Biogeochemical Expressions of buried REE Mineralization at the Norra Kärr Alkaline Complex, southern Sweden

by

Britt Bluemel

B.Sc., University of Victoria, 2008

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

in

The Faculty of Graduate and Postdoctoral Studies

(Geological Sciences)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

March, 2014

© Britt Bluemel, 2014

Abstract

Biogeochemical exploration is an effective but underutilized method for delineating covered mineralization. Plants are capable of accumulating rare earth elements (REEs) in their tissue, and ferns (pteridophytes) are especially adept because they are one of the most primitive land plants, therefore lack the barrier mechanisms developed by more evolved plants.

The Norra Kärr Alkaline Complex, located in southern Sweden approximately 300 km southwest of Stockholm, is a peralkaline nepheline syenite enriched in heavy rare earth elements (HREEs). The deposit, roughly 30 0m wide, 1300 m long, and overlain by up to 4 m of Quaternary sediments, has been well-defined by diamond drilling. The inferred REE mineral resource, over 60 million tonnes averaging 0.54% Total Rare Earth Oxide (TREO), is dominantly hosted within the pegmatitic "grennaite" unit, a eudialyte-catapleiite-aegerine nepheline syenite.

Vegetation and soil samples were collected from the surficial environment above Norra Kärr to address four key questions: which plant species is the most effective biogeochemical exploration medium; what are the annual and seasonal REE variations in that plant; how do the REEs move through the soil profile; and into which part of the plant are they concentrated.

Athyrium filix-femina (lady fern) has the highest concentration of LREEs and HREEs (up to 125.17 ppm Ce and 1.03 ppm Dy) in its dry leaves; however, there is better contrast between background and anomalous areas in *Dryopteris filix-mas* (wood fern), which makes it the preferred biogeochemical sampling medium.

The REE content in all fern species was shown to decrease from root > frond > stem, and chondrite normalized REE patterns within the plant displayed preferential fractionation of the LREEs in the fronds relative to the roots.

Samples collected from an area directly overlying the deposit had up to five times greater HREE content (0.74 ppm Dy) in August than the same plants did in June (0.14 ppm Dy).

The elevated REE content and distinct contrast to background demonstrate that biogeochemical sampling is an effective method for REE exploration in this environment.

Preface

This thesis is an original intellectual product by the author, B. Bluemel.

Chapter 1

The geological units and ice flow indicators presented in Figure 1.1 and 1.4b are publically available from the Swedish Geological survey, and have been grouped according to work done by Hogdahl et al (2004). The geological data presented in Table 1.1 and Figure 1.3 were provided by Tasman Metals Ltd. and are used with permission. The highest coastline map, Figure 1.4a, was provided by M. Johnson, University of Gothenburg, personal communication. Ages of the Norra Kärr Alkaline Complex were provided by Axel Sjöqvist, as yet unpublished data.

Chapter 3

A version of this chapter has been published as Biogeochemical expression of rare earth element and zirconium mineralization at Norra Kärr, southern Sweden (Bluemel, B. et al. 2013) in the Journal of Geochemical Exploration.

Table of Contents

Abstract ..... **ii**

Preface ..... **iii**

Table of Contents ..... **iv**

List of Tables ..... **viii**

List of Figures ..... **x**

List of Equations ..... **xvi**

Acknowledgments ..... **xvii**

Chapter 1 – Overview **1**

1.1 Rationale for Study 1

1.2 Biogeochemistry of Rare Earth Elements 2

1.3 Physiographic Setting 3

1.3.1 Regional Geology 3

1.3.2 Detailed Geology of Norra Kärr 5

1.3.3 Glacial History of Area 8

1.3.4 Anthropogenic Disturbance 10

1.4 Classification of Heavy, Middle, and Light REE 13

1.5 Eudialyte 13

1.5.1 Mineral Chemistry of Eudialyte 13

1.5.2 Weathering of Eudialyte 13

1.6 Solubility and Mobility of REEs in Surface Water 14

1.7 Thesis Structure 16

Chapter 2 - Materials and Methods **17**

2.1 Sample Site and Media Selection 17

2.2 Sample Collection 17

2.2.1 June 2011 17

2.2.2 August 2011 18

2.2.2 August 2012 18

2.3 Sample Prep 19

2.4 Sample Analysis 20

2.4.1 Vegetation Tissue and Soil Samples by Aqua Regia (Vancouver, Canada) 20

2.4.2 Soils by Sequential Leach (Vancouver, Canada) 20
2.4.3 Vegetation Tissue by Microwave Digestion (Lulea, Sweden) 21
2.4.4 Whole-rock Analysis of Representative Rock Types by Tasman Metals Inc (Luleå, Sweden) 21
2.4.5 Whole-rock Analysis of Bedrock Samples Below Vertical Profile Sites (Vancouver, Canada) 21
2.4.6 Scanning Electron Microprobe (UBC, Vancouver, Canada) 21
2.4.7 Water Chemistry in Lulea, Sweden (elements and anions) 21
2.4.8 Regional Soils (Lulea, Sweden) 22
2.5 Quality Control 22
2.6 Detection Limit Reliability 23

Chapter 3 - Variation in Rare Earth Element Content in the Surficial Environment Above the Norra Kärr Alkaline Complex 26
3.1 Lithogeochemistry 27
3.1.1 The Negative Eu anomaly 27
3.1.2 Chondrite Normalization 28
3.1.3 Classification 29
3.2 Soil Chemistry 33
3.2.1 General Soil Chemistry 33
3.2.2 Sequential Leach 36
3.2.3 Sequential Leach Discussion 47
3.3 Fern Chemistry 48
3.3.1 Root 50
3.3.2 Stem 50
3.3.3 Leaf 51
3.3.4 Fern Chemistry and Sequential Leach Data 51
3.3.5 Summary 52
3.4 Conclusions 52

Chapter 4 - Seasonal and Species Variation 54
4.1 Species Variation 54
4.1.1 REE Variation in All Species 54
4.1.2 Essential Nutrient Variation in All Species 55

4.2.1 REE Variation in Fern Species 59
4.3 Seasonal Variation 59
4.3.1 REE Variation 59
4.3.2 Essential Nutrient Variation 61
4.4 Implications for Exploration 62

Chapter 5 - Biogeochemical Distribution of Rare Earth Elements in the Surficial Environment at the Norra Kärr Alkaline Complex 63
5.1 Regional REE Signatures 63
5.1.1 REE Content in the Fern Species *Dryopteris filix-mas* and *Athyrium filix-femina* 63
5.1.2 REE Content in Regional Soils 65
5.1.3 - REE Content in Regional Surface Waters 68
5.2 Local REE Signature at the Norra Kärr Alkaline Complex 71
5.2.1 Sample Site and Media Selection 71
5.2.2 Element Correlations 71
5.2.3 Levelling 72
5.3 Discussion 75
5.3.1 – Fern Discussion 75
5.3.2 – Fern and Soil Discussion 77
5.3.3 Exploration Implications 80
5.3.4 – Spatial Distribution of REEs in Ferns Above Norra Kärr 82
5.4 Conclusions 85

Chapter 6 - Summary, Exploration Implications, and Recommendations for Future Work 86
6.1 Summary 86
6.2 Exploration Implications 89
6.3 Handy Hints for the Burgeoning Biogeochemist 90
6.3.1 Sample Station Selection 90
6.3.2 Species Selection 90
6.3.3 Sample Collection 90
6.4 Recommendations for Future Work 91
References 93

Appendices **97**
A1 – Technical memo: data reliability below certified detection limits 97
A2 –REE content in ferns, both laboratory certified and "below reliable detection limit" 106
A3 – Blind Quality Assurance Controls 114
A4 –Ash weight to dry weight conversions 142
A5 – Technical Memo: Element mapping at the Canadian Light Source Synchrotron 160
A6 – Field Duplicate quality control diagrams 161
A7 – Soil Reference Images 163
A8 – Laboratory Certificates of geochemical data 164

List of Tables

Chapter 1

Table 1.1 - Description of the main rock types in the Norra Kärr Alkaline Complex…… 6

Chapter 2

Table 2.1 - Plant species collected in June, 2011, listed by common and Latin names, with *n* values and sample details 18

Table 2.2 – Precision data for blind standards 26

Table 2.3 - Certified detection limits from Acme Analytical Laboratories, and lowest practical reliable detection limits for this thesis research. The LREEs were all above the certified detection limit, so those have been marked "not applicable" (n/a). All values are in ppm… .. 24

Chapter 3

Table 3.1 – Materials collected from the three vertical profile sites 26

Table 3.2 – Commonly used chondrite normalization values (Nakamura, 1974; Boynton 1984; Taylor and McLennan, 1985; Wakita et al., 1971). All values are in ppm 29

Table 3.3 - Summary of the REE content, as well as the median ΣREE value, for the Ah and B soil horizons 33

Table 3.4 - Physical descriptions of soil samples collected from each horizon at three vertical test pits 35

Table 3.5 – REE content in leaf, root, and stem tissue at each vertical profile site 50

Table 3.6 – REE transfer factors from root to stem for all three vertical sample sites 52

Chapter 4

Table 4.1 - Common and Latin names of species collected from Norra Kärr, including number of each species and tissue sampled 54

Table 4.2 - Average macronutrient and micronutrient content in each species, compared to standard tissue levels of essential elements required by most plants^ (Taiz and Zeiger, 2010). *All samples are leafy tissue with the exception of Norway Spruce, which is twig tissue, which has been reduced to ash and back calculated to represent dry tissue element concentration. 56

Table 4.3 - REE seasonal variation in *Dryopteris filix-mas* 59

Chapter 5

Table 5.1 - Statistical ranges of REE content in regional fern samples, grouped by species. The cells highlighted red are below reportable detection limit. Ferns analysed at ALS in Luleå, using a microwave-aided nitric acid digestion with an ICP-MS instrumental finish. The minimum and maximum values obtained from analyses of regional fern material can be used to approximate the range of biogeochemical "background" in the surficial environment above unmineralized country rock. The background range is displayed graphically in Figure 5.6, and

the minimum and maximum REE values are estimates of the regional background REE content....65

Table 5.2 - Ranges of REE content and Y (for each element) in regional soils, grouped by horizon. *Average Granite composition from Krauskopf 1967, average Växjö granite composition ("Växjö") from Appelquist 2010, and average Trans-Scandinavian Igneous Belt ("TIB") composition from Christensson 2013....66

Table 5.3 - Ranges of REE content (for each element) in regional water, grouped by water colour and filtration....68

List of Figures

Chapter 1

Figure 1.1 - Geological map of southern Sweden, domains and shear zone modified from Högdahl et al. (2004), geological polygons publically available for download from the Swedish Geological survey. The yellow star indicates the location of the NKAC 4

Figure 1.2 - Photo of the Norra Kärr Alkaline Complex "discovery outcrop", with rock hammer (approximately 1m length) for scale. The pink phenocrysts are the REE-bearing zirconosilicate mineral eudialyte 6

Figure 1.3 - Geological Map of the Norra Kärr Alkaline Complex, after Leijd (2012) unpublished data 7

Figure 1.4a - Map of southern Sweden with isolines representing "highest coastline" elevation. The area around Gränna is above the highest coastline, so the likelihood that sediments there have been reworked by wave action is low. Norra Kärr is marked with a yellow star. (adapted from M. Johnson, associate professor of Quaternary geology, University of Gothenburg, personal communication) 8

Figure 1.4b – Geological map of Norra Kärr with ice flow direction 9

Figure 1.5 – Map of surficial materials in the area around the Norra Kärr Alkaline Complex, adapted from the Swedish Geological Survey. The NKAC is marked with a yellow star on the large map, and shaded purple on the inset map 11

Figure 1.6 – Typical soil profile at Norra Kärr. Note the lack of definition between soil horizons. Image has been colour enhanced for clarity 12

Figure 1.7 - Airphoto of the Norra Kärr area with sample stations marked as yellow stars, and the deposit outlined in pink 12

Figure 1.8 – Depiction of eudialyte mineral group (after Johnsen et al. (2003)). The "M" denotes cation replacement sites, and the "X" is an anion replacement site. The chemical formula of eudialyte is $(Na, Ca, REE)_5(Fe^{2+},Mn)(Zr,Ti)[(Si_3O_9)_2]\cdot(OH,Cl,F)$ 14

Chapter 2

Figure 2.1 - Photo of fern frond, before being pressed and dried for transport back to Canada .. 19

Figure 2.2 – Neodymium precision diagram in field duplicates 22

Figure 2.3 - Methodology example of detection limit reliability. Figure 2.3b is all *Dryopteris filix-mas* data, with BDL (<0.02ppm) values replaced with 0.01ppm. Figure 2.3a shows the same data, but with the BDL values left as raw "uncertified" values. Colour scheme is based on REE (in this case, Tm) as a function of Y content. All REEs show good correlation with Y content, displayed here along the line Y = X. Data just below the certified DL (0.02ppm) is coloured green. High confidence that these samples are reliable. Samples with lower REE content, but in the same population (populations are determined based on probability plots; data plotting on a straight line without breaks, in Figure 2.3a, are deemed one population) are coloured orange, with moderate confidence that these data are reliable. Data coloured red are have low

REE content, or are part of a different population. Confidence that these data are reliable is very low 25

Chapter 3

Figure 3.1 - Locations of three vertical profile sample sites over the Norra Kärr Alkaline Complex. Sites were chosen based on high REE content in ferns, which was determined in the previous year's study 27

Figure 3.2a-c -- Photos of rock samples collected from base of vertical profile sites. (a) NK12-072: fine grained, green-grey aegerine rich nepheline syenite. (b) NK12-039 foliated nepheline syenite with phenocrysts of catapleiite and eudialyte occurring within bands of microcline and amphibole. (c) NK12-060 strongly foliated biotite rich granite with red K-feldspar porphyroblasts 30

Figure 3.3 – REE Chondrite normalized plot (after Boynton 1984) showing a compilation of all rock types at Norra Kärr (yellow circles, analysed by Tasman Metals Inc.) and the rocks collected for this thesis (grey squares). Note the difference in magnitude between the granitic "base of profile" angular fragment collected from NK12-060 compared to all other rock types 31

Figure 3.4 – Total alkali silica (TAS) classification of lithogeochemical samples collected for this thesis: three base of profile rock samples [NK12-072 (open circle), NK12-039 (open square), and NK12-060 (open triangle)]. Grey circles are averages of each major rock type present in the Norra Kärr Alkaline Complex (analyses provided by Tasman Metals Inc.) 32

Figure 3.5 – REE Chondrite normalized plot (after Boynton 1984) of soil samples collected in June 2011 (7 Ah horizon, green circles; and 7 "B" horizon, blue circles) with representative lithogeochemical samples of all rock types in the Norra Kärr complex (red circles, analysed by Tasman Metals Inc.) 34

Figure 3.6 – Photo of vertical test pit at site NK12-060. Note the lack of definition between soils horizons, particularly the A and B horizons. Depth to C horizon is 70cm 35

Figure 3.7 – Chondrite normalized plot of all sequential leaches at each site, including the sum total of all the leaches (burgundy points) which approximate the total REE content of the surficial materials 38

Figure 3.8a - Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-039, normalized to global chondrite values (Boynton, 1984). Note the positive Ce anomaly, LREE enrichment relative to HREEs, and negative Eu anomaly 40

Figure 3.8b – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-039, normalized to local bedrock. Note the same positive Ce anomaly and relative LREE enrichment, but also a weakly positive Eu anomaly in the 4acid near total 40

Figure 3.8c – Histograms of soil-forming elements, grouped by vertical profile site 41

Figure 3.9a – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-072, normalized to global chondrite values (Boynton, 1984). Note the strong negative Eu anomaly in all materials, including bedrock, and the positive Ce anomaly only in the hydroxylamine leaches (brown lines) of the B horizon. Also note the relative depletion of HREEs relative to LREEs 43

Figure 3.9b – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-072, normalized to local bedrock. Note the "flatness" of all leaches when normalized to local bedrock, with the exception the hydroxylamine leaches on the A horizon soil. Also note that the positive Ce anomaly in the hydroxylamine leached from the B horizon persists 43

Figure 3.10a – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-060, normalized to global chondrite values (Boynton, 1984). Note the appearance of a positive Eu anomaly in the samples derived from the granitic source 45

Figure 3.10b – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-060, normalized to local bedrock. Note the appearance of a positive Eu anomaly in the samples derived from the granitic source 45

Figure 3.10c - Histograms of La and Ce (LREEs), Eu (MREE), and Lu (HREE), grouped by vertical profile site. Note the proportion of REEs in the B horizon increases with increasing atomic number, meaning that the HREEs are more enriched (relative to the LREEs) in the B horizon than in the A horizon 46

Figure 3.11 – Example photo of a HFSE grain on a silicate soil particle. The HFSE grain is approximately 25μm long (medium silt sized) 46

Figure 3.12 – Differences in Fe content in the Ah and B horizon soil samples collected from the same location 47

Figure 3.13 – Chondrite normalized plots of leaf, root, and stem tissue from all three vertical profile sites. Note the decrease in REE content from stem < leaf < root 49

Figure 3.14 – Chondrite normalized plots of leaf, root, and stem tissue from ferns at all three vertical profile site, with lithogeochemical data added for reference 49

Chapter 4

Figure 4.1 – Box and whisker plots of K (left) and Ca (right) for all sampled species. The hazelnut has much higher Ca content than any other plant, and all 3 fern species have more K than Ca 57

Figure 4.2 - ΣREEs as a function of potassium for all species, with Norway recalculated to a dry weight basis 58

Figure 4.3 - Chondrite normalized plot of three fern species *Dryopteris filix-mas, Athyrium filix-femina*, and *Pteridium aquilinum.* Note relative enrichment of LREEs in *Athyrium filix-femina* 60

Figure 4.4 - REE content of *Dryopteris filix-mas* samples collected from the same location in June and August, coloured by season 60

Chapter 5

Figure 5.1 - Geological maps of the Norra Kärr area (the Alkaline Complex is marked with a yellow star), with ice flow indicators (black arrows) and regional sample station locations (green circles). The local samples (yellow circles, Figure 1.5b, cf Section 1.3.3) cover 1.5km^2, the regional samples (green circles) cover almost 750km^2, and the surface trace of the deposit is 0.4km^2 64

Figure 5.2 - Regional soil data from C and B horizons (light and dark blue, respectively) normalized to average granite (Krauskopf, 1967). Yellow points are averaged Trans-Scandinavian Igneous Belt (TIB) samples (Appelquist, 2010) and red points are averaged Växjö granite samples (Christensson, 2013). Dark grey points are average representative Norra Kärr mineralized nepheline syenites 67

Figure 5.3a - Chondrite normalized REE diagram of filtered regional surface water samples. Note the strong negative Eu and Ce anomaly 69

Figure 5.3b – Box and whisker plots of La and Dy (representative of the LREEs and HREEs, respectively) content in filtered regional surface water samples. The highest REE content is in the brown-yellow water samples, and is attributable to the higher concentration of dissolved organic acids in these samples 69

Figure 5.4 - Chondrite normalized plot of surficial materials from site NK12-060, with local unfiltered lake water data. The water sample with the higher REE content was from site TAS12-43 (Fig. 5.1), which was collected from a small lake directly above the deposit, and the water sample with the lower REE content (TAS12-02) was collected from a lake 1km NE of the deposit 70

Figure 5.5 - Two graphical representations, a histogram (above) and a "box and whisker" plot (below) of the same data set. The data is normally distributed, with some outliers (red box) and far outliers (green box). The box and whisker plot divides the data into four equal parts by finding the median, and then the 25th and 75th percentiles (which approximate the inter-quartile range, or IQR). The median is represented by the white line bisecting the box; the mean is represented by the white circle, in this case located just above the median. Outliers are represented by open black circles, and far outliers are represented by open black triangles 74

Figure 5.6 - *Athyrium filix-femina* (left) and *Dryopteris filix-mas* (right) samples collected from the surficial environment above Norra Kärr, normalized to average granite (Krauskopf, 1967). The purple shaded area represents the range of REE content in ferns sampled over unmineralized country rock. This range is assumed to represent "background" and is quantified in Table 5.2 76

Figure 5.7 – Yttrium content (as a surrogate for HREE) in three fern species over the deposit (left) and in the background (right). *Athyrium filix-femina* has higher absolute Y content over the deposit than the other two species, but the contrast between samples collected over mineralization compared to samples collected over background is much more pronounced in *Dryopteris filix-mas,* therefore *Dryopteris filix-mas* is the preferable exploration sampling medium 77

Figure 5.8 - La, Eu, Dy, and Yb content in *Athyrium filix-femina* and *Dryopteris filix-mas*, grouped by species and coloured regionally (blues) and locally (reds) 78

Figure 5.9 - La (above) and Dy (below) content in surficial media, levelled by analytical method. Since the data have been levelled, the Y axis values are standard deviations, not absolute concentrations. Sample count is displayed over each box. In the upper diagram, regional and fern data are presented, along with all soil data, and the variance between the four populations is similar based on the mean and median values. In the lower diagram all regional and local soil data, from each horizon, is presented again, but only the *Dryopteris filix-mas* data are displayed (bottom right) and the contrast between regional (light green) and local (dark green) fern samples is much more pronounced, particularly for Dy, which is a proxy for the HREEs 79

Figure 5.10 (a-c) – La (above) and Dy content (below), levelled by analytical method, in surficial materials collected regionally (lighter shades) and locally (darker shades) around the Norra Kärr Alkaline Complex. *Dryopteris filix-mas* samples both above the deposit (dark green) and in the background (light green) are graphed against each soil horizon (A, B, and C). Compared to the A horizon soils, *Dryopteris filix-mas* displays better contrast between the mineralized deposit and the surrounding country rock for both the LREEs and the HREES. *Dryopteris filix-mas* and B horizon show comparable contrast for the HREEs, and B horizon soils show more pronounced contrast for the LREEs. C horizon tills show a false anomaly over the regional country rock for the HREEs, and no clear contrast for the LREEs .81

Figure 5.11 - Sm content in ferns above the Norra Kärr Alkaline Complex 83

Figure 5.12 - Dy content in ferns above the Norra Kärr Alkaline Complex 84

Chapter 6

Figure 6.1 – Genetic model of the formation of the surficial environment above the Norra Kärr Alkaline Complex. The glacial material is derived from Växjö granites in the up-ice direction 87

Figure 6.2 – Schematic diagram of Norra Kärr with normalized REE plot of surficial materials. The REE plot is normalized to local bedrock from site NK12-060, not chondrite. Green squares are local bedrock, filled red circles are surficial materials from the A and B horizons, filled red triangles are glacial till, filled pink squares area glacially transported granitic fragments derived from nearby country rock. Blue circles are local surface water from lakes directly overlying the NKAC; surface water REE content has been multiplied by a factor of 1000 for convenience of viewing. The shaded brown region represents the range of REE content of typical Swedish podzols (n = 30) collected in Scania, approximately 200km south of Norra Kärr, and analysed by microwave-aided nitric acid digestion with and ICP-MS finish (Tyler and Olsson, 2002) which is a slightly weaker strength of digestion than the sum of the sequential leach data provided by Acme Analytical (red shapes). Not the positive Eu anomaly in the granitic fragment and the glacial till, which is not visible in the local bedrock of the surface water samples 88

Figure 6.3 - Diagram of a fern plant with underlying soil profile and corresponding REE profiles. REEs have been normalized to local bedrock at site NK12-060. Note the decrease in REE

content in the fern plant from root > leaf > stem, and the fractionation within the plant of LREEs over HREEs. Soil samples, till samples, and water samples are shown for comparison 89

List of Equations

Chapter 3

Equation 3.1 – Quantified Eu anomaly calculation after Boynton (1984) 27

Chapter 4

Equation 4.1 - Calculation of elemental concentration in dry weight of plant material based on elemental concentrations in ashed material and ash yield (Dunn, 2007).....55

Acknowledgments

This research would not have been possible without encouragement and support from many different people. First and foremost, I'd like to thank my excellent supervisors Colin Dunn and Craig Hart for all of their input and guidance, both academically and "in life", over these past two years. I was extremely fortunate to be surrounded by some of the best and brightest geochemical brains available; Pim, Fred, and Tans – our endless discussions were invaluable to me, and I can't thank you enough.

This project was generously sponsored by Tasman Metals Ltd. and ioGlobal Solutions Ltd., both of whom were unfailing in their support over the years. Particular thanks to Mark Saxon, Magnus Leijd, and Henning Holmström for field support in Sweden. Axel Sjöqvist: first of all, thanks for all the chess and laughs over there :) and secondly, thanks for the dates and ALL the geo-chats since then. I beat you to the publication bru, but not by much!

This whole "masters" thing wouldn't have been half as fun without the distractions willingly, and sometimes even forcibly, provided by my friends. Bev Quist, thank you for coming to visit me in Scandinavia, you have no idea how much it meant to me that you made the trip, and that was one of our best adventures yet! A very special thanks to Leif Bailey and Leanne Smar (you're the best besties anyone could hope for), and to my UBC family Brian McNulty, Erin Looby, Mike Tucker, and Irene del Real. I couldn't have done it without you guys.

Finally, thank you to my family: Patty, Ryan, Leah, Michelle, and Dom. Getting back on island time with you helped keep me centered and sane through it all, thank you and I love you.

Chapter 1 - Overview

Rare earth elements (REEs) have gained significant economic importance in the past 20 years due to their restricted supply and unique properties which make them essential for high tech and sustainable applications, such as smart phones, solar panels, wind turbines, and hybrid cars (Hatch, 2012). Sweden is rightly known as the home of REEs, as they were first discovered in a quarry in the village of Ytterby, near Stockholm in 1794. The Norra Kärr Alkaline Complex is located in southern Sweden, and is enriched in heavy rare earth elements (HREEs).

Rationale for Study

Biogeochemical exploration is an effective but underutilized method for discovering and delineating buried mineralization. Plants are capable of accumulating REEs in their tissue, and ferns (pteridophytes) are especially adept because they are one of the most primitive land plants. Less evolved plants can accumulate higher concentrations of harmful elements, such as heavy metals or REEs, in their tissue without adverse effects on their growth and physiography than more highly evolved land plants (Dunn, 2007). This behaviour stems from the adaptation of barrier mechanisms within the plant to protect its cells from potentially toxic levels of certain elements (Kovalevsky, 1987).

The Norra Kärr Alkaline Complex was discovered in 1906 by an assistant geologist at the Swedish Geological Survey (SGU) who found a small outcrop (Figure 1.2), collected a hand sample, and sent it to Professor A. E. Törnebohm, head of the SGU. Törnebohm made thin sections of the rock and determined it was nepheline bearing, and that it contained the REE minerals eudialyte and catapleiite (which, at the time, was spelled “katapleite”).

Many exploration methods typically used for discovering mineral deposits are ineffective at Norra Kärr. The nepheline syenite has similar density to the surrounding granitic country rock, and lacks sulphide minerals, hereby making it indistinguishable by gravity and induced polarity (IP) geophysical surveys, respectively. The deposit has unusually low uranium and thorium content for a deposit of its type (Sørensen, 1997), and therefore does not appear in the country-wide Swedish Geological Survey radiometric surveys. Extensive glaciation of the study area presents additional challenges because conventional soil surveys are unlikely to be a reliable exploration method in areas of transported cover. Plants are an advantageous exploration medium in areas where the soil profiles are disturbed or poorly defined, because plant roots can interact with several soil horizons and yield an integrated, more representative signature. The deposit is overlain by transported Quaternary sediments and Swedish boreal forest, so biogeochemical exploration methods, a little-tested technique for exploring for REE mineralization, were evaluated at the Norra Kärr Alkaline Complex. This locality was selected to confirm the efficacy of biogeochemical exploration for REE mineralization because such a deposit would be challenging to detect by conventional exploration techniques.

As the rate of discovery of near-surface mineral deposits declines, all available tools must be utilized to successfully explore for buried mineralization. The mobility of REEs in the surficial environment, a heretofore under-appreciated phenomenon, allows biogeochemistry to be used as an effective exploration tool for buried REE deposits, such as the Norra Kärr Alkaline Complex.

1.1 Biogeochemistry of Rare Earth Elements

Rare earth elements occur in measurable quantities in the tissue of various plant species (Laul et al. (1979); Markert and Li (1991); Wyttenbach et al. (1998); Tyler (2004)), but historically little attention has been paid to the biogeochemistry of REEs as a group because they were considered neither essential nor toxic. In the past 20 years, researchers have shown that REEs in phosphate and nitrate fertilizers can be beneficial to plant growth (Welch (1995); He et al. (1998); Pang et al. (2002)) and subsequently REEs have been added to agricultural fertilizers to increase crop yield (Guo et al., 1996). This practice has been most widely embraced in China, and as a result many researchers there have begun studying REEs in soil-plant systems to better understand the distribution and accumulation of REEs in the natural environment. Research has been carried out mainly on rice and corn (Li et al., 1998) as well as soybeans and wheat (Ding et al., 2007; Ding et al., 2006). This pattern of decreasing concentrations conforms with that of many trace elements (Tyler, 2004). The REE content in the fern species *Matteuccia* increases from stem to leaf to root, and the distribution patterns indicate that REEs in the fern were sourced from the silicate fraction of the soil and had once been in the dissolved state (Fu et al., 1998).

There can be a positive correlation in the distribution of REEs between the soil and the plant (Takada et al. (1996) Wang et al. (1997) Wyttenbach et al. (1998)). The REE transfer factor from soils to plants, i.e. the REE content ratio of plant/soil, in a natural background forest ecosystem ranges from 0.04 and 0.085, and the transfer ratio values were roughly equivalent for all the REEs, which indicates there was no significant fractionation between the light REEs (LREEs) and the heavy REEs in the studied plant species (Markert and Li (1991)). A transfer factor of <1 implies that there is incomplete uptake of REEs by the plant, which could be a function of REE bioavailability in the soil, and/or the minerals in the soil that host the REEs.

Biogeochemical surveys provide a viable approach to mineral exploration in most terrains because they are rapid, relatively inexpensive, and effective in areas of transported cover. Literature reviews assisted in choosing a sample medium that could adequately accumulate REEs in its tissue and was also widespread across the Norra Kärr deposit and background areas. Findings from several authors (Dunn (1998); Fu et al. (1998); Wyttenbach et al. (1998); Zhang et al. (2002); Dunn (2007)) indicate that ferns can be a suitable sample medium for REE exploration.

1.2 Physiographic Setting

The Norra Kärr Alkaline Complex is located approximately 300 km southwest of Stockholm and 10 km northeast of Gränna in southern Sweden (Figure 1.1). Norra Kärr, which is Swedish for "northern bog", is situated in a shallow topographic low and is slightly elevated at the centre of the intrusive complex. There is a low-lying swampy area at the western contact of the intrusion, and at the eastern edge there is a small creek draining into a lake which sits directly above the eastern contact; the complex intrudes Paleoproterozoic Växjö-type granites, which are "even-grained and generally felsic" (Högdahl et al., 2004). The Norra Kärr deposit outcrops in several places, but for the most part is overlain by 1-4m of Quaternary glacially transported sediments (see Section 1.3.3).

1.3.1 Regional Geology

The Norra Kärr Alkaline Complex sits within the Paleoproterozoic Småland-Varmland belt (SVB). Locally, the SVB is referred to as Växjö-type granite because the type locality is near the municipality of Växjö, 170 km south and east of Norra Kärr. The SVB comprises a group of igneous plutons attributed to the first orogenic event responsible for the formation of the Trans-Scandinavian Igneous Belt (TIB) (Högdahl et al., 2004). The SVB is mainly composed of monzodioritic, monzonitic, quartz-monzonitic, granitic plutonic rocks and, particularly in Småland, their associated felsic volcanic rocks (Andersson et al. (2004); Johansson (1988) and references therein).

The genesis of the TIB is the subject of ongoing debate because the ages of the plutons within the region range from 1.86-1.65 Ga. As well as being a long lived orogenic event, the interpretation is complicated by multiple phases of deformation both during and after emplacement. Andersson and Wikstrom (2004) "suggest a more or less continuous magma generation and emplacement of the same type over a long time, where the earliest c. 1.85Ga rocks mark the beginning of the shift from collisional to post-collisional (extensional) regimes".

Emplacement of the Norra Kärr Alkaline Complex is associated with a major NNW trending shear zone extending over 600 km through southern Sweden and into central Norway. This shear zone is also responsible for the formation of Lake Vättern (Figure 1.1), which is the second largest lake in Sweden, the 6th largest lake in Europe, and sits less than 2 km west of the Norra Kärr deposit. It has been suggested that this massive structural corridor was the "primary deep crustal / mantle tapping conduit for emplacement of the Norra Kärr nepheline syenite intrusive body" (Rankin (2011).

Blaxland (1977) determined the complex was 1580±62 Ma using a whole-rock Rb/Sr isochron, but the current "official" age of the complex, 1545±61 Ma, was recalculated using radiometric constraints by Welin (1980). Recent U/Pb isotope research using LA-ICP-MS on zircons from the complex suggests that the existing age is slightly younger, but still within the earlier-published error limits (Sjöqvist (2012), unpublished data).

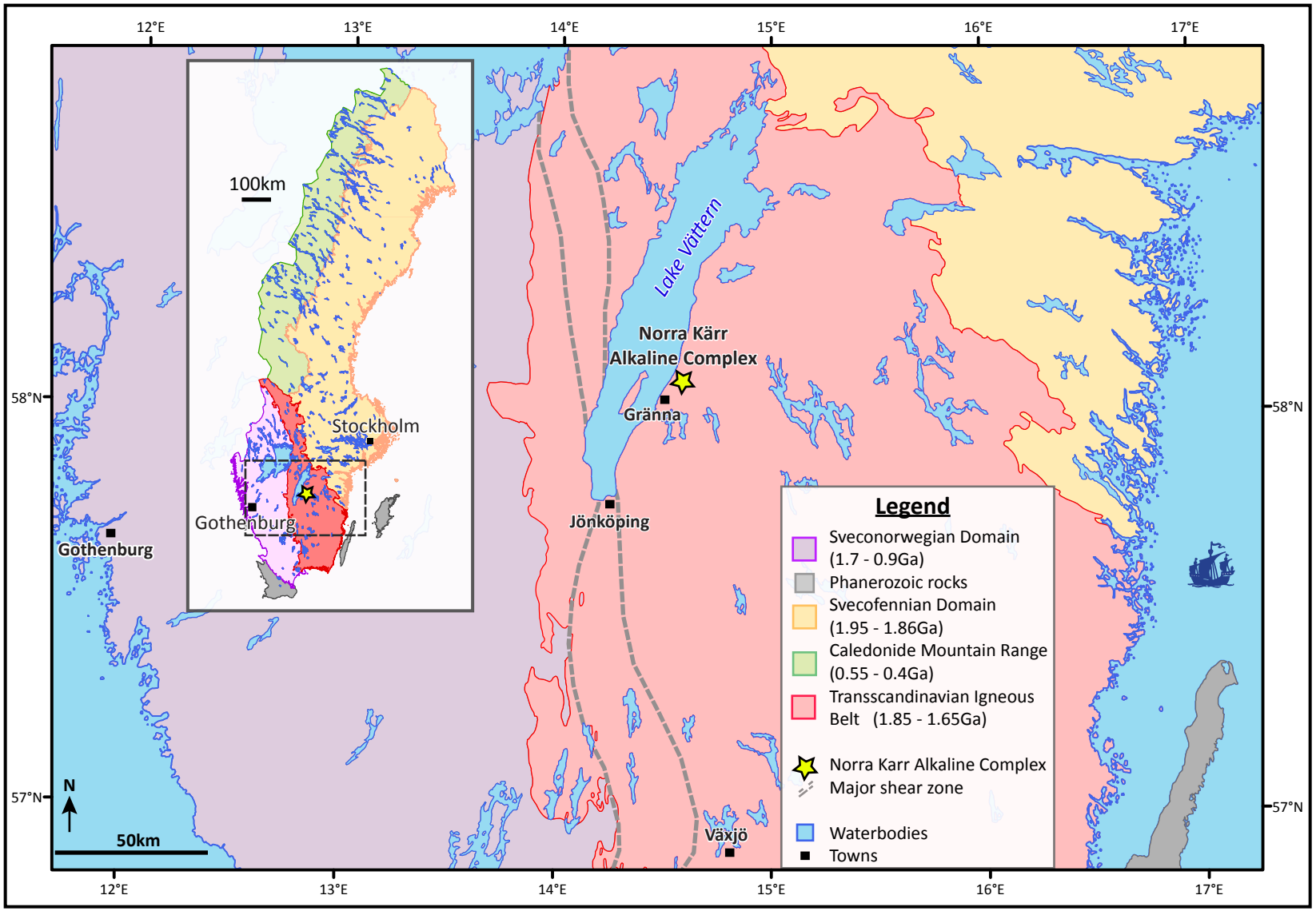


Figure 1.1 - Geological map of southern Sweden, domains and shear zone modified from Hogdahl et al. 2004, geological polygons publically available for download from the Swedish Geological survey. The yellow star indicates the location of the Norra Kärr Alkaline Complex.

1.3.2 Detailed Geology of Norra Kärr

The Norra Kärr deposit is a Mesoproterozoic intrusive suite wholly surrounded by Paleoproterozoic Växjö-type granites. The elliptical complex is roughly 1300 m long, 480 m wide, elongated in the N-S direction, and dipping approximately 45° to the west. The contact between the nepheline syenite and the surrounding granitic country rock is strongly foliated by regional metamorphism, and fenitized by hydrothermal fluids related to the emplacement of the Norra Kärr deposit. Fenitization is type of sodic hydrothermal alteration often associated with carbonatites (Adamsson, 1944). Norra Kärr may have been emplaced as a sill within the Växjö granites (Rankin, 2011), which were concurrently foliated and fenitized during the time of emplacement. As a result of this, the contact between the Växjö granites and the nepheline syenite is difficult to distinguish due to similar textures resulting from their shared hydrothermal and metamorphic history.

The dominant lithology of the Norra Kärr deposit is peralkaline nepheline syenite. Peralkaline rocks are deficient in Al such that Na and K are in excess of that required for feldspar, so nepheline, or similarly silica undersaturated feldspathoids, preferentially crystallize as rock forming minerals. Peralkaline nepheline syenites, such as those at Norra Kärr, have been termed "agpaitic" (Sørensen, 1997) because of the presence of minerals such as eudialyte, a complex Zr-Ti-REE-(F) silicate. "Agpaitic nepheline syenites are considered to have been formed by consolidation of melts oversaturated in alkalis, especially sodium, under conditions preventing volatiles from escaping" (Sørensen, 1997), and agpaitic rocks can form by extreme fractionation of alkali basaltic magma at crustal levels (Larsen and Sørensen, 1987). The term "agpaitic" originated from work done on the Ilímaussaq complex in Greenland, which is also where the specimen for the first detailed examination of eudialyte was collected.

The REE mineralization at Norra Kärr is mainly hosted by the zirconosilicate mineral eudialyte $(Na, Ca, REE)_5(Fe^{2+},Mn)(Zr,Ti)[(Si_3O_9)_2].(OH,Cl,F)$. It was named from the Greek "*eu dialytos"*, meaning "well decomposable". The susceptibility of eudialyte to the action of hydrothermal and surface water was first remarked upon by Ussing (1912) at the Ilímaussaq intrusive suite, Greenland.

Four main rock types comprise the Norra Kärr Alkaline Complex: grennaite, kaxtorpite, lakarpite, and pulaskite. All four units are type localities and named after nearby towns and local farms, with the exception of pulaskite, which was first observed in Greenland at the Ilímaussaq complex. The grennaite unit contains the most eudialyte phenocrysts, and where it is coarsely pegmatitic it contains up to 70% TREO, the highest REE concentration of any of the units in the deposit. A summary of various rock types at Norra Kärr is shown in Table 1 and displayed in Figure 1.3.

1.3.2.i - Grennaite

Grennaite is the dominant rock type. It is a fine-grained, grey-green nepheline syenite composed of alkali feldspar, nepheline, aegerine, eudialyte, and catapleiite. The concentration of REEs in the grennaite unit is much higher, especially where it is migmatized or pegmatitic, than any other rock types in the area. Eudialyte occurs both as phenocrysts and as a groundmass constituent (Adamsson, 1944). The grennaite is locally schistose, and the schistosity is parallel to that of the adjoining Växjö granites ([(Törnebohm, 1906) in Swedish], translated by Adamsson (1944)) along the long axis of the deposit, which strikes in the same direction as the belt scale shear zone in the

NNW-trending structural corridor. However, at the north and south ends of the deposit (Figure 1.3) the schistosity conforms to the margins of the grennaite unit and is perpendicular to the schistosity in the granite. This implies that the schistosity of the grennaite is precrystalline, and the grennaite crystallized from a magma intruding the Växjö granites (Adamsson, 1944).

Domain	Rock Code	Description
GTC	GT	Grennaite. Fine grained with little to no larger catapleiite grains. Less than 5% pegmatitic schlieren. Very fine grained to fine-grained groundmass.
	GTC	Grennaite with more than 3% large Catapleiite laths/needles. Generally foliated. Very fine grained groundmass.
	GTCE	Grennaite with both Catapleiite and Eudialyte blasts/grains.
PGT	GT1	Grennaite with 5-70% "pegmatitic" schlieren and/or zones. In part pegmatitic.
	PGT	70-90% Pegmatitic Grennaite with 10-30% fine-grained Grennaite zones/slabs.
	GTR	Medium grained "Grennaite". Partly coarse pegmatite.
	NEP	>90% Nepheline-syenite (Grennaite) pegmatite.
GTM	GTM	Re-crystallized, intensely deformed Grennaite.
	GTMi	Slightly re-crystallized Grennaite. In part showing crenulated folding.
KAX	KAX	Kaxtorpite. Microcline-Eckermannite-Aegirine ± Nepheline-Pectolite-Natrolite. Often intensely folded.
	KAG	Kaxtorpite with some interfolded Grennaite bands. Often intensely folded.
	GTK	Grennaite with interfolded Kaxtorpite bands
Pul	PUL	Medium to coarse grained alkaline rock occurring mainly along the western flank of the intrusive. Commonly with coarse, rounded microcline augen. Albite, Microcline, Aegirine, Amphibole and some biotite + Nepheline makes up the ground mass. Rosenbuschite, apatite, titanite and Fluorite occur as accessories. Not uncommon is Grennaite and Pulaskite occur as alternating bands/zones where it looks like the Grennaite has intruded and in part hydrothermally brecciated the Pulaskite. In part relatively rich in needle shaped, dirty pale yellow Rosenbuschite grains.
	PULF	Pulaskite or strongly feinizted granitoid. Occurs only along western margin.
Lak	LAK	Medium grained, albite-arfvedsonite-nephelinitic rock. Some microcline-rosenbuschite and minor titanite-apatite-fluorite. Both massive and schistose varieties.

Table 1.1 – Description of the main rock types in the NKAC, adapted from Tasman Metals Ltd.

Figure 1.2 – Photo of the Norra Kärr Alkaline Complex "discovery outcrop", with rock hammer (approximately 1m length) for scale. The pink phenocrysts are the REE-bearing zirconosilicate mineral eudialyte.

1.3.2.ii - Kaxtorpite

Kaxtorpite is a coarse-grained, dark alkaline rock with microcline augen and an aegerine, alkali amphibole and nepheline groundmass located only in the centre of the deposit, and is effectively barren of REE mineralization.

1.3.2.iii - Lakarpite

Lakarpite is "an often medium-grained, albite-arfvedsonite-nepheline dominated rock with some microcline-rosenbuschite and minor titanite-apatite-fluorite" (Reed, 2011). Adamsson (1944) was the first to observe nepheline in this unit, as well as abundant fluorite. Lakarpite does not appear to contain eudialyte (Sjöqvist et al., 2012).

1.3.2.iv - Pulaskite

Pulaskite occurs along the western side of the deposit, and is composed of albite, microcline, aegerine, alkali amphibole, minor biotite and nepheline. Rosenbuschite, apatite, titanite, and fluorite occur as accessory minerals in the pulaskite units. Typically the pulaskite and grennaite are inter-layered, and in places the grennaite appears to be brecciating the pulaskite. A zone of fenitization permeates the pulaskite and extends into the surrounding granitic country rock. This fenitized zone makes the contact between the outermost grennaite ± pulaskite and the Växjö granites difficult to distinguish.

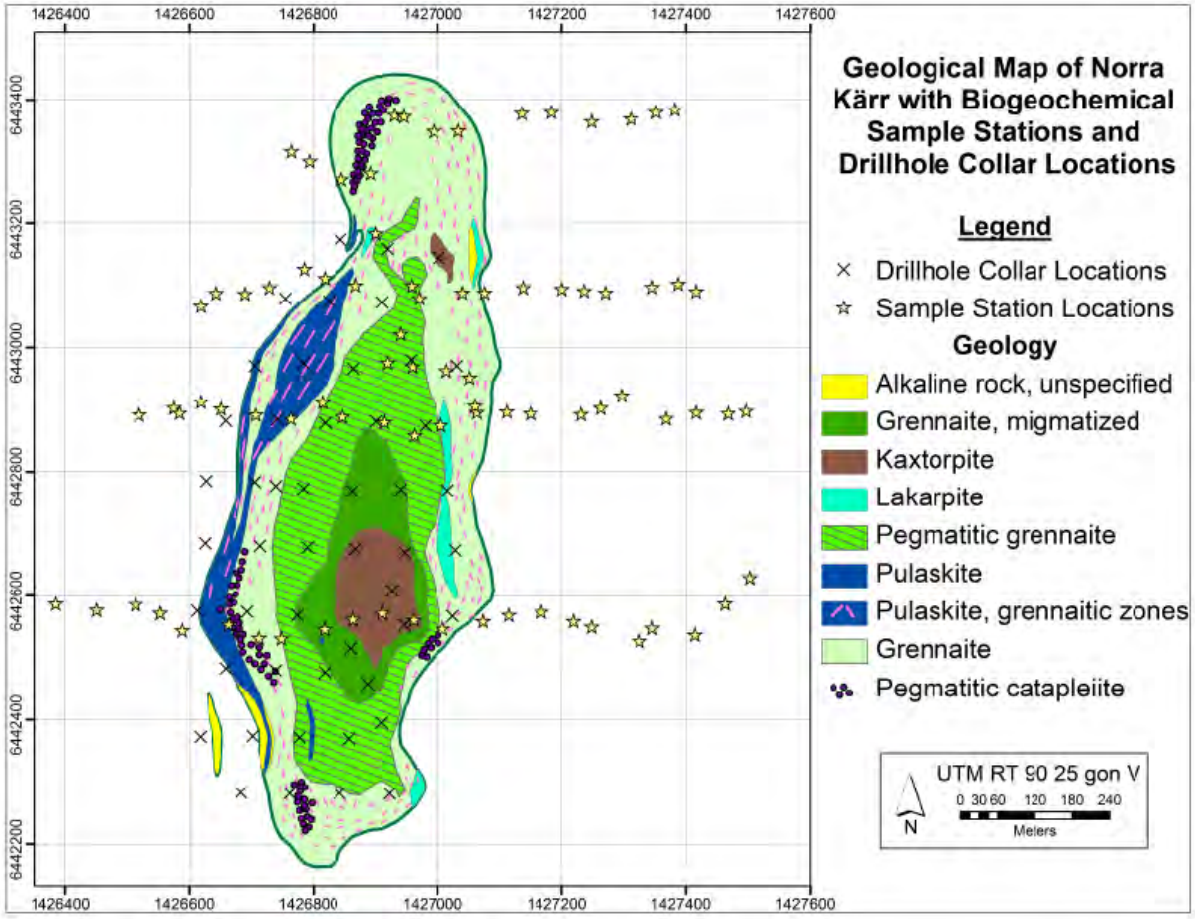


Figure 1.3 – Geological Map of the Norra Kärr Alkaline Complex, after Leijd (2012) unpublished data

1.3.3 Glacial History of Area

There were at least four glacial periods in Scandinavia: the pre-Weichselian, the first and second Weichselians, and the late Weichselian. Ice flow direction was always roughly southwards (Figure 1.4b), except the during the pre-Weichselian, when ice flowed from west to east, towards Finland, in northern Sweden (Lundqvist, 2004). The only area of permafrost in Sweden is the most northerly tip of the country, directly in contact with the Finnish border (Anders Rapp et al., 1986). The fennoscandian region (Figure 1.1) is a region of boulder depressions, and the southwestern coast, directly south of Lake Vanern, contains fossil ice wedges. Tills representing different stages of older glaciations are found below organic-bearing sediments (Lundqvist, 2004). The last glacial period was the late Weichselian, the retreat of which is marked along the southwest coast of Sweden by distinct marginal moraines. Large parts of southernmost Sweden were likely ice free by ~14,500 BP (Lundqvist and Wohlfarth, 2001). The deglaciation of southern Sweden was accompanied by isostatic rebound, such that large areas along the coast have, until relatively recently, been below sea level. This leads to the formation of "highest coastlines" which are shown in Figure 1.4a. Depending on the position of the highest coastlines, surficial material will have been reworked to different extents according to how much time it spent below sea level. Since the Norra Kärr Alkaline Complex is approximately 200 m asl, therefore above the highest isocoastlines (Figure 1.4a), the surficial environment may be treated equally. However, comparisons cannot be made between environments below and above the highest coastlines because they have been acted upon by very different processes.

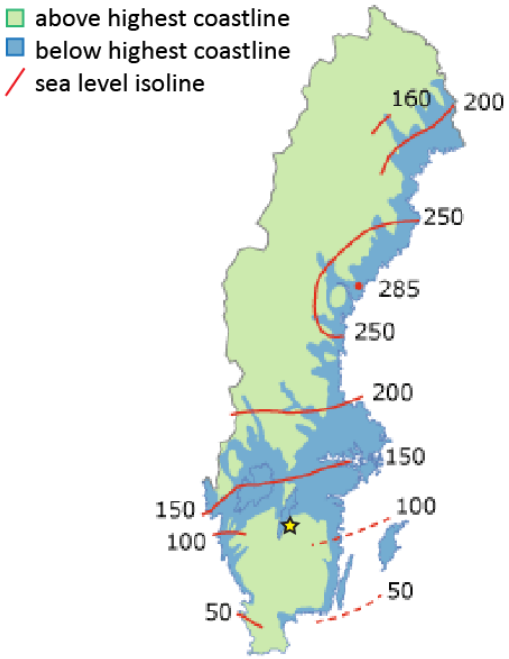


Figure1. 4a – Map of southern Sweden with isolines representing "highest coastline" elevation. The area around Gränna is above the highest coastline, so the likelihood that sediments there have been reworked by wave action is low. Norra Kärr is marked with a yellow star. (adapted from M. Johnson, Associate Professor of Quaternary geology, University of Gothenburg)

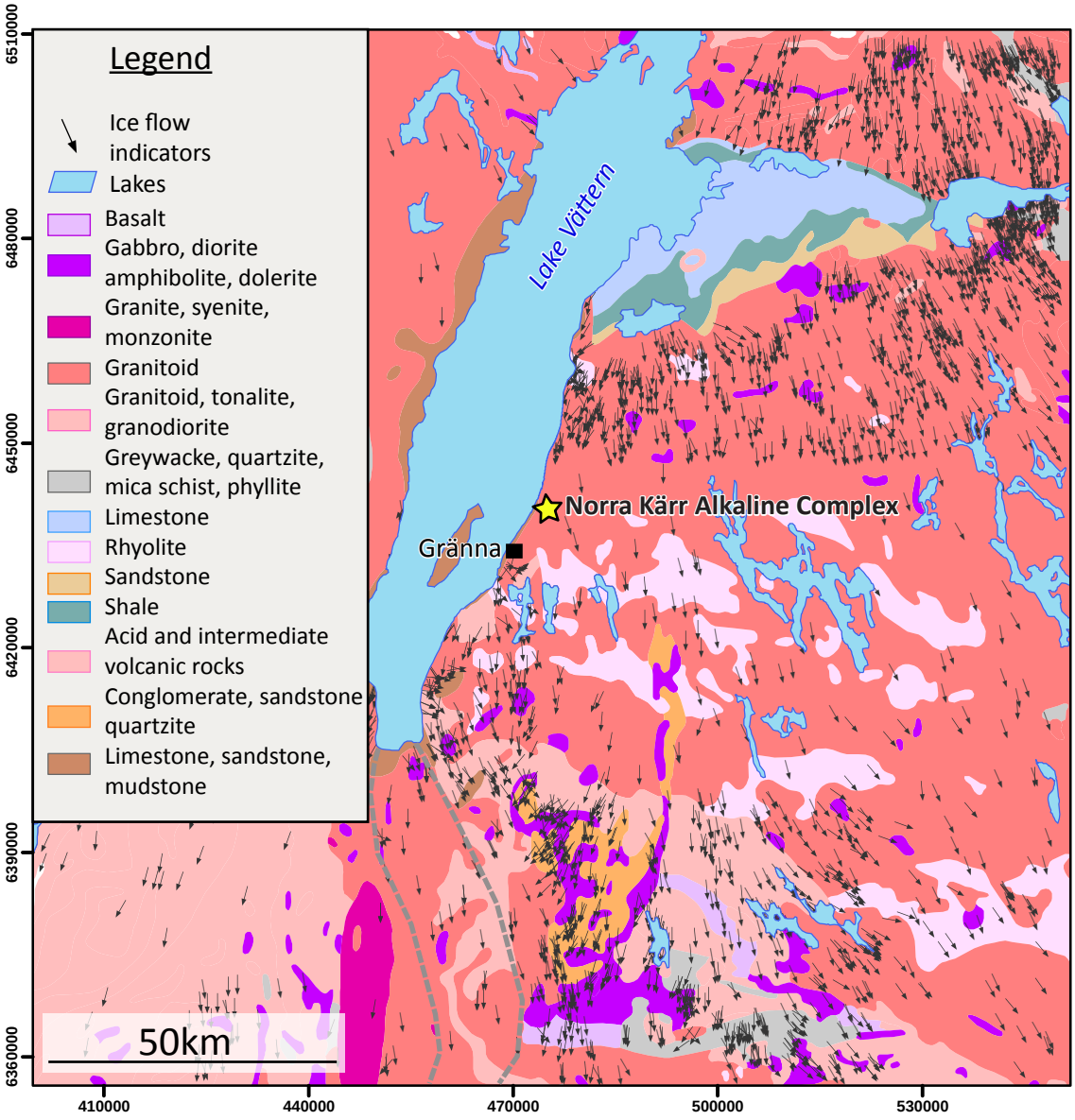


Figure1. 4b – Geological Map of Lake Vattern area with ice flow direction, ice flow data and geological polygons from the Swedish Geological Survey

The area around Norra Kärr is mapped as “thin or discontinuous soil cover” by the SGU (Figure 1.5). Bedrock outcrops in many places at topographic high points, and at lower elevations the cover is an irregular till veneer. There is a “hummocky moraine” (Figure 1.5) approximately 4 km northeast of Norra Kärr. There are also eskers and other Quaternary landforms indicating glaciofluvial transport of surficial material between the moraine and the deposit.

Zones of lower topography are filled with till and glaciofluvial material, whereas higher elevations have residual soils developing directly on bedrock. This lack of continuity in the surface material in the region introduces complications for the explorer undertaking a soil or till geochemical survey, because there is no ubiquitous sample medium. To further complicate matters, the residual soil material, derived from local bedrock, can move down slope as colluvium and sit stratigraphically above the transported tills.

1.3.4 Anthropogenic Disturbance

The surficial environment around Norra Kärr changes abruptly from grassy agricultural grazing land to typical boreal Swedish forest to dense silviculture plantations (Figure 1.7). The soil profiles (Figure 1.6) above Norra Kärr indicate that the area has been disturbed by agricultural work, which has been ongoing in the region for hundreds of years, and consequently well-developed soil horizons are rare due to anthropogenic disturbance.

