URANIUM-LEAD, ARGON-ARGON, AND LEAD ISOTOPIC CONSTRAINTS OF MAGMATISM AND ASSOCIATED MINERALIZATION WITHIN THE STIKINE TERRANE, ON THE WILLIAMS GOLD PROPERTY, NORTH CENTRAL BRITISH COLUMBIA

By

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Abstract

Stikinia is a tectonostratigraphic terrane in the Canadian Cordillera comprised of the Early Permian Asitka Group, the Late Triassic Stuhini Group and the Early to Middle Jurassic Hazelton Group. William's Gold property which coincides with the study area is located on the east-northeast margin of the Stikine terrane within a fault mosaic of Devonian to Permian Asitka Group carbonates and volcanic and sedimentary rocks of the Stuhini Group.

The primary purpose of this study is to determine the timing of mineralization and the absolute ages of the intrusions within the Williams west region of the William's Gold property. This study attempts to correlate mesothermal gold veining and Cu-Au porphyry style mineralization from the study area with mineralization that has occurred approximately 100km southeast at Kemess Mine.

U-Pb, Ar-Ar geochronology and Pb isotopic studies were used to determine the ages and isotopic signatures of rocks located within the study area. Four samples of quartz monzonite and one sample of a feldspar porphyry gave U-Pb crystallization ages ranging from 221.4 to 183.6 Ma. Two samples G090062, and G090063 contained cores that cluster between 230 and 260 Ma and 330 and 380 Ma. The oldest gave an age of 420Ma. The presence of older cores suggests that the intrusion passed through older basement rocks, possibly the Paleozic Stikine Assemblage. A sample of alteration sericite from the T-bill prospect that is believed to occur syn-mineralization was dated using the Ar-Ar method and returned an inverse isochron age of 194.6 +/-3.5 Ma. The age of the sericite alteration did not correspond to the ages of the five intrusive units analyzed during this study. This suggests that the mineralization at the T-bill prospect was likely not genetically related to any of the intrusions dated in this study.

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1.0 Introduction

The purpose of this study is to determine the timing of mineralization and the absolute ages of the intrusions within the Williams west region of the William's Gold property, located in north central British Columbia. The study area is located approximately 330 km north of Smithers and 150 km south east of Dease Lake, covering an area of approximately 370 km^2 (Fig. 1). This area is within the bounds of the William's Gold property. The study area is centered at 57 ^{o} 47' north latitude and 127 ^{o} 47' west longitude and is underlain by Asitka Group rocks and Stuhini volcanics. The Asitka and Stuhini have been subsequently intruded by various igneous phases whose origin are poorly constrained.

The study area is divided in to two parts by Park Creek, and for the purpose of this study these will be referred to as "Williams west" and "Williams east" (Fig. 2). Williams west is further subdivided into a northern portion containing the GIC prospect, and a southern portion containing the T-bill prospect. The GIC and T-bill prospect are separated by an E-W trending structure known as the Grass fault (Fig.3).

Lithologies of Williams west have been the most extensively studied within the William's Gold property. Bedrock in the vicinity of the T-bill occurrence consists of Asitka Group rocks, comprised of schists and phyllites, and shows extensive sericite and carbonate alteration. The T-bill consists of mesothermal arsenopyrite bearing veins and disseminations hosted by the Asitka Group (Weber and Awmack, 2002). The sericite and carbonate alteration is thought to have occurred during the mesothermal mineralizing event. Alternatively, the GIC prospect, primarily underlain by the Stuhini Group, is host to Cu-Au porphyry style mineralization.

Timing of mineralization and the absolute ages of the intrusions within Williams west was determined utilizing field and laboratory techniques. This was conducted in 2007 using U-Pb, and Ar-Ar geochronology in conjunction with Pb isotopic studies, field reconnaissance and mapping of the surrounding area. Mapping in 2007 was focused on Williams east in an attempt to draw correlations with the well documented Williams west.

Access to the study area was by fixed-wing aircraft and helicopter. Fixed wing aircrafts landed at the Highland Post landing strip, located 25km to the southwest of the study area (Lehtinen, 2007). Camp was first mobilized to Williams east by a Hughes 500D helicopter, with subsequent moves westward via helicopter throughout the duration of the study.

All funding for this project was provided by Rimfire Minerals Corporation. Equity Engineering Ltd provided both technical and logistical support throughout the study.

Figure from Lehtinen (2006)

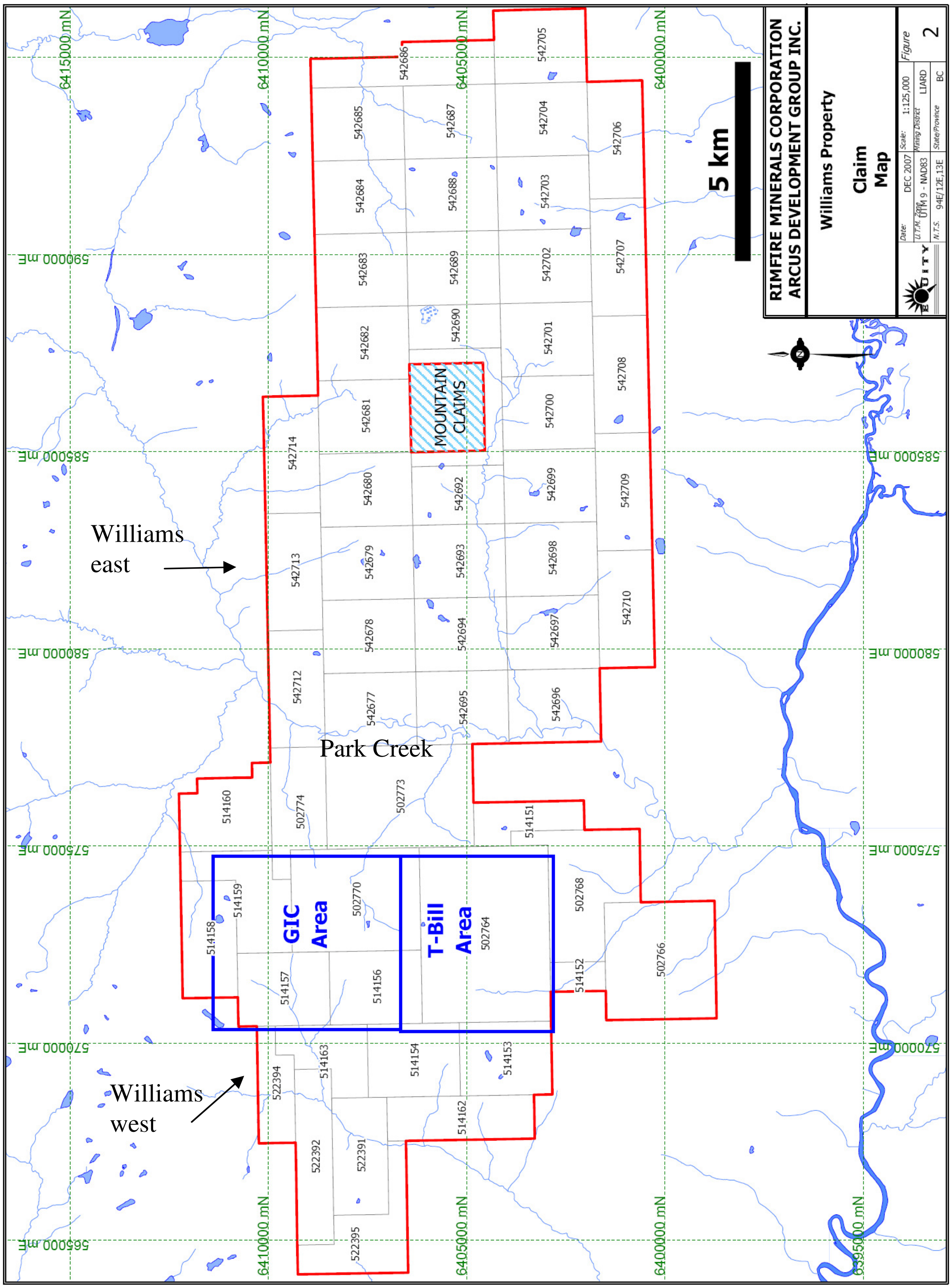


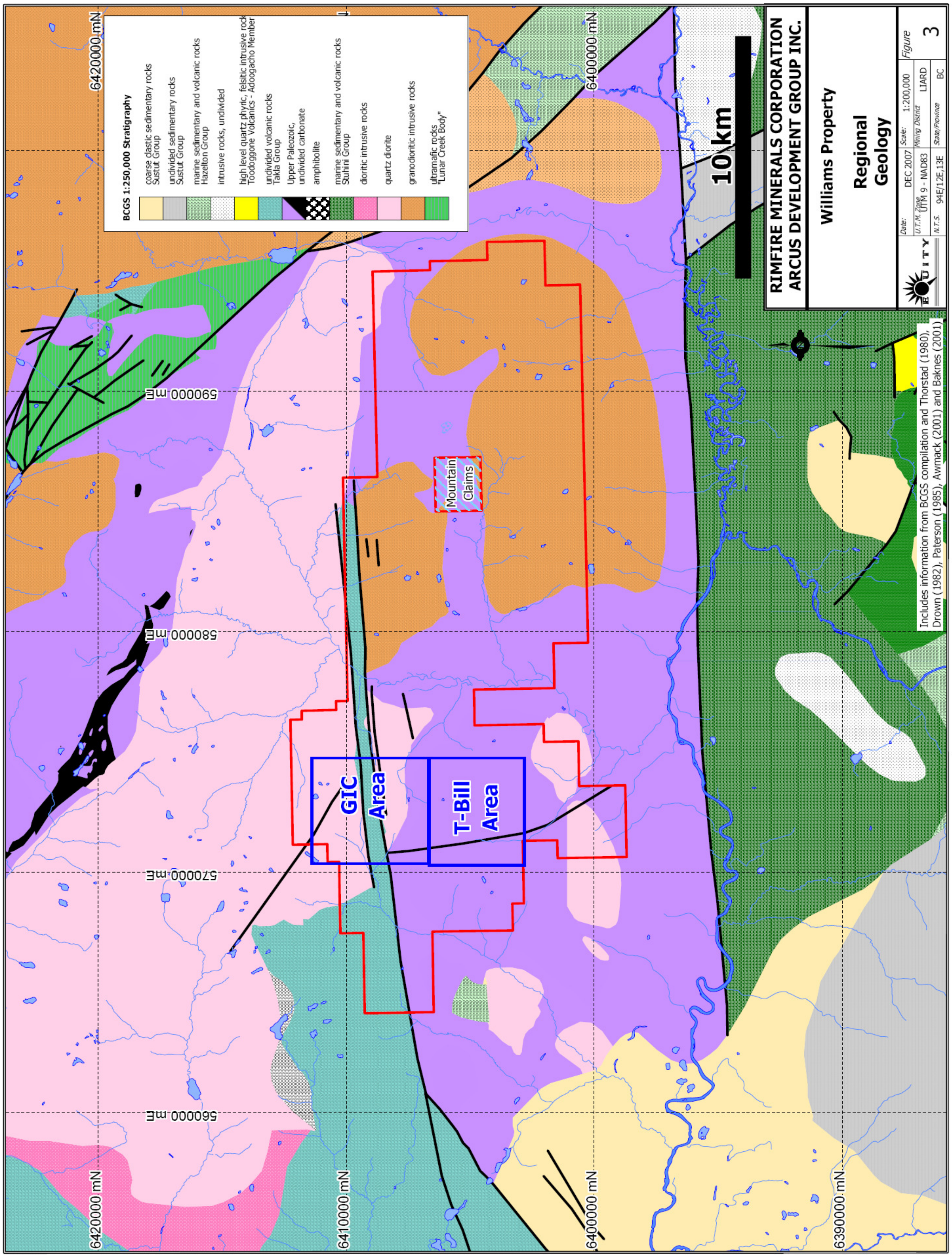
Figure modified from Lehtinen (2006)

2.0 Regional Geology

The study area is located on the Spatsizi Plateau near the eastern edge of the Intermontane geomorphological belt of the Canadian Cordillera. This portion of the Cordillera has been subdivided into four tectonostratigraphic terranes (Diakow et al., 1993). The Slide Mountain and Cache Creek terranes are characterized by dismembered oceanic crust. Stikine and Quesnellia terranes mainly comprise island-arc volcanic, plutonic and sedimentary rocks ranging in age from the Late Triassic to Early Jurassic (Diakow et al., 1993).

The study area is located on the east-northeast margin of the Stikine terrane, which in this area is comprised of the Early Permian Asitka Group, the Late Triassic Stuhini Group and the Early to Middle Jurassic Hazelton Group (Diakow et al., 1993). The Asitka Group, which is dominated by carbonates and volcanic-sedimentary rocks, is overlain by the Stuhini Group (MacIntryre et al., 2001). A more extensive description of these groups can be found in sections 5.1 and 5.2 respectively. The Late Triassic Stuhini (Takla) Group is a remnant of the Stuhini-Takla arc (Diakow et al., 1993) and is dominated by coarse augite phyric basalt, fine-grained aphyric basaltic andesite lava flows, interbeds of lapilli tuff and volcanic breccia (Diakow et al., 1993). Although the Stuhini Group in Stikinia is locally referred to as the Takla Group, strictly speaking the Takla Group refers to an assemblage of similar lithology, stratigraphy and age that occurs within Quesnellia (Diakow et al., 1993). A poorly sorted conglomerate containing clasts of Asitka and Stuhini Group is evidence that uplift and erosion of the Stuhini arc rocks occurred prior to the deposition of the Early Jurassic Hazelton Group (MacIntyre et al., 2001). The stratified rocks of the Stikine have been intruded by a number of Late Triassic to Early and Middle Jurassic stocks and batholiths, ranging in composition from felsic to ultramafic (Weber and Awmack, 2002).

