down into clays suggesting water infiltration.
Hp-08	GAB	35.49	37.49	med	Sulph	Gabbro, strongly altered and cut by faults and fractures, dark green in colour, ~15-20% sulphides (pyrite + pyrrhotite), the pyrite appears to be associated with the altn, gabbro s serpentinized and there are appears to be minor carbonate altn; appears to be of similar composition to the unit from 17.12-30m; upper contact is sharp at strong altn front, lower contact is gradational into less altered gabbro of similar composition.
Hp-08	GAB	37.49	47	med	1a	Gabbro, med grained, OPX-rich; similar to unit from 17.12-30m except cut by a series of fractures and faults that are serpentinized, serpentine altn varies from very weak to moderate locally; Bronzite rich; ~20-30% pyroxenes and are subhedral to locally euhedral, dark green to brown to dark-brown to green-grey in colour; plagioclase is grey to violet to violet-pink in colour and comprises ~55-60% of the core; sulphides and oxides are intercumulus to the plag with the exception of pyrite which is present along fractures and faults and appears to be associated with the serpentine altn; lower contact is gradational (unit below is likely a continuation of this unit, but is altered and cut by numerous fractures/faults.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-08	GAB	47	81.08	med	1a	Gabbro, med grained, similar to unit from above (37.49-47m), but with a slight decrease in pyroxene content (15-25%) and varying degrees of altn, likely a continuation of the unit above with slight variations in mineralogy (pyroxene and plagioclase content); ranges from Opx (bronzite) rich to serpentinized pyroxenes that are dark green in colour; unit is cut by numerous fractures and faults that are sources of altn (fluids/hydrothermal fluids?), most of the fractures are serpentinized +/- minor carbonates +/- pyrite; from 54.3-57.65m is similar to unit from 30-35.49m suggesting that the "leuco-gabbro" may be a product of alteration; plagioclase is white to grey to violet-pink in colour, where the alteration is strongest the plagioclase is white; pyroxenes are intercumulus to the plagioclase, ilmenite ~1%, sulphides <1-1%; the unit changes rom relatively pristine gabbro to altered gabbro according to the intensity o the structures and number of them; from 67-68.6m is serpentinized; from 71.09-79.70m the unit is highly altered and cut by numerous fractures and faults (serpentine +/- carbonate altn), at 79.7-80.4m is plagioclase rich similar to leuco-gabbro described above; then from 80.4-81.08 is Opx-rich gabbro with abundant plagioclase ~65-70%; lower contact is sharp.
Hp-08	DYK	81.08	83.81	fn	12	Dyke, Gabbroic?? Fine grained, porphyritic (amphiboles), magnetic; dark grey in colour with black speckles (amphiboles), cut by a number of fractures that are serpentinized and locally host slickenside surfaces <1% sulphides, magnetite must be very fine grained since it is not visible but the core is magnetic, plagioclase laths are visible locally and do not appear to have any preferred orientation, upper and lower contacts are sharp and slightly irregular, this suggests that this is a later feature.
Hp-08	GAB	83.81	84.95	med-cr	1ab	Gabbro (gabbro to leucogabbro), similar to unit from 47-81.08m and more precisely similar to section from ~79.69-81.08m; This interval is opx-rich from 83.81-84.21m then leucogabbro from 84.21-84.95m; med-coarse grained gabbro to leucogabbro with ~60-70% plagioclase that is grey to violet in colour, pyroxenes are dark brown to dark green and are anhedral to subhedral ~20-25%; ~1% sulphides + oxides; the bleaching of the plagioclase appears to be related to altn; shear/fracture zone from 84.41-84.48m; upper and lower contacts are sharp.
Hp-08	GAB-S	84.95	86.73	fn-med	11a?	Sheared Gabbro, likely similar composition to the unit above (altered gabbro or leucogabbro); some of the plagioclase crystals are still visible and are now rotated grains along the shear, the shear is near parallel (5-10deg) to the core axis; light green to white to violet in colour; almost has a porphyritic appearance due to the present of plagioclase grains in the shear, moderate to strong altn, pyrite is disseminated and appears to be associated with the altn <1%; lower contact is sharp.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-08	GAB	86.73	86.9	med	11a?	Gabbro, foliated (weak to mod); biotite + muscovite altn (wk-mod) alteration is replacing the pyroxenes and is present surrounding the plagioclase grains, upper contact at sharp transition from "mylonite" to foliated/altered gabbro; lower contact is sharp; unit is grey-violet in colour; <1% sulphides (pyrite).
Hp-08	GRAN-S	86.9	87.26	med	GRAN	Sheared and altered gabbro or Sheared and altered granite interfingered with med-grained foliated/altered gabbro?, biotite rich, med grained, white to violet-brown in colour, sharp upper and lower contacts: from Sheared gabbro and med-grained foliated/altered gabbro, series of mixed intervals. From: 86.9-87.26m Shr+ alt LGab, 87.26-88.07m med gr wk foln altd gab, 88.07-88.38m shr + alt LGab, 88.38-88.77m med gr mod foln mod altd gab, 88.77-89.17m shr + alt LGAB, 89.17-89.4m altd med-coarse gr gab; 89.4-90.31m SHR+altn LGAB, 90.31-90.44m med gr strong biotite altd gab; 90.44-92.02m SHR+ altn LGAB, 92.02-92.56m med gr altd gab, 92.56-95.56m shr + altn LGAB; alteration within these units varies from moderate to strong locally, biotite is most abundant; shears and foliation is at 10-40deg TCA, all the units are white to green-grey to grey-violet in colour; from 89.4m down hole in the sheared units the pyroxenes are no longer visible (composition resembles that of a diorite); lower contact is sharp.
Hp-08	GAB	87.26	88.07	med	11a?	Gabbro, med grained, weak foliation, biotite altered.
Hp-08	GRAN-S	88.07	88.38	med	GRAN	Sheared gabbro or Strongly foliated and moderately altered Granite??, biotite rich, med grained, white to violet-brown in colour, sharp upper and lower contacts
Hp-08	GAB	88.38	88.77	med	11a?	Gabbro, med grained, moderate biotite altn and moderate foliation, pyroxenes are dark green in colour, core is grey, sharp upper and lower contacts at significant changes in structure intensity and in mineralogy.
Hp-08	GRAN-S	88.77	89.17	med	GRAN	Sheared gabbro or Strongly foliated and moderately altered Granite??, biotite rich, med grained, white to violet-brown in colour, sharp upper and lower contacts
Hp-08	GAB	89.17	89.4	med-cr	11a?	Gabbro, med-coarse grained, moderate biotite alteration, weak foliation, <1% sulphides/oxides; similar to unit 88.38-88.77m but slightly coarser grained.
Hp-08	GRAN-S	89.4	90.31	med	GRAN	Sheared gabbro or Strongly foliated and moderately altered Granite??, biotite rich, med grained, white to violet-brown in colour, sharp upper and lower contacts
Hp-08	GAB	90.31	90.44	med	11a?	Gabbro, med grained; strong biotite alteration, no visible pyroxenes anymore, composed of plagioclase and biotite; no visible sulphides or oxides; sharp contacts
Hp-08	GRAN-S	90.44	92.02	med	GRAN	Sheared gabbro or Strongly foliated and moderately altered Granite??, biotite rich, med grained, white to violet-brown in colour, sharp upper and lower contacts
Hp-08	GAB	92.02	92.56	med	11a?	Gabbro, altered, med grained, weakly foliated, pyroxenes are dark green to brownish to green-grey in colour; tr sulphides/oxides

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-08	GRAN-S	92.56	95.56	med	GRAN	Sheared gabbro or Strongly foliated and moderately altered Granite??, biotite rich, med grained, white to violet-brown in colour, sharp upper and lower contacts
Hp-08	LGAB	95.56	112.06	med	11a	Gabbro (gabbro-leucogabbro), similar to unit from 83.81-84.95m; med grained; plagioclase is white to grey to violet grey in colour and ranges from 55-65% locally, euhedral laths visible locally; pyroxenes are dark green to green to green-grey to brown in colour and are intercumulus to the plagioclase framework, locally pyroxenes are altered by biotite, OPX locally present; amphiboles also appear to be present; numerous fractures cut the core and locally host carbonates +/- quartz, some of these are vuggy, where these fractures are present the core is lighter in colour (altered); ~1-2% oxides and sulphides; lower contact is gradational
Hp-08	GAB	112.06	119.07	med	11a	Gabbro, med grained; ~55% plag; ~25-30% pyroxenes, Opx rich locally, pyroxenes/amphiboles/oxides/sulphides are intercumulus to the plagioclase framework; no preferred orientation of the crystals, pyroxenes are locally rimmed (green interior and brown rim); ~1-2% sulphides + oxides; similar to unit above 95.56-112.06m, patchy alteration which renders the plagioclase from white to grey to violet-grey in colour and the pyroxenes from dark green to green-grey to brownish in colour; alteration also associated with fractures that host carbonates+/- pyrite; lower contact is sharp.
Hp-08	GRAN	119.07	119.62	med	GRAN	Foliated granite?? Or is this a foliated and altered fragment of gabbro?? foliated plagioclase segregation?? Fine to med grained with coarse grained crystals of plagioclase, weak to mod foliation; sharp upper and abrupt lower contact that hosts strong biotite alteration; white in colour and is speckled with brown-maroon coloured biotite; fn gr muscovite also present; similar to unit from 92.56-95.56m
Hp-08	GAB	119.62	122.8	med-cr	11a	Gabbro med-coarse grained, similar to unit from 112.06-119.07m, increasing pyroxene content and slight increase in crystal size, plagio is grey to violet grey in colour, pyroxenes are green-grey to dark green to brownish-green in colour and are intercumulus to the plagioclase, crystals are anhedral to subhedral, sulphides and oxides ~1-2%, biotite associated with the upper contact; locally OPX rich, lower contact is sharp.
Hp-08	GRAN	122.8	123.03	med	GRAN	Foliated granite?? Or is this a foliated and altered fragment of gabbro?? foliated plagioclase segregation?? Fine to med grained with coarse grained crystals of plagioclase, weak to mod foliation; sharp upper and abrupt lower contact that hosts strong biotite alteration; white in colour and is speckled with brown-maroon coloured biotite; fn gr muscovite also present; similar to unit from 92.56-95.56m, pyrite and serpentine along the fractures.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-08	GAB	123.03	125.39	med-cr	11a	Gabbro med-coarse grained (opx-rich), similar to unit from 112.06-119.07m, plagio is grey to violet grey in colour, pyroxenes are green-grey to dark green to brownish-green in colour and are intercumulus to the plagioclase, crystals are anhedral to subhedral, sulphides and oxides ~1-2%,upper contact is abrupt, biotite associated with the lower contact which is sharp; locally OPX rich; granitic vein from 124,74-124.84m;
Hp-08	GRAN	125.39	126.95	med-cr	GRAN	Granite, med- coarse grained, from 125.6-125.82m is coarse grained, biotite rich; sharp upper contact and abrupt lower contact, granite is locally foliated, biotite and muscovite bearing, fractures are host to pyrite mineralization locally; white in colour with black speckles; biotite is aligned along the foliation planes.
Hp-08	GAB	126.95	146.32	cr	11a	Gabbro, coarse grained, similar to unit from 123.03-125.39m, plagioclase is grey in colour ~ 60-70%, pyroxenes are dark green to dark brown to green-grey in colour ~25-30%, pyroxenes are locally rimmed/altered (multiple phases of augite? green and black coloured), the plagioclase crystals form the cumulate framework , the pyroxenes (+/- amphiboles) and sulphides/oxides are intercumulus; pyroxenes are anhedral to subhedral to locally euhedral; patchy altn of biotite and serpentine (very weak to weak) that is generally associated with the fractures, pyrite mineralization is also associated with the fractures (pyrite mineralization in increased from 145-146.32m, at 146.32m there is a solid piece of massive pyrite recovered from the broken and ground bits (mineralized contact??; ~1-2% sulphides and oxides (tr ilmenite), core at the lower contact is ground, not sure if sharp (appears to be sharp transition in grain size and mineralogy), this unit coarsens down hole and there are small sections that are very coarse grained; From 135.25-135.46m is altered+quartz+ large crystals (amphiboles??) (appears to be recrystallized) this does not appear to be a vein (no sharp contacts); from 135.59-135.8m is very coarse grained crystals up to 4cm; from 136.6-136.75m is coarse; From 137.74-138.15m is plagioclase rich segregation (~85% plag); from 138.24-138.4m is coarse; from 144.7-144.9m is very coarse with crystals up to 3cm in length; from ~144.9 to 146.32m is serpentinized and cut by a number of fractures and faults that are also serpentinized and an increase in pyrite mineralization.
Hp-08	L-Gab	146.32	147.45	fn	Ald + Sulph	Uncertain of lithology, Altered; Appears to be either a plagioclase segregation or leuco-gabbro to anorthosite, fine to med grained, altered (serpentinized) and mineralized, but by numerous fractures and faults; is green-grey in colour; unit is broken up into small fragments; fractures and faults appear to be sources of fluids; sulphide mineralization ~5-7% and locally fine grained massive seams, (pyrite, chalcopyrite, pyrrhotite, ilmenite, graphite and an additional golden coloured sulphide possibly pentlandite); sulphides appear to be secondary; lower contact at lost core.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-08	LC	147.45	147.93		LC	Lost core?? Ground ends, appears to be the only place within this run where core may have been lost. It is possible that the run was short.
Hp-08	GAB	147.93	150.85	med	11a	Gabbro, med grained, plagioclase is grey ~60-65%; pyroxenes are altered and locally have a white coloured halo surrounding them, ~15-25% locally (anhedral), unit is cut by numerous fractures that are serpentinized, some of these fractures contain pyrite mineralization as fine grained seams; thin bands of fine grained gabbro present locally (from 149.06-149.13m, 149.45-149.48m, 149.6-149.66m) and are typically host to increased sulphide mineralization, sulphides are disseminated and present as fine grained seams, Pyrite and graphite are the most abundant; sulphides ~3-6%; approaching the lower contact there is increasing plagioclase content, lower contact is gradational.
Hp-08	AN-LGAB	150.85	152.18	med	11a?	Anorthosite-Gabbro to anorthosite, plagioclase is ~75-85% and is grey and forms the framework of the cumulate, sulphides/oxides, pyroxenes are intercumulus to the plag; sulphides are fine grained ~2-3% (pyrrhotite+pyrite+chalcopyrite+ilmenite+graphite); lower contact is gradational, (plagioclase segregation??), unit is grey to greenish-grey in colour; weak altn(serpentine).
Hp-08	GAB	152.18	158.46	med	11a	Gabbro, med grained, significant variation throughout this in plagioclase content, from 152.18-153.37m is med grained gabbro with serpentine altn and cut by a number of fractures; from 153.37-153.77m is plagioclase rich segregation (plag ~75-80%) + sulphides and serpentine altn; 153.77-157.23m is med gr gab + serpentine altn +sulph, 157.23-157.68m is plagioclase ~65-70% and the plag is lighter in colour (altn?); 157.68-158.25m is weakly foliated and there is a decrease in the plagioclase content as well as the grain size, 158.25-158.46m fn grained bands of gabbro with increase sulphide mineralization; This unit is light grey to dark grey in colour, altn is variable from weak to mod locally; fractures are typically serpentinized; lower contact is at significant increase in ilmenite.
Hp-08	GAB	158.46	187.69	med	5a	Gabbro, magnetic, ilmenite rich (ilmo-magnetite) ~10-15%; upper part of this unit is mineralized and altered from 158.46-171.5m and contains pyrite, pyrrhotite, graphite, chalcopyrite, decrease in sulphides down hole from 171.5m; unit is fine-med grained (avg gr size is 1-2mm); from 158.46-170.5m unit is strongly fractured and there appears to be a major fault from 165-165.33m (coarse healed gouge present); thin bands of fn grained gabbro present locally and typically are only 2-3cm in width, some larger ones are from 171.28-171.38m and from 172.72-172.96m these small fine grained intervals are essentially the same composition as the unit above and below but are finer grained; slight preferred orientation of the pyroxenes from ~169.5m down hole at 70deg TCA; unit is dark grey to light grey in colour and has a speckled appearance attributed to the ilmenite; LOST CORE IN THIS INTERVAL (from:162.7-163m and from 168.65-169.16m) ; lower contact is gradational

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-08	GAB	187.69	187.84	med	5a	Gabbro, med grained, similar to unit above, but with increasing pyroxene content and the appearance of bronzite as intercumulus mineral, ilmenite ~15-20%, ~2% sulphides, wk biotite and serpentine altn(associated with fractures); granular feel, plagioclase is light grey in colour; unit is dark grey-brownish in colour; EOH at 187.84m
Hp-09	OVB	0	2.01		OVB	No recovery, overburden/weathered gabbro?
Hp-09	GAB	2.01	4.21	med-cr	1a/1ab?	Gabbro, med-coarse gr, weathered and oxidized, broken up and cut by numerous fractures and faults; plagioclase ~ ~55-60%, white to light grey in colour, pyroxenes are dark green to green-grey to brown-black in colour and are locally zoned ~25-30%;ilmenite ~1-2%; no visible sulphides (likely oxidized); small plagioclase segregations present locally; lower contact at lost core.
Hp-09	LC	4.21	4.9		LC	lost core/ ground up core
Hp-09	GAB	4.9	8.37	med-cr	1a/1ab?	Gabbro, med-coarse gr, weathered and oxidized, broken up and cut by numerous fractures and faults; similar to unit from 2.01-4.21m; ~1-2% ilmenite; sharp lower contact.
Hp-09	GRAN	8.37	8.94	med	GRAN	Plagiogranite?/ porphyritic (white feldspars that are subhedral, slightly rounded) sitting in a fn gr matrix, matrix of what appears to be feldspars; foliated to sheared. Sharp upper and lower contacts; biotite altn; altered, buff to purple to brownish-orange in colour; minor oxidized fractures.
Hp-09	GAB	8.94	10.05	med-cr	1a/1ab?	Gabbro, med-coarse gr, similar to units from 2.01-4.21m and from 4.9-8.37m, pyroxenes are green in colour and are anhedral (~25-30%), cut by numerous oxidized fractures; minor ilmenite (~1%); upper contact is sharp, lower contact at lost core.
Hp-09	LC	10.05	12.45		LC	lost core/ ground up core
Hp-09	GAB	12.45	14.8	med	1a/1ab?	Gabbro, med gr, similar to units from 2.01-4.21m and from 4.9-8.37m except slight change in gr size (smaller) and slight increase in the pyroxene content to ~30-35%; increasing bronzite (and darker coloured pyroxenes) locally appears to be sulphides that are breaking down and staining the core yellow +/- sulfosalts; ilmenite ~1%; cut by numerous oxidized fractures which have stained the core a brownish-orange, upper and lower contacts at lost core (likely associated with the fractures)
Hp-09	LC	14.8	15.65		LC	lost core/ ground up core

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-09	GAB	15.65	17.77	med	M-Gab	Gabbro, (altd pyroxene rich gabbro), med gr, pyroxene rich ~35-50% pyroxenes, pyroxenes are green-grey to brownish to dark brown to iridescent (pinks) in colour and are anhedral to subhedral; some of the crystals are zoned and altered; alteration is wk to moderate; plagioclase is grey to blue in colour and comprises 35-50% of the unit; oxidation is minimal after ~16.3m where the sulphides become visible; ~2-3% sulphides (there appears to be 2 generations of sulphides, primary sulphides (pyrrhotite) is intercumulus to the pyroxenes and feldspars; and 2nd generation is pyrite as fracture fill, fn gr disseminations and associated with any fluid flow through porous zones; ilmenite ~2%; upper contact is at lost core, lower contact is abrupt at sulphide zone + change in gr size.
Hp-09	MSULPH	17.77	19.21	fn-med	Sulph	Sulphides, hosted in fn gr gabbro? Magnetic, >60% sulphides that are fine gr, appears to be pyrite, pyrrhotite, chalcopyrite, magnetite and ilmenite (uncertain if any other sulphides); small pods/clasts? of what appear to be the gabbro from above caught within this sulphide rich unit; banding and magmatic textures, also what appear to be flow structures; unit is dark grey to dark brownie-grey in colour; upper contact is abrupt and lower contact is abrupt and irregular.
Hp-09	GAB	19.21	19.6	cr	M-Gab	Gabbro, coarse gr (avg gr sz is 5mm); similar to unit from 15.65-17.77m but coarser gr and stronger altn; pyroxenes are green-grey to brown to iridescent (pinkish) in colour and are coarse gr, subhedral, altered and zoned, ~35-45%; plagioclase is grey to bluish in colour ~50%; sulphides +oxides ~5-10%; upper and lower contacts are abrupt and irregular.
Hp-09	MSULPH	19.6	22.28	fn	Sulph	Sulphides, hosted in fn gr gabbro?, similar to unit from 17.77-19.21m, both magnetic, >60% sulphides that are fine gr, appears to be pyrite, pyrrhotite, chalcopyrite, magnetite and ilmenite (uncertain if any other sulphides); banding and magmatic textures, also what appear to be flow structures; unit is dark grey to dark brownie-grey in colour; upper contact is abrupt and irregular; lower contact is abrupt and irregular. (NOTE: the silvery metallic mineral (graphite) that is magnetic is also very soft (scratch with my finger nail) and is a steel-grey in colour, massive seams and disseminated, is it something else??)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-09	GAB-PYR	22.28	23.28	cr	M-Gab	Gabbro, coarse gr (varies from med to coarse locally), altered (moderate to strong); locally mineralized with irregular bands of graphite + ilmenite and sulphides; Pyroxenes and plagioclase are altered, most of the pyroxenes are zoned with brownish coloured interior and lighter green rim, pyroxene content varies from 25-90% locally (locally coarse pyroxenite); plagioclase is variably altered and ranges in colour from blue-grey to grey to violet grey ~50-10%; appears to be 2 generations of sulphides (primary intercumulus, and 2nd fluids associated); bands of the fine gr sulphides+oxides similar to that of unit above is seen from 23.05-23.2m; upper contact is abrupt and irregular at change in gr size and mineralogy, lower contact is at abrupt change in gr size from coarse to med gr, this unit is mixed from gabbro to bands of anorthosite to thick bands of pyroxenite, no distinct contacts between each, from ~24.56 to 27.45 is mostly pyroxenite with ~30% bronzite of the 90% pyroxenes.
Hp-09	AN	23.28	24.56	med-cr	6	Gabbro, coarse gr (varies from med to coarse locally), altered (moderate to strong); locally mineralized with irregular bands of graphite + ilmenite and sulphides; Pyroxenes and plagioclase are altered, most of the pyroxenes are zoned with brownish coloured interior and lighter green rim, pyroxene content varies from 25-90% locally (locally coarse pyroxenite); plagioclase is variably altered and ranges in colour from blue-grey to grey to violet grey ~50-10%; appears to be 2 generations of sulphides (primary intercumulus, and 2nd fluids associated); bands of the fine gr sulphides+oxides similar to that of unit above is seen from 23.05-23.2m; upper contact is abrupt and irregular at change in gr size and mineralogy, lower contact is at abrupt change in gr size from coarse to med gr, this unit is mixed from gabbro to bands of anorthosite to thick bands of pyroxenite, no distinct contacts between each, from ~24.56 to 27.45 is mostly pyroxenite with ~30% bronzite of the 90% pyroxenes.
Hp-09	PYR	24.56	27.45	med-cr	7+Sulph	Gabbro, coarse gr (varies from med to coarse locally), altered (moderate to strong); locally mineralized with irregular bands of graphite + ilmenite and sulphides; Pyroxenes and plagioclase are altered, most of the pyroxenes are zoned with brownish coloured interior and lighter green rim, pyroxene content varies from 25-90% locally (locally coarse pyroxenite); plagioclase is variably altered and ranges in colour from blue-grey to grey to violet grey ~50-10%; appears to be 2 generations of sulphides (primary intercumulus, and 2nd fluids associated); bands of the fine gr sulphides+oxides similar to that of unit above is seen from 23.05-23.2m; upper contact is abrupt and irregular at change in gr size and mineralogy, lower contact is at abrupt change in gr size from coarse to med gr, this unit is mixed from gabbro to bands of anorthosite to thick bands of pyroxenite, no distinct contacts between each, from ~24.56 to 27.45 is mostly pyroxenite with ~30% bronzite of the 90% pyroxenes.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-09	GAB	27.45	29.16	med	1a/1ab?	Gabbro, med gr, sharp upper and lower contacts; plagioclase is bluish in colour, med gr, ~55-60%; pyroxenes are green to brown-green in colour and are subhedral, ~35-40%; sulphides and oxides ~1-2% and are intercumulus to the plag, weak alteration; from 27.66-27.7m is a small band of Pyroxene rich gabbro that is cutting the main unit at 30deg TCA; minor carbonate associated with the fractures; unit is grey in colour; from 29-29.16m minor plagiogranite present cutting nearly parallel TCA (small folds).
Hp-09	GRAN	29.16	29.25	fn	GRAN	Plagiogranite?/ porphyritic (white feldspars that are subhedral, slightly rounded) sitting in a fn gr matrix, matrix of what appears to be feldspars; foliated to sheared. Sharp upper and lower contacts; biotite altn; altered, buff to purple to brownish-orange in colour; (first appeared at ~29m but only minor amount; main unit from 29.16-29.25m cutting the core at 20deg TCA.
Hp-09	GAB	29.25	51.4	med	1ab	Gabbro, med gr, sharp upper contact; plagioclase is bluish in colour, med gr, ~55-65%; pyroxenes are green to brown to brown-black in colour and are subhedral to euhedral, ~35-40%, locally forming a weak mineral lineation along a weak foliation plane (typically elongate crystals) at 60deg TCA (up to 70 locally), bronzite locally abundant; variable alteration throughout the unit due to proximity to fractures that are serpentinized or carbonatized; sulphides and oxides ~1% and are intercumulus to the plag, (small interval of increased sulphides from 40.46-40.59m), unit is grey in colour to light grey in proximity to the carbonatized fractures; lower contact is at lost core (appears to gave been either a fault or fracture set.)
Hp-09	LC	51.4	52.3		LC	lost core from 51.4-52.3m (ground)
Hp-09	GAB	52.3	64.85	med	1ab	Gabbro, med grained, lithology is similar to unit from 29.25-51.4m; unit is cut by numerous fractures and small faults that are carbonatized and weakly serpentinized; gabbro is weakly bleached in proximity to the fractures; weak biotite altn; sulphides ~1-2%, minor ilmenite, pyroxenes are dark green to green to brownish in colour and are anhedral to subhedral, ~25-35% (bronzite locally abundant); plagioclase is white to bluish-grey to violet-grey in colour ~50-65% locally; there appears to be a change in the composition of the plagioclase down hole, from a higher anorthosite composition to higher albite composition; upper contact at lost core, lower contact at lost core
Hp-09	LC	64.85	65.05		LC	lost core from 64.85-65.05m
Hp-09	GAB	65.05	68.8	med	1ab	Gabbro, med grained, lithology is similar to unit from 52.3-64.85m;pyroxenes are dark green to green to brownish in colour and are anhedral to subhedral, ~20-25% (bronzite locally); plagioclase is grey to violet-grey in colour ~55-65%; unit is cut by fractures that are serpentinized +/- minor carbonate; slickenside surfaces are typically present along the serpentinized structures; ~1% sulphides + oxides; upper contact is at lost core, lower contact is at change in gr size and is abrupt.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-09	GAB	68.8	69.1	fn-med	1ab	Gabbro, fine-med gr, plagioclase ~50-60%; pyroxenes are light brown to brown in colour (locally bronzite) that are anhedral to subhedral; ~35%; ~1-2% sulphides (also along the fracture planes); upper contact is sharp; lower contact is sharp at distinct gr size changes; fractures that cut this interval are serpentinized.
Hp-09	GAB	69.1	88.87	med	1ab	Gabbro, med gr; plagioclase is grey to bluish-grey to violet grey in colour, ~55-65% and are med gr (avg gr sz ~3-4mm), locally plagioclase is coarse gr with avg gr sz 5-6mm; pyroxenes are green-grey to green to brown to dark-brown black to iridescent in colour (bronzite locally abundant); pyroxenes are intercumulus to the plagioclase ~25-30%, pyroxenes are subhedral to locally euhedral; ~1-2% sulphide+oxides (locally short intervals host increase sulphide mineralization up to 15%); very weak alignment of the minerals at approx. 60-70 deg TCA; any significant fractures are serpentinized +/- carbonate; small shears locally present, and plagioclase segregations from 77.33-77.47m and from 87.73-87.92m with plagioclase up to 90%; lower contact at plagioclase segregation and is abrupt (not sharp and defined); this unit is well consolidated (lots of large pieces)
Hp-09	AN-LGAB	88.87	89.21	med	1ab	Anorthosite/Leuco-gabbro; ~90% plagioclase that is grey to violet-grey in colour, ~10% pyroxenes +sulphides+ oxides + biotite that are all intercumulus to the plagioclase; upper and lower contact are abrupt but not sharp;
Hp-09	GAB	89.21	90.14	cr	1a	Gabbro + Anorthosite (plag segregation) that is coarse grained; upper contact is abrupt but not sharp; lower contact is gradational over a few cms; from 89.21-89.9m is plagioclase rich gabbro with serpentine altn, plagioclase is coarse gr, but the pyroxenes are med gr, coarse grained (avg gr sz ~5-6mm); plagioclase ~60-65%; pyroxenes are green to dark green in colour, anhedral to subhedral and are intercumulus to the plagioclase; ~1% oxides +sulphides; from 89.9-90.14 is plagioclase segregation (similar to that from unit above 88.87-89.21m) with ~80% plagioclase that grades into the following unit.
Hp-09	NOR	90.14	94.09	med-cr	1a	Gabbro (norite), medium-coarse grained; bronzite rich, pyroxene rich ~35-40%, pyroxenes are brown to iridescent brown-pink in colour, and are subhedral, avg sz ~4-5mm; plagioclase is bluish-grey in colour ~50-55%; sulphides are irregularly distributed ~1-2%, locally pyroxenes form clusters that appear as bands; upper contact is gradational; lower contact is at decrease in pyroxene content and is abrupt.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-09	GAB	94.09	99.59	med	1a	Gabbro, med-coarse grained; plagioclase ~60% and is yellowish-grey to grey to bluish-grey in colour, coarse gr; pyroxenes are brown to iridescent brown-pink in colour (bronzite rich) ~25-30%, intercumulus to the plagioclase and are subhedral to locally euhedral; minor sulphides and oxides (~1%); weak alignment of the crystals at 60-70deg TCA; unit is grey to dark grey n colour; very few fractures, unit is solid with lots of large pieces; upper contact is abrupt, lower contact is abrupt (change in mineralogy).
Hp-09	AN-LGAB	99.59	100.42	med	1ab	Anorthosite/Leuco-gabbro; ~85-90% plagioclase that is grey to violet-grey in colour, ~10-15% pyroxenes +sulphides+ oxides + biotite that are all intercumulus to the plagioclase, each is present as bands that are intercumulus to the plag (patchy); similar to unit from 88.87-89.21m; upper and lower contacts are abrupt but not sharp, these are at distinct changes in the mineralogy; at 100.23-100.34 there are bands of sulphides (Py + Po, the Po is magnetic).
Hp-09	GAB	100.42	101.02	med	1a	Gabbro, medium to coarse grained; serpentine and carbonate altered and cut by numerous fractures; upper and lower contacts are abrupt to gradational, but not sharp; pyroxenes are dark green to dark brown-black in colour and are anhedral to subhedral ~25-30% (bronzite present); plagioclase is grey in colour ~med-coarse gr ~60%;pyrite mineralization associated with the carbonate along the fractures; ~1-2%sulphides.
Hp-09	AN	101.02	103.58	med	1ab	Anorthosite, med grained, ~90-95% plagioclase that is grey to light grey to violet-grey in colour; minor pyroxenes + sulphides/oxides; weak alignment of the plagioclase laths at 60deg TCA; upper contact is abrupt, lower contact is gradational with a slow increase in pyroxene content down hole (from 102.4-103.58m) from 5% to 15% at 103.58m.
Hp-09	GAB	103.58	106.31	med	1a	Gabbro, med grained, upper contact is gradational from 102.4-103.58m (gradual increase in pyroxene content down hole); bronzite rich, pyroxenes are dark brown to brown black to dark green in colour and are anhedral to subhedral ~20-25%; plagioclase is grey to bluish-grey in colour ~60-65%; unit is similar to that from 94.09-99.59m; towards the lower contact there is an increase in the number of fractures and alteration, serpentine and carbonate alteration is moderate to strong in proximity to the lower contact, the plagioclase is bleached almost white and the pyroxenes are dark green in colour; lower contact is abrupt at what appears to be an altered plagioclase segregation.
Hp-09	AN	106.31	107.3	med	1ab	Anorthosite/ plagioclase segregation?, med grained, ~90-95% plagioclase that is white to light grey to violet-grey in colour; minor pyroxenes + sulphides/oxides; upper contact is abrupt, lower contact is abrupt; unit is altered (carbonatized and serpentinized); from 106.82-106.96m is a small band of serpentinized gabbro; these appear to be part of cyclical layers that repeat from anorthosite to gabbro, to anorthosite to gabbro (contacts may be gradational or abrupt); fractures are serpentinized. (CYCLICAL LAYERING?)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-09	GAB	107.3	109.74	med-cr	1a	Gabbro, med-coarse grained, plagioclase is white to light grey to violet-grey in colour ~60-65%, and pyroxenes are dark green in colour and are anhedral to subhedral ~25-30%; unit is carbonatized and serpentinized; fractures are serpentinized; carbonate altn veins and fracture fill; upper contact is abrupt to sharp, lower contact is abrupt to sharp; pyrite mineralization is associated with the serpentine and carbonates and may be secondary, pyrrhotite appears to be primary sulphides, ~2% sulphides; ~1% ilmenite; From 108.88-108.96 is vein?? or plagiogranite?? sharp upper (40deg) and lower contacts (40deg TCA), carbonate altered, white in colour, host to ilmenite mineralization. (CYCLICAL LAYERING?)
Hp-09	AN	109.74	117.68	med	1ab	Anorthosite/ Plagioclase segregation; med grained (locally coarse grained plagioclase crystals), avg gr sz ~4mm; unit is white to grey to violet-grey in colour; strong carbonate altn from 109.74-111.75m and carbonate veins + vuggy veins that host euhedral carbonate crystals; ~85-90% plagioclase, pyroxenes are present as thin bands to patches that are intercumulus to the plagioclase and are green to brown in colour (bronzite also present); sulphides and oxides are also intercumulus to the plagioclase (likely an adcumulate) ~1-3% sulphides + oxides; locally fractures are host to carbonate +/- serpentine; weak alignment of the crystals at ~60deg TCA; lower contact is abrupt at change in mineralogy.(CYCLICAL LAYERING?)
Hp-09	GAB	117.68	118.17	cr	1a	Gabbro, coarse grained, similar to unit from 107.3-109.74m, pyroxenes are dark green to brownish-green in colour ~25-30%, plagioclase is grey to violet grey in colour ~60-65%, the pyroxenes are intercumulus to the plagioclase; ~1% sulphides + oxides; upper and lower contacts are abrupt at transitions in mineralogy (not sharp and defined, (NOTE: from 117.8-117.89m is a plagioclase segregation (or small anorthosite interval), ~80-85% plagioclase and ~2-3% ilmenite; upper and lower contacts are abrupt but not sharply defined, similar to unit from 109.74-117.68m.)(CYCLICAL LAYERING?)
Hp-09	AN	118.17	118.31	med	1ab	Anorthosite/Plagioclase segregation?, similar to unit from 109.74-117.68m; ~90-95% plagioclase that is violet-grey in colour, med gr, but crystals up to 1cm in length; ~5% pyroxenes + sulphides/oxides; upper and lower contacts are abrupt (not sharply defined); unit is grey-violet in colour; minor carbonate and biotite altn.(CYCLICAL LAYERING?)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-09	GAB	118.31	126.52	cr	1a	Gabbro, coarse grained, similar to unit from 117.68-118.17m, pyroxenes are dark green to brownish-green to dark brown to iridescent brown-pink in colour ~25-30% and are med-coarse gr, pyroxenes are subhedral to locally euhedral; plagioclase is light grey to grey to violet-grey in colour ~60-65%, the pyroxenes are intercumulus to the plagioclase; ~1% sulphides + oxides; slight preferred orientation of the crystals at 60deg TCA; fractures typically host serpentine +/- carbonate; From 119.23-119.50 is a plagioclase segregation or anorthosite interval similar to those above and below; from 121.79-121.84 is a band of fn-med gr gabbro that is bronzite rich and of similar composition to main unit (~35-40% pyroxenes); upper contact is abrupt, lower contact is abrupt to sharp. (CYCLICAL LAYERING?) Another An unit from 119.23-119.50m
Hp-09	AN	126.52	129.76	med	1ab	Anorthosite/ plagioclase segregation?, similar to unit from 118.17-118.31m; ~85-90% plagioclase that is grey to bluish-grey to violet-grey in colour, med grained gr, but crystals up to 1cm in length; ~5-10% pyroxenes, ~2% sulphides/oxides (locally up to 7%); fractures are host to carbonate+/- pyrite +/- serpentine, and there is a weak to moderate carbonate alteration locally; last run is short and there does not appear to be any lost core, hole EOH at 129.76, instead of the 130.02m that it is supposed to end at. (CYCLICAL LAYERING?)
Hp-10	OVB	0	1.83		OVB	Overburden/ weathered gabbro? No recovery
Hp-10	GAB	1.83	2.2	med	1a?	Gabbro, med grained; weathered and oxidized; granular feel, crumbly, composed of ~55% plag+ ~30-35% pyroxenes that are green to brown to orangey brown in colour (oxidized and altered); no visible sulphides or oxides, crystals are subhedral; core is brown to grey-brown to reddish-brown in colour.
Hp-10	LC	2.2	2.87		LC	lost core/ ground up/ no recovery
Hp-10	GAB	2.87	3.37	med	1a?	Gabbro, med grained, weathered and oxidized, similar to unit from 1.83-2.2m. Core is grey-brown to brown in colour, lower contact is sharp.
Hp-10	GRAN	3.37	5.04	fn	GRAN	Granite/plagiogranite; foliated, foliation intensity increases towards the centre of the unit, biotite is also present and the % increases towards the centre of the unit; composed of plagioclase, quart and biotite; fine gr; unit is brittle and is broken up; locally quartz veinlets cutting the unit; white to grey-brownish in colour; upper contact is broken up, but is sharp, lower contact is lost core (likely sharp contact)
Hp-10	LC	5.04	6.23		LC	lost core/ ground up/no recovery
Hp-10	GAB	6.23	6.56	med	1a?	Gabbro, med grained, weathered and oxidized; pyroxenes are brown to dark brown in colour (bronzite also present) ~30%, pyroxenes are anhedral to subhedral and are being altered; plagioclase forms the framework of the cumulate; minor ilmenite <1%; any sulphides that may have been present are oxidizing and breaking the core apart as well as staining the core yellow with sulphur; upper and lower contacts at lost core; unit is grey to orangey-brown in colour.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	LC	6.56	8.08		LC	lost core/ ground up/ no recovery
Hp-10	GAB	8.08	17.23	med	1a?	Gabbro, med grained; weathered/altered and oxidized; cut by numerous fractures and small faults that are oxidized (source of fluids); composed of ~55-60% plagioclase (white to grey to violet-grey in colour) + 30-35% pyroxenes; ilmenite is locally present <1%; pyroxenes are green to brown in colour (locally bronzite) +/- amphiboles; any sulphides that may have been present as oxidizing and breaking the core apart as well as staining the core yellow to orange in colour; decrease in altn and oxidation at ~14.5m down hole; core is typically brownish-orange to white-orangey brown in colour. (from ~14.19m down hole the core is cut, only 1/2 core available)
Hp-10	LC	17.23	17.92		LC	lost core/ ground up/ no recovery
Hp-10	GAB	17.92	19.53	med	8/1ab?	Gabbro, med grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes are green to green grey to brown in colour and are anhedral to subhedral ~30%; ilmenite is locally present <1% (intercumulus to the plagioclase); sulphides are visible from 14.5m down hole (<1-1% sulphides); unit is grey to dark grey in colour; lower contact is at lost core; (cut core to 29m)
Hp-10	LC	19.53	20		LC	lost core/ ground up/ no recovery
Hp-10	GAB	20	20.28	med	8/1ab?	Same as unit from 17.92-19.53m, with <1% sulphides (core is cut)
Hp-10	LC	20.28	21.08		LC	lost core/ ground up/ no recovery
Hp-10	GAB	21.08	22.13	med	1a/1ab?	Gabbro, med grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes (+/- amphiboles) are greenish-grey to brown to dark brown-black in colour and are anhedral to subhedral ~30% (bronzite present); ilmenite is locally present <1% (intercumulus to the plagioclase); ~1% sulphides; unit is grey to dark grey in colour; lower contact is at lost core; (cut core to 29m)
Hp-10	LC	22.13	22.63		LC	lost core/ ground up/ no recovery
Hp-10	GAB	22.63	25.2	med	1a/1ab?	Gabbro, med grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes (+/- amphiboles) are greenish-grey to grey to brown in colour and are anhedral to subhedral ~30% (bronzite present); ilmenite is locally present <1% (intercumulus to the plagioclase); <1% sulphides; unit is grey in colour; lower contact is at lost core; (cut core to 29m); locally sulphides are oxidized and stain the core yellow, these are also breaking the core apart (expanding) (core is cut)
Hp-10	LC	25.2	25.9		LC	lost core/ ground up/ no recovery