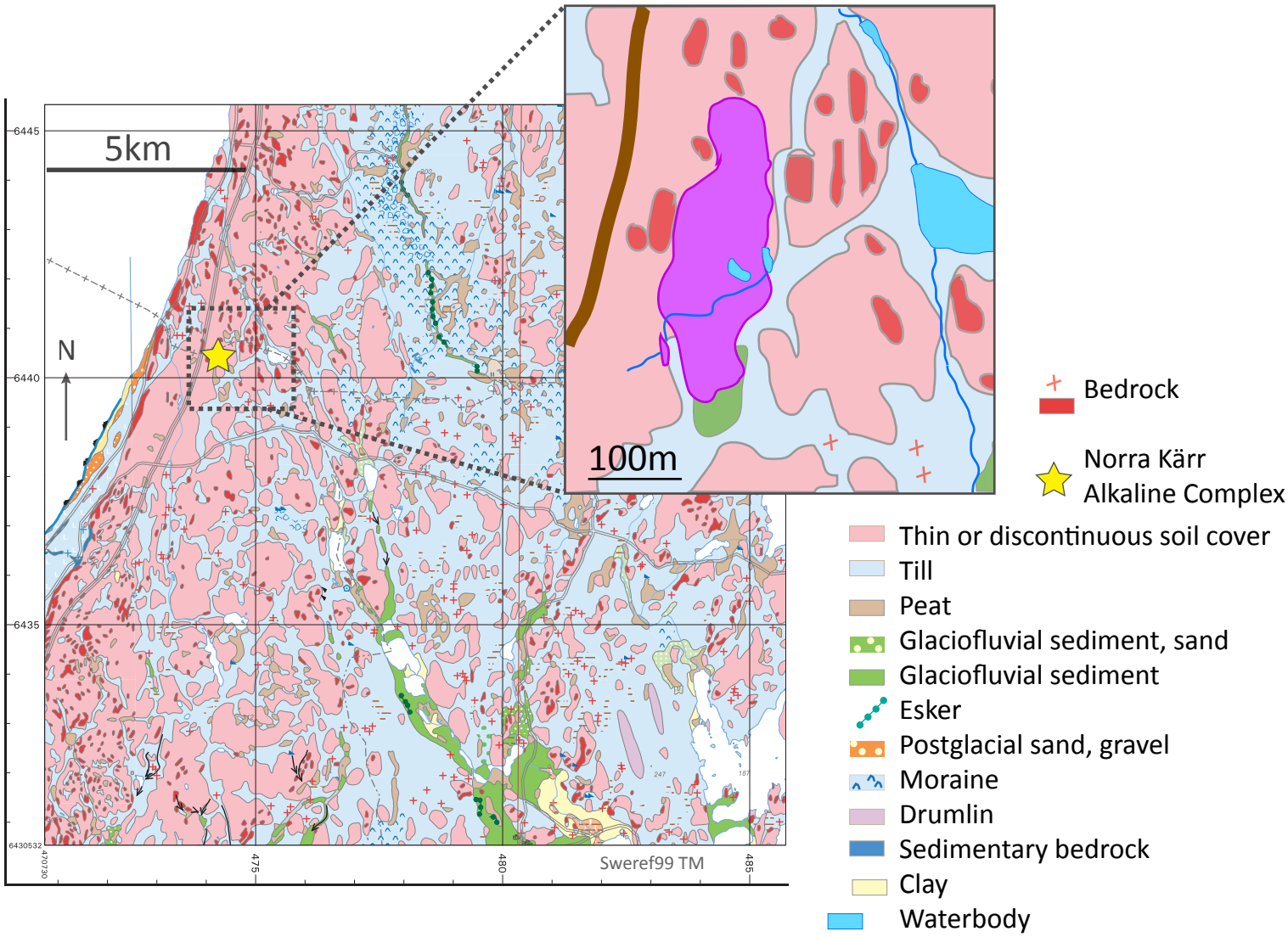


Figure 1.5 – Map of surficial materials in the area around the Norra Kärr Alkaline Complex, adapted from the Swedish Geological Survey. The NKACis marked with a yellow star on the large map, and shaded purpleon the inset map.

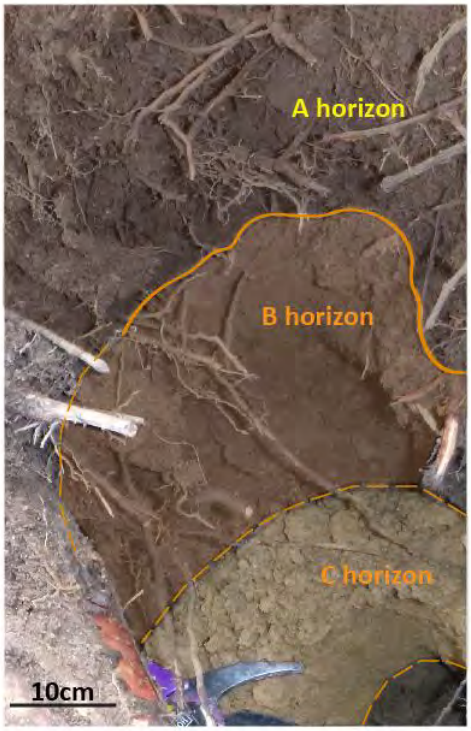


Figure 1.6– Typical soil profile at Norra Kärr. Note the lack of definition between soil horizons. Image has been colour enhanced for clarity.

Figure 1.7 – Airphoto of the Norra Kärr area with sample stations marked as yellow stars, and the deposit outlined in pink.

1.3 Classification of Heavy, Middle, and Light REE

The lanthanides comprise a chemically uniform group of elements that mostly have a 3^+ oxidation state. They vary in crustal abundance from 0.81 ppm in the case of Ce to less than reportable detection limits for Pm, which is the least abundant REE and is invariably omitted from chondrite normalized plots because of its extremely low crustal abundance (Boynton, 1984); in fact it has been estimated that the primary source of Pm is U which accounts for only 560 g Pm in the entire Earth's crust (Belli et al., 2007). Despite their chemical similarity, the individual REEs vary greatly in their ionic radius due to the phenomenon known as the "lanthanide contraction", whereby there is a greater than expected decrease in ionic radii of the elements in the lanthanide series due to poor shielding by the 4f electrons of the attractive nuclear charge, and consequently the 6s electrons are held more closely to the nucleus than expected.

Hatch (2012) wrote a concise and comprehensive synopsis on the correct distinction between light, middle, and heavy REEs, summarized hereafter. The separation between the REE weight classes is primarily based on electronic structure, so the LREEs would be those that have no 4f electrons (La, Ce, Pr, Nd, Sm, Eu, and Gd) which leaves the HREEs as (Tb, Dy, Ho, Er, Tm, Yb, and Lu). The ionic radius of Y is very similar to that of Dy, so it can be grouped with the HREEs as well. The term "middle" REE (MREE) arose from metallurgists working to chemically separate the REEs. Promethium is technically a REE, but its crustal abundance is so extremely low that it is omitted from REE plots, and ignored compared to the other more plentiful REEs. Metallurgists have taken advantage of low Pm levels, because the absence of this element causes a small "gap" between Nd and Sm in the separation process that can be exploited.

1.4 Eudialyte

1.5.1 Mineral Chemistry of Eudialyte

Eudialyte is a pink to red translucent zirconosilicate mineral, commonly occurring in nepheline syenites or alkalic granites. Eudialyte is a cyclosilicate with three and nine fold rings of Si and O tetrahedra. The structure is relatively open, and has been equated to that of zeolite (Golyshev et al. (1971); Guiseppetti et al. (1971)). Johnsen et al. (2003) elucidated the structure and advanced the nomenclature (Figure 1.8). In Figure 1.8 the M and X sites represent available cation and anion substitution sites, respectively. The M(1) site is generally occupied by Ca, the M(2) site by Fe or Mn, the M(3) by Nb, the M(4) by Si, and the X site by Cl-, F-, Oh-, or CO32-. The NA4 site readily accommodates REE, Sr, K, Y, and Ca (Johnsen, 2003)

1.5.2 Weathering of Eudialyte

Eudialyte is susceptible to breakdown by the action of hydrothermal fluids, and is readily soluble in acids (Johnsen et al., 2001). Literature reviews of eudialyte decomposition revealed that its products include catalpleiite, neptunite, aegerine, britholite, monazite, muscovite, biotite, zircon, and minor zeolites, as well as zirfesite ($Fe_2Zr(SiO_2)_2(OH)$), which is a byproduct of low temperature fluid interaction with eudialyte. At the Magnet Cove eudialyte-bearing pegmatite in Arkansas, the pink crystals were surrounded by a "soft yellowish brown powder" where the eudialyte had begun to weather" Williams (1841). At Ilímaussaq, eudialyte alters mainly to catapleiite and zircon, and as

alteration increases the Zr content of the remaining eudialyte increases, while the alkali, REE and volatile content decreases (Coulson, 1997).

The intermolecular bonding forces between eudialyte grains at Norra Kärr are more strong than the intermolecular bonding forces between eudialytes at other comparable deposits, such as Ilímaussaq, Red Wine, or REE deposits of the Kola Peninsula. This was first observed by Tony Mariano (2013, personal communication), who made concentrates from each of these deposits and noticed that much more time and energy was required to crush the Norra Kärr rocks. This indicates that the eudialytes at Norra Kärr are more resistant to physical weathering, and therefore biogeochemistry is less likely to be effective here, compared to other REE deposits with similar chemistry, because fewer REEs would be released into the surficial environment at Norra Kärr.

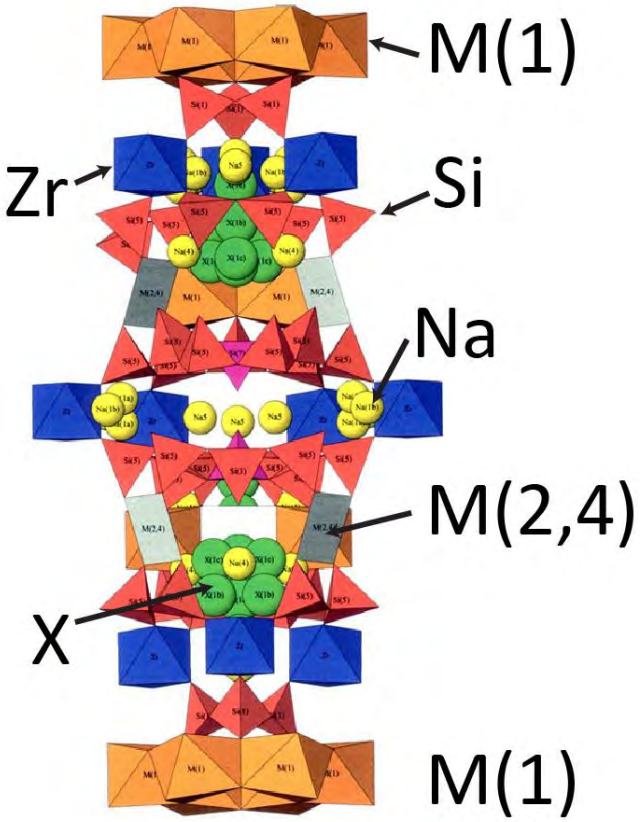


Figure 1.8 – Depiction of eudialyte mineral group (after Johnsen et al. (2003)). The "M" denotes cation replacement sites, and the "X" is an anion replacement site. The chemical formula of eudialyte is (Na, Ca, REE)$_5$(Fe^{2+},Mn)(Zr,Ti)[(Si$_3$O$_9$)$_2$]·(OH,Cl,F).

1.6 Solubility and Mobility of REEs in Surface Water

As minerals break down due to natural weathering processes, some elements become available to the surficial environment and, if they are soluble in surface waters, these elements can

secondary mineral, such as an oxide, or adsorbed onto the surface of some other substance, likely an organic acid, colloid, or manganese or iron hydroxide (Hawkes, 1957). This hydromorphic dispersion has been well documented for a variety of elements in different mineral deposit types, and the same processes occur in the surficial environments above buried REE deposits, such that "REE and Y may be dispersed into bedrock, soils, plants, stream and lake sediments and other media, forming an anomaly much larger than the deposit itself." (Wood, 1990).

It has long been known that uranium, an actinide, is mobile in groundwater (Langmuir, 1978) and the lanthanides, which are extremely chemically similar as a group, also share chemical traits with the actinide group. However, REEs, along with the other high field strength elements like Zr and Ti, are often considered "immobile" because they are commonly used as tracers to describe the evolution of igneous rocks or metamorphic units.

In the same fashion that REEs are used as tracers in geological environments, they are also used to trace geochemical processes in natural waters. Extensive research has been undertaken to determine the solubility, speciation, and complexation involved in aqueous REE transport, including the excellent review paper by Wood (1990) who summarized all the available low temperature literature data from natural waters and examined the nature and thermodynamics of inorganic complex species of the REEs and Y. His work has been heavily cited in modelling experiments that aim to determine the complexation constants of REEs with fluoride, sulphate, phosphate, carbonate, hydroxide, organic acids, simple carboxylic acids, colloids, and their behaviour as free metal ions (Smedley (1991) Lee and Byrne (1992) Johannesson et al. (1996), Dupré et al. (1999); Sholkovitz (1995) Pourret et al. (2007)). Using speciation calculations of Eu, Wood (1990) shows that "simple ion and sulphate complexes are most important at acidic pH, and that the carbonate complexes become predominant at near-neutral to basic pH".

In natural waters the REEs can be divided, based on abundances and fractionation patterns, into two groups: those in solution and those existing either in suspension or as colloids. There is disagreement in more recent literature regarding which anion is most important for REE complexation in solution, but the research is concordant in that all authors agree that pH is the dominant factor influencing REE speciation complexes. Secondarily, additional factors include presence of colloids (Smedley, 1991), concentration of carbonate (CO_3^{2-}) and phosphate (PO_4^{3-}) anions (Lee and Byrne (1992) Johannesson et al. (1996)), availability of free "hard" anions, such as fluoride or hydroxide, sulphate (Lewis et al., 1998), availability of humic acid (Pourret et al., 2007), oxalic acid (Schijf and Byrne, 2001), and/or dissolved organic matter (Tang and Johannesson, 2003). Complexation constants with NO_3 and Cl^- are relatively low, and complexation with H_2S or NH_3 is negligible (Wood, 1990).

Lake water samples collected above the Norra Kärr Alkaline Complex and regionally, from an area roughly 750 km^2, are all circum-neutral and all display strong correlations between the REEs and the organic content (see Chapter 5, Figure 5.3a), so while many anions may be contributing to the speciation of REEs in surface waters, only those complexed with organic acids will be considered hereafter.

1.7 Thesis Structure

This thesis consists of 6 chapters: Chapter 1 is an outline of the scope of the thesis, and introduces the general geological units and important REE minerals, as well as broach relatively unfamiliar concepts such as the mobility of REEs in surface waters; Chapter 2 details the sample collection, preparation, and analysis, and addresses the reliability of certified detection limits for the REEs; Chapter 3 chiefly deals with the vertical migration of REEs in the surficial environment, from the breakdown of their source mineral, eudialyte, through the overlying transported sediments, and into the overlying fern plant. Sequential leach data is used to characterize the mode of REE mobility in the surficial environment. Chapter 4 elucidates the variations in REE content in different plant species, as well as the differences in REE in fern plants attributable to seasonal variation.

Chapter 5 is the product of the combined efforts of several different workers, and has been published as a stand-alone paper (Biogeochemical expression of rare earth element and zirconium mineralization at Norra Kärr, southern Sweden) in the Journal of Geochemical Exploration, in December, 2012. The detailed geological framework was supplied by Tasman Metals Ltd., and the Swedish Geological Survey contributed the regional geological context, as well as glacial history of the area. The biogeochemical expertise for media selection and sampling procedure was generously and unhesitatingly provided by Dr. Colin Dunn.

The genetic model of the surficial environment is discussed in Chapter 6, along with exploration recommendations and final comments.

The body of this thesis is followed by a series of appendices, including certified analytical data, field duplicate and blind standard quality control data, and figures illustrating the reliability of REE data below the certified laboratory detection limits.

Chapter 2 - Materials and Methods

2.1 Sample Site and Media Selection

The Norra Kärr Alkaline Complex is situated in the southern portion of the Baltic shield, and has many features characteristic of classic "shield" environment, including numerous glacial lakes, drumlins, and moraines that give rise to low rolling topography dominated by deciduous woodland.

Southern Sweden has been inhabited for many hundreds of years, and has been farmland for much of this time. This results in varied plant species and soil types due to differences in land use. The area around the NKAC was mainly used for grazing, interspersed with coniferous plantations.

In total, 203 vegetation samples were collected from 157 sites on three occasions over the course of 15 months: (I) one week in mid June, 2011; (II) a brief visit in late August 2011; (III) three sampling programs in late August, 2012, including (i) extension of two original orientation lines, (ii) regional geochemical baseline sampling from an area covering 750km^2, and (iii) detailed sampling from three vertical test pits to determine the location of REEs in the vertical profile from bedrock, through overlying soils, and into the overlying fern plant (See Figures 1.5, 1.7, 3.1).

2.2 Sample Collection

2.2.1 June 2011

This was the preliminary pilot study, and little was known about the survey area with respect to distribution of vegetation. Nothing was known about the uptake of REEs by vegetation at this deposit, so the sampling program was comprehensive. The aim was to identify which plants, if any, would be able to accumulate appreciable amounts of REEs in their tissues, thereby making them an acceptable sample medium for biogeochemical exploration for REE deposits.

The majority of the samples were fern plants because they were the most widespread plant species in the survey area, and previous work has demonstrated the ability of ferns to take up REEs (Markert and Li, 1991; Ichihashi, 1992; Fu et al., 1998; Guo, 1996; Takada et al., 1996; Wang, 1997; Wyttenbach, 1998; Ozaki and Enomoto, 2001; Tyler, 2004; Dunn, 2007). The other species sampled were: oak leaves (*Quercus robur*), alder twigs (*Alnus glutinosa*), birch twigs (*Betula pendula*), ash twigs (*Fraxinus excelsior*), hazelnut twigs (*Corylus avellana*), Norway Spruce twigs (*Picea abies*) and feather moss (see Table 2.1).

Common Name	Latin Name	Number of samples	Sampled part
Alder	*Alnus glutinosa*	2	leaf
Ash	*Fraxinus excelsior*	2	leaf
Birch	*Betula pendula*	9	leaf
Wood Fern	*Dryopteris filix-mas*	12	leaf
Lady Fern	*Athyrium filix-femina*	20	leaf
Bracken	*Pteridium aquilinum*	60	leaf
Hazelnut	*Corylus avellana*	2	leaf
Norway Spruce	*Picea abies*	60	twig
Oak	*Quercus robur*	9	leaf

Table 2.1 – Plant species collected in June, 2011, listed by common and Latin names, with *n* values and sample details.

The fern fronds, less their stalks, were collected and packed into 4" x 10" Kraft paper soil sample bags. At least 50 g of material was taken for each sample, which yielded about 25 g of dry tissue. The twigs of the other species were cut from around the circumference of each tree, using the same pair of stainless steel pruning shears, and the entire branch, including the leaves, was stuffed into a 7" x 11" HUBCO woven polypropylene bag. It is critical in biogeochemical exploration programs to sample media consistently; both the length and width of twig should be similar for all samples collected. Previous work has shown that spruce twigs with approximately seven years growth show good reproducibility of analytical results (Dunn, 2007). The feather moss was detached from the rock, shaken vigorously to dislodge soil particulates from the rootlets, and put into the same style of polypropylene bag.

It became immediately apparent once in the field area that the soil horizons had been disturbed by anthropogenic activities, but soil samples were still collected from the Ah and B horizon in seven locations to enhance the breadth of the survey. Since the preferable sample medium is a fern plant, one of either *Dryopteris filix-mas* or *Athyrium filix-femina* was collected at each of the 82 sample sites (Markert and Li, 1991; Wyttenbach, 1998; Tyler 2004; Dunn, 2007). Multiple plant species were sampled at 28 sites, and in total 118 samples were collected.

2.2.2 August 2011

The plants sampled at the end of the summer in 2011 were collected by C. Dunn and H. Waldron while undertaking a separate field study. They collected 16 samples from seven of the same sites that samples had been collected previously. Samples were dominantly *Dryopteris filix-mas* and feather moss, as well as oak leaves from one site. The sample collection methodology was identical to that employed in early summer.

2.2.2 August 2012

Sampling in August, 2012 followed the same procedures as before and involved three separate collections: (I) regional fern sampling; (II) the extension of two original orientation lines from the previous summer; (III) a vertical sampling program designed to track the movement of REEs from the bedrock, up through the soil profile, and into the overlying fern. This involved

selecting a healthy, normal looking fern plant from a site previously sampled in 2011 which returned elevated REE values in the dry fern leaf tissue. Each fern plant was carefully excavated in its entirety using a large shovel. Soil around the rootlets was collected in a 7" x 11" woven polypropylene HUBCO bag, and the root bulb was separated from the complete fronds and placed into a separate HUBCO bag. The fern fronds were placed between sheets of unbleached brown paper, and press-dried as complete fronds (see Figure 2.1). A pit was dug below where the fern was growing, and soil samples were collected from each horizon until bedrock was reached, which was also sampled. In one instance, the bedrock was too deep to reach with a normal spade, so angular fragments, probably locally derived, were collected instead. Descriptions and annotated photos of soils collected from vertical sample sites are provided in Section 3.2.1ii.

Figure 2.1 – photo of fern frond, before being pressed and dried for transport back to Canada

2.3 Sample Prep

All samples were dried to a constant weight at 60°C, and then the leaves or needles were separated from the twigs. In the case of oak (*Quercus*) and fern (*Athyrium filix-femina, Dryopteris filix-mas,* and *Pteridium aquilinum*) samples, the leaves were prepared for analysis. The twigs of alder (*Alnus glutinosa*), birch (*Betula*), ash (*Fraxinus*), hazelnut (*Corylus*), and Norway Spruce (*Picea abies*) were prepared for analysis. Each sample was milled to a powder in a stainless steel, rotating blade, electric coffee grinder. The milled fern and oak leaves were placed in their original brown paper Kraft sample bags, whereas the milled twigs were shipped in new labelled envelopes. All of the samples were sent to Acme Analytical Laboratories in Vancouver, BC, for destructive chemical

digestion. Splits of *Dryopteris filix-mas* leaves and Norway Spruce twigs were sent to ALS in Australia for ionic leach testing.

Samples collected in August 2012 to assess the REE variation within each fern plant were separated in the field, dried, and transported back to Canada. The rootlets, analysed separately from the stem and leaf tissue, were thoroughly washed and dried in the new MDRU lab at UBC in Vancouver, Canada, prior to chemical analysis. Root, stem and leaf tissue were all prepared in the same manner as vegetation samples from the previous year.

All soil samples were sieved to -80 mesh and that size fraction was sent for chemical analysis.

A selection of samples was split and washed during the preparation stages to assess for airborne contamination, and there was no evidence in the data that airborne contamination is a problem around Norra Kärr.

All sixty Norway Spruce twig samples were reduced to ash at the Pacific Geoscience Centre, in Sidney, BC. The kiln heat was ramped up to 475°C, after which time the samples remained inside for 12 hours, and then the kiln was allowed to cool for a few hours before opening. Reducing samples to ash is particularly helpful when low concentrations of elements of interest, or high background levels, interfere with obtaining reliable results, especially near instrumental detection limits. The limitations of ashing include the increased sample prep time, and the loss of any elements, such as Hg, that will volatilize at low temperatures.

2.4 Sample Analysis

2.4.1 Vegetation Tissue and Soil Samples by Aqua Regia (Vancouver, Canada)

The 1VE package provided by ACME Analytical Laboratories is a hot, modified, aqua regia digestion of 1g of dry milled vegetation tissue, preceded by a cold nitric acid pre-treatment. The modified aqua regia solution used at ACME is 1 equal part of each water, nitric acid, and HCl, compared to the "classical" aqua regia which is 3 parts HCl and 1 part nitric acid. The cold nitric acid pre-treatment is used to oxidize the organic component of the sample and prevent the reaction from occurring too vigorously and overflowing from the beaker. The 1VE digestion is the exact same strength as the 1F digestion, but is specially modified for vegetation samples due to their high organic content.

The 1F package provided by ACME Analytical Laboratories is a hot, also modified, aqua regia digestion for low or ultra-low determinations of soils. Both 1VE and 1F digestions used in this study were followed by an ICP-MS finish for 65 elements: the full suite of 53 elements and the REE add-on. The 14 soil samples collected during the first sampling campaign in June 2011, as well as the 43 fern samples collected along the extensive southern line in August 2012, were analysed by the 1F hot aqua regia package.

2.4.2 Soils by Sequential Leach (Vancouver, Canada)

The Sequential Leach procedure at Acme Analytical Laboratories in Vancouver BC involves 5 leaches applied to the sample in order of increasing leach strength: de-ionized water, ammonium

acetate, 0.1M sodium pyrophosphate, 0.1M hydroxylamine, and 0.25M hydroxylamine. Any remaining sample material was treated with 1T, ultratrace 4 acid, for "near total" digestion.

Soil samples collected from the vertical profiles were leached sequentially to determine in which soil phases the REEs were occurring.

2.4.3 Vegetation Tissue by Microwave Digestion (Lulea, Sweden)

The samples were digested in Teflon containers in a Marsexpress microwave for 30 minutes at 170°C using 5ml HNO_3 (65%)+0.5ml H_2O_2 (30%)+20µl HF (40%). After digestion the samples were diluted up to 10 mL with MQ-water. The ICP-MS analyses were carried out according to modified US EPA method 200.8 (Creed et al., 1994).

2.4.4 Whole-rock Analysis of Representative Rock Types by Tasman Metals Inc (Lulea, Sweden)

Tasman Metals Inc. had suites of representative rock types analysed at ALS Laboratories in Sweden by four-acid "near-total" digestion (ALS package ME-MS61), as well as by lithium borate fusion (ALS package me-xrf06). The 4 acid digestion quantitatively dissolves nearly all elements for the majority of geological materials, and finishes with a combination of ICP-MS and ICP-AES instrument techniques. The XRF procedure is a lithium borate fusion with a direct analysis (XRF) determination.

2.4.5 Whole-rock Analysis of Bedrock Samples Below Vertical Profile Sites (Vancouver, Canada)

The whole rock and trace element package, provided by Acme Analytical Laboratories returns the total abundances of the major oxides (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, TiO_2, P_2O_5, Cr_2O_3) in a 0.2 g sample digested in dilute nitric acid after a lithium metaborate/tetraborate fusion, with an ICP-ES finish. The trace element portion of the analysis determines the REEs and the refractory elements by ICP-MS following a lithium metaborate/tetraborate fusion and nitric acid digest, while the precious and base metals are determined from a 0.2 g split which is digested in aqua regia and analysed by ICP-MS.

2.4.6 Scanning Electron Microprobe (UBC, Vancouver, Canada)

Soil samples (n = 8) from the vertical test pits were examined under the scanning electron microscope (SEM) at UBC, and high field strength elements (HFSEs) were analysed using an energy dispersive X-ray spectrometer. The HFSEs, identifiable by their high luminosity, contained Y and Zr, but the other REEs were not detectable. The electron microscope is a Philips XL30, with Bruker Quanta 200 energy-dispersion X-ray microanalysis systems, equipped with an Xflash 4010 SDD detector.

2.4.7 Water Chemistry in Lulea, Sweden (elements and anions)

Water samples were analysed after acidification with 1 ml of nitric acid (Suprapur) per 100 ml of water sample. Analyses were done according to EPA methods (modified) 200.7 (ICP-AES) and 200.8 (ICP-SFMS).

2.4.8 Regional soils (Lulea, Sweden)

The sample was dried at 105 ° C, and 0.1 g of sample was digested with 0375 g of $LiBO_2$ and dissolved in HNO_3. Loss on ignition (LOI) was performed at 1000 ° C.

Analysis at ALS in Lulea was done according to EPA methods (modified) 200.7. (ICP-AES) and 200.8 (ICP-QMS).

2.5 Quality control

A typical mineral exploration quality control program was utilized for this survey. Field duplicates were taken every 20 stations, blind standards (fern foliage) were inserted every ten samples, and preparation duplicates and blanks were also inserted by the laboratory. Generally the worst reproducibility arises from field duplicates because the variability is influenced by natural factors, such as plant growth, whereas laboratory variability is more easily controlled. There was good reproducibility among the field duplicates, with most duplicate analyses reporting within 30% of each other (Figure 2.2), and excellent reproducibility among the laboratory duplicates. Field duplicate precision diagrams for all REEs are presented in Appendix A6.

The precision for the blind standards (Table 2.2) is very good for the LREEs, and moderately good for the HREEs. The relative standard deviations are highest for Tm, Yb, and Lu because they were mostly below the detection limit, particularly in the cases of Tm and Lu.

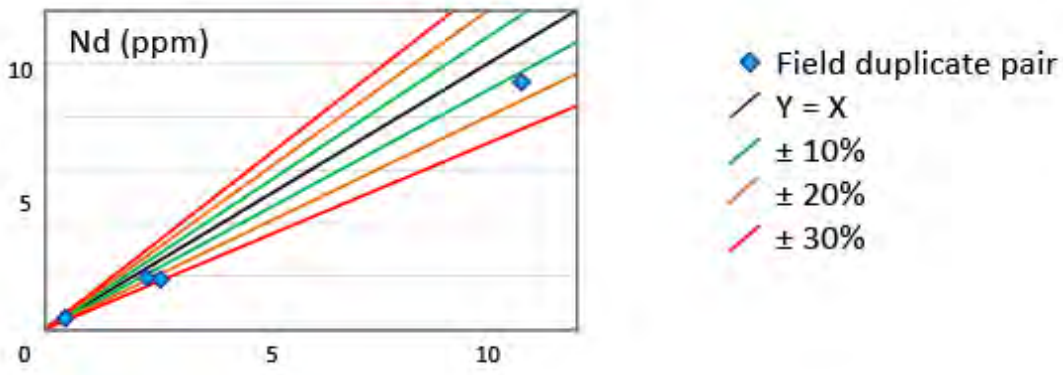


Figure 2.2 – Neodymium precision diagram in field duplicates

	Detection Limit	Average	Standard Deviation	RSD%
La (ppm)	0.01	10.29	0.41	4
Ce (ppm)	0.01	9.90	0.40	4
Pr (ppm)	0.02	1.90	0.09	5
Nd (ppm)	0.02	6.43	0.33	5
Sm (ppm)	0.02	0.96	0.07	7
Eu (ppm)	0.02	0.30	0.02	8
Gd (ppm)	0.02	0.87	0.04	5
Tb (ppm)	0.02	0.12	0.01	10
Dy (ppm)	0.02	0.48	0.06	12
Ho (ppm)	0.02	0.10	0.01	13
Er (ppm)	0.02	0.19	0.03	14
Tm (ppm)	0.02	0.02	0.01	23
Yb (ppm)	0.02	0.10	0.02	17
Lu (ppm)	0.02	0.02	0.01	30

Table 2.2 – Precision data for blind standards

2.6 Detection Limit Reliability

Thorough investigation of the REE data suggests that it is reliable below the certified detection limits provided by Acme Analytical Laboratories, based on REE probability plots and scatter plots of the REEs as a function of yttrium; yttrium suffers the fewest detection limit interferences due to its higher crustal abundance, and therefore is one of the more reliable REE-like elements. Figure 2.3 outlines the methodology used to determine a reliable detection limit based on REE populations coupled with REE content as a function of Y. The certified detection limits, as well as the lowest reliable detection limits, for the REEs are listed in Table 2.3, and both certified and <DL replaced REE data is presented in Appendix A2.

Analytical data from biogeochemical samples can be reliably used, even below the certified detection limit, because there are no matrix interferences in a biogeochemical sample. Detection limits in soil samples are complicated by the presence of silicate and resistate minerals present in the sample; however, since a biogeochemical sample is all organic material, there are no matrix interferences

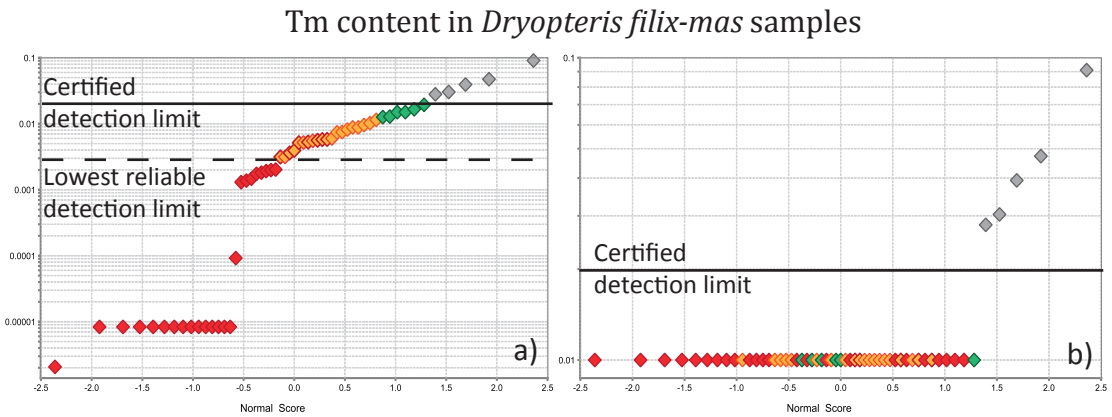
To assess DL reliability, probability plots of the uncertified raw as well as the certified replaced data were generated (see Figure 2.3a and 2.3b) to look for inflection points or breaks in the data that would indicate different populations. The values determined above the certified detection limit are all coloured grey (Figure 2.3a&b) and the data is assessed for overlap with the certified values. The next population, coloured green, on the Tm vs Y bivariate plot (Figure 2.3c)

extends from 0.019 ppm > Tm > 0.011 ppm. After that group has been selected, it is clear on the probability plot that values 0.011 ppm > Tm > 0.007 ppm belong in this population as well. Below 0.007 pm there is a natural break, which indicates that values below this threshold belong to a different population, and are therefore unreliable.

The LREEs (La, Ce, Pr, Nd) all returned values above the certified detection limit. Of the MREEs (Sm, Eu, Gd) only Sm had no BDL values, and all of the HREEs, with the exception of Y, returned at least 11% of the values below detection limit. The least reproducible elements were Tm and Lu, with 65% and 78% respectively, returning below the certified detection limit. Since the REEs behave similarly as a group, and the LREEs didn't return values below the detection limit, the methodology for determining reliability will be outlined here for Tm only. Yttrium was used with the HREEs because, even though it technically is not a HREE, they behave similarly due to their comparable chemical properties, so Y can be confidently grouped with the HREEs. Figures displaying reliability below certified detection limit for all other REEs are presented in Appendix A2. All *Dryopteris filix*-mas data from June 2011 are presented in Figure 2.3a, and Figure 2.3b is the same data set with values <0.02 ppm replaced with 0.01 ppm. Figure 2.3c is the graph of Tm as a function of Y, with no values replaced. REEs were graphed against Y to assess detection limit reliability because Y is more reproducible than most HREEs, due to its greater crustal abundance.

Element	Certified DL (ppm)	Lowest reliable DL	Element	Certified DL (ppm)	Lowest reliable DL
La	0.01	n/a	Tb	0.02	0.004
Ce	0.1	n/a	Dy	0.02	0.005
Pr	0.02	n/a	Ho	0.02	0.007
Nd	0.02	n/a	Er	0.02	0.017
Sm	0.02	n/a	Tm	0.02	0.003
Eu	0.02	0.006	Yb	0.02	0.005
Gd	0.02	0.012	Lu	0.02	0.004

Table 2.3 – Certified detection limits from Acme Analytical Laboratories, and lowest practical reliable detection limits for this thesis research. The LREEs were all above the certified detection limit, so those have been marked "not applicable" (n/a). All values are in ppm.



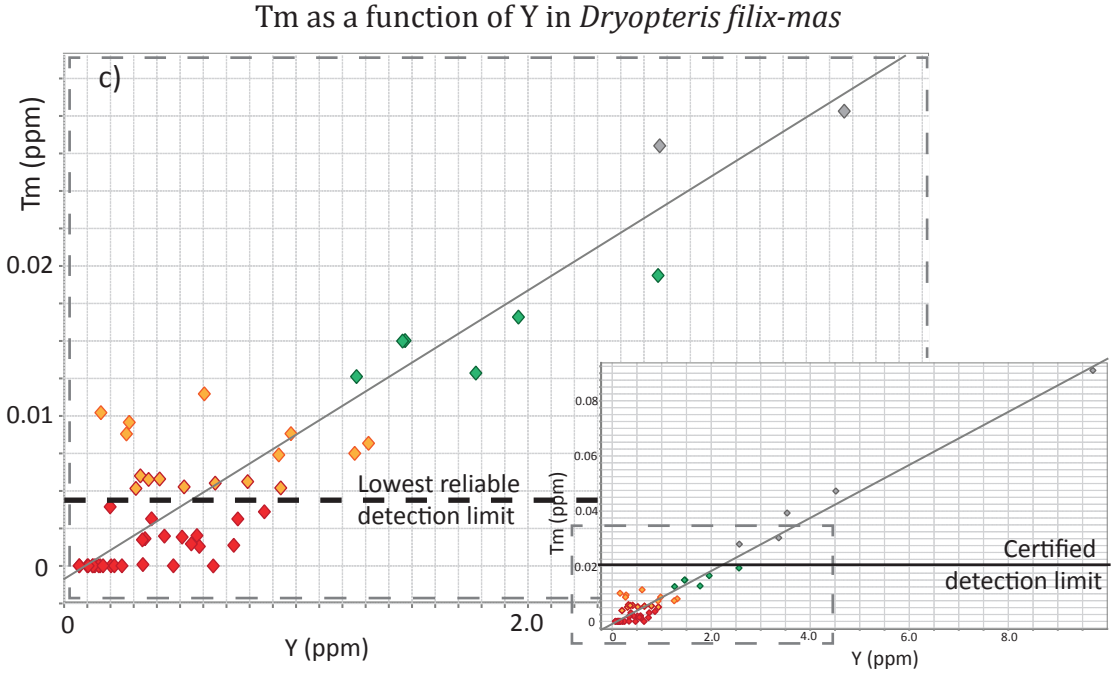


Figure 2.3 - Methodology example of detection limit reliability. Figure 2.3b is all *Dryopteris filix-mas* data, with BDL (<0.02ppm) values replaced with 0.01ppm. Figure 2.3a shows the same data, but with the BDL values left as raw "uncertified" values. Colour scheme is based on REE (in this case, Tm) as a function of Y content. All REEs show good correlation with Y content, displayed here along the line Y = X. Data just below the certifiable DL (0.02ppm) is coloured green. High confidence that these samples are reliable. Samples with lower REE content, but in the same population (populations are determined based on probability plots; data plotting on a straight line without breaks, in Figure 2.3a, are deemed one population) are coloured orange, with moderate confidence that these data are reliable. Data coloured red are have low REE content, or are part of a different population. Confidence that these data are reliable is very low.

Chapter 3 - Variation in Rare Earth Element Content in the Surficial Environment Above the Norra Kärr Alkaline Complex

It is widely known that plants can accumulate REEs in their tissue (Laul et al., 1979; Evans, 1983; Wang et al., 1983; Fu et al., 1998; Wyttenbach et al. 1998; Ozaki and Enomoto, 2001; Zhenggui, 2001; Tyler, 2004; Dunn, 2007), and that the movement of elements into plants is principally via the interaction of roots with surrounding soils. Chemical elements may be taken up by the plant either in solution, or via ion-exchange between the root and the surface of the soil particle (Taiz and Zeiger, 2010). Many authors have shown that the concentration of REEs increases from stem < leaf < root, but these experiments have mainly been in non-natural laboratory conditions, using doped solutions (Evans, 1983; Fu et al. 1998; Ding 2005).

The concentrations of REEs in soil-plant systems have been succinctly reviewed by Tyler (2004), but the variations in REE content from bedrock to soil to plant, and hypotheses regarding the mobility of the REEs for the purpose of mineral exploration in the boreal environment remain, as yet, unstudied.

An experiment was designed to assess the speciation and mobility of REEs in the environment around the Norra Kärr Alkaline Complex. In order to determine the REE content in the surficial environment around the complex, samples were collected from each component of the system: bedrock, groundwater, glacial till, surficial and subsoil materials, and overlying biological matter.

The sites for the vertical profiles (Figure 3.1) were selected based on locations where ferns collected the previous summer yielded high REE contents (see Section 5.3.4). Specific materials collected at each site are listed in Table 3.1.

NK11-060	NK11-039	NK11-072
Athyrium filix-femina stem	*Dryopteris filix-mas* stem	*Dryopteris filix-mas* stem
Athyrium filix-femina frond	*Dryopteris filix-mas* frond	*Dryopteris filix-mas* frond
Athyrium filix-femina root bulb	*Dryopteris filix-mas* root bulb	*Dryopteris filix-mas* root bulb
root soil ("A" horizon)	root soil ("A" horizon)	root soil ("A" horizon)
upper B horizon	B horizon	B horizon
lower B horizon	angular fragments within profile	angular fragments within profile
upper C horizon		
lower C horizon	profile bedrock	profile bedrock
angular fragments within profile		

Table 3.1 – Materials collected from the three vertical profile sites.

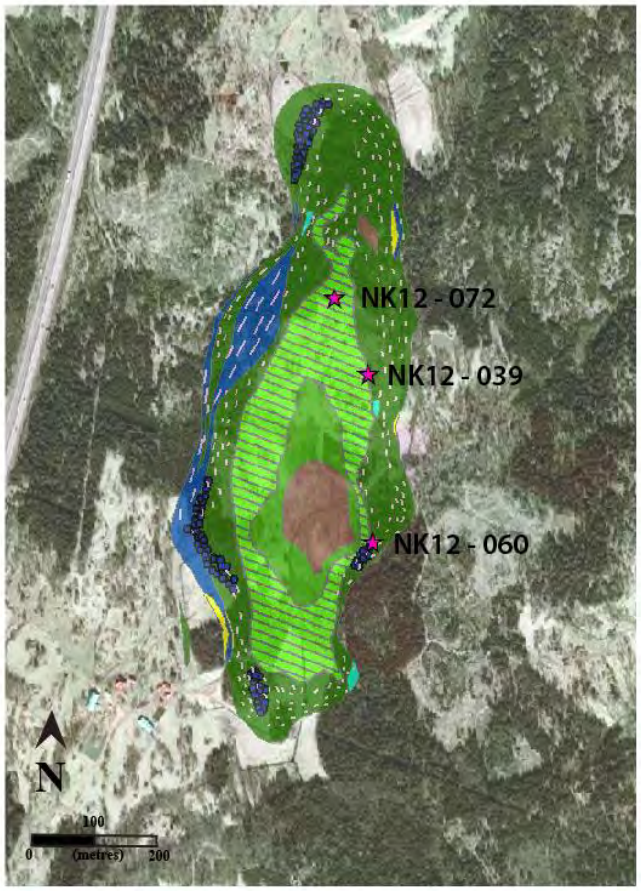


Figure 3.1 – Locations of three vertical profile sample sites over the Norra Kärr Alkaline Complex. Sites were chosen based on high REE content in ferns, which was determined in the previous year's study.

3.1 Lithogeochemistry

3.1.1 The Negative Eu anomaly

A "negative Eu anomaly" is the term for a lower concentration of Eu with respect to the levels of Sm and Gd, europium's neighbours, in any substance, such as rocks, soils, plants, or water. The Eu anomaly can be quantified using chondrite normalizing values (see Equation 3.1), or it can be determined using a chondrite normalized plot to assess the relative value of Eu compared to Sm and Gd.

$$\frac{\frac{\mathrm{Eu}}{0.0735}}{\sqrt{\frac{\mathrm{Sm}}{0.195}\times\frac{\mathrm{Gd}}{0.259}}}$$

Equation 3.1 – Quantified Eu anomaly calculation after Boynton (1984)

All of the REEs occur in the trivalent oxidation state, 3^+, with the exception of Eu and Ce, which can occur in different valences (Eu^{2+}/Eu^{3+} or Ce^{3+}/Ce^{4+}) based on the redox conditions of their surrounding environments. In crystallizing magma chambers, or hydrothermal and

metamorphic regimes, high temperatures and pressures coupled with low pH and low oxygen fugacity create a reducing environment and therefore Eu will preferentially exist as Eu^{2+}. Conversely, in the oxidizing conditions (e.g. 25°C and 1 bar) found at the surficial environment, Ce will preferentially exist as Ce^{4+}, the quadrivalent oxidized form. Under these surficial conditions, Eu^{3+} reduction to Eu^{2+} is "extremely unlikely to occur, because the Eu^{3+}/Eu^{2+} redox equilibrium is located at very low oxygen fugacity (e.g. log f_{O_2} = -86 at pH 7)" (Bau, 1991).

Negative and positive Eu and Ce anomalies can be used to infer which processes have affected the formation of minerals in a particular geological environment, and which processes continue to affect the speciation of the elements in the surficial environment.

In a reducing environment, such as a crystallizing magma chamber, Eu^{2+} has similar properties to Ca^{2+}, and substitutes for Ca^{2+} in the formation of plagioclase. This removes the Eu from the liquid phase of the magma, and produces a negative Eu anomaly. In many cases a negative Eu anomaly is caused by fractional crystallization within a reducing magma chamber.

The agpaitic nepheline syenites at Norra Kärr all have negative Eu anomalies when normalized to chondrite. This can be caused by fractional crystallization of alkali basaltic liquids at crustal levels, or extreme fractionation of nephelinitic mantle-derived melts (Sørensen, 1997) whereby alkali-rich melts crystallize under conditions that prevent volatiles from escaping.

As this thesis is chiefly concerned with the surficial environment, attention will be focused on the oxidation state of Ce and Eu at standard conditions (25°C and 1 bar).

3.1.2 Chondrite Normalization

Chondrite normalization diagrams (e.g. Figure 3.3) are generally used when discussing REE data, and the most appropriate normalizing values will depend on the nature of the sampled material. For example, evolutionary processes in mantle-derived magmas should be normalized to the primitive mantle values of McDonough and Sun (1995), while Taylor and McLennan (1985) chondrite values derived from shales can be used to approximate the upper continental crust. The values of Wakita et al. (1971) and Nakamura (1974) are based on average chondrite, whereas Boynton (1984) normalization values are based on carbonaceous chondrite (Table 3.2). Carbonaceous, or C1, chondrite values contain carbon, water, and other volatiles, and are meant to approximate the solar nebula in composition. These normalizing values have been used in this research. Wakita's, Nakamura's, and Boynton's values are nearly identical, and they fall in the middle of the range used in current literature, but Boynton's chondrite normalizing scheme was deemed most appropriate because it uses carbonaceous chondrites, it is the most complete (Nakamura's only has ten of the 16 REEs), and it was published more recently than the other comparable chondrite normalized values.

REE Chrondrite (Nakamura, 1974)		REE Chondrite Norm (Boynton, 1984)		REE Chondrite Norm (Taylor and McLennan, 1985)		REE Chondrite Norm (Wakita et al., 1971)	
La	0.329	La	0.31	La	0.367	La	0.34
Ce	0.865	Ce	0.808	Ce	0.957	Ce	0.91
Nd	0.63	Pr	0.122	Pr	0.137	Pr	0.121
Sm	0.203	Nd	0.6	Nd	0.711	Nd	0.64
Eu	0.077	Pm	0	Pm	0	Pm	0
Gd	0.276	Sm	0.195	Sm	0.231	Sm	0.195
Dy	0.343	Eu	0.0735	Eu	0.087	Eu	0.073
Er	0.225	Gd	0.259	Gd	0.306	Gd	0.26
Yb	0.22	Tb	0.0474	Tb	0.058	Tb	0.047
Lu	0.0339	Dy	0.322	Dy	0.381	Dy	0.3
		Ho	0.0718	Ho	0.0851	Ho	0.078
		Er	0.21	Er	0.249	Er	0.2
		Tm	0.0324	Tm	0.0356	Tm	0.032
		Yb	0.209	Yb	0.248	Yb	0.22
		Lu	0.0322	Lu	0.0381	Lu	0.034
				Y	2.1		

Table 3.2 – Commonly used chondrite normalization values (Nakamura, 1974; Boynton 1984; Taylor and McLennan, 1985; Wakita et al., 1971). All values are in ppm.

3.1.3 Classification

The rock samples from the base of the vertical profiles are nepheline syenites from the two northerly sites, (NK12-072 and NK12-039), and a foliated granite from the most southerly site (NK12-060). The sample from the most northern site NK12-072 (Figure 3.2a) is a dark grey-green, fine-grained nepheline syenite with minor small catapleiite and eudialyte phenocrysts, small thin fractures filled with microcline, and minor amphibole. The sample from the central site (NK12-039, Figure 3.2b) is a foliated nepheline syenite with phenocrysts of catapleiite (purple rectangular laths) and smaller eudialyte (rose coloured subhedral grains) occurring within bands of microcline and amphibole. The sample from the most southerly site (NK12-060, Figure 3.2c) is a strongly foliated biotite-rich granite with red K-feldspar porphyroblasts which surround quartz grains in places.

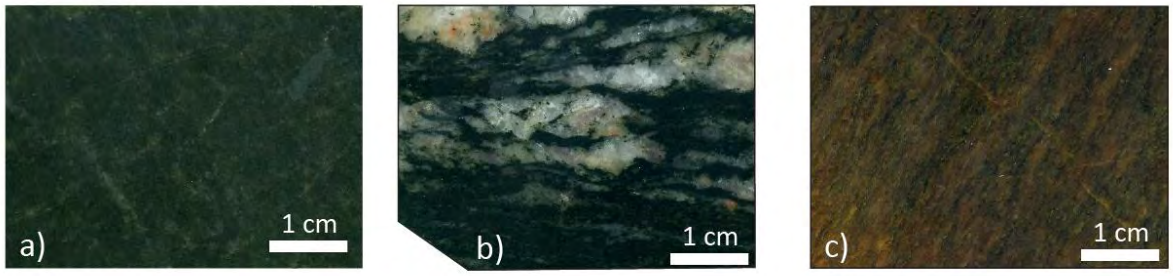


Figure 3.2a-c – Photos of rock samples collected from base of vertical profile sites. (a) NK12-072: fine grained, green-grey aegerine rich nepheline syenite. (b) NK12-039 foliated nepheline syenite with phenocrysts of catapleiite and eudialyte occurring within bands of microcline and amphibole. (c) NK12-060 strongly foliated biotite rich granite with red K-feldspar porphyroblasts.

As outlined in Section 1.3.2 (detailed geology of the NKAC), the contact between the Norra Kärr nepheline syenites and the surrounding granitic country rock is strongly foliated and fenitized as a result of regional metamorphism related to the same event responsible for the emplacement of the Norra Kärr deposit. The NKAC may have been emplaced as a sill within the Växjö granites (Rankin, 2011), which were concurrently foliated and fenitized. As a result, the contact between the Växjö granites and the NKAC is difficult to distinguish because of their similar textures resulting from their shared hydrothermal and metamorphic history. The best field indicator for distinguishing the Växjö granites from the NKAC is colour, the Växjö granites are slightly more reddish due to their high proportions of K-feldspar, and the presence of quartz grains, which are absent in the NKAC.

Lithogeochemical whole rock data from the base-of-profile rock samples were obtained using lithium metaborate/tetraborate fusion and dilute nitric acid digestion, for the major oxides and several of the minor elements, with an ICP-emission spectroscopy finish; the trace elements were determined using the same digestion but the analysis was performed using an ICP-MS. The samples were classified using a total alkali silica (TAS) diagram (Figure 3.4) devised by Cox et al. (1979) and adapted by Wilson (1989). Based on this diagram, two of the three rocks at the base of the vertical profiles are nepheline syenites, and the other is an alkali-rich granite, which corresponds with the Växjö-type granites surrounding the Norra Kärr deposit.

The vertical profile pit dug at the southernmost site (NK12-060) was greater than 1 m deep, and at the base of the pit a Dutch auger was used to collect till samples from the lower C horizon; bedrock was not reached. Since a bedrock sample was not available, angular fragments were collected from the base of the vertical profile and analysed in lieu of bedrock. Site NK12-060 is almost directly above the inferred contact between the nepheline syenite and the surrounding granites; the granitic fragments collected here are angular and therefore can be assumed to be locally derived. The granitic fragments have similar textures to Norra Kärr rocks because they originated from the foliated and fenitized aureole of the Växjö granites directly associated with the emplacement of the NKAC.

In addition, a suite of representative rock types analysed by Tasman Metals Inc. was compiled and classified in the TAS diagram (Figure 3.4). The two mafic rocks in Figure 3.4 are classified by Tasman Metals Inc as *MAA* – "mafic, probably alkaline, fine to medium grained, dark,

amphibole rich, intrusive rock" (Reed, 2011), and the most acidic rock, the granitic fragment from the southerly site (NK12-060), has greater than 70% SiO_2, and appears to be sourced from the surrounding Växjö granites. The analyses of the bedrock collected from the two more northerly sites (NK12-039 and NK12-072) are chemically equivalent to the major rock types of the NKAC.

The two syenite base-of-profile lithogeochemical samples have similar REE profiles when normalized to chondrite, but the third base-of-profile rock sample, the granitic fragment, has orders of magnitude lower REE content than the other lithogeochemical samples (Figure 3.3). Lithogeochemical analyses of the NKAC have a strong negative Eu anomaly, but the granitic fragment only has a minor negative Eu anomaly. This weak Eu anomaly (see section 3.1.2) is a different magnitude and shape than the Eu anomaly present in the other lithogeochemical samples, therefore reflects a different set of geological processes.

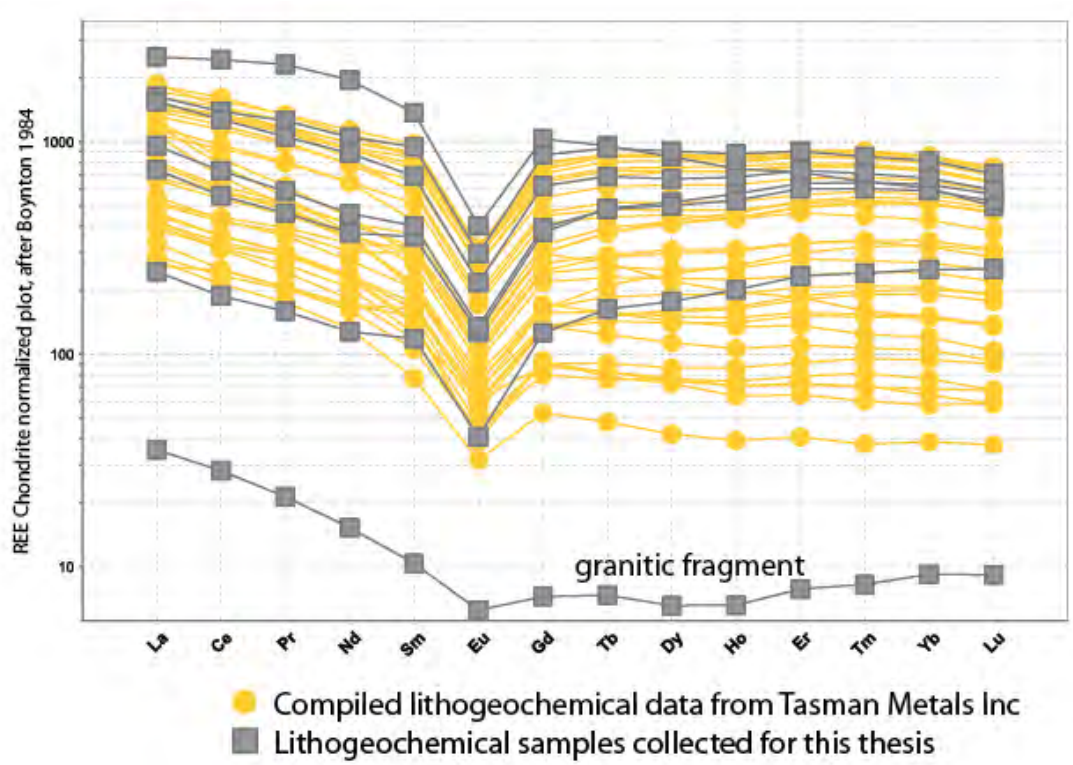


Figure 3.3 – REE Chondrite normalized plot (after Boynton 1984) showing a compilation of all rock types at Norra Kärr (yellow circles, analysed by Tasman Metals Inc.) and the rocks collected for this thesis (grey squares). Note the difference in magnitude between the granitic "base of profile" angular fragment collected from NK12-060 compared to all other rock types.