The Pitman fault is a major E-W trending fault located approximately 30 km to the north of the study area. The Pitman fault has been traced for 300 km along strike and has accommodated approximately 3 kilometers of sinistral movement with minimal vertical displacement during Eocene to Oligocene time (Alldrick, 2000). The Pitman fault is interpreted by Alldrick (2000) to be an antithetic fault associated with continental scale displacement along the Northern Rocky Mountatin Trench. There are other similarly orientated faults in the area with similar attitude and offset (Alldrick, 2000).



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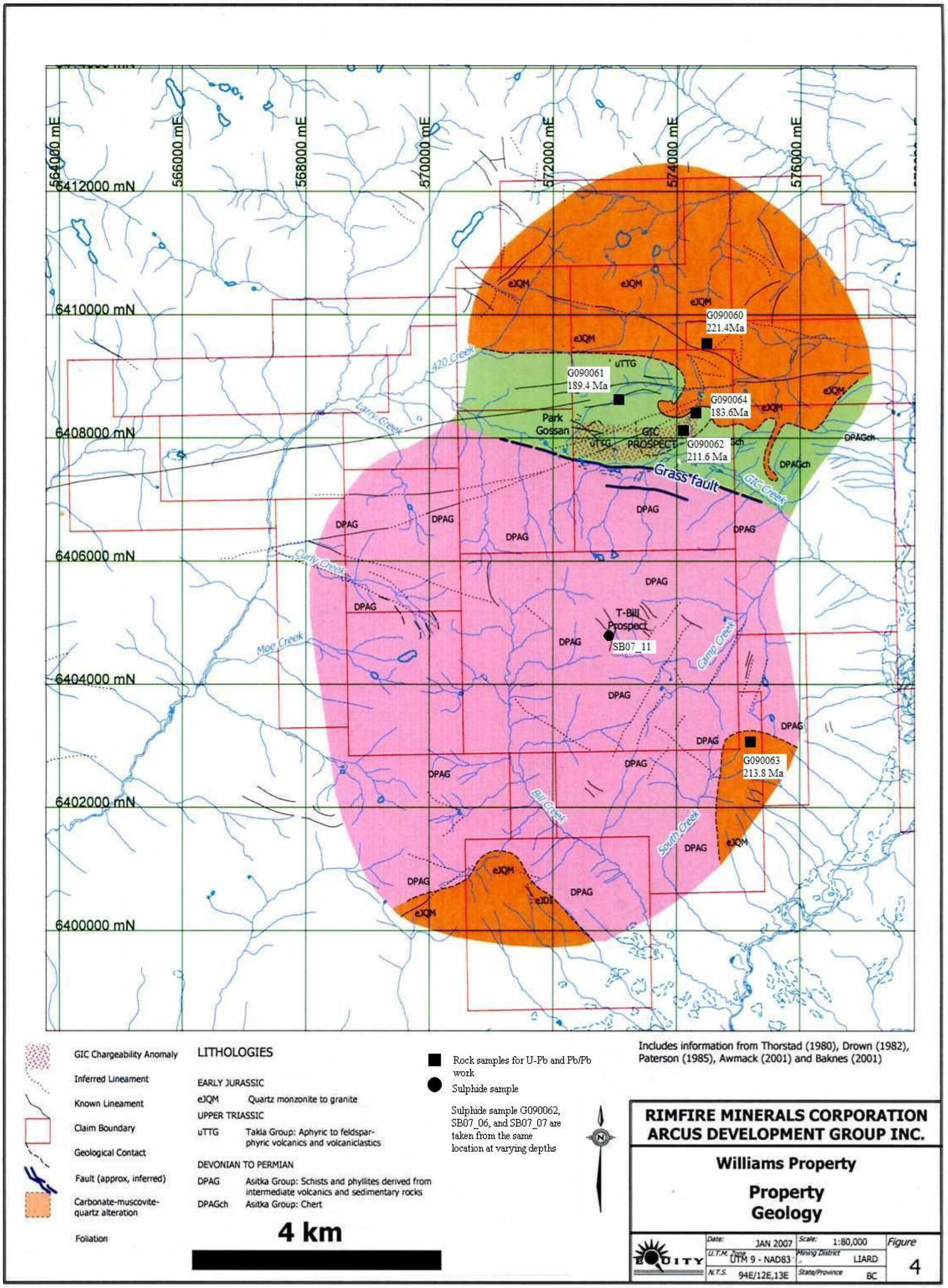


Figure 4. Shows GIC prospect, T-bill prospect and the Grass fault. Modified from Weber and Awmack (2002)

3.0 Previous Work

The study area is located in the extreme northwest of the Toodoggone District, approximately 100km to the northwest of Kemess Mine (Lehtinen, 2007). The Toodoggone district has been extensively explored for volcanic-hosted epithermal gold-silver, porphyry copper-molybdenum, skarn and placer gold (Diakow et al., 1991). Baker Mine (also know as the Chappelle deposit) is a historic mine and Kemess Mine which is currently operating are located within the Toodoggone District along with another 55 mineral prospects that have been identified since the early 1970's (Diakow et al, 1993). A summary of these occurrences and styles of mineralization can be found in Diakow et al. (1991) and Diakow et al. (1993).

Limited regional studies by the BC Geologic Survey and the Geologic Survey of Canada have been carried out in the study area, and no regional mapping has been done since Thorstad (1980). Initial exploration and discovery of the T-bill prospect occurred in the 1970s during a regional silt sampling program carried out by Cominco Ltd (Weber and Awmack, 2002). Staking was done by Cominco to cover the drainages where 10 samples exceeded 50 ppb Au and 12 740 ppm As ("Bill property"). Further exploration followed in the 1980s including soil, rock sampling, and trenching. Arsenopyrite, quartz veins returned erratic Au values up to 15 800 ppb from rock and trenching samples (Sharp, 1982).

In 1980 a silt sampling program on the GIC prospect was carried out by Du Pont of Canada Exploration Limited (Weber and Awmack, 2002). Du Pont staked their "Park claims" adjacent to the Bill property (Lehtinen, 2007).

Rimfire acquired the claims “T-Bill” (Bill prospect) to the south in 2001 and now owns a 100% interest in the 107.3 sq. km property which also include the “GIC prospect” (Park prospect) to the north (Fig. 3).

3.1 Previous Geochronology

Prior to this study there were limited age constraints on the alteration and intrusive units in the study area. The alteration was previously dated at 135$\pm$ 5 Ma using K-Ar methods on muscovite by Cominco (Weber and Awmack, 2002).

All previous work on the Toodoggone District has been focused southeast of the study area. Studies carried out by Diakow and Rhodes (2005) looked at the Graves member and Early Jurassic Black Lake intrusions and produced stratigraphic sections of the respective units.

The Graves Member is part of the Upper Toodoggone Formation that stratigraphically overlies the Lower Toodoggone Formation, the Jurassic Black Lake Intrusive Suite, the Late Triassic Takla (Stuhini) Group and the Late Carboniferous to Early Permian Asitka Group respectively (Diakow and Rhodes, 2005) . It is a dacitic ash-flow tuff containing trace quartz and biotite phenocrysts. Dating by Diakow and Rhodes (2005) yielded a U-Pb age of 192.0+/- 1.2 Ma.

The Black Lake intrusions are typically granitic in composition but may vary from quartz monzonites to monzonites. One of the youngest isotopically dated plutons in the region yielded a U-Pb zircon crystallization age of 191 +/- 0.4 Ma (Diakow and Rhodes, 2005).

Takla (Stuhini) Group rocks in the vicinity of the Kemess North deposit are intruded by the Sovereign granodiorite that has yielded a U-Pb zircon crystallization age of 202.7 +/- 1.9 Ma (Diakow, 2001). The mineralization that was spatially associated with Kemess North diorite was determined to occur at about 201.8+/- 1.2 Ma using Re-Os on molybednite (McKinley, 2006).

Dickinson (2006) studied the Pine prospect in the Toodoggone district which is located to the south of Kemess North. U-Pb ID-TIMS ages of five samples from the area were determined to constrain the relative timing of intrusions and mineralization. The Fin monzogranite was the oldest unit at 217.8+/- 0.6 Ma. The Toodoggone Formation andesite had a maximum age of 200.9+/- 0.4 Ma. Pine Quartz Monzonite which is centered around the Au, Cu, Mo mineralization is 197.6+/- 0.5Ma and is cross cut by a type 1 syenite dyke that was determined to be 193.8 +/- 0.5 Ma (Dickinson, 2006).

4.0 Property Geology

The study area lies within a fault mosaic of Devonian to Permian Asitka Group carbonates and volcanic and sedimentary rocks of the Stuhini Group (Weber and Awmack, 2002).

Williams west is underlain by the Asitka Group and the Stuhini Group volcanic rocks that are separated by a WNW trending fault known as the Grass Fault (Fig. 4) The Grass fault is believed to have experienced vertical displacement that juxtaposed the Devonian –Permian Asitka Group against the undeformed Stuhini Group (Lehtinen, 2007).

The Asitka Group comprises the majority of exposures at the T-Bill prospect which is located to the south of the Grass fault (Fig. 4). The Stuhini Group, which lies to the north of this fault, hosts the GIC prospect (historically referred to as the Park prospect). Intrusions of quartz monzonitic, granodioritic, and quartz dioritic composition intrude these two groups of rock. These intrusions typically display a strong magnetic signature with the exception of the plutons lying to the south of the T-Bill prospect, which have a distinct magnetic low (Weber and Awmack, 2002).

Williams east is located on the eastern side of Park creek (Fig. 2). Mapping carried out in the summer of 2007 by Jim Lehtinen and the author showed a large volume of intrusive rocks to the south comprised primarily of granites and granodiorites. The northern part of Williams east was underlain by of a package of laminated volcaniclastic and highly silicified altered sediments tentatively assigned to the Stuhini Group.

5.0 Lithology

5.1 Asitka Group Rocks

The Lower Permian Asitka Group on the Williams property are comprised of phyllites and schists that have been deformed to such an extent that the protolith and the primary textures can no longer be confidently identified (Weber and Awmack, 2002). Proximal to the T-Bill prospect the Asitka Group has been strongly sericitized and has undergone carbonatization (Fig 5). The foliation is cross cut by quartz veins ranging from the millimeter to 0.5 meter wide, some of which contain arsenopyrite and host mesothermal gold mineralization. The Asitka Group rocks show evidence of at least two phases of deformation. One prominent set of folds axes trends approximately north-south (ranging from 150^{o} to 020^{o}) with a moderate to steeply west-dipping foliation. A separate set of fold axes has a west-northwest trend (from 090^{o} to 130^{o}) with a shallow to moderate southwest-dipping foliation (Thorstad, 1980). The Permian age assignment of these rocks is based on fossils in the lower stratigraphic section of the Asitka Group in the McConnell Creek area (Diakow et al., 1993). Thorstad (1980), however, suggested a

Mississippian age for the middle dolomitic member of the Asitka Group, based on the presence of crinoids and conodonts.

Thorstad (1980) described five lithologic units within the Asitka Group in this portion of Stikinia. From oldest to youngest these are: (1) lower feldspathic, chlorite schist; (2) phyllite, sericite and calcareous sericite schist; (3) massive rhyolite, chert and sericite schist; (4) carbonate; and (5) upper feldspathic chlorite schist.

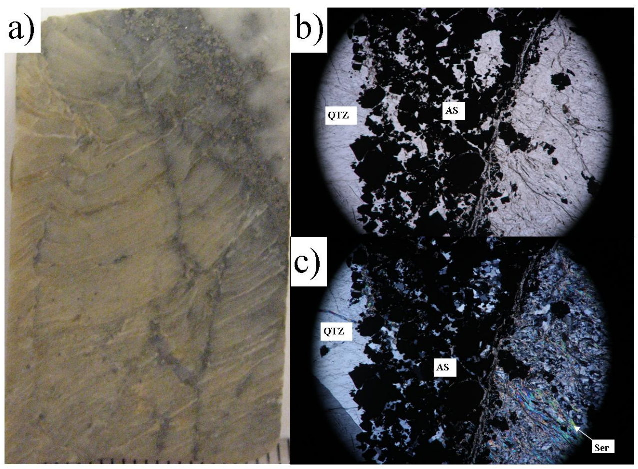


Figure 5. (a) Hand sample of sericite and carbonate altered Asitka Group rock with quartz, carbonate, arsenopyrite veining. The block is 2 cm wide. **(b)** Thin section in PPL. The field of view (FOV) is 3.6mm across. **(c)** Thin section in XPL, FOV is 3.6mm across. Qtz = quartz, As = arsenopyrite, Ser = sericite.

5.2 Stuhini (Takla) Group Rocks

The Stuhini Group in the study area consists of massive andesite and tuffaceous andesitic volcaniclastics that are cut by fine grained mafic dykes. The Stuhini Group is exposed in two locations on the Williams property. Previous mapping of Williams west showed green, aphyric to feldspar-phyric volcanics tentatively assigned to the Stuhini Group exposed north of the Grass fault (Weber and Awmack, 2002). Mapping carried out in 2007 by Jim Lehtinen and the author identified a separate area approximately 1km^2 in size to the east of the Mountain claim (Appendix 1) that comprised of andesites and andesitic volcaniclastic rock that were assigned to the Stuhini Group. There are variably altered sedimentary rocks (Fig 6a). Some of which have been highly altered and are strongly silicified and contain abundant chlorite strings (Fig 6b). In the same area there is a pervasive leucocratic aplitic dyke that is exposed for just over 1km. The aplitic dyke and the andesitic rocks appear to be cross cut by mafic dykes which is not necessarily related to the Stuhini Group.