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	25.9	26.93	med	1a/1ab?	Gabbro, med grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes (+/- amphiboles) are greenish-grey to grey to brown in colour and are anhedral to subhedral ~30% (bronzite present); ilmenite is locally present <1% (intercumulus to the plagioclase); ~1% sulphides; unit is grey in colour; lower contact is at lost core; (cut core to 29m)
Hp-10	LC	26.93	28.1		LC	lost core/ ground up/ no recovery
Hp-10	GAB	28.1	29	med	1a/1ab?	Gabbro, med grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes (+/- amphiboles) are greenish-grey to grey to brown to black in colour and are anhedral to subhedral ~30-35% (bronzite present); ilmenite is locally present <1% (intercumulus to the plagioclase); ~1% sulphides; unit is grey in colour; lower contact is at Dyke? or fn grained gabbro; (cut core to 29m) core is all broken up and fractured
Hp-10	DYK	29	29.23	fn	12	Dyke or fine grained gabbro?? Magnetic, dark green-grey in colour, appears to be gabbroic in composition; upper and lower contacts are broken or fractured, appears to be sharp contacts, ~3% sulphides (fn gr); massive, no foln; cut by a number of small fractures.
Hp-10	GAB	29.23	30.51	med	1a	Gabbro, med to medium-coarse grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes (+/- amphiboles) are greenish-grey to grey to brown to black in colour and are anhedral to subhedral ~25-30% (bronzite present); ilmenite is locally present <1% (intercumulus to the plagioclase); <1% sulphides; unit is grey in colour; numerous fractures cut the unit and are serpentinized to weakly oxidized; lower contact at lost core.
Hp-10	LC	30.51	30.95		LC	lost core/ ground up/ no recovery
Hp-10	GAB	30.95	32.18	med	1a	Gabbro, med to medium-coarse grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes (+/- amphiboles) are greenish-grey to grey to brown to black in colour and are anhedral to subhedral ~25-30% (bronzite present); ilmenite is locally present <1% (intercumulus to the plagioclase); <1% sulphides; unit is grey in colour; numerous fractures cut the unit and are serpentinized to weakly oxidized; small plagioclase segregation from 32.04-32.08m where plagioclase increases to ~90% of the interval; lower contact is abrupt and weakly mineralized
Hp-10	GAB	32.18	32.8	fn	1a	Gabbro, fine grained (finer grained then Dyke? From 29-29.23m); mineralized, appears to be a fine grained segregation +pyrrhotite mineralization; composed of plagioclase + pyroxenes + sulphides ~20%; upper and lower contacts are abrupt, but not sharply defined, mineralization along the upper contact.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	32.8	37.84	med	1a	Gabbro, med to medium-coarse grained; plagioclase is grey to violet-grey in colour and forms the framework of the cumulate, ~55-60%; pyroxenes (+/- amphiboles) are greenish-grey to grey to brown to black in colour and are anhedral to subhedral to locally euhedral ~30-35% (bronzite present); pyroxene content increases locally; ilmenite is locally present <1% (intercumulus to the plagioclase); <1% sulphides (intercumulus to the plagioclase); unit is grey in colour; fractures are typically serpentinized; weak biotite altn locally; sharp lower contact.
Hp-10	GRAN	37.84	39.04	med	GRAN	Granite/ plagiogranite, foliated to sheared, plagioclase + qtz + biotite; biotite present along the foln planes; sharp upper and lower contacts; cut by brittle fractures; small deformed and sheared qtz-plg segregations present at 10-15deg TCA;
Hp-10	GAB	39.04	40.19	med	1a	Gabbro, med-coarse grained, similar to unit from 32.8-37.84m; cumulate; plagioclase forms the framework ~55-60%; pyroxenes are green to green-grey to brown (rare bronzite) in colour ~25-30%; unit is cut by serpentinized fractures; biotite alteration is moderate and is strongest towards the upper and lower contacts; <1% ilmenite and tr sulphides; sharp upper and lower contacts.
Hp-10	GRAN	40.19	40.43	med-cr	GRAN	Granite/plagiogranite; fine to med grained along the upper and lower contacts, coarse grained from 40.26-40.32m and is composed of qtz-plag +/- k-spar + coarse biotite; remainder of the unit is similar to that from 37.84-39.04m, sharp upper and lower contacts, locally weak foliation, biotite present as small flecks along the foliation planes or in the coarse gr section as long thin books.
Hp-10	GAB	40.43	42.3	med	11a	Gabbro, med-coarse grained, similar to unit from 32.8-37.84m and from39.04-40.19m ; cumulate; plagioclase forms the framework ~55-60%; pyroxenes are green to green-grey to brown to black(rare bronzite) in colour ~25-30%; unit is cut by numerous serpentinized fractures; biotite alteration is moderate and is strongest towards the upper and lower contacts; <1% ilmenite and tr sulphides; sharp upper contact and lower contact is abrupt at change in gr size; strong serpentine associated with fractures and faults from ~40.9-42.3m, strong slickenside surfaces.
Hp-10	GAB	42.3	45.64	fn	12	Gabbro, fine grained (avg gr size ~1mm), magnetic, similar to unit from 29-29.23m; dark grey in colour, cut by numerous serpentinized fractures; broken up by these fractures; upper and lower contact are abrupt with med-coarse grained gabbro, composed of plagioclase + pyroxenes (rare bronzite); <1% sulphides; magnetite and/or ilmenite ~20%.
Hp-10	GAB	45.64	50.7	med	11a	Gabbro, med-coarse grained, similar to unit from 32.8-37.84m and from 39.04-40.19m and from 40.43-42.3m ; cumulate; plagioclase forms the framework ~55-60%; pyroxenes are green to green-grey to brown to black in colour ~25-30%, bronzite present; sulphides and ilmenite are intercumulus to the plagioclase ~1% ilmenite+ 1-2 sulphides; upper contact is abrupt, lower contact is abrupt, small section of fine grained gabbro from 49.7-49.8m (shallow angle, be that that unit is near parallel to the CA).

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	50.7	51.37	fn	12	Gabbro, fine grained (avg gr size ~1mm), magnetic, similar to unit from 42.3-45.64; dark grey in colour, ; upper and lower contacts are abrupt with med-coarse grained gabbro; composed of plagioclase + pyroxenes (rare bronzite); ~1% sulphides; magnetite and/or ilmenite ~20%; from 51.13-15.37 there is a section of med grained gabbro and comprises ~35% of the core in this section (cuts the core at ~30deg).
Hp-10	GAB	51.37	51.8	med	11a	Gabbro, med-coarse grained, similar to unit from 32.8-37.84m and from 39.04-40.19m and from 40.43-42.3m ; cumulate; plagioclase forms the framework ~55-60%; pyroxenes are green to green-grey to brown in colour ~25-30%, bronzite present, crystals are subhedral (to locally euhedral); sulphides and ilmenite are intercumulus to the plagioclase ~1% ilmenite+ 1-2% sulphides; upper and lower contacts are abrupt.
Hp-10	GAB	51.8	52.08	fn	12	Gabbro, similar to unit from 50.7-51.37m, fine grained, magnetic; ~1% sulphides, ~20% magnetite and/or ilmenite; abrupt and irregular upper and lower contacts (segregation??)
Hp-10	GAB	52.08	57.43	med	11a	Gabbro, med-coarse grained, similar to unit from 32.8-37.84m and from 39.04-40.19m and from 40.43-42.3m ; cumulate; plagioclase forms the framework ~55-60%; pyroxenes are green to green-grey to brown in colour ~25-30%, bronzite present, crystals are subhedral (to locally euhedral); sulphides and ilmenite are intercumulus to the plagioclase <1% ilmenite+ 2% sulphides; upper contact is irregular but abrupt, lower contact is at LC.
Hp-10	LC	57.43	57.68		LC	ground up??
Hp-10	GAB	57.68	60.7	cr	11a	Gabbro, similar to unit from 52.08-57.43m, cumulate; plagioclase forms the framework ~55-60%; pyroxenes are green to green-grey to brown to black in colour ~25-30%, bronzite present, crystals are subhedral (to locally euhedral); sulphides and ilmenite are intercumulus to the plagioclase <1% ilmenite+ 2-3% sulphides; upper and lower contacts at LC; biotite altn is weak; locally serpentinized fractures (pyroxenes in proximity to these are typically darker in colour). There are small bands of fine grained gabbro from 58.75-58.88 and from 59.55-59.62m which are similar to the unit from 51.8-52.08m, both are also magnetic.
Hp-10	LC	60.7	61.08		LC	cave in at 60.7m, lost core from 60.7-61.08m
Hp-10	GRAN	61.08	61.53	fn-med	GRAN	Granite/plagiogranite, similar to previous granite intersections; composed of plagioclase, biotite and qtz, wk foln, biotite along foln planes, sharp upper and lower contacts, white in colour, fine to med grained; tr pyrite present along fractures.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	61.53	67.08	med	11a	Gabbro, similar to unit from 57.68-60.7m, cumulate; plagioclase (grey t violet grey in colour) forms the framework ~55-60%; pyroxenes are green to green-grey to brown to black in colour ~25-30%, bronzite present, crystals are subhedral (to locally euhedral); sulphides and ilmenite are intercumulus to the plagioclase ~1% ilmenite+ ~2-3% sulphides; upper contact is sharp at granite, lower contact is irregular and sharp; biotite altn is very weak and irregular; locally serpentinized fractures (pyroxenes in proximity to these are typically darker in colour).
Hp-10	GAB	67.08	68.35	fn	12	Gabbro, fine grained, magnetic, upper and lower contacts are abrupt to sharp (distinct transition from coarse gr to fn grained and there is a mineralogy change but the contact between the two units is not a sharp line such a with an intrusive unit); magnetic (ilmenite or magnetite?) ~20%; ~1-2% sulphides; composed of plagioclase + pyroxenes; dark green to dark green-grey in colour. Similar to unit from 51.8-52.08m.
Hp-10	GAB	68.35	81.9	med	11a	Gabbro, medium-coarse grained, similar to unit from 61.53-67.08m; cumulate; plagioclase (grey to violet grey in colour) forms the framework ~55-60%; pyroxenes are green to green-grey to brown to black in colour ~25-30%, bronzite present, crystals are subhedral (to locally euhedral); pyroxenes are locally altered or have a rim of different composition (lighter green to green-grey in colour, v. fn gr); sulphides and ilmenite are intercumulus to the plagioclase ~1% ilmenite+ ~2-3% sulphides to approx. 77.5m where the sulphide content increases down hole from 2% to 5-7% towards the lower contact; alteration also increases down hole but is strongest from 80-81.9m where the is a reaction rim surrounding the pyroxenes; locally serpentinized+/- carbonate fractures; upper contact is sharp and lower contact is at massive sulphides; previously sampled from 75.44-87m (cut core)
Hp-10	MSULPH	81.9	83.15		Sulph	Massive sulphides hosted in altered gabbro; ~65-70% sulphides; similar in texture to previous massive sulphides zones seen in other holes; pyrrhotite is the most abundant sulphide with additional pyrite and chalcopyrite. The gabbro hosting the sulphide mineralization is similar to the units above and below. (previously sampled, cut core)
Hp-10	GAB	83.15	83.3	med	11a	Gabbro, med grained, altered and mineralized, plagioclase is abundant and "bleached" (~65-70%); numerous serpentinized and pyritized fractures cut the interval; ~20% sulphides; light grey to black in colour; brittle and lower contact at lost core (likely a fault or fracture zone.)(previously sampled, cut core)
Hp-10	LC	83.3	83.6		LC	lost core appears to be from 83.3-83.6m

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	83.6	85	med	11a	Gabbro, med grained, mineralized, altered, broken up by fractures +/- faults; strong moderate to locally strong serpentine altn; fractures are serpentinized and pyritized, ~20-30% sulphides (primary sulphide is pyrite);sulphides are also present as seams, fracture fill and pods (secondary sulphides?); sulphides consist of pyrite, chalcopyrite, minor pyrrhotite and seams of a silvery metallic sulphide with a violet hue (not metallic); pyroxenes are altered (lighter coloured rims); plagioclase is abundant ~60-70% and appears to be bleached locally; lower contact is gradational (difficult to tell, core is cut and broken up locally sulphides are oxidizing and staining the core). (previously sampled, cut core)
Hp-10	LGAB	85	86	med	11a	Anorthosite-Gabbro/ Leuco Gabbro, or is this a product of alteration?, light grey to light greenish-grey in colour, plagioclase is white to grey in colour ~70-85%; pyroxenes +/- amphiboles are fine-med grained, altered and light green to light-green-brownish in colour; abundant fine grained sulphides + ilmenite (~2-5%); no clear plagioclase grain boundaries; patchy serpentine altn (associated with fractures); towards the lower contact the unit becomes very coarse grained with pyroxenes and plagioclase crystals up to 3.5cm in length (from 85.76-86m) This is also similar to the units seen in previous holes with massive sulphide zones; lower contact is abrupt at gr sz change (gradational over a few cms). very coarse from 85.76-86m. (previously sampled, cut core)
Hp-10	GAB	86	89.23	med	11a	Gabbro, medium grained, cut by numerous serpentinized faults and fractures, moderate to strong serpentine altn; locally mineralized (pyrite +/- magnetite +/- ilmenite) +/- carbonate; pyroxenes are dark green to black in colour; fine gr bands of magnetite up to 3cm in width (largest from 8.08-88.11m); small band of leuco gabbro? or bleached gabbro up to 10cm in width from 88.76-88.9m (similar to unit from 85-86m); Gabbro is locally weakly magnetic (minor magnetite +/- ilmenite); dark grey to black in colour; ~2-3% sulphides, bronzite present locally. (previously sampled, cut core to 87m)
Hp-10	LC	89.23	89.8		LC	lost core from 89.23-89.8m (ground up)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	89.8	101.54	med	5a	Gabbro, med grained; ilmenite rich, cut by numerous serpentinized faults and fractures, weak to moderate serpentine altn; pyroxenes are dark green to dark brownish to black in colour; plagioclase is dark grey to bluish-grey in colour locally labradorite); The percentage of plagioclase vs pyroxenes varies greatly throughout this interval, such as in the plagioclase segregation bands plagioclase may comprise up to 85% of the short intervals (max 15cm), in some parts of the unit the pyroxenes are up to 45% of the interval but typically represents ~30-35% of the unit. Overall the plagioclase represents ~50-55% of the unit; Gabbro is weakly magnetic, ilmenite ~20%; dark grey to black in colour; ~2-4% sulphides (locally up to 7%), bronzite present (locally abundant); This unit changes character slightly down hole and is host to small plagioclase segregations and numerous magnetite rich bands; begins in ilmenite rich gabbro then plagioclase segregation, coarse grained gabbro then back to ilmenite rich gabbro with minor plagioclase segregations down hole, the magnetite bands are irregularly distributed and are up to 5cm in width; upper contact is ??? (ground up?); lower contact is at lost core.
Hp-10	LC	101.54	101.95		LC	Lost core, (core missing between 101.05-102.58m and appears to be from this interval.
Hp-10	GAB	101.95	151.9	med	5a	Gabbro, med gr, similar to unit from 89.8-101.54m, ilmenite rich (~20-25%) gabbro that is cut by numerous fractures that are wk to mod serpentinized +/- carbonate from 101.95-106m, weakly magnetic; magnetite (or specular hematite?) rich bands are irregularly distributed but present locally (up to 3cm in width); sulphides ~1-3% (locally up to 10%) that are also irregularly distributed and typically are present as small sulphide rich bands that are intercumulus to the plagioclase; plagioclase is grey to bluish-grey in colour ~50-60% , pyroxenes are green to light brown to dark brown to black in colour ~30-35% and decreases slightly down hole to ~25-30% (bronzite present), wk biotite altn locally; fine grained gabbro from 110.8-111.03m and is wk magnetic: ~40%plg + ~40%pyroxenes+20%ilmenite (similar to previous fn gr gabbro such as from 50.7-51.37m),Similar band from 128.53-128.72m; unit is not consistent in texture and locally contains small segregations and pods that are rich in plagioclase up to 2cm (thickness); from 137.12-137.38m is composed of fine grained gabbro + plagioclase segregations with ~5% sulphide mineralization + serpentinized fractures; fractures are typically serpentinized and may also host minor pyrite mineralization; sulphide bands are typically intercumulus to the plagioclase but rare bands are massive to semi massive and typically composed of pyrrhotite + magnetite (ex: from 136.15-136.18m); from 145.64-145.85m is a series of bands of magnetite/hematite +pyrrhotite mineralization, there is a solid band of massive magnetite from 145.64-145.7m, pyroxenes are present in association with the sulphides and are brown in colour; upper contact is at lost core; from 150.5m to 151.9m there is an increase in serpentine altn and the core is darker in colour; lower contact is abrupt at change in grain size (increase) and mineralogy (increase in plagioclase). (small section of cut core from 107.15-107.26m)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	151.9	152.91	med	5a	Gabbro, med grained, upper contact is abrupt: increase in grain size, increase in plagioclase content and decrease in ilmenite concentration; plagioclase is grey to bluish-grey in colour and appears to be labradorite in composition, ~60-70% plagioclase very weak preferred orientation of the crystals at 50deg TCA, crystals are subhedral to euhedral; pyroxenes are dark brown to green-grey in colour and are anhedral to subhedral ~15% (minor amphiboles) (bronzite present), sulphides <1%, ilmenite ~2-3%; lower contact is gradational over ~5cm, Transitional unit?
Hp-10	GAB	152.91	156.74	cr	5a	Gabbro, coarse grained, plagioclase is grey to bluish in colour (labradorite in composition?) and are locally zoned, ~60% plag; pyroxenes are brown to greyish-blue to grey-green in colour and are anhedral to subhedral (bronzite abundant), ilmenite is locally abundant but variable throughout the unit, sulphides are intercumulus to the plagioclase and are unevenly distributed, magnetite (specular hematite?) is present as fine grained pods and seams locally, from ~156 to 156.74m there is a decrease in grain size and a significant increase in ilmenite content up to 25% locally; lower contact at fault and plagiogranite? (sharp)
Hp-10	GRAN	156.74	156.86	fn	GRAN	Plagiogranite? Or strongly altered gabbro??Sharp upper and lower contacts, fine grained; minor pyroxenes that are altered (grey to green-grey in colour), biotite flecks; no sulphides or oxides; unit is grey to light grey in colour.
Hp-10	GAB	156.86	158.78	med	5a	Gabbro, med to coarse grained, similar to unit from 152.91-156.74m (and even more similar to section from 155.92-156.74m); unit is cut by numerous fractures that are serpentinized, ilmenite rich ~15-20% ; plagioclase is grey to bluish in colour (labradorite in composition), crystals are euhedral to subhedral, lath shaped to locally rounded; pyroxenes +/- amphiboles are dark brown to black to iridescent in colour (bronzite present); <1% sulphides; unit is dark grey in colour; locally crystals up to 1.5cm in size; upper contact is sharp, lower contact is at change in mineralogy.
Hp-10	GAB	158.78	161.48	med	5a	Gabbro, med-coarse grained (upper part of unit is coarse); unit is grey to bluish-grey in colour; plagioclase is grey to bluish-grey to pinkish (labradorite in composition) ~50-60%; pyroxenes are grey to brownish to green-grey to iridescent in colour and are subhedral ~30-40%, pyroxenes are locally altered; minor ilmenite ~1%, ~2-3% sulphides that are intercumulus to the plagioclase; fractures are serpentinized; fracture zone from160.55-161.48m with strong slickenside surfaces; lower contact at grain size change.
Hp-10	GAB	161.48	161.9	fn-med	5a	Gabbro, fine to med grained, similar to unit above but finer grained, upper and lower contacts at distinct grain size changes (abrupt to gradational over a few cms); pyroxenes grey to green-grey to brownish in colour ~30-40%, alteration of the pyroxenes is common and they appear to be altered by amphiboles (lighter in colour), plagioclase is grey to bluish-grey in colour ~50-60%; sulphides + oxides ~10-15% (~7-10% ilmenite); there is a weak preferred orientation of the crystals at 50-60deg TCA; unit is grey to dark grey in colour; weak alteration of the pyroxenes (locally rimmed).

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	161.9	166.28	fn-med	5a	Gabbro, mixed unit of med and fine-med grained gabbro, similar compositions to units from 158.78-161.48m and to unit from 161.48-161.9m: breakdown goes as follows: from 161.9m-162.78m is med grained gabbro, from 162.78-163.29m is fine-med grained gabbro; from 163.29-163.68m is med gr gabbro with some coarse plag xtls, from 163.68-164.07m is fn-med gr gabbro; from 164.07-164.56m is med gr gabbro with some coarse plag xtls; from 164.56-164.83m is fn-med gr gabbro; from 164.83-166.28 is med gr gabbro; the contacts between each of these transitions are abrupt; there are slight variations in sulphide and oxide mineralogy, but overall the pyroxene and plagioclase content appears to be very similar, the finer grained sections appear to have a weak preferred orientation at 65-70deg TCA; units are grey to dark grey in colour.
Hp-10	GAB	166.28	174.38	med	5a	Gabbro, med grained, similar to unit from 164.56-164.83m; plagioclase forms euhedral laths that are grey to bluish in colour and have a weak preferred orientation at ~70deg TCA (labradorite); pyroxenes are green-grey to brownish to iridescent in colour (bronzite present), pyroxenes form nice poikilitic crystals; ~7-10% ilmenite; ~2-4% sulphides (including magnetite); unit is grey in colour; upper contact is abrupt at gr sz change, from 166.28-166.73m unit is still slightly coarser, but decreases down hole; lower contact at altn change.
Hp-10	GAB	174.38	177.48	fn-med	5a	Gabbro, similar to unit above but with increased alteration (likely part of the same unit); grey in colour, white with brown and black speckles when dry; has a slight granular feel, plagioclase ~50% is light grey to greenish-grey in colour (altered); pyroxenes are light brown to iridescent (some poikilitic crystals), altered (bio +/- amphiboles); ~10% ilmenite, ~2-3% sulphides; unit has a slight recrystallized appearance; upper and lower contacts are gradational.
Hp-10	GAB	177.48	185.03	med	5a	Gabbro, med grained (avg gr siz ~2-3mm),similar to unit from 164.56-164.83m, numerous poikilitic pyroxenes that are typically bronzite in composition; plagioclase ~50-60% (labradorite locally only); pyroxenes are green-grey to brownish-black to iridescent in colour ~30-40% and are subhedral, locally altered; there is a weak preferred orientation of the crystals at 70deg TCA; sulphides ~2-3%, ilmenite~1-2%; upper contact is gradational at alteration; lower contact is sharp. From 177.67-177.95m is fn gr gabbro with increased sulphides (contacts are abrupt, and composition is similar to unit above and below); fn gr unit also from 183.03-183.2m; previously cut sample from 183.05-183.2m; from 184 to 185.03m there is increased alteration associated with fractures.
Hp-10	GRAN	185.03	185.16	med	GRAN	Plagiogranite to granite, composed of qtz+ plagioclase + biotite; sharp upper and lower contacts; wk foln, no visible sulphides; white in colour; biotite aligned along foln planes at ~40deg TCA; med grained.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-10	GAB	185.16	185.83	med	5a	Gabbro, med gr, altered (serpentinized and wk biotite + amphiboles/pyroxenes); plagioclase is light grey in colour ~50-60%; pyroxenes are light green to dark green to black in colour ~30-35% and are altered; unit is cut by numerous fractures and small faults (serpentinized + slickenside surfaces); deformation may be attributed to the intrusion of the granite?; ilmenite ~1%, <1% sulphides, likely similar to unit from 177.48-185.03m but altered; lower contact at lost core.
Hp-10	LC	185.83	186.26		LC	lost core appears to be from 185.83-186.26
Hp-10	GAB	186.26	187.14	med	5a	Gabbro, med gr, similar to unit from 185.16-185.83m; altered (serpentinized and wk biotite + amphiboles/pyroxenes); plagioclase is light grey in colour ~50-60% (med to coarse gr); pyroxenes are light green to dark green to black in colour ~30-35% and are altered (anhedral to subhedral); unit is cut by numerous fractures and small faults (serpentinized + slickenside surfaces); minor carbonate along some of the fractures; ilmenite ~1-2%, ~2-4% sulphides, EOH at 187.14m.
Hp-11	OVB	0	3.52		OVB	No recovery
Hp-11	GAB	3.52	7.74	med	1a	Appears to be bedrock but is weathered and oxidized, rock is broken up and is mainly rubble, gabbro, med grained, oxidized and altered, cut by numerous fractures and faults, plagioclase ~60%, pyroxenes are altered, ilmenite locally present; lower contact appears to be at plagioclase segregation or anorthosite??, uncertain if contact is sharp due to the broken up core.
Hp-11	AN	7.74	8.1	med	6?	Anorthosite? Or plagioclase segregation? Upper and lower contact appear to be sharp, but the core is broken up and difficult to tell; med grained, ~90% + plagioclase; wk altn; ilmenite present locally, unit is grey to grey brownish in colour.
Hp-11	GAB	8.1	17.6	med-cr	1a	Gabbro, medium to coarse grained, unit is weathered, oxidized and is brittle and locally broken up or forms rubble; cut by numerous fractures and faults; plagioclase ~50-60%; pyroxenes (Cpx and Opx (bronzite)) ~25-30%; ilmenite is also present ~1-3%, rare sulphides visible (most are likely oxidized); unit has a granular feel, locally coarse grained segregations (crystals found up to 2cm in size);From 11.41-11.58m is what appears to be K-spar rich veins?? or is this staining of the plag (uncertain) these are pink in colour and cut the core at 30deg TCA; lower contact at transition from strongly weathered gabbro to relatively pristine gabbro.
Hp-11	GAB	17.6	24.03	med	1a	Gabbro, med grained, (opx rich) grey to dark grey in colour; plagioclase ~55-60% (almost labradorite composition), pyroxenes are anhedral to subhedral and are dark brown to brown to dark greenish-brown in colour~25-30%; ilmenite is also present (~1%); ~1% sulphides, weak altn; this unit is likely the same as that above but with decreasing oxidation and alteration; lower contact at significant change in grain size. (NOTE: from 17.68-17.76m is already sampled, only 1/2core remains)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-11	GAB	24.03	26.6	cr	Sulph	Gabbro, coarse grained, locally mineralized with massive to semi-massive sulphides; presence of two black metallic sulphides/oxides that are locally abundant up to 4-5% (cobaltite?? + ilmenite, black with wk violet hue to black, one is weakly magnetic, anhedral intercumulus crystal clusters (intercumulus to the plagioclase)); crystals are coarse to very coarse with crystals up to 4cm in size; the pyroxenes (cpx + Opx) are weakly altered and locally rimmed, biotite altn is wk, plagioclase is coarse grained; ~20% sulphides from 25.65-26.25m with massive sulphide bands at 25.65-25.75m; the top part of this interval is faulted and fractures with significant fault at 24.75m with coarse gouge; upper contact is abrupt and lower contact is gradational; unit has the appearance that it has been deformed.
Hp-11	GAB	26.6	28.1	med	1a	Gabbro, med grained, similar to unit above but with small grain size and significant decrease in sulphides; plagioclase ~60-65%, pyroxenes (Cpx+Opx) are green-grey to brown to dark brown-black in colour; locally weakly altered, the percentage of pyroxenes varies throughout the interval from 5-25%;Appears to be amphiboles locally; Plagiogranite segregation from 26.87-27.06m;<1% sulphides; lower contact is gradational.
Hp-11	GAB	28.1	33.13	cr	2a	Gabbro, coarse to very coarse grained, wk to mod altn; pyroxenes (Cpx +Opx) are locally being replaced by what appears to be biotite +/- amphiboles; pyroxenes up to 4cm in size and are anhedral to subhedral (rare euhedral); plagioclase forms the cumulate framework; metallic minerals locally present as intercumulus minerals (ilmenite +/- graphite?) ~2%; minor sulphides; unit is grey in colour and is cut by numerous fractures that appear to be sources of fluids (altn); upper contact is gradational and lower contact is sharp; towards the lower contact the pyroxenes are light pinkish-grey in colour and increase in size towards to the lower contact; plagioclase crystals are locally labradorite in composition.
Hp-11	GAB	33.13	44.3	med-cr	11a	Gabbro, med-coarse grained, plagioclase is labradorite in composition (An64), ~55-60% of the unit, pyroxenes are green-grey to dark brown-iridescent in colour and are anhedral to subhedral, avg size ~4-5mm rare crystals >1cm in length; also amphiboles locally replacing the pyroxenes; unit is dark grey to grey with a slight violet hue in colour; minor sulphides down to ~42.7m then there is an increase in sulphides towards the lower contact; slight increase in grain size from 43.45-43.75m; lower contact is sharp at massive sulphides. (NOTE: previously sampled from 40.9-44.3m)
Hp-11	MSULPH	44.3	49.27	fn	Sulph	Massive sulphides, hosted in what appears to be altered gabbro; >80% pyrrhotite + Cpy + silvery metallic sulphide and rare black metallic sulphides; fn gr massive sulphides surround plagioclase +/- pyroxene+/-amphibole crystals that are subhedral to euhedral; sulphides are primary????; appears to be flow structures in the sulphides; upper contact is sharp, lower contact is sharp.
Hp-11	LC	49.27	49.66		LC	