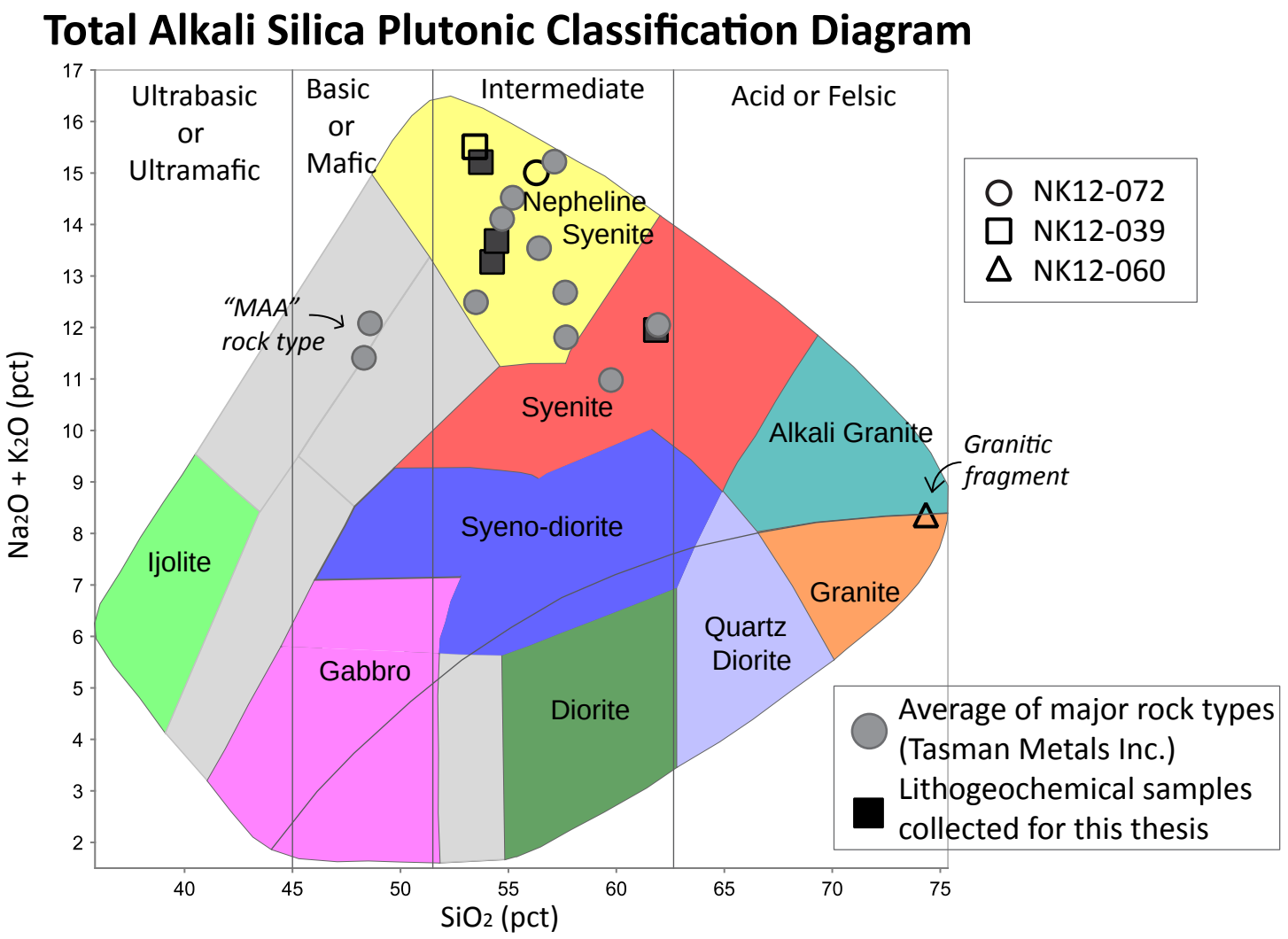


Figure 3.4 – total alkali silica (TAS) classification of lithogeochemical samples collected for this thesis: three base of profile rock samples [NK12-072 (open circle), NK12-039 (open square), and NK12-060 (open triangle)]. Grey circles are averages (n = 210) of each major rock type present in the Norra Kärr Alkaline Complex (analyses provided by Tasman Metals Inc.)

3.2 Soil Chemistry

3.2.1 General Soil Chemistry

3.2.1.i Soil Samples, June 2011

A suite of 14 soil samples was collected, as well as a variety of plant species, during the first sampling campaign in June 2011. Of the soil samples, seven were from the Ah horizon and seven were from the so-called "B" horizon. As noted in Chapter 1, the developed soil horizons above the Norra Kärr complex have been extensively disturbed by agricultural practices, which have been taking place since the middle ages. Local fauna, particularly the wild boar, which is considered a pest in southern Sweden, routinely disrupt surface and subsurface soils. Since the soil horizons were disturbed and inconsistent, soil samples were deemed an unreliable sample medium for REE exploration in this area.

The 14 soil samples all display similar geochemical patterns to the bedrock assays provided by Tasman Metals Inc., albeit at lower total rare earth element (TREE) content (Figure 3.5). The negative Eu anomaly with respect to chondrite normalization, which is apparent in all rock types at Norra Kärr, is visible in the soil samples as well, however, there is also a positive Ce anomaly in the soil profiles that does not appear in the lithogeochemistry. This could be due to several different processes, all of which are possible because Ce, like Eu, has two different oxidation states; however, Ce can exist as Ce^{3+} or Ce^{4+}, depending on whether it is in a reducing or oxidizing environment. This positive Ce anomaly in the surficial environment will be treated in more detail in section 3.2.2.

There is a distinct difference in REE content between the so-called "B" horizon soil samples and the Ah horizon soil samples. The Ah soils have consistently lower REE content than the B horizon soils taken from the same location. The median sum of the REEs in the Ah horizon is only 23.4ppm, compared to the median sum of the REE content in the B horizon, which is 87.7ppm (Table 3.3). This suggests that there is either some leaching process moving REEs away from the Ah horizon, or there is a REE-enrichment process acting on the B horizon soils. This will be commented on in more detail later in the chapter.

Soil	***n***	Σ REE	Σ LREE	Σ HREE
B	7	89.3	81.9	7.4
Ah	7	23.3	20.7	2.6

Table 3.3 - Summary of the REE content, as well as the median ΣREE value, for the Ah and B soil horizons

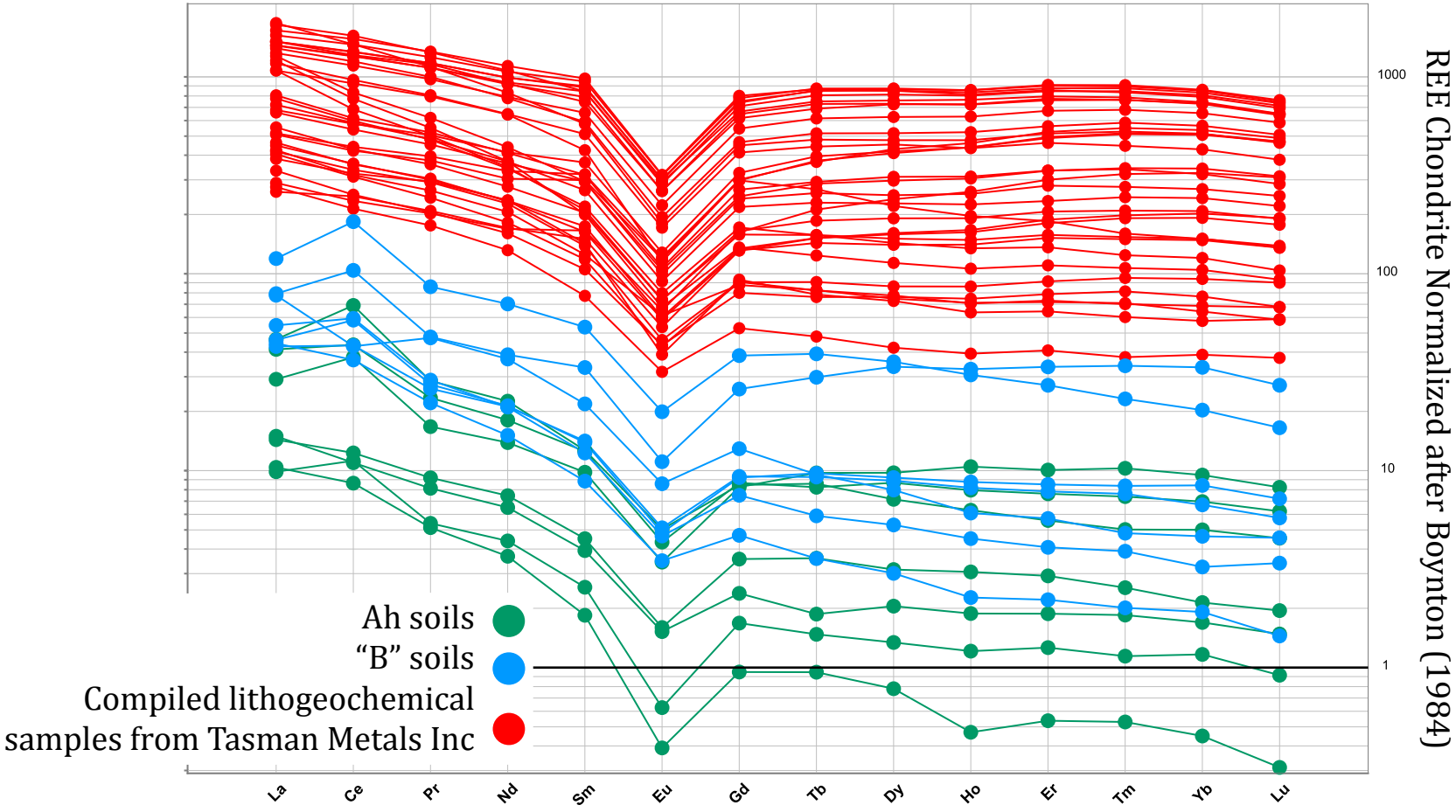


Figure 3.5 – REE Chondrite normalized plot (after Boynton 1984) of soil samples collected in June 2011 (7 Ah horizon, green circles; and 7 "B" horizon, blue circles) with representative lithogeochemical samples of all rock types in the Norra Kärr complex (red circles, analysed by Tasman Metals Inc.)

3.2.1.ii Soil Samples, August 2012

During the second sampling campaign, in late August 2012, a suite of soil samples were collected from vertical profiles to assess the variation in REE content between each soil horizon. Eight samples were collected from three test pits, and these, as well as the 14 soil samples from 2011, were sent for sequential leach analysis. The aim of this experiment was to define which labile portion of the soil sequesters the majority of the REEs, and then infer a geochemical process responsible for the REE mobility in the surficial environment. Descriptions of the soils collected from the three vertical sample pits are listed in Table 3.4, and photos of each soil sample are provided in Appendix A7.

Station ID	Horizon	Description
NK12-060	C lower	Light yellow. Clay dominant, with a few fragments of coarse sand (mainly quartz and red feldspar, both likely sources from the vaxjo granites, which are particularly red (Högdahl et al., 2004). Few mafic lithics). No organics.
NK12-060	C upper	Light tan-brown. Slightly coarser grained than the lower horizon, mainly clay and silt. Coarse sand particles mainly quartz and red feldspar, with more mafic lithics than the lower horizon). No organics.
NK12-060	B	Medium/light grey-brown. Very fine sand to coarse sand. <5% organics (rootlets, very small twig fragments). Coarse sand mainly quartz, with lesser mafic lithics and red feldspars.
NK12-060	A	Medium/dark grey-brown. 15% organics. Medium silt to coarse sand. >65% quartz. ~15% mafic lithics, <5% red feldspar
NK12-072	B	Dark brown. 50% organics, 50% lithic fragments (mainly fine sand. 10% coarse sand. dominantly quartz (80%), some plagioclase)
NK12-072	A	Dark brown. 80% organics. 20% lithic fragments (minor quartz (<20%, coarse sand sized) ~80% mafic fragments, fine sand sized)
NK12-039	B	Medium/light grey-brown. 75% fine sand, 20% organics, 5% coarse sand (quartz)
NK12-039	A	Medium grey-brown. 40% organics, 30% fine sand, 30% medium sand (felsic lithics) 5% coarse sand (quartz)

Table 3.4 - Physical descriptions of soil samples collected from each horizon at three vertical test pits

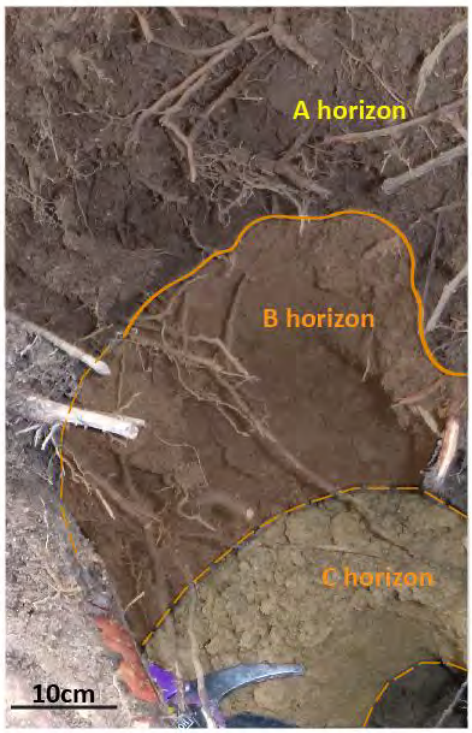


Figure 3.6 – Photo of vertical test pit at site NK12-060. Note the lack of definition between soils horizons, particularly the A and B horizons. Depth to the C horizon is 70 cm.

3.2.2 Sequential Leach

Sequential leaches are based on the same principles as selective leaches, but each selective leach is applied in order of increasing leach strength to the same sample material. Selective leaches target elements held by a specific soil phase or range of phases, thus allowing inferences of the geochemical processes acting on the sample material. The leaches target elements mobilized by groundwater, or adsorbed as ions onto clays, organic acids, or amorphous Fe and Mn oxyhydroxides.

A six step sequential leach, finishing with a "near total" 4acid digestion, was performed on 25 soil samples collected above Norra Kärr. Eight of the samples were collected from distinct horizons in the vertical profile test pits, and the other 17 samples were duplicates of soil samples collected the previous summer.

The sequential leach process involves six leaches, which are, in order of increasing strength: de-ionized water ("H_20"), ammonium acetate ("NH_3Ac"), sodium pyrophosphate ("$Na_4P_2O_7$"), 0.1M hydroxylamine ("w-NH_2OH"), 0.25M hydroxylamine ("s-NH_2OH"), and four acid "near total" digestion ("4acid"). Each of these leaches is designed to liberate elements bound to a specific soil phase or range of phases. By determining which phase dominantly hosts the REEs in the surficial environment, hypotheses can be made regarding which geochemical processes are the most influential.

Each leach liberates elements bound to the sample in specific targeted phases:

- The de-ionized water liberates ions that have been hydromorphically dispersed and are weakly adhered to soil particles.
- The ammonium acetate ("NH_3Ac") targets exchangeable cations that are either adsorbed onto clays or co-precipitated with carbonates.
- The sodium pyrophosphate ("$Na_4P_2O_7$") extracts elements adsorbed on to organic acids, such as humic or fulvic components.
- The weaker hydroxylamine (0.1M, "w-NH_2OH") attacks phases adsorbed by amorphous Mn hydroxides, which is often the reactive phase for scavenging mobile elements in arid environments.
- The stronger hydroxylamine (0.25M, "s-NH_2OH") attacks amorphous Fe hydroxides as well as crystalline Mn hydroxides.
- Finally, the four acid "near total" digestion dissolves silicates and begins to break down resistate minerals, such as zircon or monazite (Cohen et al., 2010).

It is often warned that REEs can be insoluble in four acid digestions, but as outlined in Section 1.3.2, the REEs at Norra Kärr are sourced from the zirconosilicate mineral eudialyte, which is much more soluble than some of its REE mineral counterparts, such as monazite, xenotime, or zircon.

At each site, results from the sequential leaches display similar characteristics for the Ah and B soil horizons, as well as for the tills. First of all, the de-ionized water leach always returns the lowest levels of REEs, and the 4acid "near total" digestion always returns the highest levels of REEs, approximately 100x higher than the de-ionized water leach. Secondly, the ammonium acetate and

both strengths of hydroxylamine return similar amounts of REEs for each profile, with the notable exception that the hydroxylamine signal, which is always slightly enriched in LREEs compared to the ammonium acetate. Lastly, and most interestingly, the sodium pyrophosphate leach returns the second highest concentrations of REEs, even though it is the third weakest leach.

Lithogeochemical analyses of the rocks from the Norra Kärr Alkaline Complex display a well documented negative Eu anomaly (see section 3.1.2, Figure 3.4, and Figure 3.5), and this pattern is apparent in all of the sequential leaches when normalized to chondrite. Some of the sequential leaches, however, also display a positive Ce anomaly in the Ah and B horizons which is not inherent in the parent bedrock. This could be attributable to the susceptibility of secondary Ce-bearing minerals to certain leaches, and the differential mobility of Ce in an oxidizing environment compared to the other REEs.

Generally, under geological conditions, Ce exists in the reduced state, Ce^{3+}, which is the same oxidation state as the rest of the lanthanides. When the reduced Ce^{3+} cation comes in contact with oxidizing conditions, such as those found in near surface weathering environments it will precipitate as CeO_2 (Braun et al., 1990), and this can induce a positive Ce anomaly. If the REEs have been in solution in the near surface environment, the Ce will oxidize and immediately precipitate out of solution as CeO_2 which is an extremely insoluble compound (De Baar et al., 1985). Ce (IV) can also be adsorbed on to the surfaces of oxyhydroxides, such as Fe or Mn, (de Carlo et al., 1998; Ohta and Kawabe, 2001), and in this case it will remain in the oxygenated subsoil complexed with Fe or Mn, and therefore be less available to plants than other REEs (Robinson et al., 1958). Manganese compounds present as surface coatings on soil grains can scavenge Ce^{4+} from the surficial environment (Hem, 1978).

Interpretation of the sequential leach data was done on a per-site basis because the bedrock material differs at each location. To this effect, special normalization schemes were devised for each site based on their parent bedrock, and these will be referred to as “local” normalizing schemes. Normalizing to the REE content of the underlying bedrock, on a per-site basis, is helpful because subtle variations, such as Ce and Eu variations or HREE/LREE fractionations are not visible when normalizing to global average chondrite values because their ranges are large, and therefore subtle variations are masked. There is a pervasive Eu anomaly in all of the weak leach soil chemistry data (Figure 3.7) when normalized to chondrite, but when normalized to local bedrock (Figure 3.8b, Figure 3.9b) there is actually a *positive* Eu anomaly at the southernmost site, in the granitic fragment as well as the till samples.

Of particular importance here is the transported material at the southernmost site (NK12-060) where an angular granitic fragment was taken as a proxy for local bedrock when in fact it originated from nearby Växjö granites. Therefore a compilation of lithogeochemical data from the Tasman Metals Inc. drilling database was assessed to choose a suitable representative bedrock substitute for this location. The ‘pulaskite’ unit is a “medium to coarse-grained alkaline rock composed of albite, microcline, aegerine, Na-amphibole, and minor biotite and nepheline” (Reed, 2011) and is representative of the soil chemistry at site NK12-060.

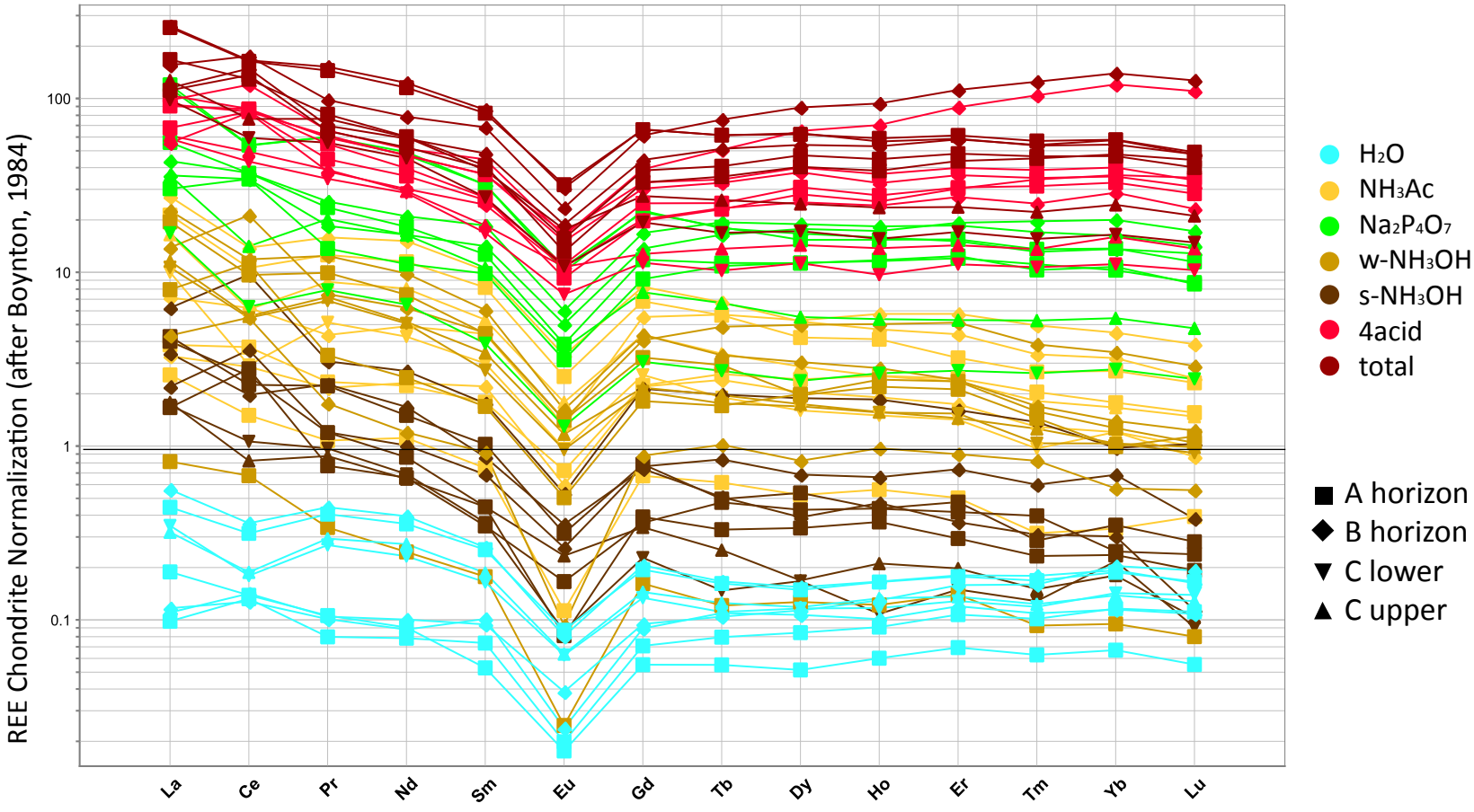


Figure 3.7 – Chondrite normalized plot of all sequential leaches at each site, including the sum total of all the leaches (burgundy points) which approximate the total REE content of the surficial materials.

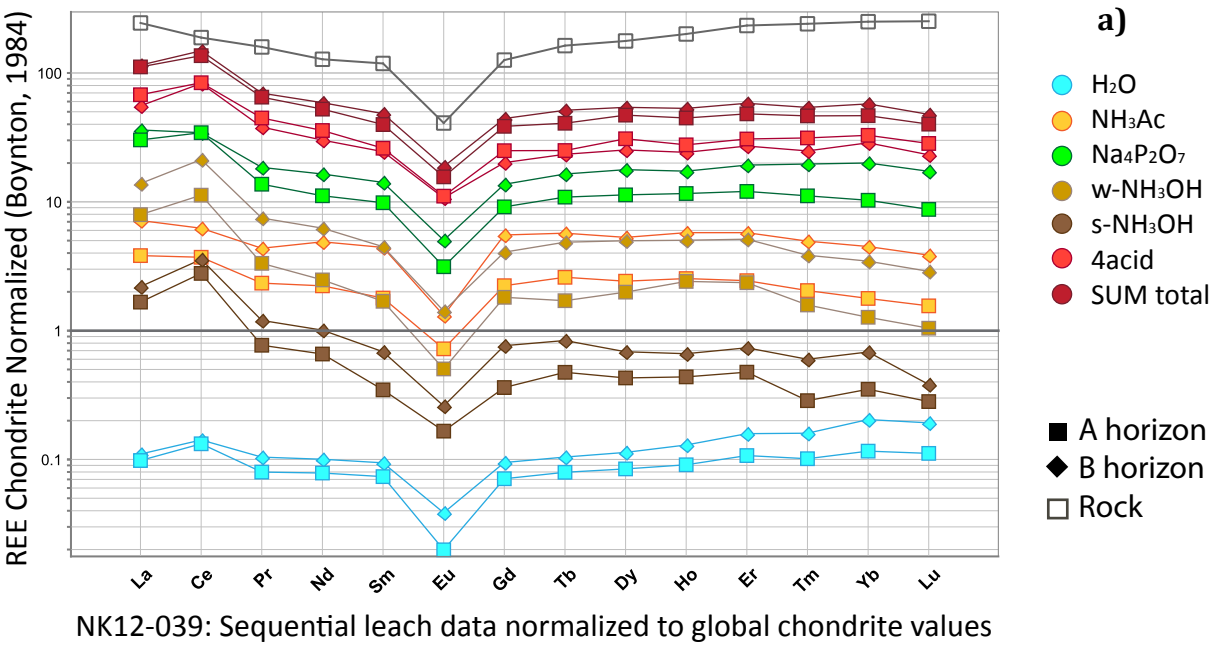
3.2.2i – Site NK12-039, the central site

The sequential leach data obtained from the A and B soil samples at this site were normalized to the bedrock sample collected here. The A and B horizons both display similar REE patterns: a positive Ce anomaly of varying magnitude depending on the strength of the leach, and an overall enrichment of LREEs relative to HREEs (Figure 3.8b). The activity of Ce^{3+} decreases with increasing pH, such that in circum-neutral soil solutions (pH 6.98-7.31) the speciation of Ce is almost wholly controlled by the formation of $CePO_4$ (Diatloff et al., 1996). At site NK12-039, the positive Ce anomaly could possibly be attributed to $CePO_4$ formation in the A and B horizons, which would not be liberated by weak NH_3Ac and H_2O leaches. Alternatively, the positive Ce anomaly observed for both strengths of hydroxylamine leach could be due to the presence of Fe and Mn hydroxides, which can act as sinks for Ce^{4+} cations (Hem, 1978).

Also of note is the lack of a strong positive Ce anomaly in the NH_3Ac leach. The ammonium acetate leach targets exchangeable ions that are either adsorbed by clays or co-precipitated with carbonates. The disparity in Ce anomaly from this leach indicates that there is little excess Ce in the exchangeable ion fraction of the soils.

When normalized to any global chondritic values, be it Haskin or Boynton or Nakamura, the REE patterns at this site remain constant (Figure 3.8a), and all show the same positive Ce anomaly and relative LREE enrichment as seen in the specialized per-site (or "local") normalization scheme (Figure 3.8b), however when normalizing to the global chondrite values a deep negative Eu anomaly is apparent. This negative Eu anomaly is not a reflection of Eu mobility in the surficial environment, but rather a reflection of Eu^{2+} substitution for Ca^{2+} into crystal lattices as the Norra Kärr intrusion fractionated and crystallized. In fact, when using the special local normalization diagram, there is a slight *positive* Eu anomaly in the 4acid near total digestion, which acts on the silicate fraction of the soil. This implies that there is more Eu than expected (relative to Sm and Gd content) in the silicate fraction of the soil relative to the underlying bedrock, so there must be some grains of zirconosilicate minerals, either catapleiite or eudialyte, from a more Eu-rich zone of the deposit that have been worked into the surficial environment above NK12-039.

This hypothesis was confirmed by examination of the soil samples using a scanning electron microscope (SEM) equipped with an energy dispersive X-ray spectrometer (EDS). Soil grains containing elements with large ionic radii, i.e. the high field strength elements (HFSEs), such as REEs, Zr, U or Th, were identified by their intense brightness, and then analysed with the EDS. The spectra obtained show that the HFSE grains contain both Zr and Y, but the REE content of the grains was too low to be detected. The HFSE grains are irregularly shaped, and range in size from fine silt (0.02 mm) to very fine sand (0.08 mm). Different sized grains are present in all soil horizons, so no conclusions about their provenance can be made, aside from that they are locally derived. An example of a medium silt-sized HFSE grain on a silicate soil particle is shown in Figure 3.11.



NK12-039: Sequential leach data normalized to global chondrite values

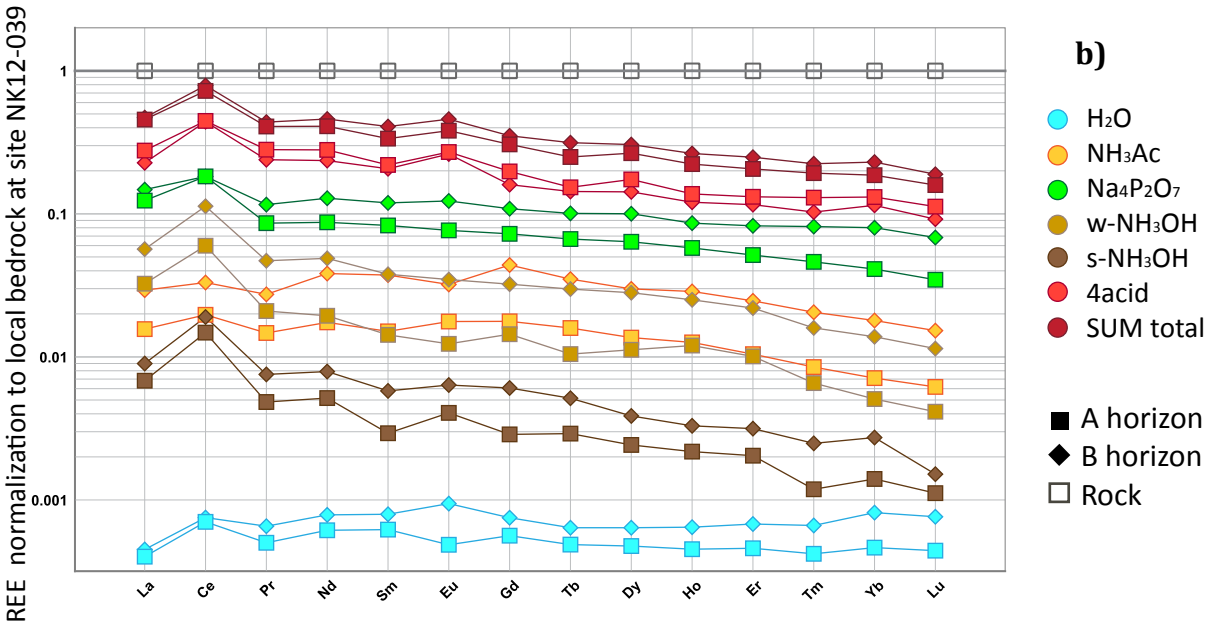


Figure 3.8a (above) - Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-039, normalized to global chondrite values (Boynton, 1984). Note the positive Ce anomaly, LREE enrichment relative to HREEs, and negative Eu anomaly.

Figure 3.8b (below) – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-039, normalized to local bedrock. Note the same positive Ce anomaly and relative LREE enrichment, but also a weakly positive Eu anomaly in the 4acid near total.

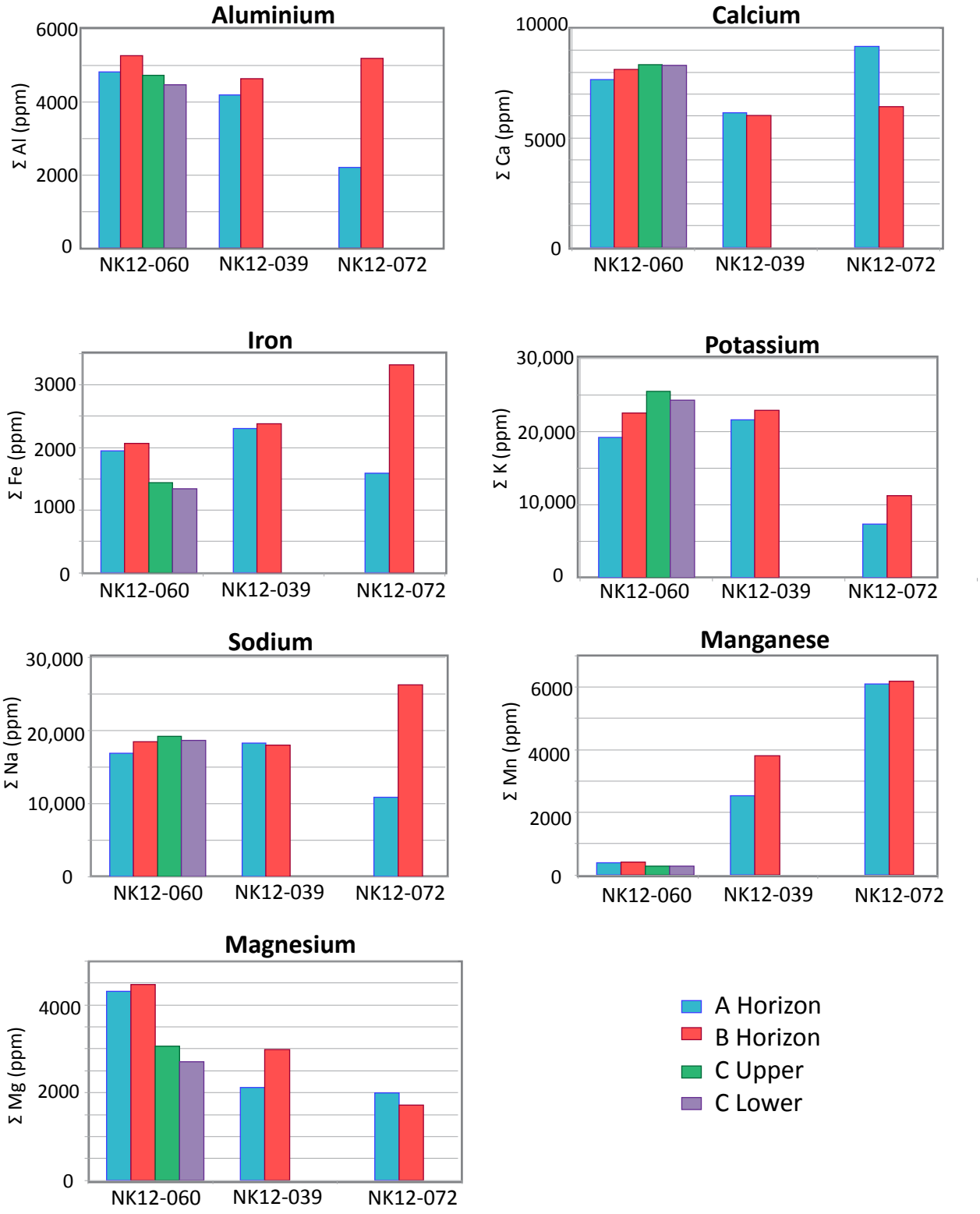


Figure 3.8c - Histograms of soil-forming elements, grouped by vertical profile site

The other important elements for characterizing soil profiles are Al, Ca, Fe, K, Mn, Mg, and Na. The B horizon at NK12-039 is slightly enriched in these elements, with the exception of Ca and Na, relative to the A horizon (Figure 3.8c). This could be because the A horizon has much more organic material, which could be adding Ca and Na to this horizon.

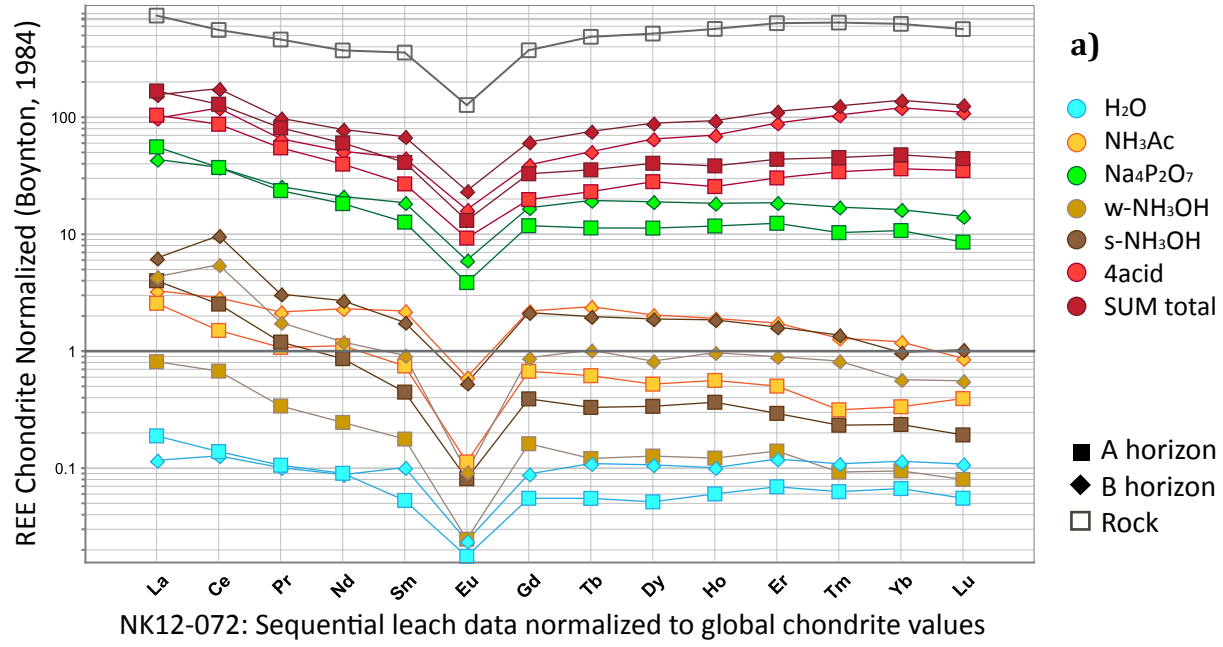
3.2.2ii – Site NK12-072, the northern site

The surficial material at NK12-072, as with the material at NK12-039, is a locally derived soil profile developed directly on mineralized bedrock. The summed total REE data in the soils are less than the REE content of the bedrock, so other components "dilute" the REE signature, and may also dampen the Eu anomaly. These other inputs could be organic materials, or reworked and re-introduced glacial material. Two of the most conspicuous features of the bedrock-normalized REE plot at site NK12-072 are the negative Eu anomaly and positive Ce anomaly in the B horizon soils with the hydroxylamine leaches. The positive Ce anomaly is apparent in the "total" leach as well, which is because the "total" leach is the mathematical sum of all of the sequential leaches. The coincident positive Ce anomaly in the B horizon hydroxylamine leaches suggests that Ce may be enriched in this horizon, possibly existing as $CePO_4$ or scavenged by Fe or Mn hydroxides.

The sums of the all the leached data for Al, Fe, K, Mn and Na are greater in the eluvial, or "enriched", B horizon than in the iluvial, or "leached", A horizon soils, while the sums of the leached data for Ca and Mg are greater in the A horizon. This indicates a greater proportion of carbonates in the A horizon (Figure 3.8c).

3.2.2iii – Site NK12-060, the southern site

The vertical profile at this site contains both A and B horizon soils, as well as glacial till originating from the nearby Växjö granites. The different REE patterns in the till and the soils are most easily distinguished in the 4 acid digest (red lines, Figure 3.10b) because it is a near-total digestion that also attacks the silicate portion of the sample. The grey boxed line with the positive Eu anomaly is the granitic fragment (Figure 3.10a&b, labelled) in the vertical profile, and it has a markedly different REE abundance and pattern compared to the local bedrock. The upper and lower till samples (lower red lines) have a similar REE pattern to the angular granitic fragment, but with higher overall REE content, and a more subdued positive Eu anomaly. Moving up-profile, into the A and B horizons (highest red lines), the silicate fraction of the soil resembles the REE pattern of the underlying Norra Kärr bedrock, and has only a slight positive Eu anomaly that could be attributable to contamination from the Växjö granites.



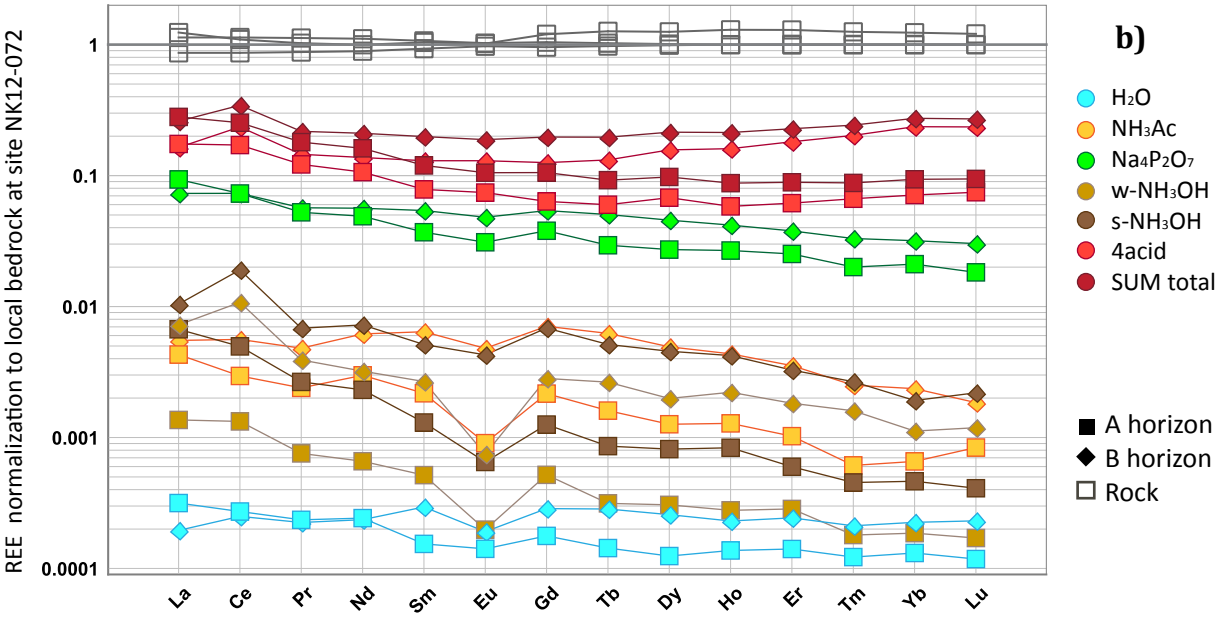


Figure 3.9a (above) – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-072, normalized to global chondrite values (Boynton, 1984). Note the strong negative Eu anomaly in all materials, including bedrock, and the positive Ce anomaly only in the hydroxylamine leaches (brown lines) of the B horizon. Also note the relative depletion of HREEs relative to LREEs.

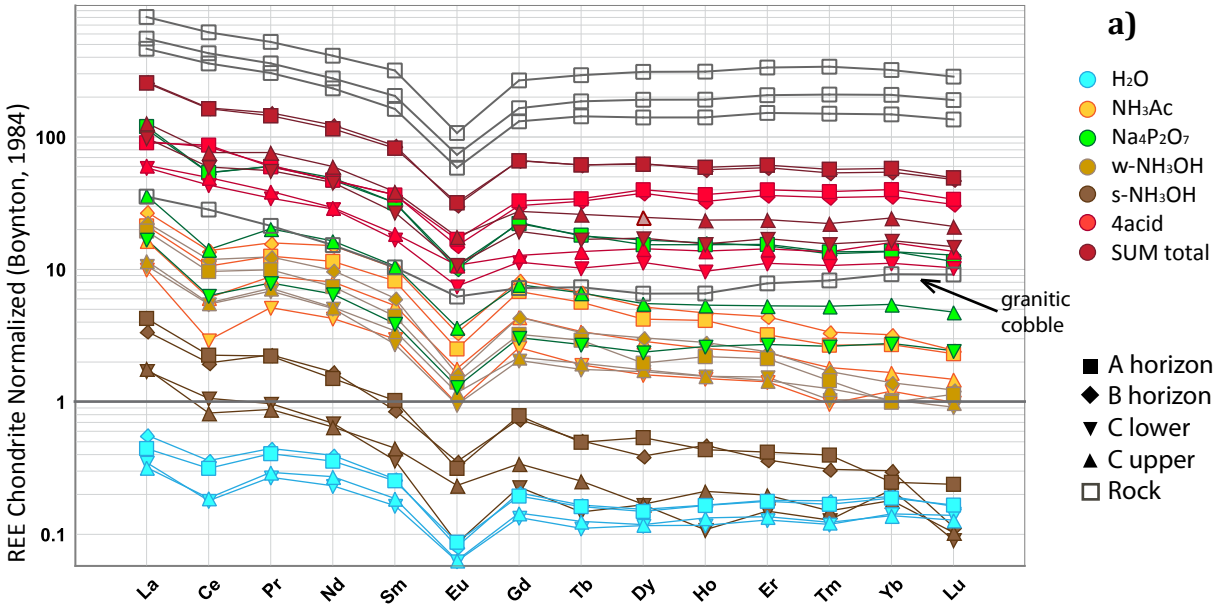
Figure 3.9b (below) – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-072, normalized to local bedrock. Note the "flatness" of all leaches when normalized to local bedrock, with the exception the hydroxylamine leaches on the A horizon soil. Also note that the positive Ce anomaly in the hydroxylamine leached from the B horizon persists.

The process of soil formation starts at the bottom, and therefore the most evolved soils are those now at the surface. The last glacial maximum in this region was approximately 14,000 years ago (Lundqvist and Wohlfarth, 2001) and soil has been forming on top of the till veneer since then. The granitic fragment and tills represent the Växjö granite chemistry, but since the tills were deposited on top of the Norra Kärr alkaline complex, they have been subjected to new surficial processes and are undergoing REE enrichment. This enrichment could be occurring in any one, or combination, of three ways:

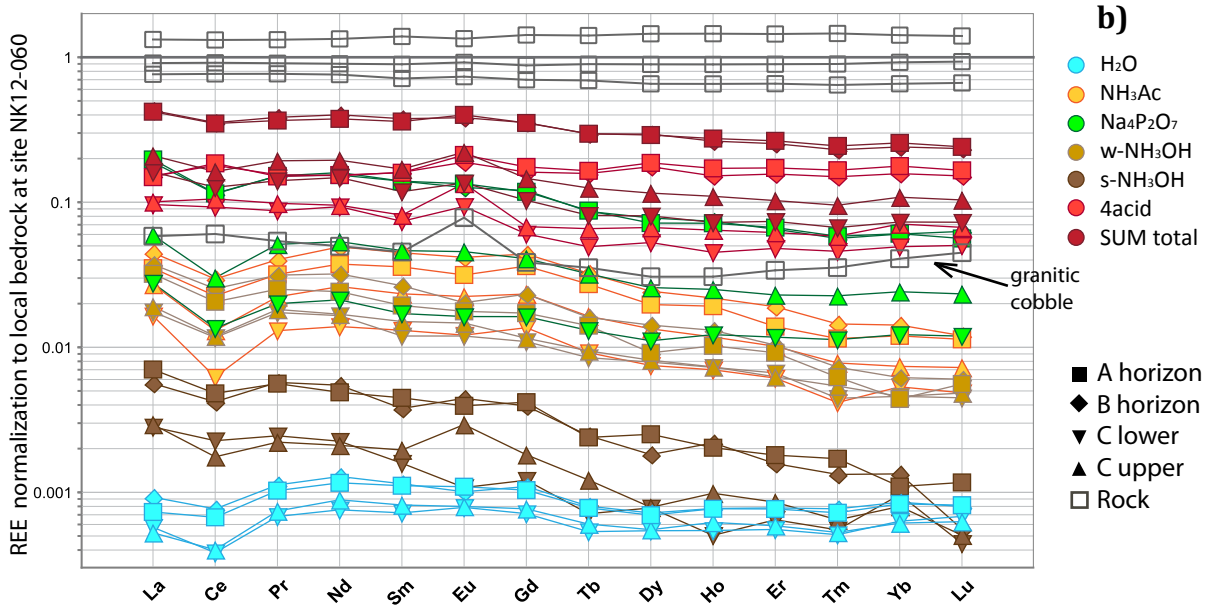
#1) Norra Kärr is a relative topographic high; mineralized colluvium from the deposit may have been transported such that it sits above the till, so REEs liberated via mechanical weathering (cd. Section 1.5.2) of REE-enriched silicate fragments (Figure 3.11) mix with the relatively REE-poor till.

#2) The vegetation at Norra Kärr has elevated REEs in its leafy tissue (Bluemel et al., 2013) so decomposition of local foliage will liberate bio-available REEs, particularly the LREEs.

#3) Humic and fulvic acids are abundant in the A and B horizons, and indeed any molecule with a carboxyl group will complex with trivalent lanthanides (Ln^{3+}) and create stable REE compounds (Yamamoto et al., 2005), so through time REEs may be complexed and sequestered with organic acids, and eventually become incorporated into the till as soil horizons develop.



NK12-060: Sequential leach data normalized to global chondrite values, including till and granitic cobble



Bedrock normalized plot of all sequential leach data from NK12-060, including till and granitic cobble

Figure 3.10a (above) – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-060, normalized to global chondrite values (Boynton, 1984). Note the appearance of a positive Eu anomaly in the samples derived from the granitic source.

Figure 3.10b (below) – Sequential leach, four acid, and summed leach data of surficial materials and bedrock from site NK12-060, normalized to local bedrock. Note the appearance of a positive Eu anomaly in the samples derived from the granitic source.

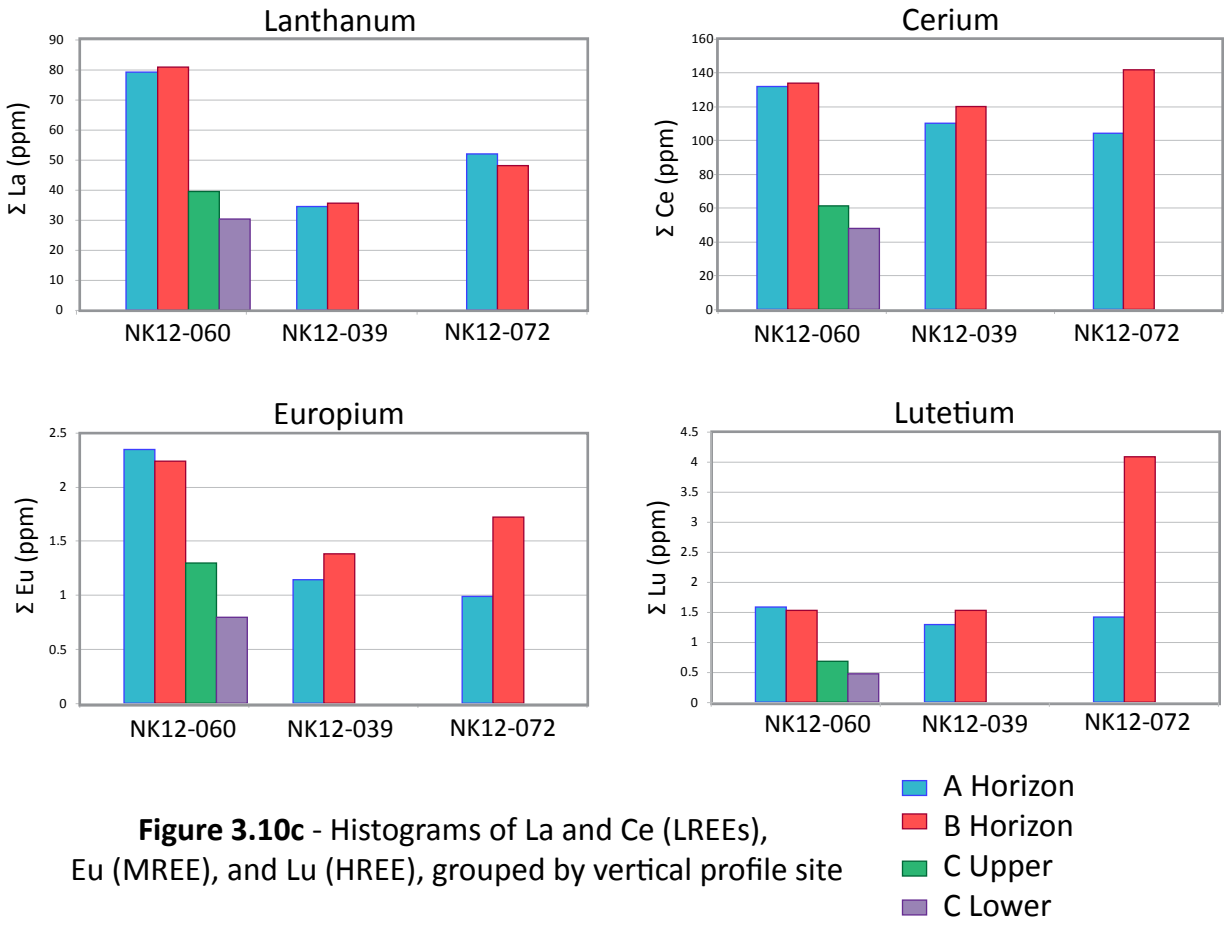


Figure 3.10c - Histograms of La and Ce (LREEs), Eu (MREE), and Lu (HREE), grouped by vertical profile site

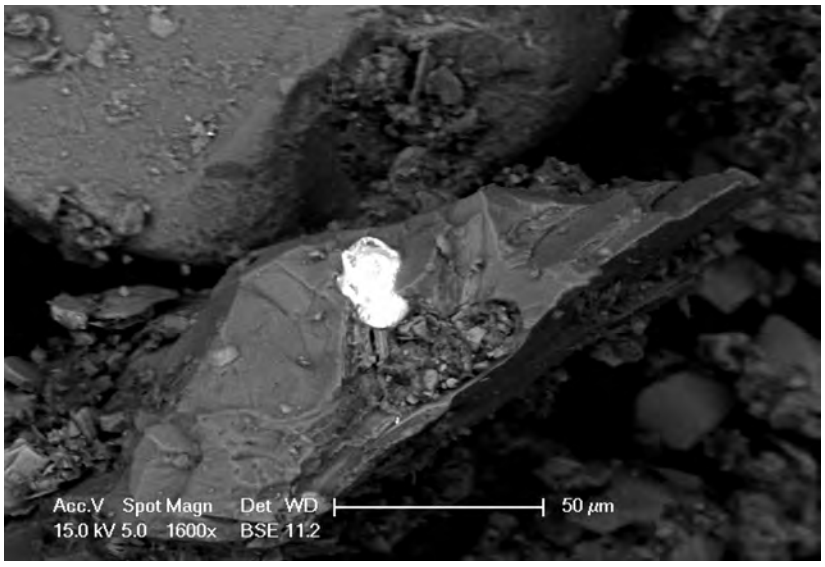


Figure 3.11 - Example photo of a HFSE grain on a silicate soil particle. The HFSE grain is approximately 25um long (medium silt sized)

3.2.3 Sequential Leach Discussion

The greater than expected level of REEs in the $Na_4P_2O_7$ leach, considering it is one of the weaker leaches, indicates that the REEs are being scavenged by organic acids and sequestered within the organic fraction of the soil. The affinity of REEs to form complexes with organic components increases with increasing pH (Lippold et al., 2007) because the trivalent lanthanide (Ln^{3+}) binds to the carboxylic and phenolic functional groups of organic acids and therefore is dependent on deprotonation of these groups (Pourret et al., 2007). Yamamoto (2005) corroborated these findings and found that any molecule with a carboxyl group, even a simple molecule like acetate, could be analogous to humic and fulvic acids. Pourret et al. (2007) found that the degree of binding between humic acids and Ln^{3+} was also dependent on the concentration of humic acids (HAs) in the solution, and that at low concentrations of HA (5mg/L) all of the available Ln^{3+} would be bound at neutral pH, while at higher HA concentrations (20mg/L) there would be complete Ln^{3+} – HA complexation beginning at lower pH, as low as pH = 4.5.