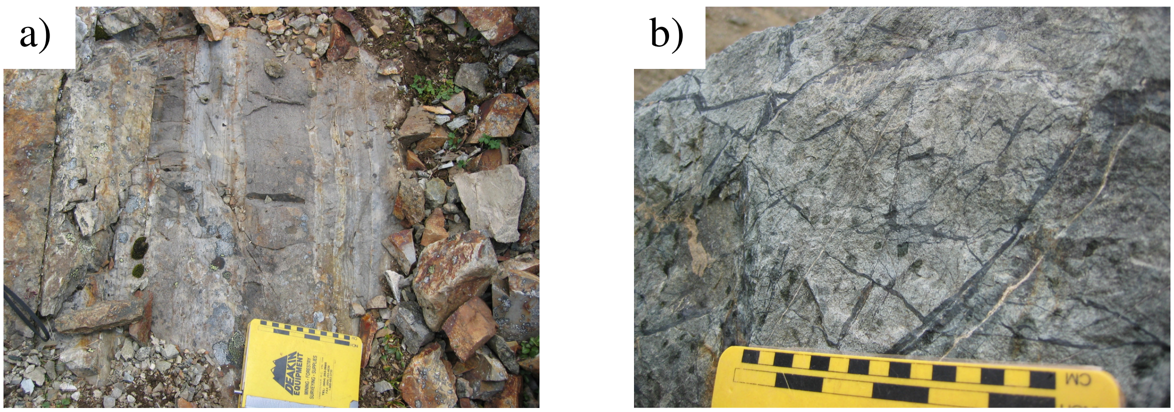


Figure 6. (a) Bedded sediments that contain variable amounts of volcaniclastics from the area just east of the Mountain claims. **(b)** Highly altered sediments that contain abundant chlorite stringers found approximately 300 meters south of “a”.

5.3 Intrusive Rocks

Both the Stuhini and Asitka group rocks are intruded by plutons of varying composition that are inferred to be of Late Triassic to Early Jurassic age. Sample locations and brief descriptions are given in Table 1. Five samples were collected for further analysis using U-Pb, Pb isotopes and geochemical analysis.

Intrusions in the Williams West area include;

a) G090063, is a sample taken from an igneous body that intrudes Asitka Group rocks in the southwest portion of Williams west . The intrusion is a non foliated quartz monzonite body (Fig. 7). The unit is typically inequigranular and porphyritic, with 50% strongly zoned plagioclase phenocrysts, 25% subhedral to anhedral interstitial K-feldspar with a minor component of k-feldspar occurring as phenocrysts, 15% subhedral quartz and 10% fine grained biotite (based on the shapes of the pseudomorph which has been altered to chlorite). There is also secondary epidote. The intrusion is characterized by a pronounced magnetic low (Weber and Awmack, 2002).

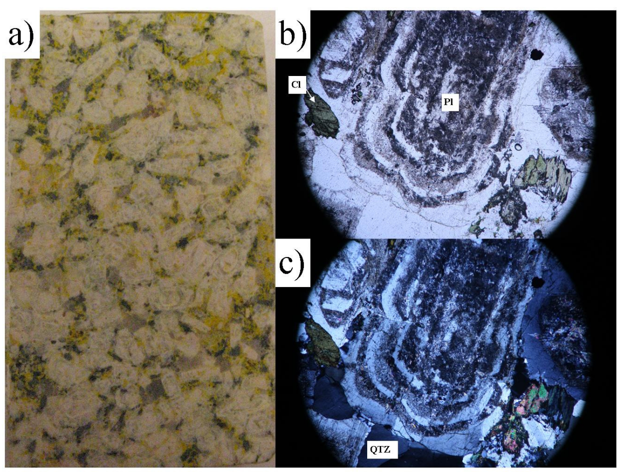


Figure 7. Sample G090063 quartz monzonite **(a)** A 2 cm wide block that has been stained for K-feldspar. "a" shows interstitial K-spar and strongly zone plagioclase. **(b)** Thin section in PPL. FOV is 3.6mm across. **(c)** Thin section in XPL. FOV is 3.6mm across. Pl = plagioclases, Cl = Chlorite

b) Local float of crowded plagioclase feldspar porphyry that has been strongly altered occurs within the Stuhini Group north of the Grass fault sample (G090061). It weathers to a light orange to brown colour (Fig. 8a). The feldspar crystals are strongly sericitized as seen in thin section (Fig. 8c).

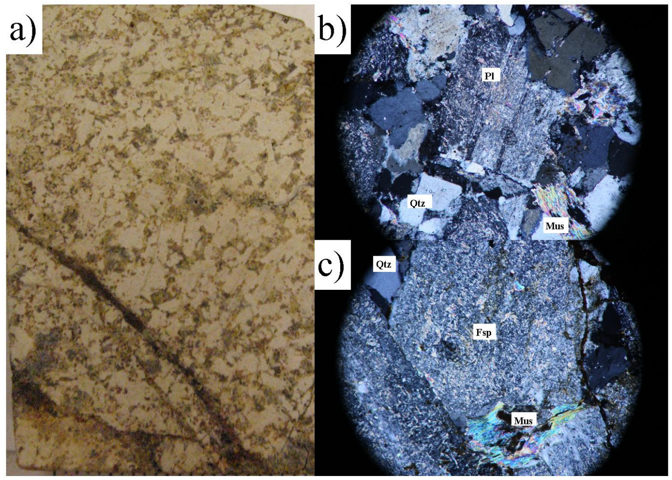


Figure 8. Sample G090061 **(a)** A stained hand sample of the crowded feldspar porphyry. The block is 2 cm wide. **(b)** Thin section in XPL showing sercitized plagioclase. FOV is 1.8mm across. **(c)** Thin section in XPL. Feldspars are too sericitized to determine if the initial crystal was K-feldspar or plagioclase. FOV is 1.8 mm across.
Mus = muscovite, Fsp = feldspar.

c) The GIC prospect is host to a quartz monzonite containing disseminated pyrite. Sample G090062 was collected from drill core WM07_05 from a depth of 82.6 - 85.0m. The plagioclase within the sample has been sericitized and is cross cut by carbonate veins (Fig. 9). Quartz and K-feldspar occurs as smaller grains between the larger sericitized plagioclase. There is some chlorite alteration, however, it is unclear what the chlorite is pseudomorphing. The drill hole targeted at a high chargability anomaly of the GIC prospect (Lehtinen, 2006).

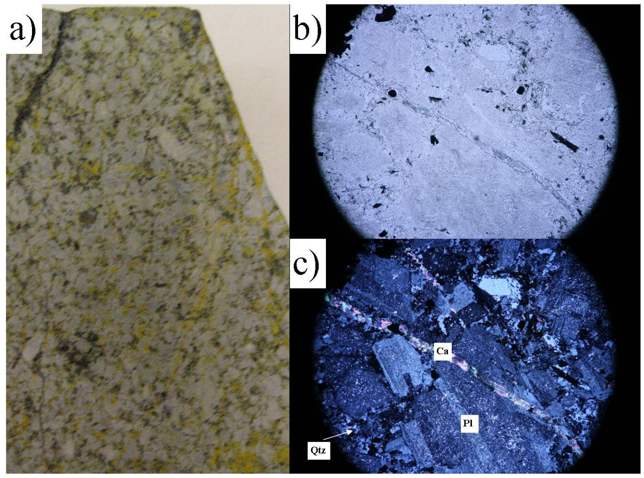


Figure 9. Sample G090062 (a) A stained hand sample of quartz mozonite. The block is 2 cm wide. (b) Thin section in PPL. FOV is 3.6 mm across. (c) Thin section in XPL. FOV is 3.6 mm across. "c" shows a moderately sericitized plagioclase crystal being crosscut by a calcite vein. Ca = calcite.

d) Sample G090064 sampled the edge of the GIC geophysical anomaly. G090064 is a monzonite that contains a larger percentage of K-feldspar relative to the other four samples from Williams west (Fig. 10). This sample has a locally brecciated vein of the surrounding wall rock. The vein has been more altered by chlorite.

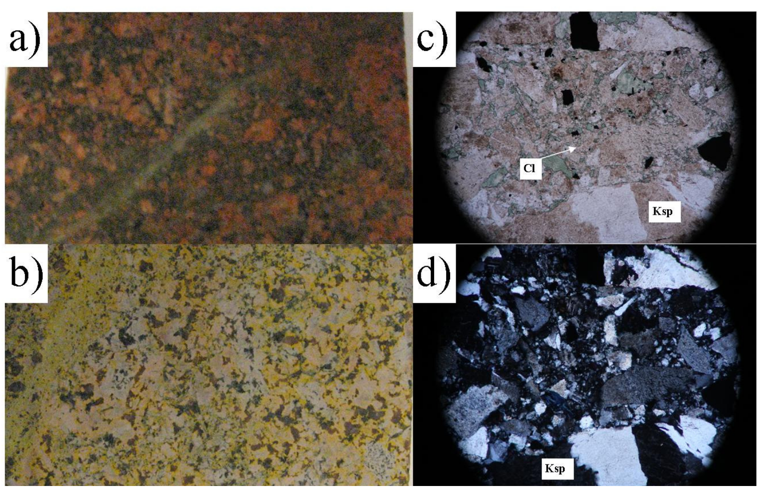


Figure 10. Sample G090064 **(a)** A hand sample of monzonite. The block is 2 cm wide. **(b)** A stained sample of "a". **(c)** Thin section in PPL, showing the chlorite rich brecciated vein. FOV is 3.6 mm across. **(d)** Thin section in XPL. FOV is 3.6 mm across.
Ksp = K- feldspar

e) A larger pluton north of the Grass fault intrudes the Stuhini Group and is classified as a quartz monzonite. Exposures of this unit appear pink in colour and were initially thought to be dominated by K-feldspar (Fig. 11). After feldspar staining in the laboratory, however, the modal composition is estimated at 55% subhedral plagioclase, 25% K-feldspar and 10% anhedral quartz, with the remainder of the rock being comprised of dark green to black mafic minerals mainly secondary chlorite, and minor components of euhedral clinopyroxene as seen in thin section (Fig. 11). Although the plagioclase feldspars that have been altered to sericite, polysynthetic twinning can still be identified. This sample appears to have a minor shear fabric to it. The presences of quartz with highly undulose extinction and irregular edges helps to confirm occurrence of shearing. These rocks are characterized by a broad magnetic high (Weber and Awmack, 2002).

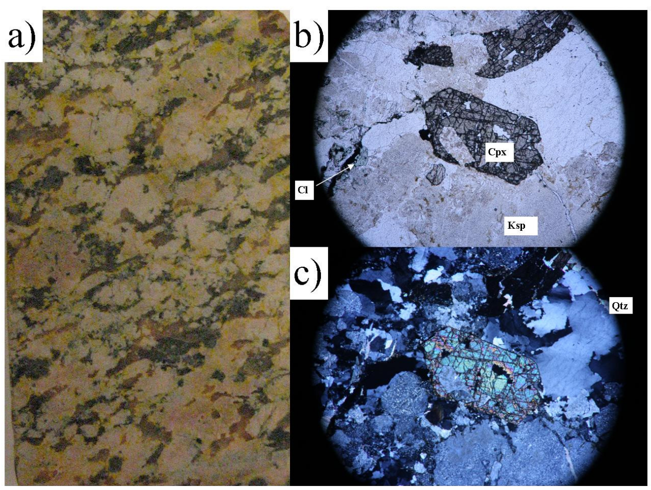


Figure 11. Sample G090060 **(a)** A stained hand sample of quartz monzonite. The block is 2 cm wide. **(b)** Thin section in PPL. FOV is 3.6 mm across. **(c)** Thin section in XPL. FOV is 3.6 mm across. The quartz shows strong undulose extinction.
Cpx = Clinopyroxene

The intrusions on the eastern portion of the property differ from those on the western part. At Williams west the dominant intrusion is a pink felsic intrusion (sample SB07_12) that spans the center of Williams east and is exposed mainly within Mountain creek (Fig.11). The intrusion also appears a few hundred metres to the north. The intrusion covers an area approximately 2 km^2. The rock is a medium to coarse grained porphyritic syenite which was determined after K-feldspar staining (Fig. 11). After staining the modal composition is estimated at 70% K-feldspar 25 % quartz, 4% plagioclase, and 1% altered mafics mainly biotite based on the shapes of pseudomorphs. Isolated patches of fine grained pyrite which is a secondary alteration is observed locally in outcrop.

Further south there is an intrusion that appears to underlie much the southern portion of the Williams (SB07_13). It is a granodiorite that has a modal composition of 60% plagioclase, 15% K-feldspar, 20% quartz, and 5% dark mafics which are mainly biotite. A few small, isolated, outcrops of diorite (SB07_13) were observed in the same local as the syenite where they are being exposed in sections of the creek. A younger pegmatitic gabbro stock which is exposed for approximetly 400m was observed in the north west portion of the claims (J. Lehtinen, personal communication, 2007); see appendix1.

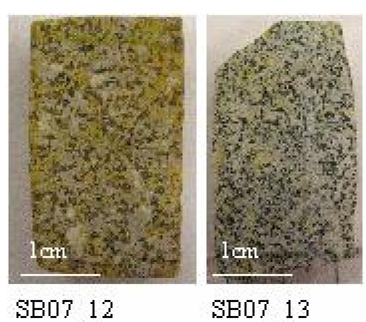


Figure 12. Stained samples of the intrusions from Williams east.

6.0 Mineralization and Alteration

There are two different styles of mineralization and alteration on the Williams property; that are, 1) the T-Bill prospect, which is located within the Asitka Group rocks that lie south of the Grass fault, and 2) the GIC prospect that lies on a geophysical, high chargebility anomaly north of the Grass fault (Lehtinen, 2007).

6.1 T-Bill prospect

The T-Bill prospect is dominated by arsenopyrite bearing hydrothermal quartz veins containing gold (know from assay results). Two samples of the T-bill quartz vein mineralization were collected SB07_10 and SB07_11 (Table 1). SB07_10 was sampled from a surface outcrop, SB07_11 was a sample from drill hole WG03_10 at a depth of 188.9-189.9m The arsenopyrite is euhedral and is localized along the edge of the 10-20cm veins and within quartz stringers that cross cut the foliation (Fig. 5). These veins lie within strongly altered muscovite, carbonate, quartz schist of the Asitka Group (Weber and Awmack, 2002). The predominant alteration is sericitic. The alteration appears to be controlled by the S1 foliation and by steep NE-SW structures (Weber and Awmack, 2002). The alteration was previously dated at 135$\pm$ 5 Ma using K-Ar methods on muscovite by Cominco Ltd. (Weber and Awmack, 2002).