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-11	MSULPH	49.66	49.97	fn	Sulph	Same as unit from 44.3-49.27m
Hp-11	GRAN	49.97	50.6	med-cr	GRAN	Granite, sharp upper contact with massive sulphides, lower contact appears to be gradational (no sharp defined contact); unit is pink in colour and is med-coarse grained; very weak foliation locally, qtz+ K-spar+ muscovite and minor biotite.
Hp-11	GAB	50.6	55.48	med	11a	Gabbro, med grained, wk to mod altn; locally plagioclase segregations that are up to 5cm in width (~90%plag); alteration is patchy and is associated with fractures and small veinlets; the altn bleached the plagioclase so that they are white in colour; pyroxenes are dark green to brown in colour, locally bronzite present, ilmenite ~3-5% locally and is weakly magnetic, thin bands and blebs of magnetite are present locally, patchy mineralization (pyrite); strong pyrite mineralization from 55.25-55.33m (~80% pyrite); lower contact is at strong altn contact.
Hp-11	GAB-ALT	55.48	57.69	fn-med	11a	Altered gabbro/anorthosite; strong serpentine and moderate carbonate alteration; unit is dark green in colour; thin veinlets of carbonate cut the core at typically 30 and 80 deg TCA; ~3-5% veinlets; pyrite mineralization associated with the altn (~1-2%); ilmenite is also present ~1-2%; unit has a brecciated appearance; upper contact is abrupt, lower contact is at a small veinlet; from ~57-57.69m appears to be primarily plagioclase.
Hp-11	GAB	57.69	63.72	med	4	Gabbro, med grained, appears to be all the same unit with varying degrees of altn, from 57.69-58m contains small plagioclase segregation that is >90% plag and altd gabbro; altn is associated with fractures, faults and small veinlets and may lead to bleaching of the plagioclase in proximity to these features or serpentinization of the pyroxenes; plagioclase is near labradorite composition, ~50-60%, the laths are typically euhedral; pyroxenes (+/-amphibole) are brown to dark green to green-grey in colour, anhedral to subhedral; sulphides are diverse (pyrite, pyrrhotite, chalcopyrite, magnetite, ilmenite and a silver metallic mineral), bands and patches of magnetite mineralization locally present, ilmenite is weakly magnetic, upper contact is at a veinlets, lower contact is gradational, towards the lower contact this unit is similar in appearance to that from Hp-08 from 158.46-187.84m.
Hp-11	GAB	63.72	81.71	fn-med	5a	Gabbro, fine to med grained, grey in colour with black speckles, when dry is light grey in colour, host to numerous small fine grained segregations that are up to 3cm in width that typically host sulphide and oxide mineralization; ilmenite ~7-10% and is weakly magnetic; plagioclase ~55-60%, pyroxenes are green-grey to brown-green-grey to brown in colour and are anhedral to subhedral; wk biotite altn; fractures are locally serpentinized; lower contact is sharp. Similar to unit in Hp-08 from 158.46-187.84m.
Hp-11	GRAN	81.71	82	med	GRAN	Granite, sharp upper and lower contacts, med grained, altered, light pink to buff-grey in colour; minor biotite.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-11	GAB	82	90.45	fn-med	5a	Gabbro, similar to unit above from 63.72-81.71m, ilmenite rich, weakly magnetic, weak biotite alteration, serpentine altn associated with fractures; grey in colour; patchy sulphide mineralization and bands/pods/seams of magnetite; from 87.35-87.84m is a fine grained segregation of similar composition to that above and below just finer grained; EOH at 90.45m, also sampled from 85-85.1m (no sample #, just marked 6)
Hp-12	OVB	0	5.04		OVB	No recovery
Hp-12	LC	5.04	5.39		LC	lost core, ground up, appears to be at the top of the run, and potentially at the bottom of the run, not sure
Hp-12	GAB	5.39	7.45	med	1a?	Gabbro, med gr, weathered, granular feel, (crumbly), grey to light grey in colour; ~55-60% plag, ~25% pyroxenes are that dark green to green to green-grey in colour, (locally bronzite); no visible sulphides (likely oxidized), minor ilmenite; fractures are oxidized; lower contact appears to be sharp (broken core),
Hp-12	DYK	7.45	7.71	fn	12	Dyke? Fine to med grained, weakly magnetic (magnetite or ilmenite?) that is disseminated ~25%, appears to be gabbroic in composition (plagioclase + mafics), contacts??broken core, ground core, dark grey in colour.
Hp-12	LC	7.71	8.9		LC	Lost core, ground up
Hp-12	DYK	8.9	9.3	fn	12	Dyke? Similar to unit from 7.45-7.71m, Fine to med grained, weakly magnetic (magnetite or ilmenite?) that is disseminated ~25%, appears to be gabbroic in composition (plagioclase + mafics), contacts??broken core, ground core, dark grey in colour.
Hp-12	GRAN	9.3	9.61	fn	GRAN	Granite/ plagiogranite, fine-med grained, upper and lower contacts are ?? (broken up or lost core); white in colour, weak-mod foliation at ~20deg TCA, biotite bearing as small flecks.
Hp-12	LC	9.61	11.14		LC	ground up core, no recovery
Hp-12	GRAN	11.14	11.2	fn	GRAN	Similar to unit from 9.3-9.61m, only small rounded pieces of rubble recovered, white, fine grained, qtz+plag, biotite bearing.
Hp-12	LC	11.2	11.7		LC	Lost core, ground-up
Hp-12	GAB	11.7	12.46	med	1a	Gabbro, med grained with fine grained segregation from 12-12.15m, plagioclase ~60%, pyroxenes are dark green to dark brown to black in colour and are subhedral, locally coarse grained crystals up to 1cm in size, bronzite also present, unit cut by numerous fractures which are oxidized, no visible sulphides, minor oxides present (ilmenite); upper contact is ground, lower contact is sharp at grain size change.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-12	GAB	12.46	25.24	fn-med	12	Gabbro, fine grained, wk to mod magnetic down hole from ~14.1m to 25.24m; ilmenite rich ~10-20%, plagioclase ~50-60%, pyroxenes are dark brown to black in colour and are fine grained ~25-30% (Bronzite?); locally coarser crystals present in fine gr matrix ; cut by numerous fractures that are locally oxidized, no visible sulphides (likely oxidized); lower contact is at significant decrease in ilmenite
Hp-12	GAB	25.24	27.69	fn-med	1a+12	Gabbro, fine to me grained, mixed unit, wk magnetic, fn gr gabbro with med grained segregations, there is a slight foliation to the unit locally that is near parallel to low angles to the core axis; unit is cut by numerous fractures that are oxidized; ~25% med gr and 75% fine gr, both are host to ~10% ilmenite that is weakly magnetic; unit is grey to orangey-brownish-grey in colour; no visible sulphides (likely oxidized); no visible bronzite; pyroxenes are locally rimmed (secondary pyroxenes or possibly amphiboles?); lower contact is at med-coarse gr gabbro, sharp (fractured and oxidized contact); this unit may be part of a cyclical series of layers.
Hp-12	GAB	27.69	28.73	med-cr	1a	Gabbro, similar to unit from 5.39-7.45m; med-coarse grained; cut by numerous fractures that are oxidized (source of oxidizing fluids);pyroxenes are dark green in colour to brownish-green (bronzite present locally); plagioclase is bleached white to grey in colour; ilmenite also present (~2%); no visible sulphides, likely oxidized; small finer grained segregations?? from 28.33-28.48m with abrupt and irregular contacts; lower contact appears to be sharp but the core is broken up. (CYCLICAL unit similar to 5.39-7.45m?)
Hp-12	GAB	28.73	29.02	fn	12	Gabbro?? Fine grained, similar to unit from 7.45-7.71m; dark grey to black in colour, rare fine gr bronzite present, weakly magnetic, ilmenite/magnetite ~25%;appears to be gabbroic in composition (plagioclase + mafics); upper and lower contacts appear to be sharp but the core at the contacts is broken up.(Cyclical unit, similar to unit from 7.45-7.71m)
Hp-12	GAB	29.02	29.43	med	1a	Gabbro, med grained, plagioclase is grey to pinkish-grey in colour; pyroxenes (including bronzite) are dark green to green to grey to brownish in colour; ~1% sulphides that are intercumulus to the plagioclase framework; weak altn but little to no oxidation (core is more pristine); upper contact is sharp?? (core broken up) and lower contact is sharp, minor ilmenite (~1%); unit has a pinkish-grey colouration; may be similar to unit from 11.7-12.46m; cyclical unit?
Hp-12	GAB	29.43	31.03	fn-med	12	Gabbro, fine-med grained (gradual increase in grain size towards the lower contact); wk to mod magnetic; ilmenite bearing ~10-15%; wk biotite altn; ~1% sulphides; plagioclase forms small laths ~50%; similar to unit from 12.46-25.24m but finer grained and slightly more mafic; upper contact is sharp, lower contact is sharp (CYCLICAL Unit similar to unit from 12.46-25.24m)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-12	GAB	31.03	34.47	med	1a	Gabbro, med grained; similar to unit from 27.69-28.73m from 31.03-33.15 and grades into unit similar to 29.02-29.43m from 33.15-33.94m then grades back into unit similar to 27.69-28.73 from 33.94-34.47m; these two unit may simply represent slight changes in alteration; from 31.63-31.79 there is a finer grained segregation with gradational contacts (similar composition to units above and below); plagioclase is yellowish-grey to pinkish-grey in colour ~50-60%; pyroxenes are dark brown to dark green to green-grey in colour and are locally altered or rimmed; wk biotite altn; ~1% sulphides; minor ilmenite ~1%; lower contact is sharp but at low angle TCA (25deg) (cyclical unit? (similar to unit from 27.69-28.73m and from 29.02-29.43m)
Hp-12	GAB	34.47	34.69	fn	12	Gabbro, fine grained, weakly magnetic, similar to unit from 7.45-7.71m and from 28.73-29.02m; dark grey in colour; sharp upper and lower contacts; ~2-3% sulphides, ~10-15% ilmenite (magnetic); rare med grained crystal present in fine grained matrix. (cyclical unit? (similar to unit from 27.69-28.73m and from 29.02-29.43m)
Hp-12	GAB	34.69	38.46	med	1a	Gabbro, med grained (to coarse grained locally), plagioclase is grey to grey-violet in colour; bronzite rich, wk to mod altn of the pyroxenes (amphiboles + biotite); pyroxenes are anhedral to subhedral ~25%; ~1% ilmenite, ~1% sulphides; locally the sulphides are oxidizing and breaking the core apart (expanding); similar to units from 31.03-34.47m, when dry the plagioclase is white in colour, when wet it is grey; upper contact is sharp, lower contact is sharp.
Hp-12	GAB	38.46	38.62	fn-med	1a	Gabbro, fine-med grained, weakly magnetic, ~2-4% sulphides, upper contact is abrupt, lower contact is abrupt but mineralized, (fine grained seams of pyrite mineralization); similar composition to unit above but finer grained, minor ilmenite (~1%) (pyrrhotite is magnetic); dark grey in colour.
Hp-12	GAB	38.62	40.46	cr	1a	Gabbro, med-coarse grained; similar to unit from 34.69-38.46m but slight increase in grain size, plagioclase is grey to grey-violet to yellowish-grey in colour and varies from 60-65% locally; pyroxenes are dark brown to dark green-grey to green-grey in colour and are anhedral to subhedral, varies from 10-25%, bronzite locally abundant; numerous fractures cut the core and appear to be sources of fluids and oxidizing fluids, locally the sulphides oxidizing and breaking the core apart (they are expanding!); unit is grey in colour; lower contact at lost core.
Hp-12	LC	40.46	40.88		LC	Lost core, no recovery

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-12	GAB	40.88	44.67	cr	1a	Gabbro, coarse grained similar to unit from 34.69-38.46m and from 38.62-40.46m 34.69-38.46m but slight increase in grain size, plagioclase is grey to grey-violet to yellowish-grey in colour and varies from 60-80% locally; pyroxenes are dark brown to dark green-grey to green-grey in colour and are anhedral to subhedral to rare euhedral, varies from 10-30%, bronzite locally abundant; numerous fractures cut the core and appear to be sources of fluids and oxidizing fluids, locally the sulphides oxidizing and breaking the core apart (they are expanding!); unit is grey in colour; lower contact at granite.
Hp-12	GRAN	44.67	44.77	med	GRAN	Granite/ plagiogranite, fine-med grained, upper and lower contacts are ?? (broken up) appear to be sharp; white in colour, mod foliation at ~30deg TCA, biotite bearing as small flecks; granular feel.
Hp-12	GAB	44.77	52.13	med	1a	Gabbro, similar to unit from 38.62-40.46 and from 40.88-44.67m, plagioclase is grey to dark grey in colour and varies from 55-65% locally; pyroxenes are dark brown to dark green-black to green in colour and are anhedral to subhedral to rare euhedral, varies from 20-30%, bronzite locally abundant; unit is grey in colour; lower contact appears to be an altn contact at ~52.13m where there is a change in the alteration from weak biotite to serpentine.
Hp-12	GAB	52.13	58.23	med	1a	Gabbro, med gr, similar to unit above but the pyroxenes are green to green-grey in colour and there is a slight textural change in the plagioclase down hole to better developed crystals and slight increase in gr sz; Plag is grey to dark-violet-grey in colour ~55-65%; pyroxenes are green to green-grey to light green in colour and are anhedral to subhedral, altered and locally zoned; minor amphiboles; sulphides ~1-2% and ilmenite <1to 1%; lower contact is gradational (arbitrary?)
Hp-12	GAB	58.23	60.5	med	11a	Gabbro, med grained (Avg gr sz ~3-4mm), similar to unit above, but with more clearly defined plagioclase, larger more abundant pyroxenes (including bronzite) and increase in sulphide mineralization; unit is grey in colour; plagioclase is grey to dark-violet-grey in colour ~50-60%; pyroxenes are green to dark green to green-grey to brownish-green in colour and are anhedral to subhedral ~25-35%; sulphides are irregularly distributed, but from 59.44 down hole there is an increase from 1-2% to 5-7%; ilmenite also present typically <1%; the sulphides are intercumulus to the plagioclase; lower contact at finer grained gabbro and is abrupt (not sharp defined contact)
Hp-12	GAB	60.5	61.06	fn-med	11a+ Sulph	Gabbro, fine to med gr (Avg gr size 1-2mm); sulphide distribution is patchy; Pyrrhotite mineralization that is present as fine gr pods and massive to semi-massive bands, unit contains ~ 10-15% sulphides; plagioclase is near labradorite in composition and is grey to bluish grey to violet-grey in colour; pyroxenes are brownish to greenish-brown in colour and are anhedral to subhedral (bronzite locally present); upper and lower contacts are abrupt (no sharp boundaries) to slightly gradational;

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-12	GAB	61.06	64.1	med-cr	4+ Sulph	Gabbro, med-coarse grained (avg gr size ~4-5mm), mineralized (strong mineralization from 63.27-64.1m); plagioclase ~45-50%; pyroxenes are brownish-green to green to grey to pinkish-brown in colour and are anhedral to subhedral to rare euhedral ~20-35%; amphiboles locally; unit is grey in colour; sulphides abundant from 63.27-64.1m and form semi-massive to disseminated pods of pyrrhotite + chalcopyrite and tr pyrite (~35-40% sulphides); minor ilmenite is also present (<1%); sulphide distribution is irregular; lower contact is at change in gr size and is weakly gradational over a couple of cms.
Hp-12	GAB	64.1	67.26	med	11a+ Sulph	Gabbro?, med grained, Plagioclase ~70-75%; pyroxenes are light green to dark green in colour and are anhedral and intercumulus to the plagioclase ~10-15%; strong sulphide mineralization locally, the sulphides are also intercumulus to the plagioclase giving the unit a similar appearance to a conglomerate or that is weakly brecciated (intercumulus material between the plagioclase ~25-30%); strong sulphide mineralization from 64.49-65.21m where there are massive and semi-massive bands of sulphides (~60% sulphides) composed of primarily pyrrhotite and chalcopyrite; sulphide mineralization above and below this interval is ~5-10%; lower contact is at fracture zone and appears to be the transition from pyrrhotite to pyrite mineralization.
Hp-12	GAB	67.26	73.38	med-cr	11a	Gabbro, med-coarse grained (grain size increases with depth), cut by numerous serpentinized fractures; pyroxenes are dark green to green to greenish-brown in colour and are locally rimmed, bronzite locally present, pyroxenes are anhedral to subhedral; some of the pyroxenes have a darker centre and a lighter green rim (reaction rim or new mineral?); in proximity to the fractures there is increased alteration and pyrite mineralization (seams, fracture fill, rims surrounding crystal grains and disseminated crystals; minor carbonate associated with the fractures including very small veinlets (1-2mm in width); sulphide mineralization is locally replacing the pyroxenes +/- amphiboles; ~2-4% sulphides; unit is grey in colour; locally small plagioclase segregations up to 5cm in thickness that are up to 90% plagioclase; strong cumulate textures; lower contact is sharp at a dyke.
Hp-12	DYK	73.38	73.49	fn	12	Dyke, fine grained, sharp upper and lower contacts, dark grey in colour, very weakly magnetic; appear to be similar composition to gabbro.
Hp-12	GAB	73.49	74.72	cr	11a	Gabbro, coarse grained, similar to unit from 67.26-73.38m, but coarser grained, cut by serpentinized fractures (moderate serpentine altn + fractures from 74.2-74.72m); strong cumulate textures; pyroxenes are dark green to brownish-green in colour, bronzite locally, mineralization associated with the serpentine +/- carbonate altn is pyrite; mineralization is irregularly distributed (<1%), ~1% ilmenite (weakly magnetic); lower contact is abrupt (change in altn and mineralogy? or just altn?)

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-12	GAB	74.72	77.36	cr	11a+Sulph	Gabbro to norite; coarse gr (avg gr sz ~5mm); plagioclase is grey ~55-60%, pyroxenes are green to dark green to brown in colour (bronzite is abundant), ~25-30%, +/- amphiboles; crystals up to 2cm in size; ilmenite is intercumulus to the plagioclase framework ~2-3%; sulphides are also intercumulus to the plagioclase ~1% except from 75.37-75.6m where pyrite, chalcopyrite and a silvery mineral (likely graphite) are present ~15%; lower contact is abrupt at grain size and foliation change; ilmenite is abundant at lower contact + minor biotite altn.
Hp-12	GAB	77.36	81.39	med	11a	Gabbro, med grained, weakly magnetic, wk to moderate foliation at 60deg TCA; ilmenite rich ~ 10-15%; plagioclase is grey in colour ~50-60%, pyroxenes are dark brown to brown to green-brown in colour ~25-35% (bronzite present); the pyroxenes are weakly aligned forming a mineral lineation at ~60deg TCA; sulphides are locally present <1%; unit is also cut by a number of serpentinized fractures so that in proximity to these fractures there is a weak serpentinization of the core; lower contact is gradational and location is arbitrary.
Hp-12	LGAB	81.39	84.04	med	11a	Leuco Gabbro (altd gab?), med grained, light grey to grey in colour, weakly magnetic, ilmenite ~10%; plagioclase ~ 55-65%, pyroxenes are light green to green in colour and are anhedral to subhedral ~20-25%; locally this unit has a bleached appearance (plagioclase is white in colour and appears to be associated with fluids); numerous serpentinized fractures cut the unit; lower contact is gradational (location is arbitrary); set at small shear. (is this unit the same as that above? with increased altn and decrease in pyroxenes?);
Hp-12	GAB	84.04	85.81	med	11a	Gabbro, med grained, magnetic, mixed unit: gabbro interbedded with fine grained gabbro and plagioclase rich sections, each of which varies in thickness; upper contact is at small shear and in a unit similar to that from 81.39-84.04m down to 84.43m. The unit is also cut by a number of fractures that are serpentinized, pyrite mineralization appears to be associated with this type of altn; unit is wk to mod magnetic depending on the ilmenite content +/- magnetite (~2-10% locally); graphite is locally present as seams and pods and is not magnetic and has a slight violet hue ~1%; plagioclase is grey to pinkish grey in colour; pyroxenes are green to dark green to green-brownish in colour; weak to moderate altn; sulphides are present as fracture fill and as intercumulus minerals (~1-2%); EOH at 85.81m
Hp-12A	OVB	0	5.05		OVB	Overburden, no recovery

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-12A	GAB	5.05	17.47	med	1ab	Gabbro, med gr, weathered and oxidized, fractured and faulted, locally poor recovery, brittle, granular feel, any sulphides that were present are either oxidized or have been reduced to their components and the sulphur is present as yellow staining of the core, core white with black specks or is brown to burnt-umber in colour (oxidation); fractures and faults appear to be sources of oxidizing and altering fluids; pyroxenes are black to dark green in colour and are subhedral ~25-30% (bronzite also present); ~1-2% veining that appear to be granitic in composition; lower contact is gradational (Lost core from 6.57-7.3m, 8.25-8.48m, 9.7-9.89m and 10.49-10.69m)
Hp-12A	GAB	17.47	19.52	med	1ab	Gabbro, med grained, uncertain if this is the same as the unit above but with increased alteration or if this is a different unit. Upper and lower contacts are abrupt but gradational (over 1-2cm), this unit is grey in colour, plagioclase is grey ~55-60%, pyroxenes are green in colour but are rimmed, centre of the crystals are dark grey to grey-brownish in colour, ~30-35% (Minor bronzite), unit is cut by numerous fractures that are oxidized; <1% ilmenite; any sulphides that may have been present are oxidized.
Hp-12A	GAB	19.52	20.83	med	1ab	Similar to unit from 5.05-17.47m; Gabbro, med gr, pyroxenes are dark green to black to brown in colour ~25-30%, bronzite also present, tr ilmenite, no visible sulphides (likely oxidized); upper and lower contacts are abrupt but gradational over 1-2cm.
Hp-12A	GAB	20.83	22.24	med	1ab	similar to unit from 17.47-19.52m, Gabbro, med grained, pyroxenes are green to dark green to green-grey in colour, cut by a number of fractures that are weak to moderately oxidized, sulphides are weathered and oxidized and stain the core yellow to orange, lower contact at lost core.
Hp-12A	LC	22.24	23.23		LC	Lost core, no recovery, chose this location due to ground ends
Hp-12A	GAB	23.23	25.13	med	1ab	similar to unit from 17.47-19.52m and from 20.83-22.24m, Gabbro, med grained, pyroxenes are green to dark green to green-grey in colour, pyroxene colour darkens and the plagioclase lightens towards the lower contact (due to altn), cut by a number of fractures that are weak oxidized, sulphides are weathered and oxidized and stain the core yellow to orange, lower contact at lost core; weak biotite altn; <1% ilmenite.
Hp-12A	LC	25.13	25.58		LC	Lost core, no recovery, chose this location due to ground ends
Hp-12A	GAB	25.58	26.13	med	1ab	similar to unit from 17.47-19.52m and from 20.83-22.24m and from 23.23-25.13m, Gabbro, med grained, pyroxenes are green to dark green in colour, pyroxene colour darkens and the plagioclase lightens towards the lower contact , cut by a number of fractures that are weak oxidized; weak biotite altn; <1% ilmenite; lower contact is sharp at granite.
Hp-12A	GRAN	26.13	26.4	med	GRAN	Granite/plagiogranite, med grained, appears to be sharp upper and lower contacts (both are broken up); white to light pinkish in colour; biotite bearing as small flecks; cut by a number of fractures, core is brittle; small quartz veins cut the granite at ~60deg TCA.

Hole ID	Litho	From	To	Grain Size	Unit Code	Description
Hp-12A	GAB	26.4	28.84	med	1ab	Gabbro, similar to that from 25.58-26.13m; plagioclase is white to grey in colour, pyroxenes are dark green to green in colour weak biotite altn; unit is cut by numerous fractures that are weakly oxidized; pyroxenes are anhedral and locally are rimmed; lower contact is sharp at granite/plagiogranite
Hp-12A	GRAN	28.84	29.45	med	GRAN	Granite/plagiogranite, similar to that seen above from 26.13-26.4m, fine to med grained, white to light grey in colour, biotite bearing as small flecks, sharp upper contact, lower contact at lost core; black metallic minerals (dull luster and is present along fractures.
Hp-12A	LC	29.45	29.7		LC	Lost core, no recovery, chose this location due to ground ends
Hp-12A	GAB	29.7	30.57	med	1ab	Gabbro, med grained, similar to unit from 26.4-28.84m; dark green to green pyroxenes are anhedral to subhedral ~30-35% that are weak to moderately altered; numerous fractures, core is brittle, weak oxidation along the factures.
Hp-12A	LC	30.57	30.8		LC	Lost core
Hp-12A	GAB	30.8	30.97	med	1ab	Similar to unit from 29.7-30.57m, Gabbro, med grained, brittle due to fractures and faults, pyroxenes are dark green and weakly to moderately altered, weak biotite altn, any sulphides/oxides are being oxidized; EOH at 30.97m

Appendix D. Logging: Alteration (all drill holes)

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
H-01	2.01	23.94	Ox	w	Bio	vw			level of oxidation is ~26m, minor biotite in the top 15m of the hole
H-01	23.94	24.27	Ser	w	Ox	w			minor alteration in vein
H-01	24.97	26.4	Ox	w					level of oxidation is ~26m
H-01	31.28	31.8	Ser	w	Ox	vw			in granitic vein
H-01	34.25	41.1	Carb	vw					Carbonates associated with the fractures and faults; very weak alteration locally.
H-01	43.65	67.5	Ox	w					oxidation associated with the numerous fractures cutting the granodiorite to
H-01	67.5	80.44	Ser	vw					very weak, light green patches of what appears to be sericite
H-01	80.44	85.83	Carb	m					
H-01	99.54	103.5	Ser	w					
H-01	110.8	114.58	Chl	w	Ser	w			thin veinlets or fracture fill with chlorite and minor sericite
H-02	2.04	5.14	Chl	w					weathered from the elements; poorly consolidated and crumbly; some lost core
H-02	5.14	23.4	Ox	w					still in the oxidation zone
H-02	74.4	76.5	Chl	w	Sil	w	Hem	vw	small band of altered granodiorite, magnetite also present and minor hematite
H-02A	1.7	11.65	Ox	m					oxi assoc with the frac and flts that cut the core most of the core has a granular feel due to weathering and the breakdown of the rocks to form sands
H-02A	11.65	12.46	Ox	w					oxidation assoc with the frac and flts that cut the core (within the weathering zone) most of the core has a granular feel due to weathering and the breakdown of the rocks to form sands; feldspars are starting to break down to form clays.
H-02A	12.46	18.94	Ox	m					oxi assoc with the frac which gives the core a orangey pinkish colouration.
H-02A	18.94	24.55	Ox	w					
H-02A	24.55	36.84	Ox	w					weak to moderate in the granodiorite (oxidized)
H-02A	38.7	42.54	Ox	w					
H-02A	42.54	44	Bio	w					alteration of the pyroxenes/ making them buff in colour or is this primary
H-02A	44	49.4	Act	vw	Bio	vw			alteration of the pyroxenes/ making them buff in colour or is this primary
H-02A	49.4	50.58	Sil	w	Ser	w	Epi	vw	appears to be VW Epi, w Ser, W sil
H-02A	50.58	57	Act	m					something that is breaking down the pyroxenes and is making them buff in color and appear to be flaky in texture
H-02A	57	58.42	Serp	m	Carb	vw			associated with fractures/ faults and makes the contrasting colours of the minerals stand out; increasing sulphide content

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
H-03	0.9	5.86	Ox	m					upper weathering zone and oxidation zone; water infiltration and deterioration of the core
H-03	6.58	7.19	Ox	m					upper weathering zone and oxidation zone; water infiltration and deterioration of the core
H-03	7.19	13.82	Ox	w					granite has Fe-staining and is oxidized along the fractures; attributed to oxidation of sulphides
H-03	13.82	14.28	Act	w	Ox	vw			actinolite alteration of the pyroxenes; minor Fe-oxides along fractures and
H-03	14.93	20.29	Ox	w	Act	w			minor Fe-oxides along frac and flts, and staining; actinolite altn of the pyrox
H-03	20.29	33.53	Act	w	Bio	vw			actinolite alteration of the pyroxenes +/- minor biotite alteration
H-03	33.75	44.2	Bio	vw	Serp				very weak biotite alteration of the pyroxenes, serpentine along fractures
H-03	45.32	45.64	Bio	w					biotite alteration of the pyroxenes
H-03	47.89	48.24	Bio	m					biotite alteration of the pyroxenes
H-03	48.24	50.7	Ox	w					along fractures
H-03	84.6	92.2	Serp	w	Carb	w	Bio	w	serpentine is associated with the faults and fractures, the carbonate is associated with the veins and fractures and the biotite is a weak pervasive alteration of the pyroxenes but becomes more intense in proximity to the veins
H-03	92.2	97.57	Serp	w	Bio	vw			serp is assoc with the flts and frac, and the biotite is a weak pervasive alteration of the pyrox but becomes more intense in proximity to the vns and frac.
H-03	97.57	101.4	Bio	vw					locally biotite alteration of the pyroxenes
H-03	101.4	115.1	Serp	w	Bio	vw			serpentine present along fractures and faults and very weak alteration
H-03	115.1	121.16	Bio	vw					
H-03	122.09	122.45	Serp	w					
H-03	122.45	128.5	Bio	vw	Serp	vw			white colouration (plag segregation or possibly a bleaching effects assoc with flts and frac, no distinct contact for these to be veins.
H-04	2.74	3.64	Ox	m					weathered from surficial weathering
H-04	3.83	5.25	Ox	m					weathered from surficial weathering
H-04	5.25	19.7	Ox	w	Serp	vw	Bio	w	
H-04	19.7	22.43	Carb	vw					
H-04	22.43	25.5	Serp	vw	Carb	vw			
H-04	27.06	28.4	Serp	w					

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
H-04	28.4	29.67	Bio	vw					
H-04	29.67	30.9	Serp	w					
H-04	30.9	31.37	Bio	w					
H-04	31.37	33.46	Serp	vw	Act	vw			appears to be actinolite alteration of the pyroxenes
H-04	3.46	34.6	Serp	w	Bio	w			
H-04	34.6	38.9	Serp	w	Carb	vw	Epi	w	shr zones are light green-grey in colour and composed of epi/serp?
H-04	38.9	41.45	Carb	w					carbonate along the fracture and fault planes and in breccia
H-04	41.45	44.62	Bio	vw	Act	vw			alteration of pyroxenes
H-04	44.7	44.81	Act	vw					alteration of pyroxenes
H-04	44.81	44.88	Bio	s					band of biotite?
H-04	45.06	45.15	Bio	m					bands of biotite altn
H-04	45.15	48.08	Bio	m					
H-04	48.08	56.3	Bio	vw					
H-04	56.3	56.94	Serp	w					
H-04	60.33	60.87	Bio	m					bio altn along the cont of the ga/ granite, centre of gab is not altd, bwn-red bio
H-04	75.83	76.17	Fcarb	w					
H-04	76.5	76.6	Fcarb	w	Bio	w			
H-04	76.6	77.12	Act	vw					
H-04	77.12	77.2	Serp	m	Fcarb	vw			
H-04	77.2	77.32	Bio	vw					
H-04	77.32	81.09	Act	w	Serp	VW			alteration of the pyroxenes, serpentine along the fractures and faults
H-04	81.09	88.23	Serp	w	Bio	vw			
H-04	88.23	88.69	Bio	w					
H-04	88.69	89.58	Serp	vw					
H-04	89.58	89.74	Bio	m					
H-04	89.74	91.91	Serp	w	Bio	vw			
H-04	91.91	93	Serp	m					
H-04	93	94.4	Bio	w					
H-04	94.8	95.28	Bio	w					
H-04	95.28	100.3	Bio	w	Serp	vw			

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
H-04	100.3	102.82	Bio	m	Serp	w			
H-04	102.82	103.15	Bio	w					
H-04	103.15	103.68	Bio	vw					
H-04	103.68	105.7	Serp	vw	Bio	vw			
H-04	114	117.65	Serp	vw	Bio	vw			
H-04	117.65	121.66	Serp	vw	Bio	vw			serp along frac and locally as v wk altn, v wk bio altn of the pyrox locally
H-04	121.66	122.48	Serp	w					
H-04	124.13	131.26	Bio	vw	Serp	vw			
H-05	1.21	8.23	Ox	m					
H-05	8.23	13.75	Ox	m					poor recovery, LC in this interval, recovered pieces are oxidized and weathered
H-05	13.75	19.5	Ox	w					oxidation associated with the fractures and faults that cut the interval
H-05	19.5	20.26	Bio	w					
H-05	22.93	23.38	Bio	w					
H-05	26.22	26.45	Bio	s					
H-05	26.45	27.19	Bio	w					
H-05	27.88	28.6	Carb	vw					weak carbonate that rims the ilmenite crystals
H-05	28.6	29.26	Bio	s					
H-05	29.26	31.43	Bio	w					patches of what appear to be sections of gabbro that are strongly altered
H-05	31.43	31.74	Bio	s					moderate to strong altn
H-05	31.74	36.08	Bio	w					biotite alteration of the pyroxenes
H-05	36.43	37.39	Bio	vw	Act	vw			alteration of the pyroxenes
H-05	37.39	37.82	Bio	vw					
H-05	37.82	65.42	Bio	vw					typically assoc with the plag segregation vns, but there is a v wk bio altn
H-05	66.2	66.85	Bio	vw					
H-05	68.04	81.26	Bio	vw					
H-05	81.26	83.26	Bio	vw	Act	vw			small band of strong biotite at 81.5-81.58m
H-05	83.26	88.33	Bio	vw					very weak to weak
H-05	88.33	88.35	Bio	m					
H-05	88.73	88.89	carb	vw					appears to be a rim of carbonate surrounding the ilmenite crystals
H-05	88.89	89.2	Bio	vw	Serp	vw			

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
H-05	89.2	92	Bio	vw					
H-05	97.3	101.04	Serp	vw	Bio	vw			serpentine is typically along fractures, biotite altn of the pyroxenes
H-06	1.64	4.89	Ox	m					iron oxidation, and weathered, rock is breaking down
H-06	4.89	7.67	Ox	w					iron oxidation of the granite and the Fe-bearing minerals and along fractures
H-06	7.67	9.17	Ox	m					numerous frac and flts are conduits for fluids to oxi and break down the rock.
H-06	9.17	10.21	Bio	vw	Act	w			alteration of the pyroxenes
H-06	10.21	10.58	Ox	m	Bio	w			
H-06	10.58	21.4	Bio	vw					
H-06	21.4	38.23	Bio	w	Serp	vw			
H-06	38.23	40.48	Bio	vw					
H-06	44	45	Act	vw					alteration to the pyroxenes, weak
H-06	45	45.36	Bio	w					weak to moderate alteration
H-06	45.36	45.8	Bio	m					
H-06	45.8	45.96	Bio	m					
H-06	45.96	46.77	Bio	m					
H-06	46.77	48.9	Bio	m	Serp	vw			patches of moderate biotite alteration, serpentine along fractures
H-06	48.9	49.15	Bio	w					
H-06	49.15	50.73	Bio	vw					
H-06	50.73	52.26	Bio	s	Serp	m			What type of alteration will cause the core to be purple in colour??
H-06	52.26	56.95	Serp	vw					
H-06	56.95	57.4	Serp	w					
H-06	57.4	70	Bio	vw	Serp	vw			serpentinized fractures
H-06	71.3	71.95	Bio	w					
H-06	83	83.35	Bio	w					
H-06	88.58	89	Bio	w					
H-06	92.7	93.52	Serp	w					serpentine associated with fractures and faults
H-06	94.5	94.7	Serp	w					fractures
H-06	98.38	110.1	Bio	vw					
H-06	108	108.32	Serp	w					
H-06	111.5	111.6	Bio	w					
H-06	111.6	112.5	Serp	vw					

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
H-06	116.9	122.24	Serp	vw	Bio	vw			very weak biotite locally, serpentine altn associated with the fractures
H-06	122.24	123.74	Bio	vw					altn of the pyroxenes
H-06	123.74	123.88	Bio	w					
H-06	123.88	126.28	Bio	vw					
H-06	126.28	130	Bio	vw					
H-06	130	133.2	Serp	vw	Bio	vw			
H-06	133.2	138.5	Bio	vw					locally coarse biotite associated with plagioclase segregations
H-06	140.15	140.5	Serp	w					
H-06	141.4	141.85	Serp	w					
H-06	143.9	144.45	Serp	w					
H-06	144.45	150	Bio	vw					
H-06	150	151	Serp	w					
H-06	155.5	156.5	Bio	w					
H-06	159	160	Bio	w					
H-06	163.15	163.5	Serp	w					
H-06	163.5	173.2	Bio	vw					
H-06	173.2	173.4	Serp	w					
H-06	174.7	175.1	Serp	m					
H-06	175.75	176.2	Serp	w					
H-06	176.6	177.4	Serp	w					
H-06	177.4	180.66	Bio	w					
H-06	180.66	191.62	Bio	w	Serp	vw			patchy biotite altn; serpentine is typically associated with fractures and faults
Hp-07	1.95	3.4	Hem	s					weathered and strongly oxidized
Hp-07	3.4	3.44	Hem	m					mainly along fractures
Hp-07	3.96	4.57	Hem	m					mainly along fractures
Hp-07	4.57	5.75	Hem	s					pervasive
Hp-07	5.75	6.05	Hem	m					
Hp-07	6.05	8.36	Hem	m	Act	m			altn of the pyroxenes
Hp-07	8.91	16.22	Hem	s					pervasive oxidation attributed to fractures and faults
Hp-07	16.91	17.16	Hem	s					very strong oxidation and what appears to be clays developing
Hp-07	17.3	20.2	Hem	s					
Hp-07	20.5	21.53	Hem	m					

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-07	21.53	23.5	Hem	s					
Hp-07	23.5	24.26	Hem	w	Act	w			
Hp-07	24.26	25.24	Carb	vw	Serp	vw			
Hp-07	25.24	27.44	Serp	vw					
Hp-07	28.13	28.64	Act	vw					
Hp-07	32.3	39.65	Serp	w					serp altn assoc with the frac and faults and also appears as altn of the pyroxenes.
Hp-07	39.65	44.45	Serp	w					
Hp-07	44.45	50.35	Serp	vw					typically along fractures
Hp-07	55.63	58	Serp	w					
Hp-07	58	58.87	Mus	w					
Hp-07	58.87	60	Serp	m					type of altn has rendered patches of the plag in the gab white to light pink
Hp-07	60	64.33	Serp	vw	Act	w			
Hp-07	64.33	65	Serp	w					
Hp-07	67.85	69.2	Serp	w					
Hp-07	70.8	72.2	Serp	w					
Hp-07	72.2	72.96	Serp	vw					along fractures
Hp-07	72.96	76.42	Bio	vw	Act	vw			
Hp-07	76.42	83	Serp	w					
Hp-07	83	88.78	Act	vw					very weak altn of the pyroxenes
Hp-07	89.08	90.31	Act	vw					very weak altn of the pyroxenes
Hp-08	11.36	17.12	Ox	m					weathering of the gab and sulph, in the upper oxi and weathering zone.
Hp-08	17.12	30	Act	vw					vw to w altn of the Cpx
Hp-08	30	34	Act	vw	Serp	vw			
Hp-08	34	35.49	Ble	s	Serp	vw	Hem	vw	Bleached plag + hem+serpentine
Hp-08	35.49	37.46	Serp	s	Py	m			
Hp-08	37.46	49.35	Serp	w					weak to moderate altn, typically associated with the fractures/faults
Hp-08	49.35	57.65	Serp	w	Carb	vw	Ble	w	associated with the fractures
Hp-08	57.65	62.6	Serp	w					
Hp-08	67	68.6	Serp	m					moderate to strong locally

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-08	71.09	77.5	Serp	m					numerous faults and fractures
Hp-08	77.5	80.1	Serp	s					bleached plagioclase (w-mod)
Hp-08	80.1	81.08	Serp	m					bleached plagioclase (w)
Hp-08	81.08	83.81	Serp	w					associated with the fractures
Hp-08	83.81	84.95	Serp	w					
Hp-08	84.95	86.73	Bio	w					
Hp-08	86.73	86.9	Bio	m					
Hp-08	86.9	87.26	Bio	m					
Hp-08	87.26	88.07	Bio	m					
Hp-08	88.07	88.38	Bio	s					
Hp-08	88.38	88.77	Bio	s					
Hp-08	88.77	89.17	Bio	s					
Hp-08	89.17	89.4	Bio	m					
Hp-08	89.4	90.31	Bio	s					
Hp-08	90.31	90.44	Bio	s					
Hp-08	90.44	92.02	Bio	s					
Hp-08	92.02	92.56	Bio	s					
Hp-08	92.56	95.56	Bio	s					
Hp-08	95.56	97.35	Bio	m					weak to moderate altn
Hp-08	99	100.27	Bio	w					
Hp-08	103	108.6	Carb	vw	Serp	vw			serpentine associated with fractures locally
Hp-08	108.6	112.06	Serp	vw					
Hp-08	112.06	118.25	Serp	vw	Act	vw			altn of the pyroxenes
Hp-08	118.25	119.07	Bio	w					
Hp-08	119.07	119.62	Bio	m	Mus	w			
Hp-08	119.62	120	Bio	w					
Hp-08	124.84	125.39	Bio	w					
Hp-08	126.95	128	Bio	w					
Hp-08	128	135.25	Serp	vw	Act	w			associated with the fractures; alteration of the pyroxenes by actinolite??
Hp-08	135.25	135.46	Sil	w	Amp	w			plag is white, qtz present, and large lath to tabular dark green crystals present
Hp-08	135.46	135.8	Bio	w	Serp	w			coarse to very coarse grained
Hp-08	135.8	144.9	Serp	w	Act	vw			serpentine along the fractures and locally altn of the pyroxenes (actinolite?)