The positive Ce anomaly in the hydroxylamine leaches indicates that Ce is being co-precipitated with Fe and Mn hydroxides, which are therefore acting as a Ce sink (Hem, 1978). The positive Ce anomaly is more obvious in the B horizon than in the A horizon, which corresponds with the higher Fe content in the B horizon than in the A horizon (Figure 3.12).

These findings are significant because they demonstrate two things: #1) there are definitely REEs in solution at Norra Kärr, and they are being hydromorphically dispersed, which leads to the question of the distance travelled by the REEs and their mechanism of dispersion. #2) There is a high proportion of REE content in the sodium pyrophosphate leach, compared to the other "stronger" leaches, therefore we can conclude that a large proportion of the REEs are binding with either humic or fulvic acids and scavenged with organic complexes. This is corroborated by work done by Shan, 2002; Pourret et al. (2007); and Marsac et al. (2012).

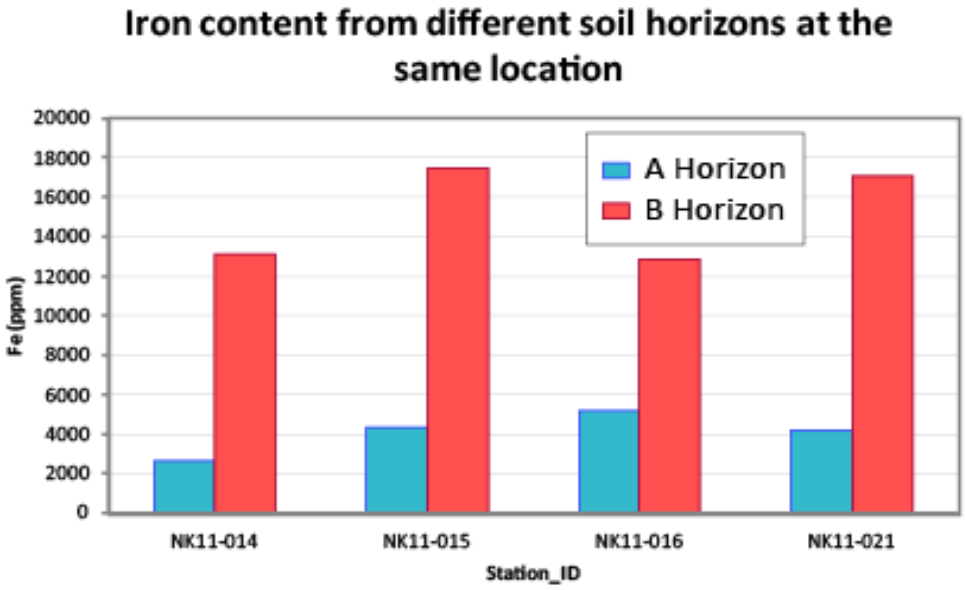


Figure 3.12 – Differences in Fe content in the Ah and B horizon soil samples collected from the same location

3.3 Fern Chemistry

Complete fern plants were collected in August 2012 from locations that were selected based on high REE content in fern leaves the previous summer (see Section 5.3.4). The fern fronds and root bulbs were separated in the field (see Section 2.2) and analysed in three parts; roots, stems, and leaves, in order to establish where the fern is sequestering the REEs. This also helps to determine which part of the fern is the most effective sample media for biogeochemical exploration.

Rare earth element content in fern plants generally increases from stem < leaf < root. These findings agree with those of Fu et al. (1998), who studied spatial REE variation in the fern species *Matteuccia* in order to determine the provenance of the REEs in the fern tissue. Fu et al. (1998) hypothesized that REEs had once been in solution, were originally derived from silicate particles in the soil, and were finally being stored in the cortex of the rootlet. This supports the findings at Norra Kärr, where the highest HREE content is in the root, but the highest LREE content in the leafy tissue. This will be addressed in more detail in Section 3.3.3.

There is a paucity of information regarding the limits upper threshold of REEs possible in a living plant before physiological processes are inhibited. It is likely that the presence of REEs in the natural system will have a greater effect on the soil micro-flora than on the plant physiology, therefore, which in turn will contribute to the cycling of major nutrients in the soil (Jenkinson and Ladd, 1981) particularly in the case of Gd^{3+}, which is readily absorbed onto various microorganisms (Andres et al. 2000)

The three fern plants displayed similar REE distributions within the different tissue types, even though two of the fern plants were *Dryopteris filix-mas* and the other was *Athyrium filix-femina*. Generally the *Athyrium filix-femina* had lower levels of HREEs, and in the stem tissue it had elevated levels of LREEs compared to the *Dryopteris filix-mas* samples. Of particular note is that the leaf and stem tissues are more strongly fractionated with respect to the LREEs than the root tissue (Figure 3.13). This implies that there is some fractionation mechanism within the fern plant that preferentially transports LREEs over HREEs, likely due to their different ionic radii.

There is a well documented phenomenon known as the “lanthanide contraction”, whereby the ionic radii of the lanthanides become smaller with increasing atomic number, due to shielding effects of the 4f electrons. This is significant because the light and middle REEs have ionic radii similar to that of the Ca and P ions, which could explain in part why the LREEs appear to travel more freely than the HREEs within the biological system.

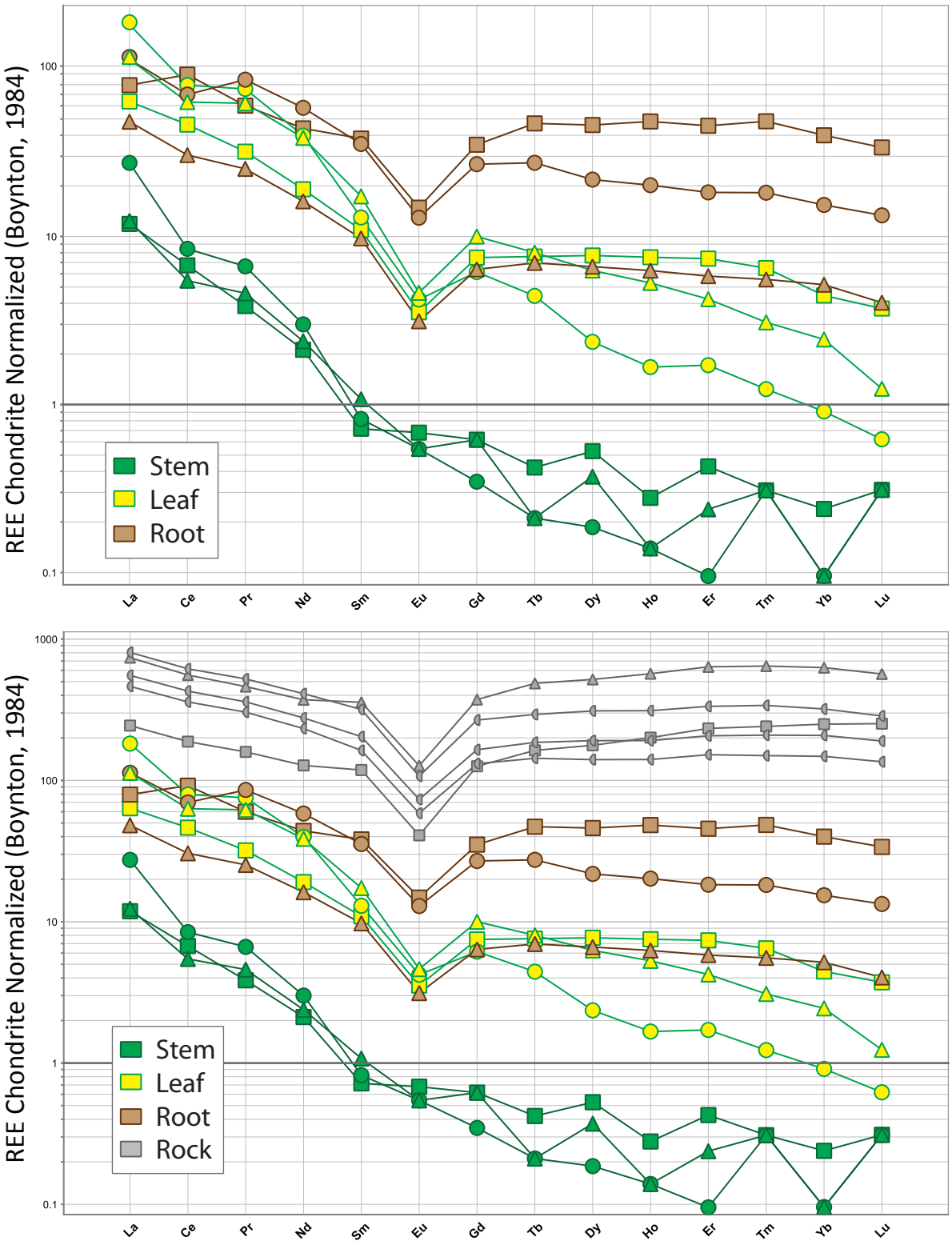


Figure 3.13 (above) – Chondrite normalized plots of leaf, root, and stem tissue from all three vertical profile sites. Note the decrease in REE content from stem < leaf < root.
Figure 3.14 (below) – Chondrite normalized plots of leaf, root, and stem tissue from ferns at all three vertical profile site, with lithogeochemical data added for reference

	NK12-039 (D.Fm)			NK12-060 (A.Ff)			NK12-072 (D.Fm)		
Element (ppm)	Root	Leaf	Stem	Root	Leaf	Stem	Root	Leaf	Stem
La	24.63	19.7	3.68	35.1	56.47	8.49	14.93	35.13	3.84
Ce	74.18	37.41	5.44	56.46	64.21	6.82	24.66	50.98	4.41
Pr	7.32	3.9	0.47	10.45	9.2	0.81	3.08	7.56	0.56
Nd	26.37	11.46	1.27	34.96	23.87	1.8	9.71	23.18	1.43
Sm	7.46	2.13	0.14	6.92	2.53	0.16	1.9	3.38	0.21
Eu	1.09	0.26	0.05	0.95	0.31	0.04	0.23	0.34	0.04
Gd	9.1	1.94	0.16	6.97	1.59	0.09	1.65	2.59	0.16
Tb	2.23	0.36	0.02	1.3	0.21	0.016 (>0.01)	0.33	0.38	0.013 (>0.01)
Dy	14.82	2.48	0.17	7.02	0.76	0.06	2.13	2.02	0.12
Ho	3.47	0.54	0.02	1.45	0.12	0.004 (<0.01)	0.45	0.38	0.017 (>0.01)
Er	9.57	1.55	0.09	3.84	0.36	0.02	1.22	0.89	0.05
Tm	1.57	0.21	0.02	0.59	0.04	0.002 (<0.007)	0.18	0.1	0.0045 (<0.007)
Yb	8.36	0.93	0.05	3.22	0.19	0.02	1.08	0.51	0.02
Lu	1.09	0.12	0.005 (<0.009)	0.43	0.02	0.001 (<0.009)	0.13	0.04	0.003 (<0.009)
ΣREE	191.26	82.99	11.58	169.66	159.88	18.31	61.68	127.48	10.84
Y	77.5	19.74	1.21	40.57	4.483	0.267	11.57	11.43	0.497
Zr	142.3	0.57	0.21	30.55	2.23	0.58	66.77	0.73	0.36

Table 3.5 – REE content in leaf, root, and stem tissue at each vertical profile site

3.3.1 Root

The REE content in the root samples of each fern plant is listed in Table 3.5, and the ΣREE content ranges from 58.6 ppm to 183.94 ppm. The root samples have higher HREE values than the stem or leaf at all sites, but lower LREE values, particularly with respect to La and Ce. The northernmost site (NK12-072) is located directly over HREE mineralized outcrop, and the root tissue collected here actually displays *lower* LREE content than the corresponding leaf tissue, but higher HREE content (Figure 3.13 and 3.14). This indicates the LREEs are more mobile within the plant than the HREEs. The root sample from the southernmost site (NK12-060) displays a negative Ce anomaly, corresponding with the soils from that site (see Section 3.2.2iii).

There is a small degree of LREE enrichment in the root samples compared to the rock samples, but generally the slope of the root REE line approximates the slope of the REE line from the bedrock (Figure 3.14).

3.3.2 Stem

The stem samples from each site, and for each fern species, contain much lower levels of all REEs than the corresponding root or leaf tissue from the same fern (Figure 3.13). This could be attributable to the mechanism by which plants protect themselves from high concentrations of harmful elements by preferentially sequestering the harmful elements in tissues that are non-essential for metabolic function. It is also possible that there is a "threshold" REE content in fern stems. There may be a finite number of sites within the cell wall that a REE can occupy, and once all

of these sites are filled, the REEs must travel further through the plant system before they can be deposited.

The most notable feature of the chondrite normalized plot displaying the REE content in the stems is the enrichment of LREEs, especially compared to the roots and rocks, and the stem tissue is depleted in all REEs heavier than Sm (Figure 3.14).

3.3.3 Leaf

The leaf tissue has intermediate HREE values between the stems and the roots. Like the stems, the leaves display LREE enrichment, relative to the roots, and the degree of enrichment is approximately equivalent between the stems and the leaves, meaning that the slope of the REE chondrite normalized line from La to Eu is approximately the same for the stem and leaf samples, whereas the slope of the chondrite normalized line for the root tissues is much less steep. One root tissue sample has comparable HREE levels to the leaf tissue, but generally the leaf tissues have fewer HREEs and more LREEs than their corresponding root counterparts.

The leaves also show a wide range of variability for the heaviest and lightest REEs compared to the variability observed for the MREEs. The REE content in the leaf tissue ranges from 19.7 ppm to 56.47 ppm for La, and 0.02 ppm to 0.12 ppm for Lu, but for Eu the variation is only 0.26 ppm to 0.34 ppm. The standard deviation for La is 18.46, while one standard deviation for Eu is only 0.04 ppm, but since this is based on three samples, the statistics are not robust enough for a detailed analysis. The Lu content is quite low (0.05 ppm) but this is not surprising because levels of Lu are quite low in the continental crust (Lu = 0.0381 ppm, Taylor and McLennan (1995)). Both the leaf and the stem tissue exhibit similar REE patterns; they are both highly enriched in the LREEs, enriched in the MREEs, and the depleted in HREEs with the exception, of course, of Eu.

3.3.4 Fern Chemistry and Sequential Leach Data

The most striking feature of the sequential leach paired with the vegetation data is that the chondrite normalized patterns and REE magnitude in the fern leaf and root are nearly equivalent to the sodium pyrophosphate selective leach on the B and A horizons. Since sodium pyrophosphate extracts elements complexed with organic acids, such as humic or fulvic acid, the comparability of the REE content in the roots and leaves of the ferns suggests that the “selective leach” performed by the roots on the soil is analogous to the action of sodium pyrophosphate.

This corollary is not visible in the upper or lower C samples because organic acids are not abundant in this horizon.

The transfer factors from root tissue to leaf tissue range from 0.4, in the case of the LREEs from site NK12-072, to 21.5, in the case of the HREEs from site NK12-060 (Table 3.6). In all three vertical profiles, the transfer factor for the HREEs is greater than the transfer factors for the MREEs or the LREEs, meaning the HREE concentration in the root is much greater than the concentration of HREE in the leaf. This difference of transfer factor is likely a function of increased mobility of the LREEs within the plant.

Element	Transfer Factor (root to leaf)		
	NK12-039	NK12-060	NK12-072
La	1.3	0.6	0.4
Ce	2.0	0.9	0.5
Pr	1.9	1.1	0.4
Nd	2.3	1.5	0.4
Sm	3.5	2.7	0.6
Eu	4.2	3.1	0.7
Gd	4.7	4.4	0.6
Tb	6.2	6.2	0.9
Dy	6.0	9.2	1.1
Ho	6.4	12.1	1.2
Er	6.2	10.7	1.4
Tm	7.5	14.8	1.8
Yb	9.0	16.9	2.1
Lu	9.1	21.5	3.3

Table 3.6 – REE transfer factors from root to stem for all three vertical sample sites

3.3.5 Summary

#1) Norra Kärr is a relative topographic high, so any mineralized colluvium from the deposit will sit above the till and erode to liberate REEs (see Chapter 1.5.2), and REE-enriched silicate fragments will mix with the relatively REE-poor till.

#2) The vegetation at Norra Kärr has elevated amounts of REEs in its leafy tissue (Bluemel, 2013) so decomposition of local foliage will liberate bio-available REEs, particularly the LREEs.

#3) Humic and fulvic acids are more abundant in the A and B horizons than the underlying till. These organic compounds, and indeed any molecule with a carboxyl group, will complex with trivalent lanthanides (Ln^{3+}) and create stable compounds (Yamamoto et al., 2005), so through time REEs may be complexed and sequestered with organic acids, and eventually become incorporated into the till as soil horizons develop.

3.4 Conclusions

It appears that REEs are being mobilized by the processes of weathering and breakdown of eudialyte crystals from the bedrock at Norra Kärr and are being transported via colluvium, in solution, and recycled with organic material throughout the surficial environment. Samples collected vertically from bedrock through the developed soil horizons and into the overlying ferns show similar REE patterns to the underlying bedrock, with the exception of the leafy parts. Elemental fractionation within the ferns, between the root and the stem, preferentially transports LREEs rather than HREEs into the leafy tissue. This likely occurs because the LREEs have similarly sized ionic radii as the cations of essential macronutrients, such as Ca, Mg, P and K (e.g. the ionic radius of Nd^{3+} is 0.100 Å, whereas the ionic radius of Ca^{2+} is 0.099 Å).

The Norra Kärr REE deposit is buried by transported Quaternary sediments, upon which soil horizons have been developing with elemental input from the REE-enriched bedrock. The glacial till and Norra Kärr bedrock have different REE signatures emphasizing that the till was derived from the regional granitoids. However, the upper soil horizons, A and B, are both enriched in REEs relative to their parent C horizon, demonstrating that REEs originating from the bedrock have been mobilized and incorporated into the upper soil horizons. The A and B horizons have higher organic matter contents, and are therefore better trap sites because REEs can be sequestered through the formation of complexes with humic and fulvic acids.

Chapter 4 - Seasonal and Species Variation

4.1 Species Variation

The ability of a plant to incorporate REEs into its living tissue is a function of its morphology and evolutionary adaptations. The more highly evolved a plant is, the more "barrier mechanisms" (Kovalevsky, 1987) it will have which allow it to selectively uptake some elements over others through its root system. Ten different plant species were sampled in June 2011 to determine which species could accumulate the highest levels of REEs in its tissue. The Latin and common name of each species collected, as well as the median values of all REEs, are presented in Table 4.1. Comparisons of elemental variation in the different plant species at Norra Kärr have been made using data with the below detection limit values replaced with positive half of the detection limit (see Section 2.6) because, with the exception of the fern species, the ashed Norway spruce twigs, and the feather moss, all samples either fall below the certified REE detection limit, or hover close to it, and only the fern data appear to be reliable below the detection limit.

Common Name	Tissue	Latin Name	Median ΣREE	Number of samples	Median ΣLREE	Median ΣHREE
Alder	leaf	*Alnus glutinosa*	1.02	2	0.92	0.09
Ash	leaf	*Fraxinus excelsior*	0.98	2	0.90	0.07
Birch	leaf	*Betula pendula*	0.17	9	0.09	0.07
Wood Fern	leaf	*Dryopteris filix-mas*	23.36	12	23.00	0.32
Lady Fern	leaf	*Athyrium filix-femina*	56.21	20	55.73	0.35
Bracken	leaf	*Pteridium aquilinum*	8.66	60	8.57	0.08
Hazelnut	leaf	*Corylus avellana*	0.59	2	0.51	0.07
Norway Spruce (ashed)	twig	*Picea abies*	10.46	60	9.84	0.59
Norway Spruce (dry weight equiv*)	twig	*Picea abies*	0.38	60	0.30	0.07
Oak	leaf	*Quercus robur*	0.47	9	0.39	0.07

Table 4.1 – Common and Latin names of species collected from Norra Kärr, including number of each species and tissue sampled.

4.1.1 REE Variation in All Species

The median values of the sums of the REEs, HREEs, and LREEs have been compared instead of the absolute values to highlight trends in the LREEs relative to the HREEs. The ΣLREEs show very similar patterns to the ΣREEs, because the LREEs are present in higher abundances than the HREEs, so the ΣREEs is more strongly influenced by the total amounts of LREEs.

The highest levels of REEs are found in the fern species *Athyrium filix-femina* (median ΣREE 56.21 ppm). There are higher levels of REEs present in the single moss mat sampled (ΣREE = 136.52 ppm), but since it still had its roots attached, it is extremely likely that there was contamination by soil particulates adhering to the rootlets. Lower levels of REEs, median ΣREE 23.36 ppm, are found in the fern species *Dryopteris filix-mas*. The third highest levels of REEs are observed in the fern species *Pteridium aquilinum* (median ΣREE 8.66 ppm), which has approximately the same REE content as the ashed twigs of the Norway Spruce (median ΣREE 10.46 ppm). The levels of LREEs are slightly higher in *Alnus* than in *Fraxinus*, *Quercus*, and *Corylus*. There is no visible fractionation among the HREEs because the abundances have dropped well below the reportable detection limits. *Betula* has the lowest levels of REEs in its tissue (median ΣREE 0.17 ppm).

The ΣLREEs and ΣHREEs show similar patterns at high REE concentrations; the fern species *Athyrium filix-femina* and *Dryopteris filix-mas* have the highest REE content for the ΣREEs and ΣLREEs, however, ashed Norway Spruce twigs have comparable ΣHREE content to *Dryopteris filix-mas*. The formula used to calculate elemental dry weight equivalencies from ashed analytical data is given in Equation 4.1. At this point it is important to reiterate that reducing any organic material to ash, and analysing the ash will give results higher than analysing the dry tissue. In these experiments the ashed Norway spruce twigs returned REE values tens to hundreds of times greater than the calculated dry weight values, with only Y, La, and Ce showing REE content above the certified detection limit. With this in mind, considering the goal of this research is to identify the most effective biogeochemical exploration tool for REE mineralization, the fern species *Athyrium filix-femina* and *Dryopteris filix-mas* remain the most suitable candidates.

$$\text{Dry weight equivalent} = \text{Element concentration in ash} \times \left(\frac{\text{ash weight}}{\text{dry weight}} \right)$$

Equation 4.1 – Calculation of elemental concentration in dry weight of plant material based on elemental concentrations in ashed material and ash yield (Dunn, 2007).

4.1.2 Essential Nutrient Variation in All Species

The essential macronutrients are grouped as K, Ca, Mg, P and S by Taiz and Zeiger (2010). Each macronutrient is used by the plant for a different metabolic function; K, Ca, and Mg are nutrients that remain in ionic form, K being a principle cation in establishing cell turgor and maintaining cell electroneutrality, Ca being a constituent in the middle lamellae of cell walls, and Mg being a constituent of the chlorophyll molecule. Phosphorus is a component of sugar phosphates and nucleic acids, and has a key role in reactions that involve adenosine triphosphate (ATP), and S is a component of several amino acids.

All of the macronutrients display similar behaviour in each of the species sampled, with a few interesting exceptions (Table 4.2). The Ca levels in Hazelnut, average 1.4%, are considerably

higher than all of the other species, which range in average Ca content from 0.2% to 1.0% (Figure 4.1). Of particular note is that the 3 fern species have lower Ca levels than the other species sampled, but the fern species have high REE content relative to the other plants, so there appears to be an inverse relationship between Ca content and REE content.

		Alder	Ash	Birch	Lady fern	Wood fern	Bracken	Hazelnut	Norway Spruce*	Oak
Element	*Standard value^*	*Alnus glutinosa*	*Fraxinus*	*Betula*	*Athyrium filix-femina*	*Dryopteris filix-mas*	*Pteridium aquilinum*	*Corylus*	*Picea abies*	*Quercus*
Ca (pct)	***0.5***	0.9	1.0	0.7	0.3	0.5	0.2	1.4	0.4	0.6
P (pct)	***0.2***	0.2	0.3	0.2	0.2	0.3	0.2	0.3	0.1	0.2
K (pct)	***1.0***	1.2	1.2	0.8	2.1	1.8	1.8	1.1	0.5	1.1
Mg (pct)	***0.2***	0.2	0.4	0.3	0.3	0.3	0.2	0.4	0.1	0.2
S (pct)	***0.1***	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.0	0.2
Fe (ppm)	***100***	116	77	73	69	68	63	102	56	73
B (ppm)	***20***	15	13	14	14	12	9	14	8	15
Mn (ppm)	***50***	488	785	1490	55	294	67	1470	517	1089
Na (ppm)	***10***	60	52	50	291	72	48	53	111	52
Zn (ppm)	***20***	77	14	192	22	49	24	25	64	22
Cu (ppm)	***6***	24	5	6	9	7	7	9	5	8
Ni (ppm)	***0.1***	1.4	1.3	2.7	0.3	1.6	1.1	3.0	1.0	0.9
Mo (ppm)	***0.1***	0.9	0.2	0.1	0.3	0.2	0.1	0.1	0.1	0.1

Table 4.2 - Average macronutrient and micronutrient content in each species, compared to standard tissue levels of essential elements required by most plants^ (Epstein, 1999). *All samples are leafy tissue with the exception of Norway Spruce, which is twig tissue, which has been reduced to ash and back calculated to represent dry tissue element concentration.

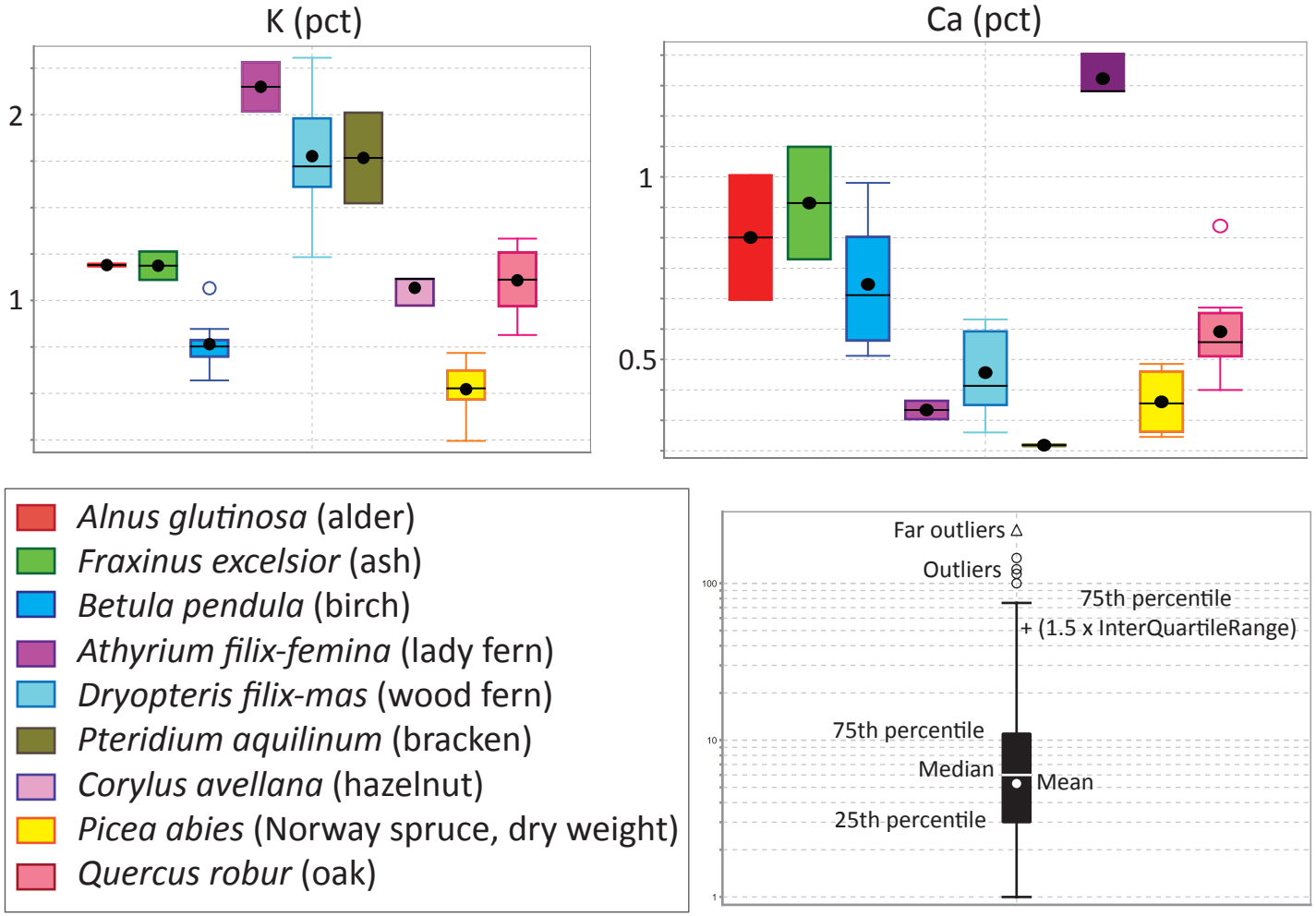


Figure 4.1 - Box and whisker plots of K (left) and Ca (right) for all sampled species. The hazelnut has much higher Ca content than any other plant, and all 3 fern species have more K than Ca

The opposite is true of potassium, because the three fern species all have high levels of K compared with the other plants (range of average K content in ferns: 1.8%-2.1%, range of average K content in other plants: 0.5%-1.2%). This is particularly interesting because there is a correlation between K and the REEs, and it is especially strong for the LREEs. This correlation is particularly visible once the Norway Spruce data has been recalculated to represent the dry weight values of the essential macronutrients. The concentration of essential macronutrients in the ashed Norway Spruce data is many times higher than the macronutrient content in the dry tissue of the other plants, so the subtle REE-K correlation is swamped by the strong K-Ca-Mg-P-S correlation (Figure 4.2). Box and whisker plots of K and Ca data are displayed in Figure 4.1.

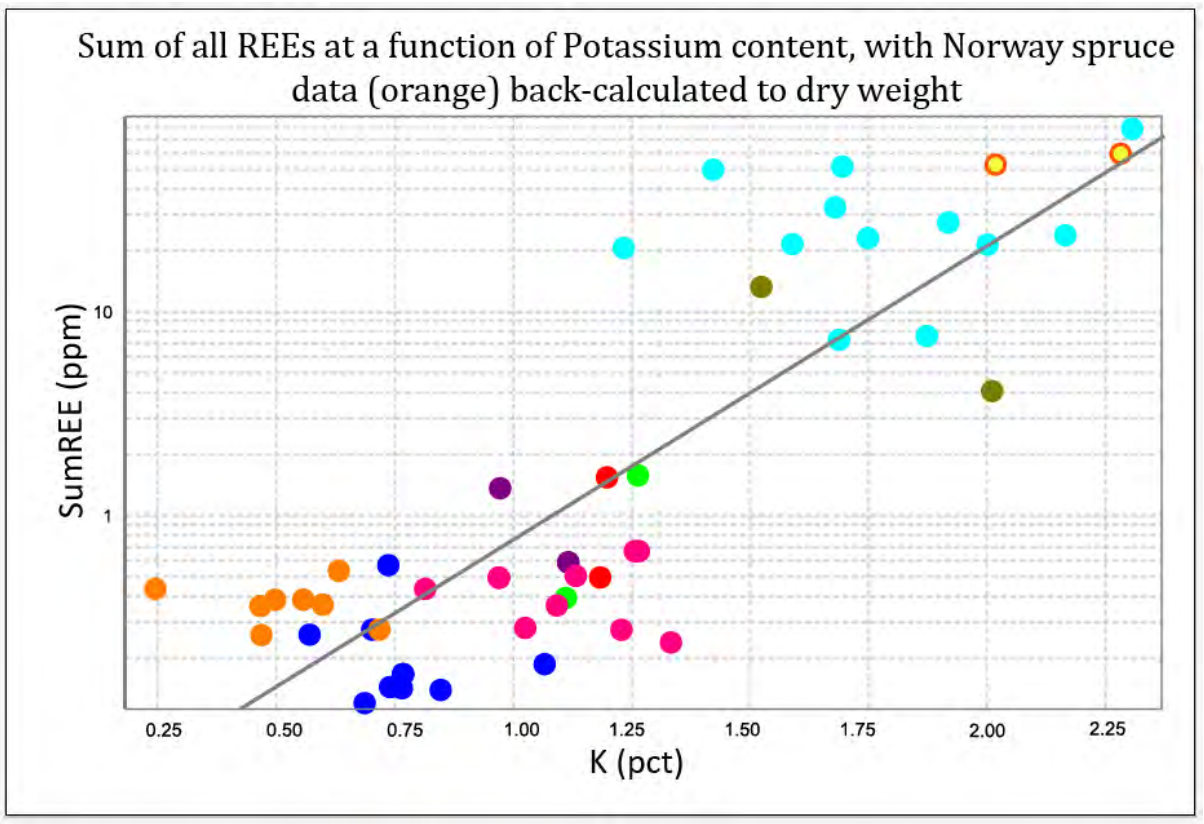


Figure 4.2 - ΣREEs as a function of potassium for all species, with Norway recalculated to a dry weight basis

There is also a correlation between the majority of the REEs and Al, as well as a correlation between Na-Al, and Na-Eu. The mineralization is hosted by a peralkaline nepheline syenite, so it's not surprising that there is a correlation between Na and the REEs because, by definition, peralkaline rocks have excess Na and K relative to Al for the formation of feldspars (Section 1.3.2). The deposit is surrounded by granitic rocks, so the majority of the bedrock in the area is comprised of aluminosilicates, so it is not surprising to see elevated Al as well as Na in the surficial environment.

4.2.1 REE Variation in Fern Species

The three species of ferns have significantly different chemical compositions. *Pteridium aquilinum* has the lowest REE values; *Athyrium filix-femina* has the highest REE values, and *Dryopteris filix-mas* has intermediate values between the other two species (Figure 4.3). Similar behaviour and mobility within the HREEs (Tb, Dy, Ho, Er, Tm, Yb, Lu) the LREEs (La, Ce, Nd) and the MREEs (Sm, Eu, and Gd), is well documented (see Section 1.6), and is observable in the HREE and LREE content in the ferns.

All three fern species fractionate the LREEs preferentially, and they all exhibit a subtle negative Eu anomaly. The Eu anomaly is less apparent for *Pteridium aquilinum* because that species has low HREE content, and the data are more scattered on the heavy side of the chondrite normalized plot due to poor data quality nearing the detection limit (Figure 4.3).

4.3 Seasonal Variation

4.3.1 REE Variation

In August 2011 an assortment of media was collected to compare the seasonal variation at the beginning and the end of a growing season. Among the media were seven ferns, six of which were *Dryopteris filix-mas*. The other was *Pteridium aquilinum*. These six *Dryopteris filix-mas* samples were compared to the *Dryopteris filix-mas* samples collected at the beginning of the summer to establish whether there was any elemental variation in the sampled ferns that could be attributed to seasonal variation.

The median REE values for *Dryopteris filix-mas* samples collected at the end of the summer in 2011 are much higher than the median REE values from the spring of that year (Table 4.3). This increase in REE content can be attributed to their longer growing season, whereby more REEs were able to accumulate in the leafy tissue through the course of the summer because they had more time and greater influx of solutes. *Dryopteris filix-mas* is a deciduous fern, so immature leaves will not have as much accumulation of elements as mature leaves. The Dy content in the *Dryopteris filix-mas* leaves is 15x higher at the end of the summer than in June (Table 4.3).

	La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)
June, 2011	7.83	10.89	1.05	2.67	0.25
August, 2011	27.51	44.79	4.14	12.04	1.48
	Eu (ppm)	**Gd (ppm)**	**Tb (ppm)**	**Dy (ppm)**	**Ho (ppm)**
June, 2011	0.03	0.08	0.01	0.07	0.01
August, 2011	0.15	1.10	0.19	1.09	0.19
	Er (ppm)	**Tm (ppm)**	**Yb (ppm)**	**Lu (ppm)**	**Y (ppm)**
June, 2011	0.03	0.01	0.02	0.01	0.51
August, 2011	0.46	0.06	0.25	0.03	6.85

Table 4.3 - REE seasonal variation in *Dryopteris filix-mas*

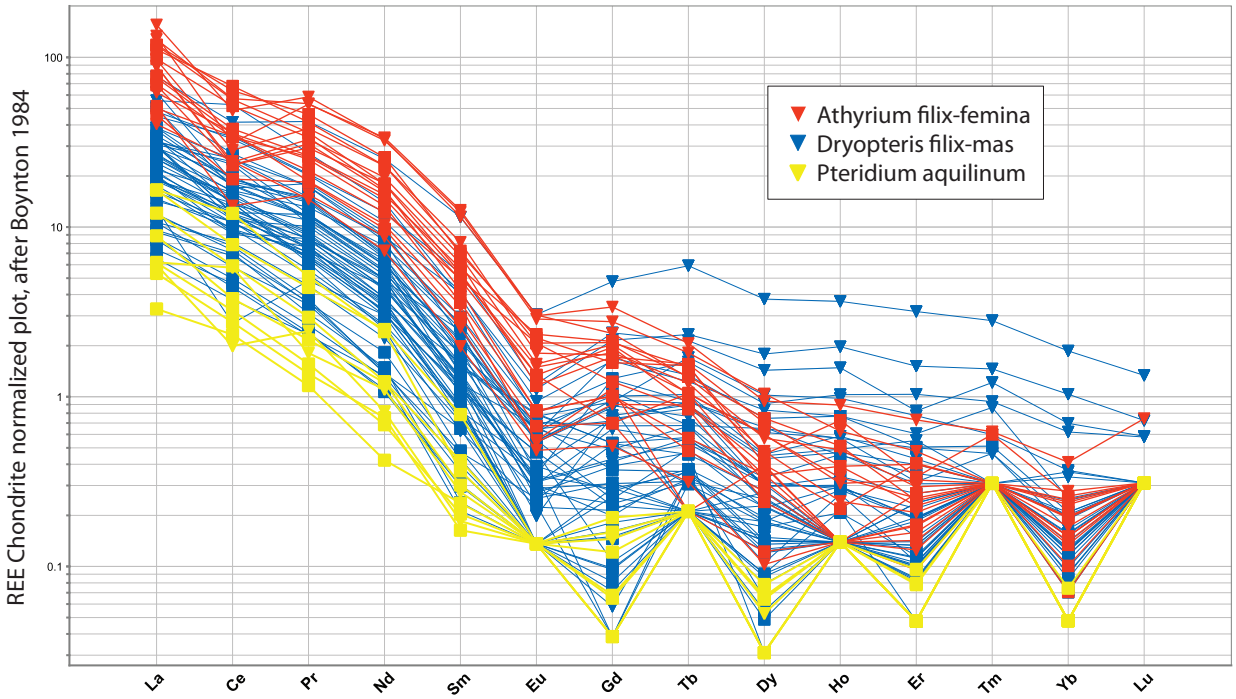


Figure 4.3 - Chondrite normalized plot of three fern species *Dryopteris filix-mas, Athyrium filix-femina,* and *Pteridium aquilinum*. Note relative enrichment of LREEs in *Athyrium filix-femina.*

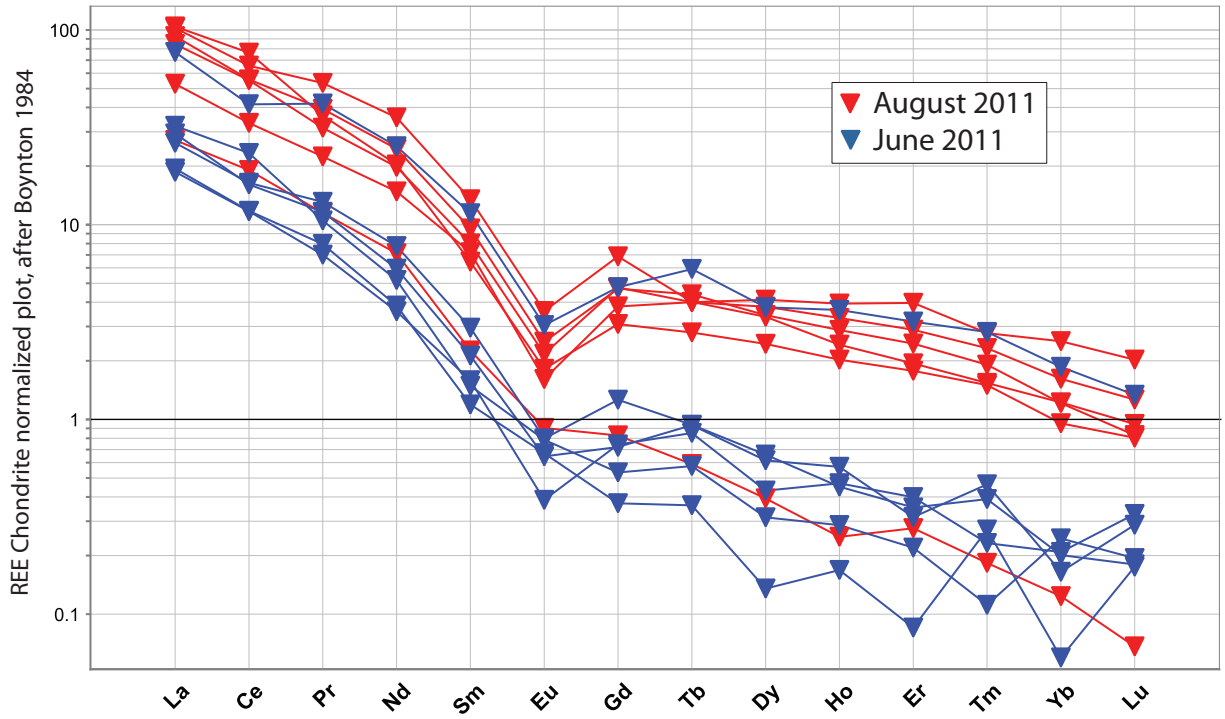


Figure 4.4 - REE content of *Dryopteris filix-mas* samples collected from the same location in June and August, coloured by season.

Samples obtained from the same species at same location, analyzed at the same lab, but collected in different years were also compared. In the instance of NK11-054 compared with NK12-034, which are sample sites are roughly 10 m apart, the REE values doubled, for every element but Tm and Lu, in the *Athyrium filix-femina* sampled at the end of the summer relative to the one sampled in June.

Rare Earth Element content is higher for every sample collected at the end of August, with the exception of NK11-031 (Figure 4.4). Since this site is near the end of one of the sample lines, it has much lower REE values than the other samples which were collected near the centre of the deposit. The inverse is true for site NK11-072; this sample site is directly above a catapleiite-bearing outcrop, and here samples taken in June are extremely high for all REEs. In fact, the REE content of the sample from site NK11-072 has higher REE content, with the exception of La and Ce, than all of the samples taken in August. This is obviously due to its extreme proximity to highly mineralized outcrop. The samples taken from the same site in August also have high REE content, almost identical to the REE content of the sample collected here in June, so while the majority of samples exhibit an increase in REE content throughout the growing season, any ferns directly associated with mineralization will have an "upper threshold" of REE tolerance before the REE concentration becomes adverse to the plant's physiology.

4.3.2 Essential Nutrient Variation

4.3.2 i – Macronutrients – Ca P K Mg S

The levels of macronutrients in the leafy fern tissue at the beginning and the end of the summer are similar, with the exception of Ca and P, which behave inversely. There is more Ca in the leaves at the end of the summer, but there is more P in the leaves at the beginning of the summer. This could be attributable to the increased influx of solutes in the spring, corresponding with the most rapid growth times. Phosphorus has a key role in all biochemical reactions involving ATP (Taiz and Zeiger, 2010), so when the plant is growing and photosynthesizing rapidly, there will be more ATP reactions occurring and therefore higher levels of P. The increased Ca levels in August can likely be attributable to the Ca required in the cell walls. Since the plants are larger at the end of the summer, cell walls in leaves might be thicker because they've been growing longer.

The distribution of the essential macronutrients in fern leaves is displayed in Table 4.2. Tissue levels of macronutrients required by most plants (Epstein, 1999) are shown in italics.

4.3.2 ii – Micronutrients - Fe B Na Mn Cu

The levels of micronutrients within the ferns sampled at the beginning and the end of the summer are generally similar, with the exception of B and Cu. Boron was shown to be correlative with the REEs (Section 5.2) so it follows that whatever part of the leafy tissue is steadily becoming enriched in REEs throughout the growing season is also becoming enrich in B.

Copper exhibits a much larger range of values at the beginning of the summer, suggesting that some ferns sampled in June were able to accumulate more Cu in their leafy tissue than others. This could be a function of varying Cu content in soils at the specific locations, because the ferns that had high Cu in June also had relatively high Cu in August. The highest Cu values were in

Dryopteris filix-mas samples from NK11-031, with greater than 9 ppm Cu in June. Samples taken from the same plant in August had 6.53 ppm Cu. The second pair of samples elevated with respect to Cu were from NK11-039N, and they had a much tighter range of Cu values (6.53 ppm to 6.68 ppm). The site with high Cu values in June, NK11-031, is located at the western end of one of the sample lines. Elevated Cu here could be attributed to availability of organic matter; Howell and Gawthorne (1987) reported the importance of humic and fulvic acid for the solubility of copper. The difference in Cu content is not likely attributable to changing moisture content because none of the other samples showed the same variations, and all of them underwent the same changes in season and therefore available soil moisture.

Manganese content in all of the species sampled at Norra Kärr is much higher than the standard tissue levels of essential elements required by most plants (Table 4.2; Epstein, 1999).

Oak leaves were collected from the same site, NK11-042, in June and August and for each REE, including Y and Zr, the concentration was 30 to 40x higher in the sample collected at the end of the summer. Some of the essential nutrients, such as Ca, Mg, K and B were present in lower levels at the end of the summer, while other essential nutrients, such as S and P, were higher in the samples collected in June. In general, the patterns displayed by the elemental variation in oak leaves corroborate the patterns in the fern fronds, in that the concentration of many essential nutrients, as well as the REEs, is elevated in August.

4.4 Implications for Exploration

The rare earth elements, as well as many other essential micronutrients and macronutrients, are elevated in leafy plant tissue at the end of the growing season, for a variety of species. This demonstrates that the most beneficial time to sample is at the end of the growing season, because the elevated levels of REEs in the plant tissue will make chemical analysis more robust, and the highest contrast in HREEs occurred in the plants sampled in August.

Chapter 5 - Biogeochemical Distribution of Rare Earth Elements in the Surficial Environment at the Norra Kärr Alkaline Complex

Biogeochemical exploration is effective in areas where bedrock is under cover because it takes advantage of the mechanisms of natural elemental mobility within the surficial environment. Buried mineral deposits can have a larger geochemical footprint than the physical extent of the mineralized bedrock because certain labile, or "pathfinder", elements can be mobilized beyond the boundaries of the mineralized bedrock, thus producing a larger halo in the surficial environment for the explorer (Rose et al., 1979). The key to biogeochemical exploration, and indeed all types of geochemical exploration, is determining what elemental geochemical thresholds define "background" in an area, so elements introduced or removed by the mineralizing process will be anomalous relative to that pre-defined threshold (Sinclair, 1974).

To establish background and anomalous REE levels in the surficial environment of southern Sweden, a suite of plant and soil samples were collected. The REE signature in the surficial environment at Norra Kärr is "anomalous" due to proximity of the mineralized alkaline complex, compared to the "background" REE signature in the surficial environment, which results from unmineralized country rock.

Biogeochemical samples (n = 24) were collected on a regional scale, from an area of about 750 km^2, as well as on a local scale, from a 1.5 km^2 area directly around the deposit, with the aim of defining biogeochemical background in this geological setting (Figure 5.1). The Norra Kärr Alkaline Complex (NKAC) has a physical footprint of 0.4 km^2.

5.1 Regional REE Signatures

5.1.1 REE Content in the Fern Species *Dryopteris filix-mas* and *Athyrium filix-femina*

To establish the background concentration of REEs in ferns in the Swedish boreal environment around Norra Kärr, the fern species *Athyrium filix-femina* (n = 17) and *Dryopteris filix-mas* (n = 7) were collected regionally from a large area around the deposit (Figure 5.1a). These samples were collected using the same procedure as all other fern samples. Analyses were performed at the ALS facility in Luleå, northern Sweden (see Section 2.4.3).

Regionally, the ΣREE values in the combined *Athyrium filix-femina* and *Dryopteris filix-mas* populations range from 3.7 to 134.4 ppm, with median ΣREE values of 57.6 and 24.3 ppm, respectively. *Athyrium filix-femina* has two to three times higher median REE contents than *Dryopteris filix-mas*, which is consistent with the total abundances observed in the respective ferns directly associated with the NKAC (see Section 4.1.1). The REE concentrations, grouped by species, are listed in Table 5.1.

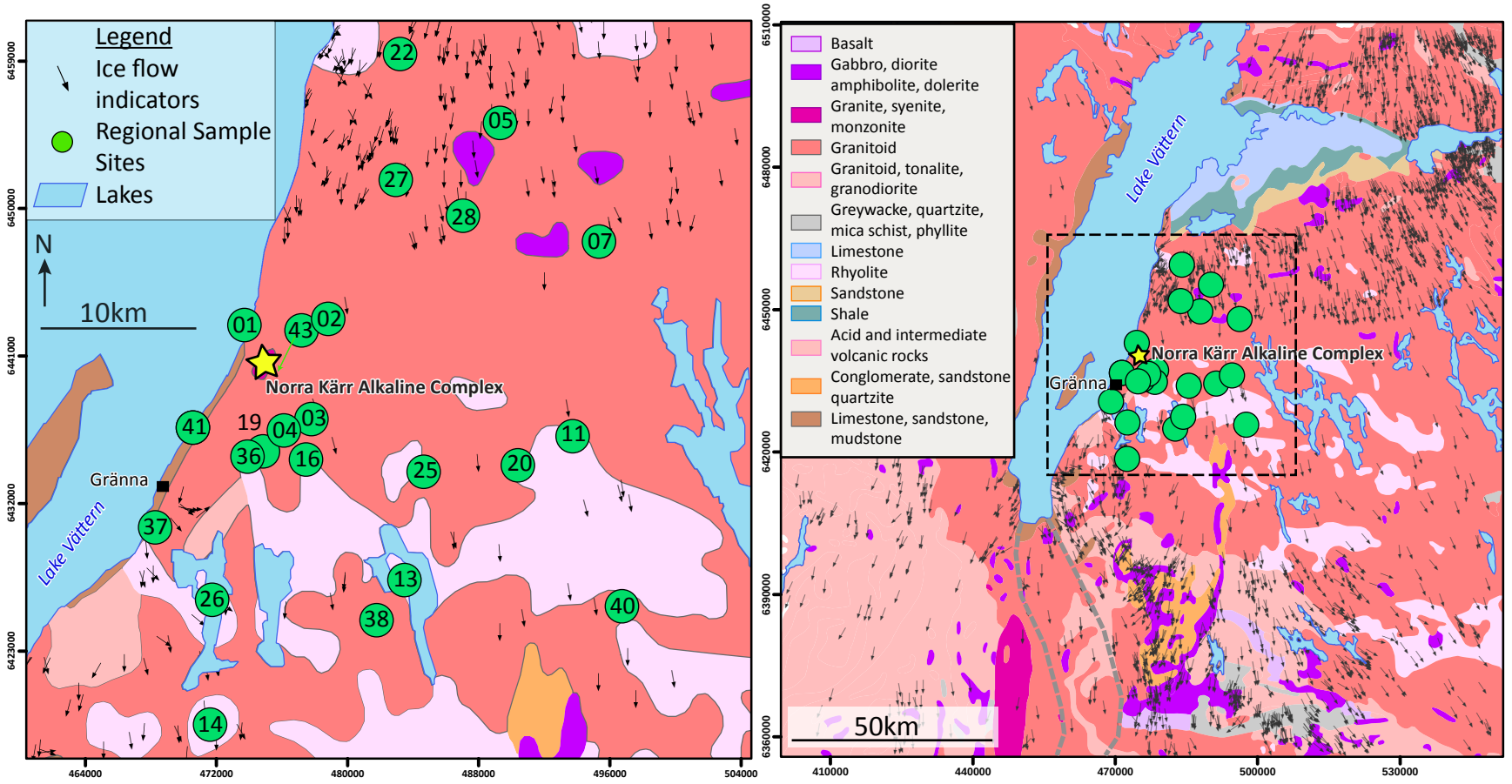


Figure 5.1 - Geological maps of the Norra Karr area (the Alkaline Complex is marked with a yellow star), with ice flow indicators (black arrows) and regional sample station locations (green circles). The local samples (yellow circles, Figure 1.5b, cf Section 1.3.3) cover 1.5 km^2, the regional samples (green circles) cover almost 750 km^2, and the surface trace of the deposit is 0.4 km^2

		Athyrium filix-femina (n = 17)			*Dryopteris filix-mas (n = 7)*		
	DL	Min	Max	Median	Min	Max	Median
La (ppm)	0.001	1.670	54.500	21.700	1.350	23.900	9.910
Ce (ppm)	0.0006	1.980	53.600	22.100	1.800	36.000	8.520
Pr (ppm)	0.01	0.165	5.930	2.870	0.139	2.790	1.480
Nd (ppm)	0.0007	0.373	16.500	9.510	0.317	7.540	3.880
Sm (ppm)	0.0003	0.023	1.840	0.950	0.022	0.718	0.315
Eu (ppm)	0.0004	0.002	0.235	0.095	0.003	0.090	0.027
Gd (ppm)	0.003	0.009	0.963	0.205	0.008	0.336	0.121
Tb (ppm)	0.0009	<0.0009	0.081	0.013	<0.0009	0.036	0.008
Dy (ppm)	0.0008	0.004	0.413	0.097	0.005	0.199	0.050
Ho (ppm)	0.0006	0.001	0.069	0.017	0.001	0.035	0.007
Er (ppm)	0.001	0.002	0.148	0.040	0.003	0.077	0.016
Tm (ppm)	0.001	<0.001	0.014	0.004	<0.001	0.007	0.002
Yb (ppm)	0.002	<0.002	0.065	0.023	<0.002	0.035	0.007
Lu (ppm)	0.0003	<0.0003	0.009	0.003	<0.0003	0.005	<0.0003
ΣREE		4.228	134.367	57.628	3.647	71.767	24.343

Table 5.1 – Ranges of REE content in regional fern samples, grouped by species, analysed at ALS in Luleå, using a microwave-aided nitric-acid digestion with an ICP-MS instrumental finish. The cells highlighted red are below reportable detection limit. The minimum and maximum values obtained from analyses of regional fern material can be used to approximate the range of biogeochemical "background" in the surficial environment above unmineralized country rock. The background range is displayed graphically in Figure 5.6, and the minimum and maximum REE values are estimates of the regional background REE content.

5.1.2 REE Content in Regional Soils

The surficial environment in southern Sweden has been strongly influenced by glaciation. Bedrock outcrops in many places, particularly at topographic highs, whereas lower elevations are typically filled with till and glaciofluvial materials. Residual soils have developed on top of bedrock and till alike in the past 14,000 years, since the last glacial maximum in southern Sweden (see Section 1.3.3), and the surficial materials have been mapped as "thin or discontinuous soil cover" by the SGU (Figure 1.5).