There were three distinct styles of gold mineralization noted, at the T-bill prospect (Weber and Awmack, 2002):

a) Disseminated and vein pyrite-arsenopyrite in carbonatized rock adjacent to mineralized veins.

b) Brecciated quartz veins or carbonatized rock associated with movement of faults or joints. These breccias are pre-mineralization and post carbonatization. The breccia matrix contains quartz, arsenopyrite, pyrite, and carbonate +/- chalcopyrite.

c) Quartz-carbonate-arsenopyrite-pyrite veins. These are planar tension veins that occur in swarms and are typically 0.2-30cm wide. They cross cut foliation and are responsible for the high grade surface and core assays.

6.2 GIC prospect

The GIC prospect is located on the ridge north of GIC creek (Fig. 3, 4). Cu-Au-Mo mineralization is located within the GIC prospect. Four samples of GIC mineralization were sampled from drill hole WM06_5 at various depths (Table. 1). Goethite and jarosite are abundant along the contact between the crowded feldspar porphyry (G090061) and andesitic tuff (Lehtinen, 2007). The andesitic tuff is strongly silicified and has a box work texture from the weathering of sulphides (Lehtinen, 2007). The feldspar porphyry is dominated by 1mm placioclase crystals that have undergone extensive replacement by sericite. There are larger muscovite crystals with a maximum size of 0.2mm that appear to be a replacement of the plagioclase. The plagioclase crystals are surrounded by 0.1-0.2mm crystals of subhedral quartz some of the crystals have undulose extinction. There is also a dominant iron oxide present in fractures due to the extensive weathering that has occurred.

Table 1. Sample locations and brief sample descriptions from the study area.

Sample Number	Sample Type	U-Pb	Fs-Pb	Ar-Ar	Sx	Sx-Pb	Whole Rock	Thin Section	Polished Section	Easting	Northing	Williams	Description
G090052	Grab							1		588357	6405021	east	Highly altered Seds/Volcanics with chlorite veining
G090055	Float								1	588003	6406230	east	Magnetite, epidote and calcite with some py
G090056	Float				Cp				1	588018	6406203	east	Epidote, Magnetite, py, cp with calcite
G090058	Grab				Py			1		587991	6405363	east	Andesite dyke with disseminated py
G090060	Grab	1	1				1	1		574092	6409521	west	Collected North of GIC quartz monzonite
G090061	Grab	1			MG-Py		1	1		572786	6408265	west	Strongly weathered feldspar porphory
G090062	Core	1	1		Py	1	1		1	574284	6408169	west	WM06_5 82.6m-85.0m qtz monzonite
G090063	Grab	1	1				1	1		575086	6402188	west	SE intrusion monzonite, strongly zoned plag
G090064	Grab	1	1				1	1		574318	6408538	west	Pink altered monzonite
SB07_06	Core				Mo-Py	1			1	574284	6408169	west	WM06_5 80.0m depth, sulphide in small vein
SB07_07	Core				Py	1			1	574284	6408169	west	WM06_5 135.9m, disseminated sulphides
SB07_08	Core				Cp			1		574284	6408169	east	WM06_5 136.1m
SB07_09	Core				Cp				1	574284	6408169	east	WM06_5 136.4m trace chalcopyrite in brecciated core
SB07_10	Grab				As	1			1	572998	6404943	west	T-bill arsenopyrite in quartz veining
SB07_11	Core			1	As	1			1	Drill hole	WG03_10	west	Tbill 188.9-189.1 arsenopyrite in quartz veining
SB07_12	Grab							1		588090	6404140	east	Pink granite
SB07_13	Grab							1		588145	6403341	east	Light grey diorite
SB07_14	Grab							1		588145	6403340	east	Light pink quartz monzonite
SB07_15	Grab							1		588001	6406102	east	Feldspar porphory (crystals up to 0.5cm)

7.0 Methodology

7.1 Geological Mapping and Sampling

Mapping was carried out on the western portion of the property during the 2007 field season by the author and Jim Lehtinen, while employed by Equity Engineering Ltd., of Vancouver, B.C. Initial camp mobilization was done by helicopter from the Highland Post airstrip. Access to the area was by foot and we progressively moved camp from the east towards park creek during the course of the mapping. A total of 21 samples were collected for thin section analysis, of which 8 samples were used for whole rock analysis. Samples were collected for U-Pb analysis from five different intrusive suites from Williams west. Four of the samples were collected at the surface whereas sample G090062 was taken from core drilled during the 2006 field season on the GIC prospect. Sulphide samples from the GIC prospect were taken from drill hole WM06_5 at several different depths. Two sulphide samples were collected from the T-Bill prospect; one from drill hole WG03_10, and the other sample was collected from the surface.

7.2 Lithogeochemistry

Research grade whole rock analysis was performed on 8 samples by ALS Chemex laboratory in North Vancouver, B.C., using XRF techniques. The gold content was determined in the ALS Chemex laboratory using their AAU23 analytical package.

7.3 Petrography

All samples for standard and polished thin section preparation were cut to billets by the author at the University of British Columbia and then sent to Vancouver Petrographics Ltd. for preparation. The remaining offcut blocks from thin section preparation were subsequently stained for feldspars by the author, using a standard sodium cobaltinitrite staining method.

7.4 Lead Isotopic Study

Lead isotope compositions of sulphides from five rock samples were measured to determine the geochemical fingerprint of the mineralizing fluid, for comparison with the composition of the igneous feldspars from possibly mineralizing plutons. The lead isotopic composition of igneous feldspars from four intrusive samples was also determined for comparison with the sulphide mineralization. Sample preparation was done by the author, and analyses were carried out by J.E. Gabites of the Pacific Center for isotopic and Geochemical Research (PCIGR) at the University of British Columbia, using conventional thermal ionization mass spectrometry methods. The hand picked sulfides and feldspar samples were leached in dilute hydrochloric acid to remove surface contamination and dissolved in dilute nitric acid. Following ion exchange chemistry, approximately 50-500 nanograms of lead in chloride from was loaded on rhenium filaments using a phosphoric acid-silica gel emitter. Isotopic ratios were determined with a modified VG54R thermal ionization mass spectrometer in peak-switching mode on a Faraday detector. Measurements ratios were corrected for instrumental mass fractionation of 0.12% based on multiple analyses of NBS981 standard lead, and the values in Thirlwall (2000). Errors are reported at the 2 sigma level.

7.5 U-Pb Geochronology

Crystallization ages of five samples were determined by U-Pb dating of zircon in this study to help determine temporal relationships between different intrusive suites in the area. Five samples were prepared for U-Pb analysis using conventional crushing and grinding, Wilfley table, heavy liquids, and Franz magnetic separation methods. Zircons for analysis then were hand picked and mounted for U-Pb analysis using laser ablation ICP-MS methods. U-Pb sample preparation and analyses were carried out by the author and J.K. Mortensen of the PCIGR at the University of British Columbia.

Zircons were analyzed using laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) at the PCIGR at the University of British Columbia. Zircons were handpicked from the heavy mineral concentrate and mounted in an epoxy puck along with several grains of the Plešovice zircon standard and brought to a very high polish. High quality portions of each grain free of alteration, inclusions, or cores were selected for analysis. The surface of the mount was washed for 10 minutes with dilute nitric acid and rinsed in ultraclean water prior to analysis. A New Wave UP-213 laser ablation system and a ThermoFinnigan Element2 single collector, double-focusing, magnetic sector ICP-MS was employed for the analyses. Line scans rather than spot analyses were employed in order to minimize elemental fractionation during the analyses. Backgrounds were measured with the laser shutter closed for ten seconds, followed by data collection with the laser firing for approximately 29 seconds. The time-integrated signals were analyzed using the GLITTER software, which automatically subtracts background measurements, propagates all analytical errors, and calculates isotopic ratios and ages. Corrections for mass and elemental fractionation were made by bracketing analyses of unknown grains with replicate analyses of the zircon standard. A typical analytical session consists of four analyses of the standard zircon, followed by four analyses of unknown zircons, two standard analyses, four unkown analyses, etc., and finally four standard analyses. Final interpretation and plotting of the analytical results employ the ISOPLOT software (Ludwig, 2003). Interpreted ages are based on a weighted average of the individual calculated $^{206}Pb/^{238}U$ ages.

7.6 Ar-Ar Geochronology

A sample of alteration sericite thought to be related to mineralization was dated using 40Ar/39Ar methods at the PCIGR. The sericite was hand-picked from sample SB07_11 and then sent to for irradiation at the McMasters Reactor Facility. The analysis and data reduction was carried out by Tom Ullrich at the PCIGR, University of British Columbia.

8.0 Results

8.1 Lithogeochemistry

Major and trace element analyses were carried out to better classify the intrusive units located within the study area. Results are given in Table 2.

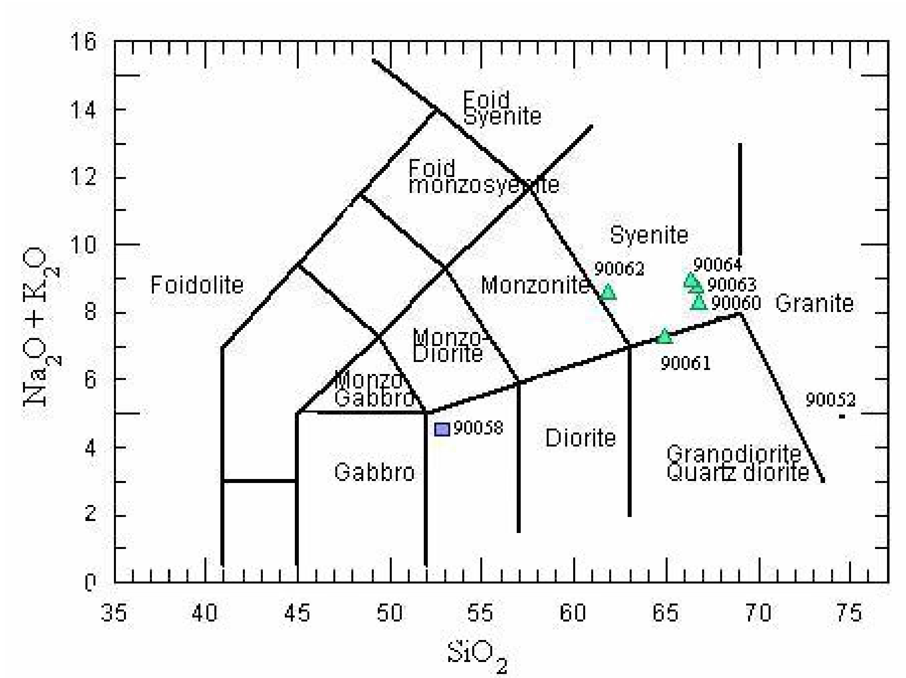
Four samples (G090060, G090062, G090063, and G090064) were initially considered to be quartz monzonites based on their modal mineralogy. Sample G090061 was highly weathered feldspar porphyry that was sampled from local float. A dark grey aphanitic andesitic dyke from William's east (G090058) cross cuts a series of fine grained volcanic and sedimentary rocks that are thought to be part of the Stuhini Group. Geochemistry was carried out by ALS Chemex Ltd and the results were plotted using Igpet.

On total alkalis versus silica diagram (Fig. 13a) the five intrusive samples (G090060 to G090064) plot within the syenite field which is inconsistent with the assigned field classification and model mineralogy estimated from stained blocks. Potassic alteration is possible explanation for this inconsistancy. Sample G090058 plots between the gabbro and diorite field which confirms the initial field name given. The Irvine and Baragar (1971) classification schemes show that the rocks are subalkaline in affinity and that sample G090062 is on the borderline of being weakly alkaline (Fig. 13b). This is more consistent with the field names given but is contradicatory to the total alkalis versus silica diagram. Staining of the offcut blocks showed that the majority of the potassium is located along grain boundaries and within fractures. This helps to support the hypothesis that the samples have undergone some potassic alteration.