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-08	144.9	146.32	Serp	w					weak to moderate altn intensity
Hp-08	146.32	147.45	Serp	m					
Hp-08	147.93	154.75	Serp	w					patchy altn
Hp-08	154.75	154.8	Bio	w	Serp	w			
Hp-08	154.8	158.46	Serp	w					patchy altn
Hp-08	158.46	165.03	Serp	w	Bio	w			patchy altn, locally coarse biotite associated with fractures
Hp-08	165.03	165.33	Serp	m					fault
Hp-08	165.03	171.2	Serp	w	Bio	vw			
Hp-08	171.2	176	Bio	vw					
Hp-08	176	179.6	Serp	vw	Bio	vw			
Hp-08	184.6	187.69	Serp	vw	Bio	vw			
Hp-08	187.69	187.84	Bio	w	Serp	vw			
Hp-09	2.01	4.21	Ox	m					normal oxidation and weathering associated with oxidation zone
Hp-09	4.9	8.37	Ox	m					
Hp-09	8.37	8.94	Ox	w					
Hp-09	8.94	10.05	Ox	m					
Hp-09	12.45	14.8	Ox	m					
Hp-09	15.65	16.3	Ox	m					
Hp-09	16.3	17.77	Ox	vw	Amp	w			alteration of the pyroxenes
Hp-09	17.77	19.21	Ox	vw					
Hp-09	19.21	19.6	Amph	m					
Hp-09	20.7	20.9	Ox	m					associated with fracture zone
Hp-09	20.9	22.39	Sul	s					alteration associated with the fluids and sulphides (Sulphidation)
Hp-09	22.39	27.45	Amph	m	Bio	w			altn of the pyrox by more pyrox? Or amph? intensity from mod to local strong
Hp-09	27.45	29.16	Amph	w	Bio	w	Carb	w	alteration of the pyroxenes
Hp-09	29.16	29.25	Bio	w	Bio				foliated porphyritic plagiogranite
Hp-09	29.25	32.2	Serp	w	Bio	vw			
Hp-09	32.2	33.3	Amph	w					altn of the pyroxenes
Hp-09	33.3	40.8	Serp	w	Amp	w	Bio	vw	alteration of the pyroxenes locally (Locally rimmed)
Hp-09	40.8	41.5	Carb	w	Serp	w			
Hp-09	41.5	42.5	Serp	w					

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-09	42.5	45.6	Carb	w	Serp	w			
Hp-09	45.6	51.4	Serp	w	Carb	vw	Bio	vw	
Hp-09	52.3	56	Carb	m	Serp	m	Bio	w	
Hp-09	56	62	Serp	m	Bio	w	Carb	vw	serpentine is strong associated with fractures,
Hp-09	62	64.85	Serp	w	Bio	w	Amph	w	alteration of the pyroxenes (locally rimmed)
Hp-09	65.05	68.8	Serp	vw	Bio	vw	Amph	vw	
Hp-09	68.8	69.1	Amph	w	Bio	vw			uralitization
Hp-09	69.1	73.38	Serp	vw	Bio	vw	Amph	vw	
Hp-09	73.38	79.3	Bio	vw					
Hp-09	79.3	79.6	Carb	w	Serp	w			associated with small shear
Hp-09	79.6	84.1	Carb	vw	Serp	vw	Bio	vw	intensity increases in proximity to the fractures
Hp-09	84.1	88.87	Bio	vw					
Hp-09	88.87	89.21	Bio	w	Amp	vw			pyroxenes are weakly altered
Hp-09	89.21	90.14	Serp	vw	Amp	vw	Bio	vw	
Hp-09	90.14	94.09	Bio	vw	Serp	vw			serpentine is only locally present and associated with fractures
Hp-09	94.09	99.59	Bio	vw					
Hp-09	99.59	100.42	Carb	vw	Bio	vw			
Hp-09	100.42	101.02	Serp	m	Carb	m	Bio	w	
Hp-09	101.02	103.58	Bio	vw	Carb	vw			
Hp-09	103.58	105.64	Bio	w					
Hp-09	105.64	106.31	Serp	m	Carb	m			plagioclase is bleached
Hp-09	106.31	107.3	Carb	m	Serp	m	Bio	vw	
Hp-09	107.3	108.5	Carb	w	Serp	w			
Hp-09	108.5	109.05	Carb	s	Serp	w			
Hp-09	109.5	109.74	Carb	m	Serp	w			
Hp-09	109.74	110.21	Serp	m	Carb	w			
Hp-09	110.21	111.75	Carb	s	Serp	w			strong to very strong carbonate
Hp-09	111.75	117.68	Carb	vw	Bio	vw	Serp	vw	serpentine along a few of the fractures
Hp-09	117.68	118.17	Serp	w	Bio	w	Carb	vw	
Hp-09	118.17	118.31	Carb	w	Bio	vw			
Hp-09	118.31	120.4	Serp	vw	Carb	vw	Bio	vw	
Hp-09	120.4	124.5	Bio	w	Carb	vw	Amph	vw	locally alteration of the pyroxenes

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-09	124.5	126.52	Serp	w	Carb	w	Amph	w	biotite vw
Hp-09	126.52	129.76	Carb	w	Serp	vw	Bio	vw	
Hp-10	1.83	2.2	Ox	m		m			alteration of the pyroxenes and feldspars to clays and micas
Hp-10	2.87	3.37	Ox	m		m			alteration of the pyroxenes and feldspars to clays and micas
Hp-10	3.37	5.04	Bio	m					
Hp-10	6.23	6.56	Ox	w		m			alteration of the pyroxenes and feldspars to clays and micas
Hp-10	8.08	17.23	Ox	m		m			alteration of the pyroxenes and feldspars to clays and micas
Hp-10	17.92	19.53	Ox	vw		w			alteration of the pyroxenes and feldspars to clays and micas
Hp-10	20	20.28	Ox	vw					
Hp-10	21.08	22.13	Bio	vw					
Hp-10	22.63	25.2	Ox	vw	Bio	vw			
Hp-10	25.9	26.93	Ox	w					
Hp-10	28.1	29	Ox	w					
Hp-10	29	29.23	Ox	vw					along fractures
Hp-10	29.23	30.51	Serp	w	Bio	vw			
Hp-10	30.95	32.18	Serp	vw					
Hp-10	32.18	32.8	Bio	vw					
Hp-10	32.8	37.84	Serp	w	Bio	vw			
Hp-10	37.84	39.04	Bio	w					
Hp-10	39.04	40.19	Bio	m					
Hp-10	40.19	40.43	Bio	vw					
Hp-10	40.43	40.9	Bio	w	Serp	w			
Hp-10	40.9	42.3	Serp	m	Carb	w			carbonate associated with the serpentinized fractures and faults
Hp-10	42.3	45.64	Serp	w	Bio	w	Carb	vw	
Hp-10	45.64	50.7	Bio	w					
Hp-10	50.7	51.37	Carb	vw	Bio	vw			
Hp-10	51.37	51.8	Bio	w					
Hp-10	51.8	52.08	Bio	vw					
Hp-10	52.08	54	Bio	vw					
Hp-10	54	57.43	Serp	vw	Bio	vw			
Hp-10	57.68	60.7	Serp	vw	Bio	vw			
Hp-10	61.08	61.53	Bio	vw					

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-10	61.53	67.08	Bio	vw					
Hp-10	68.35	80	Serp	vw	Bio	vw			
Hp-10	80	81.9	Act	m	Serp	vw			alteration of the pyroxenes (rims surrounding them)
Hp-10	81.9	83.15	Serp	w	Act	vw			
Hp-10	83.15	83.3	Serp	m					
Hp-10	83.6	85	Serp	m					
Hp-10	85	86	Serp	w					
Hp-10	86	89.23	Serp	m	Carb	vw			moderate to locally strong serpentine altn
Hp-10	89.8	101.54	Serp	m	Carb	vw			moderate to locally strong serpentine altn
Hp-10	101.95	106	Serp	m	Carb	vw			
Hp-10	106	115.95	Serp	w	Bio	w			locally moderate serpentine altn
Hp-10	115.95	125.65	Bio	w					
Hp-10	125.65	133	Serp	vw	Bio	vw			
Hp-10	133	134.9	Bio	w					
Hp-10	134.9	137.38	Serp	vw	Bio	vw			
Hp-10	137.38	150	Bio	vw					minor serpentine associated with fractures
Hp-10	150	151.9	Serp	w					
Hp-10	151.9	152.91	Bio	w					
Hp-10	152.91	156	Bio	w					
Hp-10	156	156.74	Serp	w	Bio	vw			
Hp-10	156.74	156.86	Serp	vw	Bio	vw			
Hp-10	156.86	158.78	Serp	w					serpentinized fractures
Hp-10	158.78	160.55	Act	w					alteration of the feldspars
Hp-10	160.55	161.48	Serp	w					serpentinized fractures
Hp-10	161.48	166.73	Bio	vw	Act	w			alteration of the pyroxenes by amphiboles + other pyroxenes
Hp-10	166.73	169.73	Bio	vw	Hbld	w			alteration of the pyroxenes by amphiboles + other pyroxenes
Hp-10	169.73	174.38	Serp	vw	Hbld	vw			altn of the pyrox by amphiboles + other pyroxenes; serpentinized fractures
Hp-10	174.38	177.48	Bio	w	Amp	w			alteration of the pyroxenes and feldspars (recrystallized)
Hp-10	177.48	185.03	Bio	vw	Amp	w			alteration of the pyroxenes
Hp-10	185.03	185.16	Bio	vw					plagiogranite/granite
Hp-10	185.16	185.83	Serp	w	Amp	w	Bio	vw	

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-10	186.26	187.14	Serp	m	Amp	w	Bio	vw	
Hp-11	3.52	7.74	Ox	m					surface weathering and oxidation, moderate to strong in intensity
Hp-11	7.74	8.1	Ox	vw					wk altn of the feldspars (and minor oxidation)
Hp-11	8.1	17.6	Ox	m					surface weathering and oxidation, moderate to strong (locally) in intensity
Hp-11	17.6	24.03	Ox	w			Bio	vw	
Hp-11	24.03	25.22	Ox	m					fault zone
Hp-11	25.22	26.6	Bio	w	Amp	w			
Hp-11	26.6	28.1	Bio	w	Amp	vw			
Hp-11	28.1	33.13	Bio	w	Amp	w	Serp	w	not sure what the altn of the pyroxenes is that makes them a pinkish grey colour
Hp-11	33.13	44.3	Bio	vw	Amp	vw			
Hp-11	44.3	49.27	Bio	vw					
Hp-11	49.66	49.97	Bio	vw					
Hp-11	49.97	50.6	Bio	w					
Hp-11	50.6	55.48	Bio	w	Serp	w	Epi	w	appear to be epidote altn veins
Hp-11	55.48	57.69	Serp	s	Carb	m			
Hp-11	57.69	58.52	Bio	w					
Hp-11	58.52	59.1	Serp	w					
Hp-11	59.1	61.45	Bio	vw					
Hp-11	61.45	65.1	Serp	w					
Hp-11	65.1	81.71	Bio	vw	Serp	vw			serpentine associated with fractures
Hp-11	81.71	82	Bio	vw	Serp	vw	Chl	vw	altered granite
Hp-11	82	86.5	Serp	w	Bio	vw			
Hp-11	86.5	90.45	Bio	w	Serp	vw			serpentine associated with fractures
Hp-12	5.39	7.45	Amph	m	Ox	w			weathering of the pyroxenes and plagioclase crystals (breaking down to clays)
Hp-12	9.3	9.61	Bio	w					
Hp-12	11.14	11.2	Bio	w					
Hp-12	11.7	12.46	Ox	m					
Hp-12	12.46	25.24	Ox	vw	Bio	vw			
Hp-12	25.24	27.69	Ox	w	Bio	vw			
Hp-12	27.69	28.73	Ox	w	Bio	vw			
Hp-12	29.02	29.43	Bio	vw	Amp	vw			
Hp-12	29.43	31.03	Bio	vw	Ox	vw			

Hole ID	From	To	Altn	Int 1	Altn	Int 2	Altn	Int 3	Description
Hp-12	31.03	32	Bio	vw	Ox	vw			
Hp-12	32	34.47	Bio	vw					
Hp-12	34.47	34.69	Bio	w					
Hp-12	34.69	38.46	Bio	w	Amp	w	Ox	w	
Hp-12	38.46	38.62	Bio	vw					
Hp-12	38.62	40.46	Ox	w	Bio	vw			
Hp-12	40.88	44.67	Ox	vw	Bio	vw			
Hp-12	44.67	44.77	Bio	vw					
Hp-12	44.77	52.13	Bio	vw					
Hp-12	52.13	58.23	Serp	vw					
Hp-12	58.23	60.5	Bio	vw	Act	w			altn of the pyroxenes forming rims of lighter green pyroxenes or amphiboles??
Hp-12	60.5	61.06	Act	w					altn of the pyroxenes forming rims of lighter green pyroxenes or amphiboles??
Hp-12	61.06	64.1	Act	w					altn of the pyroxenes forming rims of lighter green pyroxenes or amphiboles??
Hp-12	64.1	67.26	Act	w					altn of the pyroxenes forming rims of lighter green pyroxenes or amphiboles??
Hp-12	67.26	73.38	Serp	w	Carb	vw			
Hp-12	73.49	74.2	Serp	vw	Carb	vw			
Hp-12	74.2	74.72	Serp	m	Carb	w			
Hp-12	74.72	77.36	Bio	vw	Serp	vw			
Hp-12	77.36	81.39	Bio	w	Serp	vw			
Hp-12	81.39	84.04	Serp	vw	Bio	vw			
Hp-12	84.04	85.81	Serp	w	Bio	vw			
Hp-12A	5.05	17.47	Ox	Carb	vw				Fe-staining and oxidation
Hp-12A	17.47	19.52	Ox	w	Act	vw			altn of the pyroxenes (rims of amphiboles?)
Hp-12A	19.52	20.83	Ox	w	Bio	vw			oxidation associated with fractures
Hp-12A	20.83	22.24	Ox	w	Bio	vw	Act	vw	
Hp-12A	23.23	25.13	Ox	w	Bio	w			
Hp-12A	25.58	26.13	Bio	w	Ox	vw	Act	vw	
Hp-12A	26.13	26.4	Hem	vw					
Hp-12A	26.4	28.84	Bio	w	Act	w			
Hp-12A	28.84	29.45	Bio	w					
Hp-12A	29.7	30.57	Bio	w	Act	w	Ox	vw	
Hp-12A	30.8	30.97	Bio	vw	Act	w	Serp	vw	

Appendix E. Logging: Mineralization (all drill holes)

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-01	2.01	7.66	Ilm	1					metallic luster to vitreous, h ~5, occurs in irregular to angular blebs, black in colour/metallic
H-01	7.66	7.9	Ilm	5					metallic luster to vitreous, h ~5, occurs in irregular to angular blebs, black in colour/metallic
H-01	7.9	19.04	Ilm	1					
H-01	19.04	23.94	Ilm	2					locally up to 4%
H-01	24.27	31.28	Ilm	0.5					locally up to 1%
H-01	31.8	42	Ilm	0.5	Po	0.1	Py	tr	tr chalcopyrite as well, all the sulphides are disseminated, present as small irregular to angular shaped blebs, locally pyrrhotite associated with chalcopyrite
H-01	43.65	80.44	Py	1	Hem	0.1			pyrite is present as fine grained seams, fracture fill and disseminated, concentrated along fracture and fracture planes, locally small pyrite suns; rare euhedral clusters of pyrite crystals.
H-01	80.44	85.83	Ilm	0.5					small angular blebs of what appears to be ilmenite; dark black
H-01	85.83	14.58	Py	0.5					locally up to 1%; disseminated, small clusters of irregular crystals that are subhedral to euhedral; locally fracture fill.
H-02	74.4	76.5	Mag	3					irregular blebs, patches and diss magnetite, locally is oxidize to hem; Ilm?
H-02	85.99	89.56	Mag	15	Py	0.5			pyrite present along frac as fn gr suns and blebs; highly mag, Ilm?
H-02	89.56	107.83	Mag	20	Py	1	Cpy	0.1	diss. fn gr sulphides; mag is diss. unit is highly magnetic. Ilm?
H-02	107.83	116.66	Mag	20	Py	2			highly magnetic, disseminated fine grained magnetite crystals. Ilmenite?
H-02	116.66	120.91	Mag	20	Py	1.5			highly magnetic, disseminated fine grained magnetite crystals. Ilmenite?
H-02A	1.7	10.95	Hem	0.1					
H-02A	10.95	11.65	Hem	0.5					
H-02A	11.65	12.46	Hem	0.1					
H-02A	12.46	18.94	Hem	0.5					
H-02A	24.82	36.84	Hem	0.5	Py	0.1			fracture fill and blebs (pyrite typically present as fracture fill)
H-02A	38.7	42.54	Hem	0.2					
H-02A	42.54	49.45	Py	1	Cpy	0.1	Po	0.1	
H-02A	49.45	50.68	Py	1	Cpy	0.5	Po	0.1	

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-02A	50.68	57	Po	2	Py	1	Cpy	0.5	diss and locally present in fn gr bands of sulph, mainly diss
H-02A	57	58.42	Py	3	Po	2	Cpy	1	small bands at 58.3 that contains sphalerite??, and un-identified oxide (black in colour)
H-03	7.19	13.82	Py	0.5					
H-03	14.93	20.29	Py	0.1	Hem	0.5			
H-03	20.29	33.53	Po	2	Cpy	1	Sph	0.5	small band of fine grain disseminated sulphides
H-03	33.75	44.2	Po	0.5	Cpy	0.1			disseminated sulphides
H-03	44.2	45.32	Py	0.1					disseminated
H-03	45.32	45.64	Po	0.5	Cpy	0.1			disseminated
H-03	47.89	48.24	Po	0.1	Cpy	0.1			disseminated
H-03	48.24	83.3	Py	0.5					diss, locally euhedral crystals that are fn gr, and suns along fracture planes
H-03	83.3	97.57	Po	0.5	Cpy	0.1	Py	0.1	fn gr diss; unidentified black oxide present locally as fn gr diss subhedral crystals (ilm?), brownish-buff coloured min rutile?,tr Sph.
H-03	97.57	101.4	Mag	0.5	Po	0.5	Cpy	0.1	Py 0.1%, dis and locally irregular blebs of sulph, mag is present as diss crystals and intercumulus crystals.
H-03	101.4	114.1	Po	0.2	Py	0.1	Mag	0.1	tr cpy
H-03	104.1	119	Po	0.5	Mag	0.1			
H-03	119	120.26	Po	1	Cpy	0.1			disseminated
H-03	120.26	121.16	Po	7	Cpy	0.5			semi-massive and disseminated
H-03	121.16	122.09	Po	25	Cpy	1			semi-massive and disseminated
H-03	122.09	122.45	Po	7	Cpy	0.5			semi-massive
H-03	122.45	124.7	Po	5	Cpy	0.1	Py	0.1	disseminated and small pods
H-03	124.7	128.5	Po	0.5	Gra	0.5	Cpy	0.1	Mystery oxide ~0.5% (graphite?)
H-04	2.74	3.64	Ilm	0.5					Diss crystals and small irregular blebs of a black coloured, oxide with locally Fe-stained core surrounding it.
H-04	3.83	5.59	Ilm	0.5					Diss crystals and small irregular blebs of a black coloured, oxide with locally Fe-stained core surrounding it.
H-04	5.87	19.7	Ilm	0.5					diss crystal and small irregular blebs of black coloured oxide, not magnetic

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-04	19.7	2.43	Ilm	0.1	Py	0.1	Po	0.1	
H-04	24.3	25.5	Ilm	0.1	Py	0.1			
H-04	25.5	26.1	Po	5	Py	0.5	Cpy	0.5	
H-04	26.1	27.06	Po	3	Py	0.5	Cpy	0.1	
H-04	27.06	28.4	Ilm	0.1	Po	0.1			
H-04	28.4	29.67	Po	0.5	Cpy	0.1			
H-04	30.9	31.37	Po	0.5	Cpy	0.1			disseminated
H-04	31.37	33.46	Po	0.5	Cpy	0.1			
H-04	33.46	34.6	Po	1	Py	0.3	Cpy	0.1	diss and small irregular shaped blebs (fn gr); pyrite is assoc with frac and is present as suns and fine gr crystals as well as diss
H-04	34.6	34.8	Po	4	Cpy	0.2			
H-04	34.8	39.82	Po	1	Cpy	0.1	Py	0.2	diss and small irregular shaped blebs (fn gr); pyrite is associated with fractures and is present as suns and fine gr crystals as well as disseminated
H-04	39.82	41.45	Po	0.5	Cpy	0.1			
H-04	41.45	44.62	Po	1.5	Cpy	0.1	Py	0.1	
H-04	44.62	44.7	Po	1	Cpy	0.1			
H-04	44.7	44.81	Po	2.5	Cpy	0.2			
H-04	44.81	48.08	Po	4	Cpy	0.2	Py	0.2	Pyrite is present along fractures and faults
H-04	48.08	56.3	Ilm-mag	8	Py	0.5	Po	0.5	tr Cpy
H-04	56.3	56.94	Ilm-mag	3	Py	0.1			
H-04	56.94	60.33	Py	0.1					
H-04	60.33	60.87	Ilm-mag	0.5	Po	0.1	Py	0.1	
H-04	60.87	75.83	Py	0.1					fn gr pyrite as fracture fill, rendering the fractures black in colour
H-04	75.83	76.5	Po	1.5	Cpy	0.1			irregular and disseminated blebs (intercumulus sulphides)
H-04	76.5	76.6	Po	1.5	Cpy	0.1			
H-04	76.6	77.2	Po	1	Py	0.1			
H-04	77.2	77.32	Py	0.5					
H-04	77.32	79.9	Po	1	Cpy	0.1	Py	0.1	Pyrite is present along fractures and faults
H-04	79.9	80.12	Po	3	Cpy	0.1			
H-04	80.12	80.2	Po	10	Cpy	2			vein-like sulphides and irregular blebs and pods

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-04	80.2	80.36	Po	30	Cpy	0.5			semi-massive to massive sulphides
H-04	80.36	82.1	Po	5	Cpy	0.5			
H-04	82.1	82.83	Po	1	Py	0.5	Cpy	0.1	
H-04	82.83	82.95	Po	27	Cpy	0.5			semi-massive to massive sulphides
H-04	82.95	83.12	Po	10	Cpy	1	Py	0.2	
H-04	83.12	91.91	Po	0.5	Cpy	0.1	Py	0.1	rare ilmo-magnetite
H-04	91.91	93	Po	0.5	Py	0.1			
H-04	93	94.86	Po	0.5	Py	0.2	Cpy	0.1	Graphite ~0.1-0.2%, fn gr, disseminated.
H-04	94.86	94.88	Po	80	Cpy	1			
H-04	94.88	95.28	Py	6	Po	1			small band of pyrite mineralization at 95.15m
H-04	95.28	102.82	Ilm- Mag	15	Po	0.5	Cpy	0.1	
H-04	102.82	103.15	Po	0.5					
H-04	103.15	103.68	Po	0.5	Ilm-Mag	0.2	Cpy	0.1	tr Py
H-04	103.68	105.7	Po	1	Ilm-Mag	1	Gra	0.1	tr Cpy
H-04	105.7	121.66	Ilm- Mag	10	Po	1	Mag	0.1	locally small bands and seams of magnetite; also tr Cpy, ilmenite is present as disseminated crystals that range from 5-20% of the interval
H-04	121.66	122.48	Ilm- Mag	0.5	Po	0.5			
H-04	122.43	123.43	Ilm- Mag	12	Po	1	Cpy	0.1	
H-04	123.43	124.13	Po	1	Ilm-Mag	0.1			
H-04	124.13	127.52	Ilm- Mag	10	Po	1	Cpy	0.1	tr pyrite
H-04	127.52	127.61	Po	25	Cpy	0.1			
H-04	127.61	131.26	Ilm- Mag	10	Po	1	Cpy	0.1	
H-05	8.23	13.75	Ilm	10					disseminated ilmenite, any sulphides are oxidized

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-05	13.75	17.74	Ilm	10	Gra	0.5	Py	0.3	graphite ~0.5%, tr Po
H-05	17.74	17.88	Ilm	20	Mag	4	Gra	2	Py 0.5
H-05	17.88	19	Ilm	10	Py	0.1	Gra	0.1	
H-05	19	22.75	Ilm	8	Po	1	Py	0.1	Cpy 0.1; disseminated and locally small bands of Pyrrhotite
H-05	22.75	22.93	Po	10	Py	3	Ilm	3	Magnetite ~2, Cpy, 0.5
H-05	22.93	23.38	Ilm	9	Mag	3	Py	2	Po 1; Cpy 0.5
H-05	23.38	25.1	Ilm	10	Po	1	Py	0.1	
H-05	25.1	25.2	Ilm	25	Po	10	Py	7	
H-05	25.2	26.45	Ilm	7	Po	1			
H-05	27.88	28.45	Py	5	Ilm	2	Po	0.5	
H-05	28.45	29.26	Ilm	5					
H-05	31.43	33	Ilm	5	Po	0.5			
H-05	33	36	Ilm	9	Po	1	Gra	0.5	Cpy 0.1;
H-05	36	36.08	Ilm	5	Mag	3	Po	2	
H-05	36.08	36.43	Po	30	Mag	15	Gra	10	Cpy1, ilmenite 1
H-05	36.43	37.39	Ilm	10	Po	3	Gra	2	tr Cpy
H-05	37.39	37.82	Py	0.5					disseminated
H-05	37.82	41.43	Ilm	10	Po	1	Gra	1	cpy 0.1
H-05	41.43	41.47	Po	45	Cpy	1	Ilm	1	
H-05	41.47	42.53	Ilm	7	Po	3	Py	0.1	
H-05	42.53	42.6	Ilm	25	Po	25	Mag	2	
H-05	42.6	42.8	Po	25	Ilm	10	Mag	5	Graphite 2%, Cpy 1%
H-05	42.8	44.9	Ilm	7	Po	3	Gra	1	Cpy 0.1
H-05	44.9	44.96	Po	10	Ilm	7	Gra	2	Cpy1%
H-05	44.96	46	Ilm	10	Po	2	Gra	2	Cpy 0.1
H-05	46	54.5	Ilm	10	Po	2	Mag	1	Py 0.2, Cpy, 0.1, graphite 0.1
H-05	54.5	54.72	Ilm	20	Po	20	Mag	15	Cpy 2
H-05	54.72	60.45	Ilm	8	Po	2	Mag	1	Cpy 0.1
H-05	60.45	60.49	Po	40	Ilm	3	Cpy	0.5	
H-05	60.49	65.42	Ilm	10	Po	1	Mag	0.5	
H-05	65.42	66.2	Po	30	Mag	25	Ilm	5	Cpy 1%
H-05	66.2	66.85	Ilm	10	Po	2	Mag	0.5	

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-05	66.85	68.04	Ilm	0.5					
H-05	68.04	73.6	Ilm	10	Mag	3	Po	1	<1% pyrite and Cpy (together)
H-05	73.6	81.55	Ilm	10	Po	1	Cpy	0.1	tr py
H-05	81.55	81.58	Py	4	Po	1			
H-05	81.58	88.33	Ilm	10	Po	1	Py	0.5	pyrite is typically along the fractures
H-05	88.73	88.89	Ilm	10	Po	0.5			
H-05	88.89	89.2	Ilm	0.4	Po	0.4	Py	0.2	
H-05	89.2	91.58	Ilm	10	Po	1	Py	0.5	Cpy 0.1
H-05	91.58	91.78	Po	10	Cpy	0.5	Py	0.5	
H-05	91.78	92	Ilm	5	Py	0.5			
H-05	92	97.3	Py	0.1					
H-05	97.3	98.42	Ilm	10	Po	1	Cpy	0.1	Py 0.1
H-05	98.42	98.51	Po	20	Mag	20	Cpy	1	
H-05	98.51	101.04	Ilm	10	Po	1	Cpy	0.1	
H-06	1.64	4.89	Ilm	10					disseminated
H-06	7.67	10.21	Ilm	10	Po	1	Cpy	0.1	tr Py
H-06	10.21	10.5	Mag	25	Ilm	15	Gra	10	; Po ~7%, Py ~4%, Cpy ~1%
H-06	10.5	12.41	Ilm	10	Po	1.5	Cpy	0.1	
H-06	12.41	12.46	Po	10	Ilm	1			
H-06	12.46	13.23	Ilm	10	Po	1.5	Cpy	0.1	
H-06	13.23	13.24	Gra	80	Po	7	Ilm	5	
H-06	13.24	13.62	Ilm	10	Po	1.5	Cpy	0.1	
H-06	13.62	13.88	Po	7	Ilm	1	Cpy	0.1	
H-06	13.88	18.95	Ilm	10	Po	1.5			
H-06	18.95	19.05	Gra	60	Po	20			Graphite with violet hue, not magnetic, fn gr seam that are cut by faults.
H-06	19.05	24.26	Ilm	10	Po	1	Py	0.5	pyrite is associated with the fractures and faults (present along the planes)
H-06	24.26	24.33	Po	70	Gra	3	Ilm	2	Py 1%, Cpy 0.5%
H-06	24.33	34.79	Ilm	10	Po	1.5	Py	0.1	pyrite present along fractures
H-06	34.79	34.86	Po	20	Gra	10	Py	0.5	
H-06	34.86	40.48	Ilm	10	Po	1	Py	0.1	
H-06	40.48	43.05	Po	0.5	Ilm	0.1			

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-06	43.05	43.1	Po	50	Gra	25	Py	4	Pyrrhotite is magnetic
H-06	43.1	45	Po	0.5					
H-06	45	45.36	Po	2					
H-06	45.36	45.8	Po	30	Py	1			Po is fn gr, diss/seams/pods &Py in frac as euhedral xtls and fn gr pods.
H-06	45.8	45.96	Po	2					
H-06	45.96	46.77	Po	1					
H-06	46.77	48.9	Po	65	Py	2	Cpy	0.5	
H-06	48.9	50.73	Po	0.7	Ilm	0.1			
H-06	50.73	52.26	Po	3	Py	1	Cpy	0.1	Pyrrhotite is magnetic
H-06	52.26	56.95	Po	1	Ilm	0.1			
H-06	57.4	65.78	Po	2	Py	0.1			
H-06	65.78	65.89	Po	20					
H-06	65.89	71.3	Po	1					
H-06	71.3	71.5	Po	10	Py	1	Cpy	0.5	
H-06	71.5	78.76	Po	1	Py	0.1	Ilm	0.1	
H-06	78.76	78.8	Po	10					
H-06	78.8	83.35	Po	1	Py	0.1	Ilm	0.1	
H-06	83.35	88.58	Py	0.1					
H-06	88.58	95.12	Po	1	Py	0.1			
H-06	95.12	98.38	Po	1.5					
H-06	98.38	99.13	Po	1					
H-06	99.13	99.18	Po	15					
H-06	99.18	109.78	Po	1	Py	0.1			
H-06	109.78	109.84	Po	25	Cpy	0.1	Py	0.1	
H-06	109.84	113.5	Po	1	Py	0.1			
H-06	113.5	117.15	Po	3	Mag	0.5	Cpy	0.1	graphite associated with the pyrrhotite, tr Cpy and Py
H-06	117.15	117.8	Po	7	Mag	5	Py	0.5	tr Cpy
H-06	117.8	122.24	Po	2	Cpy	0.1	Py	0.1	tr Mag
H-06	123.59	126.07	Po	2					
H-06	126.07	126.11	Po	15					
H-06	126.11	136.8	Po	1.5	Cpy	0.1	Py	0.1	up to 2% + small bands that contain up to 10% over 2-3cm locally

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
H-06	136.8	136.9	Po	15	Cpy	0.5			
H-06	136.9	169.95	Po	1.5	Cpy	0.1	Py	0.1	Po intercumulus anhedral, fn gr pods, 1-3cm bands of sulph locally (< 20%)
H-06	169.95	170.02	Po	20	Cpy	0.1			
H-06	170.02	180.66	Po	1.5	Cpy	0.1	Py	0.1	
H-06	180.66	182.53	Po	1.5	Cpy	0.1	Py	0.1	
H-06	182.53	183.18	Po	2.5	Cpy	0.1	Py	0.1	
H-06	183.18	191.62	Po	1.5	Cpy	0.1	Py	0.1	pyrite is typically associated with the fractures
Hp-07	3.4	3.44	Po	0.5					
Hp-07	3.96	4.57	Po	0.5					
Hp-07	23.66	24.26	Po	0.75					
Hp-07	25.24	28.13	Po	3	Ilm	2	Cpy	0.1	Pyrite 0.1 (typically along fractures)
Hp-07	28.13	28.64	Po	0.5	Py	0.1	Cpy	0.1	
Hp-07	28.64	29.45	Po	5	Ilm	2	Cpy	0.1	
Hp-07	29.45	29.48	Po	80	Cpy	1			massive band of sulphides (intercumulus/poikilitic)
Hp-07	29.48	32.3	Po	3	Ilm	1	Cpy	0.1	Pyrite 0.1 (typically along fractures)
Hp-07	32.3	39.65	Po	1.5	Py	0.3	Cpy	0.1	
Hp-07	39.65	44.45	Po	1	Py	0.2	Cpy	0.1	Pyrite is associated with the fractures
Hp-07	44.45	45.7	Py	2	Po	1	Cpy	0.1	
Hp-07	45.7	50.28	Po	2.5	Cpy	0.1	Py	0.1	
Hp-07	50.28	50.32	Po	25	Cpy	0.1			
Hp-07	50.32	52.51	Po	2.5	Cpy	0.1	Py	0.1	
Hp-07	52.51	52.55	Po	50	Cpy	2	Py	0.5	
Hp-07	52.55	55.63	Po	1	Cpy	0.1	Py	0.1	
Hp-07	55.63	58	Po	1.5	Py	0.5	Cpy	0.1	
Hp-07	58	58.87	Py	1					
Hp-07	58.87	62.2	Py	1.5	Po	0.5	Cpy	0.1	
Hp-07	62.2	64.33	Po	1.5	Cpy	0.1	Py	0.1	
Hp-07	64.33	72.96	Po	1	Cpy	0.1	py	0.1	
Hp-07	72.96	76.42	Po	1	Ilm	0.5	Cpy	0.1	tr Py
Hp-07	76.42	82.61	Po	1	Ilm	0.5	Cpy	0.1	
Hp-07	82.61	88.78	Po	1	Ilm	0.5	Py	0.1	tr Cpy

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-07	89.08	90.31	Ilm	1	Po	1	Cpy	0.1	
Hp-08	11.36	17.12	Ilm	1	Py	0.2	Po	0.2	ilmenite is an intercumulus mineral
Hp-08	17.12	30	Po	1	Ilm	1	Py	0.1	Cpy 0.1
Hp-08	30	35.44	Py	1	Ilm	0.5	Po	0.5	Py is present as fracture fill and pods, ilm and Po are intercumulus minerals
Hp-08	35.44	37.46	Py	10	Po	5	Cpy	0.5	pyrite is disseminated and fn gr, part of the altn
Hp-08	37.46	47	Py	0.5	Po	0.5	Cpy	0.1	pyrite is associated with the serpentine along the fractures and faults
Hp-08	47	67	Ilm	1	Po	0.5	Py	0.2	
Hp-08	67	71.07	Ilm	0.5	Py	0.2	Po	0.2	Cpy 0.1
Hp-08	71.07	80.1	Ilm	0.5	Py	0.1	Po	0.1	Cpy 0.1
Hp-08	80.1	81.08	Ilm	0.5	Po	0.2	Cpy	0.1	Py 0.1
Hp-08	81.08	83.81	Mag	5	Py	0.5			
Hp-08	83.81	84.95	Ilm	1	Py	0.2			
Hp-08	84.95	86.73	Py	0.2					
Hp-08	86.73	86.9	Ilm	0.5	Py	0.5			
Hp-08	86.9	87.26	Py	1					fracture fill, disseminated
Hp-08	87.26	88.07	Ilm	0.5	Po	0.1	Py	0.1	
Hp-08	88.38	88.77	Ilm	0.5	Py	0.1			rims of what appears to be carb surrounding the ilm (white in colour), fn gr
Hp-08	88.77	89.17	Py	0.1					
Hp-08	89.17	89.4	Ilm	0.5					rims of what appears to be carb surrounding the ilm (white in colour), fin gr
Hp-08	89.4	90.31	Py	tr					
Hp-08	90.44	92.02	Py	tr					
Hp-08	92.02	92.56	Ilm	tr					
Hp-08	92.56	95.56	Py	0.5					fracture fill and locally disseminated
Hp-08	95.56	112.06	Ilm	1	Po	0.5	Py	0.1	Cpy 0.1
Hp-08	112.06	119.07	Ilm	0.75	Po	1	Py	0.2	tr Cpy
Hp-08	119.07	119.62	Py	0.1					
Hp-08	119.62	122.8	Ilm	1	Po	0.5			
Hp-08	122.8	123.03	Py	0.1					
Hp-08	123.03	125.39	Po	1	Ilm	0.5	Py	0.1	

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-08	125.39	126.95	Py	0.1					
Hp-08	126.95	129	Ilm	1	Py	0.5	Po	0.1	
Hp-08	129	135.25	Po	1	Py	0.2	Ilm	0.1	
Hp-08	135.25	135.46	Py	0.5					
Hp-08	135.46	141.5	Po	1	Cpy	0.1	Py	0.1	pyrrhotite is magnetic
Hp-08	141.5	144.9	Po	2	Cpy	0.5	Py	0.2	pyrrhotite is magnetic
Hp-08	144.9	146.32	Py	3	Po	0.5	Cpy	0.5	(dull golden metallic sulp is either chalcopyrite or possibly pentlandite)
Hp-08	146.32	147.45	Py	7	Gra	1	Cpy	0.5	<1% pyrrhotite
Hp-08	147.93	149.45	Py	3	Gra	1	Ilm	1	Cpy 0.5%
Hp-08	149.45	149.7	Py	8	Gra	7	Ilm	1	Po ~1%, Cpy 0.5%
Hp-08	149.7	150.85	Po	2	Gra	1.5	Py	1	Cpy 0.2
Hp-08	150.85	158.46	Py	2	Ilm	1	Po	1	Magnetite <1% (small band at 155.47m), and graphite<1%, Cpy <1%
Hp-08	158.46	169.5	Ilm	12	Po	2	Gra	2	Py 1, Cpy 0.5
Hp-08	169.5	169.62	Gra	35	Po	20	Cpy	3	Py1, ilmenite 3
Hp-08	169.62	171.28	Ilm	15	Po	1	Gra	1	Cpy 0.1
Hp-08	171.28	171.38	Po	40	Gra	5	Cpy	0.1	
Hp-08	171.38	179.55	Ilm	17	Po	1	Py	0.5	
Hp-08	179.55	179.6	Mag	50	Po	20			
Hp-08	179.6	187.69	Ilm	17	Po	1	Py	0.2	
Hp-08	187.69	187.84	Ilm	25	Py	1	Po	0.5	
Hp-09	2.01	4.21	Ilm	1.5					
Hp-09	4.9	8.37	Ilm	1.5					
Hp-09	8.37	8.94	Hem	0.5					
Hp-09	8.94	10.05	Ilm	1					
Hp-09	12.45	14.8	Ilm	1					
Hp-09	15.65	16.3	Ilm	2					
Hp-09	16.3	17.77	Ilm	2	Po	1	Py	1	
Hp-09	17.77	19.21	Gra	30	Po	30	Py	10	ilmenite 5%, Cpy 1%
Hp-09	19.21	19.6	Po	5	Ilm	3	Py	1	
Hp-09	19.6	22.28	Gra	30	Po	30	Py	15	ilmenite 5%, Cpy 1%
Hp-09	22.28	24.3	Gra	7	Po	6	Py	5	Cpy 2%, ilmenite 1%