Regional soil samples were collected from 21 sites in southern Sweden to determine the natural REE contents in the Swedish boreal forest (Figure 5.1). Soil samples were collected from the B (n = 17) and C (n = 4) horizons. The median ΣREE value for the B horizon is 128.14 ppm, while the ΣREE value for the C horizon ranges from 104.14 ppm to 465.71 ppm.

The REE patterns in the regional, or "background", soil samples from both the C and B horizons reflect the underlying geology (Figure 5.2). The NKAC is wholly surrounded by Växjö granites, which are part of the Trans-Scandinavian Igneous Belt (TIB, see Chapter 1.3.1, Högdahl et al., 2004). The TIB has slightly lower LREE content and slightly higher HREE content than average granites (Krauskopf and Bird, 1967), and the B and C horizon samples have the same chondrite-

normalized REE patterns. Mineralized nepheline syenites from the NKAC (dark grey points) have many times more REE content than either the TIB (yellow points) or Växjö granites (red points), but the REE pattern, normalized to average granite, is consistent (Figure 5.2). This indicates that the NKAC, TIB, and Växjö granites share a magmatic source and fractionation history, but since Norra Kärr is slightly younger (the alkaline complex is 1.545±61Ga, the TIB is 1.86-1.65Ga), it is more fractionated, and therefore more enriched in REEs.

	TIB (n = 11)	Växjö (n = 4)	Average granite*	B horizon (n = 17)			C horizon (n = 4)	
				Min	Max	Median	Min	Max
La (ppm)	54.0	40.2	101.0	15.60	62.70	24.90	19.40	82.40
Ce (ppm)	114.3	85.3	170.0	33.20	96.40	59.60	46.30	224.00
Pr (ppm)	12.3	9.2	19.0	3.38	14.40	5.47	4.59	20.90
Nd (ppm)	51.3	34.4	55.0	12.20	56.20	19.70	17.20	80.10
Sm (ppm)	8.0	5.9	8.3	2.40	10.90	3.70	3.12	14.20
Eu (ppm)	1.4	0.8	1.3	0.58	2.16	0.74	0.79	3.00
Gd (ppm)	6.6	5.1	5.0	2.35	9.86	3.50	3.23	13.10
Tb (ppm)	1.1	0.7	0.5	0.41	1.40	0.55	0.57	1.86
Dy (ppm)	5.7	3.8	2.4	2.64	7.66	3.60	3.18	10.80
Ho (ppm)	1.2	0.7	0.4	0.58	1.63	0.79	0.70	2.21
Er (ppm)	3.0	2.1	1.2	1.85	4.42	2.40	2.18	6.05
Tm (ppm)	0.5	0.3	0.2	0.28	0.63	0.36	0.32	0.84
Yb (ppm)	3.3	2.7	1.1	1.89	3.73	2.45	2.18	5.39
Lu (ppm)	0.5	0.3	0.2	0.32	0.58	0.38	0.38	0.85
ΣREE	**263.1**	**191.5**	**365.5**	**77.68**	**272.67**	**128.14**	**104.14**	**465.71**
Y (ppm)	34.3	19.8	13.0	16.10	44.30	21.30	19.10	57.80

Table 5.2 – Ranges of REE content and Y in regional soils, grouped by horizon. *Average Granite composition from Krauskopf 1967, average Växjö granite composition ("Växjö") from Appelquist 2010, and average Trans-Scandinavian Igneous Belt ("TIB") composition from Christensson 2013.

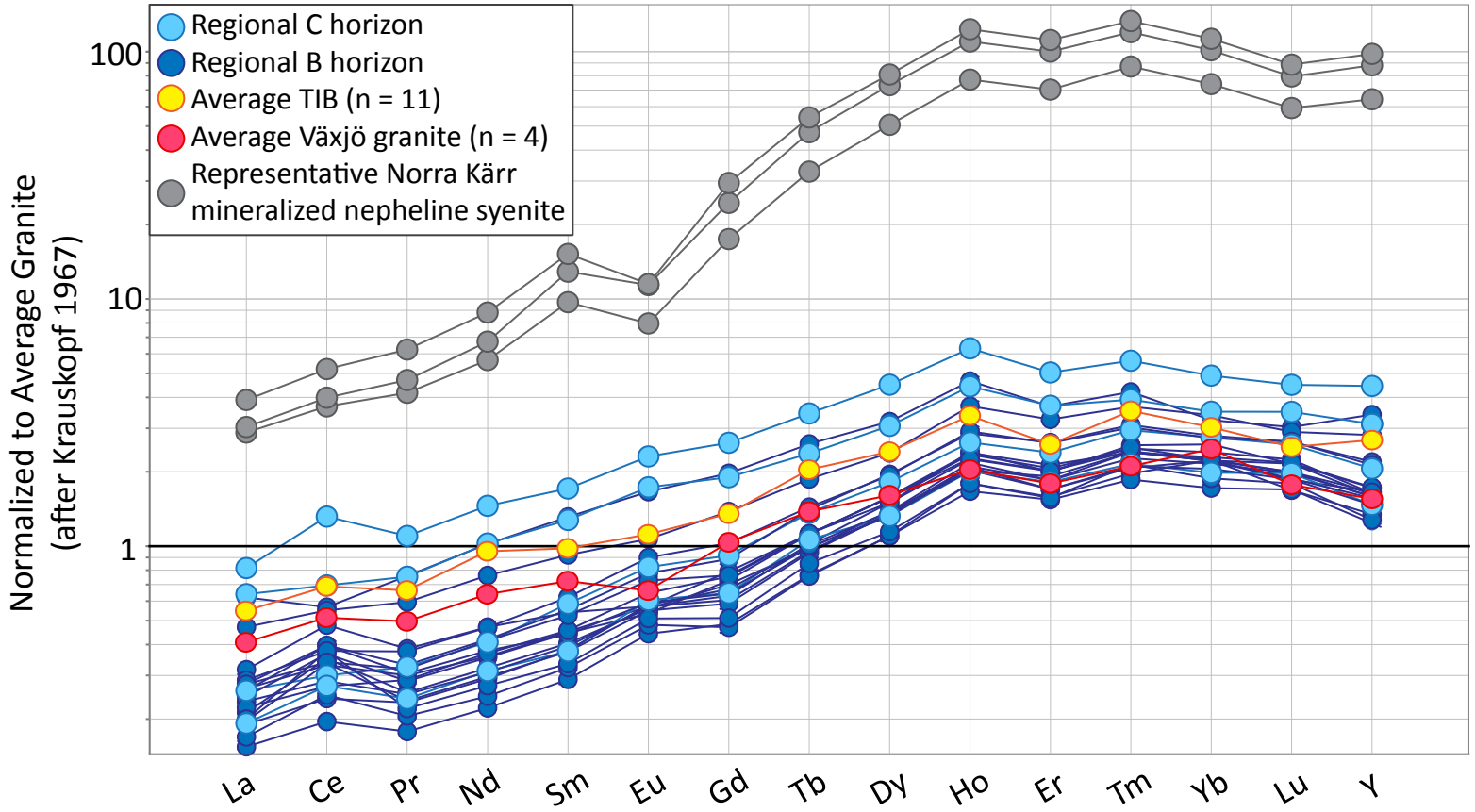


Figure 5.2 - Regional soil data from C and B horizons (light and dark blue, respectively) normalized to average granite (Krauskopf, 1967). Yellow points are averaged Transscandinavian Igneous Belt (TIB) samples (Appelquist, 2010) and red points are averaged Växjö granite samples (Christensson, 2013). Dark grey points are average representative Norra Kärr mineralized nepheline syenite.

5.1.3 - REE content in Regional Surface Waters

Water samples, both filtered and unfiltered, were collected from 42 lakes in the vicinity of the NKAC, and analysed within 48 hours of collection as outlined in Chapter 2.4.8. The unfiltered water samples had higher REE contents than the filtered water samples, median ΣREE = 7.47 ppm compared to median ΣREE = 5.19 ppm, respectively (Table 5.3, Figure 5.3a&b), and the REE content is higher in lakes with more dissolved organic content, i.e. those with brownish water. Interestingly, the darkest brown water, which could be assumed to be the richest in dissolved organic matter, did not have the highest REE concentrations. The brown-yellow lakes had the highest REE content (median ΣREE = 3.41 ppm) compared to the brown (median ΣREE = 2.84 ppm) or the colourless (median ΣREE = 0.3 3ppm) lakes. Individual REE concentrations are listed, grouped by lake-water colour, in Table 5.3.

An interesting pattern in the REE content of the regional surface waters is that they all display negative Ce and Eu anomalies, based on the shape of the chondrite normalized diagram (Figure 5.3a). This dual negative Ce and Eu anomaly is also visible in the weak leach data for the soil samples collected at site NK12-060, situated at the eastern contact of the Norra Kärr intrusion with the surrounding Växjö granites (Figure 5.4). This indicates that C horizon tills from site NK12-060 have a "regional" REE signature, even though they were collected proximal to the deposit.

Element (ppb)	Detection Limit (ppb)	Unfiltered				Filtered			
		brown (n = 10)	brown-yellow (n = 5)	light yellow (n = 13)	colourless (n = 14)	brown (n = 10)	brown-yellow (n = 5)	light yellow (n = 13)	colourless (n = 13)
La	0.005	0.69	0.75	0.19	0.05	0.31	0.70	0.11	0.02
Ce	0.005	0.72	0.75	0.16	0.05	0.30	0.59	0.07	0.01
Pr	0.005	0.18	0.21	0.05	0.02	0.09	0.19	0.04	0.02
Nd	0.005	0.68	0.87	0.22	0.06	0.36	0.77	0.14	0.02
Sm	0.005	0.13	0.17	0.05	0.02	0.07	0.16	0.04	0.02
Eu	0.005	0.02	0.03	0.01	0.01	0.01	0.03	0.01	0.01
Gd	0.005	0.12	0.18	0.05	0.03	0.06	0.16	0.04	0.02
Tb	0.005	0.02	0.03	0.01	0.01	0.01	0.02	0.02	0.01
Dy	0.005	0.10	0.16	0.04	0.02	0.06	0.14	0.03	0.02
Ho	0.005	0.02	0.03	0.02	0.01	0.01	0.03	0.01	0.01
Er	0.005	0.07	0.10	0.04	0.02	0.04	0.10	0.03	0.01
Tm	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Yb	0.005	0.06	0.10	0.04	0.02	0.04	0.10	0.03	0.01
Lu	0.005	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01
ΣREE		2.83	3.41	0.90	0.33	1.38	3.02	0.58	0.21

Table 5.3 – Median REE content of regional water lake water samples, grouped by water colour and filtration.

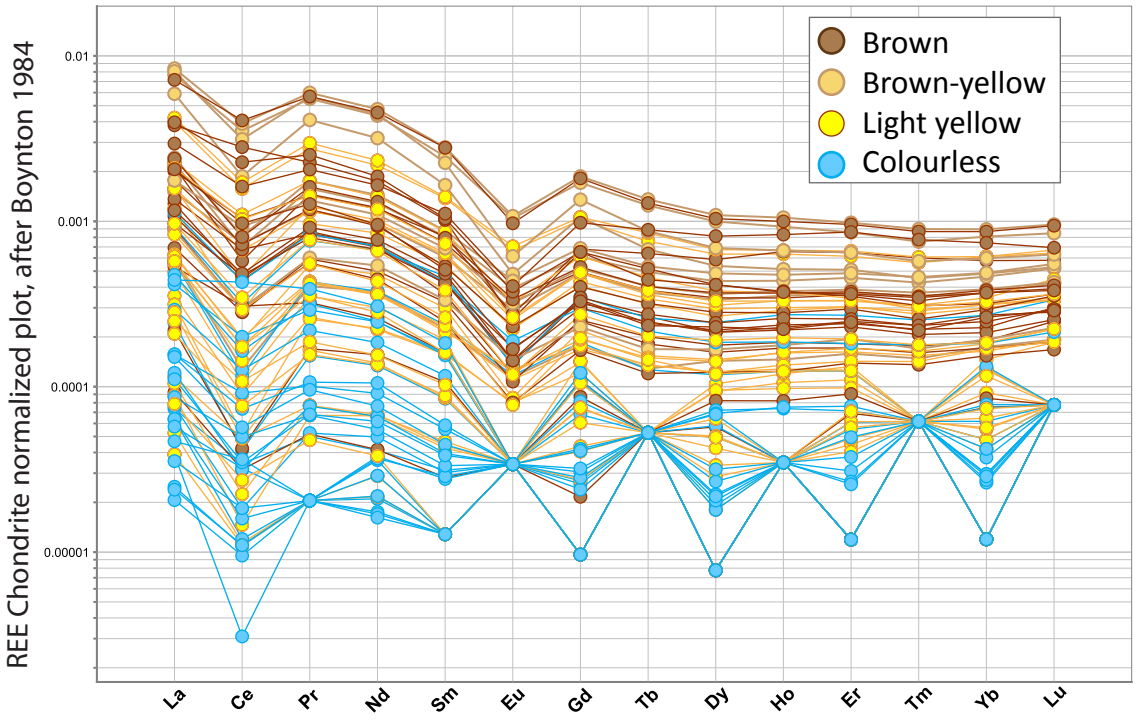


Figure 5.3a - Chondrite normalized diagram of filtered regional surface water samples. Note the strong negative Eu and Ce anomalies.

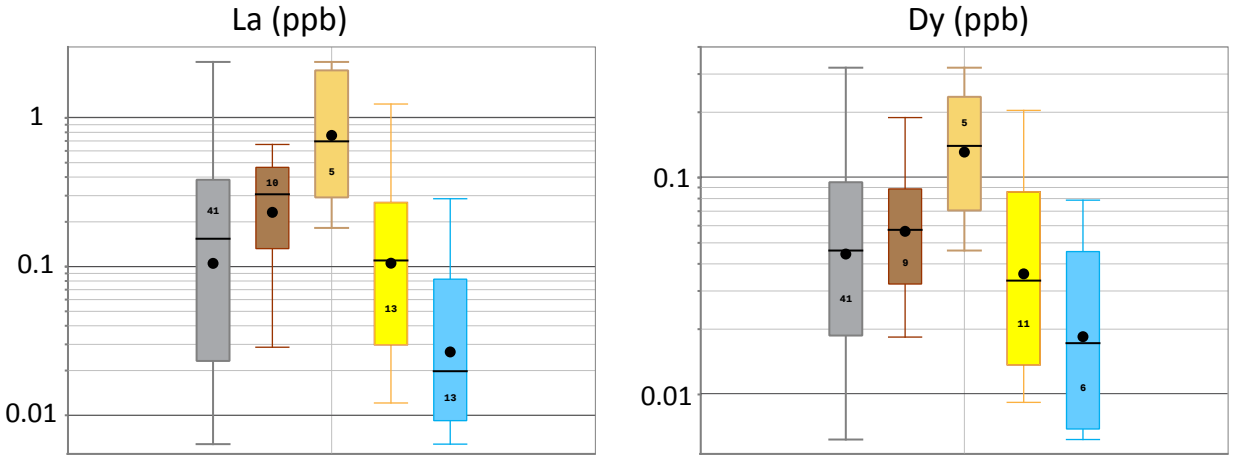


Figure 5.3b - Box and whisker plots of La and Dy (representative of the LREEs and HREEs, respectively) content in filtered regional surface water samples. The highest REE content is in the brown-yellow water samples, and is attributable to the higher concentration of dissolved organic acids in these samples.

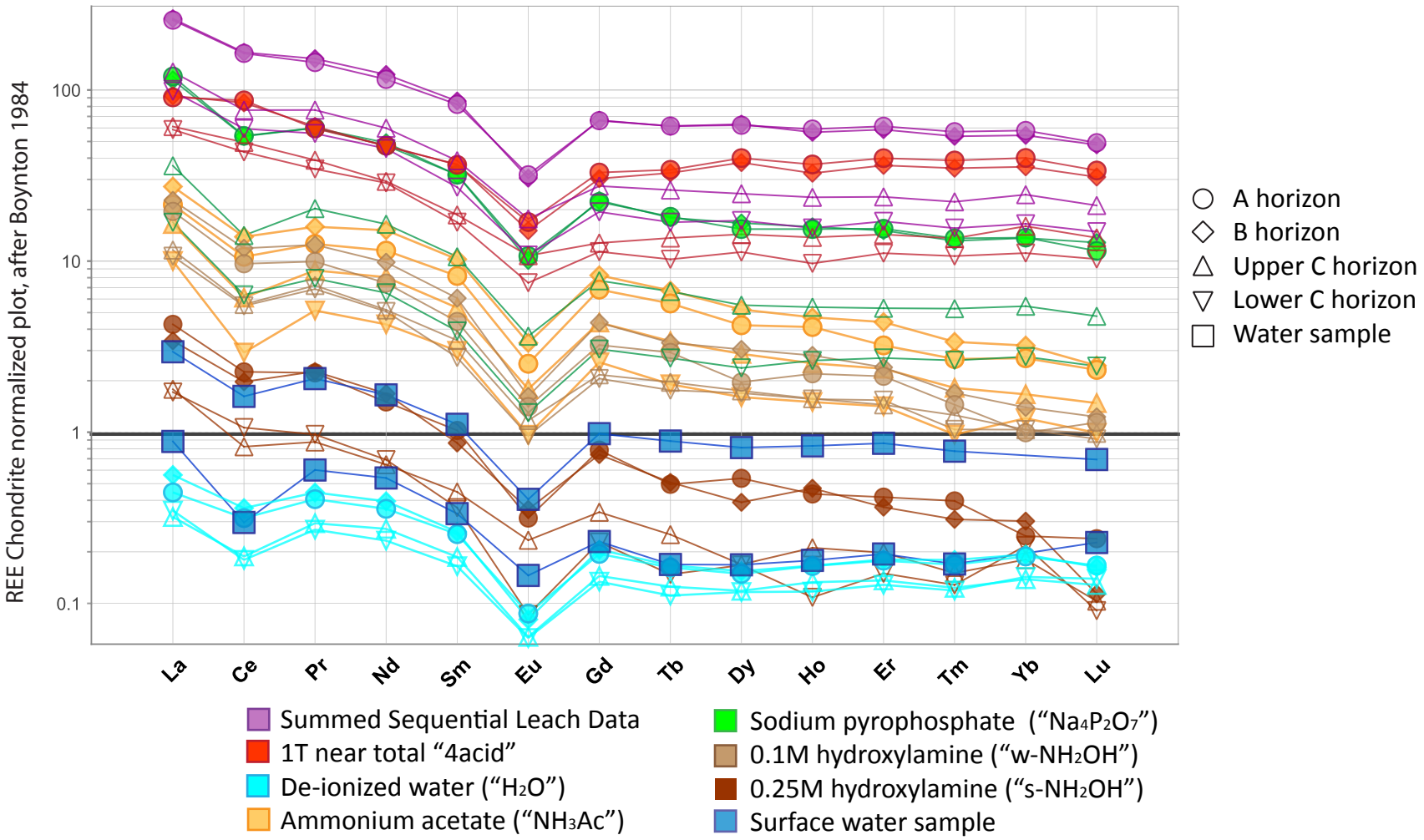


Figure 5.4 – Chondrite-normalized REE diagram of surficial materials from site NK12-060, with local unfiltered lake water data. The water sample with the higher REE content was from site TAS12-43 (Fig. 5.1), which was collected from a small lake directly above the deposit, and the water sample with the lower REE content (TAS12-02) was collected from a lake 1 km NE of the deposit.

5.2 Local REE Signature at the Norra Kärr Alkaline Complex

5.2.1 Sample Site and Media Selection

Vegetation samples (n = 142) were collected from 126 stations above and proximal to the Norra Kärr Alkaline Complex. Soil samples (n = 14) were also collected from the surficial environment around Norra Kärr, but they were deemed unsuitable as a sampling medium because of the extensive disturbance of the soil horizons by anthropogenic activity in the area (see Chapter 1.3.4). Undisturbed soils were present at the base of trees, but were generally inconsistent throughout the survey area. Conversely, both the fern species *Dryopteris filix-mas* and *Athyrium filix-femina* were ubiquitous in the survey area, making ferns the preferred sample media.

The first set of fern samples (n = 92) was collected in June 2011, the second set of samples (n = 7) was collected from the same locations in August 2011 to assess seasonal variability, and the third set of samples (n = 43) was collected in August 2012, along an extended southerly line, to ensure samples were taken from the "background" surficial environment. All samples were collected and analysed according to the procedure outlined in Chapter 2.

The stations were located along east-west lines transecting the deposit, designed to intersect each different rock type and continue 1.5 km into the surrounding country rock. Extensive drilling has already taken place over the deposit, so its lateral extent is well constrained. The drillhole sections were oriented E-W, and particular care was taken in choosing the location of the biogeochemistry sample lines to avoid possible contamination. The drills were lubricated with clean water only, to avoid contamination from drilling muds. In the rare instance that a biogeochemical sample site was nearby a drill collar, the vegetation was collected from at least ten metres away to minimize the likelihood of contamination. Also, many of the samples in the eastern part of the survey were taken from within densely forested areas, lowering the likelihood of wind-borne contaminants.

Samples were collected along five survey lines across the deposit. These lines varied in length depending on the width of the intrusion at that latitude. The northernmost survey line was truncated in the west because there is a major highway less than 300 m away from this part of the complex, and the southernmost line continues 1.7 km past the eastern edge of the NKAC.

5.2.2 Element Correlations

The REEs, major elements, macronutrients, and micronutrients were tabulated in a Spearman Ranked Correlation (rs) matrix, using data from all 92 samples from the first sampling campaign, to determine which elements are correlated. There is a correlation (rs = 0.6 and 0.53, respectively) between the LREEs, B, and Ca. There is a good correlation (rs =

0.75) between the LREEs and Y, with confidence greater than the 75th percentile, as well as a strong correlation, confidence greater than the 90th percentile, between Y and the HREEs (rs = 0.97), which is not surprising due to their chemical similarities.

Calcium is an essential macronutrient, and is widely available to plant roots in neutral and alkaline environments (Lucas and Davis, 1961). Though Ca^{2+} has many metabolic functions, it is particularly useful to the plant as a structural element in the cell wall. Matoh and Kobayashi (1998) found that, when coupled with Ca, B forms a B-RG-II complex that is "ubiquitous in higher plants"; these two elements bind to pectic polysaccharides and maintain the integrity of cell walls.

The correlation between B, Ca, and the LREEs leads to the supposition that REEs taken up into the plant structure are being sequestered in the cell wall, but more detailed analyses are required for confirmation. This is in agreement with findings by Ding et al. (2007) who determined that REE fractionation in soybean roots was controlled by REE-phosphate precipitation and cell-wall absorption.

5.2.3 Levelling

5.2.3i – Levelling by fern species

Different species of ferns can naturally accumulate different amounts of REEs in their plant structure (see Chapter 4.2, Figure 4.2), so to make a coherent biogeochemical response map over the deposit and surrounding area, REE values must be levelled to account for variation in sample species. The levelling method undertaken here was Z-Score ^{10}log-transformation. Employing a ^{10}log-transformation is appropriate because the data is log-normally distributed. Z-Score transformation was used instead of median calculation because levelling by the median does not account for the spread of the data, so variables with a wide distribution and outliers will dominate in a median-levelled distribution. The other advantage to using a Z-Score transformation is that the outliers, ranging from 1.5 to 3 standard deviations, are preserved for each variable. Outliers are classified as outside of 1.5x (Q3-Q1), and are represented as open circles; far outliers are classified as outside of 3x (Q3-Q1), and are represented as open triangles.

Box and whisker plots (e.g. Fig. 5.5) are an effective way to display levelled data from related populations with similar distributions but different outliers. These plots divide the data into four parts by calculating the median, 75th, and 25th percentiles, which are represented as the black line in the centre, and the upper and lower limits of the coloured box, respectively. Any values that fall outside of 1.5x this range are considered "outliers" and will be displayed as points either above or below the vertical coloured line, which is referred to as the "whisker". The black circle near the centre of the coloured box represents the mean of the population.

5.2.3ii – Levelling by analytical method

The regional and local samples, for ferns as well as soils, were analysed at different labs by different methods, so in order to compare the local REE signature at the NKAC with the regional background signature, the data must be levelled. The two suitable levelling parameters are "laboratory" or "analytical method". The former is appropriate because the regional soils and ferns were analysed at ALS Analytical Laboratories in Luleå, by lithium metaborate fusion and nitric acid digestion, and the local ferns and soils were analysed at Acme Analytical Laboratories in Vancouver, by aqua regia digestion (see Section 2.4). However, levelling by "analytical method" is preferable to levelling by "laboratory" because the soils and ferns were analysed by different techniques at each lab.

When comparing different analytical techniques, it is important to remember that differences in analytical procedure, particularly with respect to the strength of digestion, can result in quantifiable differences in elemental concentrations. For example, aqua regia digestion, such as that performed by Acme Analytical Laboratories on the locally collected fern plants, is a "near total" digestion, meaning it will target carbonates, soluble or weakly adsorbed phases, oxides, and some silicates. Contrarily, lithium metaborate/tetraborate is a "fusion" digestion, which targets all the same phases as aqua regia, *plus* any resistate minerals, such as garnet or xenotime. It is unreasonable to expect to be able to compare aqua regia data with fusion data without first taking their different strengths into consideration; levelling both datasets by "analytical method" allows comparison of outliers and median values, rather than absolute concentrations, so in an exploration program, where contrast with background is more critical than total element concentration, comparing levelled data is acceptable.

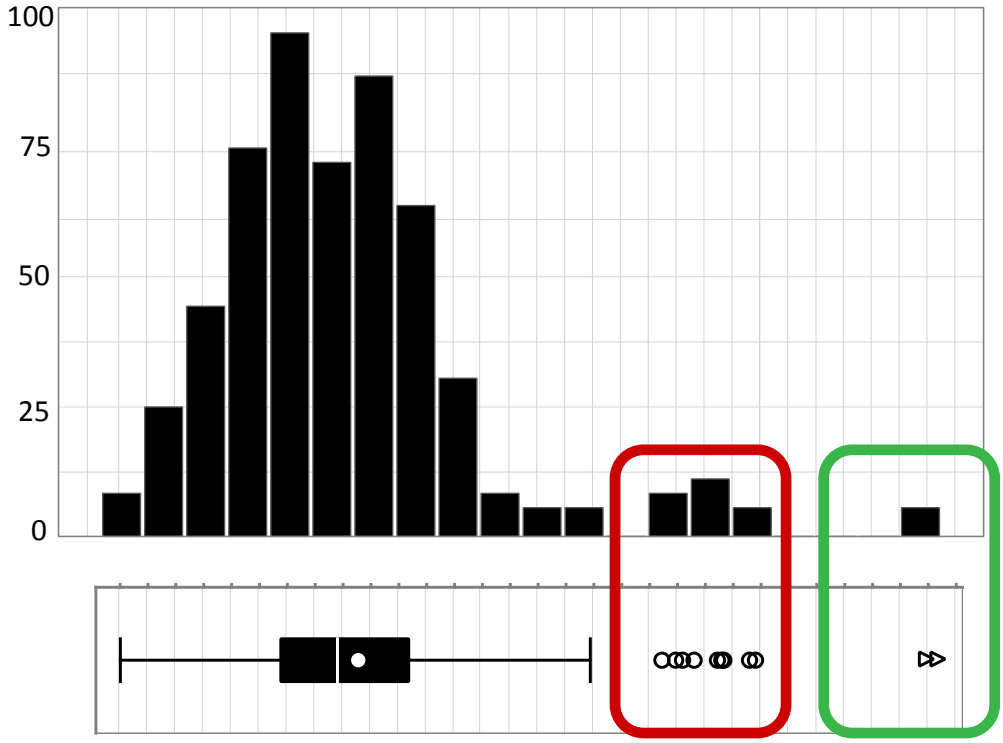


Figure 5.5 - Two graphical representations, a histogram (above) and a "box and whisker" plot (below) of the same data set. The data is normally distributed, with some outliers (red box) and far outliers (green box).

The box and whisker plot divides the data into four equal parts, by finding the median, and then the 25^{th} and 75^{th} percentiles (which approximate the interquartile range, or IQR). The median is represented by the white line bisecting the box; the mean is represented by the white circle, in this case located just above the median. Outliers are represented as open black circles, and far outliers are represented as open black triangles.

5.3 Discussion

5.3.1 – Fern Discussion

The biogeochemical samples collected above mineralization are elevated in both the heavy and light REEs, particularly the HREEs, compared to samples collected from the surficial environment above unmineralized country rock (Figure 5.6). The range of REE contents from the fern samples collected over the "background" area is listed in Table 5.2 and displayed in Figure 5.6.

Of the three fern species sampled, *Athyrium filix-femina* has the highest levels of LREEs, and the highest average value for the HREEs. The REE and Y content is higher in both species of ferns over the deposit than at background sites, but there is clearer contrast in *Dryopteris filix-mas* than in *Athyrium filix-femina* (Figure 5.6 and 5.7). This is because, in general, *Athyrium filix-femina* can have higher REE content in its leafy tissue than *Dryopteris filix-mas* (Figure 5.8). However, when the surficial environment is enriched in REEs, such as above a REE deposit, *Dryopteris filix-mas* will accumulate more REEs in its tissue, relatively, than *Athyrium filix-femina*. This is critical because the physiology of *Dryopteris filix-mas* prevents it from accumulating REEs in its leafy tissue unless there is an abundance of REEs in the growing conditions. This heightened contrast, relative to the contrast observable in *Athyrium filix-femina*, makes *Dryopteris filix-mas* the preferable sample medium (Figure 5.7).

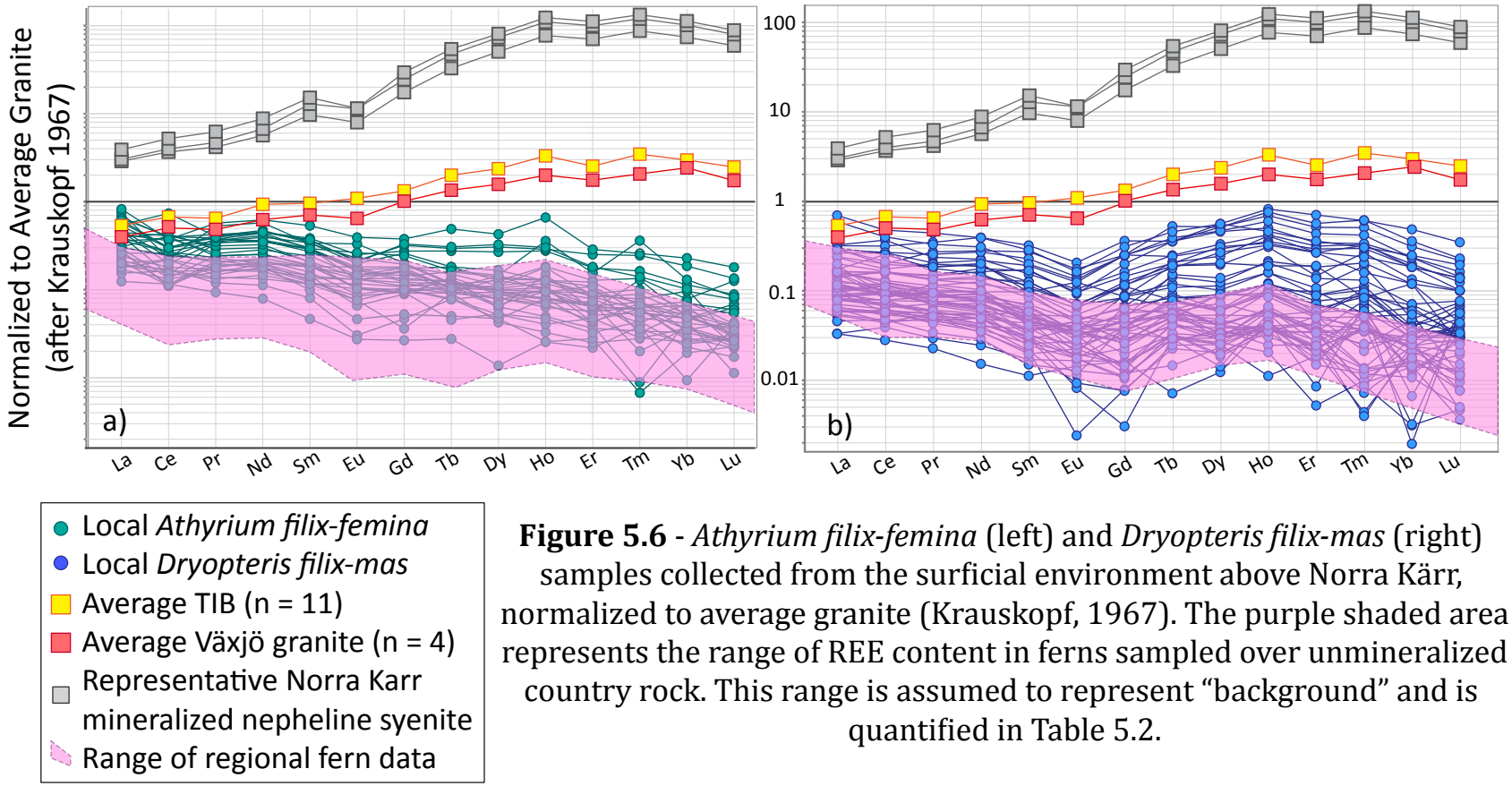


Figure 5.6 - *Athyrium filix-femina* (left) and *Dryopteris filix-mas* (right) samples collected from the surficial environment above Norra Kärr, normalized to average granite (Krauskopf, 1967). The purple shaded area represents the range of REE content in ferns sampled over unmineralized country rock. This range is assumed to represent "background" and is quantified in Table 5.2.

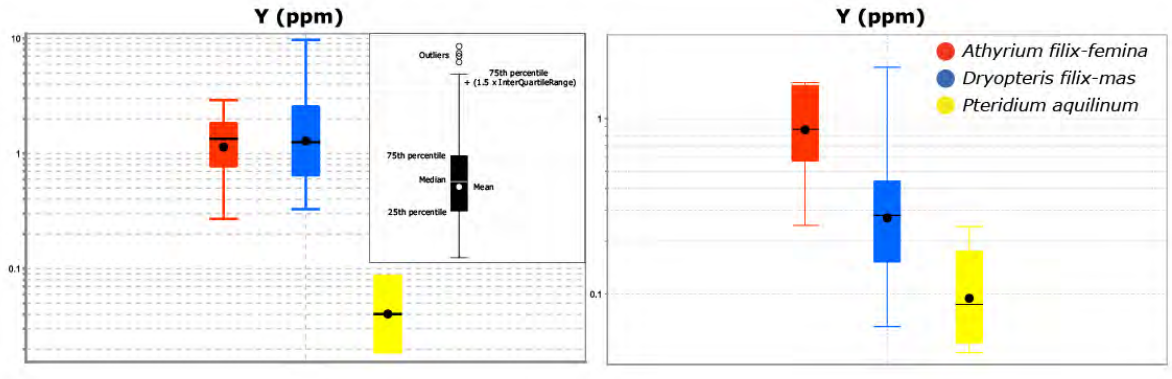


Figure 5.7 – Yttrium content (as a surrogate for HREE) in three fern species over the deposit (left) and in the background (right). *Athyrium filix-femina* has higher absolute Y content over the deposit than the other two species, but the contrast between samples collected over mineralization compared to samples collected over background is much more pronounced in *Dryopteris filix-mas,* therefore *Dryopteris filix-mas* is the preferable exploration sampling medium.

The fern samples collected over unmineralized country rock display the same relative REE variation by species (Figure 5.8). Regionally, *Dryopteris filix-mas* has a median ΣREE value of 24.3 ppm, while *Athyrium filix-femina* has a higher ΣREE value of 57.6 ppm (Table 5.1). *Athyrium filix-femina* has higher "background" REE content, which supports the earlier conclusion that *Dryopteris filix-mas* is the preferable sample medium, as it displays better contrast between mineralized and unmineralized areas.

5.3.2 – Fern and Soil Discussion

The fern and soil samples collected both regionally and locally were combined and levelled by analytical methods (see Section 5.2.3ii and Section 2.4), to determine which sample medium is the most effective for identifying covered REE mineralization. In all cases, the soil has higher total REE abundance than the overlying fern plant, though in some cases, for instance the samples collected directly over mineralized bedrock, the leafy tissue of the fern plant is particularly enriched in LREEs and is comparable to the LREE content of the soils.

The La and Dy content in all regional (lighter shades) and local (darker shades) fern (green boxes) and soil (brown boxes) data is displayed in Figure 5.9. The data have been levelled by analytical method, so the Y-axis values are standard deviations, not absolute concentrations. The variance in REE content over mineralization compared to unmineralized country rock is similar for both the fern data and the soil data, based on mean and median values (Figure 5.9).

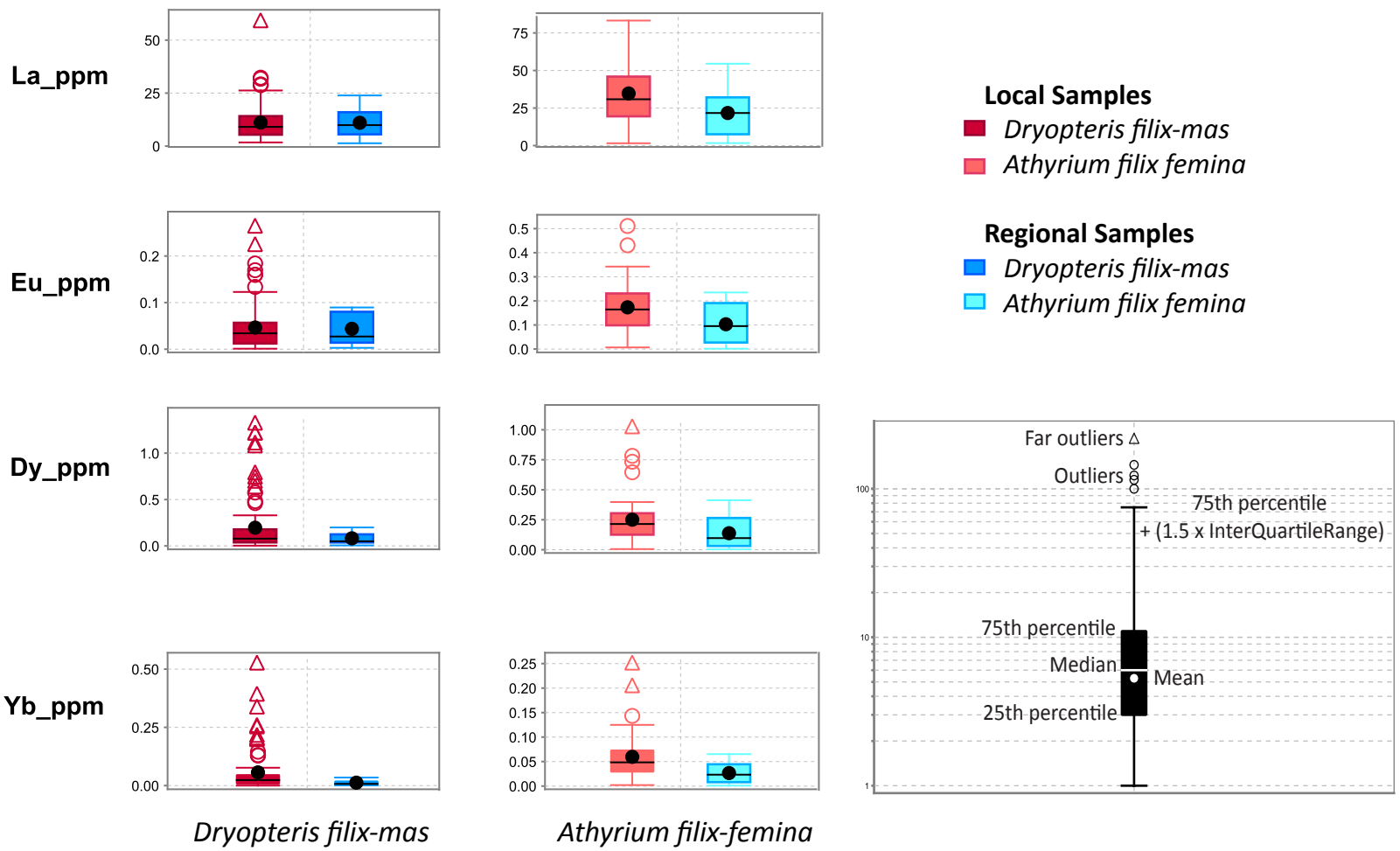


Figure 5.8 – La, Eu, Dy, and Yb content in Athyrium filix-femina and Dryopteris filix-mas, grouped by species and coloured regionally (blue) and locally (red).

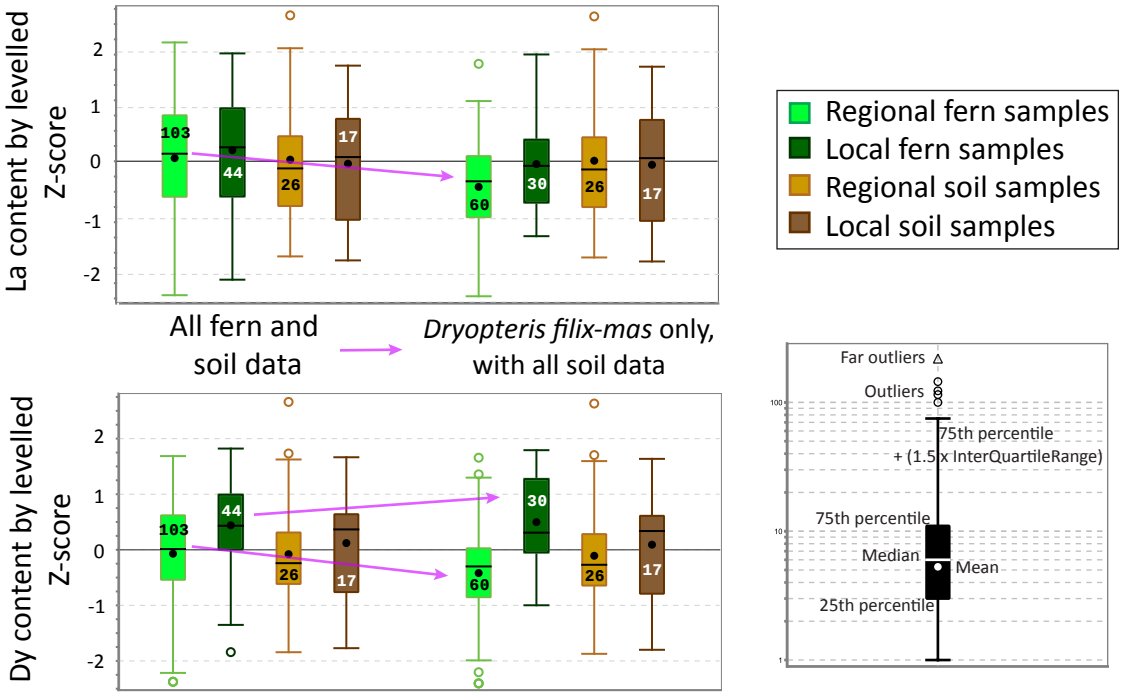


Figure 5.9 - La (above) and Dy (below) content in surficial media, levelled by analytical method. Since the data have been levelled, the Y axis values are standard deviations, not absolute concentrations. Sample count is displayed over each box. In the upper diagram, regional and fern data is presented, along with all soil data, and the variance between the four populations is similar based on the mean and median values.

In the lower diagram all regional and local soil data, from each horizon, is presented again, but only the *Dryopteris filix-mas* data is displayed (bottom right) and the contrast between regional (light green) and local (dark green) fern samples is much more pronounced, particularly for Dy, which is a proxy for all the HREEs.

By comparing the regional data to the local data using only *Dryopteris filix-mas*, the contrast between background and deposit becomes more pronounced (Figure 5.9 and 5.10). The fern samples collected over the deposit (dark green) have higher Dy contents than those collected regionally (light green). The contrast becomes stronger still if the soil samples are grouped into populations based on soil horizons. Using Dy as a proxy for all the HREEs and La as a proxy for the LREEs, background contrast between *Dryopteris filix-mas* samples and each soil horizon was compared (Figure 5.10). The contrast between regional and local samples for the C horizon soils is poor; in fact, the regional C horizon soils have *higher* median REE content than those collected directly over the deposit, so a false anomaly is generated over unmineralized country rock. Since the C horizon is composed of transported glacial till, it is reasonable to expect the REE signature to be different from the underlying bedrock (Figure 5.10c). The contrast between the regional and local B horizon soils is comparable to the *Dryopteris filix-mas* samples for HREEs, and slightly better for LREEs (Figure 5.10b). The contrast between the A horizon soils collected regionally and those collected locally is poor; A horizon soil results have large variability of REE distribution based on a small (n = 2) sample group, preventing further interpretation of the A horizon soils.

5.3.3 Exploration Implications

Both *Dryopteris filix-mas* and B horizon soil samples demonstrate good contrast over mineralized bedrock compared to regional background samples; however, considering the paucity of well developed soil horizons due to anthropogenic disturbances and the glacial history of the area, *Dryopteris filix-mas* is the most reliable sample medium. *Athyrium filix-femina*, as well as A and C horizon soils, are deemed less useful sample media in this environment when exploring for buried REE mineralization.

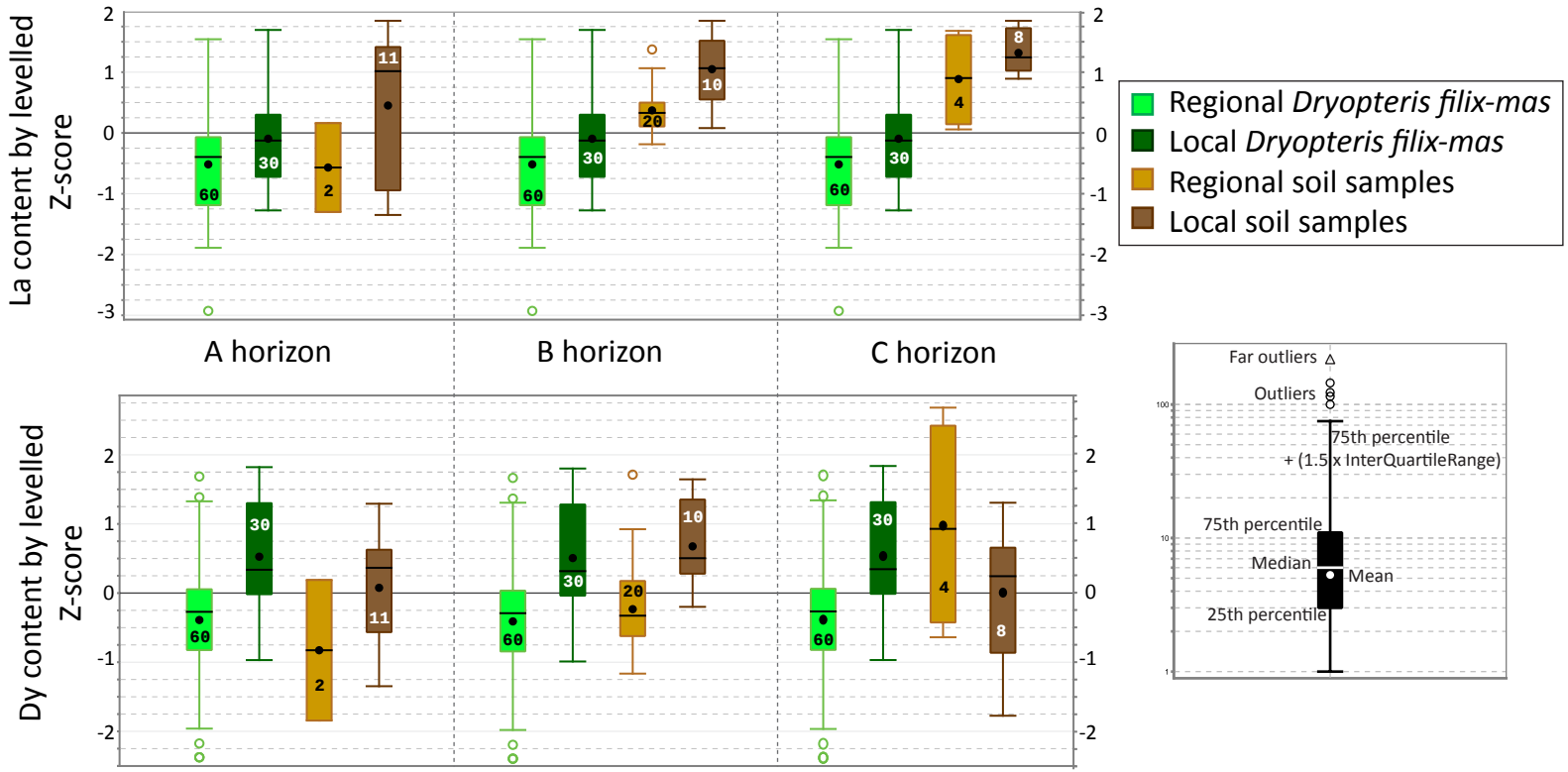


Figure 5.10 (a-c) - La (above) and Dy content (below), levelled by analytical method, in surficial materials collected regionally (lighter shades) and locally (darker shades) around the Norra Kärr Alkaline Complex. *Dryopteris filix-mas* samples both above the deposit (dark green) and in the background (light green) are graphed against each soil horizon (A, B, and C). Compared to the A horizon soils, *Dryopteris filix-mas* displays better contrast between the mineralized deposit and the surrounding country rock for both the LREEs and the HREES. *Dryopteris filix-mas* and B horizon show comparable contrast for the HREEs, and B horizon soils show more pronounced contrast for the LREEs. C horizon tills show a false anomaly over the regional country rock for the HREEs, and no clear contrast for the LREEs.

5.3.4 – Spatial Distribution of REEs in Ferns Above Norra Kärr

The spatial variation of REEs around the NKAC was assessed by collecting 142 fern samples from 126 sample stations above and proximal to the mineralized zone. Profile lines showing variations in Sm, representing the LREEs, and Dy, representing the HREEs, are displayed in Figure 5.11 and Figure 5.12. The LREE signature associated with mineralization is most clearly visible in the Line 4, on the eastern edge of the complex. This is because Norra Kärr forms a relative topographic high, and both east and west margins are low-lying areas. On the western margin there is a swampy zone, and on the eastern margin there is a small stream running southwards. The LREE peak in the southeast corner of the deposit is likely attributable to increased surface-water flow, thereby allowing increased REE mobility in this area and a stronger LREE response (Figure 5.11 – Sm profile)

The response of Dy in the profile lines above the deposit is clearer, likely because Norra Kärr is enriched in HREEs. There is a strong Dy peak in the third line, directly over the pegmatitic grennaite unit, which has the highest HREE content of all the rock types present at Norra Kärr. There is also a positive response in the second line. In Line 4 there is a strong positive response in the same location as the Sm peak. The peaks in these two elements are likely both caused by increased moisture content in the soil, which facilitates Ln^{3+} mobility. The other Dy peaks are also recognized in Sm, but not as strongly as the response in the south-eastern part of the deposit (Figure 5.12 – Dy profile).

Both Dy and Sm show weak positive responses in the northwest corner of the deposit, coincident with the pegmatitic catapleiite zone. The depletion of LREEs and HREEs in the southernmost line could be attributable to the presence of kaxtorpite, which has the lowest REE content of any rock type in the NKAC with similar patterns displayed in the LREE profile (Figure 5.11) to the HREE profile (Figure 5.12) but the central line, which shows a strong response for the HREEs, has slightly more minor irregular variation ("noise") in the LREE data.

The peaks in Sm and Dy off the eastern side of the deposit, in Line 3, could also be caused by increased soil moisture, even though it is technically off of the deposit. Further studies are required determine whether the REE signature here is due to Ln^{3+} ions mobilized in the surficial environment.