Table 2. Geochemical Data analyzed by ALS Chemex

SAMPLE#	Ba	Co	Cr	Cu	FeO	K	Mg	Mn	Na	Ni	P	Pb	S	Sb	Sc	Sr	Ti	V	Zn
90052	-10	9	33	98	1.98	0.03	0.33	218	0.12	21	320	-2	1	4	5	4	0.17	59	18
90057	80	3	14	18	2.07	0.24	0.76	240	0.04	5	190	4	0.13	5	2	7	0.01	9	23
90058	50	23	26	17	5.9	0.14	1.64	613	0.25	19	2030	3	0.31	3	5	99	0.28	141	61
90060	60	6	16	116	2.07	0.11	0.76	510	0.09	6	560	4	0.01	2	5	33	0.17	52	58
90061	70	6	1	50	3.75	0.25	0.13	112	0.11	1	530	3	0.21	5	1	27	-0.01	14	4
90062	50	24	2	862	3.11	0.25	0.67	259	0.12	5	1200	-2	2.32	6	5	22	0.11	71	10
90063	260	3	7	9	1.06	0.14	0.32	458	0.1	2	410	4	0.01	4	2	99	0.07	31	48
90064	60	6	6	11	2.7	0.11	0.86	396	0.1	3	770	-2	0.01	-2	5	11	0.01	57	41
	SiO2	**Al2O3**	**Fe2O3**	**CaO**	**MgO**	**Na2O**	**K2O**	**Cr2O3**	**TiO2**	**MnO**	**P2O5**	**SrO**	**BaO**	**LOI**	**Total**				
90052	74.53	9.98	4.06	2.01	2.24	4.77	0.13	0.01	0.47	0.06	0.071	0.01	0.01	1.53	99.87				
90057	76.83	11.74	3.22	0.14	1.7	1.39	2.07	-0.01	0.29	0.03	0.051	0.01	0.07	2.34	99.88				
90058	54.01	17.67	9.74	5.57	4.09	3.54	1.1	0.01	1.13	0.12	0.437	0.04	0.07	2.34	99.86				
90060	65.93	15.41	3.24	2.35	1.28	5.12	3.05	-0.01	0.43	0.07	0.12	0.06	0.15	2.53	99.74				
90061	64.46	17.4	5.62	0.11	0.56	4.71	2.46	-0.01	0.66	0.01	0.121	0.02	0.05	3.66	99.83				
90062	61.06	17.52	4.76	2.1	1.27	5.64	2.81	-0.01	0.61	0.04	0.263	0.03	0.11	3.67	99.87				
90063	66.22	18.26	2.14	2.27	0.66	5.7	2.94	-0.01	0.2	0.08	0.096	0.14	0.24	0.89	99.84				
90064	66.31	15.37	3.91	0.83	1.5	5.15	3.73	-0.01	0.7	0.05	0.167	0.01	0.12	1.55	99.4				

a)



b)

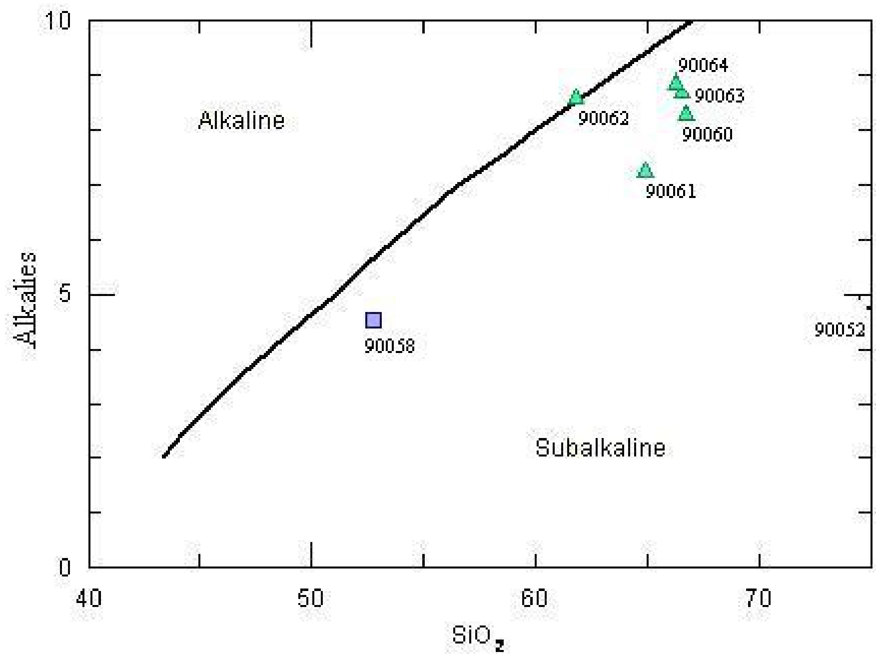


Figure 13. Lithogeochemical plots for the intrusive suites on the William's Gold property. **(a)** A total alkalis vs silica plot. Field from Le Bas et al. (1986). **(b)** Alkalies vs silica. Fields from Irvine and Baragar (1971).

8.2 Lead Isotopic Study

Sampling was carried out of various intrusive units on Williams west for U-Pb and Pb isotopic studies. The Pb isotopic study is aimed at determining the geochemical fingerprint of the feldspar Pb to compare with the fingerprint of the sulfide Pb. This allows us to determine if the intrusions are associated with the mineralizing event. Analyses were performed by Janet Gabites, PCIGR at the University of British Columbia.

A total of five intrusive units were sampled. Field observations suggest that the intrusions have been emplaced into Asitka and Stuhini Group rocks. Of the five intrusive samples taken (G090060 to G090064) only three samples G090060, G090062, and G090062 contained sufficient unaltered feldspars. Feldspars in sample G090061 were strongly altered and were not analyzed. Feldspars from sample G090064 yielded Pb/Pb isotopic ratios that plotted on the far right of the Pb^{207}/Pb^{204} versus Pb^{206}/Pb^{204} diagram with a Pb^{206}/Pb^{204} ratio around 21.40. This may indicate there was a highly radiogenic inclusion (e.g., zircon) was contained within the feldspar separate.

The samples for the feldspar analysis are as follows;

a) Sample G090060 was collected from the northern portion of Williams west and has been determined to be a quartz monzonite.

b) Sample G090062 was sampled from drill hole WM06_5 at a depth of 82.6-85m. This hole was targeted at the core of the high chargeability anomaly. This sample is a quartz monzonite and contains disseminated pyrite as well as trace chalcopyrite.

c) G0900063 is a sample from the south eastern intrusion on Williams west. It is a quartz monzonite that is plagioclase phyric.

The Pb isotopic composition of five sulphide samples were determined to compare with the feldspar leads. Sample G090062, SB07_06, SB07_07 were all sampled from drill hole WM06_05 at depth of 82.6 - 85.0m, 139.5m, and 188.9-189.9m respectively. The sulphides from G090062, SB07_06, SB07_07 were all pyrite and were typical of the GIC prospect mineralization. Samples SB07_10 and SB07_11 are sulphides from the quartz veining within the Asitka Group rocks on the T-bill prospect. SB07_10 sampled pyrite from a quartz vein at surface whereas sample SB07_11 is arsenopyrite from drill hole WG03_10 at a depth of 188.9-189.1m.

Results of the Pb isotopic study are plotted in Figure 14, and the feldspar and sulfide analysis are given in Table 3. Fields defined for Early to Middle Jurassic and Early Tertiary intrusive rocks and associated mineralization in the Iskut region of northwestern British Columbia (from Alldrick, 1990, and Godwin et al., 1991) are also shown. Reference fields for Pb isotopic compositions from a variety of intrusions, as well as volcanic and sedimentary wall rocks and mineralization from the Kemess area, approximately 100 km southeast of the Williams property are also shown; these fields are taken from Mckinley (2006) and Dickinson thesis (2006). The Pb isotopic signatures of feldspars from three of the intrusive units within the Williams property fall within the main field for Jurassic intrusions and intrusion-related mineralization in the Iskut area. Note that Pb isotopic compositions for Takla Group whole rock samples from the Kemess area (Mckinley, 2007; Dickinson, 2007) also overlap the Jurassic field from the Iskut region; hence, Pb derived from Jurassic intrusions cannot be distinguished from Pb derived from the Takla Group volcanic rocks on the basis of its isotopic signature.

Table 1. Pb isotopic compositions from sulphides and feldspars analyzed during this study

Sample Number	Mineral	206Pb/ 204Pb	Error % 2 sigma	207Pb/ 204Pb	Error % 2 sigma	208Pb/ 204Pb	Error % 2 sigma	207Pb/ 206Pb	Error % 2 sigma	208Pb/ 206Pb	Error % 2 sigma
G090062	py	19.7265	0.45	15.6972	0.44	39.1049	0.47	0.7964	0.180	1.9818	0.095
SB07-06	py	18.8623	0.07	15.5711	0.10	38.3784	0.14	0.8262	0.160	2.0341	0.040
SB07-07	py	19.0548	0.09	15.5266	0.10	38.4322	0.15	0.8155	0.168	2.0164	0.071
SB07-10	py	18.8983	0.05	15.6131	0.08	38.2790	0.12	0.8268	0.162	2.0250	0.042
SB07-11	asp	19.2506	0.17	15.5900	0.18	38.6432	0.21	0.8105	0.163	2.0069	0.053
G90062	pl	18.7742	0.04	15.5927	0.08	38.4058	0.12	0.8312	0.160	2.0451	0.040
G90064	pl	21.4034	0.09	15.5830	0.11	39.2938	0.15	0.7286	0.162	1.8354	0.043
G90063	pl	18.7539	0.08	15.5730	0.10	38.3526	0.21	0.8310	0.165	2.0445	0.160
G90060	ks	18.7491	0.04	15.5660	0.08	38.3248	0.12	0.8309	0.160	2.0436	0.041

*Analyses by Janet Gabites, PCIGR, UBC, Vancouver BC. Errors are reported at the 2 sigma level.
Minerals analysed: pl = plagioclase feldspar, ks = K-feldspar, py = pyrite, asp=arsenopyrite

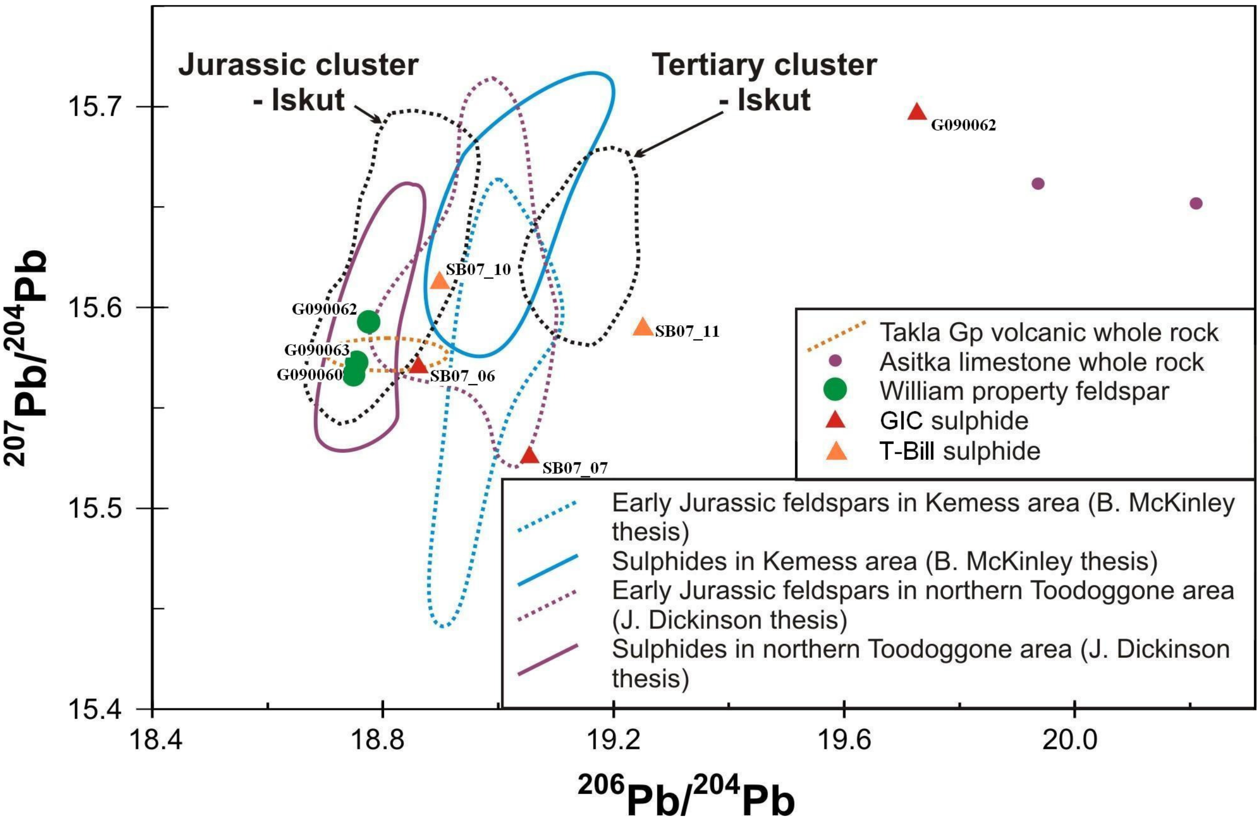


Figure 14. $^{207}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ plot of Pb isotopic data from Williams east. Field previously defined for Early Tertiary and Middle Jurassic sulphide leads from northwest BC by Alldrick (1990), Godwin (1991). Jurassic and Tertiary fields from Mortensen et al. (2005). Takla Group and Asitka limestone whole rock field(McKinley, 2006) and (Dickinson, 2006).

8.3 U-Pb Geochronology

Five samples from Williams west were collected for U-Pb geochronology (G090060-G090064), and all yielded zircons. All samples were collected to determine the age of the different intrusion in the area to see if they were similar to the timing of mineralization at other deposits located within the Toodoggone District. Sample preparation and analyses were carried out by the author and J.K. Mortensen of the PCIGR at the University of British Columbia.

Sample G090060 was collected north of GIC prospect and is thought to be the oldest of the five samples because it is had a pervasive shear fabric to it in hand sample. Zircons that were analyzed from this sample were clear and euhedral. The grains had a 2:1 length to width ratio and were approximately 149 μm in length; the zircons were the larges of the five samples analyzed. A total of 16 individual laser ablation analyses were done. All cluster on or near concordia (Fig. 15) and give a weighted 206Pb/238U age of 221.4 ± 1.2 Ma (MSWD = 1.2) which is interpreted to give the crystallization age of the sample.

Within the GIC prospect sample G090061 that is an altered feldspar porphyry was sampled from local float, in gossanous soil. It produced mainly <104 μm zircons that were elongate (length to width ration of 3:1) euhedral crystals with simple terminations. Sixteen individual laser ablation analyses cluster on concordia (Fig. 15) and give a weighted average 206Pb/238U age of 189.4 ± 1.6 Ma (MSWD = 4.2) which gives the age of the sample.

Sample G090062 was collected from a depth of 82.6-85.0m from WM06_5 (GIC prospect) and is a quartz monzonite that contains disseminated pyrite. A bimodal distribution of grains were observed, the larger grains were stubby with a length to width ratio of 3:2, whereas the smaller of the two were more elonglated and prismatic. The larger zircons appeared similar in shape to sample G090063. Sixteen laser ablation analyses were carried out on zircons from this sample. Thirteen of these form a tight cluster on concordia (Fig. 16) with a weighted average 206Pb/238U age of 211.6 ± 2.2 Ma (MSWD = 6.4) which is interpreted to be the crystallization age of the sample. One analysis gives a much younger age and appears to reflect substantial post-crystallization Pb-loss. Two other grains give older 206Pb/238U ages (227 and 308 Ma). These grains are interpreted to have been xenocrysts that were entrained from an older source in the basement.