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-09	24.3	27.45	Py	2	Po	2	Ilm	1	Cpy 0.5%
Hp-09	27.45	29.16	Ilm	0.5	Po	0.5	Py	0.2	
Hp-09	29.16	29.25	Py	0.1					fracture fill
Hp-09	29.25	32.2	Po	0.5	Py	0.2	Ilm	0.1	
Hp-09	32.2	40.46	Po	0.2	Ilm	0.1			
Hp-09	40.46	40.59	Po	20	Py	1	Cpy	1	
Hp-09	40.59	51.4	Po	0.5	Ilm	0.2	Py	0.2	
Hp-09	52.3	64.85	Py	0.5	Po	0.5	Ilm	0.2	Cpy tr
Hp-09	65.05	68.8	Py	0.5	Po	0.5	Ilm	0.2	Cpy tr
Hp-09	68.8	69.1	Po	1	Ilm	0.1	Cpy	0.1	
Hp-09	69.1	72	Po	0.5	Ilm	0.5	Py	0.1	
Hp-09	72	78.44	Po	1	Ilm	0.25			
Hp-09	78.44	78.97	Po	8	Ilm	0.25			
Hp-09	78.97	83.15	Po	1.5	Ilm	0.25			
Hp-09	83.15	83.2	Po	25					
Hp-09	83.2	88.87	Po	1	Ilm	0.25			
Hp-09	88.87	89.21	Ilm	1	Po	0.5			
Hp-09	89.21	90.14	Ilm	0.5	Po	0.5			
Hp-09	90.14	94.09	Py	1	Po	1	Ilm	0.2	Tr Cpy
Hp-09	94.09	99.59	Po	0.5	Ilm	0.1			
Hp-09	99.59	100.23	Po	2	Ilm	0.5			
Hp-09	100.23	100.42	Py	20	Po	6			
Hp-09	100.42	101.02	Py	1	Po	0.5			
Hp-09	101.02	103.58	Ilm	1.5	Po	1			
Hp-09	103.58	106.31	Po	0.2	Ilm	0.2			
Hp-09	106.31	107.3	Py	0.5	Ilm	0.25	Po	0.1	
Hp-09	107.3	109.74	Py	1.5	Ilm	1	Po	0.5	
Hp-09	109.74	111.75	Ilm	1	Py	0.5			
Hp-09	111.75	117.68	Ilm	2	Po	0.5	Py	0.1	
Hp-09	117.68	118.17	Ilm	0.5	Po	0.5	Py	0.1	
Hp-09	118.17	118.31	Ilm	0.5	Po	0.1			
Hp-09	118.31	126.52	Ilm	0.5	Po	0.1			

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-09	126.52	127.6	Ilm	1	Po	0.5			
Hp-09	127.6	127.9	Po	5	Py	3	Cpy	1	Ilmenite ~1%
Hp-09	127.9	129.76	Ilm	1	Py	0.5			
Hp-10	6.23	6.56	Ilm	0.5					
Hp-10	8.08	14.5	Ilm	0.5					
Hp-10	14.5	17.23	Ilm	0.5	Po	0.5			
Hp-10	17.92	19.53	Po	0.5	Ilm	0.2			
Hp-10	20	20.28	Ilm	0.5	Po	0.5			
Hp-10	21.08	22.13	Ilm	0.5	Po	0.5			
Hp-10	22.63	25.2	Ilm	0.5	Po	0.5			
Hp-10	25.9	26.93	Ilm	0.5	Po	0.5			
Hp-10	28.1	29	Ilm	0.5	Po	0.5			
Hp-10	29	29.23	Mag	2	Ilm	2	Py	3	
Hp-10	29.23	30.51	Ilm	0.5	Po	0.5	Py	0.2	
Hp-10	30.95	32.18	Ilm	0.5	Po	0.5	Py	0.2	
Hp-10	32.18	32.8	Po	20	Py	1			
Hp-10	32.8	37.84	Ilm	0.5	Po	0.5	Py	0.1	
Hp-10	39.04	40.19	Ilm	0.5	Po	0.1			
Hp-10	40.43	42.3	Ilm	0.5					
Hp-10	42.3	45.64	Ilm	20	Po	0.5			Magnetite or ilmenite??
Hp-10	45.64	50.7	Po	1	Ilm	1	Py	0.1	
Hp-10	50.7	51.37	Ilm	20	Po	1			Magnetite or ilmenite??
Hp-10	51.37	51.8	Po	1	Ilm	1			
Hp-10	51.8	52.08	Ilm	20	Po	1			Magnetite or ilmenite??
Hp-10	52.08	57.43	Po	2	Ilm	0.5	Py	0.1	
Hp-10	57.68	60.7	Ilm	2	Po	1.5	Cpy	0.1	
Hp-10	61.53	67.08	Py	1	Po	1	Ilm	1	Cpy 0.1%
Hp-10	67.08	68.35	Ilm	20	Py	1	Po	1	Magnetite or ilmenite??
Hp-10	68.35	77.5	Po	1.5	Py	1	Ilm	1	
Hp-10	77.5	78.5	Po	3	Py	0.5	Ilm	0.5	Cpy 0.1%
Hp-10	78.5	81.9	Po	5	Py	0.5	Ilm	0.5	Cpy 0.5%
Hp-10	81.9	83.15	Po	55	Py	5	Cpy	5	

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-10	83.15	83.3	Py	17	Cpy	2			
Hp-10	83.6	85	Py	20	Gra	5	Po	2	Cpy ~2%;
Hp-10	85	86	Ilm	2	Py	1	Cpy	1	
Hp-10	86	89.23	Py	2	Gra	1	Mag	1	small mag bands locally (mag or specular hem?), ilm also present ~1%
Hp-10	89.8	92.65	Ilm	20	Po	5	Py	2	Mag 1%, Cpy 1%, Graphite 0.5%
Hp-10	92.65	101.54	Ilm	20	Py	2	Mag	1	Graphite 1%, Po 1%, Cpy 0.5%
Hp-10	101.95	110.8	Ilm	25	Py	0.5	Mag	0.5	graphite 0.25%, Po 0.25%, Cpy 0.1%
Hp-10	110.8	111.03	Ilm	20					
Hp-10	111.03	112.25	Ilm	20	Po	3	Mag	2	Py 1%, Cpy 0.1%
Hp-10	112.25	112.4	Po	15	Py	3	Gra	2	Ilmenite ~2%, Cpy 1%
Hp-10	112.4	123	Ilm	20	Mag	5	Po	2	Py 1%, Cpy 0.1%, graphite 0.1%
Hp-10	123	125.85	Ilm	20	Po	1.5			
Hp-10	125.85	131.09	Ilm	20	Po	3	Mag	1	<1% Py+ Cpy, sulphides most abundant in small bands
Hp-10	131.09	134.48	Ilm	20	Po	1	Mag	0.1	
Hp-10	134.48	134.53	Po	20	Ilm	7	Mag	5	
Hp-10	134.53	136.15	Ilm	20	Po	1	Py	1	
Hp-10	136.15	136.18	Po	30	Mag	30	Ilm	5	
Hp-10	136.18	137.12	Ilm	20	Po	1	Mag	0.25	
Hp-10	137.12	137.38	Ilm	15	Po	5	Mag	2	
Hp-10	137.38	142	Ilm	17	Po	1	Mag	0.1	Py 0.1%
Hp-10	142	145.64	Ilm	20	Po	1			
Hp-10	145.64	145.7	Mag	80	Po	0.5			
Hp-10	145.7	145.85	Mag	15	Ilm	5	Po	5	
Hp-10	145.85	151.9	Ilm	20	Po	0.5	Mag	0.1	
Hp-10	151.9	152.91	Ilm	5	Po	0.5	Py	0.1	Mag 0.1%
Hp-10	152.91	155.77	Ilm	7	Po	2	Mag	1	
Hp-10	155.77	156.74	Ilm	20	Po	0.5	Mag	0.5	
Hp-10	156.86	158.78	Ilm	15	Po	0.1	Py	0.1	
Hp-10	158.78	161.48	Po	3	Ilm	1	Mag	0.1	
Hp-10	161.48	161.9	Ilm	8	Po	3	Mag	3	
Hp-10	161.9	162.78	Ilm	1	Po	0.1	Mag	0.1	

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-10	162.78	163.29	Ilm	5	Po	3	Mag	2	small bands of magnetite locally
Hp-10	163.29	163.68	Ilm	0.5	Po	0.5			
Hp-10	163.68	164.07	Ilm	5	Po	3	Mag	2	pods of magnetite
Hp-10	164.07	164.56	Ilm	1	Po	1			
Hp-10	164.56	164.83	Ilm	15	Po	5	Py	0.5	
Hp-10	164.83	166.28	Ilm	1	Po	0.5			
Hp-10	166.28	166.73	Ilm	10	Po	5	Mag	2	thin band of magnetite at 166.73m
Hp-10	166.73	174.38	Ilm	10	Po	3	Mag	0.5	tr pyrite as well, magnetite is present as pods and thin seams locally
Hp-10	174.38	177.48	Ilm	10	Po	2.5	Mag	0.5	
Hp-10	177.48	177.67	Ilm	1.5	Po	2			
Hp-10	177.67	177.95	Po	25	Ilm	1			
Hp-10	177.95	185.03	Po	2	Ilm	1.5	Mag	0.5	rare bands of magnetite (one from 184.27-184.31m
Hp-10	185.16	185.83	Ilm	1	Po	0.5			
Hp-10	186.26	187.14	Po	3	Ilm	1.5	Mag	0.1	
Hp-11	3.52	7.74	Ilm	1					
Hp-11	8.1	17.6	Ilm	1	Py	0.1			
Hp-11	17.6	19.8	Ilm	1	Po	0.5	Py	0.1	
Hp-11	19.8	24.03	Ilm	1	Po	0.5	Cpy	0.1	Py 0.1
Hp-11	24.03	25.65	Ilm	4	Po	0.1			
Hp-11	25.65	25.75	Po	65	Cpy	5			pyrrhotite is magnetic
Hp-11	25.75	26.25	Po	25	Cpy	6	Ilm	3	
Hp-11	26.25	26.6	Ilm	6	Po	1	Cpy	0.5	
Hp-11	26.6	28.1	Po	1	Ilm	1	Py	0.5	Cpy 0.2
Hp-11	28.1	33.13	Ilm	2	Po	0.2	Cpy	0.1	metallic mineral is striated (black with violet hue)
Hp-11	33.13	42.7	Po	0.5	Py	0.1	Cpy	0.1	
Hp-11	42.7	43.13	Po	1	Cpy	0.1			
Hp-11	43.13	43.17	Po	50	Cpy	1			
Hp-11	43.17	44.3	Po	4	Cpy	0.5			
Hp-11	44.3	49.27	Po	80	Cpy	3	Gra	0.5	
Hp-11	49.66	49.97	Po	65	Py	10	Cpy	3	
Hp-11	49.97	50.6	Py	0.1					
Hp-11	50.6	55.25	Ilm	5	Po	0.5	Py	0.2	Cpy 0.1

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-11	55.25	55.33	Py	65	Ilm	2			
Hp-11	55.33	55.48	Py	6	Ilm	3			
Hp-11	55.48	57.69	Py	2	Ilm	2			
Hp-11	57.69	62.38	Ilm	3	Po	0.5	Py	0.5	Cpy 0.1, Mag 0.1
Hp-11	62.38	62.9	Mag	10	Py	6	Ilm	3	Cpy 0.2, Po 0.2, Gra 0.1
Hp-11	62.9	63.72	Ilm	1	Po	1	Mag	0.5	Py 0.5, Gra 0.2
Hp-11	63.72	76.13	Ilm	9	Po	1	Mag	0.1	Py 0.1, Cpy 0.1
Hp-11	76.13	76.21	Mag	20	Po	15	Ilm	5	Cpy 1, Gra 0.5
Hp-11	76.21	81.71	Ilm	9	Po	1	Mag	0.5	Py 0.2, Cpy 0.1
Hp-11	82	87.35	Ilm	10	Po	5	Mag	0.5	Py 0.1, Cpy 0.1
Hp-11	87.35	87.84	Ilm	9	Po	3			
Hp-11	87.84	90.45	Ilm	8	Mag	1	Po	0.5	Py 0.1
Hp-12	5.39	7.45	Ilm	0.5					
Hp-12	7.45	7.71	Ilm	25					
Hp-12	8.9	9.3	Ilm	25					
Hp-12	11.7	12.46	Ilm	0.5					
Hp-12	12.46	25.24	Ilm	15					magnetic
Hp-12	25.24	27.69	Ilm	10					weakly magnetic
Hp-12	27.69	28.73	Ilm	2					
Hp-12	28.73	29.02	Ilm	25					magnetic
Hp-12	29.02	29.43	Po	1	Ilm	0.5	Cpy	0.1	
Hp-12	29.43	31.03	Ilm	14	Po	0.5	Py	0.1	Cpy 0.1%
Hp-12	31.03	34.47	Ilm	1	Po	0.5	Cpy	0.1	
Hp-12	34.47	34.69	Ilm	14	Po	1.5	Cpy	0.2	magnetic
Hp-12	34.69	38.46	Po	1	Ilm	1	Cpy	0.1	
Hp-12	38.46	38.62	Po	3	Ilm	1	Cpy	0.2	
Hp-12	38.62	38.64	Py	15					fine grained mineralization below the contact
Hp-12	38.64	40.46	Po	1	Ilm	0.2	Cpy	0.1	
Hp-12	40.88	44.67	Ilm	1	Po	0.5	Py	0.1	Cpy 0.1%
Hp-12	44.77	52.13	Po	0.5	Ilm	0.5	Py	0.3	Cpy 0.1%
Hp-12	52.13	58.23	Po	1.5	Ilm	0.5	Cpy	0.1	
Hp-12	58.23	59.44	Po	1	Ilm	0.5	Cpy	0.1	

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-12	59.44	59.82	Po	12	Cpy	0.5	Ilm	0.5	
Hp-12	59.82	60.5	Po	2	Ilm	0.5	Cpy	0.1	
Hp-12	60.5	61.06	Po	12	Cpy	0.5	Ilm	0.5	
Hp-12	61.06	63.27	Po	4	Ilm	0.5	Cpy	0.5	
Hp-12	63.27	64.1	Po	30	Cpy	1.5	Ilm	0.5	
Hp-12	64.1	64.49	Po	5	Cpy	0.1			
Hp-12	64.49	65.21	Po	58	Cpy	3	Py	0.1	
Hp-12	65.21	67.26	Po	7	Cpy	0.5	Ilm	0.5	Py 0.1
Hp-12	67.26	73.38	Py	2	Ilm	1	Po	0.5	Cpy 0.2%
Hp-12	73.38	73.49	Ilm	5					
Hp-12	73.49	74.72	Ilm	1	Py	0.5	Po	0.2	Cpy 0.1%
Hp-12	74.72	75.37	Ilm	2.5	Py	0.5			
Hp-12	75.37	75.6	Gra	7	Py	5	Cpy	3	Ilmenite ~2%,
Hp-12	75.6	77.36	Ilm	3	Po	0.5	Py	0.3	Cpy 0.1%
Hp-12	77.36	81.39	Ilm	12	Po	0.2	Py	0.2	Cpy 0.1%
Hp-12	81.39	84.04	Ilm	10	Py	0.2			
Hp-12	84.04	85.81	Ilm	5	Gra	1	Py	1	magnetite 0.5%, Cpy 0.1%
Hp-12A	5.05	17.47	Ilm	0.1					
Hp-12A	17.47	19.52	Ilm	0.5					
Hp-12A	19.52	20.83	Ilm	0.2					
Hp-12A	20.83	22.24	Ilm	0.1					
Hp-12A	23.23	25.13	Ilm	0.1					
Hp-12A	25.58	26.13	Ilm	0.1					
Hp-12A	26.13	26.4	Gra	0.1					black metallic oxides along fra (dull black, blebs, not magnetic) 0.1%
Hp-12A	26.4	28.84	Gra	0.1					black metallic oxides along frac (dull black, blebs, not magnetic) 0.1%
Hp-12A	28.84	29.45	Gra	0.1					black metallic oxides along fra (dull black, blebs, not magnetic) 0.1%
Hp-12A	29.7	30.57	Gra	0.1					black metallic oxides along fra (dull black, blebs, not magnetic) 0.1%

Hole ID	From	To	Min 1	Min 1%	Min 2	Min 2%	Min 3	Min 3%	Description
Hp-12A	30.8	30.97	Hem	0.5					oxidized and weathered sulphides (possibly pyrite or pyrrhotite previously)

Appendix F. Logging: Structure (all drill holes)

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-01	6	6.1	FLT	w	20	veined fault with minor carbonates and oxides
H-01	6.8	6.8	CON	sharp	30	
H-01	7.66	7.66	CON	sharp	60	
H-01	7.66	7.9	FOL	w	60	very weak
H-01	7.9	7.9	CON	trans	60	weakly gradational contact/transition
H-01	8.1	8.1	CON	sharp	60	
H-01	9	9	GCON	grad	60	
H-01	9	10.2	FRA		5	weakly oxidized; cuts down the CA
H-01	11.4	11.4	CON	sharp	60	
H-01	13.2	13.2	CON	sharp	50	sharp transition from med to coarse grained
H-01	13.45	13.47	FLT		50	small fault, healed
H-01	14.83	14.83	CON	sharp	40	
H-01	15	15	CON	sharp	40	
H-01	15	16.26	FRA	m	10	frac at various angles, one set at 10 deg TCA
H-01	16.26	16.26	CON	sharp	60	between fn-med and coarse grained gab
H-01	17.14	17.15	FLT	w	30	minor gouge
H-01	18	18.01	FLT	w	30	minor gouge
H-01	19.04	19.04	CON	sharp	30	
H-01	23.93	23.94	FLT	m	40	minor gouge
H-01	24.77	24.78	FLT	w	20	minor gouge
H-01	26.34	26.34	FLT	w	30	
H-01	26.34	31.28	FOL	w	40	v wk to wk foln or pref orient of feld at 40-50 deg TCA
H-01	31.28	31.28	CON	sharp	30	upper contact of granitic vein/dyke
H-01	31.8	31.8	CON	sharp	40	lower contact of granitic vein/dyke with Gab
H-01	34.25	34.6	FRZ	w	20	Frac zone; surf of the frac host to minor Py min& carb
H-01	35.36	35.4	VN	sharp	20	granitic vein, white in colour

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-01	35.93	35.94	FLT	w	20	small fault; minor slickensides
H-01	36.39	36.5	FLT	m	20	gouge present and small qtz vein along fault plane
H-01	37.3	37.31	FLT	w	15	fault leading into a small broken up section of core, likely due to numerous faults and fractures
H-01	37.31	37.8	FRZ	m	20	Frac zone; frac are coated with carb; broken core
H-01	37.8	37.81	FLT	w	30	small healed fault, filled with carbonate
H-01	38.25	38.45	FRZ	m	30	fracture zone; carbonate filled fractures; brittle core
H-01	39.46	39.5	FRA	m	10	broken core; fracture is weakly oxidized and filled with carbonate
H-01	40.5	40.6	FRA	m	70	carbonate vein filled fracture; rubble after drilling
H-01	43.65	43.65	CON	sharp	60	contact between gabbro and Granite/granodiorite
H-01	47.54	47.64	FRZ	m	50	Fracture zone
H-01	80.44	80.44	CON	sharp	50	
H-01	82.76	82.78	FLT	m	40	brittle core; carbonates along the fault planer; minor slickensides
H-01	84.72	85.83	FLT	S		core is all broken up, some ground/lost; no angle due to condition of core, small pieces suggest 50deg TCA.
H-01	85.83	85.86	BCON	m	40	brecciated contact between gabbro and Granodiorite. Angular fragments.Picture of contact
H-02	5	5.14	FLT	s		flt zone; gouge present; some small healed fragments; some fragments with evidence of slickensides; at contact with consolidated plutonic
H-02	5.14	5.14	CON	sharp	50	contact between faulted and poorly consolidated granodiorite and solid granodiorite
H-02	5.14	6	FRA	vw	60	set of fractures at 60 deg TCA; 4 of them
H-02	6	10	FRA	w	30	approx. 3-5 FRAC/m that are at 25-30deg TCA
H-02	10	13.6	FRA	vw	60	approx. 1-2 frac/m that are at 50-60deg TCA

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-02	13.7	13.7	FRA	w	20	
H-02	14.65	14.65	FRA	w	20	
H-02	15.85	15.85	FRA	w	20	
H-02	20.16	20.16	FRA	w	10	
H-02	25.2	25.5	FRZ	m	10	fracture zone
H-02	44.64	44.64	FRA	w	20	
H-02	47.87	47.92	FRZ	m	30	carbonates present along fracture planes
H-02	48.94	48.94	FRA	w	20	
H-02	49.5	49.6	FRZ	w	25	minor carbonates along fractures (at 25-30deg TCA
H-02	50.12	50.12	FRA	w	30	minor carbonate along fracture surface
H-02	51.18	51.18	FRA	w	30	minor carbonate along fracture surface
H-02	52.24	52.24	FRA	w	20	
H-02	58.5	59.9	MLIN	m	50	alignment of bio flecks at 40-60deg TCA; v wk foln
H-02	60.2	60.25	FOL	w	50	flow banding? Or ductile deformation/ weak foliation
H-02	64	64.03	FRA	w	30	
H-02	72.93	72.94	FLT	w	20	healed; weak slickensides on the surface of the fault
H-02	76.3	76.4	FRZ	m	20	
H-02	77	77.25	FRZ	m	15	multiple fractures; broken up core
H-02	83.17	83.17	FLT	w	60	healed flt; minor brx; flt material is sand like (cr gouge)
H-02	83.25	83.25	FLT	w	50	healed flt; minor brx; flt material is sand like (cr gouge)
H-02	85.99	85.99	CON	sharp	25	chilled contact in the mafic unit (picture taken of
H-02	89.56	91.95	GCON	grad		gradational contact
H-02	98.55	98.55	FRA	w	20	
H-02	98.7	98.7	FRA	w	20	
H-02	98.86	98.86	FRA	W	20	
H-02	103.34	103.36	FRA	m	60	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-02	103.66	103.76	GCON	grad		gradational contact
H-02	104	104.15	GCON	grad		gradational contact
H-02	107.83	107.83	GCON	grad		gradational contact
H-02	116.66	116.66	GCON	grad		gradational contact
H-02	118.13	118.14	FRA	w	50	appears to be water ingress along this fracture
H-02	118.73	118.73	FRA	w	50	appears to be water ingress along this fracture
H-02	119.27	119.27	FRA	w	60	appears to be water ingress along this fracture
H-02	119.75	120.05	FRZ	m	20	appears to be water ingress along this fracture
H-02A	2.3	2.3	FRA	m	20	oxidized
H-02A	3.82	3.82	FRA	m	40	oxidized
H-02A	4.56	4.57	FRA	m	50	oxidized
H-02A	5.19	5.19	CON	sharp	60	sharp transition in mineralogy
H-02A	5.19	5.7	FRZ	m	60	fractures vary from 40-70 deg TCA, oxidized
H-02A	5.89	5.89	CON	sharp	70	sharp transition in mineralogy
H-02A	5.99	6	FRA	m	40	oxidized
H-02A	6.05	6.1	FRZ	m	60	oxidized
H-02A	6.26	6.26	CON	sharp	30	sharp transition in mineralogy
H-02A	6.54	6.54	FRA	m	30	oxidized
H-02A	6.9	6.92	FRA	m	60	oxidized
H-02A	7.2	7.2	FRA	m	40	oxidized
H-02A	7.53	7.53	FRA	m	40	oxidized
H-02A	7.69	7.69	CON	sharp	60	sharp transition in mineralogy
H-02A	8	8	FRA	w	20	oxidized
H-02A	8.85	8.86	FLT	m	55	minor gouge and oxidized
H-02A	9.47	9.47	FRA	m	50	oxidized
H-02A	10.13	10.13	FRA	m	40	oxidized
H-02A	10.13	10.95	FRZ	m	30	factures at 30-60 deg TCA; oxidized
H-02A	10.95	10.95	CON	sharp	45	
H-02A	11.65	11.65	CON	sharp	10	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-02A	12.46	12.46	CON	sharp	10	
H-02A	13.9	13.9	FRA	m	10	oxidized
H-02A	15.8	15.8	FRA	w	20	oxidized
H-02A	18.94	18.94	CON	sharp	60	
H-02A	21.24	21.24	CON	sharp	40	
H-02A	21.87	21.87	CON	sharp	40	
H-02A	23.8	23.8	FRA	w	20	
H-02A	24.35	24.35	CON	sharp	70	
H-02A	24.66	24.66	CON	sharp	80	
H-02A	24.69	24.69	CON	sharp	65	
H-02A	24.72	24.72	CON	sharp	65	
H-02A	24.82	24.82	CON	sharp	50	
H-02A	26.73	26.73	FRA	m	60	
H-02A	27.5	27.5	FLT	m		fault/ breccia fault is the cause of the cave- in the hole?
H-02A	32.84	32.85	FRA	m	20	oxidized
H-02A	34.67	34.67	FRA	w	20	stained halo around the fracture
H-02A	36.84	34.84	CON	sharp	70	
H-02A	38.32	38.32	FLT	m	10	slickenslides on surface; suface is irregular
H-02A	38.7	38.7	CON	sharp	50	
H-02A	41.67	41.67	FRA	m	20	
H-02A	42.54	42.54	CON	sharp	50	
H-02A	43.8	44	FRZ	m	70	weakly oxidized fracture at 70-80deg TCA
H-02A	44.84	44.84	FRA	m	25	
H-02A	47.45	47.45	FLT	m	30	
H-02A	49.84	49.84	FLT	w	60	
H-02A	49.93	49.96	SHR	m	60	Small veins along shear
H-02A	50.2	50.55	FRZ	m	20	Lots flts and frac; slickenslide surfaces; broken up core

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-02A	50.9	50.91	FLT	m	50	
H-02A	52.95	52.95	FLT	w	40	
H-02A	55.23	55.23	FLT	w	30	
H-02A	57.25	58.22	FTZ	m	54	numerous flts and frac that are at 30-70deg TCA; many slickenslides; serp surfaces
H-03	6.58	7	FLT	s		only rubble, sand and mud/gouge present; flt would explain the poor quality core
H-03	7.19	7.19	CON	sharp	60	gabbro and granite
H-03	7.83	7.83	FRA	w	30	oxidized fracture plane
H-03	13.82	13.82	CON	sharp	70	granite and gabbro
H-03	15.28	15.29	FRA	m	30	carbonate along fracture plane
H-03	15.6	15.61	FRA	m	40	oxidized; set of small parallel fractures
H-03	16.5	16.5	FRA	m	20	oxidized and minor carbonate along fracture plane
H-03	17	17	FRA	m	30	oxidized
H-03	17.4	17.4	FRA	m	20	oxidized
H-03	17.87	17.88	FRA	m	60	oxidized with Fe-stained halo
H-03	18	18	FRA	m	70	oxidized
H-03	18	20.29	FRZ	w	20	oxidized set of fractures at 20Deg TCA
H-03	21.2	21.2	FRA	w	60	oxidized
H-03	21.54	21.55	FRA	w	70	oxidized
H-03	25.28	25.65	FRZ	m	20	altd and oxi; minor carb along fracture surfaces
H-03	26.85	26.9	FRZ	m	20	minor oxi along frac plane; wk aln halo assoc with fract
H-03	28.34	28.42	SHR	vw	60	small band that has the reverse foliation of the main unit; small shear
H-03	29.17	29.17	FRA	w	20	minor oxi along frac plane; wk aln halo assoc with fract

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-03	29.76	29.76	FRA	w	30	minor oxi along frac plane; wk altn halo assoc with frac
H-03	30.05	30.05	FRA	w	20	minor oxi along frac plane; wk altn halo assoc with frac
H-03	30.56	30.56	FRA	w	20	minor oxi along frac plane; wk altn halo assoc with frac
H-03	31.95	31.95	FRA	w	20	minor oxi along frac plane; wk altn halo assoc with frac
H-03	33.13	33.13	FRA	w	20	No oxidation
H-03	33.53	33.53	CON	sharp	70	
H-03	33.75	33.75	CON	sharp	70	
H-03	36.35	36.35	FLT	m	20	slickensides, serpentinized
H-03	37.9	37.9	FLT	m	10	slickensides, serpentinized
H-03	43.63	43.64	SHR	m	40	biotite rich
H-03	44.52	44.52	CON	sharp	50	
H-03	45.32	45.32	CON	sharp	70	
H-03	45.64	45.64	CON	sharp	60	
H-03	47.89	47.89	CON	sharp	55	
H-03	47.85	47.86	FRA	w	20	healed
H-03	48.24	48.24	CON	sharp	70	
H-03	52.83	53.94	FLTZ	m	30	ductile deformation also present
H-03	75.35	75.35	FLT	w	30	small mm scale band of healed gouge along fault plane
H-03	77.43	77.43	FRZ	m	10	numerous frac that cut the core at 10deg TCA; minor breccia; all healed
H-03	79.8	79.8	FRA	w	20	healed
H-03	80.06	80.06	FLT	w	50	small fault; slickensides
H-03	83.3	83.3	CON	sharp	80	granite and gabbro

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-03	83.3	84.3	MLIN	vw	70	v wk min lin to wk foln; appears to be associated with a weak ductile deformation of the gabbro.
H-03	84.77	84.77	FLT	m	50	
H-03	85.19	85.19	FRA	vw	50	veinlet filled fracture
H-03	85.83	85.83	FRA	m	10	carbonate and serpentine filled facture that has some slickenside surfaces; cuts at shallow angle TCA
H-03	86.4	86.5	FRZ	m	20	carb and serp/chl filled facture that has some slickenside surfaces; cuts at shallow angle TCA
H-03	87.03	87.05	FRA	m	50	series of healed fractures
H-03	87.42	87.52	BFLT	m	70	breccia flt; wkly healed with carb and qtz- carb vnlts; serp altn also present
H-03	88.51	88.7	FLT	m	10	fault surfaces are serpentinized; and locally host minor pyrite; core is broken up
H-03	89.55	89.55	FRA	w	15	
H-03	90.5	90.5	FRA	m	10	serpentinized
H-03	92	92.02	SHR	m	50	small shear
H-03	92.52	92.52	FRA	w	50	carbonate on surface of fracture
H-03	94.74	94.74	FRA	m	10	serpentinized
H-03	95.63	96.9	FRZ	s	10	serpentinized fractures; locally slickensides
H-03	97.27	97.27	FRA	m	20	
H-03	97.57	97.57	CON		85	contact between these two units is sharp, but there is no distinct linear contact, contact is nearly perpendicular to the CA, abrupt change in gabbro texture, mineralogy
H-03	99.68	99.68	FRA	w	20	carbonate and serpentine covered fracture surfaces
H-03	101.15	101.15	FLT	w	30	strong slickensides, serpentine covered surfaces
H-03	101.4	101.4	GCON			arbitrary contact, gradational transition

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-03	101.6	102.97	FRZ	s	10	frac are at 10-30deg TCA; surfaces are serp, core is in poor condition, broken up; slickensides on some surf
H-03	103.13	103.3	FLT	s	20	little to no recovery for this interval
H-03	104.7	104.8	FRZ	m	50	at 40-60deg TCA (healed)
H-03	104.3	104.3	FRA	m	20	
H-03	105.64	105.64	FRA	m	10	
H-03	106.42	106.47	FLT	w	35	small fault; slickensides
H-03	117.83	108.69	FRZ	m	20	10-30deg TCA, numerous frac; surfaces covered in serp and locally carb vnlts along structure planes
H-03	109.13	109.13	FRA	w	20	carbonate and serpentine covered fracture surfaces
H-03	109.8	109.88	SHR	s	70	sharp contacts; angle is upper contact; Mylonitized se, angle in shr zone is at 50 deg TCA, lower contact 60 deg TCA
H-03	110.21	110.27	SHR	m	80	upper contact at 80, lower at 50 and angle of the shear is at 70deg TCA
H-03	110.34	110.36	SHR	w	60	shear vein, sharp contacts
H-03	111.25	111.28	SHR	m	40	
H-03	111.35	111.35	FRA	m	20	serpentinized
H-03	112.38	112.38	FRA	w	10	small vein filled fracture. At low angle TCA
H-03	114.54	114.54	FRA	m	10	serpentinized
H-03	115.4	115.4	FRA	w	40	carbonate along surface
H-03	116.58	116.58	FLT	w	40	fault that intersects a fracture
H-03	117.31	117.4	SHR	s	70	sharp contacts, all at 70 deg TCA
H-03	119.3	119.3	SHR	m	50	
H-03	120.36	120.43	SHR	m	70	
H-03	122.09	122.09	FLT	m	30	faulted contact
H-03	122.45	122.45	FLT	m	20	faulted contact

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-03	124.24	124.62	FLTZ	m	25	slickensides/ serpentinized
H-03	125.35	125.35	FRA	w	20	
H-03	126	126.8	FRZ	m	20	multiple fracture at 20 deg TCA
H-03	127.7	127.7	FLT	m	10	slickensides
H-03	128.3	128.1	FRZ	m	30	
H-03	118.63	118.63	CON	sharp	40	faulted contact, slickensides, serpentinized
H-03	118.7	118.7	CON	w	60	no sharp defined linear contact, weakly gradational
H-04	3.22	3.25	FLT	m	10	slickensides along fault surface; oxidized; core is brittle
H-04	3.6	3.64	FRA	m	70	fractures in strongly weathered Gabbro
H-04	4	4.3	FRZ	m	30	fractures at multiple angles from 30-60deg TCA; broken up, core is strongly weathered and moderately
H-04	5.2	5.25	FRA	m	30	core is broken up
H-04	5.59	5.59	CON	abrupt	70	Abrupt contact
H-04	5.87	5.87	CON	abrupt	70	Abrupt contact
H-04	6.9	6.9	FRA	m	40	
H-04	8.33	8.45	FRZ	m	20	
H-04	11.14	11.2	FLT	m	30	minor shearing associated with the fault
H-04	11.3	12.4	FRZ	s	20	multiple frac that are at 10-30deg TCA; core is all broken up and the surfaces of the frac locally host minor slickensides; and minor carb; wkly oxidized.
H-04	12.4	12.43	FLT	m	30	minor shearing associated with the fault/ contact
H-04	12.43	12.53	FRZ	m	30	
H-04	13.06	13.18	FLT	m	20	two flts with block of gab between that is also faulted
H-04	14.02	14.02	FLT	w	50	
H-04	14.4	14.86	FRZ	m	40	
H-04	15.1	15.87	FRZ	m	20	multiple fractures and small faults at 20-30deg TCA
H-04	17.06	17.06	FRA	m	20	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-04	17.22	17.22	FLT	m	30	
H-04	18.92	19	FRZ	w	50	healed
H-04	19.3	19.3	FLT	m	20	slickensides along fault surface
H-04	19.69	19.71	GCON	grad		
H-04	21.3	21.3	FRA	m	5	fracture filled with carbonate and serpentine
H-04	21.7	21.75	FLT	w	25	slickensides along fault surface
H-04	22.43	22.43	GCON	grad		gradational over 10cm
H-04	22.8	24.93	FRZ	m	20	multiple fractures
H-04	24.9	24.9	FLT	w	15	
H-04	25.4	25.44	SHR	m	40	
H-04	25.5	25.56	FLT	m	40	series of small faults
H-04	25.6	25.6	FLT	m	15	slickensides along fault surface
H-04	26.1	26.21	FTZ	m	15	slickensides along fault surface
H-04	27.06	27.06	FRA	w	40	slickensides along fracture surface
H-04	27.3	27.31	SHR	w	40	
H-04	27.31	27.42	FRZ	m	30	
H-04	27.42	27.42	FLT	w	30	
H-04	27.42	28.4	FRZ	m	30	fracs at low angles; some have slickenside surfaces
H-04	28.6	28.6	FRA	w	20	
H-04	28.73	28.76	FRA	m	50	
H-04	29.88	30.35	FTZ	m	50	faults at 30-50Deg TCA
H-04	30.88	30.91	GCON	grad		
H-04	31.33	31.38	GCON	grad		
H-04	31.66	31.8	FRZ	w	55	set of fractures at 50-60deg tca
H-04	32.1	32.11	FRZ	m	55	healed fractures at 55-60deg TCA
H-04	33.46	33.46	FLT	m	10	slickensides along fault surface
H-04	33.62	33.62	FLT	w	50	
H-04	33.8	33.9	FLT	m	20	slickensides along fault surface

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-04	34.55	34.55	FLT	m	30	
H-04	35	35.5	FRZ	m	30	
H-04	35.5	35.55	FLT	s	20	strong slickensides, carbonates and tr pyrite mineralization, minor gouge, serp,
H-04	35.8	35.95	FRZ	m	75	set of fractures at 75-80deg TCA
H-04	36.33	36.34	SHR	m	55	
H-04	36.5	36.88	SHZ	m	50	shears at 40-60deg TCA
H-04	37.8	37.85	SHR	m	60	
H-04	37.97	37.99	FLT	w	30	
H-04	38.15	38.17	SHR	m	70	
H-04	38.2	38.3	FRZ	m	30	
H-04	38.46	38.46	FRA	m	30	healed
H-04	38.8	38.85	FLT	m	30	carb along frac plane, serp and slickensides present
H-04	39.81	39.83	CON	abrupt		sharp transition from gab to plag rich, grad over 2-3cm.
H-04	40.1	40.65	BRX	m		breccia; and fracture set (fracture set at 30deg TCA)
H-04	41.37	41.45	FRZ	m	40	fractures at 40-70deg TCA
H-04	42.15	42.15	FRA	m	20	
H-04	43.45	43.45	FLT	w	30	
H-04	44.62	44.62	CON	irreg	80	sharp but irregular
H-04	44.62	44.7	BAN	m	80	
H-04	44.7	44.7	CON	irreg	65	sharp but irregular
H-04	44.81	44.81	CON	sharp	80	
H-04	44.81	44.88	FOL	m	70	
H-04	44.88	44.88	CON	sharp	65	
H-04	45	45	FRA	m	30	serpentinized
H-04	47.8	48.03	FRZ	m	30	fracture zone slickensides present
H-04	48.08	48.08	CON	sharp	80	at small vein