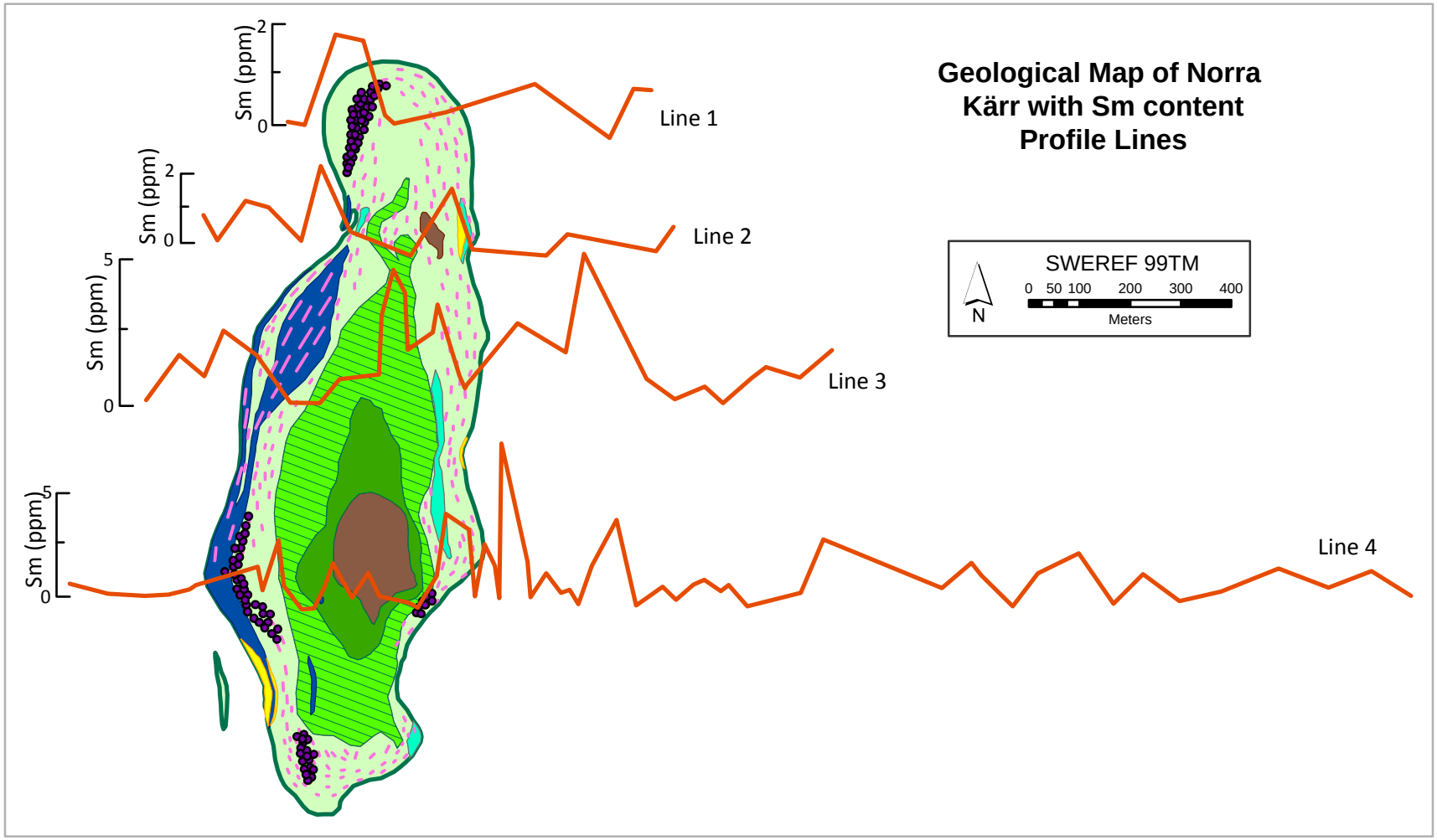


Figure 5.11 – Sm content in ferns above the Norra Kärr Alkaline Complex

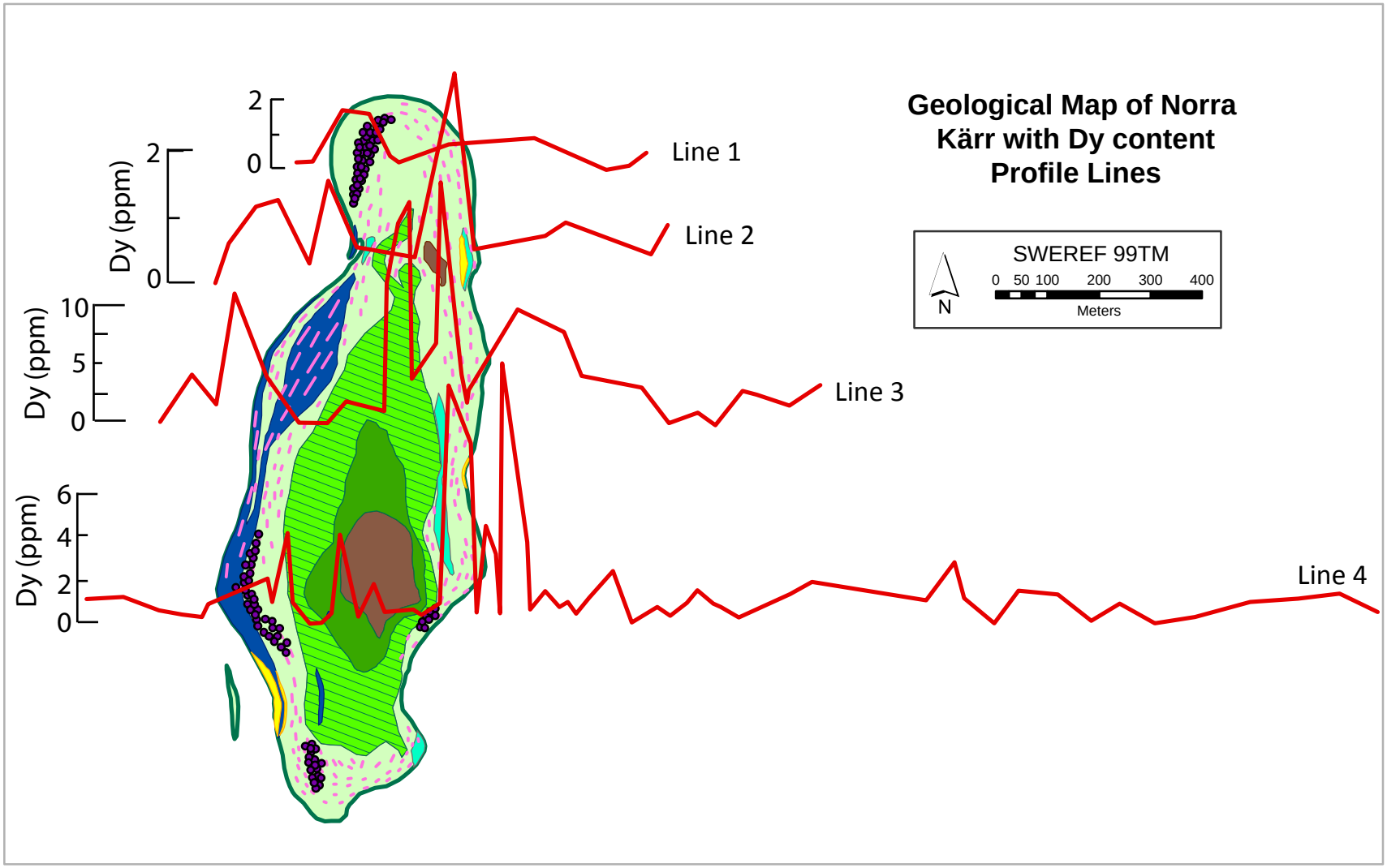


Figure 5.12 – Dy content in ferns above the Norra Kärr Alkaline Complex

5.4 Conclusions

This biogeochemical orientation survey shows the following:

a) All sampled fern species, particularly *Athyrium filix-femina* and *Dryopteris filix-mas*, are able to incorporate appreciable amounts of REEs into their leafy tissue.

b) Regionally, C and A-horizon soil samples have lower, or comparable, REE content than C and A-horizon soil samples collected locally, but the B horizon soils at Norra Kärr have a positive REE response when compared to the background B-horizon soils. The range of "background" REE content in regional soils is quantified in Table 5.2.

c) Compared to regional samples, local *Athyrium filix-femina* samples do not show good contrast over the deposit; conversely, *Dryopteris filix-mas* shows strong contrast when comparing regional and local samples. The upper limit of REE content in samples collected over unmineralized bedrock is assumed to represent the "background" threshold in this environment (Table 5.1).

d) There is a correlation between the REEs, Ca, and B, which may be associated with the physiological roles of Ca and B within the plant. The correlation between Ca and the REEs suggests that the REEs may be incorporated into the cell walls.

e) There are positive responses in the ferns collected over areas of known mineralization, particularly the pegmatitic grennaite units and zones with phenocrysts of catapleiite.

f) *Athyrium filix-femina* fractionates the LREEs more strongly than *Dryopteris filix-mas* or *Pteridium aquilinum.*

g) *Athyrium filix-femina* has higher absolute contents of LREEs and HREEs in its leaves; however, there is better contrast between background and anomalous areas when sampling *Dryopteris filix-mas*, which makes it the preferable biogeochemical sampling medium.

Chapter 6 - Summary, Exploration Implications, and Recommendations for Future Work

6.1 Summary

The geochemical environment around the Norra Kärr Alkaline Complex has developed over several different time scales, from the evolution of the bedrock geology over millions of years, to the development of the surficial environment over tens of thousands of years since the last glacial maximum, to the perennial growth of a fern plant over several years, to the changes in metal content in that fern plant over the course of one summer.

The study of rare earth elements (REEs) provides a tool to help unravel these intertwined geochemical systems; REEs are a unique group of elements due to their similar chemical properties and hence they have been studied extensively as tracer elements in igneous geochemistry, hydrogeology, aqueous geochemistry, and natural water chemistry. Rare earth element research has been topical in the past decade due to the high demand and limited supply of REEs for the burgeoning technology market, and their increased use has enabled advances in both green technology and nanotechnology.

Biogeochemical exploration methods presented herein, were successfully used to delineate the Norra Kärr Alkaline Complex, a HREE-enriched, eudialyte bearing, Mesoproterozoic nepheline syenite. The NKAC was emplaced as a sill in a N-S trending shear zone within the Paleoproterozoic Trans-Scandinavian Igneous Belt (TIB) during a stage of crustal scale deformation, followed by post-mineralization thrust faulting in the Ediacaran. Subsequent glaciation of southern Sweden, terminating approximately 14,000 years ago, buried the deposit with transported Quaternary materials derived from the Växjö granites, a subset of the TIB. Since the last glacial maximum, soil horizons have begun developing on the glacial till, and they differ chemically from the till because of input from other sources. The NKAC is, locally, a topographic high point (Figure 6.1); in places where the REE-enriched bedrock is exposed, erosion and subsequent deposition of colluvial material derived from the NKAC endows the till in the surrounding region with HREE-bearing zirconosilicate fragments (Figure 3.11).

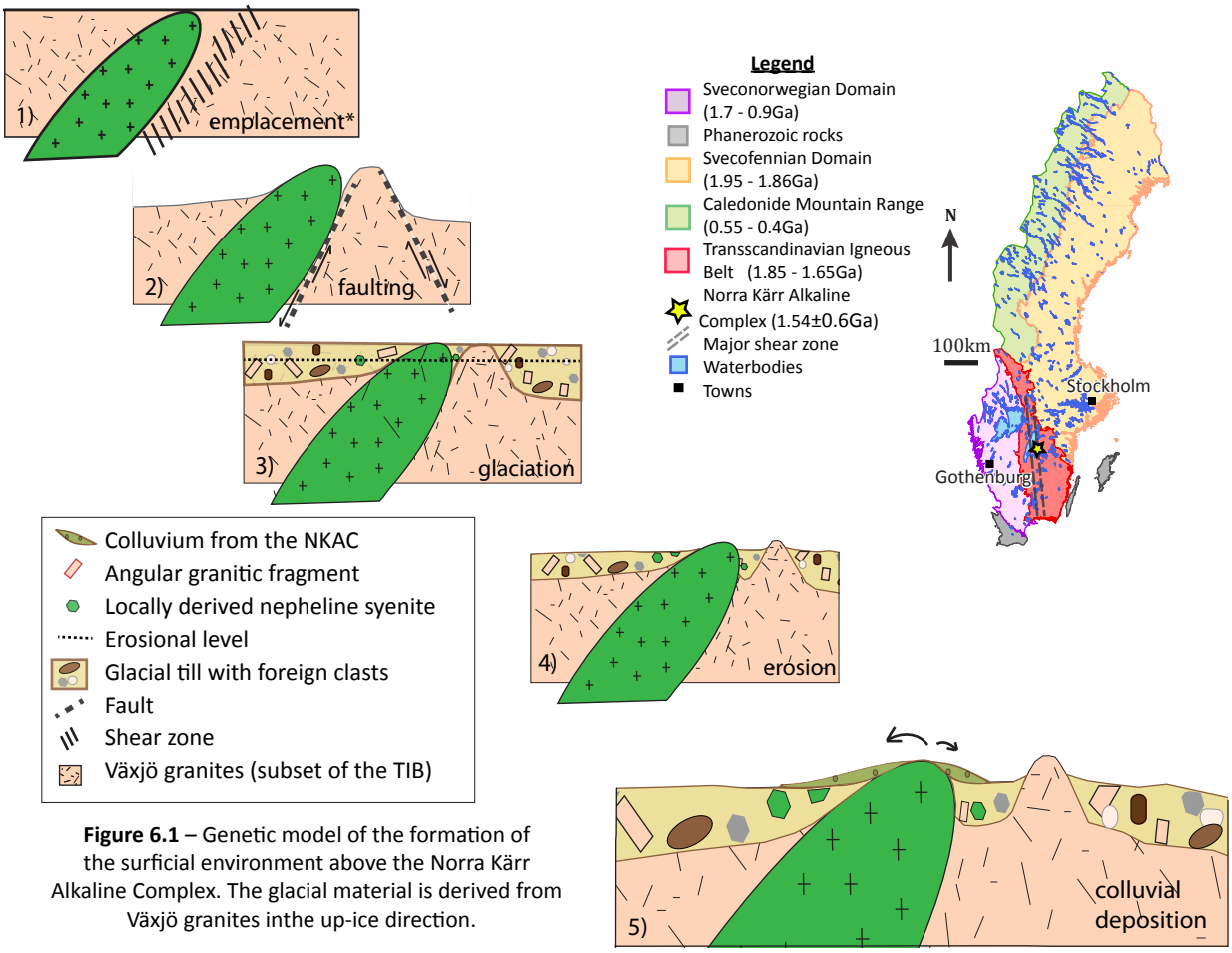


Figure 6.1 – Genetic model of the formation of the surficial environment above the Norra Kärr Alkaline Complex. The glacial material is derived from Växjö granites inthe up-ice direction.

The REE signature of the buried bedrock mineralization was mobilized into the surficial environment following the mechanical weathering of the zirconosilicate mineral eudialyte. As eudialyte breaks down, REEs are dissolved and transported by surface waters until they are complexed and re-deposited. Of the REEs, Ce is the least mobile in the surficial environment because it has two oxidation states, 3^+ and 4^+. Under typical surficial conditions, Ce will exist in the oxidized form, Ce^{4+}, which is extremely insoluble, and will precipitate immediately as CeO_2 or $CePO_4$, which is why there is often a negative Ce anomaly observed in natural surface waters (Figure 6.2). The other REEs can adsorb onto colloids or Mn hydroxides, form stable compounds with carbonate, phosphate, fluoride or hydroxide anions, or, most likely, form complexes via bonding with the carboxyl group of any dissolved organic acid (see Section 1.6 and references therein).

Different REE patterns in a surficial environment can be used to infer the provenance of the surficial materials, be it soils or plants or glacial till, therefore subtle variations in these REE pattern, discernible from normalizing plots, can be used to distinguish materials derived from different sources. In Figure 6.2, there are positive Eu anomalies in the three different materials: the glacial till sample collected above the NKAC (red triangles); granitic fragments (pink squares) taken as a proxy for Växjö-type granites; and a suite of soil samples from a distal, typical, boreal, podzol in southern Sweden (brown shaded region). All of these media have the same REE pattern, indicating that they originated from the same source.

Typical Swedish podzolic soil samples collected and analysed by Tyler and Olsson (2002), feature a strong positive Nd anomaly (brown dashed lines represent the actual data range), which is substantially different than any of the rocks in the Trans-Scandinavian Igneous Belt (see Section 5.1.2); speculation on the cause of this anomaly is outside the scope of this thesis, so the Nd content of the podzolic soil data has been estimated based on the Pr and Sm content.

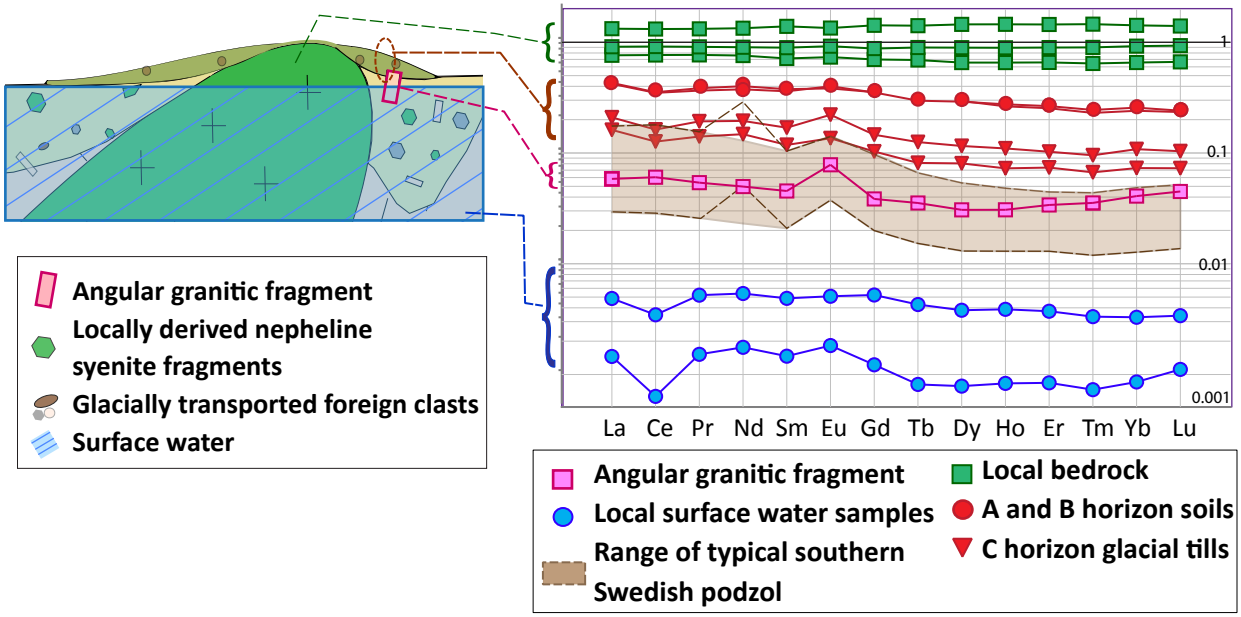


Figure 6.2 – Schematic Diagram of Norra Kärr withnormalized REE plot of surficial materials. The REE plot is normalized to local bedrock from site NK12-060, not chondrite. Green squares are local bedrock, filled red circles are surficial material from the A and B horizons, filled red riangles are glacial till, filled pink squares are glacially transported granitic fragments derived from nearby country rock. Blue circles are local surface waters from lakes directly overlying the NKAC; surface water REE content has been multiplied by a factor of 1000 for convenience of viewing. The shaded brown region represents the range of REE content of typical Swedish podzols (n = 30) collected in Scania, approximately 200km south of Norra Kärr, and analysed by microwave-aided nitric acid digestion, with an ICP-MS finish (Tyler and Olsson, 2002) which is a slightly weaker strength of digestion than the sum of the sequential leach data provided by Acme Analytical (red shapes). Note the positive Eu anomaly in the granitic fragment and the glacial till, which is not visible in the local bedrock or surface water samples.

The highest concentrations of REEs in the soil profile above the NKAC are found in the B horizon soils, and are due to a combination of the presence of colluvial zirconosilicate mineral grains, and downward translocation of REEs via complexation with soluble organic acids from the eluvial “A horizon” into the illuvial “B horizon”. The precipitation of these metal-organic complexes at depth could be attributable to metal saturation, organic polymerization, or changes in pH (Drever and Vance, 1994). Organic acids, which are measurable as the dissolved organic carbon content in soil water, surface water and groundwater, provide an efficient trap site to sequester REEs.

The B horizon soils at Norra Kärr developed from the underlying glacially transported till, and show a weak positive Eu anomaly (Figure 6.3) therefore are not representative of the underlying bedrock.

6.2 Exploration Implications

Fern plants are an ideal biogeochemical sampling medium when exploring for HREE mineralization because they can have measurable amounts of REEs in their leaves, and they provide an integrated chemical signature based on all the components of the surficial environment. Plants utilize mycorrhizal fungi and transport vast quantities of surface water to acquire nutrients, and therefore their tissue is a composite sample of the geochemical environment, involving surface water, soil substrate, and bedrock, in which they grow (Figure 6.3). The fern plants above the Norra Kärr Alkaline Complex contain appreciable amounts of REEs in varying quantities (root > leaf > stem) in their tissue. The root tissue has comparable REE content with the till samples collected from the same site, and the leaf tissue has similar LREE levels, but considerably less HREE content than the soils or the root tissue. This indicates there is some preferential physiological mechanism within the plant that transports LREEs more readily than HREEs, likely due to differences in their ionic radii or charge density.

Other plant species were collected and analyzed at Norra Kärr as well, but ferns, particularly Dryopteris filix-mas, displayed the best contrast between mineralization and background, so was deemed the effective biogeochemical sampling medium for evaluating an area of covered boreal forest for buried HREE mineral potential.

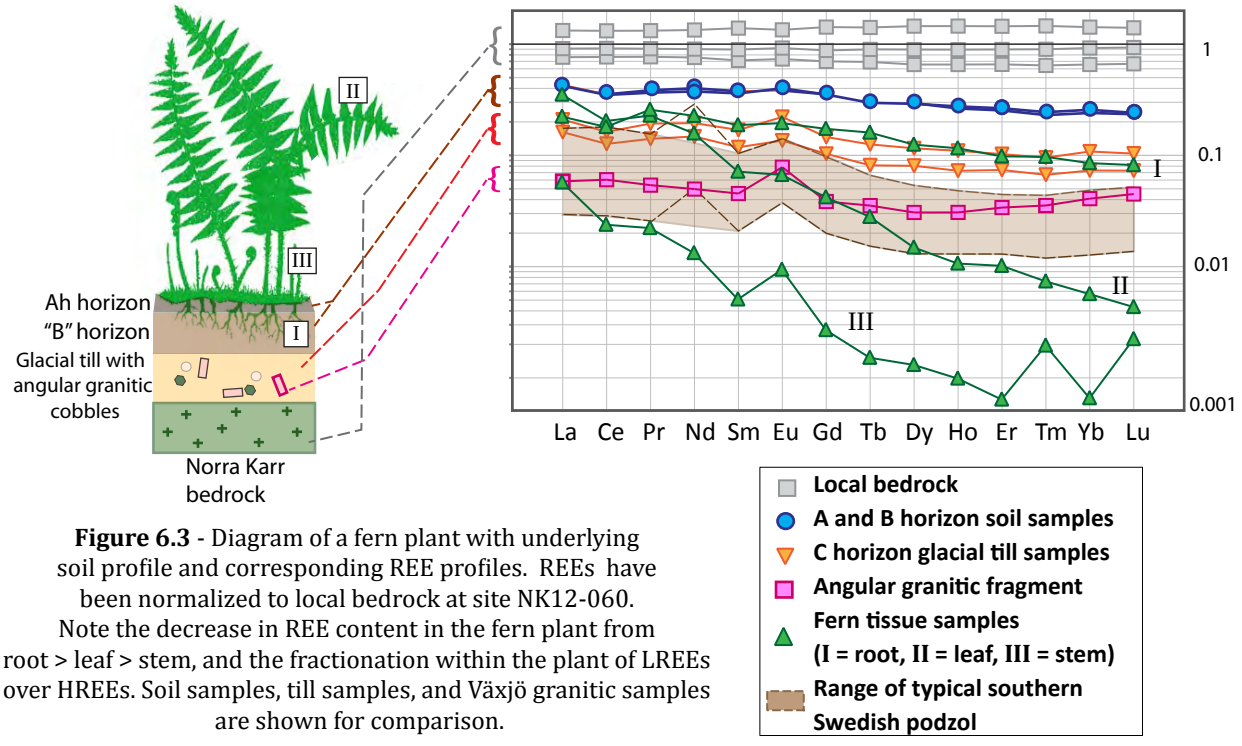


Figure 6.3 - Diagram of a fern plant with underlying soil profile and corresponding REE profiles. REEs have been normalized to local bedrock at site NK12-060. Note the decrease in REE content in the fern plant from root > leaf > stem, and the fractionation within the plant of LREEs over HREEs. Soil samples, till samples, and Växjö granitic samples are shown for comparison.

As the rate of discovery of near-surface mineral deposits declines, all available tools must be utilized to successfully explore for buried mineralization. The mobility of REEs in the surficial environment, a heretofore under-appreciated phenomenon, allows biogeochemistry to be used as an effective exploration tool for buried REE deposits, such as the Norra Kärr Alkaline Complex.

6.3 Handy Hints for the Burgeoning Biogeochemist

6.3.1 Sample Station Selection

As with any geochemical exploration program, the target size will dictate the optimal sample spacing. It is critical to undertake an orientation survey first, and extend the orientation survey lines as far as is practical for cost and time efficiency. If there are some limitations in the surrounding environment preventing long sample lines, go to an area nearby that you're *sure* has no mineralization and collect a few samples there, to establish "background".

6.3.2 Species Selection

It's all well and good to know that Douglas fir trees concentrate As in unusually high levels (Warren et al., 1964), but if you only have maple trees on your property... you're probably going to sample maple trees. I hear the syrup is delicious... But this brings us to the first and most important rule of geochemical sampling: <u>be consistent!!</u> In the same way that you cannot properly compare soils collected from different horizons, you also cannot compare different plant species, it's like the age old adage chiefly concerned with the differences between apples and oranges. Depending on the species you choose, you can usually sample bark, leaves, twigs, or cones. If you're not sure which media shows the best response in your area, the orientation survey is a great way to find out.

6.3.3 Sample Collection

1. Collect at least 100 g of sample material, because at least half is water weight.

2. Place the samples in woven polypropylene bags (*not plastic, not zip loc*) so the samples don't sweat, mold, and rot before they get to the lab

3. dry the samples out thoroughly as soon as possible. Not only will this save you valuable exploration dollars on you shipping costs, but it will prevent sample rot.

4. If you aren't totally sure what species you're sampling, and even if you're *pretty* sure, collect a specimen, press it nicely in your notebook, and refer to it later in the survey, or in the sample prep stages to confirm you've collected the right species consistently (see Rule #1). If you have a botanist friend, try and convince them to come sampling with you!

5. Use the same tools throughout the entire survey – you wouldn't switch shovels part way through a soil survey, so don't switch scissors/shears mid-survey when you're collecting biogeochemical samples.

6. When sampling, for instance, a tree, there are several different media available for collection: bark, twigs, leaves/needles, or cones. Be sure to create a composite sample by collecting the selected tissue from all around the perimeter of the tree. In some cases, particular elements may be concentrated on the north (or south) aspect of the tree, depending on the individual species physiology.

7. Be sure to sample plants that have similar age and health. An older tree will have a more developed root system that interacts with a greater volume of soil, so could give you a false positive anomaly, if you otherwise only sampled young trees.

8. Take detailed notes of the sample site (topography, moisture content, slope aspect, species present) as well as detailed notes and photos of the individual plant being sampled (age, size, health), and while you're on the ground, do some geology! In many instances you're the only person who will go to that site, so be sure to capture as much information as possible.

Now get out there and go do some biogeochemistry!

6.4 Recommendations for Future Work

As with any research, this thesis posed questions that could be addressed with further study. Some recommended areas for future research are:

1) Laboratory based experiments to assess the detailed vertical migration of REEs in a controlled environment:
    a. Modelling the breakdown of REE-enriched substrate under controlled "natural" weathering conditions. This could include agitating REE-bearing mineral grains in solutions of varying acidity for different lengths of time and monitoring the REE concentration of the resulting solution. This will assist in quantifying the effects of mechanical and chemical weathering on the REE-bearing mineral grain, therefore allow the explorer to predict the rate of weathering under natural conditions.
    b. Tracing the flow of REEs through different media using doped isotopic REE solutions. Many metal ions are translocated through the surficial environment via complexation with organic acids, and research has been done testing the rate of complexation of REEs with varying concentrations of REEs and humic acids under conditions of varying pH. However, this research was all performed in solution. Experiments modelling the transport of REEs under more natural conditions, mimicking those of soil pore water, have not been attempted. These conditions should encompass a range of pH values, as well as a variety of substrates, such as clean quartz sand, to organic rich clays and silts of varying permeability due to compaction. This will assist in hypothesizing the rate of transport under natural conditions, and allow estimations of expected REE distribution in the natural environment based on the age of the deposit and the nature of the surficial environment.
2) Biogeochemical orientation surveys over other styles of REE deposit (monazite-bearing placers, carbonatites, pegmatites associated with metaluminous granites, Fe oxide phosphate rocks, laterites) to assess the relative size of the biogeochemical footprint relative to the style of mineralization. The main factor inducing REE solubility is the nature of the host REE minerals; for instance, a churchite- bearing (hydrous REE

phosphate) laterite deposit will have a much larger REE footprint than a xenotime-bearing (REE, Zr phosphate) pegmatite because its REEs are more easily weathered.

3) Physiological studies of plants to determine what internal mechanism is responsible for the preferential mobility of LREEs over HREEs. This preferential mobility is observable by the increased proportion of LREEs in the leaf tissue compared to the root tissue. In this thesis, experiments were performed on the CLS synchrotron in Saskatoon to determine which part of the plant was hosting the REEs; unfortunately, the level of REEs was too low to be measured. Since REEs are toxic to plants at the high concentrations necessary for detection, plants should be grown in a REE-free or REE-poor solution, and then immersed in a REE-rich solution at increased air temperature to promote solution uptake into the plant. This may ultimately kill the plant, but not before the REEs infiltrate the plant tissue.
4) Lateral migration of REEs sourced from mineralization through groundwater or along aquifers. Since REEs are mobilized mainly via complexation with the carboxyl groups of organic acids, there may not be significant REE concentrations in groundwater reservoirs, however, surface water flow, especially in swampy or marshy areas, could be a significant consideration in the contributions to the REE budget.

References

Adamsson, O. J., 1944, The petrology of the Norra Karr district: Geologiska Föereningan i Stockholm, v. 66, no. 2, p. 142.

Anders Rapp, Rolf Nyberg, and Lindh, L., 1986, Nivation and local glaciation in N. and S. Sweden. A progress report.: Geografiska Annaler, v. 68, p. 8.

Andersson, U. B., Sjostrom, H., Hogdahl, K., and Eklund, O., 2004, The Transscandinavian igneous belt, evolutionary models: SPECIAL PAPER-GEOLOGICAL SURVEY OF FINLAND, v. 37, p. 104.

Andres, Y., Thouand, G., Boualam, M., and Mergeay, M. 2000. Factors influencing the biosorption of gadolinium by micro-organisms and its mobilisation from sand. Applied Microbiology and Biotechnology, 54:262 – 267.

Bau, M., 1991, Rare-earth element mobility during hydrothermal and metamorphic fluid-rock interaction and the significance of the oxidation state of europium: Chemical Geology, v. 93, no. 3, p. 219-230.

Belli, P.; Bernabei, R.; Cappella, F. et al. (2007). "Search for α decay of natural Europium". Nuclear Physics A 789 (1–4): 15–29.

Blaxland, A., 1977, Agpaitic magmatism at Norra Karr? Rb-Sr isotopic evidence: Lithos, v. 10, p. 8.

Bluemel, B., Leijd, M., Dunn, C., Hart, C., Saxon, M., and Sadeghi, M., 2013, Biogeochemical expression of Rare Earth Element and Zirconium mineralization at Norra Kärr, Southern Sweden: Journal of Geochemical Exploration.

Boynton, W. V., 1984, Cosmochemistry of the rare earth element: meteorite studies., Amsterdam, Elsevier, Rare Earth Element Geochemistry.

Braun, J.-J., Pagel, M., Muller, J.-P., Bilong, P., Michard, A., and Guillet, B., 1990, Cerium anomalies in lateritic profiles: Geochimica et Cosmochimica Acta, v. 54, no. 3, p. 781-795.

Cohen, D. R., Kelley, D. L., Anand, R., and Coker, W. B., 2010, Major advances in exploration geochemistry, 1998-2007: Geochemistry: Exploration, Environment, Analysis, v. 10, p. 13.

Coulson, I. M., 1997, Post-magmatic alteration in eudialyte from the North Qoroq centre, South Greenland: Mineralogical Magazine, v. 61, p. 10.

Cox, K. G., Bell, J. D., and Pankhurst, R. J., 1979, The interpretation of igneous rocks, G. Allen & Unwin.

Creed, J. T., Brockhoff, C. A., and Martin, T. D., 1994, Method 200.8 Determination of trace elements in waters and wastes by inductively coupled plasma - mass spectrometry, *in* development., E. m. s. l. o. o. r. a., ed.: Cincinnati Ohio.

De Baar, H. J. W., Bacon, M. P., Brewer, P. G., and Bruland, K. W., 1985, Rare earth elements in the Pacific and Atlantic Oceans: Geochimica et Cosmochimica Acta, v. 49, no. 9, p. 1943-1959.

Diatloff, E., Asher, C., and Smith, F., 1996, Concentrations of rare earth elements in some Australian soils: Soil Research, v. 34, no. 5, p. 735-747.

Ding, S., Liang, T., Yan, J., Zhang, Z., Huang, Z., and Xie, Y., 2007, Fractionations of rare earth elements in plants and their conceptive model: Science in China Press, v. 50, p. 9.

Ding, S., Liang, T., Zhang, C., Huang, Z., Xie, Y., and Chen, T., 2006, Fractionation mechanisms of Rare Earth Elements (REEs) in hydroponic wheat: An application for metal accumulation by plants: Environmental Science and Technology, v. 40, p. 7.

Drever, J. I., and Vance, G. F., 1994, Role of soil organic acids in mineral weathering processes, Organic acids in geological processes, Springer, p. 138-161.

Dunn, C. E., 1998, Regional and detailed biogeochemical surveys in the Nechako NATMAP area and in the Babine Porphyry Belt, in: New Geological Constraints on Mesozoic to Tertiary Metallogenesis and on Mineral Exploration in Central British Columbia: Nechako NATMAP Project., *in* L.C. Struik, D. G. M., ed., Short Course Extended Abstracts, Cordilleran Section of the Geological Association of Canada, p. 17.

Dunn, C. E., 2007, Biogeochemistry in Mineral Exploration, Amsterdam, Elsevier, Handbook of Exploration and Environmental Geochemistry.
Dupré, B., Viers, J., Dandurand, J.-L., Polve, M., Bénézeth, P., Vervier, P., and Braun, J.-J., 1999, Major and trace elements associated with colloids in organic-rich river waters: ultrafiltration of natural and spiked solutions: Chemical Geology, v. 160, p. 17.
Epstein, E., 1999, Silicon: Annual Review of Plant Physiology & Plant Molecular Biology, v. 50, p. 4.
Fu, F., Akagi, T., and Shinotsuka, K., 1998, Distribution Pattern of Rare Earth Elements in Fern - Implications for intake of fresh silicate particles by plants: Biological Trace Element Research, v. 64, p. 14.
Golyshev, V. M., Simonov, V. I., and Belov, N. V., 1971, Kristallografiya: Sov. Phys. Crystallogr., v. 16, p. 56.
Guiseppetti, G., Mazzi, F., and Tadini, C., 1971, TMPM Tschermaks Mineral: Petrogr. Mitt., v. 16, p. 105.
Guo, F., Wang, Y., Sun, J., and Chen, H., 1996, REE Bound Proteins in Natural Plant Fern *Dicranopteris dichitoma* by MAA.: Journal of Radioactivity and Nuclear Chemistry, v. 209, p. 9.
Hatch, G., 2012, Dynamics in the Global Market for Rare Earths: Elements, An International Magazine of Mineralogy, Geochemistry, and Petrology, v. 8, p. 6.
Hawkes, H. E., 1957, Principles of geochemical prospecting, US Govt. Print. Off., v. 1000.
He, Y., Wang, J., Fang, N., Gan, W., and Zhao, G., 1998, Effects of rare earth micro-fertilizer on plant physiological indexes and yield of hot pepper: Chinese Rare Earth, v. 19, no. 2, p. 36-40.
Hem, J. D., 1978, Redox processes at surfaces of manganese oxide and their effects on aqueous metal ions: Chemical Geology, v. 21, no. 3–4, p. 199-218.
Högdahl, K., Andersson, U. B., and Eklund, O., 2004, The Trans-Scandinavian Igneous Belt (TIB) in Sweden: a review of its character and evolution, *in* Finland, G. S. o., ed., Volume Special Paper 37: Finland, Gological Survey of Finland, p. 125.
Howell, J., and Gawthorne, J., 1987, Copper in animals and man.
Jenkinson, D. S and Ladd, J. N. 1981. Microbial mass in soil: measurement and turnover, in: Paul, E. A., Jia, W. Z., Di, G. T. (Eds.), Rare Earths and Agriculture. Agriculture Press, Beijing, 1-3.

Johannesson, K. H., Stetzenbach, K. J., Hodge, V. F., and Lyons, W. B., 1996, Rare earth element complexation behavious in circumneutral pH groundwaters: assessing the role of carbonate and phophate ions: Earth and planetary science letters, v. 139, p. 14.
Johansson, Å., 1988, The age and tectonic setting of the Småland-Värmland granite-porphyry belt: Geologiska Föereningan i Stockholm, v. 110, no. 2, p. 5.
Johnsen, O., Ferraris, G., Gault, R. A., Grice, J. D., Kampf, A. R., and Pekov, I. V., 2003, The nomenclature of eudialyte group minerals: The Canadian Mineralogist, v. 41, p. 9.
Johnsen, O., Grice, J. D., and Gault, R. A., 2001, The eudialyte group: a review: Geology of Greenland Survey Bulletin, v. 190, p. 65-72.
Kovalevsky, A. L., 1987, Biogeochemical Exploration for Mineral Deposits, The Netherlands, VNU Science Press BV.
Krauskopf, K. B., and Bird, D. K., 1967, Introduction to geochemistry, McGraw-Hill New York.
Langmuir, D., 1978, Urnaium solution-mineral equilibria at low temperatures with applications to sedimentary ore deposits: Geochimica et Cosmochimica Acta, v. 42, p. 22.
Larsen, L. M., and Sørensen, H., 1987, The Ilímaussaq intrusion - progressive crystallization and formation of layering in an agpaitic magma: Alkaline Igneous Rocks, v. 30, p. 15.
Laul, J. C., Weimer, W. C., and Rancitelli, L. A., 1979, Biogeochemical distribution of rare earths and other trace elements in plants and soils: Physics and chemistry of the earth, v. 11, p. 8.
Lee, J. H., and Byrne, R. H., 1992, Complexation of trivalent rare earth elements (Ce, Eu, Gd, Tb, Yb) by carbonate ions: Geochimica et Cosmochimica Acta, v. 57, p. 7.

Lewis, A. J., Komninou, A., Yardley, B. W. D., and Palmer, M. R., 1998, Rare earth element speciation in the geothermal fluids from yellowstone national park, Wyoming, USA: Geochimica et Cosmochimica Acta, v. 62, no. 4, p. 6.

Li, F., Shan, X., Zhang, T., and Zhang, S., 1998, Evaluation of plant availability of rare earth elements in soils by chemical fractionation and multiple regression analysis: Environmental Pollution, v. 102, p. 9.

Lippold, H., Evans, N., Warwick, P., and Kupsch, H., 2007, Competitive effect of iron (III) on metal complexation by humic substances: Characterisation of ageing processes: Chemosphere, v. 67, no. 5, p. 1050-1056.

Lucas, R. E., and Davis, J. F., 1961, Relationships between pH values of organic soils and availabilities of 12 plant nutrients: Soil Science, v. 92, no. 3, p. 177.

Lundqvist, J., 2004, Glacial History of Sweden: Quaternary Glaciations - Extent and Chronology, v. 3, p. 11.

Lundqvist, J., and Wohlfarth, B., 2001, Timing and east-west correlation of south Swedish ice marginal lines during the late Weichselian: Quaternary Science Reviews, v. 20, p. 22.

Markert, B., and Li, Z. D., 1991, Natural background concentrations of rare-earth elements in a forest ecosystem: The science of the total environment, v. 103, p. 8.

Marsac, R., Davranche, M., Gruau, G., Dia, A., and Bouh-Le Coz, M., 2012, Aluminium competitive effect on rare earth elements binding to humic acid: Geochimica et Cosmochimica Acta, v. 89, p. 9.

Matoh, T., and Kobayashi, M., 1998, Boron and Calcium, Essential Inorganic Constituents of Pectic Polysaccharids in Higher Plant Cell Walls: Journal of Plant Research, v. 111, p. 12.

McDonough, W. F., and Sun, S.-S., 1995, The composition of the Earth: Chemical Geology, v. 120, no. 3, p. 223-253.

Nakamura, N., 1974, Determination of REE, Ba, Fe, Mg, Na and K in carbonaceous and ordinary chondrites: geochimica et cosmochimica acta, v. 38, no. 5, p. 757-775.

Ozaki, T., and Enomoto, S., 2001, Uptake of rare earth elements by Dryopteris erythrosora (autumn fern): RIKEN REVIEW, p. 84-87.

Pang, X., Li, D., and Peng, A., 2002, Application of rare-earth elements in the agriculture of China and its environmental behavior in soil: Environmental Science and Pollution Research, v. 9, no. 2, p. 143-148.

Pourret, O., Davrache, M., Gruau, G., and Dia, A., 2007, Rare earth elements complexation with humic acid: Chemical Geology, v. 243, p. 13.

Rankin, L., 2011, Structural setting of the Norra Kärr intrusive complex, central Sweden: Australia, p. 40.

Reed, G. C., 2011, NI 43-101 Technical Report, Norra Karr REE-Zirconium Deposit, Granna, Sweden.

Robinson, W. O., Bastron, H., and Murata, K. J., 1958, Biogeochemistry of rare earth elements with particular references to hickory trees: Geochimica et Cosmochimica Acta, v. 14, p. 12.

Rose, A. W., Hawkes, H. E., and Webb, J. S., 1979, Geochemistry in mineral exploration, Academic Press London.

Schijf, J., and Byrne, R. H., 2001, stability constants for mono- and dioxalato-complexes of Y and the REE, potentially important species in groundwaters and surface freshwaters: Geochimica et Cosmochimica Acta, v. 65, no. 7, p. 9.

Sholkovitz, E. R., 1995, The aquatic chemistry of rare earth elements in rivers and estuaries: Aquatic Geochemistry, v. 1, p. 34.

Sinclair, A., 1974, Selection of threshold values in geochemical data using probability graphs: Journal of Geochemical Exploration, v. 3, no. 2, p. 129-149.

Sjöqvist, A., 2012, U/Pb isotope research, *in* Bluemel, B., ed.: University of Göteborg, Sweden.

Sjöqvist, A., Cornell, D., Andersen, T., Erambert, M., Ek, M., and Leijd, M., 2012, Three varieties of eudialyte-group REE-ore mineral from the Norra Kärr Alkaline Complex, southern Sweden: Minerals, v. 2, p. 28.
Smedley, P. L., 1991, The geochemistry of rare earth elements in groundwater from the Carnmenellis area, southwest E: Geochimica et Cosmochimica Acta, v. 55, p. 12.
Sørensen, H., 1997, The agpaitic rocks - an overview: Mineralogical Magazine, v. 61, p. 14.
Stanley, C. R., 2003, Statistical evaluation of anomaly recognition performance: Geochemistry: Exploration, Environment, Analysis, v. 3, no. 1, p. 3-12.
Taiz, L., and Zeiger, E., 2010, Plant Physiology, USA, Sunauer Associates, Inc., 782 p.:
Takada, J., Sumino, T., Nishimura, K., Tanaka, Y., and Akaboshi, M., 1996, Determination of rare earth elements in fern leaves using instrumental neutron activation analysis: Journal of Radioactivity and Nuclear Chemistry, v. 214, no. 2, p. 13.
Tang, J., and Johannesson, K. H., 2003, Speciation of rare earth elements in natural terrestrial waters: assessing the role of dissolved organic matter from the modelling approach: Geochimica et Cosmochimica Acta, v. 67, no. 13, p. 8.
Taylor, S. R., and McLennan, S. M., 1985, The continental crust: its composition and evolution.
Taylor, S. R., and McLennan, S. M., 1995, The geochemical evolution of the continental crust: Reviews of Geophysics, v. 33, no. 2, p. 241-265.
Törnebohm, A. E., 1906, Katapleiit-syenit, en nyupptackt varietet af nefelinsyenit i Sverige, *in* SGU, ed., Volume C: Stockholm.
Tyler, G., 2004, Rare earth elements in soil and plant systems - A review: Plant and Soil, v. 267, p. 16.
Tyler, G., and Olsson, T., 2002, Conditions related to solubility of rare and minor elements in forest soils: Journal of Plant Nutrition and Soil Science, v. 165, no. 5, p. 594-601.
Ussing, N. V., 1912, Geology of the country around Julianehaab, Greenland.
Wakita, H., Rey, P., and Schmitt, R., Abundances of the 14 rare-earth elements and 12 other trace elements in Apollo 12 samples: five igneous and one breccia rocks and four soils, *in* Proceedings Lunar and Planetary Science Conference Proceedings1971, Volume 2, p. 1319.
Wang, Y. Q., Sun, J. X., Chen, H. M., and Guo, F. Q., 1997, Determination of the contents and distribution chacteristics of REE in natural plants by NAA: Journal of Radioactivity and Nuclear Chemistry, v. 219, p. 4.
Warren, H. V., Delavault, R. E., and Barakso, J., 1964, The role of arsenic as a pathfinder in biogeochemical prospecting: Economic Geology, v. 59, no. 7, p. 1381-1385.
Welch, R. M., 1995, Micronutrient nutrition of plants: Critical Review of Plant Science, v. 14, p. 33.
Welin, E., 1980, Tabulation of recalculated radiometric ages published 1960-1979 for rocks and minerals in Sweden: Geologiska Föereningan i Stockholm, no. 104, p. 12.
Williams, J. F., 1841, Eudialyte and Eucolite from Magnet Cove, Arkansas: American Journal of Science, v. 40, p. 5.
Wilson, B. M., 1989, Igneous petrogenesis a global tectonic approach, Chapman & Hall.
Wood, S. A., 1990, The aqueous geochemistry of the rare-earth elements and yttrium: Chemical Geology, v. 82, p. 27.
Wyttenbach, A., Furrer, V., Schleppi, P., and Tobler, L., 1998, Rare earth elements in soil and soil-grown plants: Plant and Soil, v. 199, p. 7.
Yamamoto, Y., Takahashi, Y., and Shimizu, H., 2005, Systematics of stability constants of fulvate complexes with rare earth ions: Chemistry Letters, v. 34, no. 6, p. 880-881.
Zhang, Z., Wang, Y., Li, F., Xiao, H., and Chai, Z., 2002, Distribution characteristics of rare earth elements in plants from a rare earth ore area.: Journal of Radioactivity and Nuclear Chemistry v. 252, p. 5.

Appendix A1

Technical Memo: Data Reliability Below Certified Detection Limits

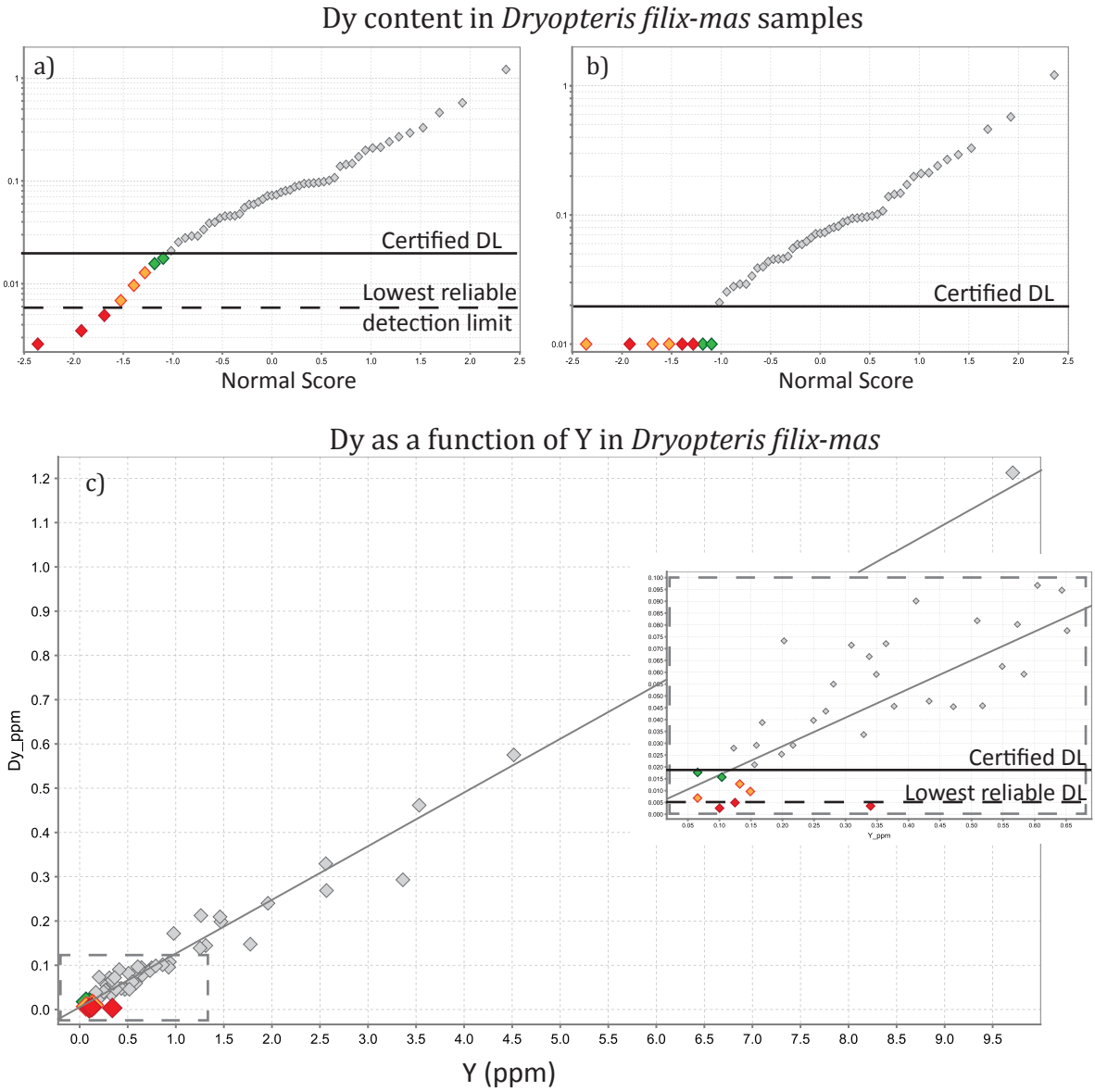
The detection limit (DL) of a particular analytical method is defined as the lowest concentration level that can be determined to be statistically different from a blank with >99% confidence. The main factors influencing the DL of any particular analysis are: the matrix, the method, and the analyte. Classically, the detection limit is quantified as three times the standard deviation of the blank. However, depending on the nature of the blank, the background can be variable, and this in effect "heightens" the detection limit because the median of the background determined from the blank encompasses a wider range of values. In this way, an unclean blank can also erroneously contribute to the signal from the analyte.

It is important to consider matrix matching between the blank and the analyte, as well as to use the same acids and instruments of the same relative sensitivity to ensure the lowest possible detection limit. Matrix effects are interferences from other components of the sample aside from the material of interest. For instance, in a mineral exploration soil sample there will be an analytical signal attributable to mineralization, but there will also be a signal resulting from the other mineral constituents present in the sample. These are known as matrix effects and decrease the confidence with which the detection limit for a particular element can be stated.

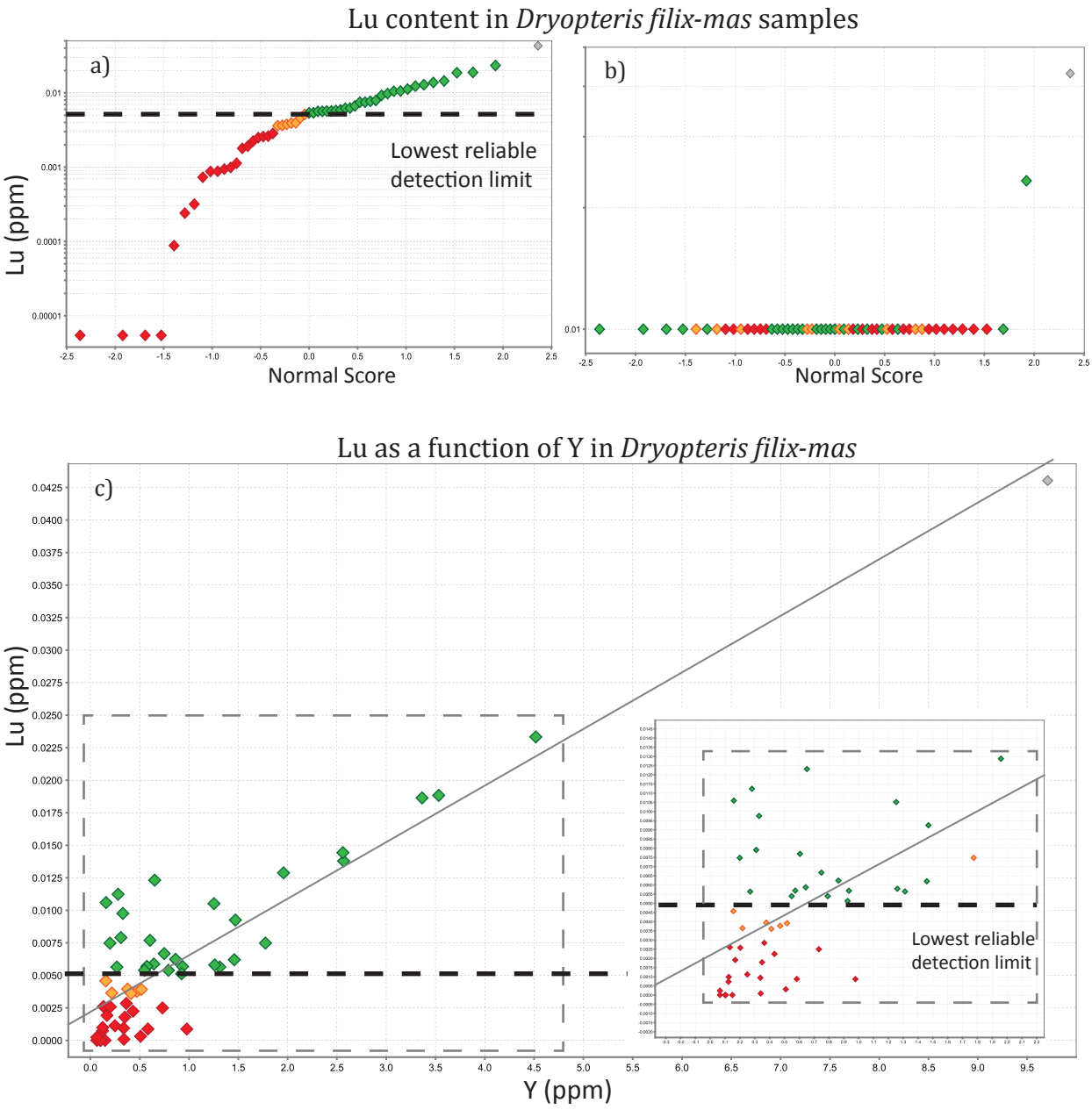
Biogeochemical samples have negligible matrix effects because their matrix is almost entirely organic material. Upon digestion, the organic component of the sample exsolves and is released as CO_2. The lack of matrix effects in a biogeochemical sample allows the chemical composition of the sample to be reported reliably below the certified limit for a particular method, if that analytical method must be applied to soil and rock samples as well.

In this research, uncertified REE values were used to differentiate biogeochemical samples collected over mineralization from those collected in background regions. Geochemical sampling in mineral exploration focuses on the contrast between mineralized and unmineralized areas, therefore having reliable low-level analytical data from background regions is as important as having good quality data from highly mineralized zones.

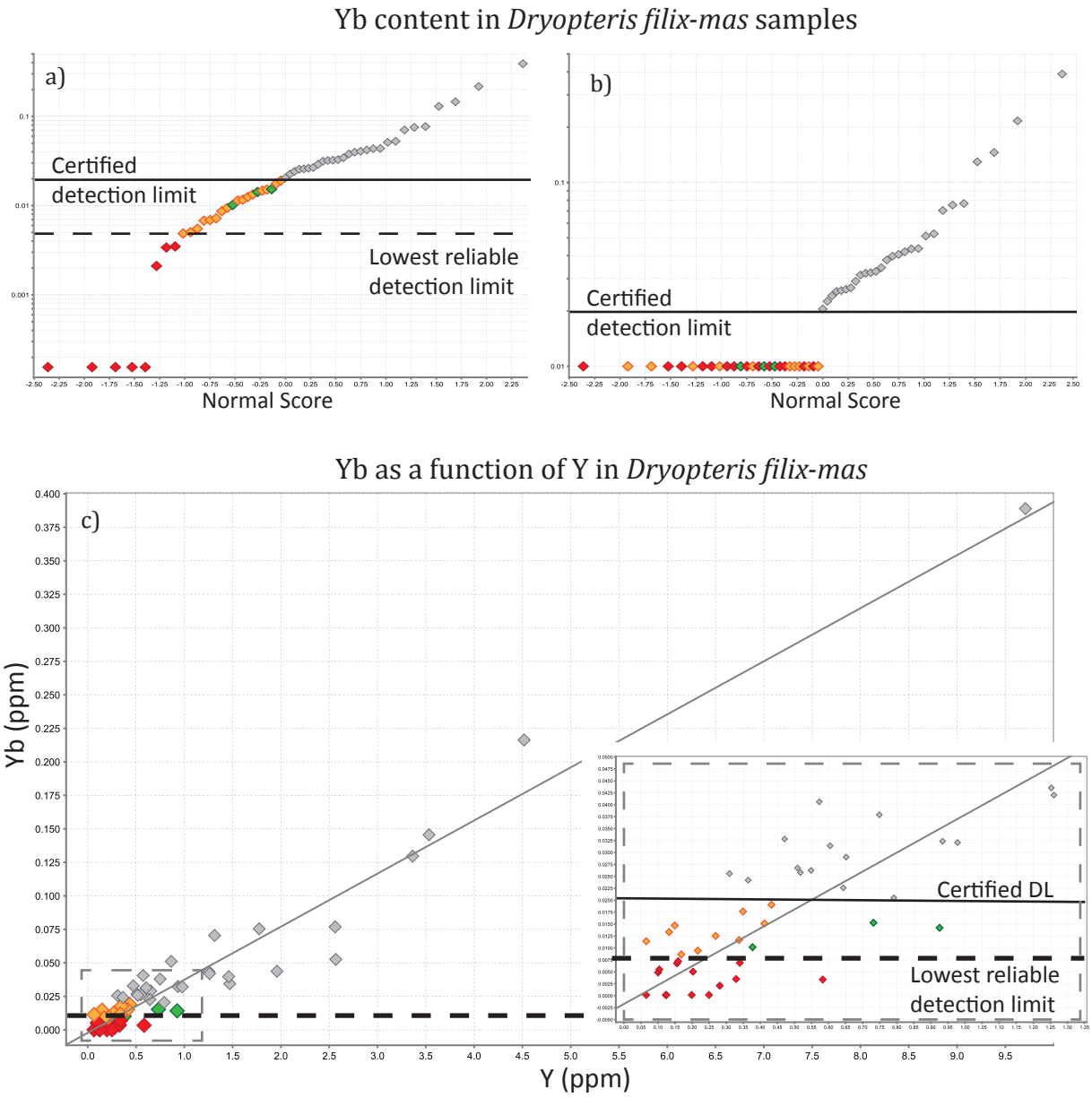
The LREEs all returned values above the limit of detection, however, the HREEs returned BDL values due to their lower crustal abundance. To circumvent the problems caused by the paucity of <DL data for the HREEs, each element was ratioed to Y to bolster confidence near and below the detection limit. Yttrium is technically a rare earth element, though it isn't in the lanthanide series. This means it has higher crustal abundance, but still behaves very chemically similarly to the other HREE. If a correlation is present between Y values and the other REE values (see following diagrams) then the <DL HREE values can be used with more confidence. Probability plots were also used to assess the BDL data; different populations are identified by determining breaks in slope on a probability plot, therefore if some values just below the detection limit still fall within the same population as those samples above the detection limit, then those BDL samples can be used more confidently.