A quartz monzonite, G090063 is a sample of the southeast intrusion, located south of the T-bill prospect. It contains strongly zone plagioclase crystals. Zircons that were separated were stubby square prisms and had simple to rounded edges, possibly from resorption. One zircon grain appeared to have a rounded core within it. The laser ablation analyses scatter along concordia from 214 Ma to 420 Ma (Fig. 16). The time-resolved age spectra from several of grains that were analyzed showed the clear presence of older inherited zircon cores that were not recognized during hand picking of zircons from this sample. The two youngest ages overlap with a weighted average 206Pb/238U age of 213.8 ± 1.1 Ma (MSWD = 0.8), which is thought to be the best estimate for the crystallization age of the sample. The rest of the analyses were of grains with large inherited cores of older zircon or xenocrysts. The ages of these older zircon components cluster between 230 and 260 Ma and 330 and 380 Ma, with a single grain giving an age of ~420 Ma. The first two age clusters approximately correlate with known ages of igneous rock units in the basement of northern Stikinia (Paleozoic Stikine Assemblage).

Sample G090064 was collected proximal to the GIC prospect and is a monzonite that has been strongly altered and appears pink in colour. The zircons that were obtained from this sample were <104 μm and were stubby square prisms with simple rounded terminations. Sixteen individual laser ablation analyses cluster on concordia (Fig. 16) and give a weighted average 206Pb/238U age of 183.6 ± 0.9 (MSWD = 2.9) which gives the age of the sample.

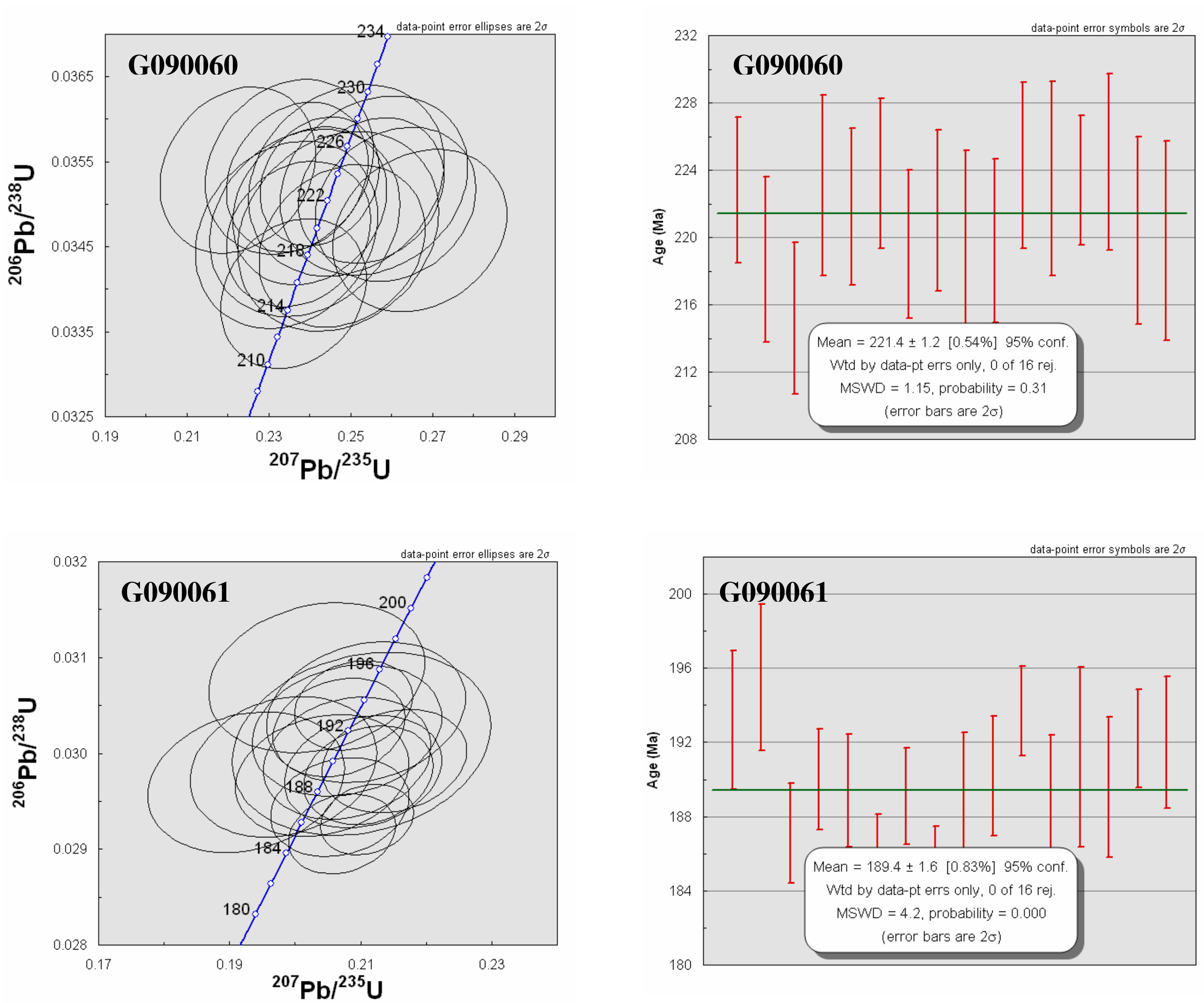


Figure15. Concodia diagrams and weighted mean plots showing zircon crystallization ages
*analysis by J.K. Mortensen with the PCIGR at the University of British Columbia

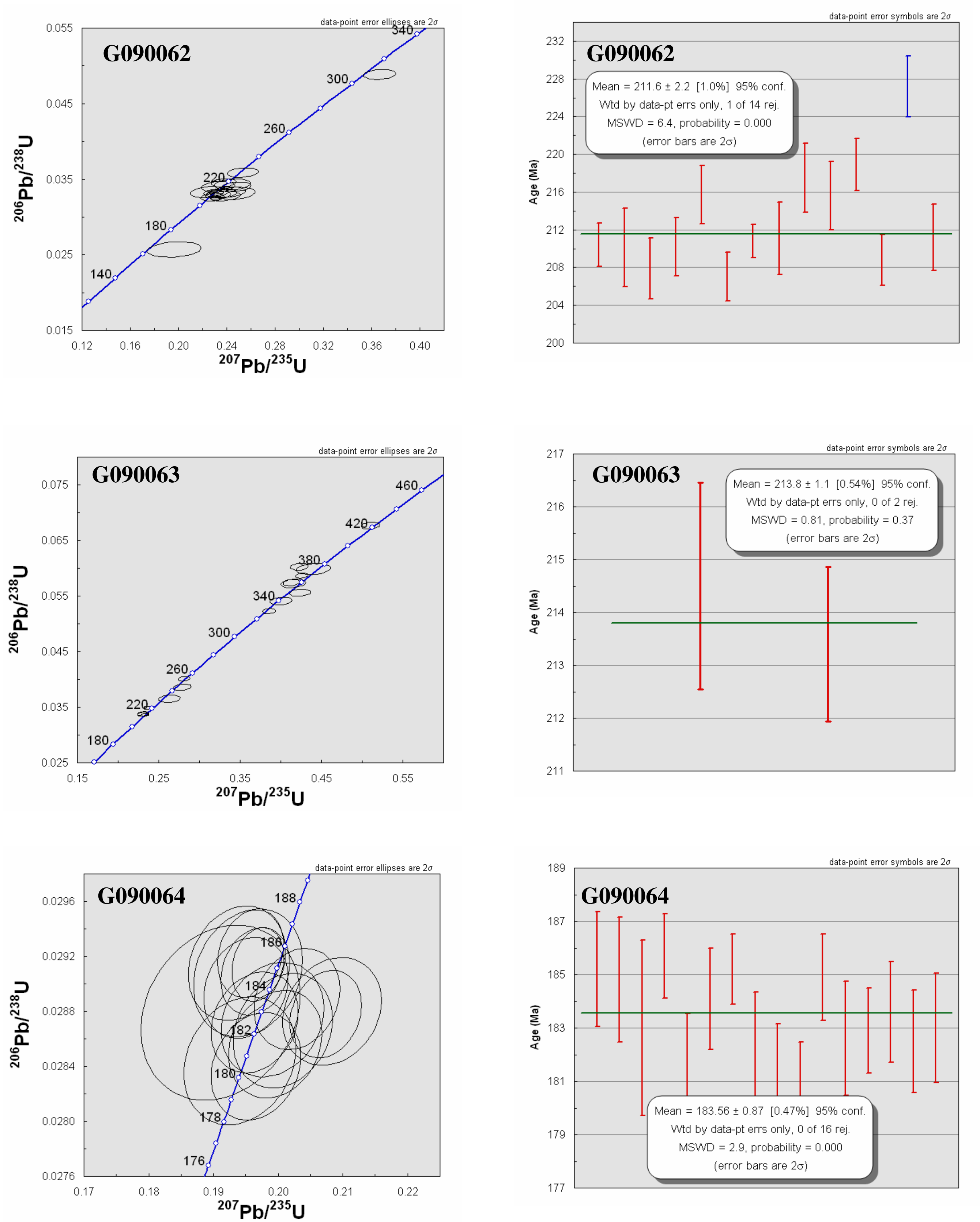


Figure 16. Concodia diagrams and weighted mean plots showing zircon crystallization ages
*analysis by J.K. Mortensen with the PCIGR at the University of British Columbia

Table 4. Laser ablation U-Pb data of samples analyzed during this study at the PCIGR.