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-04	50.75	50.75	FLT	w	15	carbonate and serpentine along plane
H-04	56.3	56.94	FRZ	s	50	angles vary from 50-80deg TCA broken up core, some of fracture have carbonate along the planes
H-04	56.94	56.94	CON	sharp	70	
H-04	60.33	60.33	CON	sharp	50	
H-04	60.87	60.87	CON	sharp	60	
H-04	62.04	62.04	CON	sharp	50	
H-04	62.04	62.16	FOL	m	40	biotite rich and foliated granite
H-04	62.16	62.16	CON	sharp	60	
H-04	72.17	72.17	FRA	m	25	sulphide rich fracture
H-04	72.7	75.35	FRZ	m	30	fractures are at 15-30deg TCA and are carbonate filled
H-04	75.83	75.83	CON	sharp	70	
H-04	76.17	76.17	FLT	m	70	
H-04	76.5	76.6	FTZ	m	50	faults at 30-60deg TCA
H-04	77.12	77.18	FLT	m	40	
H-04	77.18	77.2	FLT	m	60	
H-04	77.2	77.2	CON	sharp	45	
H-04	77.32	77.32	CON	sharp	60	
H-04	77.86	78.23	FRZ	m	40	fracs with slickenside surf. flt at78.04m 50deg TCA
H-04	79.66	79.66	FLT	m	20	serpentinized
H-04	79.89	79.9	SHR	w	30	
H-04	80.88	80.88	FLT	m	30	
H-04	81.07	81.09	FRA	m	60	
H-04	81.4	81.5	FRZ	m	30	serpentinized
H-04	82.3	82.5	FRZ	m	20	serpentinized
H-04	83	83	FLT	m	60	
H-04	83.4	83.4	FRA	m	25	
H-04	83.63	83.71	FTZ	m	50	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-04	83.9	84.2	FTZ	m	15	
H-04	84.7	84.92	FRZ	m	50	
H-04	85.64	85.64	FRA	w	20	carbonate and serpentine along plane
H-04	87.17	87.17	FLT	m	30	serpentinized
H-04	87.4	87.4	FLT	m	30	serpentinized
H-04	88.07	88.5	FRZ	m	30	series of factures at 30deg TCA
H-04	90.45	90.45	FRA	w	20	
H-04	91.6	91.91	FRZ	m	30	fractures at 30-40deg TCA
H-04	91.91	93	FTZ	s	30	broken up, strong slickenside surfaces, fractures as well
H-04	95.06	95.28	FTZ	m	50	
H-04	95.28	95.28	CON	fltd	70	faulted
H-04	96.06	96.31	FTZ	m	50	faults at 40-60deg TCA
H-04	100.5	101.05	FTZ	m	20	serpentinized, strong slickensides along fault plane
H-04	102.5	102.5	FRA	m	10	serpentinized along fracture plane
H-04	104.06	104.4	FRZ	m	40	series of fractures, some healed
H-04	95.28	102.82	MLIN	w	50	very weak foliation/mineral lineation
H-04	105	105.65	FLT	m	10	
H-04	111.45	111.45	FLT	m	20	
H-04	112.06	112.06	FLT	w	20	
H-04	113.9	113.9	FLT	m	20	
H-04	114.4	115.4	FRZ	m	30	series of fractures
H-04	116	116	FLT	m	10	
H-04	116.25	116.28	FRZ	m	50	
H-04	119.6	120.2	FRZ	m	15	frac filled with serp that cut the core at shallow angles
H-04	121.17	121.3	FRZ	m	20	broken core
H-04	121.66	121.66	CON	sharp	70	
H-04	122.48	122.48	CON	sharp	50	
H-04	123.43	123.43	GCON	grad	60	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-04	124.13	124.13	CON	sharp	60	at a fracture
H-04	129.3	129.3	FLT	m	40	
H-04	129.3	130	FRZ	m	10	series of fractures that cut the core at shallow angles
H-05	3.65	3.65	FRA	m	40	oxidized fracture
H-05	4.58	4.58	FRA	w	30	oxidized fracture
H-05	8.23	8.23	CON			broken up contact
H-05	14.16	14.16	FRA	w	60	
H-05	14.4	14.4	FRA	w	10	oxidized fracture
H-05	15.14	15.14	FRA	w	30	oxidized fracture
H-05	15.8	15.9	FRZ	m	20	oxidized fractures
H-05	16.54	16.78	FRZ	m	80	
H-05	17.22	17.22	FRA	m	10	oxidized fractures that is at low angle TCA;
H-05	18.5	19	FRZ	m	10	oxidized fractures that is at low angle TCA;
H-05	19.8	19.8	FRA	m	20	
H-05	22.93	23.38	FOL	m	65	cont at 60 & 50 resp. (from med to fn gr then fn to med.
H-05	26.16	26.16	FRA	m	20	oxidized
H-05	26.45	26.45	CON	sharp	20	
H-05	27.88	27.88	CON			cannot get an angle since core is broken up
H-05	29.26	29.26	CON	sharp	30	
H-05	30.6	31.2	FRZ	m	10	
H-05	31.43	31.43	CON	sharp	20	
H-05	35.1	35.1	FRA	w	10	serpentinized
H-05	36.08	36.08	GCON	grad	75	gradational upper contact
H-05	36.08	36.43	MLIN	m	70	sulphide banding and seams
H-05	36.43	36.43	CON	abrupt	70	
H-05	37.35	37.39	GCON	grad	80	
H-05	37.82	37.82	CON	abrupt	80	
H-05	38.6	38.6	FRA	w	20	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-05	40.5	40.5	FLT	m	10	serpentinized + slickensides
H-05	41.6	41.6	FLT	m	40	serpentinized + slickensides
H-05	41.75	41.75	FLT	m	45	serpentinized + slickensides
H-05	42.3	42.38	FRZ	m	30	
H-05	44.45	44.45	FRA	w	30	carbonate along fracture
H-05	50.63	50.63	FRA	w	30	
H-05	52.07	52.13	FRZ	m	30	series of fractures
H-05	52.63	52.63	CON	sharp	80	contact between med-gr and fn gr
H-05	52.7	52.7	CON	sharp	60	contact between fn gr and med gr
H-05	65.4	65.43	GCON	grad		
H-05	66.2	66.2	CON	abrupt	75	
H-05	66.48	66.48	CON	sharp	70	
H-05	66.62	66.62	CON	sharp	80	
H-05	66.85	66.85	CON	sharp	75	
H-05	68.04	68.04	CON	sharp	75	
H-05	70.43	70.56	FRZ	m	35	pyrite along fractures
H-05	72	72.23	FRZ	m	30	series of fractures with pyrite along the planes
H-05	80	80.1	FRZ	m	15	
H-05	81.32	81.39	SHR	m	30	mylonite
H-05	81.55	81.58	FOL	m	40	biotite rich
H-05	83.3	84.27	FRZ	m	20	fractures at 20-50 deg TCA
H-05	84.8	86.4	FRZ	m	50	numerous fractures at 50 deg TCA
H-05	86.85	87.05	FRZ	m	20	
H-05	87.44	87.64	FRZ	m	40	
H-05	88.33	88.33	CON	sharp	65	
H-05	88.73	88.73	CON	sharp	65	
H-05	88.89	88.89	CON	abrupt	80	
H-05	89.18	89.2	GCON	grad	70	
H-05	91.58	91.58	CON	abrupt	70	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-05	91.78	91.78	CON	abrupt	80	
H-05	91.89	92	FRZ	m	60	
H-05	92	92	CON	sharp	80	
H-05	92.5	92.5	FRA	m	10	
H-05	97.3	97.3	CON	sharp	40	
H-05	97.3	97.7	FRZ	m	20	series of fractures that are at low angles TCA
H-05	97.91	97.91	SHR	m	30	small thin shear
H-05	98.07	98.07	FRA	M	20	
H-05	98.42	98.42	CON	abrupt	75	
H-05	98.51	98.51	CON	abrupt	70	
H-05	100.93	101	FRZ	m	40	
H-06	2.18	2.18	FRA	m	30	oxidized
H-06	3	3	FRA	m	85	oxidized
H-06	3.08	3.08	FRA	m	10	oxidized
H-06	3.08	4.87	FRZ	m	20	fractures at 20deg, and small faults at 60deg TCA
H-06	4.89	4.89	CON	sharp	40	
H-06	7.67	7.67	CON	sharp	75	
H-06	7.67	7.92	FRZ	m	80	oxidized
H-06	8.18	8.18	FLT	w	20	
H-06	8.43	9.08	FRZ	m	80	oxidized
H-06	9.17	9.18	VN	m	20	plag seg vn? Or granitic vein (plag+ bio) that appears to have filled a frac, altn halo surrounding the vein.
H-06	13.75	13.75	FLT	m	15	
H-06	13.75	13.84	FRZ	m	75	
H-06	16.45	16.58	FTZ	m	60	
H-06	16.58	16.6	VN		60	Granitic vein
H-06	16.6	16.67	FRZ	m	60	broken up and oxidized
H-06	16.8	16.8	FRA	w	10	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-06	16.9	16.93	FRA	m	80	
H-06	17.83	18.22	FRZ	m	30	series of fractures that cu the core at 25-30deg TCA
H-06	18.59	18.59	FRA	m	15	
H-06	21.83	21.83	FRA	m	10	shallow fracture
H-06	22.6	22.6	FRA	m	20	
H-06	22.87	22.87	FLT	m	20	carbonate and serpentine filled
H-06	23.4	23.4	FLT	m	10	strong slickensides, serpentinized fault surface
H-06	23.7	23.7	FRA	m	15	
H-06	23.83	23.83	FLT	m	15	carbonate and serpentine filled
H-06	24.08	24.08	FRA	m	15	carbonate and serpentine filled
H-06	25.56	25.56	FLT	m	55	
H-06	27.1	27.1	FLT	m	15	
H-06	27.65	27.65	FRA	m	10	
H-06	31.04	31.13	FTZ	m	55	
H-06	32.2	33.4	FRZ	m	20	fracture zone
H-06	33.06	33.07	FRA	m	15	
H-06	34	34.16	FRZ	m	30	fracture zone
H-06	34.95	35.86	FRZ	m	20	numerous fractures at 20deg TCA, serpentinized
H-06	36.77	37.9	FRZ	m	30	numerous fractures at 30deg TCA, serpentinized
H-06	38.23	38.23	FRA	w	20	
H-06	39.3	39.3	FRA	w	30	
H-06	39.92	40.48	FRZ	m	30	
H-06	40.47	40.49	GCON	grad		contact (change in mineralogy)
H-06	41.52	41.52	FRA	w	30	
H-06	41.87	41.87	FRA	w	30	
H-06	40.71	40.71	FLT	m	20	
H-06	43.8	43.8	FRA	w	30	serpentinized
H-06	45.36	45.36	CON	abrupt	60	
H-06	45.8	45.8	CON	sharp	40	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-06	45.96	45.96	CON	sharp	60	
H-06	46.28	46.28	FRA	m	50	
H-06	46.58	46.68	FRZ	m	50	
H-06	46.77	46.77	CON	abrupt	50	approx.
H-06	47.85	47.85	FRA	m	20	
H-06	48.9	48.9	CON	sharp	70	
H-06	49	49.2	FRZ	m	20	
H-06	50.4	50.4	FRA	w	20	
H-06	51.9	52.02	FRZ	m	30	
H-06	52.02	52.02	CON	irreg		dyke?? ~50deg TCA
H-06	52.12	52.12	CON	irreg		dyke?? ~50deg TCA
H-06	52.26	52.26	CON	abrupt	80	approx.
H-06	52.25	52.26	FLT	m	10	
H-06	52.8	52.95	FRZ	m	20	
H-06	54.08	54.08	FLT	w	40	
H-06	55.12	55.12	FLT	w	40	
H-06	55.2	55.2	FRA	w	30	
H-06	55.3	55.3	FRA	w	50	
H-06	55.46	55.5	FRZ	m	50	
H-06	56.02	56.2	FTZ	m	10	
H-06	56.4	56.44	FRZ	m	30	
H-06	56.73	56.73	FRA	w	70	
H-06	56.76	56.76	FRA	w	50	
H-06	56.94	56.96	GCON	grad		
H-06	57.23	57.23	FRA	m	50	
H-06	57.39	57.41	GCON	grad		
H-06	57.46	57.46	FRA	m	15	
H-06	57.58	57.66	FRZ	m	30	
H-06	60.04	60.05	FLT	m	40	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-06	60.83	60.83	FLT	m	10	Slickensides, serpentinized
H-06	62.6	62.6	FLT	m	20	Slickensides, serpentinized
H-06	63.43	63.5	FRZ	m	20	
H-06	64.42	64.42	FRA	m	40	Slickensides, serpentinized
H-06	65.17	65.24	FRZ	m	30	Slickensides, serpentinized
H-06	68.46	68.46	FRA	m	30	Slickensides, serpentinized
H-06	69.08	69.08	FRA	m	10	Slickensides, serpentinized
H-06	80	80	FRA	w	20	
H-06	81.66	81.66	FLT	m	20	
H-06	82.1	82.16	FRZ	m	50	
H-06	83.35	83.35	CON	sharp	60	
H-06	88.58	88.58	CON	sharp	60	
H-06	88.69	88.69	FRA	w	20	serpentinized
H-06	89	89	FRA	w	30	
H-06	90.53	90.53	FRA	w	20	
H-06	90.72	90.72	FRA	w	30	
H-06	92.7	93.52	FTZ	m	30	flt and frac zone, slickensides are abundant, serp
H-06	94.03	94.03	FRA	w	20	
H-06	94.5	94.7	FRZ	m	30	
H-06	95.1	95.15	GCON	grad		
H-06	98.35	98.4	GCON	grad		
H-06	99.97	99.97	FRA	m	40	serpentinized
H-06	108.18	108.32	FRZ	m	50	
H-06	108.6	108.6	FRA	m	20	
H-06	109.03	109.03	FLT	m	30	
H-06	111.62	111.88	FRA	m	40	serpentinized
H-06	112.36	112.36	FRA	m	20	
H-06	115.45	115.45	FRA	m	40	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-06	114.56	114.61	FRZ	m	30	
H-06	115.9	115.9	FLT	m	20	serpentinized
H-06	116.9	116.9	FRA	w	50	
H-06	117.13	117.13	FRA	m	40	serpentinized
H-06	122.47	122.2	FRZ	m	40	fractures at 10 to 40deg TCA
H-06	122.24	122.24	CON	abrupt	50	grains size contact, abrupt
H-06	122.59	122.59	CON	abrupt	80	
H-06	123.1	123.16	FRZ	m	40	
H-06	124.95	125.3	FRZ	m	30	
H-06	126.11	126.11	FRA	m	30	
H-06	126.24	126.32	GCON	grad		
H-06	126.73	126.73	FLT	m	30	
H-06	128.18	128.18	FLT	m	30	
H-06	130	130.6	FRZ	m	20	fractures at 10-30 deg TCA
H-06	131.55	131.98	FRZ	m	20	series of fractures at 20deg TCA
H-06	133.12	133.12	FLT	m	20	
H-06	133.74	133.74	FRA	w	30	
H-06	134.6	134.64	FRZ	m	30	
H-06	135.24	135.24	FRA	m	20	serpentinized
H-06	139.43	139.43	FRA	m	20	serpentinized + slickensides
H-06	140.26	140.26	FRA	m	5	serpentinized + slickensides
H-06	141.47	141.47	FRA	w	30	serpentinized + slickensides
H-06	141.77	141.77	FLT	w	10	serpentinized + slickensides
H-06	144	144.1	FTZ	m	20	serpentinized + slickensides
H-06	147.45	147.45	FRA	m	20	
H-06	147.86	148.4	FRZ	m	20	
H-06	149.7	149.7	FRA	w	20	serpentinized
H-06	150.05	150.05	FRA	w	20	serpentinized
H-06	150.4	150.8	FRZ	m	10	serpentinized + slickensides

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-06	155.52	155.58	FRZ	m	50	
H-06	156.05	156.09	GCON	grad		coarse grained
H-06	156.28	156.3	GCON	grad		
H-06	157.27	157.32	GCON	grad		
H-06	157.65	157.67	GCON	grad		
H-06	163.3	163.41	FRZ	m	10	serpentinized + slickensides
H-06	164.77	164.77	FRA	w	10	
H-06	166	166	FRA	m	20	
H-06	166.8	166.8	FRA	m	10	serpentinized + slickensides
H-06	167	167.08	FRZ	m	20	
H-06	170.61	170.62	GCON	grad		coarse grained gabbro to gabbro-norite
H-06	170.9	170.91	GCON	grad		
H-06	173.25	173.36	FRZ	m	40	series of serpentinized fractures
H-06	174.76	175	FRZ	m	20	broken up, some nice euhedral crystals; slickensides
H-06	175.83	176.1	FRZ	m	20	serpentinized fractures
H-06	176.63	176.74	FRZ	m	30	
H-06	176.9	177.04	FTZ	m	10	serpentinized + slickensides; series of fractures
H-06	180.15	180.66	FRZ	m	20	serpentinized
H-06	180.66	180.68	VN	sharp	40	
H-06	181.07	181.07	FRA	w	20	
H-06	181.75	181.82	VN	sharp	40	
H-06	181.82	181.9	SHR	m	30	
H-06	182.51	182.55	GCON	grad		gradational contact (altn contact?)
H-06	183.16	183.19	GCON	grad		
H-06	184.9	185.2	FRZ	m	30	fractures at 10-30deg TCA
H-06	186.52	187	FRZ	s	30	core is all broken up
H-06	187.75	187.75	FLT	m	20	
H-06	189.15	189.15	FRA	w	20	
H-06	189.48	189.62	FRZ	m	70	

Hole ID	From	To	Struct	Int	Angle TCA	Description
H-06	190.57	190.57	FRA	w	60	
H-06	191.34	191.5	FRZ	m	20	
Hp-07	3.14	3.14	FRA	m	40	oxidized
Hp-07	3.29	3.29	FRA	m	60	oxidized
Hp-07	3.4	3.4	CON	sharp	30	
Hp-07	4	4.57	FRZ	s	40	fractures at 30-50deg TCA
Hp-07	4.75	4.9	FRZ	s	80	
Hp-07	5.02	5.02	FRA	m	60	
Hp-07	5.09	5.09	FRA	m	80	
Hp-07	5.2	5.75	FRZ	s	70	oxidized
Hp-07	6.5	8.36	FRZ	m	70	fractures at 60-70deg TCA, oxidized
Hp-07	8.91	12.36	FRZ	s		fractures at 10-80deg TCA, broken up and oxidized
Hp-07	13.33	13.37	FLT	m	70	appears to be oxidized sulphides
Hp-07	13.85	13.9	FLT	m	50	
Hp-07	14.15	14.15	FRA	m	10	oxidized
Hp-07	14.5	14.55	FLT	m	35	
Hp-07	14.8	14.8	FLT	m	30	
Hp-07	14.8	15.8	FRZ	s	35	fractures at 30-40deg Tca
Hp-07	15.8	16.22	FLT	s	10	flt zone, minor fine, but mainly cr gouge; core is strongly oxi and is very brittle (source of water ingress)
Hp-07	16.91	17.16	FLT	s	30	coarse gouge,
Hp-07	17.3	18.68	FRZ	s		broken up core; fragments
Hp-07	18.8	19.63	FRZ	s		broken up core; fragments
Hp-07	19.85	20.2	FRZ	s		broken up core; fragments
Hp-07	20.5	21.15	FTZ	s		gouge present in this interval
Hp-07	21.53	21.54	FLT	m	30	Faulted contact and oxidized
Hp-07	21.6	22	FRZ	m		fracture zone, core is brittle and breaking up.
Hp-07	22.14	22.14	FRA	m	50	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-07	22.3	22.3	FRA	m	40	
Hp-07	22.42	22.66	FTZ	m	30	broken up core
Hp-07	23	23	FRA	m	40	
Hp-07	23.08	23.11	FLT	m	50	
Hp-07	23.11	24.26	FRZ	m	70	fractures at 10-80deg TCA, broken up and oxidized
Hp-07	24.26	24.26	CON	sharp	60	
Hp-07	24.26	25.24	FRZ	m		fractures at various angles, core is broken up
Hp-07	25.24	25.27	GCON	grad		
Hp-07	25.86	25.86	FRA	w	40	
Hp-07	26.2	26.2	FRA	m	30	
Hp-07	26.93	26.93	FRA	w	25	
Hp-07	27.04	27.04	FRA	w	80	
Hp-07	27.17	27.2	FLT	m	75	
Hp-07	27.34	27.44	FRZ	m	55	50-60deg TCA
Hp-07	28.13	28.13	CON	sharp	85	
Hp-07	28.64	28.64	CON	sharp	70	
Hp-07	32.3	32.8	FRZ	m	30	serpentinized and slickensides
Hp-07	33.1	33.3	FRZ	m	30	serpentinized and slickensides
Hp-07	33.52	33.75	FTZ	m	15	serpentinized and slickensides
Hp-07	33.75	33.75	GCON	grad		
Hp-07	33.94	33.94	GCON	grad		
Hp-07	34.5	34.5	FRA	m	20	serpentinized and slickensides
Hp-07	34.57	34.57	CON	abrupt		
Hp-07	34.75	34.75	CON	abrupt		
Hp-07	34.77	34.85	FRZ	m	40	
Hp-07	35.5	35.5	CON	grad		
Hp-07	35.62	35.62	GCON	grad		
Hp-07	36.7	36.97	FLT	m	20	serpentinized and slickensides
Hp-07	37.5	38	FRZ	m	30	20-40deg TCA, serpentinized

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-07	39.65	39.65	GCON	grad		
Hp-07	40.14	40.14	FRA	w	20	
Hp-07	41.28	41.32	FRZ	m	30	
Hp-07	43	43	FRA	m	10	
Hp-07	43.02	43.02	FRA	m	30	
Hp-07	43.06	44.26	FRZ	m	50	fractures at 20 to 50deg TCA
Hp-07	44.45	44.45	GCON	grad		
Hp-07	44.87	44.87	FRA	m	30	
Hp-07	45.16	45.3	FRZ	m	70	
Hp-07	45.8	45.8	FLT	m	30	
Hp-07	45.9	45.9	FLT	m	70	
Hp-07	47.61	47.64	FRZ	m	50	
Hp-07	48.4	48.4	FRA	w	40	
Hp-07	50	50.1	FRZ	m	30	
Hp-07	51.46	51.46	FRA	w	30	
Hp-07	51.6	51.6	FRA	m	5	
Hp-07	52.1	52.1	FRA	m	20	
Hp-07	53.36	53.36	FRA	m	20	
Hp-07	55.1	55.1	FRA	m	20	serpentinized and slickensides
Hp-07	55.63	55.63	GCON	grad		
Hp-07	55.9	55.9	FRA	m	20	
Hp-07	56.8	57.05	FRZ	m	40	
Hp-07	57.05	57.3	FRZ	m	60	
Hp-07	57.3	57.64	FRZ	m	20	
Hp-07	58	58	CON	sharp	30	faulted contact
Hp-07	58.87	58.87	CON	sharp	30	
Hp-07	59.18	59.18	FRA	m	20	
Hp-07	60.16	60.16	FRA	w	20	
Hp-07	60.27	60.27	FRA	w	25	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-07	60.66	60.66	FRA	m	30	
Hp-07	61.08	61.08	FRA	w	40	
Hp-07	61.45	61.74	FRZ	w	40	series of fractures
Hp-07	63.35	63.56	FRZ	m	20	
Hp-07	64	64	FLT	w	40	
Hp-07	64.54	64.54	FRA	w	30	
Hp-07	64.62	64.62	FLT	m	30	
Hp-07	64.81	64.81	FRA	m	20	
Hp-07	67.6	67.6	FLT	m	20	strong slickensides, serpentinized
Hp-07	67.9	68.34	FRZ	m	20	
Hp-07	68.74	68.74	FRA	m	20	
Hp-07	70	70	FRA	m	30	
Hp-07	71.24	71.24	FRA	m	20	
Hp-07	71.5	71.6	FTZ	m	20	
Hp-07	72.3	72.3	FRA	w	20	
Hp-07	72.96	72.96	GCON	grad		
Hp-07	75.2	75.2	FRA	w	5	
Hp-07	75.5	75.5	FRA	w	30	
Hp-07	75.76	75.76	FRA	w	30	
Hp-07	76.05	76.05	FRA	w	30	
Hp-07	76.42	76.42	GCON	grad		
Hp-07	76.92	76.92	FRA	w	40	serpentinized
Hp-07	77.08	77.13	FRZ	m	75	
Hp-07	79.2	79.2	FRA	m	5	oxidized, sulph are oxi and staining the core py); serp
Hp-07	80.2	80.2	FRA	m	10	serpentinized
Hp-07	80.4	80.44	FLT	m	50	
Hp-07	81.24	81.24	FLT	m	35	serpentinized + slickensides and smeared pyrite
Hp-07	82.35	82.69	FRZ	m	20	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-07	82.74	82.76	SHR	m	30	
Hp-07	83.38	83.38	FRA	m	30	
Hp-07	83.4	83.42	SHR	m	25	shr vein
Hp-07	84.21	84.77	FRZ	m	10	
Hp-07	84.8	85	FRZ	m	50	
Hp-07	85.41	85.45	SHR	m	20	shr vein
Hp-07	88.21	88.23	FRZ	m	50	
Hp-07	89.53	89.53	FRA	w	30	
Hp-08	11.36	13.8	FRZ	m	20	majority of the fractures cut the core at 20deg TCA
Hp-08	14	14	FRA	m	30	
Hp-08	15.55	15.55	FRA	m	5	
Hp-08	15.84	15.85	FLT	m	35	
Hp-08	16	16.73	FRZ	m	15	
Hp-08	16.73	16.76	FLT	m	70	
Hp-08	16.84	16.85	FLT	m	20	
Hp-08	17.12	17.12	CON	w	50	at frac between oxi and poorly consolid gab and gab
Hp-08	18.2	18.2	FRA	m	5	
Hp-08	18.26	18.26	FRA	m	30	
Hp-08	18.55	18.55	FRA	m	20	
Hp-08	19.07	19.07	FRA	m	10	
Hp-08	19.34	19.34	FRA	w	15	
Hp-08	20.62	20.62	FRA	w	30	
Hp-08	22.2	22.7	FRZ	m	30	
Hp-08	24	24	FRA	m	30	
Hp-08	24.59	24.76	FRZ	m	30	
Hp-08	26.67	26.67	FRA	w	40	
Hp-08	26.87	26.87	FRA	w	30	
Hp-08	26.46	27.15	FRZ	m	20	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-08	30	30	GCON	grad		
Hp-08	30.05	30.05	FRA	m	30	
Hp-08	30.33	30.33	FRA	m	10	
Hp-08	30.87	30.89	SHR	m	30	
Hp-08	31.25	31.25	FRA	m	30	
Hp-08	31.9	32	FRZ	m	30	
Hp-08	34	34.07	FRZ	m	40	
Hp-08	34.07	34.09	SHR	m	25	
Hp-08	34.09	35.49	FRZ	m	50	
Hp-08	35.49	35.5	CON	sharp	20	altn contact/ litho change
Hp-08	37.27	37.27	FLT	m	15	serpentinized + slickensides
Hp-08	37.46	37.46	FRA	m	30	
Hp-08	37.46	38.55	FRZ	m	50	fractures at 20-60deg TCA
Hp-08	38.9	38.9	FRA	m	30	serpentinized + slickensides
Hp-08	38.94	38.94	FRA	m	50	serpentinized + slickensides
Hp-08	39.06	39.06	FRA	m	30	serpentinized + slickensides
Hp-08	39.33	45.5	FRZ	m	20	serpentinized +/- slickensides; frac are at 10-50deg TCA, most are at 20-30deg TCA; frac are
Hp-08	47.87	48.65	FRZ	m	30	fra at 2040deg TCA, most are serp +/- slickensides
Hp-08	48.9	49.7	FRZ	m	40	numerous fractures
Hp-08	52	54	FRZ	m	50	fractures at 20-60deg TCA
Hp-08	54.95	54.95	FRA	m	30	
Hp-08	55.2	55.5	FRZ	m	30	numerous fractures
Hp-08	55.83	55.86	SHR	m	20	
Hp-08	56	57.53	FRZ	m	40	fractures at 40-50deg TCA
Hp-08	57.7	62	FRZ	s	20	Frac at 15-30deg TCA, numerous frac, serp +/- slickensides.
Hp-08	63.7	65.18	FRZ	m	50	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-08	67.07	68.59	FRZ	s	30	serp +/- slickensides, frac at 20-50deg TCA, some are curved, triple junction at 67.52m
Hp-08	68.59	68.61	FLT	m	30	
Hp-08	68.9	71	FRZ	m	60	fractures as 30-60deg TCA, most at 60
Hp-08	71.57	71.59	FRZ	m	50	
Hp-08	71.74	71.74	FLT	m	20	
Hp-08	71.88	71.88	FRA	m	20	
Hp-08	72.02	73.54	FRZ	m	30	fractures at 30-70deg TCA, most at 30
Hp-08	73.75	73.75	FRA	m	40	
Hp-08	73.83	73.83	FLT	m	20	minor carbonate along plane
Hp-08	74.43	74.5	FRZ	m	40	
Hp-08	74.84	75.07	FRZ	m	30	
Hp-08	76.59	79.73	FRZ	s	20	gen shallow frac, strong altn, core is brittle, lots slickenside surfaces, part of large flt
Hp-08	79.9	81.08	FRZ	s	20	serpentinized fractures at 10-50deg TCA
Hp-08	81.08	81.08	CON	sharp	20	
Hp-08	81.08	83.81	FRZ	m	50	fracture sets at 50deg TCA
Hp-08	83.81	83.81	CON	sharp	30	
Hp-08	84.41	84.48	SHR	m	25	
Hp-08	84.57	84.57	FLT	m	20	
Hp-08	84.95	84.95	CON	sharp	30	
Hp-08	84.95	86.73	SHR	sharp	10	mylonitic
Hp-08	86.73	86.73	CON	sharp	20	
Hp-08	86.73	86.9	FOL	m	35	
Hp-08	86.9	86.9	CON	sharp	30	
Hp-08	86.9	87.26	FOL	s	40	
Hp-08	87.26	87.26	CON	sharp	40	
Hp-08	88.07	88.07	CON	sharp	25	sheared contact, strong slickensides
Hp-08	88.07	88.38	SHR	m	30	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-08	88.38	88.38	CON	sharp	20	
Hp-08	88.38	88.77	FOL	m	20	
Hp-08	88.77	88.77	CON	sharp	20	
Hp-08	88.77	89.17	SHR	m	20	
Hp-08	89.17	89.17	CON	sharp	20	
Hp-08	89.17	89.4	FOL	w	30	
Hp-08	89.4	89.4	CON	sharp	20	
Hp-08	89.4	90.31	SHR	m	10	
Hp-08	90.31	90.31	CON	sharp	20	
Hp-08	90.44	90.44	CON	sharp	30	
Hp-08	90.44	92.02	SHR	m	20	varies from 10-20deg TCA
Hp-08	92.02	92.02	CON	sharp	40	
Hp-08	92.02	92.56	FOL	W	40	
Hp-08	92.56	92.56	CON	sharp	40	
Hp-08	92.56	93.64	SHR	m	30	varies from 20-30deg TCA
Hp-08	93.64	93.8	FLT	m	50	
Hp-08	93.8	94.04	SHR	m	30	
Hp-08	94.04	94.05	FLT	m	30	
Hp-08	94.05	95.56	FOL	m	35	varies from 30-40deg TCA
Hp-08	95.56	95.56	CON	sharp	20	
Hp-08	97.03	97.08	SHR	m	30	
Hp-08	99	99	FRA	m	10	
Hp-08	99.75	99.75	FLT	m	20	serpentinized
Hp-08	101.7	101.7	FRA	m	20	
Hp-08	103.37	103.38	SHR	m	20	
Hp-08	104.14	104.14	FLT	m	60	
Hp-08	105.1	105.1	FRA	m	40	
Hp-08	105.37	105.37	FRA	m	20	vuggy
Hp-08	106.13	106.13	FRA	m	20	vuggy

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-08	106.4	106.6	FRZ	m	60	
Hp-08	107.62	107.62	FRA	m	20	carbonates along factures, vuggy
Hp-08	108.56	108.6	FRZ	m	60	
Hp-08	108.88	109.25	FRZ	m	40	
Hp-08	110.25	111.64	FRZ	m	20	
Hp-08	112.06	112.06	GCON	grad		
Hp-08	113.04	113.04	FRA	m	40	
Hp-08	114.23	114.23	FLT	m	30	
Hp-08	115.33	115.33	FRA	m	30	
Hp-08	118.47	118.47	FRA	m	30	vuggy
Hp-08	119.07	119.07	CON	sharp	30	
Hp-08	119.07	119.62	FOL	m	20	
Hp-08	119.62	119.62	CON	sharp	20	
Hp-08	120.79	120.79	FRA	m	20	
Hp-08	122.8	122.8	CON	sharp	50	
Hp-08	122.8	123.03	FOL	m	70	
Hp-08	123.03	123.03	CON	abrupt	50	
Hp-08	123.15	123.43	FRZ	m	50	
Hp-08	125.39	125.39	CON	sharp	50	
Hp-08	125.39	126.95	FOL	m	40	foln from 40 at up cont to 10 then to50 at low cont
Hp-08	126.95	126.95	CON	abrupt	50	
Hp-08	127.27	128.41	FRZ	m	30	fractures at 10-40deg TCA
Hp-08	128.63	128.63	FLT	m	40	
Hp-08	131.34	131.34	FLT	m	40	
Hp-08	132.05	132.05	FLT	M	30	serpentinized and pyrite rich; strong slickensides
Hp-08	132.31	132.32	FLT	m	30	
Hp-08	132.47	132.47	FLT			
Hp-08	133.76	133.77	FRA	m	10	serpentinized

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-08	134.8	134.8	FRA	m	20	
Hp-08	137	137.06	FRZ	m	20	
Hp-08	140.2	140.6	FRZ	m	10	serpentinized
Hp-08	141.55	141.55	FLT	m	10	serpentinized
Hp-08	143.83	143.84	FLT	m	30	slickensides, serpentinized, fn grained serpentinized
Hp-08	144.45	144.46	FRA	s	40	slickensides and serpentinized
Hp-08	144.54	144.54	FRA	m	20	
Hp-08	144.66	144.71	FTZ	m	50	slickensides and serpentinized
Hp-08	145.25	145.25	FRA	m	50	slickensides and serpentinized + pyrite
Hp-08	145.49	146.32	FRZ	m	70	
Hp-08	146.32	146.32	CON			ground core at the contact, appears to have been sharp.
Hp-08	146.76	147.23	FRZ	m	20	mineralized
Hp-08	147.23	147.23	FLT	m	40	mineralized
Hp-08	148.72	149.3	FRZ	m	30	
Hp-08	150	150	FRA	w	45	
Hp-08	150.08	150.08	FRA	m	10	
Hp-08	150.56	150.56	FLT	m	20	
Hp-08	150.85	150.85	GCON	grad		
Hp-08	151.1	151.44	FRZ	m	20	
Hp-08	152.18	152.54	FRZ	m	60	
Hp-08	152.58	152.98	FRZ	m	20	20-30deg TCA
Hp-08	154.6	154.6	FRA	m	40	
Hp-08	155.16	155.16	FLT	m	40	
Hp-08	155.34	155.9	FRZ	m	70	
Hp-08	155.9	156	FRZ	m	20	serpentinized + pyrite+ slickensides
Hp-08	156.54	156.54	FLT	m	20	
Hp-08	156.75	157	FRZ	m	20	
Hp-08	157.5	158	FRZ	m	40	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-08	158.23	158.23	FRA	m	20	small veinlet along facture plane
Hp-08	158.46	158.46	CON	sharp	70	change in mineralogy, sharp
Hp-08	158.57	158.57	FRA	m	30	small veinlet along facture plane
Hp-08	159.25	159.48	FRZ	m	40	
Hp-08	159.7	162.77	FRZ	m	40	
Hp-08	164	165.03	FRZ	m	70	
Hp-08	165.03	165.33	FLT	m	30	healed fault gouge
Hp-08	165.33	165.65	FRZ	m	60	
Hp-08	166	166.5	FRZ	m	60	
Hp-08	167	170.5	FRZ	m	60	
Hp-08	171.28	171.28	CON	sharp	75	
Hp-08	171.28	171.38	FOL	w	80	
Hp-08	171.38	171.38	CON	sharp	75	
Hp-08	171.38	172.72	MLIN	w	70	
Hp-08	172.72	172.72	CON	sharp	80	
Hp-08	172.72	172.96	FOL	w	80	
Hp-08	172.96	172.96	CON	sharp	80	
Hp-08	174.9	174.9	FRA	w	50	
Hp-08	176.12	176.2	FRZ	m	20	
Hp-08	176.7	176.7	FRA	m	10	
Hp-08	176.85	176.85	FLT	m	30	
Hp-08	177.18	177.18	FLT	m	25	
Hp-08	178.33	178.33	FRA	m	20	serpentinized + slickensides
Hp-08	178.78	178.78	FRA	m	20	
Hp-08	179.08	179.08	FRA	m	10	
Hp-08	179.08	185.2	MLIN	m	70	
Hp-08	185.2	185.36	FRZ	m	30	
Hp-08	186	186	FRA	m	30	
Hp-08	186.54	186.63	FRZ	m	30	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-08	187.69	187.69	GCON	grad		
Hp-08	187.75	187.75	FRA	m	20	
Hp-09	2.01	4.21	FRZ	m	30	multiple angles for fractures from 10-50deg TCA
Hp-09	4.9	5.83	FRZ	m	30	multiple angles for fractures from 10-50deg TCA
Hp-09	5.83	5.84	FLT	m	30	small coarse gouge
Hp-09	5.84	8.37	FRZ	m	30	multiple frac at various angles, typically from 20-40deg TCA, most are oxidized
Hp-09	8.37	8.37	CON	sharp	15	
Hp-09	8.37	8.94	FOL	m	20	
Hp-09	8.94	8.94	CON	sharp	15	
Hp-09	8.94	10.05	FRZ	m	20	fractures typically at 20-30deg TCA
Hp-09	12.45	14.8	FRZ	m	20	fractures typically at 20-30deg TCA
Hp-09	16.94	16.94	FRA	m	60	
Hp-09	17.7	17.7	FRA	m	10	intersecting frac, one at 10 and the other at 70 deg TCA
Hp-09	17.77	17.77	CON	abrupt		irregular contact
Hp-09	18.35	18.5	BAN	m	30	banding at 30deg TCA
Hp-09	18.5	18.7	BAN	m	40	banding at 40deg TCA
Hp-09	18.7	19	BAN	m	50	banding at 50deg TCA
Hp-09	19.21	19.21	CON	abrupt		irregular contact
Hp-09	19.6	19.6	CON	abrupt		irregular contact
Hp-09	19.6	20.8	BAN	m	20	banding at 20 deg TCA
Hp-09	20.8	20.85	FRZ	m	60	frac appear to have been source of fluids, oxidized surrounding the frac + minor carb along frac
Hp-09	20.85	20.85	BAN	m	30	banding at 30 deg TCA
Hp-09	22.28	22.28	CON	abrupt	30	Change in gr sz, mineralogy and sulph/oxide content
Hp-09	22.28	23	BAN	m	30	moderate banding
Hp-09	25.07	25.07	FRA	m	30	