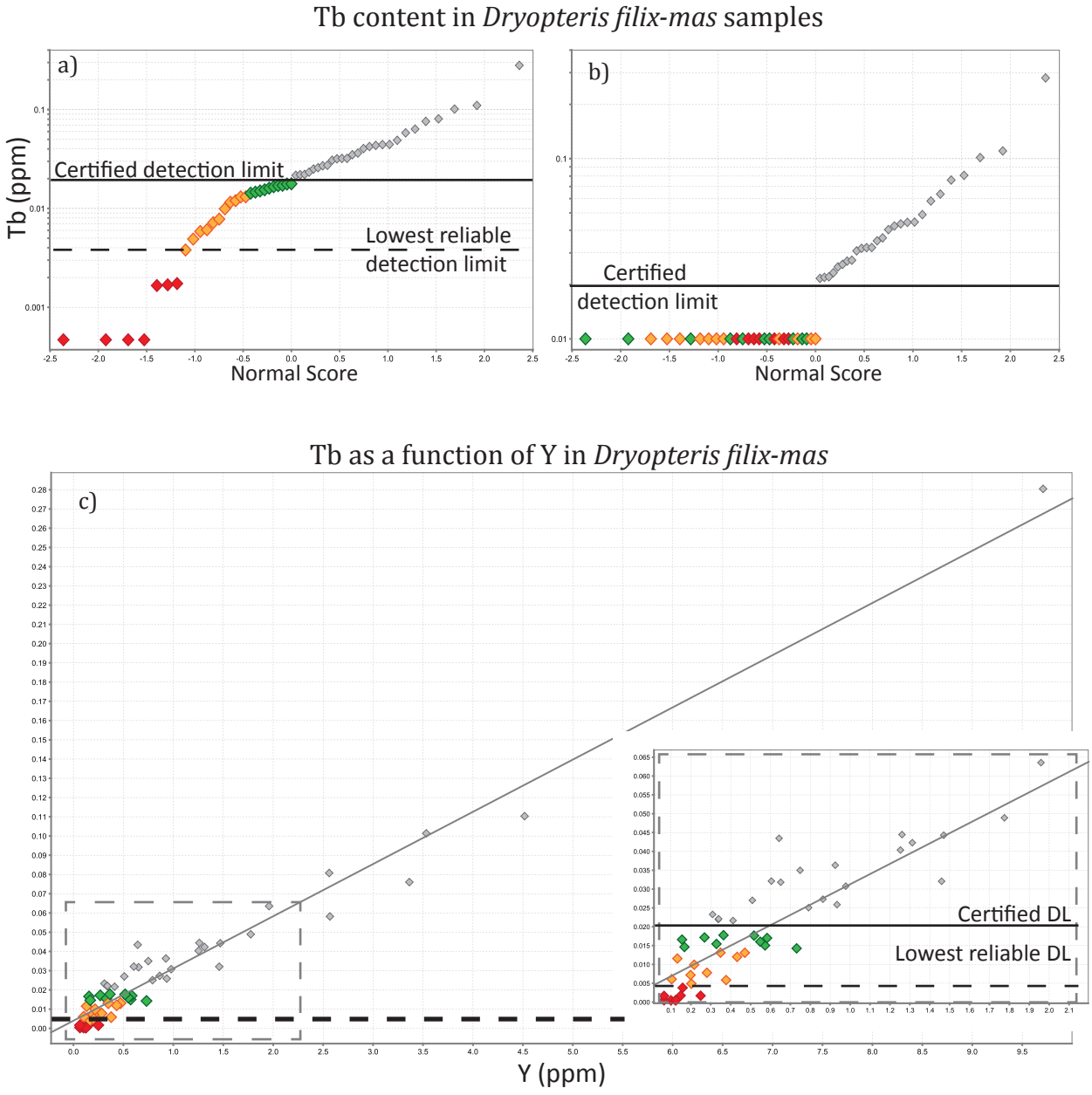
Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.



Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.

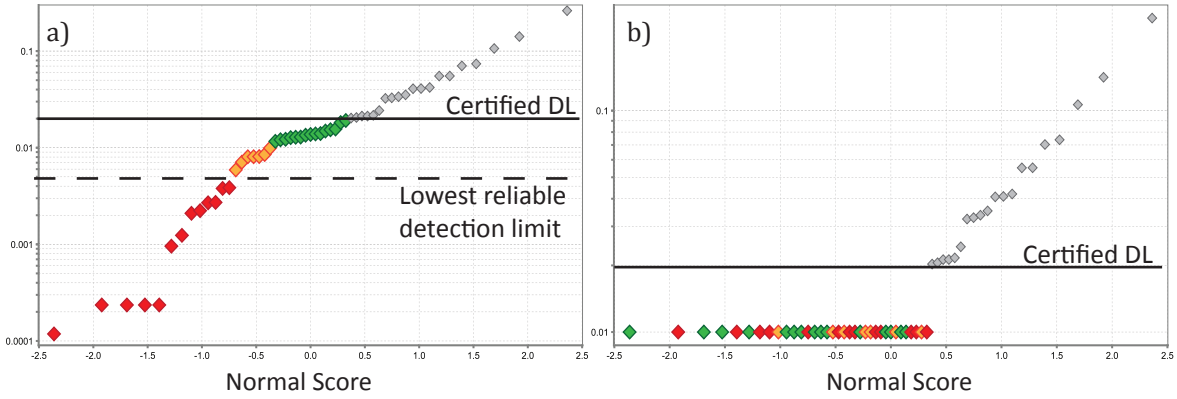


Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.

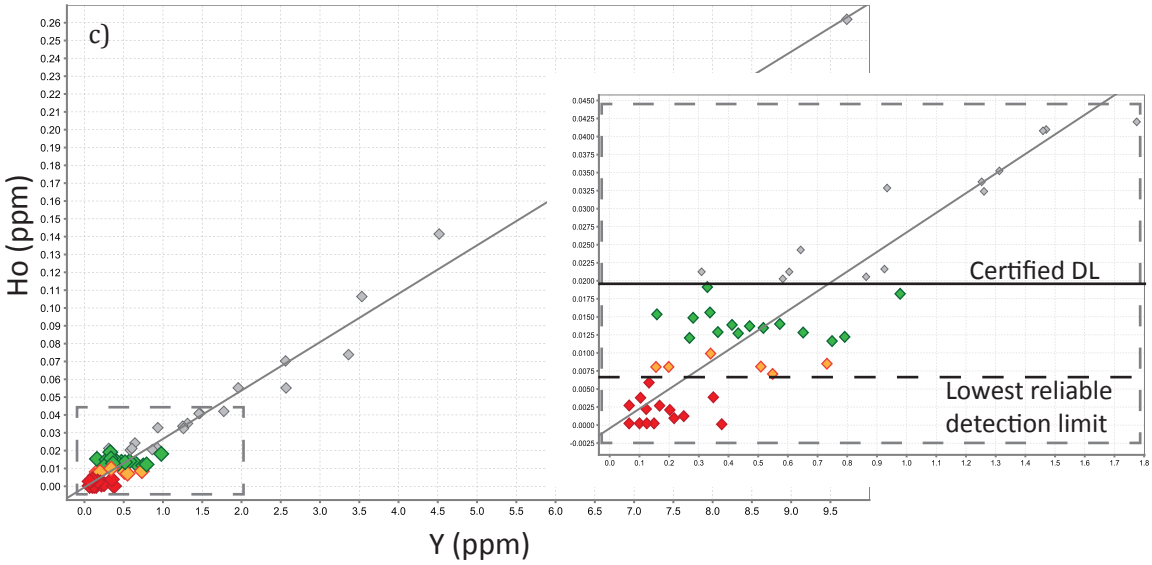


Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.

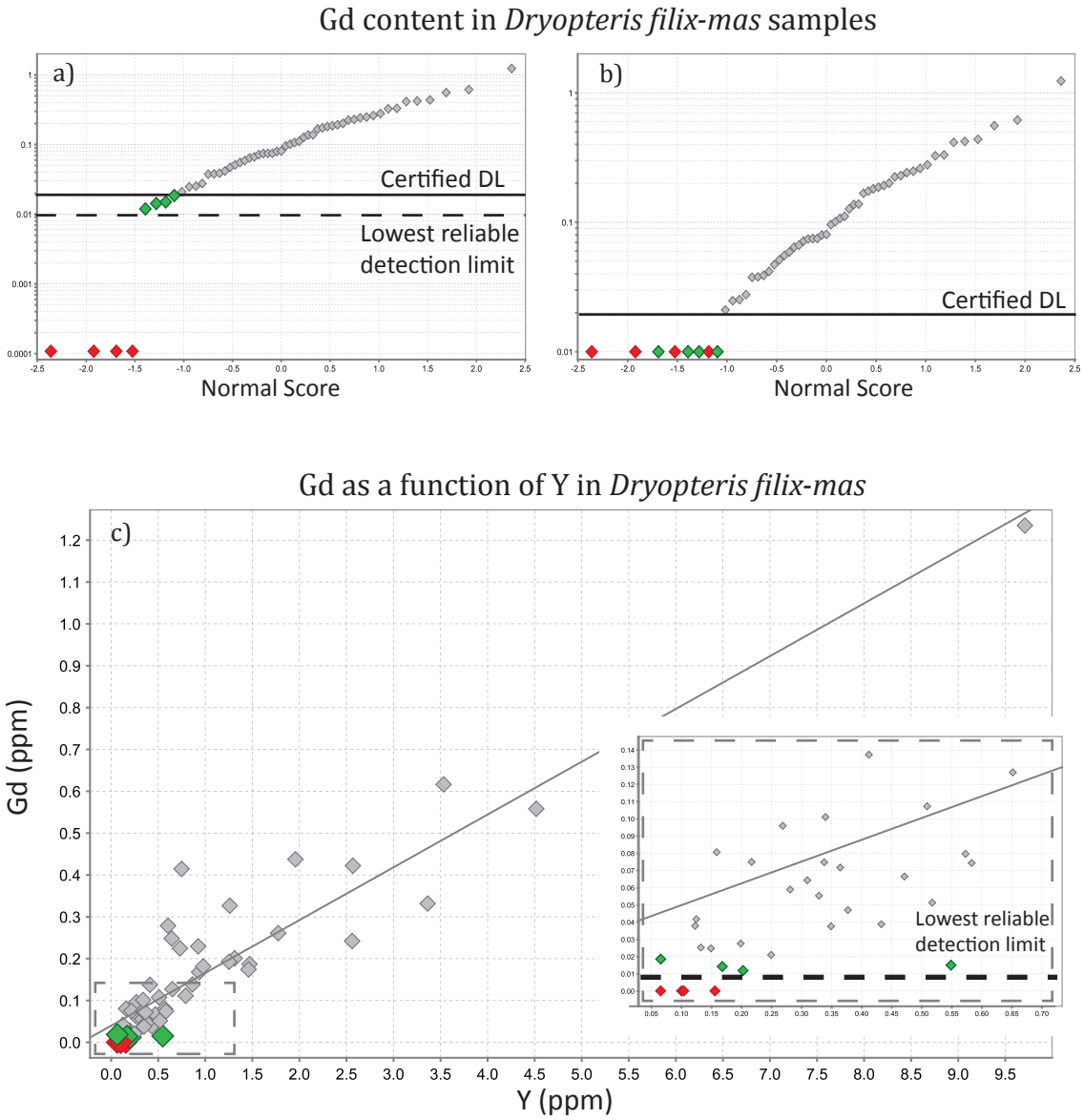
Ho content in *Dryopteris filix-mas* samples



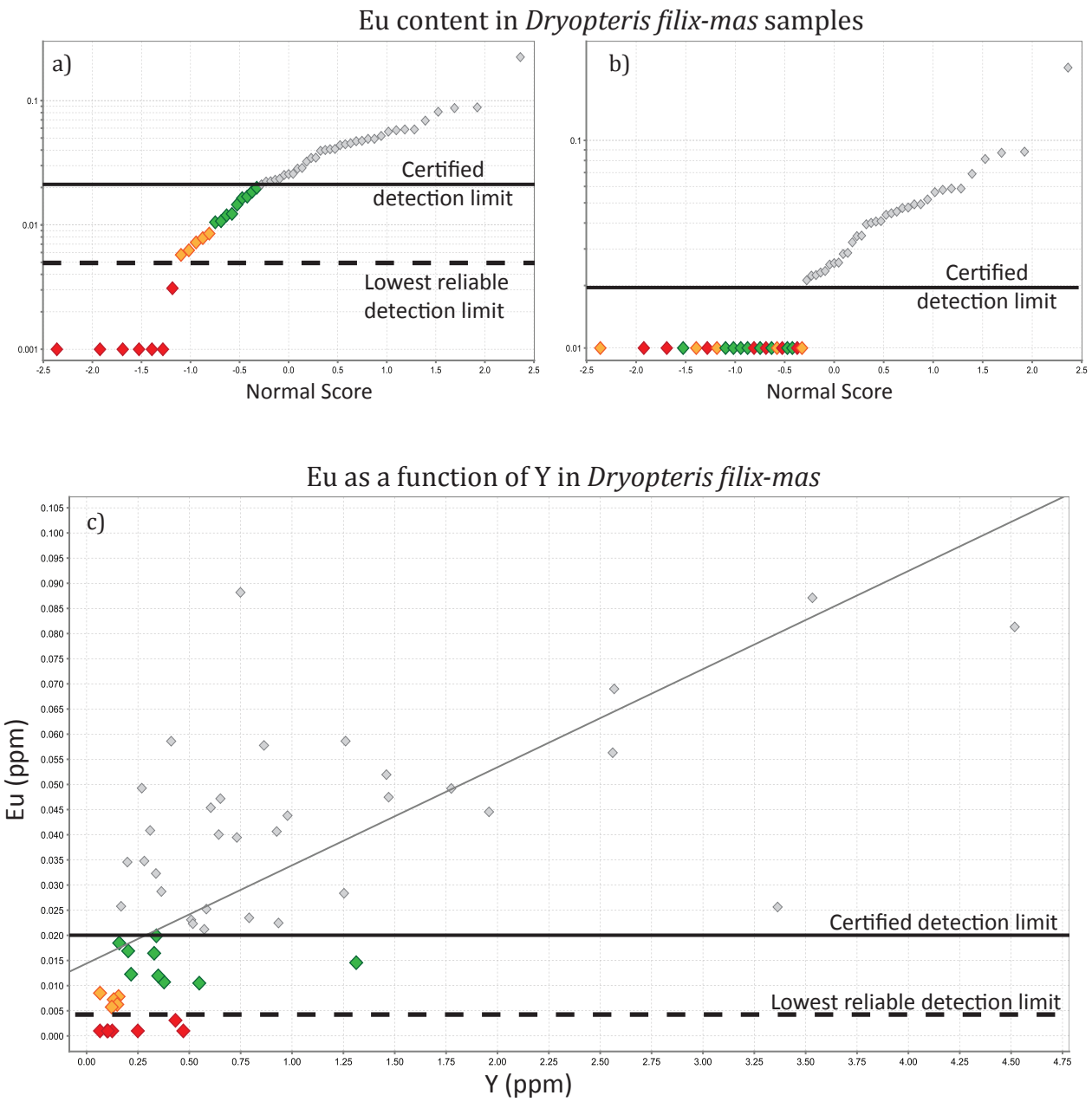
Ho as a function of Y in *Dryopteris filix-mas*



Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.

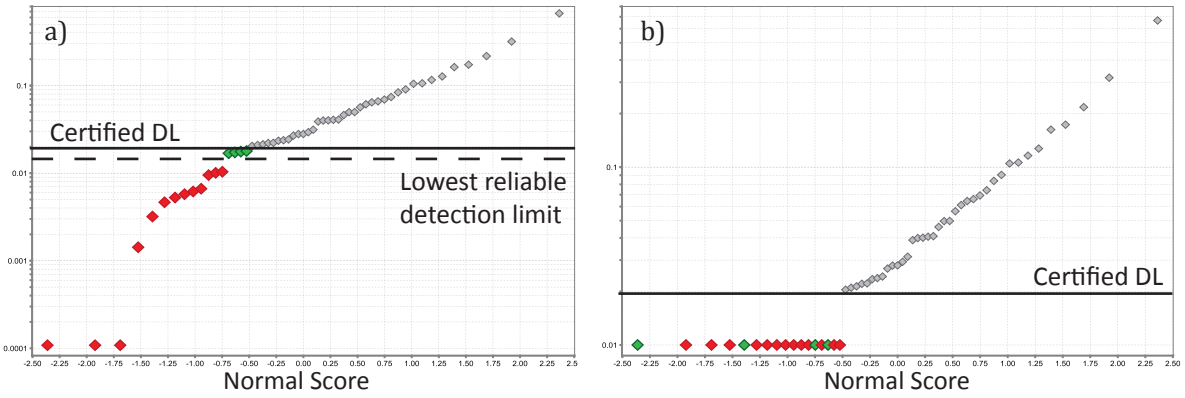


Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.

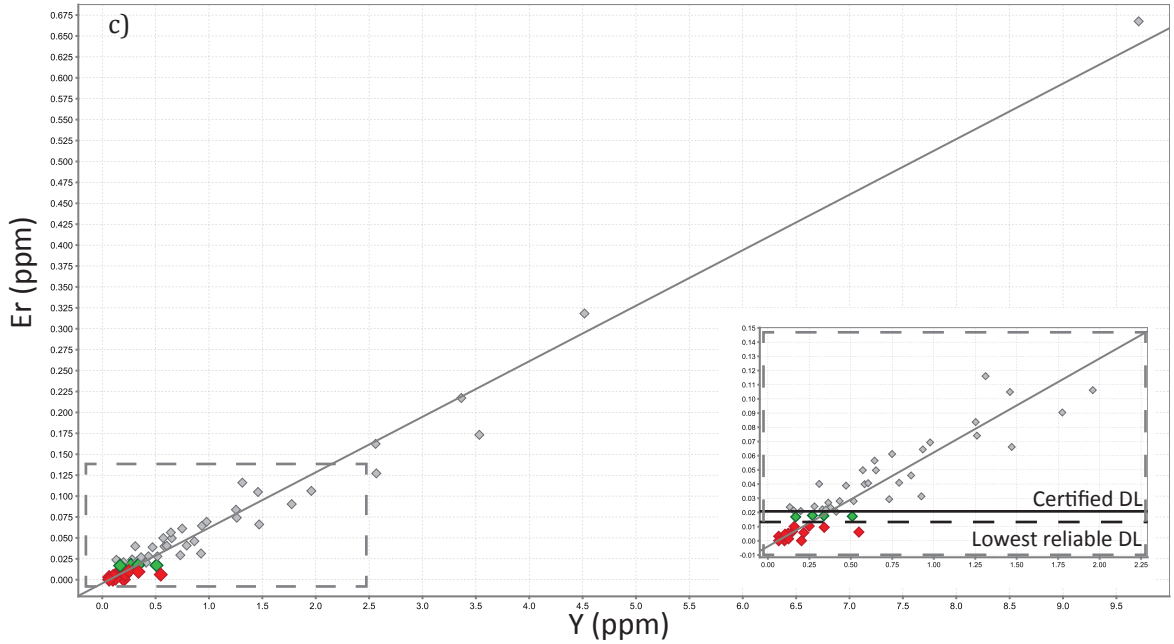


Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.

Er content in *Dryopteris filix-mas* samples



Er as a function of Y in *Dryopteris filix-mas*



Detection Limit Confidence Diagrams. a) Probability plot of all REE data. b) Probability plot of all REE data with values <0.02ppm replaced with 0.01ppm. c) Diagram of REE as a function of Y. In all diagrams the >DL data is coloured grey, the most confidently reliable data is coloured green, the reliable data is coloured orange, and the unreliable data is coloured red.

APPENDIX A2 - REEs ONLY, RELIABLE BDL VALUES

StationID	La_ppm	Ce_ppm	Pr_ppm	Nd_ppm	Sm_ppm	Eu_ppm	Gd_ppm	Tb_ppm	Dy_ppm	Ho_ppm	Er_ppm	Tm_ppm	Yb_ppm	Lu_ppm
NK11-001	15.99	21.85	2.11	4.96	0.337	0.041	0.064	0.023	0.071	0.021	0.040	0.005	0.026	0.008
NK11-002	10.40	10.89	1.34	3.28	0.306	0.047	0.127	0.032	0.078	0.013	0.050	0.006	0.029	0.012
NK11-003	5.83	11.17	0.79	1.81	0.142	0.008	0.000	0.017	0.021	0.008	0.021	0.000	0.007	0.005
NK11-004	11.90	20.26	2.12	5.33	0.506	0.040	0.248	0.043	0.095	0.024	0.056	0.000	0.023	0.006
NK11-005	11.54	14.52	1.71	3.94	0.375	0.022	0.168	0.026	0.108	0.033	0.064	0.005	0.032	0.006
NK11-006	1.92	4.66	0.22	0.66	0.053	0.001	0.038	0.009	0.003	0.001	0.007	0.000	0.013	0.004
NK11-007	3.31	6.55	0.55	1.33	0.139	0.021	0.080	0.015	0.080	0.014	0.050	0.002	0.041	0.006
NK11-008	9.83	20.45	1.83	5.24	0.799	0.081	0.558	0.110	0.575	0.141	0.318	0.047	0.216	0.023
NK11-009	19.24	29.00	2.27	6.19	0.670	0.039	0.233	0.042	0.111	0.028	0.084	0.003	0.041	0.005
NK11-010	1.65	2.22	0.17	0.45	0.032	0.001	0.005	0.011	0.003	0.010	0.020	0.000	0.007	0.000
NK11-011	1.91	2.60	0.19	0.41	0.040	0.001	0.050	0.006	0.021	0.004	0.014	0.000	0.016	0.000
NK11-012	2.60	3.57	0.28	0.80	0.071	0.001	0.067	0.013	0.045	0.014	0.039	0.000	0.033	0.004
NK11-013	3.98	2.19	0.59	1.82	0.230	0.023	0.107	0.027	0.082	0.008	0.017	0.002	0.027	0.000
NK11-014	5.30	7.39	0.93	2.19	0.177	0.003	0.039	0.012	0.048	0.013	0.028	0.002	0.019	0.002
NK11-016	5.45	7.86	0.87	2.67	0.251	0.015	0.201	0.042	0.145	0.035	0.116	0.008	0.070	0.006
NK11-017	2.90	5.45	0.44	0.86	0.077	0.007	0.025	0.012	0.013	0.006	0.024	0.000	0.013	0.003
NK11-018	5.12	6.37	0.54	1.49	0.153	0.002	0.000	0.010	0.021	0.005	0.017	0.000	0.013	0.002
NK11-019	6.28	7.46	1.04	2.97	0.216	0.025	0.074	0.017	0.059	0.020	0.040	0.001	0.003	0.001
NK11-020	5.14	9.73	0.62	1.45	0.071	0.001	0.041	0.009	0.021	0.004	0.016	0.000	0.007	0.000
NK11-021	2.67	4.02	0.32	0.78	0.041	0.001	0.000	0.000	0.003	0.000	0.000	0.000	0.005	0.000
NK11-022	9.39	8.85	1.23	2.96	0.201	0.006	0.025	0.002	0.010	0.000	0.007	0.000	0.015	0.000
NK11-023	36.78	51.49	5.64	15.43	1.360	0.163	0.411	0.072	0.128	0.016	0.085	0.000	0.041	0.004
NK11-024	21.26	18.73	3.58	10.83	1.191	0.086	0.445	0.074	0.226	0.028	0.048	0.001	0.048	0.002
NK11-026	1.94	2.57	0.19	0.44	0.039	0.001	0.014	0.000	0.003	0.000	0.000	0.000	0.006	0.000
NK11-027	3.29	4.70	0.43	0.83	0.092	0.018	0.081	0.004	0.029	0.015	0.010	0.010	0.007	0.011
NK11-028	6.58	8.94	0.94	2.01	0.209	0.035	0.059	0.008	0.055	0.015	0.024	0.010	0.002	0.011
NK11-029	9.06	16.30	1.39	3.36	0.370	0.045	0.279	0.032	0.097	0.021	0.041	0.011	0.031	0.008
NK11-030	6.02	9.51	0.97	2.30	0.233	0.049	0.096	0.017	0.044	0.012	0.018	0.009	0.013	0.006
NK11-031	8.43	15.40	1.40	4.28	0.440	0.066	0.214	0.028	0.126	0.018	0.058	0.006	0.026	0.002
NK11-031	4.99	8.61	0.81	1.94	0.218	0.035	0.028	0.007	0.025	0.008	0.021	0.004	0.000	0.007
NK11-032	10.73	15.53	1.78	4.29	0.528	0.045	0.437	0.064	0.240	0.055	0.106	0.017	0.044	0.013
NK11-033	41.50	25.26	6.46	20.18	2.451	0.220	0.876	0.098	0.303	0.064	0.153	0.020	0.086	0.024

StationID	La_ppm	Ce_ppm	Pr_ppm	Nd_ppm	Sm_ppm	Eu_ppm	Gd_ppm	Tb_ppm	Dy_ppm	Ho_ppm	Er_ppm	Tm_ppm	Yb_ppm	Lu_ppm
NK11-034	4.55	7.96	0.64	1.57	0.123	0.016	0.055	0.015	0.034	0.019	0.022	0.006	0.003	0.010
NK11-035	12.54	19.71	1.78	4.35	0.386	0.036	0.133	0.015	0.033	0.009	0.026	0.006	0.010	0.007
NK11-036	9.48	19.58	1.46	3.58	0.427	0.049	0.261	0.049	0.148	0.042	0.090	0.013	0.075	0.007
NK11-037	11.97	15.45	1.74	4.17	0.488	0.041	0.229	0.036	0.096	0.022	0.031	0.007	0.014	0.005
NK11-037N	32.29	61.70	4.43	12.21	1.258	0.134	0.799	0.133	0.786	0.146	0.373	0.049	0.200	0.026
NK11-037N	6.33	10.49	0.88	2.49	0.238	0.001	0.146	0.021	0.184	0.021	0.080	0.011	0.084	0.009
NK11-037N	9.11	13.00	1.42	3.56	0.414	0.047	0.187	0.044	0.198	0.041	0.066	0.015	0.034	0.009
NK11-038	14.84	26.67	2.47	6.46	0.812	0.069	0.422	0.058	0.269	0.055	0.127	0.028	0.053	0.014
NK11-038N	26.25	44.60	3.84	11.87	1.559	0.160	1.231	0.190	1.221	0.238	0.607	0.075	0.338	0.041
NK11-038N	9.98	18.85	1.28	3.12	0.290	0.058	0.138	0.027	0.101	0.021	0.046	0.004	0.051	0.006
NK11-039	13.93	27.56	2.50	7.34	1.040	0.087	0.616	0.101	0.462	0.106	0.173	0.039	0.146	0.019
NK11-039N	16.38	26.90	2.73	8.88	1.406	0.118	0.984	0.190	1.325	0.282	0.833	0.090	0.527	0.065
NK11-039N	5.79	9.48	0.85	2.15	0.310	0.028	0.193	0.040	0.139	0.034	0.084	0.008	0.044	0.011
NK11-040	7.83	11.49	1.09	2.65	0.353	0.052	0.174	0.032	0.209	0.041	0.105	0.015	0.040	0.006
NK11-040N	5.90	10.11	1.04	2.89	0.479	0.026	0.332	0.076	0.293	0.074	0.217	0.030	0.130	0.019
NK11-041	27.59	18.80	3.78	9.71	1.011	0.110	0.472	0.057	0.154	0.017	0.044	0.005	0.036	0.005
NK11-042	31.75	52.93	6.51	21.33	2.632	0.264	1.780	0.190	1.084	0.174	0.407	0.050	0.256	0.030
NK11-042	8.16	13.25	1.60	4.65	0.577	0.059	0.327	0.044	0.212	0.032	0.074	0.013	0.042	0.006
NK11-043	8.74	15.86	1.34	3.87	0.387	0.044	0.182	0.031	0.172	0.018	0.069	0.009	0.032	0.001
NK11-044	23.34	29.33	3.72	10.13	1.029	0.088	0.414	0.035	0.094	0.012	0.061	0.003	0.038	0.007
NK11-046	9.22	9.83	1.45	3.68	0.216	0.017	0.012	0.005	0.073	0.002	0.000	0.000	0.005	0.003
NK11-047	14.18	15.48	2.25	5.86	0.569	0.049	0.181	0.007	0.039	0.002	0.013	0.001	0.008	0.002
NK11-048	6.02	8.54	0.83	2.10	0.163	0.012	0.075	0.010	0.029	0.001	0.006	0.000	0.009	0.004
NK11-049	2.29	3.75	0.29	0.64	0.058	0.001	0.000	0.000	0.007	0.000	0.003	0.000	0.000	0.000
NK11-050	36.51	45.68	4.40	10.77	1.044	0.099	0.181	0.049	0.102	0.012	0.030	0.004	0.040	0.004
NK11-051	24.19	30.61	3.22	9.30	1.114	0.172	0.548	0.062	0.241	0.037	0.051	0.011	0.050	0.012
NK11-052	34.49	54.75	5.06	13.78	1.413	0.152	0.318	0.040	0.077	0.008	0.037	0.003	0.031	0.000
NK11-053	1.85	1.61	0.30	0.49	0.036	0.001	0.000	0.000	0.017	0.000	0.000	0.000	0.002	0.000
NK11-054	27.43	19.51	4.01	11.77	1.312	0.115	0.525	0.049	0.193	0.022	0.068	0.009	0.029	0.006
NK11-055	29.99	22.93	4.65	13.77	1.587	0.133	0.456	0.050	0.191	0.024	0.053	0.009	0.031	0.004
NK11-056	15.53	13.72	2.20	5.57	0.449	0.039	0.225	0.014	0.088	0.009	0.029	0.001	0.015	0.002
NK11-057	9.45	9.68	1.05	2.29	0.246	0.010	0.015	0.016	0.062	0.007	0.006	0.001	0.026	0.005
NK11-058	19.30	14.92	1.83	4.04	0.271	0.023	0.111	0.025	0.099	0.012	0.041	0.006	0.020	0.005

StationID	La_ppm	Ce_ppm	Pr_ppm	Nd_ppm	Sm_ppm	Eu_ppm	Gd_ppm	Tb_ppm	Dy_ppm	Ho_ppm	Er_ppm	Tm_ppm	Yb_ppm	Lu_ppm
NK11-059	16.00	10.77	1.90	5.27	0.499	0.041	0.289	0.001	0.127	0.004	0.020	0.003	0.002	0.002
NK11-060	48.23	39.38	7.14	19.78	2.244	0.223	0.611	0.061	0.184	0.035	0.062	0.008	0.052	0.013
NK11-061	21.58	27.39	3.16	8.85	0.953	0.099	0.507	0.043	0.125	0.014	0.057	0.004	0.028	0.005
NK11-062	30.43	41.83	4.11	9.99	0.824	0.060	0.262	0.027	0.113	0.009	0.033	0.001	0.021	0.004
NK11-063	3.58	6.24	0.46	0.83	0.126	0.001	0.021	0.002	0.040	0.001	0.010	0.000	0.000	0.001
NK11-064	4.42	8.68	0.68	1.60	0.170	0.011	0.047	0.006	0.046	0.000	0.023	0.003	0.010	0.004
NK11-065	2.03	3.01	0.28	0.66	0.059	0.006	0.038	0.000	0.028	0.002	0.005	0.000	0.000	0.001
NK11-066	1.02	1.88	0.14	0.25	0.046	0.009	0.018	0.000	0.010	0.000	0.002	0.000	0.001	0.002
NK11-067	2.97	5.67	0.38	0.89	0.047	0.001	0.042	0.000	0.005	0.000	0.001	0.000	0.000	0.001
NK11-068	23.49	28.75	3.06	8.00	0.700	0.061	0.261	0.023	0.089	0.005	0.036	0.000	0.015	0.002
NK11-069	7.81	12.29	1.14	2.97	0.298	0.059	0.137	0.022	0.090	0.014	0.020	0.006	0.015	0.004
NK11-070	8.11	11.87	1.11	2.61	0.247	0.022	0.051	0.018	0.046	0.013	0.028	0.005	0.026	0.004
NK11-071	7.01	10.49	0.90	1.86	0.171	0.012	0.038	0.013	0.059	0.004	0.022	0.002	0.018	0.002
NK11-072	28.78	44.98	4.79	14.70	1.862	0.184	1.215	0.208	1.105	0.207	0.515	0.062	0.253	0.027
NK11-072	23.87	33.54	5.11	15.16	2.231	0.224	1.235	0.280	1.213	0.262	0.667	0.091	0.389	0.043
NK11-074	10.83	17.22	1.46	3.45	0.260	0.032	0.075	0.022	0.067	0.016	0.018	0.002	0.012	0.001
NK11-075	6.41	9.72	0.81	1.91	0.161	0.029	0.072	0.018	0.072	0.013	0.027	0.006	0.024	0.003
NK11-076	15.54	27.83	2.63	7.32	0.964	0.152	0.540	0.071	0.147	0.052	0.071	0.019	0.054	0.006
NK11-077	10.10	14.39	1.41	3.85	0.267	0.020	0.101	0.022	0.003	0.010	0.009	0.000	0.007	0.000
NK11-078	7.40	11.48	0.91	2.22	0.145	0.026	0.014	0.015	0.039	0.003	0.017	0.000	0.009	0.002
NK11-079	8.42	11.25	0.75	1.50	0.094	0.001	0.000	0.006	0.016	0.004	0.005	0.000	0.006	0.000
NK11-080	3.69	5.90	0.44	1.10	0.084	0.009	0.019	0.002	0.018	0.003	0.000	0.000	0.011	0.000
NK11-081	17.23	42.58	3.33	8.41	0.759	0.056	0.242	0.081	0.329	0.070	0.162	0.019	0.077	0.014
NK11-082	39.62	46.15	6.51	19.42	2.388	0.211	0.717	0.086	0.335	0.045	0.100	0.013	0.058	0.006
NK12-001	19.17	26.06	2.52	8.03	0.963	0.133	0.467	0.025	0.128	0.016	0.039	0.007	0.024	0.003
NK12-002	13.12	17.04	1.64	5.07	0.382	0.041	0.139	0.027	0.082	0.010	0.025	0.001	0.023	0.002
NK12-003	16.99	22.67	2.98	10.86	1.518	0.236	0.903	0.082	0.268	0.062	0.102	0.012	0.106	0.015
NK12-004	58.73	51.44	7.80	25.97	2.817	0.431	1.005	0.064	0.232	0.028	0.077	0.006	0.077	0.011
NK12-005	6.17	8.00	0.66	1.70	0.184	0.034	0.060	0.011	0.019	0.009	0.014	0.000	0.011	0.001
NK12-006	1.88	2.64	0.23	0.61	0.091	0.001	0.002	0.001	0.003	0.001	0.000	0.001	0.006	0.000
NK12-007	42.99	61.25	7.12	24.23	2.424	0.233	0.643	0.069	0.216	0.027	0.078	0.011	0.039	0.008
NK12-008	2.17	2.97	0.23	0.65	0.066	0.001	0.076	0.002	0.009	0.001	0.008	0.000	0.004	0.000
NK12-009	12.26	19.60	1.67	4.93	0.554	0.045	0.128	0.022	0.079	0.014	0.033	0.001	0.027	0.001

StationID	La_ppm	Ce_ppm	Pr_ppm	Nd_ppm	Sm_ppm	Eu_ppm	Gd_ppm	Tb_ppm	Dy_ppm	Ho_ppm	Er_ppm	Tm_ppm	Yb_ppm	Lu_ppm
NK12-010	12.76	18.53	1.46	4.31	0.361	0.037	0.146	0.014	0.089	0.009	0.011	0.003	0.006	0.000
NK12-011	1.76	2.92	0.26	0.61	0.038	0.001	0.000	0.005	0.003	0.001	0.000	0.000	0.009	0.001
NK12-012	16.09	20.94	1.92	5.27	0.339	0.050	0.215	0.030	0.069	0.023	0.042	0.001	0.034	0.006
NK12-013	55.06	125.17	7.65	24.71	3.188	0.326	1.372	0.149	0.646	0.097	0.212	0.024	0.125	0.017
NK12-014	26.20	44.40	3.83	12.53	1.504	0.172	0.678	0.065	0.249	0.042	0.100	0.009	0.039	0.005
NK12-015	15.84	15.72	2.14	6.84	0.691	0.061	0.312	0.029	0.113	0.012	0.041	0.002	0.016	0.001
NK12-016	17.98	36.66	2.81	9.82	1.183	0.170	0.600	0.051	0.317	0.045	0.108	0.015	0.066	0.010
NK12-017	2.47	5.47	0.40	0.92	0.038	0.001	0.000	0.003	0.018	0.002	0.014	0.000	0.011	0.001
NK12-018	10.42	18.19	1.14	2.81	0.189	0.001	0.005	0.012	0.055	0.005	0.000	0.000	0.004	0.002
NK12-019	39.88	73.53	5.51	16.47	1.724	0.182	0.793	0.050	0.222	0.033	0.132	0.005	0.064	0.007
NK12-020	9.23	15.32	1.10	2.71	0.228	0.012	0.104	0.014	0.046	0.013	0.017	0.002	0.021	0.000
NK12-021	29.13	32.99	3.44	10.60	0.883	0.091	0.551	0.042	0.142	0.032	0.062	0.014	0.065	0.006
NK12-022	11.55	15.75	1.58	4.61	0.435	0.032	0.169	0.016	0.070	0.012	0.040	0.004	0.031	0.005
NK12-023	7.78	13.29	0.97	2.66	0.200	0.022	0.054	0.016	0.060	0.014	0.029	0.001	0.019	0.001
NK12-024	53.23	50.54	6.83	22.79	2.478	0.166	0.841	0.056	0.345	0.034	0.075	0.009	0.073	0.004
NK12-025	17.30	18.88	1.77	5.41	0.476	0.036	0.241	0.026	0.218	0.030	0.059	0.008	0.059	0.002
NK12-026	59.23	66.96	6.18	16.73	1.628	0.170	1.239	0.129	0.695	0.123	0.346	0.044	0.200	0.019
NK12-027	67.42	67.21	8.07	24.68	2.992	0.279	1.595	0.159	0.734	0.101	0.302	0.037	0.204	0.026
NK12-028	75.80	38.31	10.07	31.70	2.777	0.296	0.972	0.062	0.305	0.037	0.078	0.009	0.058	0.007
NK12-029	31.27	68.30	4.57	13.97	1.531	0.138	0.494	0.060	0.162	0.033	0.095	0.007	0.046	0.007
NK12-030	35.79	65.42	4.91	15.60	2.001	0.190	0.810	0.057	0.238	0.033	0.111	0.011	0.056	0.006
NK12-031	20.21	37.17	3.39	11.50	1.493	0.191	0.883	0.056	0.266	0.045	0.147	0.010	0.080	0.008
NK12-033	45.27	69.72	5.98	17.89	1.708	0.133	0.499	0.042	0.213	0.024	0.088	0.005	0.027	0.005
NK12-034	46.17	33.67	6.63	21.76	2.823	0.258	1.295	0.098	0.398	0.044	0.131	0.008	0.053	0.007
NK12-035	16.23	26.76	2.80	9.58	1.372	0.123	0.714	0.108	0.735	0.117	0.318	0.035	0.200	0.026
NK12-036	2.56	2.75	0.32	0.87	0.072	0.007	0.033	0.002	0.006	0.001	0.000	0.000	0.003	0.000
NK12-037	1.57	1.96	0.21	0.68	0.106	0.049	0.046	0.000	0.012	0.000	0.000	0.000	-	0.000
NK12-038	65.33	68.47	7.28	19.17	2.437	0.342	1.219	0.089	0.351	0.125	0.185	0.054	0.143	0.016
NK12-039	5.09	8.15	0.69	1.94	0.025	0.035	0.000	0.008	0.024	0.016	0.029	0.001	0.000	0.000
NK12-040	19.95	27.63	2.51	7.80	0.942	0.089	0.570	0.095	0.636	0.112	0.315	0.024	0.131	0.008
NK12-041	28.96	35.66	3.46	10.91	0.790	0.160	0.426	0.102	0.482	0.065	0.225	0.012	0.130	0.005
NK12-042	83.22	63.37	10.82	34.15	4.437	0.511	1.884	0.264	1.026	0.231	0.344	0.039	0.251	0.034
NK12-043	62.19	50.80	7.50	24.72	3.068	0.269	1.653	0.166	0.783	0.106	0.218	0.021	0.112	0.005

StationID	La_cert	Ce_cert	Pr_cert	Nd_cert	Sm_cert	Eu_cert	Gd_cert	Tb_cert	Dy_cert	Ho_cert	Er_cert	Tm_cert	Yb_cert	Lu_cert
NK11-001	15.99	21.85	2.11	4.96	0.337	0.041	0.064	0.023	0.071	0.021	0.040	<0.02	0.026	<0.02
NK11-002	10.40	10.89	1.34	3.28	0.306	0.047	0.127	0.032	0.078	<0.02	0.050	<0.02	0.029	<0.02
NK11-003	5.83	11.17	0.79	1.81	0.142	<0.02	<0.02	<0.02	0.021	<0.02	0.021	<0.02	<0.02	<0.02
NK11-004	11.90	20.26	2.12	5.33	0.506	0.040	0.248	0.043	0.095	0.024	0.056	<0.02	0.023	<0.02
NK11-005	11.54	14.52	1.71	3.94	0.375	0.022	0.168	0.026	0.108	0.033	0.064	<0.02	0.032	<0.02
NK11-006	1.92	4.66	0.22	0.66	0.053	<0.02	0.038	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-007	3.31	6.55	0.55	1.33	0.139	0.021	0.080	<0.02	0.080	<0.02	0.050	<0.02	0.041	<0.02
NK11-008	9.83	20.45	1.83	5.24	0.799	0.081	0.558	0.110	0.575	0.141	0.318	0.047	0.216	0.023
NK11-009	19.24	29.00	2.27	6.19	0.670	0.039	0.233	0.042	0.111	0.028	0.084	<0.02	0.041	<0.02
NK11-010	1.65	2.22	0.17	0.45	0.032	<0.02	<0.02	<0.02	<0.02	<0.02	0.020	<0.02	<0.02	<0.02
NK11-011	1.91	2.60	0.19	0.41	0.040	<0.02	0.050	<0.02	0.021	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-012	2.60	3.57	0.28	0.80	0.071	<0.02	0.067	<0.02	0.045	<0.02	0.039	<0.02	0.033	<0.02
NK11-013	3.98	2.19	0.59	1.82	0.230	0.023	0.107	0.027	0.082	<0.02	<0.02	<0.02	0.027	<0.02
NK11-014	5.30	7.39	0.93	2.19	0.177	<0.02	0.039	<0.02	0.048	<0.02	0.028	<0.02	<0.02	<0.02
NK11-016	5.45	7.86	0.87	2.67	0.251	<0.02	0.201	0.042	0.145	0.035	0.116	<0.02	0.070	<0.02
NK11-017	2.90	5.45	0.44	0.86	0.077	<0.02	0.025	<0.02	<0.02	<0.02	0.024	<0.02	<0.02	<0.02
NK11-018	5.12	6.37	0.54	1.49	0.153	<0.02	<0.02	<0.02	0.021	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-019	6.28	7.46	1.04	2.97	0.216	0.025	0.074	<0.02	0.059	0.020	0.040	<0.02	<0.02	<0.02
NK11-020	5.14	9.73	0.62	1.45	0.071	<0.02	0.041	<0.02	0.021	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-021	2.67	4.02	0.32	0.78	0.041	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-022	9.39	8.85	1.23	2.96	0.201	<0.02	0.025	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-023	36.78	51.49	5.64	15.43	1.360	0.163	0.411	0.072	0.128	<0.02	0.085	<0.02	0.041	<0.02
NK11-024	21.26	18.73	3.58	10.83	1.191	0.086	0.445	0.074	0.226	0.028	0.048	<0.02	0.048	<0.02
NK11-026	1.94	2.57	0.19	0.44	0.039	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-027	3.29	4.70	0.43	0.83	0.092	<0.02	0.081	<0.02	0.029	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-028	6.58	8.94	0.94	2.01	0.209	0.035	0.059	<0.02	0.055	<0.02	0.024	<0.02	<0.02	<0.02
NK11-029	9.06	16.30	1.39	3.36	0.370	0.045	0.279	0.032	0.097	0.021	0.041	<0.02	0.031	<0.02
NK11-030	6.02	9.51	0.97	2.30	0.233	0.049	0.096	<0.02	0.044	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-031	8.43	15.40	1.40	4.28	0.440	0.066	0.214	0.028	0.126	<0.02	0.058	<0.02	0.026	<0.02
NK11-031	4.99	8.61	0.81	1.94	0.218	0.035	0.028	<0.02	0.025	<0.02	0.021	<0.02	<0.02	<0.02
NK11-032	10.73	15.53	1.78	4.29	0.528	0.045	0.437	0.064	0.240	0.055	0.106	<0.02	0.044	<0.02
NK11-033	41.50	25.26	6.46	20.18	2.451	0.220	0.876	0.098	0.303	0.064	0.153	0.020	0.086	0.024

StationID	La_cert	Ce_cert	Pr_cert	Nd_cert	Sm_cert	Eu_cert	Gd_cert	Tb_cert	Dy_cert	Ho_cert	Er_cert	Tm_cert	Yb_cert	Lu_cert
NK11-034	4.55	7.96	0.64	1.57	0.123	<0.02	0.055	<0.02	0.034	<0.02	0.022	<0.02	<0.02	<0.02
NK11-035	12.54	19.71	1.78	4.35	0.386	0.036	0.133	<0.02	0.033	<0.02	0.026	<0.02	<0.02	<0.02
NK11-036	9.48	19.58	1.46	3.58	0.427	0.049	0.261	0.049	0.148	0.042	0.090	<0.02	0.075	<0.02
NK11-037	11.97	15.45	1.74	4.17	0.488	0.041	0.229	0.036	0.096	0.022	0.031	<0.02	<0.02	<0.02
NK11-037N	32.29	61.70	4.43	12.21	1.258	0.134	0.799	0.133	0.786	0.146	0.373	0.049	0.200	0.026
NK11-037N	6.33	10.49	0.88	2.49	0.238	<0.02	0.146	0.021	0.184	0.021	0.080	<0.02	0.084	<0.02
NK11-037N	9.11	13.00	1.42	3.56	0.414	0.047	0.187	0.044	0.198	0.041	0.066	<0.02	0.034	<0.02
NK11-038	14.84	26.67	2.47	6.46	0.812	0.069	0.422	0.058	0.269	0.055	0.127	0.028	0.053	<0.02
NK11-038N	26.25	44.60	3.84	11.87	1.559	0.160	1.231	0.190	1.221	0.238	0.607	0.075	0.338	0.041
NK11-038N	9.98	18.85	1.28	3.12	0.290	0.058	0.138	0.027	0.101	0.021	0.046	<0.02	0.051	<0.02
NK11-039	13.93	27.56	2.50	7.34	1.040	0.087	0.616	0.101	0.462	0.106	0.173	0.039	0.146	<0.02
NK11-039N	16.38	26.90	2.73	8.88	1.406	0.118	0.984	0.190	1.325	0.282	0.833	0.090	0.527	0.065
NK11-039N	5.79	9.48	0.85	2.15	0.310	0.028	0.193	0.040	0.139	0.034	0.084	<0.02	0.044	<0.02
NK11-040	7.83	11.49	1.09	2.65	0.353	0.052	0.174	0.032	0.209	0.041	0.105	<0.02	0.040	<0.02
NK11-040N	5.90	10.11	1.04	2.89	0.479	0.026	0.332	0.076	0.293	0.074	0.217	0.030	0.130	<0.02
NK11-041	27.59	18.80	3.78	9.71	1.011	0.110	0.472	0.057	0.154	<0.02	0.044	<0.02	0.036	<0.02
NK11-042	31.75	52.93	6.51	21.33	2.632	0.264	1.780	0.190	1.084	0.174	0.407	0.050	0.256	0.030
NK11-042	8.16	13.25	1.60	4.65	0.577	0.059	0.327	0.044	0.212	0.032	0.074	<0.02	0.042	<0.02
NK11-043	8.74	15.86	1.34	3.87	0.387	0.044	0.182	0.031	0.172	<0.02	0.069	<0.02	0.032	<0.02
NK11-044	23.34	29.33	3.72	10.13	1.029	0.088	0.414	0.035	0.094	<0.02	0.061	<0.02	0.038	<0.02
NK11-046	9.22	9.83	1.45	3.68	0.216	<0.02	<0.02	<0.02	0.073	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-047	14.18	15.48	2.25	5.86	0.569	0.049	0.181	<0.02	0.039	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-048	6.02	8.54	0.83	2.10	0.163	<0.02	0.075	<0.02	0.029	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-049	2.29	3.75	0.29	0.64	0.058	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-050	36.51	45.68	4.40	10.77	1.044	0.099	0.181	0.049	0.102	<0.02	0.030	<0.02	0.040	<0.02
NK11-051	24.19	30.61	3.22	9.30	1.114	0.172	0.548	0.062	0.241	0.037	0.051	<0.02	0.050	<0.02
NK11-052	34.49	54.75	5.06	13.78	1.413	0.152	0.318	0.040	0.077	<0.02	0.037	<0.02	0.031	<0.02
NK11-053	1.85	1.61	0.30	0.49	0.036	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-054	27.43	19.51	4.01	11.77	1.312	0.115	0.525	0.049	0.193	0.022	0.068	<0.02	0.029	<0.02
NK11-055	29.99	22.93	4.65	13.77	1.587	0.133	0.456	0.050	0.191	0.024	0.053	<0.02	0.031	<0.02
NK11-056	15.53	13.72	2.20	5.57	0.449	0.039	0.225	<0.02	0.088	<0.02	0.029	<0.02	<0.02	<0.02
NK11-057	9.45	9.68	1.05	2.29	0.246	<0.02	<0.02	<0.02	0.062	<0.02	<0.02	<0.02	0.026	<0.02
NK11-058	19.30	14.92	1.83	4.04	0.271	0.023	0.111	0.025	0.099	<0.02	0.041	<0.02	0.020	<0.02

StationID	La_cert	Ce_cert	Pr_cert	Nd_cert	Sm_cert	Eu_cert	Gd_cert	Tb_cert	Dy_cert	Ho_cert	Er_cert	Tm_cert	Yb_cert	Lu_cert
NK11-059	16.00	10.77	1.90	5.27	0.499	0.041	0.289	<0.02	0.127	<0.02	0.020	<0.02	<0.02	<0.02
NK11-060	48.23	39.38	7.14	19.78	2.244	0.223	0.611	0.061	0.184	0.035	0.062	<0.02	0.052	<0.02
NK11-061	21.58	27.39	3.16	8.85	0.953	0.099	0.507	0.043	0.125	<0.02	0.057	<0.02	0.028	<0.02
NK11-062	30.43	41.83	4.11	9.99	0.824	0.060	0.262	0.027	0.113	<0.02	0.033	<0.02	0.021	<0.02
NK11-063	3.58	6.24	0.46	0.83	0.126	<0.02	0.021	<0.02	0.040	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-064	4.42	8.68	0.68	1.60	0.170	<0.02	0.047	<0.02	0.046	<0.02	0.023	<0.02	<0.02	<0.02
NK11-065	2.03	3.01	0.28	0.66	0.059	<0.02	0.038	<0.02	0.028	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-066	1.02	1.88	0.14	0.25	0.046	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-067	2.97	5.67	0.38	0.89	0.047	<0.02	0.042	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-068	23.49	28.75	3.06	8.00	0.700	0.061	0.261	0.023	0.089	<0.02	0.036	<0.02	<0.02	<0.02
NK11-069	7.81	12.29	1.14	2.97	0.298	0.059	0.137	0.022	0.090	<0.02	0.020	<0.02	<0.02	<0.02
NK11-070	8.11	11.87	1.11	2.61	0.247	0.022	0.051	<0.02	0.046	<0.02	0.028	<0.02	0.026	<0.02
NK11-071	7.01	10.49	0.90	1.86	0.171	<0.02	0.038	<0.02	0.059	<0.02	0.022	<0.02	<0.02	<0.02
NK11-072	28.78	44.98	4.79	14.70	1.862	0.184	1.215	0.208	1.105	0.207	0.515	0.062	0.253	0.027
NK11-072	23.87	33.54	5.11	15.16	2.231	0.224	1.235	0.280	1.213	0.262	0.667	0.091	0.389	0.043
NK11-074	10.83	17.22	1.46	3.45	0.260	0.032	0.075	0.022	0.067	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-075	6.41	9.72	0.81	1.91	0.161	0.029	0.072	<0.02	0.072	<0.02	0.027	<0.02	0.024	<0.02
NK11-076	15.54	27.83	2.63	7.32	0.964	0.152	0.540	0.071	0.147	0.052	0.071	<0.02	0.054	<0.02
NK11-077	10.10	14.39	1.41	3.85	0.267	<0.02	0.101	0.022	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-078	7.40	11.48	0.91	2.22	0.145	0.026	<0.02	<0.02	0.039	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-079	8.42	11.25	0.75	1.50	0.094	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-080	3.69	5.90	0.44	1.10	0.084	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-081	17.23	42.58	3.33	8.41	0.759	0.056	0.242	0.081	0.329	0.070	0.162	<0.02	0.077	<0.02
NK11-082	39.62	46.15	6.51	19.42	2.388	0.211	0.717	0.086	0.335	0.045	0.100	<0.02	0.058	<0.02
NK12-001	19.17	26.06	2.52	8.03	0.963	0.133	0.467	0.025	0.128	<0.02	0.039	<0.02	0.024	<0.02
NK12-002	13.12	17.04	1.64	5.07	0.382	0.041	0.139	0.027	0.082	<0.02	0.025	<0.02	0.023	<0.02
NK12-003	16.99	22.67	2.98	10.86	1.518	0.236	0.903	0.082	0.268	0.062	0.102	<0.02	0.106	<0.02
NK12-004	58.73	51.44	7.80	25.97	2.817	0.431	1.005	0.064	0.232	0.028	0.077	<0.02	0.077	<0.02
NK12-005	6.17	8.00	0.66	1.70	0.184	0.034	0.060	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-006	1.88	2.64	0.23	0.61	0.091	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-007	42.99	61.25	7.12	24.23	2.424	0.233	0.643	0.069	0.216	0.027	0.078	<0.02	0.039	<0.02
NK12-008	2.17	2.97	0.23	0.65	0.066	<0.02	0.076	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-009	12.26	19.60	1.67	4.93	0.554	0.045	0.128	0.022	0.079	<0.02	0.033	<0.02	0.027	<0.02