Analysis	207Pb/206Pb	error*	207Pb/235U	error*	206Pb/238U	error*	207Pb/206Pb age	error**	207Pb/235U age	error**	206Pb/238 age	error**
Sample 90060												
90061-1	0.05276	0.00143	0.25497	0.00725	0.03516	0.00035	318.6	60.28	230.6	5.87	222.8	2.17
90061-2	0.05113	0.00164	0.24789	0.0083	0.03451	0.00039	246.6	71.99	224.9	6.75	218.7	2.46
90061-3	0.05085	0.00149	0.23599	0.00726	0.03395	0.00036	233.9	66.4	215.1	5.96	215.2	2.25
90061-4	0.05196	0.00182	0.25567	0.00937	0.03522	0.00043	283.8	78.2	231.2	7.58	223.1	2.69
90061-5	0.05312	0.00155	0.26098	0.00804	0.035	0.00037	333.9	64.98	235.5	6.47	221.8	2.33
90061-6	0.0489	0.00138	0.2369	0.00706	0.03532	0.00036	143.3	65.05	215.9	5.8	223.8	2.22
90061-7	0.04912	0.00142	0.23725	0.00722	0.03465	0.00035	153.6	66.22	216.2	5.92	219.6	2.2
90061-8	0.0504	0.00153	0.23998	0.00768	0.03498	0.00038	213.2	68.97	218.4	6.29	221.6	2.39
90061-9	0.05167	0.00193	0.23435	0.00911	0.03464	0.00045	270.9	83.19	213.8	7.49	219.5	2.82
90061-10	0.05388	0.00165	0.26689	0.00868	0.03469	0.00039	365.7	67.44	240.2	6.95	219.8	2.44
90061-11	0.04632	0.00153	0.22235	0.00775	0.0354	0.0004	14	76.79	203.9	6.44	224.3	2.47
90061-12	0.05251	0.00196	0.24897	0.00977	0.03528	0.00046	307.6	83	225.7	7.95	223.5	2.88
90061-13	0.04992	0.00111	0.24241	0.00593	0.03527	0.00031	191.2	51.02	220.4	4.85	223.4	1.92
90061-14	0.04859	0.00163	0.23501	0.00839	0.03544	0.00042	128.1	77.29	214.3	6.9	224.5	2.62
90061-15	0.04938	0.00186	0.23877	0.0095	0.03478	0.00045	166	85.84	217.4	7.79	220.4	2.78
90061-16	0.05177	0.00199	0.2469	0.01003	0.03468	0.00048	275.2	85.47	224.1	8.17	219.8	2.97
Sample 90061												
90061-1	0.04915	0.0014	0.21079	0.0062	0.03043	0.0003	155	65.59	194.2	5.2	193.2	1.87
90061-2	0.04895	0.00159	0.20326	0.00674	0.03079	0.00032	145.4	74.54	187.9	5.69	195.5	1.98
90061-3	0.04986	0.00101	0.20681	0.00431	0.02944	0.00021	188.5	46.55	190.9	3.63	187.1	1.34
90061-4	0.05095	0.00104	0.21514	0.00451	0.02992	0.00022	238.5	46.33	197.9	3.77	190	1.35
90061-5	0.0516	0.00117	0.21034	0.00489	0.02981	0.00024	267.6	51.13	193.8	4.1	189.4	1.51
90061-6	0.05118	0.00068	0.21096	0.00289	0.02931	0.00015	248.8	30.21	194.4	2.43	186.2	0.95
90061-7	0.05068	0.00094	0.21121	0.00403	0.02977	0.00021	226.2	42.15	194.6	3.38	189.1	1.3
90061-8	0.0495	0.00077	0.20715	0.00334	0.02916	0.00017	171.7	36	191.2	2.81	185.3	1.09
90061-9	0.04804	0.0015	0.19251	0.00614	0.0297	0.0003	101.3	72.3	178.8	5.23	188.7	1.91
90061-10	0.0501	0.00122	0.20795	0.00522	0.02995	0.00026	199.8	55.72	191.8	4.38	190.2	1.61
90061-11	0.04882	0.00083	0.20891	0.00369	0.0305	0.00019	139.2	39.54	192.6	3.1	193.7	1.2
90061-12	0.04929	0.00127	0.20413	0.00541	0.02977	0.00026	161.6	59.28	188.6	4.56	189.1	1.64
90061-13	0.04997	0.00187	0.21013	0.00807	0.0301	0.00039	193.4	84.64	193.7	6.77	191.2	2.43
90061-14	0.04875	0.00139	0.19821	0.00582	0.02986	0.0003	135.6	65.75	183.6	4.93	189.6	1.89
90061-15	0.04923	0.00095	0.20668	0.00413	0.03027	0.00021	158.9	44.4	190.8	3.47	192.2	1.33
90061-16	0.0494	0.00136	0.20786	0.00591	0.03024	0.00028	167	63.3	191.8	4.97	192	1.78
Sample 90062												
90062-1	0.05047	0.00072	0.22899	0.00339	0.03318	0.00018	216.5	32.66	209.4	2.8	210.4	1.15
90062-2	0.05347	0.00073	0.36657	0.00548	0.04887	0.00027	348.9	30.69	317.1	4.07	307.6	1.68
90062-3	0.05654	0.00263	0.19643	0.00921	0.02571	0.00041	473	100.46	182.1	7.82	163.7	2.58
90062-4	0.05202	0.0014	0.24654	0.00692	0.03314	0.00033	286.5	60.43	223.8	5.64	210.1	2.08
90062-5	0.05187	0.00111	0.23826	0.00529	0.03278	0.00026	279.5	48.24	217	4.34	207.9	1.62
90062-6	0.05126	0.00107	0.23576	0.00507	0.03315	0.00025	252.7	47.13	214.9	4.17	210.2	1.55
90062-7	0.05295	0.00102	0.24792	0.00497	0.03403	0.00025	326.7	43.05	224.9	4.04	215.7	1.53
90062-8	0.04988	0.00083	0.2279	0.00394	0.03263	0.00021	189.2	38.25	208.5	3.26	207	1.29
90062-9	0.05003	0.0005	0.23103	0.00242	0.03323	0.00014	196.1	22.95	211	2	210.8	0.88
90062-10	0.04919	0.00137	0.22558	0.00645	0.03328	0.00031	157	63.78	206.5	5.34	211.1	1.91
90062-11	0.05117	0.00122	0.24484	0.00606	0.03432	0.00029	248.5	54	222.4	4.94	217.5	1.82
90062-12	0.04938	0.00117	0.23284	0.00574	0.03402	0.00029	165.9	54.6	212.5	4.73	215.6	1.8
90062-13	0.0501	0.00085	0.23756	0.00422	0.03454	0.00022	199.5	39.03	216.4	3.46	218.9	1.38
90062-14	0.05094	0.0009	0.23272	0.00429	0.03291	0.00021	238.2	40.43	212.4	3.53	208.8	1.34
90062-15	0.05027	0.00098	0.25343	0.00517	0.03587	0.00026	207.5	44.59	229.4	4.19	227.2	1.62
90062-16	0.05121	0.00124	0.24079	0.00603	0.0333	0.00028	250.4	54.78	219.1	4.93	211.2	1.77
Sample 90063												
90063-1	0.05012	0.00057	0.23092	0.00273	0.03383	0.00016	200.6	26.1	211	2.25	214.5	0.98
90063-2	0.05252	0.0005	0.42284	0.00444	0.06027	0.00025	308	21.44	358.1	3.17	377.3	1.5
90063-3	0.05299	0.00079	0.27907	0.0044	0.03859	0.00023	328.4	33.51	249.9	3.49	244.1	1.42
90063-4	0.05303	0.00073	0.41542	0.00629	0.05726	0.00031	330.1	30.72	352.8	4.51	358.9	1.91
90063-5	0.05013	0.00033	0.23551	0.00164	0.03491	0.00011	201.2	15.38	214.7	1.35	221.2	0.69
90063-6	0.05453	0.00062	0.42389	0.00529	0.05558	0.00026	392.8	25.1	358.8	3.77	348.7	1.59
90063-7	0.05133	0.00052	0.2813	0.00303	0.0401	0.00017	255.9	23.22	251.7	2.4	253.4	1.06
90063-8	0.05514	0.00044	0.51045	0.00459	0.06766	0.00025	417.7	17.56	418.7	3.08	422.1	1.5
90063-9	0.05091	0.00039	0.23328	0.00186	0.03366	0.00012	237	17.47	212.9	1.53	213.4	0.73
90063-10	0.0537	0.00037	0.4259	0.0032	0.05867	0.00019	358.4	15.29	360.3	2.28	367.5	1.17
90063-11	0.04984	0.00053	0.23009	0.00256	0.03373	0.00015	187.6	24.61	210.3	2.11	213.9	0.92
90063-12	0.05372	0.00048	0.41289	0.00407	0.05739	0.00023	359	20.03	351	2.93	359.7	1.39
90063-13	0.05416	0.0007	0.40013	0.00566	0.0541	0.00029	377.4	28.83	341.7	4.11	339.6	1.75
90063-14	0.05268	0.00093	0.44004	0.00859	0.05986	0.0004	315.2	39.47	370.3	6.06	374.8	2.46
90063-15	0.05324	0.00104	0.26307	0.0054	0.03652	0.00028	338.8	43.72	237.1	4.34	231.2	1.72
90063-16	0.05347	0.00041	0.38562	0.00325	0.05228	0.00019	348.6	17.32	331.2	2.39	328.5	1.14
Sample 9064												
90064-1	0.04904	0.00076	0.19362	0.00306	0.02915	0.00017	149.8	35.76	179.7	2.61	185.2	1.08
90064-2	0.04852	0.00083	0.19535	0.00344	0.02908	0.00019	124.8	39.97	181.2	2.92	184.8	1.17
90064-3	0.04881	0.00126	0.1911	0.00502	0.02879	0.00026	138.8	59.33	177.6	4.28	183	1.65
90064-4	0.04984	0.00051	0.19573	0.00208	0.02922	0.00013	187.7	23.78	181.5	1.77	185.7	0.79
90064-5	0.05024	0.00072	0.19955	0.00294	0.02856	0.00016	206.3	32.83	184.7	2.49	181.5	1.01
90064-6	0.04895	0.00065	0.195	0.00266	0.02897	0.00015	145.4	30.8	180.9	2.26	184.1	0.95
90064-7	0.04956	0.00039	0.19684	0.00163	0.02914	0.00011	174.3	18.28	182.5	1.38	185.2	0.66
90064-8	0.05124	0.00078	0.20073	0.00314	0.02866	0.00017	251.5	34.67	185.7	2.66	182.2	1.07
90064-9	0.04926	0.00087	0.19409	0.00353	0.02844	0.00019	160.3	40.96	180.1	3	180.8	1.17
90064-10	0.05028	0.0007	0.19658	0.00282	0.0284	0.00016	207.9	31.84	182.2	2.39	180.5	0.99
90064-11	0.0502	0.00053	0.19647	0.00217	0.02909	0.00013	204.1	24.46	182.1	1.84	184.9	0.81
90064-12	0.04971	0.00078	0.19913	0.00324	0.02874	0.00017	181.5	36.38	184.4	2.74	182.6	1.07
90064-13	0.05289	0.00055	0.20734	0.00225	0.02878	0.00013	324	23.29	191.3	1.89	182.9	0.8
90064-14	0.05111	0.00066	0.20292	0.00271	0.02889	0.00015	245.9	29.34	187.6	2.29	183.6	0.94
90064-15	0.04938	0.00066	0.19637	0.00274	0.02872	0.00015	166.1	31.06	182.1	2.33	182.5	0.96
90064-16	0.05229	0.00075	0.20832	0.00312	0.0288	0.00016	298.1	32.47	192.1	2.62	183	1.02

8.4 Ar-Ar

There is pervasive sericitic alteration on the T-bill property; it is thought to be coeval with the quartz veining and mineralization in the Asitka Group rocks. A single sample of sericite from sample SB07_11, initially sampled from drill hole WG03_10 at a depth of 188.9-189.9m was analyzed to determine it Ar-Ar age. Determining the timing of the alteration allows us to decide if the alteration was coeval with the emplacement of any of the intrusive units in the area and possible the mineralization. The analyses were performed by Tom Ullrich using $^{40}Ar/^{39}Ar$ methods at the PCIGR at the University of British Columbia. The isoplot step heat data and isoplot inverse isochron data are located in Table 5.

Sericite was analyzed using $^{40}Ar/^{39}Ar$ incremental heating technique. A saddle shaped spectrum had a plateau between steps four and seven inclusively indicate, while steps 1-3 indicated the presence of excess argon. The plateau age gave an age of 200.2 +/- 1.3 Ma which was not representative of the actual age (Fig.17a). The inverse isochron technique was then used on various steps to better constrain the age of the sericite sample. The use of the inverse isochron for the plateau steps gave an age aged of 198.1 +/-3.3 Ma that was within error of the plateau age but was poorly constrained and was only based four points (Fig. 17b) . The inverse isochron results for all the steps gave an age of 194.6 +/- 3.5Ma based on the fit of 9 points (Fig. 17c). The Ar-Ar isochron age of 194.6±3.5 Ma was decided to be the most likely age. A total of nine points were plotted, the initial composition was not that of atmospheric but this is correlative with an excess amount of argon being present. The Inverse isochron from the high temperatures steps gave an age of 191.7 +/- 6.6 Ma on four points (Fig. 17d) this model gave a better fit of the data but was not as well constrained as (Fig.17c).

a)

Isoplot Step-Heat Data		
Cum39Ar	Age	error (2- σ)
2.23	344	9.91
7.75	229.41	10.73
17.1	206.93	5.75
31.24	202.18	2.98
49.58	200.59	1.65
73.06	199.3	1.34
87.78	200.61	1.84
95.51	205.73	2.5
99.99	221.34	4.57

b)

Isoplot Inverse Isochron Data					
%39Ar	39Ar/40Ar	error (2-σ)	36Ar/40Ar	err (2-σ)	Rho (ρ)
2.23	0.021255	0.000325	0.000514	0.000077	0.03
5.52	0.03637	0.001645	0.000214	0.000045	0.09
9.35	0.042389	0.000742	0.000072	0.000077	0.004
14.14	0.043581	0.000514	0.000062	0.000033	0.002
18.34	0.043798	0.000348	0.000073	0.00001	0.011
23.48	0.044624	0.00026	0.000033	0.000013	0
14.72	0.044102	0.000372	0.00005	0.000015	0.003
7.73	0.042985	0.000434	0.000046	0.000025	-0.002
4.48	0.03879	0.000592	0.000129	0.000048	0.005

Table 5. (a) Gives the cumulative amount of ^{39}Ar and corresponding ages for the heat data. (b) gives the data that was used for the inverse isochron plots with the corresponding error.

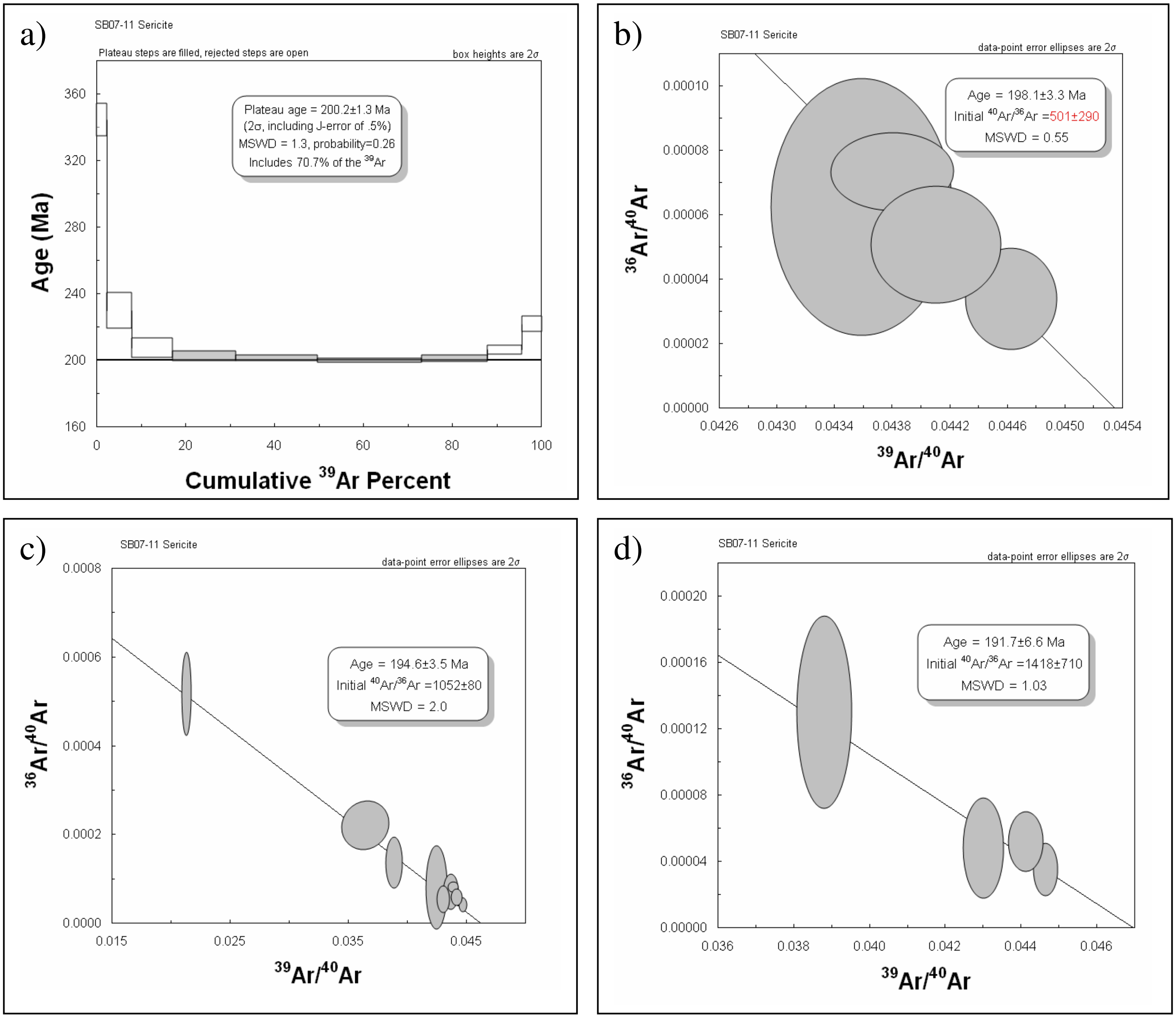


Figure 17. (a) Plateau Age Results. (b) Inverse Isochron Results Plateau Steps. (c) Inverse Isochron Results on All Steps, high MSWD (Mean Square Weighted Deviates). Higher MSWD indicates a poorer fit of line to the data (d) Inverse Isochron on High Temperature Steps (6-9) Better fit but less well constrained.