Hole ID	**From**	**To**	**Struct**	**Int**	**Angle TCA**	**Description**
Hp-09	26.25	26.25	FRA	m	20	
Hp-09	26.6	26.6	FRA	m	60	
Hp-09	27.45	27.45	CON	sharp	70	change in gr sz.
Hp-09	27.66	27.66	CON	sharp	30	
Hp-09	27.7	27.7	CON	sharp	40	
Hp-09	27.73	27.73	FRA	m	20	carbonate along fracture plane
Hp-09	28.12	28.13	FRA	m	30	carbonate along fracture plane
Hp-09	28.74	29	FRZ	m	30	
Hp-09	29.16	29.16	CON	sharp	20	
Hp-09	29.16	29.25	FOL	m	20	weakly sheared
Hp-09	29.25	29.25	CON	sharp	20	
Hp-09	29.25	49	FOL	w	60	varies locally up to 70 deg TCA
Hp-09	29.68	29.77	FRZ	m	40	
Hp-09	30.28	30.28	FLT	m	20	serpentinized + carbonate
Hp-09	30.6	30.8	FRZ	m	30	serpentinized + carbonate (moderate alteration)
Hp-09	31.23	31.4	FRZ	m	40	
Hp-09	33	34	FRZ	m	50	
Hp-09	35.95	35.95	FRA	m	30	
Hp-09	37	37	FRA	m	30	
Hp-09	37.68	37.73	FRZ	m	40	
Hp-09	40.9	40.9	FRA	m	30	
Hp-09	41.1	41.1	FRA	m	20	
Hp-09	42.07	42.07	FRA	m	20	Serpentinized fractures
Hp-09	42.23	42.23	FRA	m	20	Serpentinized fractures
Hp-09	42.38	42.38	FRA	m	30	Serpentinized fractures
Hp-09	43.08	43.08	FRA	m	20	carbonate along fracture plane
Hp-09	43.35	43.6	FRZ	m	30	carbonate along fracture planes
Hp-09	43.83	43.9	FRZ	m	30	
Hp-09	44.84	44.95	FRZ	m	30	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-09	46.46	46.46	FRA	m	20	
Hp-09	46.7	46.7	FRA	m	20	
Hp-09	48.27	48.3	FRZ	m	30	Serpentinized fractures
Hp-09	48.7	48.7	FRA	m	30	carbonatized
Hp-09	49	51.4	FOL	m	70	
Hp-09	51	51	FRA	m	20	Serpentinized fractures
Hp-09	52.3	53.04	FRZ	m	40	fractures at 30-40deg TCA
Hp-09	53.21	53.24	FRZ	m	50	carbonatized
Hp-09	53.24	53.82	FRZ	m	40	
Hp-09	53.82	54.05	FTZ	m	40	healed what appears to be coarse fault gouge, or breccia
Hp-09	54.3	54.3	FRA	m	40	carbonatized
Hp-09	54.48	54.8	FRZ	m	60	
Hp-09	55.2	55.2	FRA	m	70	
Hp-09	55.5	56.62	FRZ	m	60	
Hp-09	57.2	59.92	FRZ	m	10	number of serp frac that cut near parallel TCA; core is broken due to frac and their orientations
Hp-09	60.26	60.26	FRA	m	20	serpentinized + slickensides
Hp-09	60.9	61.07	FRZ	m	20	serpentinized + slickensides
Hp-09	61.6	61.6	FRA	m	20	serpentinized + slickensides
Hp-09	61.78	62	FRZ	m	50	serpentinized + slickensides
Hp-09	62.34	63	FRZ	m	50	
Hp-09	63.35	63.4	FRZ	m	20	
Hp-09	63.7	63.8	FRZ	m	40	
Hp-09	64.36	64.36	FRA	m	20	
Hp-09	65.67	65.67	FRA	m	30	
Hp-09	66.95	66.95	FRA	m	20	
Hp-09	67.14	67.14	FRA	m	15	serpentinized + slickensides
Hp-09	67.77	68.56	FRZ	m	40	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-09	68.66	68.66	FRA	m	45	slickensides
Hp-09	68.88	68.88	CON	sharp	25	fracture as well
Hp-09	69.1	69.1	CON	sharp	70	
Hp-09	69.35	69.35	FRA	m	10	serpentinized + slickensides
Hp-09	70.95	70.95	FRA	m	20	serpentinized + slickensides
Hp-09	71.5	71.5	FRA	m	15	serpentinized + slickensides
Hp-09	73.27	73.38	FRZ	m	10	
Hp-09	73.38	73.38	FRA	m	30	
Hp-09	77.53	77.55	SHR	m	50	
Hp-09	79.38	79.41	SHR	m	30	carbonate and serpentine altd
Hp-09	80.55	80.68	FRZ	m	20	serpentinized
Hp-09	82.87	82.92	FRZ	m	20	carbonate along fractures
Hp-09	83.93	84	FRZ	m	30	carbonate along fractures
Hp-09	86.66	86.66	FRA	m	20	serpentinized
Hp-09	88.87	88.87	CON	abrupt		not sharp and defined
Hp-09	89.21	89.21	CON	abrupt		not sharp and defined
Hp-09	89.39	89.39	FRA	m	15	serpentinized
Hp-09	90.1	90.1	FRA	m	15	
Hp-09	90.1	90.15	CON	grad		gradational contact over ~5cm, from 90.1-90.15m
Hp-09	91.72	91.72	FRA	m	20	carbonate+ serpentine+ sulphides along fracture plane
Hp-09	94.09	94.09	CON	abrupt		change in pyroxene content (not sharp defined contact)
Hp-09	94.53	94.53	FRA	m	20	
Hp-09	98.42	98.42	FRA	m	20	serpentinized
Hp-09	99.08	99.08	FRA	m	20	carbonate
Hp-09	99.59	99.59	CON	abrupt		change in mineralogy
Hp-09	100.42	100.42	CON	abrupt		change in mineralogy
Hp-09	100.47	101.13	FRZ	m	10	carb and serp along the frac planes and minor pyrite

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-09	102.4	103.58	CON	grad		grad contact with increase in pyrox % down hole
Hp-09	99.45	99.45	FRA	m	30	serpentinized
Hp-09	99.58	99.58	FRA	m	25	serpentinized
Hp-09	105.77	106.19	FRZ	m	40	partially healed (serpentinized and carbonatized)
Hp-09	106.31	106.31	CON	abrupt		
Hp-09	106.96	107	FLT	m	50	
Hp-09	107.2	107.2	FRA	m	15	serpentinized
Hp-09	107.3	107.3	CON	abrupt		
Hp-09	107.84	107.84	FRA	m	20	serpentinized
Hp-09	108.33	108.33	FRA	m	30	serpentinized
Hp-09	108.88	108.88	CON	sharp	40	
Hp-09	108.96	108.96	CON	sharp	40	
Hp-09	109.4	109.4	FRA	m	30	carbonate
Hp-09	109.7	109.7	FRA	m	20	carbonate filled fracture
Hp-09	109.74	109.74	CON	abrupt		
Hp-09	109.8	109.8	FRA	m	20	serpentinized + carbonatized
Hp-09	109.9	109.9	FRA	m	30	serpentinized + carbonatized
Hp-09	110	110.3	FRZ	m	40	serpentinized + carbonatized
Hp-09	111	111	FLT	m	40	
Hp-09	111.75	111.75	CON	sharp	50	alteration contact
Hp-09	112.21	112.21	FRA	m	20	serpentinized + carbonatized
Hp-09	113.45	113.45	FRA	m	30	
Hp-09	115	115	FRA	m	20	carbonate along fracture plane
Hp-09	116.15	116.15	FRA	m	20	
Hp-09	116.47	116.47	FRA	m	20	carbonate along fracture plane
Hp-09	117.68	117.68	CON	abrupt		
Hp-09	117.96	117.96	FRA	m	20	serpentinized + carbonatized
Hp-09	118.17	118.17	CON	abrupt		

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-09	118.31	118.31	CON	abrupt		
Hp-09	118.86	119.03	FRZ	m	40	carbonatized and serpentinized fractures
Hp-09	119.03	119.05	FLT	m	30	
Hp-09	119.23	119.23	CON	abrupt		
Hp-09	119.35	119.73	FRZ	m	30	
Hp-09	121.18	121.18	FRA	m	30	serpentinized
Hp-09	122.54	122.54	FRA	m	20	
Hp-09	124.36	124.36	FRA	m	40	
Hp-09	125.25	125.3	FLT	m	70	
Hp-09	126.52	126.52	CON	abrupt	60	sharp
Hp-09	126.52	127.6	FOL	w	60	weak alignment of the feldspars
Hp-09	127.6	127.6	FRA	m	40	
Hp-09	128.7	129	FRZ	m	30	carbonate filled fractures at 20-30deg TCA
Hp-09	129.26	129.26	FRA	m	30	Carbonate + sulphides
Hp-09	129.3	129.3	FRA	m	40	Carbonate + sulphides
Hp-10	3	3	FRA	m	30	oxidized
Hp-10	3.37	3.37	CON	sharp		broken core/ cannot get an angle
Hp-10	3.37	5.04	FRZ	m	50	multiple fractures at 20-60deg TCA
Hp-10	3.37	4	FOL	w	30	
Hp-10	4	4.8	FOL	m	10	increase in biotite and foliation intensity
Hp-10	4.8	5.04	FOL	w	30	
Hp-10	5.04	5.04	CON	sharp	30	angle taken, but unsure if more granite was ground
Hp-10	8.08	8.08	FRA	m	50	oxidized
Hp-10	8.9	8.9	FRA	m	30	oxidized
Hp-10	8.9	11.68	FRZ	sharp	50	oxidized, multiple fractures at 20-50deg TCA
Hp-10	11.68	11.69	FLT	m	30	oxidized
Hp-10	11.69	14.5	FRZ	m	50	oxidized, multiple fractures at 20-50deg TCA
Hp-10	29	29	CON	sharp		core is broken
Hp-10	29.23	29.23	CON	sharp		core is broken

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-10	29.23	30.51	FRZ	m	60	serpentinized fractures
Hp-10	30.95	32.18	FRZ	m	60	serpentinized fractures
Hp-10	32.18	32.18	CON	abrupt	70	
Hp-10	32.8	32.8	CON	abrupt	70	
Hp-10	32.8	33.3	FRZ	m	50	
Hp-10	36.22	36.22	FRA	m	20	
Hp-10	37.63	37.68	FRZ	m	20	
Hp-10	37.84	37.84	CON	sharp	40	
Hp-10	37.84	39.04	FOL	m	25	
Hp-10	39.04	39.04	CON	sharp	30	
Hp-10	40.19	40.19	CON	sharp	25	
Hp-10	40.43	40.43	CON	sharp	25	
Hp-10	40.64	40.64	FRA	m	10	
Hp-10	40.9	40.95	FLT	m	40	
Hp-10	41.08	42.3	FTZ	s	40	frac and flt zone, abundant strong slickensides, frac and flts at various angles but typically from 20-60deg TCA
Hp-10	42.3	42.3	CON	abrupt	10	
Hp-10	42.77	42.77	FRA	m	20	
Hp-10	43	43	FRA	m	30	
Hp-10	43.2	43.2	FRA	m	20	
Hp-10	43.2	45.64	FRZ	m	50	
Hp-10	45.64	45.64	CON	abrupt	10	
Hp-10	46.4	46.4	FRA	m	35	
Hp-10	46.6	46.6	FRA	m	20	
Hp-10	47.71	47.71	FRA	m	20	
Hp-10	49	49	FLT	m	20	
Hp-10	50.7	50.7	CON	abrupt		ground ends, cannot tell if sharp or not
Hp-10	51.37	51.37	CON	abrupt	60	contact is irregular, not well defined sharp contact

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-10	51.8	51.8	CON	abrupt	20	contact is irregular, not well defined sharp contact
Hp-10	52.08	52.08	CON	abrupt	30	
Hp-10	52.55	52.55	FRA	m	10	
Hp-10	55.25	55.25	FRA	w	20	
Hp-10	57	57	FRA	m	40	
Hp-10	57.94	58	FRZ	m	60	
Hp-10	58.75	58.75	CON	sharp	30	
Hp-10	58.88	58.88	CON	sharp	30	
Hp-10	58.88	59.05	FRZ	m	60	
Hp-10	59.55	59.55	CON	sharp	30	
Hp-10	59.62	59.62	CON	sharp	10	
Hp-10	61.08	61.53	FOL	vw	30	
Hp-10	61.53	61.53	CON	sharp	15	
Hp-10	62.8	62.8	FRA	m	10	
Hp-10	65	65	FRA	m	30	
Hp-10	65.3	65.3	FRA	m	30	
Hp-10	66	66.3	FRZ	m	20	
Hp-10	67.08	67.08	CON	sharp	10	
Hp-10	68.35	68.35	CON	sharp	20	
Hp-10	69.53	69.54	FLT	m	70	coarse pyrite and qtz veinlet along the plane
Hp-10	71.82	71.82	FRA	m	20	
Hp-10	76.07	76.07	FLT	m	20	thin gouge (<1cm)
Hp-10	77	77	FRA	w	30	
Hp-10	77.3	77.3	FRA	m	15	
Hp-10	77.62	77.62	FRA	m	40	
Hp-10	86.2	87.45	FRZ	s	20	serpentinized fractures
Hp-10	87.45	87.6	FRZ	s	30	serpentinized fractures
Hp-10	88.5	88.76	FRZ	s	40	numerous angles, strong serp, core is broken up

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-10	88.86	88.86	FLT	m	30	
Hp-10	90.32	90.32	FRA	m	30	serpentinized fracture
Hp-10	90.9	90.9	FLT	m	20	very strong slickensides, serpentinized
Hp-10	91.54	91.57	FRZ	m	30	
Hp-10	92.32	92.32	FLT	m	20	strong slickensides, serpentinized
Hp-10	92.88	93.78	FRZ	m	40	serpentinized
Hp-10	94.07	95	FRZ	m	50	
Hp-10	95.2	95.36	FRZ	m	30	
Hp-10	96.15	96.48	FRZ	s	20	slickensides are strong and at 75deg TCA
Hp-10	97	97.15	FRZ	s	10	slickensides are strong and at 80deg TCA
Hp-10	98.01	98.22	FRZ	m	20	
Hp-10	98.4	98.85	FRZ	m	15	serpentinized
Hp-10	100	110.3	FRZ	m	40	
Hp-10	102.94	103.4	FRZ	m	30	fractures at 20-50deg TCA
Hp-10	104.1	105.75	FRZ	m	40	
Hp-10	107.72	107.72	FRA	m	20	
Hp-10	109.07	109.07	FRA	m	20	
Hp-10	109.93	110.03	SHR	m	20	serpentine+carbonate sheared vein
Hp-10	112.18	112.18	FRA	m	30	
Hp-10	113.42	113.42	FLT	m	30	
Hp-10	115.72	115.77	VN	sharp	30	sharp contacts, serpentinized + carbonate
Hp-10	119.86	119.86	FRA	m	30	
Hp-10	120.97	120.97	FRA	m	40	
Hp-10	122.97	123.1	FRZ	m	30	
Hp-10	125.67	126.13	FRZ	m	30	serpentinized fractures
Hp-10	132.5	132.5	FRA	m	10	
Hp-10	132.5	132.5	FLT	m	25	
Hp-10	128.93	129.4	FRZ	w	50	
Hp-10	130.2	130.2	FRA	m	20	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-10	130.4	130.4	FRA	m	20	
Hp-10	130.6	131	FRZ	m	20	
Hp-10	132.5	132.5	FRA	m	30	
Hp-10	134.97	134	FRZ	m	30	
Hp-10	134.05	134.12	FTZ	m	30	
Hp-10	135.59	135.65	FLT	m	30	
Hp-10	135.9	135.9	FLT	m	20	
Hp-10	136.84	136.84	FRA	m	30	
Hp-10	138.26	138.26	FRA	m	30	
Hp-10	138.8	139	FRZ	m	30	
Hp-10	139.75	140.13	FRZ	m	20	serpentinized fractures
Hp-10	141	141.26	FRZ	m	20	serpentinized fractures
Hp-10	142.25	142.25	FRA	m	30	
Hp-10	144.05	144.05	FRA	m	30	
Hp-10	146.73	146.73	FRA	m	30	
Hp-10	147.9	147.9	FRA	m	10	
Hp-10	149.25	149.25	FRA	m	10	
Hp-10	150.4	150.6	FRZ	m	10	
Hp-10	151	151.06	FRZ	m	20	
Hp-10	151.06	151.08	VN	m	30	fracture or fault
Hp-10	151.9	151.9	CON	abrupt		
Hp-10	152.2	152.2	FRA	m	15	
Hp-10	152.52	152.75	FRZ	m	30	
Hp-10	152.91	152.91	GCON	grad		gradational contact over ~5cm from 152.9-152.95m
Hp-10	153.14	153.14	FLT	m	30	slickenside surfaces and serpentinized
Hp-10	155.27	155.4	FRZ	m	30	
Hp-10	156.68	156.74	FLT	m	20	
Hp-10	156.74	156.74	CON	sharp	30	
Hp-10	156.86	156.86	CON	sharp	30	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-10	156.86	157.44	FRZ	m	20	
Hp-10	157.52	158.42	FRZ	m	40	serpentinized fractures
Hp-10	158.78	158.78	CON	abrupt		
Hp-10	160.55	160.65	FRZ	m	40	slickensides
Hp-10	160.65	160.65	FLT	m	30	strong slickensides, serpentinized
Hp-10	160.65	160.81	FRZ	m	40	
Hp-10	161	161.02	FLT	m	50	
Hp-10	161.02	161.48	FRZ	m	10	serpentinized
Hp-10	161.48	161.48	CON	abrupt		gr sz change
Hp-10	162.66	162.66	FRA	m	20	
Hp-10	163.29	163.29	FRA	m	20	
Hp-10	164.09	164.09	FRA	m	20	
Hp-10	166.28	166.28	CON	abrupt		gr sz change
Hp-10	169.85	170.04	FRA	m	40	
Hp-10	171.75	171.75	FRA	m	10	
Hp-10	172.16	172.16	FRA	m	20	
Hp-10	172.5	172.5	FRA	m	20	
Hp-10	173.34	173.34	FRA	m	50	
Hp-10	177.55	177.55	FRA	m	40	slickensides + serpentinized
Hp-10	180.07	180.07	FRA	m	10	carbonate along plane
Hp-10	183.35	183.7	FRZ	m	50	
Hp-10	184.87	185.03	FRA	m	30	
Hp-10	185.03	185.03	CON	sharp	40	
Hp-10	185.03	185.16	FOL	vw	40	
Hp-10	185.16	185.16	CON	sharp	30	
Hp-10	185.16	185.83	FRZ	m	30	slickensides + serpentinized
Hp-10	186.26	187.14	FRZ	m	30	slickensides + serp; frac at var angles 20-50deg TCA
Hp-11	3.52	7.74	FRZ	s	20	core is all broken up/ rubble

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-11	7.74	7.74	CON	sharp		Sharp contact?? (broken up core)
Hp-11	8.1	8.1	CON	sharp	70	Sharp contact?? (broken up core)
Hp-11	8.1	13.26	FRZ	s	20	fractures and possibly faults, core is all broken up.
Hp-11	13.26	13.4	FRZ	m	30	oxidized
Hp-11	14	14	FRA	m	20	
Hp-11	14.74	15.1	FRZ	m	10	
Hp-11	17.26	17.26	FRA	m	20	
Hp-11	18	18	FRA	w	40	
Hp-11	18.7	18.8	FRZ	m	30	
Hp-11	19	19.8	FRZ	m	40	
Hp-11	21	22	FRZ	m	30	
Hp-11	22	22	FRA	m	40	
Hp-11	22.13	22.13	FRA	m	20	
Hp-11	22.38	22.38	FRA	m	30	
Hp-11	24.03	24.03	GCON	grad	70	
Hp-11	24.03	24.75	FRZ	m	40	
Hp-11	24.75	24.87	FLT	s	30	coarse gouge present
Hp-11	26.65	26.8	FRZ	m	30	
Hp-11	27.92	28.1	FRZ	m	20	
Hp-11	28.75	28.75	FRA	m	40	
Hp-11	30	30	FRA	m	20	
Hp-11	31.3	31.5	FRZ	m	30	
Hp-11	33.13	33.13	CON	sharp	60	
Hp-11	33.27	33.27	FRA	m	30	
Hp-11	36.08	36.08	FRA	m	20	
Hp-11	37.34	37.34	FRA	w	20	
Hp-11	42.48	42.78	FRZ	m	40	fractures at 30-40deg TCA
Hp-11	49.97	49.97	CON	sharp	50	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-11	50.6	50.6	CON	abrupt		
Hp-11	53.13	53.5	FRZ	m	50	
Hp-11	55.48	57.69	FRZ	s	40	lots frac and vnlts cut the core at 40 and 80deg TCA
Hp-11	58.44	58.52	SHR	w	60	
Hp-11	61.54	61.58	FRZ	m	30	
Hp-11	62.63	62.63	FRA	m	50	
Hp-11	63.72	63.72	GCON	grad		
Hp-11	64.52	64.52	FRA	m	10	
Hp-11	64.9	64.9	FRA	m	30	
Hp-11	65	65	FRA	m	20	
Hp-11	66.15	66.15	FRA	m	30	
Hp-11	68.18	68.18	FRA	m	20	
Hp-11	76.66	76.66	FRA	m	20	
Hp-11	73	73.02	FRZ	m	50	
Hp-11	74.73	75	FRZ	m	20	
Hp-11	75.8	76.58	FRZ	m	30	
Hp-11	77.24	77.24	FLT	m	30	
Hp-11	77.62	77.62	FRA	m	30	
Hp-11	78.85	78.85	FRA	m	40	
Hp-11	81.71	81.71	CON	sharp	30	
Hp-11	82	82	CON	sharp	20	
Hp-11	83.06	83.06	FRA	m	20	
Hp-11	83.72	83.76	FRZ	m	20	
Hp-11	86.24	86.24	FRA	m	30	
Hp-11	87.35	87.35	CON	abrupt	80	
Hp-11	87.78	87.78	FLT	m	40	
Hp-11	87.84	87.84	CON	abrupt	70	
Hp-11	89.5	90.03	FRZ	m	30	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-12	7.18	7.18	FRA	m	20	
Hp-12	7.45	7.45	CON			core is broken up, appears to have been a sharp contact
Hp-12	9.3	9.3	CON			core is broken up, appears to have been a sharp contact
Hp-12	11.2	11.2	CON			core is broken up, appears to have been a sharp contact
Hp-12	12	12	CON	abrupt	50	transition from med to fn gr
Hp-12	12	12.66	FRZ	m	30	numerous fractures, oxidized
Hp-12	12.75	13.3	FRZ	m	20	oxidized fractures
Hp-12	14.05	15.05	FRZ	m	20	oxidized fractures
Hp-12	16.39	16.39	FRA	m	5	
Hp-12	18.45	18.76	FRZ	m	50	
Hp-12	19	19.46	FRZ	m	20	fractures at 20-30deg TCA
Hp-12	20	20.36	FRZ	m	30	
Hp-12	20.73	20.73	FLT	m	50	
Hp-12	21	21	FRA	m	20	oxidized
Hp-12	23	23	FRA	m	15	oxidized
Hp-12	24	24.03	FLT	m	20	
Hp-12	25.05	25.05	FRA	m	30	
Hp-12	25.24	25.24	CON	sharp	35	
Hp-12	27.2	27.2	FRA	m	10	
Hp-12	27.69	27.69	CON	abrupt	50	
Hp-12	27.9	28.15	FRZ	m	30	
Hp-12	28.73	28.73	CON	sharp		core is broken up, appears to have been a sharp contact
Hp-12	29.02	29.02	CON	sharp		core is broken up, appears to have been a sharp contact
Hp-12	30.95	31.03	FRZ	m	30	
Hp-12	31.03	31.03	CON	sharp	30	
Hp-12	33.04	33.04	FRA	m	35	
Hp-12	33.48	33.48	FRA	m	20	
Hp-12	34.47	34.47	CON	sharp	20	
Hp-12	34.69	34.69	CON	sharp	35	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-12	38.46	38.46	CON	abrupt	70	
Hp-12	38.62	38.62	CON	abrupt	80	
Hp-12	39.66	40	FRZ	m	20	
Hp-12	41.1	41.1	FRA	m	20	
Hp-12	44.67	44.67	CON	sharp	30	
Hp-12	44.77	44.77	CON	sharp	30	
Hp-12	47.9	48	FRZ	m	60	
Hp-12	51.37	51.37	FRA	m	30	
Hp-12	51.96	51.96	FRA	m	30	
Hp-12	52.13	52.13	FRA	m	30	serpentinized/ contact
Hp-12	53.05	53.05	FRA	m	20	
Hp-12	54.66	54.66	FRA	m	20	
Hp-12	55	55	FRA	m	30	
Hp-12	56.46	56.49	FRZ	m	40	
Hp-12	58.23	58.23	CON	abrupt		
Hp-12	60.49	60.51	GCON	grad		gradational over a few cm
Hp-12	61.05	61.07	GCON	grad		gradational over a few cm
Hp-12	66.68	66.68	FRA	m	40	carbonate and pyrite along facture
Hp-12	67.26	67.3	FRZ	m	60	
Hp-12	67.53	67.53	FRA	m	70	
Hp-12	67.6	67.6	FRA	m	70	
Hp-12	67.9	67.9	FRA	m	30	serpentinized
Hp-12	68.38	68.38	FRA	m	20	
Hp-12	68.92	68.94	FRZ	m	70	
Hp-12	69.05	69.05	FRA	m	40	
Hp-12	70.09	70.33	FRZ	m	50	
Hp-12	70.7	71.1	FRZ	m	30	serpentinized
Hp-12	72	72	FRA	m	20	serpentinized
Hp-12	73.38	73.38	CON	sharp	35	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-12	73.49	73.49	CON	sharp	40	
Hp-12	74.2	74.2	FRA	m	80	
Hp-12	74.63	74.63	FLT	m	65	
Hp-12	74.72	74.72	FRA	m	70	
Hp-12	76.12	76.12	FRA	m	25	
Hp-12	77.36	77.36	CON	abrupt	70	
Hp-12	77.36	81.39	MLIN	m	60	mineral lineation/foliation
Hp-12	81	81.39	FRZ	m	40	serpentinized
Hp-12	81.82	81.82	FRA	m	20	
Hp-12	81.93	81.93	FRA	m	20	
Hp-12	81.39	83.6	MLIN	w	60	mineral lineation/foliation
Hp-12	84.04	84.05	SHR	m	20	also contact
Hp-12	84.05	84.55	FRZ	m	30	
Hp-12A	13.05	13.05	FRA	m	20	oxidized
Hp-12A	13.4	14.3	FRZ	m	30	oxidized
Hp-12A	14.3	16.9	FRZ	s		core is brittle and broken up, frac and flts present
Hp-12A	17.09	17.09	FRA	m	30	
Hp-12A	17.35	17.4	FRZ	m	40	
Hp-12A	17.47	17.47	CON	abrupt	70	
Hp-12A	18.1	18.1	FRA	m	20	
Hp-12A	19.15	19.15	FRA	m	20	
Hp-12A	19.5	19.5	FRA	m	20	
Hp-12A	19.52	19.52	CON	abrupt	70	
Hp-12A	20.26	20.26	FRA	m	30	
Hp-12A	20.44	20.44	FRA	m	30	
Hp-12A	20.78	20.78	FRA	m	20	
Hp-12A	20.83	20.83	CON	abrupt	70	
Hp-12A	21.7	21.82	FRZ	m	20	

Hole ID	From	To	Struct	Int	Angle TCA	Description
Hp-12A	21.82	22.24	FRZ	m	40	
Hp-12A	23.7	23.7	FRA	m	20	
Hp-12A	24.05	24.22	FRZ	m	20	
Hp-12A	26.13	26.13	CON	sharp	40	
Hp-12A	26.4	26.4	CON	sharp		core is broken cannot get angle
Hp-12A	26.95	27.92	FRZ	s	30	
Hp-12A	28.4	28.4	FRA	m	20	
Hp-12A	28.84	28.84	CON	sharp	30	
Hp-12A	29.45	29.45	CON	sharp	30	
Hp-12A	30.7	30.72	FLT	m	60	

Appendix G. Logging: Veining (all drill holes)

Hole ID	From	To	Vein type	%	Upper angle	Texture	Description
H-01	8.4	8.41	qtz-carb	100	70	cr	small qtz carb vein that cuts the gabbro
H-01	18.99	19.03	qtz	100	40	cr	small vein along a contact
H-01	23.94	24.27	gran	100	40	cr	white qtz-carb-feld-garnet vein (from pluton??) upper contact at a fault
H-01	31.28	31.8	gran	100	30	cr	pegmatitic; granitic in composition; qtz-feldspars and garnets + minor sericite alteration; white to very light pink in colour
H-01	35.36	35.4	gran	100	20	cr	granitic in composition; small white vein; sharp upper and lower contacts; host to minor garnets.
H-01	81.09	81.1	qtz-carb	100	30	med	med to coarse grained white, qtz-carb vein
H-02	116.7	116.71	carb	100	60	cr	small carbonate vein ; ivory in colour
H-02	117.7	117.82	carb	7	60	med	Small carb veinlets that cut the core at 50-60 degTCA
H-02A	42.83	42.84	plag-seg	100	35	cr	white to light grey in colour/ likely a plagioclase segregation and not a vein
H-02A	49.93	49.96	sil-epi-ser	100	65	siliceous	White to buff to light green in colour/ shr vn(chl?)
H-03	40.13	0.17	gran	100	50	fn	garnetiferous and biotite rich
H-03	43.64	43.68	gran	100	50	fn	garnetiferous and biotite rich
H-03	85.34	85.36	gran	100	70	pegmatitic	coarse pegmatitic, graphic texture
H-03	85.42	85.46	qtz-feld	100	70	cr	white in colour; qtz vein
H-03	87.14	87.15	carb	100	60	fn	milky white to light pinkish in colour
H-03	85.51	85.54	gran	100	70	cr	granitic, graphic texture, almost pegmatitic
H-03	111.1	111.11	calcite	100	70	vuggy	crystal of carbonate and rare euhedral crystals of pyrite
H-04	48.03	48.08	plag-seg	100	80	cr	plagioclase segregation vein
H-04	49.9	49.93	plag-seg	100	60	med	white in colour, sharp contacts
H-04	77.2	77.32	qtz-plag	100	45	cr	white to light grey in colour, pyrite in fractures
H-04	109.19	109.25	qtz-plag	100	70	cr	

Hole ID	From	To	Vein type	%	Upper angle	Texture	Description
H-04	124.27	124.28	plag-seg	100	40	med	
H-04	124.83	124.86	plag-seg	100	75	cr	
H-05	21.53	21.56	plag-seg	100	80	cr	
H-05	32.62	32.63	plag-seg	85	50	cr	not sharp contacts
H-05	32.74	32.76	plag-seg	85	60	cr	biotite altn
H-05	33.3	33.31	plag-seg	80	60	cr	not sharp contacts
H-05	43.25	43.28	plag-seg	90	75	cr	
H-05	44.1	44.9	plag-seg	10	70	cr	series of plag seg-vns and increased gr size and plagioclase content
H-05	46.17	46.22	plag-seg	90	65	cr	
H-05	46.36	46.38	plag-seg	100	70	cr	
H-05	46.66	46.72	plag-seg	90	70	cr	
H-05	47.73	47.76	plag-seg	90	80	cr	
H-05	51.76	51.82	plag-seg	90	60	cr	
H-05	54.82	54.88	plag-seg	80	70	cr	
H-05	64.95	65.04	plag-seg	75	70	cr	
H-05	74	74.02	plag-seg	100	30	cr	
H-05	82.98	83.04	gran	100	40	cr	granitic vein, garnet bearing
H-05	91.67	91.72	qtz-plag	75	75	fn	small almost sheared or faulted veins, white in colour.
H-06	9.17	9.18	gran	100	20	granular	possibly associated with the granite above; medium grained, granular
H-06	16.58	16.6	gran	100	60	cr	small vein of granite, coarse gr, qtz-plag-bio
H-06	21	32	plag-seg	15	20	cr	plagioclase segregation veins, host to coarse biotite that is brown-maroon in colour; typically cut the core at shallow angles.
H-06	47.19	47.2	plag-seg	100	80	fn	small veinlet
H-06	70.71	70.73	gran	100	80	cr	sharp contacts, garnet and biotite bearing

Hole ID	From	To	Vein type	%	Upper angle	Texture	Description
H-06	123.74	123.88	plag-seg	100	50	fn	fine gr, milky white to ivory in colour, disseminated biotite altn, biotite concentrated along the lower contact; sharp contacts
H-06	148.73	148.74	plag	100	80	fn	small milky white vein with coarse pyrrhotite associated with it (adjacent above the vein)
H-06	180.66	180.68	gran	90	40	med	white in colour, appears to be granitic in composition; sulphide bearing (~2-3%)
H-06	181.75	181.82	gran	100	40	med	white to grey in colour; biotite altn; pyrrhotite (~1-2%); sharp upper and lower contacts; lower contact is sheared, granitic in composition?
Hp-07	5.75	6.05	qtz-plag	75		cr	white veins that have sharp but irregular contacts; two veins;
Hp-07	6.64	6.65	qtz-plag	100	70	cr	similar to veins up hole, small white qtz-plag veins
Hp-07	57.2	57.21	gran	100	5	med	small veinlet likely from the granite
Hp-07	57.85	57.86	gran	100	5	cr	granitic vein
Hp-07	83.4	83.42	gran	100	25	fn	shr vein
Hp-07	85.41	85.45	gran	100	20	med	shr vein
Hp-07	90.3	90.31	plag	10	20	fn	
Hp-08	96.28	96.3	plag-seg+ bio	100	45	med	white in colour, plag segregation vn
Hp-08	99.36	99.42	plag-seg+ bio+ser	100	20	cr	white in colour
Hp-08	124.71	124.84	gran	100	60	cr	Granitic vein, white in colour, sharp contacts.
Hp-09	55.06	55.2	calcite	30	70	fn	carbonate altn veins, cut the core at high angles; fn gr, thin, no nice sharp contacts.
Hp-09	110.25	111.75	calcite	50	30	fn-med	carbonate altn veins that are locally vuggy and host euhedral white calcite crystals; unit is strong altd.
Hp-10	3.37	5.04	qtz	1	30	glassy	white to clear qtz veinlets

Hole ID	**From**	**To**	**Vein type**	**%**	**Upper angle**	**Texture**	**Description**
Hp-10	115.72	115.77	qtz-plag	100	30	cr	serpentinized contacts, appears to be open space filling (structural) vein
Hp-10	151.06	151.08	qtz-carb	100	40	cr	large bluish-black coloured amphiboles?
Hp-11	11.41	11.58	kfeld	90	30	med-cr	veins??they are light pink and green in colour, appear to be K-spar, but uncertain.
Hp-11	53.93	53.95	gran	95	70	med-cr	light pink in colour, contacts are not very sharp
Hp-11	55.48	57.69	carb	5	60	fn-med	thin white carbonate veinlets that cut the core at 40-80 deg TCA, associated with mod-strong serpentinization.
Hp-11	79.72	79.77	qtz-pyrite-feld	75	40	cr	large coarse pyrite associated with this small white vein
Hp-11	26.87	27.06	plagiogranite	100	40	fn-med	white to buff in colour, fine to med grained, sharp contacts, plagioclase segregation/plagiogranite
Hp-12	67.34	67.38	carb-sulph	90	75	med	there appears to be a late carbonate system that has filled any fractures or open spaces in proximity to this veins and the fractures associated with it.
Hp-12	74.2	74.24	carb-sulph-serpentine	80	80	fn-med	alteration vein?
Hp-12	74.33	74.72	carb-py	5		fn-med	veinlets are irregular, white in colour, alteration
Hp-12A	14.15	14.18	qtz-plag	90	30	cr	alteration associated with this vein
Hp-12A	28.03	28.05	qtz	90	50	cr	white in colour, biotite altn associated with vn

Appendix H. Logging: Sampling (all drill holes)

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
H-01	00921	30	30.3	0.3	coarse gr gabbro	cr gr gabbro and pyroxene rich	30.0-30.05m	921-01
H-01	00922	81.59	81.92	0.33	gabbro med-coarse gr	altd, med-cr gr gabbro, serpentinized fractures	81.61-81.66m	922-01
H-01	G-001	54.18	54.57	0.39	Granite, collected for Undergraduate thesis			
H-01	G-002	94.57	94.97	0.4	Granite, collected for Undergraduate thesis			
H-01	G-003	107.84	108.26	0.42	Granite, collected for Undergraduate thesis			
H-02	00923	86.96	87.3	0.34	Porphyritic Gabbro	fn gr gabbro		
H-02	00924	95.33	95.65	0.32	Gabbro (magnetic)	similar to 00926	95.60-95.65m	924-01
H-02	00925	112.15	112.52	0.37	Gabbro (magnetic)	similar to 924 and 926 but slight change in gr size.		
H-02	00926	117.18	117.5	0.32	Gabbro (magnetic) (metal tags for samples created)	similar to 00924		
H-02	G-004	31.53	31.81	0.28	Granite, collected for Undergraduate thesis (metal tags for			
H-02	G-005	51.6	52	0.4	Granite, collected for Undergraduate thesis (metal tags for			
H-02	G-006	82.81	83.11	0.3	Granite, collected for Undergraduate thesis (metal tags for			
H-02A	00776	46.9	47.4	0.5	Gabbro med-coarse gr	plag 55-60%, fewer pyroxenes	47.04-47.09m	776-01
H-02A	00777	56.17	56.6	0.43	Gabbro med-coarse gr	plag ~45% more pyrox, predominant orient of the crystals at ~60deg TCA, pyrox are altd, plag looks washed out.		
H-03	00778	20.63	21.12	0.49	Gabbro, med gr	Similar to 00776	27.67-27.72m	778-01
H-03	00779	38.28	38.75	0.47	coarse grained gabbro	leucogabbro, coarse gr and plag rich, altd pyroxenes	38.28-38.33m	779-01
H-03	00780	58.9	59.43	0.53	granite (muscovite)	Provided to Mark Lam for thesis		
H-03	00781	72.11	72.65	0.54	Granite (biotite)	Provided to Mark Lam for thesis		
H-03	00782	83.6	84.1	0.5	Gabbro, med-cr gr	plag rich		
H-03	00783	93.8	94.3	0.5	Gabbro, med-cr gr	similar to 00779 but finer grained, part of the same unit as 00783.	93.8-93.85m	783-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
H-03	00784	100	100.5	0.5	Gabbro, med-cr gr, wk magnetic	similar to 00776, some of the pyrox appear to be bronzite, pyrox are altd, minor ilm, plag is host to numerous frac and appear to be replaced by sulph.		
H-03	00785	110.4	110.87	0.47	Gabbro, cr gr	leucogabbro, plag ~70%, pyrox are dk green, similar to 00779, ilmenite ~1-2%, minor sulph		
H-03	00786	118.75	119.25	0.5	Gabbro, cr gr (prev sample and this one part of same unit)	med-cr gr gab, sim to 785 with slightly smaller gr sz, pyrox are dk green & altd, 1-2% ilm, minor bio.		
H-03	00787	120.37	120.8	0.43	Mineralized Gabbro, cr gr	~10-15% sulph, what appear to be vns composed of feld +qtz+bio altn, pyrox associated with these vns are bio altd.		
H-03	00788	121.16	121.6	0.44	Mineralized Gabbro+ bronzite, med gr	Intercumulus to poikilitic sulph, pyrox are altd (+/- amph), bronzite present, pyrox ~30-35%		
H-03	00789	121.67	122.09	0.42	Mineralized Gabbro (15-20% sulphides) med gr	intercumulus to poikilitic sulphides, pyrox are altd (+/- amph), bronzite present, pyrox ~30-35%, similar to 00788		
H-03	00790	123.64	124.2	0.56	Gabbro/Norite (bronzite+ sulphides)med gr	bronzite rich + ~7% sulph, similar to 00789 but finer grained and fewer sulph, pyroxenes are altd	123.76-123.81m	790-01
H-03	00791	124.7	125.25	0.55	Gabbro + anorthosite or plagioclase segregation? + bronzite, med gr	Segregation vein present? Or possibly from the granite? ~5-7% ilmenite, pyroxene is dk green		
H-03	00792	128.1	128.5	0.4	Gabbro/Norite (bronzite), med-cr gr	similar to 00790 but fewer sulph and slight increase in pyrox content, bronzite rich, pyrox are altd.	128.31-128.36m	792-01
H-04	00793	17.77	18.12	0.35	Gabbro, med-cr gr (5cm diam core)	altd pyrox, minor sulph, minor bronzite, similar to784,776, 778	17.86-17.91m	793-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
H-04	00794	20.55	20.93	0.38	Gabbro, med-cr gr (3cm diam core) same as previous?	altd pyrox, lighter in colour than previous, Bronzite present, same as previous??, sight change in altn?		
H-04	00795	40.02	40.35	0.33	An-Gab cr-gr	leuco-gabbro/ An-Gab, slightly brecciated appearance, plag is cr gr, pyroxenes are altd	40.06-40.11m	795-01
H-04	00796	52.12	52.5	0.38	Gabbro fn gr, ilmenite ~10%, wk magnetic	ilmenite ~10-15%, weakly magnetic, fn gr, plag ~50% and bluish in colour, pyroxenes altd ~35-40%	52.45-52.50m	796-01
H-04	00797	79.03	79.48	0.45	gabbro coarse gr	bronzite present, aug is bluish-grey and is altd, sulph are intercumulus to the plag, plag is bluish in colour	79.39-79.44m	797-01
H-04	00798	96.9	97.34	0.44	Gabbro fn-med gr, Wk magnetic Ilmenite ~20%	pyrox ~50% altd, bronzite present, ilm ~20%, plag ~35%, Pyroxenite-Gab, (similar to 00796 but coarser and more pyrox)	97.24-97.29m	798-01
H-04	00799	111.55	112	0.45	Gabbro, med gr	pyroxenes are altd, similar to 00798, ilmenite rich ~20-30%, magnetic		
H-04	00800	123.8	124.13	0.33	An-gab cr-gr (leucogabbro)	leucogabbro/ An-Gabbro, similar to 00785, and 00779	124.08-124.13m	800-01
H-04	00801	130.4	130.9	0.5	Gabbro med gr, ilmenite rich	similar to 00798, 00799, plag is bluish-grey, pyroxenes are altd (~35-45%), bronzite present, ilmenite ~10-15%		
H-05	00802	22.56	22.93	0.37	gabbro med gr, wk magnetic (10-20% ilmenite)	sulphide bands, ilmenite rich, minor plag segregation, contains silvery metallic mineral (soft H~3-4)		
H-05	00803	22.93	23.31	0.38	gabbro fn gr/ foliated/ mineralized + magnetic	mineralized+ ilm+ med-cr gr segregation veins? Mod min lin/wk foln, magn, sulph are along the lin planes and are intercumulus to the plag and pyrox, pyrox are altd (blue- green in colour), plag is bluish in colour		
H-05	00804	36.08	36.43	0.35	gabbro, fn-med gr, mineralized	med gr gabbro with ~25% sulphides and the silvery metallic mineral	36.34-36.39m	804-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
H-05	00805	36.43	36.83	0.4	gabbro med gr, ilm 10-15%	med gr gabbro, ilmenite rich ~10-15%, plag ~60%, pyroxenes are altd, bronzite present, pyroxenes are dk grey to bluish in colour, similar to		
H-05	00806	52.27	52.79	0.52	gabbro med gr, ilm 7-10%, wk mag	similar to 805,801, 798, 799 med gr gabbro, ilm rich ~10-15%, bronzite + anhedral and altd pyrox (aug), fn gr segregations in this sample.	52.32-52.37m, 82.67-52.72m	806-01, 806-02
H-05	00807	65.42	65.77	0.35	gabbro fn -med gr mineralized (sulph+ oxide >40%)	med gr gabbro + sulphides including the silvery metallic sulphide		
H-05	00808	67	67.49	0.49	gabbro fn gr	plag ~55-60%, pyrox ~35-40%, ilm ~5-7%, finer gr version of 00807 but with less ilm, plag is coarser than the pyroxenes (not equigranular).		
H-05	00809	75.3	75.7	0.4	gabbro med gr	ilm rich~10%, wk magnetic, bronzite + aug that is bluish-grey in colour, ~1-3% sulph, similar 806, 805, 798,799		
H-05	00810	88.89	89.2	0.31	An-Gab (leucogabbro) coarse gr	lgab, similar to 00785, 00779, 00800, dark green pyrox, plag rich ~70- 75%.	88.89-88.94m	810-01
H-05	00811	89.2	89.6	0.4	gabbro med gr, wk magnetic ~10% ilm	ilm rich ~10-15%, wk magnetic, bronzite, plag is bluish in colour, similar to 798, 799, 805, 806,809		
H-05	00812	99.29	99.7	0.41	gabbro med gr, ~10% ilm	similar to 811, 809, 806, 805,00799, 00798, slight predominant orientation of the plagioclase crystals at~60deg TCA, bronzite present, augite is altd.	99.29-99.34m	812-01
H-06	00813	10.12	10.56	0.44	Mineralized gabbro, fn-med gr (5cm diam core)	fn gr gab, mineralized and oxidized, host to metallic silvery mineral		
H-06	00814	17.06	17.46	0.4	gabbro, med gr	ilm rich, bronzite present, similar to 812, 811, 809, 806, 805,799, 798	17.41-17.46m	814-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
H-06	00815	42.97	43.42	0.45	gabbro, med-cr gr, bronzite rich	~1% sulph, pyrox are altd (anhedral to subhedral), dk grey to black in colour and are intercumulus to the plag	43.37-43.42m	815-01
H-06	00816	45.36	45.8	0.44	Mineralized gabbro, fn gr (50-60% sulph)	An-Gab/ Anorthosite, ~40-50% sulph hosted in fn gr plag + minor pyrox and bio altn (vein like in appearance)		
H-06	00817	45.8	45.96	0.16	An-Gab cr gr	Anorthosite, ~85-90% plag + bio +/- amphs + pyrox + sulph		
H-06	00818	45.96	46.77	0.81	coarse gabbro	pyrox are altd and are dk green in colour, bio altn, slight predominant orientation of the pyrox at 45-50deg TCA, pyrox are anhedral		
H-06	00819	46.77	47.27	0.5	An-sulph, sulphides 60-70%	sulph hosted in fn gr gabbro, vein (plag + qtz) related to pluton? Clearly cuts the sulph and minl lin, gra present		
H-06	00820	47.27	47.54	0.27	An-sulph, sulphides 60-70%	massive sulphides and patches of plag, >60% sulph (quartered, kept 1/4, rest to Cantex for Analysis)		
H-06	00821	47.54	48.14	0.6	An-sulph, sulphides 60-70%	massive sulphides hosted in Anorthosite,		
H-06	00822	48.14	48.52	0.38	An-sulph, sulphides 60-70%	massive to semi-massive sulphides ~40- 50% hosted in Anorthosite		
H-06	00823	48.52	48.9	0.38	An-sulph, sulphides 60-70%	massive to semi-massive sulphides ~50% hosted in Anorthosite		
H-06	00824	48.9	49.37	0.47	gabbro, med gr	`1-2% sulph, pyrox are altd and are green to green-grey in colour, similar to 00776, 00777		
H-06	00825	51.18	51.7	0.52	altn + sulphides in gabbro fn gr	altd gab (pinkish to grey in colour) with sulph (incl graph), pink sections have the appearance of a fn gr gran		
H-06	00826	51.7	52.26	0.56	altn + sulphides in gabbro (dyke? From 52.02-52.12m)	altd gabbro, similar to 00825		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
H-06	00827	62.78	63.3	0.52	gabbro, med gr, opx rich	bronzite present, poikilitic xtls, similar to 826 but with little to no ilm.	63.22-63.27m	827-01
H-06	00828	91.26	91.74	0.48	gabbro, med gr, opx rich, similar to 00827	similar to 00827		
H-06	00829	96.8	97.3	0.5	gabbro, med gr	pyrox are subhedral and green-grey in colour and are wkly oriented at ~70deg TCA, slight variation from 827/8	97.25-97.30m	829-01
H-06	00830	106.98	107.45	0.47	gabbro, med gr, opx rich, similar to 00827/00828	Bronzite rich, ~1-2% sulphides, augite is dk green to black in colour, similar to 00827/00828		
H-06	00831	117.12	117.6	0.48	altd mineralized gabbro, med gr	Anorthosite to leucogabbro, fn to med gr, altd and mineralized, ~5-10% sulph (bands of an/ plag segregations?)		
H-06	00832	137	137.46	0.46	gabbro, med gr, opx rich, similar to 00827/28/30	Pyrox ~25-30% including bronzite, aug is bluish grey to greenish-grey in colour and are more intensely altd than the OPX, pyrox are anhedral to subhedral, similar to 827/828/830 but with a slight increase in altn int (similar to833)	137.00-137.05m	832-01
H-06	00833	160.32	160.85	0.53	gabbro, med gr, opx rich, similar to 00827/28/30/32	pyro are subhedral to euhedral ~25-30%, bronzite present, plag is bluish in colour (lab), decrease in altn (less intense then 832), ~1% sulph		
H-06	00834	176.16	176.63	0.47	gabbro, med gr, opx rich, similar to 00827/28/30/32/33	similar to 827/828, bronzite present,~1% sulph, pyrox are intercumulus and poikilitic to the plag, subhedral to rare euhedral, wk altn, plag is grey to bluish grey in colour		
H-06	00835	188.6	189	0.4	gabbro, med gr	wk bio altn, pyrox are green to green-grey in colour, minor sulph , rare bronzite, similar to 776	188.91-188.96m	835-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-07	00836	27.46	27.82	0.36	gabbro med-cr gr, altd? Opx+ cpx	med gr gab, bronzite rich (2nd??) that is euhedral, aug is subhedral to anh and is altd, plag is grey to brownish grey, ~1-2% sulph, similar to 834-833	27.77-27.82m	836-01
Hp-07	00837	28.13	28.46	0.33	gabbro fn-med gr	fn to locally med gr, gab to An-Gab, plag 60-70%, pyrox are altd, rare bronzite, thin vnlt, fracture filled with Py, locally cr segregations that appear to be related to the vein-like structures		
Hp-07	00838	29.35	29.7	0.35	gabbro med-cr gr,	med gr gab, bronzite rich (euhedral and poikilitic), ~1-2% intercumulus sulph, plag is grey to white to brownish in colour, xtls are at ~60-70deg TCA.		
Hp-07	00839	51	51.32	0.32	gabbro med gr, similar to 00838	bronzite rich (subhedral to euhedral), ~1- 2% intercumulus sulph, plag is grey to brownish in colour, wk orient of the xtals at 60deg TCA, aug is altd, similar to 838 but with a decrease in crystal habit and min lin.	51.02-51.07m	839-01
Hp-07	00840	69	69.5	0.5	gabbro med gr, bronzite rich, similar to 00839	bronzite rich (sim to 839), 1-2% sulph (Po, Cpy, Py), slight increase in plag over 839, bronzite is subhedral to euhedral to poikilitic, aug is altd.	69.40-69.45m	840-01
Hp-07	00841	75.5	75.77	0.27	gabbro med gr	similar in text to 840 but with increase in altn, minor bronzite (~1-2%), sulph ~1-2%, aug is altd, 35-40% pyrox, 50-55% plag that is grey to violet grey to brownish in colour.		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-07	00842	87.61	87.94	0.33	L-gab, med gr	lgab/An-plag rich with dark green pyrox similar to 810, bronzite present and is poikilitic, ~1% sulph, ilm ~1-2%, aug is altd, plag is white to dk grey with wk violet hue in colour.	87.64-87.69m	842-01
Hp-08	00843	19.91	20.29	0.38	Gabbro, med gr, opx rich, bx 2	bronzite rich (subhedral to euhedral and rare poikilitic), 1-2% sulph, rare ilm, plag is grey brown to grey in colour, slight lin to the crystals at 80-90deg TCA, similar to 838/839/840	20.10-20.15m	843-01
Hp-08	00844	66.6	67.06	0.46	Gabbro, med gr, opx+cpx, bx 10	augite altd, bronzite rich (subhedral to euhedral, locally poikilitic), pyrox are rim by another min (amph?), rare sulph, serp altn close to frac, plag is dk grey to violet grey in colour, <1% ilm		
Hp-08	00845	81.47	81.9	0.43	Dyke? Fn gr, magnetic, bx 13	magnetic, gabbroic in comp, dyke???	81.85-81.90m	845-01
Hp-08	00846	91.3	91.83	0.53	foliated/ sheared granite? bx 15	For Mark Lam Undergraduate thesis under supervision of Dr. J. Greenough		
Hp-08	00847	102.6	103	0.4	bx 17, altd gabbro/leuco-gabbro, med gr	plag rich gabbro/ leucogabbro, plag 60-70% is grey to milky white in colour, pyrox are altd (by amph?), minor ilm ~1%, <1% sulph, locally poikilitic pyrox, altd along frac		
Hp-08	00848	139.6	140.1	0.5	bx 23, gabbro coarse gr and altd	bronzite rich (subhedral to euhedral to poikilitic), aug is altd, sulph 1-2%,<1-1% ilm, plag is white to grey to violet grey in colour, similar to 843	139.72-139.77m	848-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-08	00849	150.15	150.56	0.41	bx 25, gabbro med gr, sulph	gabbro to Anorthosite-gabbro (gradational), fn to med gr, 5-10% sulph)Py+Po+gra present as disseminations and seams\0, numerous fractures, pyrox are altd, plag 60-75%.		
Hp-08	00850	169.47	169.79	0.32	bx 28 gabbro med gr, sulph	mineralized (Po+Cpy+grap+ ilm~15-20%, bronzite rich, very magnetic, plag is grey to bluish grey in colour		
Hp-08	00851	171.26	171.6	0.34	bx 29, gabbro + sulph + fn gr segregation	gabbro med gr + fn gr segregation (mineralized and min lin at 80- 85deg TCA), magnetic, ilm ~10-15%, graph(pods, diss and dendrites), aug is altd, rare bronzite, plag is grey to bluish in colour, predominant orientation of the crystals at 80deg TCA, similar to 843 minus the bronzite	171.26-171.31m, 171.54-171.59m	851-01, 851-02
Hp-09	00892	16.37	16.74	0.37	Gabbro	med gr, bronzite rich ~15-20% + augite~15-20% (pyrox ~30-40%), ~1-2% sulph, ~1% ilm, plag is grey to bluish in colour, crystal are subhedral, wk lin at 40deg TCA		
Hp-09	00893	17.77	18.24	0.47	sulphides	mineralized, fn gr, >60% sulph (Po+Py+ gra), locally visible pyrox and plag, contact with fn gr zone is irregular but abrupt		
Hp-09	00894	18.24	18.77	0.53	sulphides	min gab with coarser gr segregations, >50% sulph (similar to 00893)		
Hp-09	00895	18.77	19.21	0.44	sulphides	mineralized fn gr gabbro with med gr segregations, >50% sulphides, similar to 00894		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-09	00896	19.21	19.6	0.39	altd coarse gab + sulph	cr gr gab to pyroxenite (gabbro-pyroxenite) that is altd+ sulph ~3-5% + ilm ~3%, ~60% pyrox (Aug +~1-5% bronzite) +/- amph, sulph are poikilitic .		
Hp-09	00897	19.6	20.16	0.56	sulphides	mineralized fn gr gabbro, plag is bluish to grey in colour, ~50% sulph, (both augite + bronzite)		
Hp-09	00898	20.16	20.64	0.48	sulphides	mineralized gabbro, fn gr, ~50% sulph (Po+Py+grap) (Quartered sample, kept 1/4, other to Cantex for Analysis)		
Hp-09	00899	20.64	21.08	0.44	sulphides	mineralized gabbro, fn gr, ~50% sulph (Po+Py+ graphite), seams with coarser gr gabbro that are pyrox rich and contain minor bronzite		
Hp-09	00900	21.08	21.63	0.55	sulphides	mineralized gabbro, fn gr, ~50% sulph (Po+Py+ graphite), sulph form bands at 30deg TCA		
Hp-09	00901	21.63	22.28	0.65	sulphides	mineralized fn gr gab, seams that are pyrox rich with rare bronzite, lin at 30-40deg TCA		
Hp-09	00902	22.28	22.71	0.43	mineralized gabbro	gabbro, fn to med gr, mineralized ~20% sulph, Po+ gra, aug + bronzite+ amph, seams of alternating fn to med gr, locally carb along frac, mixed unit		
Hp-09	00903	22.71	23.28	0.57	mineralized gabbro	gab, med & fn gr (similar to 902), min hosted in fn gr gab, ~20- 30% pyrox (Aug + minor bronzite)+/- amph, plag is grey to bluish in colour, Po+Py +Gral		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-09	00904	23.28	23.8	0.52	mineralized gabbro	gab, plag rich (An to Lgab), plag ~65-70% that is grey to bluish grey in colour, locally orangish in colour due to oxidized fract, ~5% sulph, serp altn along fract, both aug and bronzite		
Hp-09	00905	23.8	24.28	0.48	mineralized AN to pyroxenite	An-Gab to gab with bands of sulph (Po+Py+Gra), plag rich, altd aug+1-3% bronzite, magnetic, ~35sulph		
Hp-09	00906	24.28	24.93	0.65	mineralized Pyroxenite	Mixed unit of Pyroxenitic gab to An, from 24.28-24.56 is An (mineralized) then from 24.56-24.93 is pyroxenite (with ~30% bronzite) of the 95% pyrox	24.28-24.33m, 24.69-24.74m	906-01, 906-02
Hp-09	00907	24.93	25.6	0.67	altd gabbro-pyroxenite + sulphides	Pyroxenite, cr gr, altd + sulph~7%, aug+cores of bronzite/amph?,plag is altd and is grey to yellowish/orangey creamy grey, grades from pyroxenite to gabbro back to pyroxenite (bronzite rich), (mixed unit)		
Hp-09	00908	25.6	25.93	0.33	Pyroxenite/ Pyroxenitic gabbro?	pyroxenite, ~90% pyrox (Bronzite + aug), cr gr, plag ~10%, ~3% sulphides	25.88-25.93m	908-01
Hp-09	00909	32.17	32.49	0.32	Gabbro	gabbro, med gr, lin at 60deg TCA, pyrox are long (bronzite locally ~5%) aug are subhedral and altd, ~1-2% sulph, ~50-55% plag and is grey to violet grey in colour	32.20-32.25m	909-01
Hp-09	00910	50	50.3	0.3	Gabbro	plag rich ~65%, bronzite long crystals that are subhedral to euhedral, lineation at 70deg TCA, plag is grey, ~1% sulph + ilm		
Hp-09	00911	66.28	66.5	0.22	Gabbro	med gr plag is grey to violet grey in colour~60-65%, 25-30% pyrox (rare bronzite), ~1% sulph		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-09	00912	75.16	75.57	0.41	Gabbro	med gr, plag is more rounded than lath shaped (adcumulus growth?), lin at 60deg TCA, minor bronzite ~1%, aug is subhedral and alts, amph?, <1-1% sulph		
Hp-09	00913	87.55	88.04	0.49	gab + plag seg	gabbro + plag segregation, gab is similar to 912, plag is grey to bluish-grey to violet in colour, bronzite ~1-3%, aug is altd, ~1% sulph, <1% ilm		
Hp-09	00914	91.92	92.32	0.4	Pyroxene rich gabbro	med-cr gr, ~70% pyrox (bronzite rich), plag is bluish to grey in colour, <1% ilm, pyrox are altd, ~1% sulph, lin at ~60deg TCA		
Hp-09	00915	96.49	96.85	0.36	Gabbro	plag rich gabbro ~65-70% bluish to grey in colour, ~1% sulph+ ilm, ~25-30% pyrox (Aug + bronzite)		
Hp-09	00916	101.8	102.14	0.34	Anorthosite/Plagioclase rich segregation?	An ~90-95% plag, ~5% pyrox + sulph + oxides, similar to 920	101.90-101.95m	916-01
Hp-09	00917	104.11	104.42	0.31	Gabbro	med-cr gr, plag rich ~60-65% that is grey to bluish in colour, ~25-30% pyroxenes (Aug altd+ bronzite (~5-7%)), <1% sulph, similar to 00915		
Hp-09	00918	115.32	115.65	0.33	Anorthosite/Plagioclase rich segregation?	An ~90% plag that is grey to violet brownish in colour, ~10% pyrox + sulph+ oxides		
Hp-09	00919	122	122.39	0.39	Gabbro	plag rich, med to cr gr, ~25% pyrox (aug +bronzite ~5%), plag is grey to violet grey in colour ~65-70%,~1-3% ilm, wk bio altn		
Hp-09	00920	126.97	127.26	0.29	Anorthosite/Plagioclase rich segregation?	An ~95% plag that is grey to violet in colour, ~5% pyrox (Aug) + ilm<1% + sulph (<1%), similar to 916		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-10	00876	35.16	35.52	0.36	gabbro (med-coarse gr)	aug+ bronzite (5-7%), pyrox are subhedral to euhedral, wk- mod lin@ 65-70deg TCA, 1-2% sulph, plag is grey -violet grey (brownish) in colour, minor serp altn, similar to 00843	35.42-35.47m	876-01
Hp-10	00877	45.04	45.26	0.22	fn gr gabbro? (dyke?)	magnetic, fn to med gr gab, dyke?, contains larger plag xtls, ilm?, similar to845 without the dark spots	45.04-45.09m	877-01
Hp-10	00878	53.84	54.1	0.26	coarse gr gabbro	bronzite ~7% that is subhedral to euhedral to poikilitic, aug is wkly altd, <1% sulph, plag is grey to brownish-violet in col, ~1% ilm, pyrox are brownish to greenish in col and laths up to 1.5cm in size, similar to 876		
Hp-10	00879	63.33	63.76	0.43	Gabbro	med-cr gr, minor bronzite (1-3%), 1-2% sulph, plag is grey - violet grey in col(adcumulus growth?), pyrox are green-grey and are subhedral to euhedral to poikilitic, minor ilm ~1%, similar to 878 but plag is not as euhedral		
Hp-10	00880	68.1	68.4	0.3	fn gr gabbro	fn gr gab, very magnetic, ilm /ilmenomagnetite? ~25-30%, plag+ pyrox, similar to 845, minor coarser gab along the upper contact	68.20-68.25m	880-01
Hp-10	00881	91.58	91.91	0.33	gabbro med gr + sulphides	Pyroxenitic gabbro, med gr, ilm rich + sulph (magnetic), bronzite ~1-3%, aug rich ~40-45% that is wk altd, slight lin at 70-75deg TCA, ilm + sulph ~15-25%, plag is grey to blue in colour ~40-45%, pyrox are subhedral to euhedral to poikilitic.		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-10	00882	94.1	94.33	0.23	Leuco-gabbro/An + sulph	plag seg hosted in med gr gab, plag seg (Anorthosite?) are med to cr gr with plag laths up to =>1cm, plag is grey to violet grey to yellowish in col; ~5-10% ilm (magnetic), gra ~1-2%, sulph ~1- 3%, minor bronzite, aug are grey- green-grey to dk grey in colour.		
Hp-10	00883	119.05	119.34	0.29	gabbro + mag band	med gr + fn gr segregations+ sulph ~2-3%, ilm ~7-10% (not magnetic), Gra <1%, aug is wk altd +~1% bronzite (pyrox ~35%); plag forms euhedral laths that are grey to brownish grey in colour ~50-55%, the pyrox are metallic appearance		
Hp-10	00884	139.15	139.5	0.35	gabbro fn-med gr	med gr, ilm rich ~10-15% (very wkly mag), similar to 883, pyrox are a metallic appearance, lin at ~85-90deg TCA, bronzite present and is poikilitic, ~1% sulph, pyrox ~35%	139.15-139.20m	884-01
Hp-10	00885	155.42	155.77	0.35	coarse gr gabbro	~1-3% bronzite, aug altd, ~30% pyrox, ~5% sulphides (Po+Cpy+ gra), ilm~5-15%, locally mag, plag is grey to violet to bluish in col, laths are euhedral to sub		
Hp-10	00886	159.51	159.84	0.33	gabbro coarse-med gr + sulph	med-cr gr, bronzite ~1-5% that is locally poikilitic, aug is altd (grey in colour),~30% pyrox, ~5-7% sulph including minor gra, <1% ilm, similar to 885 but less ilm, plag laths are sub rounded (adcumulus growth?)		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-10	00887	163.54	163.96	0.42	gabbro med gr, wk foln	bronzite ~1%, aug is subhedral to euhedral ~30%, lin at ~80- 90 degTCA, ilm ~10%, unit has a metallic appear, similar to 883, sulph ~2-4% incl graph, wk magnetic, plag is grey - dk grey to bluish in col, laths.		
Hp-10	00888	174.54	174.83	0.29	altd gab + ilmenite	bronzite present that is euhedral to poikilitic, lin at 80-90deg TCA, similar to 887 (fewer sulphides), ilm ~10%, altn assoc with frac (serp), plag is bluish to grey in colour, augite is most abundant pyrox, pyrox ~30%, ~2% sulph, not magnetic, has a slight metallic appearance similar to 00887		
Hp-10	00889	177.63	178.05	0.42	fn gr gab + >20% sulph (fn gr segregation?)	med gr gabbro hosting a fn gr gab segregation + sulph ~10-15%, med gr gab is similar to that of 888, ilm~1%		
Hp-10	00890	178.78	179.13	0.35	gabbro med gr + sulph (what prev sample is sitting in)	bronzite rich, poikilitic, sulph ~3-5%, ilm ~5-10%, aug looks metallic similar to 887/888/889, ~30-35% pyrox, not magnetic	178.78-178.83m	890-01
Hp-10	00891	186.26	186.45	0.19	gabbro med-coarse gr + sulph	bronzite ~1-3%, ~1-3% sulph, ~5-7% ilm+graph <1%, cut by numerous frac that are serp, aug is altd, ~25-30% pyrox, plag is grey to bluish to yellowish-grey in colour		
Hp-11	00852	25.66	25.95	0.29	bx 5, mineralized (massive sulphides)coarse gr gabbro	magnetic, grades into cr gr gab down hole, ~25% sulph (Po+Cpy+ graph), gab is host to ~35% pyrox (Aug + bronzite) that are altd and locally rimd, plag is grey to bluish in colour ~55-60%, minor ilm, similar in text to 872		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-11	00853	25.95	26.25	0.3	bx 5, mineralized gabbro (massive sulphides), (coarse gr)	magnetic, v cr gr, ilm ~2- 5%, pyrox are altd (aug + bronzite (~5-7%)) +/- hbld, unusual euhedral white min present that appears to be 2ndry, minor bio		
Hp-11	00854	32.5	32.87	0.37	bx 7, coarse gabbro, altered pyroxenes	v cr gr, pyrox are altd (Hbld +bio +sulph), bronzite ~1-5%, pyrox are subhedral, plag is grey in colour and striated, ilm `1-3%	32.58-32.63m	854-01
Hp-11	00855	37.4	37.8	0.4	bx 8, gabbro med-gr gr, labradorite (previous sampling of this unit from 40.9-44.3m	plag is grey to bluish in colour, pyrox are subhedral (aug + bronzite(~1-5%)) and are altd, locally hbld?, ~1-2% ilm,<1% sulph, v wk lin of the pyrox @ 70deg TCA		
Hp-11	00856	62.32	62.66	0.34	bx 12, gabbro med gr, altd	wkly magnetic, med gr gab + fn gr segregation, sulph+ oxides (Py + mag), plag is grey to bluish in colour, pyrox are altd (aug + bronzite ~1- 3%), sulph ~7-10% (Py+Mag+gra), ~1-2% ilm, pyrox have a metallic appearance, similar to 874	62.50-62.55m, 62.61-62.66m	856-01, 856-02
Hp-11	00857	69.15	69.47	0.32	bx 13, gabbro fn-med gr, ilmenite 7- 10%, wk magnetic	fn to med gr gab, wk mag, ilm~10%, aug rich, pyrox look almost metallic, ~2% sulph + graph, lin @~80deg TCA		
Hp-12	00859	21.81	22.23	0.42	Gabbro (magnetic)	med gr, ilm rich ~10-15%, magnetic,+ mag ~1-2%, oxidized, plag laths, pyrox are altd, weathered and has a granular text (in upper oxi zone)	22.18-22.23m	859-01
Hp-12	00860	29.83	30.22	0.39	fn gr gabbro	fn to med gr, wk magnetic, ilm ~5-10%, bronzite ~1-5%, unit is dk grey to black in colour, altd, has almost metallic appearance similar to888 but fn gr	30.12-30.17m	860-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-12	00861	32.07	32.47	0.4	altd gabbro	med-cr gr, plag ~60% is yellowish-brownish-orangish in col (in upper oxi zone), bronzite ~1-5%, aug is altd and anhedral to subhedral, ~1% ilm		
Hp-12	00862	33.2	33.7	0.5	gabbro (similar to prev sample, unaltd)	plag rich gab, med gr, plag ~60-65% that is grey to violet-brownish in colour, laths appear almost rounded (adcumulus growth?), pyrox are aug ~20-25% and bronzite ~5%, <1% sulph + ilm, similar tin text to 861 but slightly finer gr and less altd		
Hp-12	00863	45.75	46.19	0.44	gabbro med gr, bronzite rich	med to cr gr, bronzite ~12% + aug ~15%, altd (serp), plag is grey to dk grey in colour, ~1% sulph, <1% ilm, pyrox are subhedral to euhedral.		
Hp-12	00864	56.93	57.3	0.37	gabbro med gr, similar to 00863 (diff altn)	~5% sulph, 1-3% bronzite, aug is subhedral to rare euhedral and is altd, plag is grey to violet grey in colour, ~55-60%, pyrox ~30-35%, rare ilm <1%, similar in text to 00863 but finer gr and less bronzite		
Hp-12	00865	62.95	63.27	0.32	gabbro med-cr gr	med-cr gr, `5-10% sulph (intercumulus to poikilitic to the plag), ~5-7% bronzite (subhedral to euhedral to poikilitic), aug~25-30%, plag is light grey to grey-bluish in col, no ilm		
Hp-12	00866	63.27	63.71	0.44	Mineralized gabbro med-cr gr	med gr, mineralized ~15-20% sulph, pyrox are altd (by amph?), and are dk brown to black in colour, bronzite ~1-5%, ~25-30% pyrox, plag is grey to light grey to bluish-grey tin colour ~55%, similar to 865 with more sulph	63.34-63.39m	866-01

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-12	00867	63.71	64.1	0.39	Mineralized gabbro med-cr gr	med gr, ~25% sulph that are poikilitic, aug is altd and crystals are subhedral, bronzite 1-3%, plag is grey to bluish-grey in col and is subhedral to local euhedral, similar to 866 but more sulph.		
Hp-12	00868	64.1	64.48	0.38	Gabbro med gr	gab to An-gab, med gr, ~5% sulph, variable from plag seg to med gr gab, rare bronzite <1-1%, aug is alts, plag grey- light grey in col (subhedral to rare euhedral)		
Hp-12	00869	64.48	64.9	0.42	Mineralized gabbro med gr (~60% sulph)	mass to semi-massive bands of sulph that are poikilitic (50-60%), An- gab (plag rich), appears to be a plag vn with locally cr gr pyrox, variable gr sizes min and text, mineralization appears to be related to the plag rich zones.		
Hp-12	00870	64.9	65.24	0.34	Mineralized gabbro med gr	Mineralized and altd, sulph ~15% locally poikilitic, fn to med gr, plag rich, pyrox are altd, sm vnlts of carb?		
Hp-12	00871	65.24	65.64	0.4	gabbro med gr	An-gabbro/leucogabbro, mineralized ~15% sulph (intercumulus to poikilitic), plag rich (subhedral to euhedral laths), minor pyrox ~5-10%, med gr, plag is grey to light grey in colour		
Hp-12	00872	68.92	69.29	0.37	gabbro med-cr gr	cr gr, plag ~55-60% and is grey to violet-grey in col the laths appear almost rounded as a result of adcum growth?, aug is green-grey and is altd, locally rim, bronzite ~2-5%, ~1% sulph, ~1% ilm +/- amph.		

Hole ID	Sample Nbr	From	To	Length (m)	Description	Add info	Thin section	TS Number
Hp-12	00873	75.27	75.65	0.38	Gabbro to norite coarse gr	Gab to An Gab, plag rich 65-75%, sulph ~7% (Po+Py+Cpy+ Gra + ilm ~1-2%, med to cr gr (gr size is variable), plag is grey to bluish in colour, ~5-7% bronzite, locally altd by serp and amph?		
Hp-12	00874	78.45	78.89	0.44	gabbro med gr, wk magnetic, ilm ~10- 15%	preferred orientation of the crystals at ~60deg TCA, plag is bluish-grey in colour~55%, pyrox appear almost metallic, bronzite ~1-4%, ~1% sulph, aug is wk altd, pyrox are subhedral, similar to 888/887/890	78.52-78.57m	874-01
Hp-12	00875	83.41	83.74	0.33	L-gab/ altd gab?, med gr, wk magnetic, ilm ~10%	An-Gab/ L gab, pyrox are altd~10-15%, ilm 5-10% is magnetic, ~1- 3% sulph, plag is milky grey, + Gra?		
Hp-12A	00858	29.06	29.33	0.27	plagiogranite (5cm diam core)	Provided to Mark Lam as part of granite study for undergraduate thesis		