*All analysis were performed by Tom Ullrich at the PCIGR with the University of British Columbia.

9.0 Discussions and Conclusions

9.1 Geochemical Implications

Intrusive rock on Williams west, samples G090060 to G090064 were deemed “monzonites” to“quartz monzonites” in the field based on the modal mineral percentages. The fields suggested by Le Bas et al. (1986) do not agree with the modal mineral percentages rock classification.

The inconsistency between the two plots may suggest potassic alteration. More geochemical results including the Rare Earth Elements (REE) are needed. Observation made post staining appear to show that the majority of the K-feldspar is located around grain boundaries and within fractures. This is especially noticeable in sample G090064 and G090062 (Fig. 9 and 10). The majority of feldspars from samples G090062, G090063, G090064 were plagioclase while sample G090060 contained a more dominant component of K-feldspar. The feldspars in G090061, were too altered by sericite to determine the original mineralogy but some polysynthetic twining can be seen within the grains (Fig. 8). No halos around the feldspars were observer but this was made difficult due to the strong sericitization of the feldspars. There was also limited to no secondary biotite seen in the samples the biotite that was present has been altered to chlorite.

9.2 Lead Isotopic Study

The three samples G090060, G090062 and G090063 that were not omitted due to analytical problems plotted within the main field for Jurassic intrusions and intrusion-related mineralization in the Iskut area. Samples G090060, G090062 and G090063 all had corresponding U-Pb ages of Late Triassic ranging in age from 221.4 +/- 1.2 Ma to 211.6 +/- 2.2 Ma.

The sulphides have much larger variability in the Pb isotopic signature which suggests that the metals were derived from a source that was not consistent with the feldspar samples. Three possible explanations for the sulphides having varying Pb compositions may be; the sulphide Pb were derived from fluids from an intrusion other than the three sampled by the feldspars, interaction fluids that are transporting the sulfides with the surrounding wall rock, or the sulphides sampled had a non negligible amount of uranium in them that increased the ^{206}Pb and the ^{207}Pb component relative to the 204 component. The presence of small mm sized carbonate veins in thin section (Fig. 9) suggest that it is probable the fluids are distal or have interacted with wall rock, possibly Asitka Group during transport.

SB07_06 and SB07_10 are consistent with the field for Early Jurassic feldspars in the northern Toodoggone area (Dickinson, 2006). Feldspar Pb from Fin Monzogranite plotted just to the right of the feldspars G090060, G090062, G090063 sampled during this study. The Fin Monzonite was oldest dated intrusive event at Kemess and was dated to be 217.8 +/- 0.6 Ma (Dickinson, 2006), which is similar to the ages of the samples G090060, G090062, G090063 analyzed from Williams west.

G090062, SB07_11 and SB07_7 have a higher radiogenic component of Pb than the feldspars and SB07_06 and SB07_10. This suggests that the Asitka rocks may have influence the Pb composition of the sulphides that are drawn out to the right.

9.3 U-Pb Geochronology

Previous work done approximately 100km the southeast, as well as an Ar-Ar date of sericite alteration suggests the intrusions in the area would likely yield a crystallization age between ca. 190 Ma and 200 Ma. The five ages determined from samples collected on Williams west did not replicate ages similar to most of the intrusions found to the southeast in the Kemess area.

Two samples G090061 and G090064 gave Early to Mid Jurassic ages of 189.4 +/- 1.6 Ma and 183.6 +/- 0.9 Ma respectively. Sample G090061 which is the strongly altered feldspar porphyry located near the GIC prospect has an age of 189.4+/- 1.6. It is within error of the youngest isotopically dated pluton “Fredrikson pluton” in the Black Lake inrusive suite, which yielded an age of 191.0+/- 0.4 Ma (Diakow and Rhodes, 2005). The Fredrikson pluton is described as a large monzongranite stock with a minor quartz monzodiorite phase located to the southeast of Kemess Mine (Diakow and Rhodes, 2005). G090064 with an age of 183.6 +/- 0.9 Ma is the youngest pluton in Williams west and is also younger than all previously dated plutons located to the southeast.

Sample G090062 was sampled the GIC prospect and was taken from drill hole WM06_05. An age of 211.6 +/- 2.2 Ma was determined. This age is younger than the Fin monzogranite, which was the oldest unit at Kemess south with an age of 217.8+/- 0.6 Ma (Dickinson, 2006). G090062 contains two cores that give older $^{206}Pb/^{238}U$ ages (227 and 308 Ma). These grains are interpreted to have been xenocrysts that were entrained from an older source in the basement. Possibly from the Asitka Group rocks which are known to be Carboniferous to Early Permian (Diakow and Rhodes, 2005). The zircon grains were noted to appear similar in shape and size to those from sample G090063.

G090063 was the most variable in age of all the samples that were analyzed. The two youngest ages overlap with a weighted average of 213.8 ± 1.1 Ma. The age of samples G090063 overlaps with that of G090062 and both samples contained inherent cores. The number and size of inherent cores in sample G090063 was much greater. One inherent cores from G090062 fall within the clusters defined in G090063 that are ages between 230 and 260 Ma and 330 and 380 Ma, the other core from G090062 is between the two cluster. These ages suggest that the intrusion must have passed through an older package of rocks encorporating the older zircons. The Paleozoic Stikine assemblage is know to include Lower Devonian carbonates and other Paleozoic strata (Gordey et al. 1991). This may explain the two clusters of older zircons.

G090060 was the only intrusive sample of the five to contain a shear fabric. This fabric was presumably formed prior to the emplacement of the other four samples (G090061 - G090064), since they do not contain a shear fabric. This sample gave an age of 221.4 ± 1.2 Ma. It is the oldest intrusive unit and is located the furthest north of the five samples collected on Williams west. There is a range of approximately 38 Ma between the five samples from Williams west. None of the ages from the five samples collected coincide with the timing of the alteration at the T-bill property.

9.4 Ar-Ar

SB07_11 is a core sample that was taken from drill hole WG03_10 at a depth of 188.9-189.9m. S07_11 sampled the Asitka group phyllites that have undergone quartz veining and have been strongly sericitized. The previous K-Ar (135± 5 Ma) date of the sericite alteration was not consistant with the Ar-Ar date from this study. The Ar-Ar date of 194.6 +/- 3.5 Ma is taken to be the more representative age of the alteration.

This is the only age within the study area that is correlative to the timing of mineralization at Kemess. The mineralization at Kemess is centered by the 197.6+/- 0.5 Ma Pine Quartz Monzonite that is cross cut by 193.6-193.8 Ma Dykes (Dickenson, 2006). The alteration does not appear to be co-magmatic with any of the intrusions analyzed during the course of this study.

References

Alldrick, D.J.(2000): Exploration Significance of the Iskut River Fault; in Geologic Fieldwork, 1999, British Columbia Geologic Survey, Paper 2000-1, p. 237-247.

Alldrick, D.J., Godwin, Cl., Gabites, I.E. and Pickering, A.D.R. (1990): Turning Lead into Gold - Galena Lead Isotope Data from the Anyox, Kitsault, Stewart, Sulphurets and Iskut Mining Camps, Northwest B.C.; Geological Association of Canada and Mineralogical Association of Canada, Vancouver '90, Program and Abstracts, Volume 15, pp. A2.

Diakow, L.J., (2001):Geology of the Southern Toodoggone River and Northern McConnel Creek Map Areas, North-Central British Columbia. B.C. Ministry of Energy and Mines, BCMEM Geoscience Map 2001-1, 1:50 000 scale.

Diakow, L.J., Panteleyev, A. and Schroeter, T.G., (1991): Jurassic Epithermal deposits in the Toodoggone River Area, Northern British Columbia: Examples of well-preserved, volcanic-hosted, precious metal mineralization. Economic Geology **86:** p. 529-554.

Diakow, L.J., Panteleyev, A. and Schroeter, T.G., (1993): Geology of the Early Jurassic Toodoggone Formation and Gold-Silver Deposits in the Toodoggone River Map Area, Northern British Columbia. British Columbia Ministry of Enery, Mines and Petroleum Resources, 86, Victoria, Canada.

Diakow, L.J. and Rhodes, R., (2005): Geology between the Toodoggone River and Chukachida Lak (Parts of NTS 94E/6,7,10 and 11), North Central British Columbia. Geologic Filedwork 2005, Paper 2006-1, p.29-38.

Dickenson, J. (2006): Jura-Triassic Magmatism and Porphyry Au-Cu Mineralization at the Pine Prospect, Toodoggone District, North-central British Columbia. Masters Thesis at the University of British Columbia, p. 1-116.

Dostal, J., Gale, V., and Church, B.N., (1999): Upper Triassic Takla Group volcanic rocks, Stikine Terrane, north-central British Columbia: geochemistry, petrogenesis, and tectonic implications. Canadian Journal of Earth Sciences **36:** 1483-1494.

Godwin, C.I., Pickering, A.D.R., Gabites, J.E., and Alldrick, D.J.(1991): Interpretation of galena lead isotopes from the Stewart-Iskut area (1030,P;104A,B,GI: British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork 1990, Paper 1991-1, p.235-243.

Gordey, S.P., Geldsetzer, H.H.J., Morrow, D.W., Bamber, E.W., Henderson, C.M., Richards, B.C., McGugan, A., Gibson, D.W., and Poulton, T.P., (1991): Part A. Ancestral North Americ; in Upper Devonian to Middle Jurassic assemblages, Chapter 8 of Geology of the Cordilleran Orogen in Canada, H. Gabrielse and C.J. Yorath (ed.); Geological Survey of Canada, Geology of Canada, no. 4, p. 219-327.

Irvine, T.N. and Baragar, W.R.A. (1971): A guide to the chemical classification of the common volcanic rocks. Canadian Journal of Earth Sciences **8:** 523-548.

Le bas, M.J., Le Maitre, R.W., Streckeisen, A. and Zanettin, B. (1986):. A chemical classification of volcanic rocks based on the total alkali-silica diagram. Journal of Petrology **27:** 745-750.

Lehtinen, J.(2007): 2006 Diamond Drill Report on the Williams Property. Unpublished Assesment report for Arcus Development Group Inc and Rimfire Minerals Corporation. p. 1-16.

Ludwig, K., (2003): Isoplot/Ex, version 3: A geochronological toolkit for Microsoft Excel: Berkeley, California, Geochronology Center, Berkeley.

MacIntyre, D.G., Villeneuve, M.E., and Schiarizza, P., (2001): Timing and tectonic setting of Stikine Terrane magmatism, Babine-Taqkla lakes area, central British Columbia. *Canadian Journal of Earth Sciences* **38:** 579-601.

McKinley, B., (2006): Geological Characteristics and Genesis of the Kemess North Porphyry Au-Cu-Mo Deposit, Toodoggone Distric, North-Central British Columbia, Canada. Master thesis at the University of British Columbia, p.1-133.

Mortenson, J.K., P. Wojdak, R. Macdonald, S.M. Gordee and J.E. Gabites (2005): Regional Studies of VMS Mineralization and Potential within the Early Jurassic Hazelton Group, British Columbia; Geological Field work 2004, Paper 2005-1, p. 49-59.

Renne, P. R., Karner, D. B. and Ludwig, K. R. (1998a): Absolute ages aren't exactly. Science **282:** 1840–41.

Rogers, C., and Houle, J., (1999): Geological setting of the Kemess South Au-Cu Porphyry Deposit and Local Geology between Kemess Creek and Bicknell Lake (NTS 94E/2); Geological Field work 1998, Paper 1999-1, p.103-114.

Sláma, J., J., Košler, J., Condon, D.J. Crowley, J.L., Gerdes, A., Hanchar, J.M., Horstwood, M.S.A., Morris, G.A., Nasdala, N., Norberg, N., Schaltegger, U., Schoene, B., Tubrett, M.N. and Whitehouse, M.J., (2007): Plešovice zircon — A new natural reference material for U–Pb and Hf isotopic microanalysis, Chemical Geology, v. 249, pp. 1-35.

Sharp, R.J.,(1982): 1981 Geological, Geochemical and Trenching Report on the Bill 1, 2, and 3 Mineral Claims; British Columbia Ministry of Energy and Mines. Assessment Report # 8973

Stacey, J. S. & Kramer, J. D. (1975): Approximation of terrestrial lead isotope evolution by a two-stage model. *Earth and Planetary Science Letters 26,* 207-221.

Thorstad, L., (1980):Upper paleozoic volcanic and volcaniclastic rocks in the northwest Toodoggone map area, British Columbia. Geological Survey of Canada Paper 80-1B, p.207-211.

Thirwall, M.F. (2000): Inter-laboratory and other errors n Pb isotope analyses investigated using ^{207}Pb-^{204}Pb double spike. *Chemical Geology* **163**:299-322.

Weber, J.S. and Awmack, H.J. (2002): The Bill Property a Mesothermal Gold Target in North-Central BC. Exploration and Mining in British Columbia- 2001, p. 89-96