StationID	La_cert	Ce_cert	Pr_cert	Nd_cert	Sm_cert	Eu_cert	Gd_cert	Tb_cert	Dy_cert	Ho_cert	Er_cert	Tm_cert	Yb_cert	Lu_cert
NK12-010	12.76	18.53	1.46	4.31	0.361	0.037	0.146	<0.02	0.089	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-011	1.76	2.92	0.26	0.61	0.038	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-012	16.09	20.94	1.92	5.27	0.339	0.050	0.215	0.030	0.069	0.023	0.042	<0.02	0.034	<0.02
NK12-013	55.06	125.17	7.65	24.71	3.188	0.326	1.372	0.149	0.646	0.097	0.212	0.024	0.125	<0.02
NK12-014	26.20	44.40	3.83	12.53	1.504	0.172	0.678	0.065	0.249	0.042	0.100	<0.02	0.039	<0.02
NK12-015	15.84	15.72	2.14	6.84	0.691	0.061	0.312	0.029	0.113	<0.02	0.041	<0.02	<0.02	<0.02
NK12-016	17.98	36.66	2.81	9.82	1.183	0.170	0.600	0.051	0.317	0.045	0.108	<0.02	0.066	<0.02
NK12-017	2.47	5.47	0.40	0.92	0.038	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-018	10.42	18.19	1.14	2.81	0.189	<0.02	<0.02	<0.02	0.055	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-019	39.88	73.53	5.51	16.47	1.724	0.182	0.793	0.050	0.222	0.033	0.132	<0.02	0.064	<0.02
NK12-020	9.23	15.32	1.10	2.71	0.228	<0.02	0.104	<0.02	0.046	<0.02	<0.02	<0.02	0.021	<0.02
NK12-021	29.13	32.99	3.44	10.60	0.883	0.091	0.551	0.042	0.142	0.032	0.062	<0.02	0.065	<0.02
NK12-022	11.55	15.75	1.58	4.61	0.435	0.032	0.169	<0.02	0.070	<0.02	0.040	<0.02	0.031	<0.02
NK12-023	7.78	13.29	0.97	2.66	0.200	0.022	0.054	<0.02	0.060	<0.02	0.029	<0.02	<0.02	<0.02
NK12-024	53.23	50.54	6.83	22.79	2.478	0.166	0.841	0.056	0.345	0.034	0.075	<0.02	0.073	<0.02
NK12-025	17.30	18.88	1.77	5.41	0.476	0.036	0.241	0.026	0.218	0.030	0.059	<0.02	0.059	<0.02
NK12-026	59.23	66.96	6.18	16.73	1.628	0.170	1.239	0.129	0.695	0.123	0.346	0.044	0.200	<0.02
NK12-027	67.42	67.21	8.07	24.68	2.992	0.279	1.595	0.159	0.734	0.101	0.302	0.037	0.204	0.026
NK12-028	75.80	38.31	10.07	31.70	2.777	0.296	0.972	0.062	0.305	0.037	0.078	<0.02	0.058	<0.02
NK12-029	31.27	68.30	4.57	13.97	1.531	0.138	0.494	0.060	0.162	0.033	0.095	<0.02	0.046	<0.02
NK12-030	35.79	65.42	4.91	15.60	2.001	0.190	0.810	0.057	0.238	0.033	0.111	<0.02	0.056	<0.02
NK12-031	20.21	37.17	3.39	11.50	1.493	0.191	0.883	0.056	0.266	0.045	0.147	<0.02	0.080	<0.02
NK12-033	45.27	69.72	5.98	17.89	1.708	0.133	0.499	0.042	0.213	0.024	0.088	<0.02	0.027	<0.02
NK12-034	46.17	33.67	6.63	21.76	2.823	0.258	1.295	0.098	0.398	0.044	0.131	<0.02	0.053	<0.02
NK12-035	16.23	26.76	2.80	9.58	1.372	0.123	0.714	0.108	0.735	0.117	0.318	0.035	0.200	0.026
NK12-036	2.56	2.75	0.32	0.87	0.072	<0.02	0.033	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-037	1.57	1.96	0.21	0.68	0.106	0.049	0.046	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02
NK12-038	65.33	68.47	7.28	19.17	2.437	0.342	1.219	0.089	0.351	0.125	0.185	0.054	0.143	<0.02
NK12-039	5.09	8.15	0.69	1.94	0.025	0.035	<0.02	<0.02	0.024	<0.02	0.029	<0.02	<0.02	<0.02
NK12-040	19.95	27.63	2.51	7.80	0.942	0.089	0.570	0.095	0.636	0.112	0.315	0.024	0.131	<0.02
NK12-041	28.96	35.66	3.46	10.91	0.790	0.160	0.426	0.102	0.482	0.065	0.225	<0.02	0.130	<0.02
NK12-042	83.22	63.37	10.82	34.15	4.437	0.511	1.884	0.264	1.026	0.231	0.344	0.039	0.251	0.034
NK12-043	62.19	50.80	7.50	24.72	3.068	0.269	1.653	0.166	0.783	0.106	0.218	0.021	0.112	<0.02

APPENDIX A3 - BLIND QUALITY ASSURANCE CONTROLS

A3i - FERNS

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy
	Unit	ppb	%	ppm	ppb	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	2	0.01	0.1	0.2	1	0.1	0.1	0.02	0.01	0.01	0.01	0.01	0.1	0.01	0.01	0.02
NK11-009X SF-2 STD.		2	0.06	0.1	<0.2	16	34.1	0.1	<0.02	0.40	0.07	9.81	0.06	1.5	0.03	8.89	0.42
NK11-018X SF-2 STD.		<2	0.06	<0.1	0.8	15	32.9	<0.1	<0.02	0.39	0.05	9.88	0.07	1.6	0.03	8.96	0.53
NK11-024X SF-2 STD.		2	0.06	<0.1	1.3	15	30.7	<0.1	<0.02	0.38	0.10	9.59	0.04	1.4	0.03	8.63	0.41
NK11-033X SF-2 STD.		3	0.06	0.2	0.8	15	30.5	<0.1	<0.02	0.38	0.09	9.66	0.10	1.9	0.03	9.99	0.46
NK11-037X SF-2 STD.		<2	0.06	0.2	0.3	16	31.4	<0.1	<0.02	0.39	0.10	10.21	0.07	1.7	0.03	9.11	0.53
NK11-040X SF-2 STD.		<2	0.06	0.2	0.3	18	29.6	<0.1	<0.02	0.37	0.08	9.31	0.08	1.5	0.03	9.14	0.49
NK11-046X SF-2 STD.		3	0.06	0.3	0.2	16	30.7	<0.1	<0.02	0.39	0.09	9.48	0.07	1.7	0.03	9.12	0.47
NK11-054X SF-2 STD.		3	0.06	0.4	<0.2	15	31.2	<0.1	<0.02	0.40	0.07	9.72	0.07	1.8	0.03	8.8	0.39
NK11-063X SF-2 STD.		2	0.06	0.1	0.5	16	31.1	<0.1	<0.02	0.40	0.08	10.5	0.08	1.6	0.03	9.3	0.53
NK11-069X SF-2 STD.		2	0.06	<0.1	0.3	17	34.8	<0.1	<0.02	0.42	0.09	10.7	0.08	1.4	0.03	8.91	0.55
NK11-076X SF-2 STD.		3	0.06	0.3	0.6	15	31.5	<0.1	<0.02	0.42	0.09	10.02	0.07	1.2	0.04	9.01	0.55
	Average	**BDL**	**0.06**	**BDL**	**BDL**	**16**	**31.7**	**0.1**	**BDL**	**0.39**	**0.08**	**9.89**	**0.07**	**1.6**	**0.03**	**9.08**	**0.48**
	Std. Dev.	**BDL**	**0**	**BDL**	**BDL**	**0.98**	**1.59**	**BDL**	**BDL**	**0.02**	**0.01**	**0.42**	**0.01**	**0.2**	**0**	**0.35**	**0.06**
	RSD%	**BDL**	**0**	**BDL**	**BDL**	**6**	**5**	**BDL**	**BDL**	**4**	**18**	**4**	**20**	**13**	**8**	**4**	**12**

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo
	Unit	ppm	ppm	%	ppm	ppm	ppm	ppm	ppb	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm
	MDL	0.02	0.02	0	0.1	0.02	0.01	0.001	1	0.02	0.02	0.01	0.01	0.01	0.02	0	1	0.01
NK11-009X SF-2 STD.		0.18	0.33	0.01	<0.1	0.92	0.07	0.005	50	0.10	<0.02	1.84	10.3	0.03	<0.02	0.26	82	0.49
NK11-018X SF-2 STD.		0.21	0.30	0.01	<0.1	0.84	<0.01	<0.001	44	0.12	<0.02	1.82	10.3	0.09	<0.02	0.26	81	0.53
NK11-024X SF-2 STD.		0.16	0.30	0.01	<0.1	0.86	<0.01	0.001	39	0.08	<0.02	1.83	9.91	0.06	<0.02	0.26	83	0.51
NK11-033X SF-2 STD.		0.21	0.30	0.02	<0.1	0.81	0.03	<0.001	41	0.11	<0.02	1.78	9.97	0.13	<0.02	0.27	85	0.52
NK11-037X SF-2 STD.		0.19	0.31	0.01	<0.1	0.82	0.04	0.001	41	0.09	<0.02	1.81	10.5	0.02	<0.02	0.26	82	0.54
NK11-040X SF-2 STD.		0.19	0.29	0.01	<0.1	0.86	0.01	<0.001	42	0.09	<0.02	1.82	9.71	0.04	<0.02	0.25	82	0.51
NK11-046X SF-2 STD.		0.17	0.24	0.01	<0.1	0.82	<0.01	<0.001	38	0.08	<0.02	1.84	9.98	0.03	0.02	0.26	86	0.52
NK11-054X SF-2 STD.		0.21	0.28	0.01	<0.1	0.85	0.05	<0.001	36	0.1	<0.02	1.83	10.1	<0.01	<0.02	0.25	80	0.49
NK11-063X SF-2 STD.		0.19	0.31	0.01	<0.1	0.93	0.03	<0.001	38	0.09	<0.02	1.79	10.6	0.02	0.02	0.26	84	0.51
NK11-069X SF-2 STD.		0.26	0.31	0.01	<0.1	0.87	0.06	0.004	46	0.11	<0.02	1.89	11.0	0.05	<0.02	0.28	87	0.54
NK11-076X SF-2 STD.		0.18	0.30	0.01	<0.1	0.94	<0.01	<0.001	33	0.11	<0.02	1.85	10.9	0.03	<0.02	0.27	90	0.51
	Average	**0.20**	**0.30**	**0.01**	**BDL**	**0.87**	**BDL**	**BDL**	**41**	**0.10**	**BDL**	**1.83**	**10.3**	**0.05**	**BDL**	**0.26**	**84**	**0.52**
	Std. Dev.	**0.03**	**0.02**	**0**	**BDL**	**0.05**	**BDL**	**BDL**	**4.76**	**0.01**	**BDL**	**0.03**	**0.41**	**0.04**	**BDL**	**0.01**	**2.96**	**0.02**
	RSD%	**14**	**8**	**20**	**BDL**	**5**	**BDL**	**BDL**	**12**	**14**	**BDL**	**2**	**4**	**71**	**BDL**	**3**	**4**	**3**

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Na	Nb	Nd	Ni	P	Pb	Pd	Pr	Pt	Rb	Re	S	Sb	Sc	Se	Sm	Sn
	Unit	%	ppm	ppm	ppm	%	ppm	ppb	ppm	ppb	ppm	ppb	%	ppm	ppm	ppm	ppm	ppm
	MDL	0	0.01	0.02	0.1	0	0.01	2	0.02	1	0.1	1	0.01	0.02	0.1	0.1	0.02	0.02
NK11-009X SF-2 STD.		0.02	<0.01	6.70	0.5	0.29	0.14	3	1.84	<1	19.5	<1	0.22	<0.02	0.1	0.2	0.93	0.02
NK11-018X SF-2 STD.		0.02	<0.01	6.25	0.5	0.28	0.08	5	1.88	<1	19.3	<1	0.21	<0.02	0.2	0.3	1.08	<0.02
NK11-024X SF-2 STD.		0.02	<0.01	6.09	0.5	0.28	<0.01	3	1.82	<1	18.9	<1	0.22	<0.02	<0.1	<0.1	0.87	0.03
NK11-033X SF-2 STD.		0.02	0.03	6.21	0.4	0.29	0.3	4	1.95	<1	19.4	<1	0.22	<0.02	0.2	0.2	0.98	0.05
NK11-037X SF-2 STD.		0.02	<0.01	6.55	0.6	0.28	0.21	4	1.98	<1	19.6	<1	0.24	<0.02	0.1	0.3	0.98	0.04
NK11-040X SF-2 STD.		0.02	<0.01	5.85	0.6	0.27	0.16	<2	1.85	<1	19.3	<1	0.21	<0.02	0.2	0.3	0.89	0.03
NK11-046X SF-2 STD.		0.02	<0.01	6.40	0.6	0.28	0.12	5	1.80	<1	19.1	<1	0.2	<0.02	0.1	0.2	0.96	0.04
NK11-054X SF-2 STD.		0.02	<0.01	6.38	0.6	0.27	0.12	4	1.76	<1	18.4	<1	0.22	<0.02	0.1	0.2	0.85	0.04
NK11-063X SF-2 STD.		0.02	<0.01	6.84	0.5	0.28	0.15	5	2.01	<1	20.2	<1	0.19	0.02	0.2	0.4	1.03	0.05
NK11-069X SF-2 STD.		0.02	<0.01	6.99	0.6	0.30	0.19	4	2.03	<1	21.6	<1	0.23	<0.02	0.1	0.5	0.98	0.04
NK11-076X SF-2 STD.		0.02	<0.01	6.45	0.5	0.28	0.19	4	1.98	<1	19.9	<1	0.25	<0.02	<0.1	0.3	1.00	0.03
	Average	**0.02**	**BDL**	**6.43**	**0.5**	**0.28**	**0.17**	**4**	**1.90**	**BDL**	**19.6**	**BDL**	**0.22**	**BDL**	**0.1**	**0.29**	**0.96**	**0.04**
	Std. Dev.	**0**	**BDL**	**0.33**	**0.1**	**0.01**	**0.06**	**1**	**0.09**	**BDL**	**0.83**	**BDL**	**0.02**	**BDL**	**0.05**	**0.1**	**0.07**	**0.01**
	RSD%	**4**	**BDL**	**5**	**13**	**3**	**37**	**18**	**5**	**BDL**	**4**	**BDL**	**8**	**BDL**	**36**	**34**	**7**	**26**

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.5	0.001	0.02	0.02	0.01	1	0.02	0.02	0.01	2	0.1	0	0.02	0.1	0.01
NK11-009X SF-2 STD.		24.1	0.002	0.12	<0.02	<0.01	14	<0.02	<0.02	0.01	2	<0.1	4.05	0.1	26.6	0.04
NK11-018X SF-2 STD.		23.6	<0.001	0.14	<0.02	<0.01	14	<0.02	<0.02	0.01	<2	<0.1	4.02	0.12	27.8	0.05
NK11-024X SF-2 STD.		23.3	0.001	0.13	<0.02	<0.01	13	<0.02	<0.02	<0.01	<2	<0.1	3.92	0.1	26.5	0.04
NK11-033X SF-2 STD.		22.5	0.001	0.12	<0.02	<0.01	23	<0.02	0.03	0.01	<2	<0.1	3.98	0.11	28.6	0.07
NK11-037X SF-2 STD.		23.6	<0.001	0.11	<0.02	<0.01	13	<0.02	0.03	<0.01	<2	<0.1	4.14	0.09	28.8	0.04
NK11-040X SF-2 STD.		22.9	0.001	0.1	<0.02	<0.01	13	<0.02	0.03	0.01	<2	<0.1	3.74	0.08	26.9	0.04
NK11-046X SF-2 STD.		23.1	<0.001	0.12	0.04	<0.01	14	<0.02	<0.02	0.01	<2	<0.1	4.03	0.09	28.1	0.06
NK11-054X SF-2 STD.		22.8	<0.001	0.12	<0.02	<0.01	14	<0.02	0.02	<0.01	<2	<0.1	4.08	0.07	26.7	0.06
NK11-063X SF-2 STD.		24.1	<0.001	0.13	<0.02	<0.01	14	<0.02	0.02	<0.01	<2	<0.1	4.08	0.12	27.3	0.04
NK11-069X SF-2 STD.		25.3	<0.001	0.14	<0.02	<0.01	12	<0.02	0.03	0.01	<2	<0.1	4.35	0.09	27.2	0.08
NK11-076X SF-2 STD.		24.7	<0.001	0.12	0.02	<0.01	12	<0.02	0.02	0.01	<2	<0.1	4.32	0.12	28.5	0.03
	Average	**23.6**	**BDL**	**0.12**	**BDL**	**BDL**	**14**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**	**4.06**	**0.10**	**27.5**	**0.05**
	Std. Dev.	**0.85**	**BDL**	**0.01**	**BDL**	**BDL**	**3**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**	**0.17**	**0.02**	**0.85**	**0.02**
	RSD%	**4**	**BDL**	**10**	**BDL**	**BDL**	**21**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**	**4**	**17**	**3**	**31**

A3ii - SEQUENTIAL LEACH

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Ag	Al	As	Au	Ba	Be	Bi	Br	Ca	Cd	Ce
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.0005	1	0.005	0.001	0.01	0.001	0.0005	0.01	5	0.0005	0.001
LKSD-4A	Soil Pulp	<0.0005	98	0.187	0.001	1.37	0.007	0.0013	8.13	3284	0.0561	0.116
LKSD-4B	Soil Pulp	<0.0005	90	0.174	<0.001	1.33	0.003	0.0012	7.74	3122	0.0544	0.110
LKSD-4C	Soil Pulp	<0.0005	91	0.178	<0.001	1.30	0.003	0.0010	7.84	3156	0.0510	0.107
LKSD-4D	Soil Pulp	<0.0005	92	0.182	<0.001	1.31	0.004	0.0011	8.27	3169	0.0576	0.093
LKSD-4E	Soil Pulp	<0.0005	94	0.177	<0.001	1.43	0.006	0.0011	7.92	3332	0.0566	0.092
	Average	**BDL**	**93**	**0.180**	**BDL**	**1.35**	**0.005**	**0.0011**	**7.98**	**3213**	**0.0551**	**0.103**
	Std. Dev.	**BDL**	**3.10**	**0.01**	**BDL**	**0.05**	**0.00**	**0.00**	**0.22**	**90.17**	**0.00**	**0.01**
	RSD%	**BDL**	**3**	**3**	**BDL**	**4**	**40**	**11**	**3**	**3**	**5**	**10**

	Method	1SLO	1SLO	1SLO	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Yb	Zn	Zr	Ag	Al	As	Au	Ba	Be	Bi	Ca
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.005	0.1	0.02	0.003	1	0.1	0.001	0.05	0.02	0.005	5
LKSD-4A	Soil Pulp	0.703	37.2	2.81	0.010	787	1.2	0.003	82.04	0.05	<0.005	740
LKSD-4B	Soil Pulp	1.011	46.7	1.63	<0.003	756	1.4	0.001	79.44	<0.02	<0.005	732
LKSD-4C	Soil Pulp	0.961	43.8	2.15	<0.003	808	1.3	0.001	78.68	0.04	<0.005	708
LKSD-4D	Soil Pulp	0.873	44.2	0.94	0.006	595	1.3	0.001	74.89	<0.02	<0.005	699
LKSD-4E	Soil Pulp	0.928	46.6	1.09	<0.003	686	1.1	0.001	75.09	0.03	<0.005	707
	Average	**0.895**	**43.7**	**1.73**	**BDL**	**726**	**1.2**	**0.001**	**78.03**	**BDL**	**BDL**	**717**
	Std. Dev.	**0.12**	**3.86**	**0.77**	**BDL**	**86.59**	**0.08**	**0.00**	**3.04**	**BDL**	**BDL**	**17.63**
	RSD%	**13**	**9**	**45**	**BDL**	**12**	**6**	**41**	**4**	**BDL**	**BDL**	**2**

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Cl	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	2	0.001	0.0005	0.005	0.0001	0.0001	0.0001	0.1	0.0005	0.0001	0.0001	0.0001
LKSD-4A	Soil Pulp	22	0.560	0.0047	0.192	0.0109	0.0081	0.0027	31.2	0.0083	0.0148	0.0076	0.0021
LKSD-4B	Soil Pulp	21	0.525	0.0047	0.189	0.0099	0.0077	0.0027	28.1	0.0081	0.0139	0.0081	0.0024
LKSD-4C	Soil Pulp	23	0.529	0.0045	0.179	0.0115	0.0081	0.0026	28.5	0.0079	0.0139	0.0078	0.0026
LKSD-4D	Soil Pulp	26	0.534	0.0045	0.179	0.0093	0.0071	0.0024	29.9	0.0083	0.0110	0.0086	0.0022
LKSD-4E	Soil Pulp	23	0.536	0.0047	0.183	0.0085	0.0079	0.0021	29.8	0.0088	0.0106	0.0087	0.0025
	Average	**23**	**0.537**	**0.0046**	**0.185**	**0.0100**	**0.0078**	**0.0025**	**29.5**	**0.0083**	**0.0129**	**0.0082**	**0.0024**
	Std. Dev.	**1.84**	**0.01**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**1.27**	**0.00**	**0.00**	**0.00**	**0.00**
	RSD%	**8**	**3**	**3**	**3**	**12**	**5**	**10**	**4**	**4**	**15**	**6**	**9**

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.02	0.005	0.02	0.005	0.02	0.005	0.005	0.005	5	0.02	0.005	0.05
LKSD-4A	Soil Pulp	0.49	0.947	1.06	0.057	0.20	0.022	0.025	<0.005	1032	0.03	0.052	<0.05
LKSD-4B	Soil Pulp	0.49	0.866	1.06	0.053	0.32	0.029	0.031	<0.005	922	0.03	0.051	<0.05
LKSD-4C	Soil Pulp	0.48	0.844	1.03	0.057	0.29	0.029	0.032	<0.005	954	0.03	0.041	<0.05
LKSD-4D	Soil Pulp	0.49	0.596	1.06	0.046	0.31	0.019	0.022	<0.005	848	0.02	0.051	<0.05
LKSD-4E	Soil Pulp	0.49	0.620	0.94	0.052	0.32	0.024	0.024	<0.005	870	0.03	0.039	<0.05
	Average	**0.49**	**0.775**	**1.03**	**0.053**	**0.29**	**0.025**	**0.027**	**BDL**	**925**	**0.03**	**0.047**	**BDL**
	Std. Dev.	**0.01**	**0.16**	**0.05**	**0.00**	**0.05**	**0.00**	**0.00**	**BDL**	**73.13**	**0.00**	**0.01**	**BDL**
	RSD%	**1**	**20**	**5**	**8**	**18**	**18**	**17**	**BDL**	**8**	**7**	**14**	**BDL**

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.001	0.00005	0.00005	2	0.002	0.0001	0.00005	0.1	0.05	0.001	3	0.0005
LKSD-4A	Soil Pulp	<0.001	0.00235	0.00016	66	0.072	0.0439	0.0014	326.1	103.24	0.033	36.8	0.0053
LKSD-4B	Soil Pulp	<0.001	0.00222	0.00007	62	0.066	0.0473	0.0013	304.5	100.79	0.029	32.8	0.0049
LKSD-4C	Soil Pulp	<0.001	0.00245	0.00009	61	0.067	0.0441	0.0014	318.5	101.52	0.028	34.4	0.0053
LKSD-4D	Soil Pulp	<0.001	0.00169	0.00018	63	0.056	0.0438	0.0014	306.5	103.57	0.030	33.2	0.0044
LKSD-4E	Soil Pulp	<0.001	0.00220	0.00018	65	0.055	0.0403	0.0013	332.0	107.81	0.029	35.2	0.0064
	Average	**BDL**	**0.00218**	**0.00014**	**64**	**0.063**	**0.0439**	**0.0014**	**317.6**	**103.39**	**0.030**	**34.5**	**0.0053**
	Std. Dev.	**BDL**	**0.00**	**0.00**	**2.03**	**0.01**	**0.00**	**0.00**	**12.00**	**2.73**	**0.00**	**1.58**	**0.00**
	RSD%	**BDL**	**13**	**38**	**3**	**12**	**6**	**3**	**4**	**3**	**6**	**5**	**14**

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.02	0.005	0.02	0.01	5	0.005	0.02	0.005	1	0.05	0.01	0.01
LKSD-4A	Soil Pulp	<0.02	<0.005	<0.02	<0.01	<5	0.837	0.58	<0.005	164	24.71	<0.01	<0.01
LKSD-4B	Soil Pulp	<0.02	<0.005	<0.02	<0.01	<5	0.724	0.58	<0.005	148	21.15	<0.01	<0.01
LKSD-4C	Soil Pulp	<0.02	<0.005	<0.02	<0.01	<5	0.750	0.51	<0.005	152	21.45	<0.01	<0.01
LKSD-4D	Soil Pulp	<0.02	<0.005	<0.02	<0.01	<5	0.501	0.32	<0.005	146	20.29	<0.01	<0.01
LKSD-4E	Soil Pulp	<0.02	<0.005	<0.02	<0.01	<5	0.558	0.43	<0.005	137	18.57	<0.01	<0.01
	Average	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**	**0.674**	**0.48**	**BDL**	**149**	**21.24**	**BDL**	**BDL**
	Std. Dev.	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**	**0.14**	**0.11**	**BDL**	**9.93**	**2.25**	**BDL**	**BDL**
	RSD%	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**	**21**	**23**	**BDL**	**7**	**11**	**BDL**	**BDL**

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.001	0.005	0.1	0.003	0.0005	0.002	0.00005	10	0.001	0.02	0.005
LKSD-4A	Soil Pulp	0.071	1.082	22.8	0.331	0.0163	0.241	0.00120	3462	0.082	0.02	0.052
LKSD-4B	Soil Pulp	0.068	0.993	21.7	0.290	0.0156	0.241	0.00122	3263	0.082	0.02	0.049
LKSD-4C	Soil Pulp	0.070	0.944	21.3	0.294	0.0150	0.238	0.00106	3308	0.076	<0.02	0.053
LKSD-4D	Soil Pulp	0.061	0.997	22.0	0.284	0.0138	0.238	0.00123	3332	0.081	0.02	0.055
LKSD-4E	Soil Pulp	0.060	1.016	21.9	0.302	0.0131	0.256	0.00115	3434	0.080	0.02	0.050
	Average	**0.066**	**1.006**	**21.9**	**0.300**	**0.0147**	**0.243**	**0.00117**	**3360**	**0.080**	**0.02**	**0.052**
	Std. Dev.	**0.01**	**0.05**	**0.54**	**0.02**	**0.00**	**0.01**	**0.00**	**84.81**	**0.00**	**0.00**	**0.00**
	RSD%	**8**	**5**	**2**	**6**	**9**	**3**	**6**	**3**	**3**	**7**	**4**

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Nd	Ni	P	Pb	Pr	Rb	Re	Sb	Sc	Se	Sm
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.005	0.05	5	0.02	0.005	0.005	0.002	0.005	0.1	0.2	0.005
LKSD-4A	Soil Pulp	0.395	5.13	731	9.22	0.115	0.252	<0.002	0.022	<0.1	<0.2	0.046
LKSD-4B	Soil Pulp	0.337	5.54	792	8.56	0.085	0.251	<0.002	0.010	<0.1	<0.2	0.051
LKSD-4C	Soil Pulp	0.313	5.08	739	7.26	0.101	0.255	<0.002	0.015	<0.1	<0.2	0.051
LKSD-4D	Soil Pulp	0.264	4.62	698	6.06	0.070	0.230	<0.002	0.012	<0.1	<0.2	0.053
LKSD-4E	Soil Pulp	0.296	4.53	687	6.24	0.082	0.232	<0.002	0.012	<0.1	<0.2	0.039
	Average	**0.321**	**4.98**	**729**	**7.47**	**0.091**	**0.244**	**BDL**	**0.014**	**BDL**	**BDL**	**0.048**
	Std. Dev.	**0.05**	**0.41**	**41.05**	**1.40**	**0.02**	**0.01**	**BDL**	**0.00**	**BDL**	**BDL**	**0.01**
	RSD%	**15**	**8**	**6**	**19**	**19**	**5**	**BDL**	**32**	**BDL**	**BDL**	**11**

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.0005	0.001	0.01	0.0005	0.00005	0.001	0.002	0.05	0.0002	0.00005	0.0001
LKSD-4A	Soil Pulp	0.0135	0.005	9.10	<0.0005	0.00179	0.001	0.046	0.56	0.0235	0.00125	0.1857
LKSD-4B	Soil Pulp	0.0136	0.006	8.71	<0.0005	0.00182	0.002	0.041	0.47	0.0233	0.00097	0.1744
LKSD-4C	Soil Pulp	0.0126	0.006	9.02	<0.0005	0.00183	0.002	0.036	0.47	0.0234	0.00102	0.1745
LKSD-4D	Soil Pulp	0.0117	0.006	9.08	<0.0005	0.00146	<0.001	0.026	0.46	0.0233	0.00100	0.1663
LKSD-4E	Soil Pulp	0.0105	0.005	9.31	<0.0005	0.00159	<0.001	0.024	0.47	0.0245	0.00114	0.1715
	Average	**0.0124**	**0.006**	**9.04**	**BDL**	**0.00170**	**BDL**	**0.035**	**0.48**	**0.0236**	**0.00108**	**0.1745**
	Std. Dev.	**0.00**	**0.00**	**0.22**	**BDL**	**0.00**	**BDL**	**0.01**	**0.04**	**0.00**	**0.00**	**0.01**
	RSD%	**10**	**7**	**2**	**BDL**	**10**	**BDL**	**28**	**8**	**2**	**11**	**4**

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.02	0.02	0.02	0.005	0.02	0.02	1	0.005	0.005	0.005	0.05
LKSD-4A	Soil Pulp	<0.02	7.97	<0.02	0.007	<0.02	<0.02	2	0.049	<0.005	0.092	1.14
LKSD-4B	Soil Pulp	<0.02	8.13	<0.02	0.005	<0.02	<0.02	2	0.049	<0.005	0.081	1.09
LKSD-4C	Soil Pulp	<0.02	7.60	<0.02	0.011	<0.02	<0.02	2	0.051	<0.005	0.082	0.91
LKSD-4D	Soil Pulp	<0.02	7.32	<0.02	0.007	<0.02	<0.02	2	0.051	<0.005	0.078	0.82
LKSD-4E	Soil Pulp	<0.02	7.60	<0.02	<0.005	<0.02	<0.02	2	0.045	<0.005	0.067	0.81
	Average	**BDL**	**7.72**	**BDL**	**0.008**	**BDL**	**BDL**	**2**	**0.049**	**BDL**	**0.080**	**0.95**
	Std. Dev.	**BDL**	**0.32**	**BDL**	**0.00**	**BDL**	**BDL**	**0.23**	**0.00**	**BDL**	**0.01**	**0.15**
	RSD%	**BDL**	**4**	**BDL**	**31**	**BDL**	**BDL**	**11**	**5**	**BDL**	**11**	**16**

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	V	W	Y	Yb	Zn	Zr	Ag	Al	As	Au	Ba
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.05	0.002	0.001	0.0005	0.01	0.001	0.003	1	0.1	0.001	0.05
LKSD-4A	Soil Pulp	0.43	0.007	0.081	0.008	11.72	0.093	<0.003	238	0.4	0.006	17.66
LKSD-4B	Soil Pulp	0.42	0.006	0.075	0.009	11.25	0.086	<0.003	245	0.1	<0.001	18.18
LKSD-4C	Soil Pulp	0.42	0.007	0.075	0.008	11.16	0.089	0.005	237	0.4	<0.001	18.89
LKSD-4D	Soil Pulp	0.41	0.006	0.072	0.008	11.69	0.088	0.006	238	0.4	<0.001	20.18
LKSD-4E	Soil Pulp	0.42	0.007	0.072	0.008	11.82	0.083	<0.003	236	<0.1	<0.001	20.25
	Average	**0.42**	**0.006**	**0.075**	**0.008**	**11.53**	**0.088**	**0.006**	**239**	**0.3**	**BDL**	**19.03**
	Std. Dev.	**0.01**	**0.00**	**0.00**	**0.00**	**0.30**	**0.00**	**0.00**	**3.63**	**0.13**	**BDL**	**1.16**
	RSD%	**2**	**7**	**5**	**6**	**3**	**4**	**22**	**2**	**40**	**BDL**	**6**

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	W	Y	Yb	Zn	Zr	Ag	Al	As	Au	Ba	Be
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.01	0.005	0.005	0.1	0.02	0.003	1	0.1	0.001	0.05	0.02
LKSD-4A	Soil Pulp	<0.01	0.295	0.024	23.5	<0.02	0.092	465	1.1	<0.001	18.02	0.07
LKSD-4B	Soil Pulp	<0.01	0.247	0.013	22.0	<0.02	0.098	463	1.1	0.001	17.63	<0.02
LKSD-4C	Soil Pulp	<0.01	0.261	0.013	22.0	<0.02	0.083	518	1.4	0.002	18.30	0.05
LKSD-4D	Soil Pulp	<0.01	0.225	0.016	21.7	<0.02	0.080	491	1.3	<0.001	20.80	0.07
LKSD-4E	Soil Pulp	<0.01	0.229	0.014	21.1	<0.02	0.073	497	1.1	<0.001	18.04	<0.02
	Average	**BDL**	**0.252**	**0.016**	**22.0**	**BDL**	**0.085**	**487**	**1.2**	**BDL**	**18.56**	**BDL**
	Std. Dev.	**BDL**	**0.03**	**0.00**	**0.88**	**BDL**	**0.01**	**23.14**	**0.13**	**BDL**	**1.28**	**BDL**
	RSD%	**BDL**	**11**	**30**	**4**	**BDL**	**11**	**5**	**10**	**BDL**	**7**	**BDL**

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.02	0.005	5	0.02	0.005	0.02	0.005	0.02	0.005	0.005	0.005
LKSD-4A	Soil Pulp	<0.02	0.030	2783	0.49	1.142	0.92	0.060	0.29	0.111	0.071	0.034
LKSD-4B	Soil Pulp	<0.02	0.034	2815	0.51	1.185	0.91	0.063	0.30	0.103	0.064	0.038
LKSD-4C	Soil Pulp	<0.02	0.040	2794	0.48	1.138	0.94	0.063	0.33	0.083	0.045	0.045
LKSD-4D	Soil Pulp	<0.02	0.038	2776	0.51	1.113	0.92	0.057	0.26	0.105	0.057	0.040
LKSD-4E	Soil Pulp	0.10	0.025	2855	0.57	1.178	0.94	0.056	0.33	0.145	0.061	0.034
	Average	**BDL**	**0.033**	**2805**	**0.51**	**1.151**	**0.93**	**0.060**	**0.30**	**0.110**	**0.060**	**0.038**
	Std. Dev.	**BDL**	**0.01**	**31.66**	**0.04**	**0.03**	**0.01**	**0.00**	**0.03**	**0.02**	**0.01**	**0.00**
	RSD%	**BDL**	**18**	**1**	**7**	**3**	**1**	**5**	**10**	**21**	**16**	**12**

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.005	5	0.02	0.005	0.02	0.005	0.02	0.005	0.005	0.005	5
LKSD-4A	Soil Pulp	0.011	158	0.08	1.456	0.78	0.105	0.41	0.061	0.036	0.013	2236
LKSD-4B	Soil Pulp	0.006	173	0.08	1.320	0.74	0.093	0.39	0.057	0.049	0.012	2169
LKSD-4C	Soil Pulp	0.013	164	0.07	1.264	0.73	0.099	0.35	0.056	0.030	0.014	2196
LKSD-4D	Soil Pulp	0.009	179	0.10	1.367	0.74	0.092	0.39	0.061	0.038	0.013	2219
LKSD-4E	Soil Pulp	<0.005	170	0.08	1.156	0.75	0.083	0.34	0.064	0.032	0.015	2070
	Average	**0.010**	**169**	**0.08**	**1.313**	**0.75**	**0.094**	**0.38**	**0.060**	**0.037**	**0.014**	**2178**
	Std. Dev.	**0.00**	**8.10**	**0.01**	**0.11**	**0.02**	**0.01**	**0.03**	**0.00**	**0.01**	**0.00**	**65.30**
	RSD%	**30**	**5**	**11**	**9**	**2**	**9**	**8**	**6**	**20**	**9**	**3**

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	5	0.02	0.005	0.05	0.02	0.005	0.02	0.01	5	0.005	0.02	0.005
LKSD-4A	Soil Pulp	114	<0.02	0.189	<0.05	<0.02	<0.005	0.02	0.01	12	0.717	<0.02	0.007
LKSD-4B	Soil Pulp	114	<0.02	0.188	<0.05	<0.02	<0.005	0.02	0.01	12	0.744	<0.02	0.006
LKSD-4C	Soil Pulp	114	<0.02	0.141	<0.05	<0.02	<0.005	0.02	0.01	11	0.724	<0.02	0.010
LKSD-4D	Soil Pulp	116	<0.02	0.200	<0.05	<0.02	<0.005	0.02	<0.01	12	0.741	0.02	0.008
LKSD-4E	Soil Pulp	118	<0.02	0.179	<0.05	<0.02	<0.005	0.02	0.01	13	0.768	<0.02	0.009
	Average	**115**	**BDL**	**0.179**	**BDL**	**BDL**	**BDL**	**0.02**	**0.01**	**12**	**0.739**	**BDL**	**0.008**
	Std. Dev.	**1.91**	**BDL**	**0.02**	**BDL**	**BDL**	**BDL**	**0.00**	**0.00**	**0.60**	**0.02**	**BDL**	**0.00**
	RSD%	**2**	**BDL**	**13**	**BDL**	**BDL**	**BDL**	**3**	**15**	**5**	**3**	**BDL**	**20**

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.02	0.005	0.05	0.02	0.005	0.02	0.01	5	0.005	0.02	0.005	1
LKSD-4A	Soil Pulp	0.05	0.103	<0.05	<0.02	0.011	<0.02	<0.01	<5	1.032	1.21	<0.005	293
LKSD-4B	Soil Pulp	0.04	0.101	<0.05	<0.02	0.008	<0.02	<0.01	5	0.997	1.30	0.008	294
LKSD-4C	Soil Pulp	0.04	0.093	<0.05	<0.02	0.010	<0.02	<0.01	<5	0.984	1.24	0.005	292
LKSD-4D	Soil Pulp	0.04	0.107	<0.05	<0.02	0.010	<0.02	<0.01	<5	0.950	1.32	<0.005	295
LKSD-4E	Soil Pulp	0.04	0.088	<0.05	<0.02	0.008	<0.02	<0.01	<5	0.865	1.04	0.006	270
	Average	**0.04**	**0.098**	**BDL**	**BDL**	**0.009**	**BDL**	**BDL**	**BDL**	**0.966**	**1.22**	**BDL**	**289**
	Std. Dev.	**0.00**	**0.01**	**BDL**	**BDL**	**0.00**	**BDL**	**BDL**	**BDL**	**0.06**	**0.11**	**BDL**	**10.59**
	RSD%	**7**	**8**	**BDL**	**BDL**	**15**	**BDL**	**BDL**	**BDL**	**7**	**9**	**BDL**	**4**

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	Sb
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	1	0.05	0.01	0.01	0.005	0.05	5	0.02	0.005	0.005	0.002	0.005
LKSD-4A	Soil Pulp	167	115.11	0.06	<0.01	0.669	2.16	24	15.91	0.168	0.485	<0.002	0.072
LKSD-4B	Soil Pulp	169	115.16	0.05	<0.01	0.760	2.01	21	17.02	0.173	0.507	0.003	0.067
LKSD-4C	Soil Pulp	161	113.95	0.02	<0.01	0.824	1.83	21	17.64	0.160	0.524	<0.002	0.077
LKSD-4D	Soil Pulp	160	115.37	0.06	<0.01	0.751	1.74	20	17.08	0.165	0.508	<0.002	0.062
LKSD-4E	Soil Pulp	162	114.48	0.04	<0.01	0.795	2.00	22	17.66	0.169	0.527	0.002	0.072
	Average	**164**	**114.81**	**0.05**	**BDL**	**0.760**	**1.95**	**22**	**17.06**	**0.167**	**0.510**	**BDL**	**0.070**
	Std. Dev.	**3.92**	**0.59**	**0.02**	**BDL**	**0.06**	**0.17**	**1.28**	**0.71**	**0.00**	**0.02**	**BDL**	**0.01**
	RSD%	**2**	**1**	**35**	**BDL**	**8**	**9**	**6**	**4**	**3**	**3**	**BDL**	**8**

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	Sb	Sc
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.05	0.01	0.01	0.005	0.05	5	0.02	0.005	0.005	0.002	0.005	0.1
LKSD-4A	Soil Pulp	23.14	0.02	<0.01	0.615	2.81	314	9.45	0.161	0.496	<0.002	0.023	0.3
LKSD-4B	Soil Pulp	22.87	<0.01	<0.01	0.579	2.77	335	8.95	0.166	0.457	<0.002	0.021	0.2
LKSD-4C	Soil Pulp	22.39	0.02	<0.01	0.612	2.67	337	8.37	0.177	0.478	<0.002	0.021	0.2
LKSD-4D	Soil Pulp	22.02	<0.01	<0.01	0.665	3.19	366	8.96	0.169	0.496	<0.002	0.017	0.2
LKSD-4E	Soil Pulp	20.50	0.02	<0.01	0.572	2.69	304	8.29	0.131	0.445	<0.002	0.019	0.2
	Average	**22.18**	**0.02**	**BDL**	**0.609**	**2.83**	**331**	**8.80**	**0.161**	**0.475**	**BDL**	**0.020**	**0.2**
	Std. Dev.	**1.04**	**0.00**	**BDL**	**0.04**	**0.21**	**24.10**	**0.48**	**0.02**	**0.02**	**BDL**	**0.00**	**0.05**
	RSD%	**5**	**11**	**BDL**	**6**	**7**	**7**	**5**	**11**	**5**	**BDL**	**11**	**24**

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.1	0.2	0.005	0.02	0.02	0.02	0.005	0.02	0.02	1	0.005	0.005
LKSD-4A	Soil Pulp	0.2	<0.2	0.190	<0.02	12.11	<0.02	0.022	<0.02	0.13	<1	0.184	0.006
LKSD-4B	Soil Pulp	0.1	<0.2	0.180	<0.02	12.50	<0.02	0.018	<0.02	0.14	<1	0.178	0.009
LKSD-4C	Soil Pulp	<0.1	<0.2	0.204	<0.02	12.51	<0.02	0.023	<0.02	0.12	<1	0.196	<0.005
LKSD-4D	Soil Pulp	0.3	<0.2	0.163	<0.02	12.48	<0.02	0.019	<0.02	0.13	<1	0.182	0.008
LKSD-4E	Soil Pulp	0.3	<0.2	0.150	<0.02	12.72	<0.02	0.020	<0.02	0.14	<1	0.187	0.006
	Average	**0.2**	**BDL**	**0.178**	**BDL**	**12.47**	**BDL**	**0.020**	**BDL**	**0.13**	**BDL**	**0.185**	**0.007**
	Std. Dev.	**0.08**	**BDL**	**0.02**	**BDL**	**0.22**	**BDL**	**0.00**	**BDL**	**0.01**	**BDL**	**0.01**	**0.00**
	RSD%	**40**	**BDL**	**12**	**BDL**	**2**	**BDL**	**10**	**BDL**	**7**	**BDL**	**4**	**21**

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.2	0.005	0.02	0.02	0.02	0.005	0.02	0.02	1	0.005	0.005	0.005
LKSD-4A	Soil Pulp	<0.2	0.102	<0.02	1.43	<0.02	0.016	<0.02	<0.02	1.66	0.030	0.007	0.137
LKSD-4B	Soil Pulp	0.2	0.096	<0.02	1.46	<0.02	0.009	<0.02	<0.02	1.78	0.027	<0.005	0.119
LKSD-4C	Soil Pulp	<0.2	0.084	<0.02	1.44	<0.02	0.010	<0.02	<0.02	1.78	0.026	<0.005	0.108
LKSD-4D	Soil Pulp	<0.2	0.102	<0.02	1.55	<0.02	0.013	<0.02	<0.02	1.57	0.026	<0.005	0.112
LKSD-4E	Soil Pulp	<0.2	0.090	<0.02	1.50	<0.02	0.015	<0.02	<0.02	1.49	0.028	0.005	0.105
	Average	**BDL**	**0.095**	**BDL**	**1.48**	**BDL**	**0.013**	**BDL**	**BDL**	**1.66**	**0.027**	**BDL**	**0.116**
	Std. Dev.	**BDL**	**0.01**	**BDL**	**0.05**	**BDL**	**0.00**	**BDL**	**BDL**	**0.13**	**0.00**	**BDL**	**0.01**
	RSD%	**BDL**	**8**	**BDL**	**3**	**BDL**	**22**	**BDL**	**BDL**	**8**	**6**	**BDL**	**11**

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLO	1SLO	1SLO	1SLO
	Analyte	U	V	W	Y	Yb	Zn	Zr	Ag	Al	As	Au
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.005	0.05	0.01	0.005	0.005	0.1	0.02	0.003	1	0.1	0.001
LKSD-4A	Soil Pulp	7.935	<0.05	<0.01	0.773	0.050	42.3	0.12	0.018	2134	3.4	0.005
LKSD-4B	Soil Pulp	8.135	0.20	<0.01	0.747	0.043	45.0	0.15	0.025	2639	4.4	<0.001
LKSD-4C	Soil Pulp	8.403	<0.05	<0.01	0.754	0.053	44.4	0.14	0.026	2567	4.6	0.004
LKSD-4D	Soil Pulp	7.663	<0.05	<0.01	0.778	0.052	48.8	0.12	0.028	2581	4.9	0.005
LKSD-4E	Soil Pulp	7.955	<0.05	<0.01	0.805	0.037	47.4	0.11	0.038	2648	5.1	<0.001
	Average	**8.018**	**BDL**	**BDL**	**0.771**	**0.047**	**45.6**	**0.13**	**0.027**	**2514**	**4.5**	**BDL**
	Std. Dev.	**0.27**	**BDL**	**BDL**	**0.02**	**0.01**	**2.55**	**0.02**	**0.01**	**215.04**	**0.66**	**BDL**
	RSD%	**3**	**BDL**	**BDL**	**3**	**14**	**6**	**12**	**26**	**9**	**15**	**BDL**

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1T	1T	1T	1T	1T
	Analyte	V	W	Y	Yb	Zn	Zr	Mo	Cu	Pb	Zn	Ag
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.05	0.01	0.005	0.005	0.1	0.02	0.05	0.02	0.02	0.2	0.02
LKSD-4A	Soil Pulp	1.51	<0.01	0.554	0.046	16.1	<0.02	1.44	31.09	24.83	59.4	0.14
LKSD-4B	Soil Pulp	1.35	<0.01	0.508	0.040	16.6	<0.02	1.33	30.89	26.70	60.9	0.16
LKSD-4C	Soil Pulp	1.72	<0.01	0.483	0.032	15.6	<0.02	1.28	32.16	28.52	64.3	0.17
LKSD-4D	Soil Pulp	1.26	<0.01	0.475	0.019	17.4	<0.02	1.51	33.47	31.15	61.9	0.17
LKSD-4E	Soil Pulp	1.31	<0.01	0.452	0.032	15.8	<0.02	1.33	33.19	32.56	65.0	0.20
	Average	**1.43**	**BDL**	**0.495**	**0.034**	**16.3**	**BDL**	**1.38**	**32.16**	**28.75**	**62.3**	**0.17**
	Std. Dev.	**0.18**	**BDL**	**0.04**	**0.01**	**0.72**	**BDL**	**0.10**	**1.17**	**3.16**	**2.33**	**0.02**
	RSD%	**13**	**BDL**	**8**	**31**	**4**	**BDL**	**7**	**4**	**11**	**4**	**13**

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.05	0.02	0.005	5	0.02	0.005	0.02	0.005	0.02	0.005	0.005
LKSD-4A	Soil Pulp	17.17	0.18	0.171	838	0.42	14.974	0.70	0.008	1.95	1.132	0.735
LKSD-4B	Soil Pulp	19.99	0.15	0.232	1070	0.53	18.614	0.79	0.012	3.75	1.625	0.943
LKSD-4C	Soil Pulp	20.83	0.06	0.206	1037	0.48	19.208	0.82	0.009	3.57	1.497	0.933
LKSD-4D	Soil Pulp	21.29	0.12	0.202	989	0.46	18.397	0.81	0.011	3.52	1.472	0.910
LKSD-4E	Soil Pulp	20.61	0.22	0.227	1064	0.53	19.055	0.88	0.011	3.49	1.579	0.924
	Average	**19.98**	**0.15**	**0.208**	**1000**	**0.49**	**18.049**	**0.80**	**0.010**	**3.26**	**1.461**	**0.889**
	Std. Dev.	**1.64**	**0.06**	**0.02**	**95.80**	**0.05**	**1.75**	**0.07**	**0.00**	**0.74**	**0.19**	**0.09**
	RSD%	**8**	**41**	**12**	**10**	**10**	**10**	**8**	**18**	**23**	**13**	**10**

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.1	0.2	2	200	0.2	0.1	0.1	0.1	1	0.02	0.02
LKSD-4A	Soil Pulp	24.6	8.7	188	24798	10.24	6.96	<0.1	3.3	94	0.09	1.43
LKSD-4B	Soil Pulp	24.5	8.4	199	25498	9.99	7.04	<0.1	3.3	96	0.10	1.31
LKSD-4C	Soil Pulp	25.6	8.2	194	24989	9.34	6.88	<0.1	3.1	88	0.08	1.37
LKSD-4D	Soil Pulp	25.6	8.8	191	25569	9.51	7.56	<0.1	3.4	89	0.09	1.43
LKSD-4E	Soil Pulp	26.1	8.3	188	24838	9.02	7.49	<0.1	3.4	89	0.09	1.37
	Average	**25.3**	**8.5**	**192**	**25138**	**9.62**	**7.19**	**BDL**	**3.3**	**91**	**0.09**	**1.38**
	Std. Dev.	**0.69**	**0.25**	**4.76**	**368.82**	**0.49**	**0.32**	**BDL**	**0.13**	**3.64**	**0.01**	**0.05**
	RSD%	**3**	**3**	**2**	**1**	**5**	**4**	**BDL**	**4**	**4**	**8**	**4**

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.005	5	0.05	0.005	0.05	0.02	0.005	0.02	0.01	5	0.005
LKSD-4A	Soil Pulp	0.390	2254	0.19	1.579	<0.05	0.12	0.010	0.27	0.02	<5	10.438
LKSD-4B	Soil Pulp	0.460	2909	0.28	2.025	<0.05	0.10	0.005	0.30	0.03	<5	13.275
LKSD-4C	Soil Pulp	0.475	2819	0.26	1.908	<0.05	0.12	0.007	0.31	0.02	<5	13.758
LKSD-4D	Soil Pulp	0.430	2824	0.25	1.968	<0.05	0.10	0.013	0.33	0.02	<5	13.587
LKSD-4E	Soil Pulp	0.429	2829	0.25	1.868	<0.05	0.11	0.010	0.33	0.03	<5	13.977
	Average	**0.437**	**2727**	**0.24**	**1.870**	**BDL**	**0.11**	**0.009**	**0.31**	**0.02**	**BDL**	**13.007**
	Std. Dev.	**0.03**	**267.11**	**0.03**	**0.17**	**BDL**	**0.01**	**0.00**	**0.03**	**0.00**	**BDL**	**1.46**
	RSD%	**8**	**10**	**14**	**9**	**BDL**	**11**	**33**	**8**	**17**	**BDL**	**11**

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Bi	V	Ca	P	La	Cr	Mg	Ba	Ti	Al	Na
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.04	1	200	10	0.1	1	200	1	10	200	20
LKSD-4A	Soil Pulp	0.45	37	4883	2903	12.8	35	4883	218	2020	21794	6626
LKSD-4B	Soil Pulp	0.43	38	5313	2897	13.1	35	5036	227	2080	23374	6660
LKSD-4C	Soil Pulp	0.42	36	5054	2663	12.5	34	4954	213	1985	22221	6629
LKSD-4D	Soil Pulp	0.43	37	4780	3708	13.6	35	4949	223	2060	21549	6493
LKSD-4E	Soil Pulp	0.42	36	4987	3027	13.9	34	4841	222	1967	22742	6115
	Average	**0.43**	**37**	**5003**	**3040**	**13.2**	**35**	**4933**	**221**	**2022**	**22336**	**6505**
	Std. Dev.	**0.01**	**0.77**	**201.75**	**396.35**	**0.58**	**0.56**	**74.59**	**5.13**	**47.75**	**736.20**	**227.29**
	RSD%	**3**	**2**	**4**	**13**	**4**	**2**	**2**	**2**	**2**	**3**	**3**

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.02	0.005	1	0.05	0.01	0.01	0.005	0.05	0.02	0.005	0.005
LKSD-4A	Soil Pulp	0.05	0.122	32	43.37	0.64	0.15	8.923	3.18	25.88	2.130	0.058
LKSD-4B	Soil Pulp	0.11	0.147	43	52.66	0.76	0.08	10.713	3.88	31.62	2.677	0.083
LKSD-4C	Soil Pulp	0.07	0.145	41	48.88	0.74	0.16	10.691	4.03	30.75	2.707	0.081
LKSD-4D	Soil Pulp	0.05	0.143	41	47.16	0.70	0.05	10.373	3.86	31.67	2.616	0.095
LKSD-4E	Soil Pulp	0.05	0.138	42	47.83	0.81	0.05	10.818	3.71	31.50	2.717	0.073
	Average	**0.07**	**0.139**	**40**	**47.98**	**0.73**	**0.10**	**10.303**	**3.73**	**30.28**	**2.569**	**0.078**
	Std. Dev.	**0.02**	**0.01**	**4.18**	**3.34**	**0.06**	**0.05**	**0.79**	**0.33**	**2.49**	**0.25**	**0.01**
	RSD%	**36**	**7**	**11**	**7**	**9**	**56**	**8**	**9**	**8**	**10**	**18**

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	K	W	Zr	Sn	Be	Sc	S	Y	Ce	Pr	Nd
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	200	0.1	0.2	0.1	1	0.1	400	0.1	0.02	0.1	0.1
LKSD-4A	Soil Pulp	7355	0.5	53.5	3.6	<1	4.5	7056	9.8	24.60	3.4	13.2
LKSD-4B	Soil Pulp	7453	0.5	47.9	3.4	<1	4.7	6972	10.4	26.58	3.6	14.1
LKSD-4C	Soil Pulp	7370	0.5	49.8	3.2	<1	4.4	7149	9.9	25.33	3.3	14.4
LKSD-4D	Soil Pulp	7284	0.6	48.2	3.4	<1	4.4	7238	9.9	26.04	3.5	13.6
LKSD-4E	Soil Pulp	7347	0.6	42.8	3.1	<1	4.3	7374	10.3	26.40	3.6	14.3
	Average	**7362**	**0.5**	**48.5**	**3.3**	**BDL**	**4.5**	**7158**	**10.1**	**25.79**	**3.5**	**13.9**
	Std. Dev.	**60.56**	**0.06**	**3.87**	**0.16**	**BDL**	**0.17**	**156.83**	**0.25**	**0.82**	**0.14**	**0.51**
	RSD%	**1**	**11**	**8**	**5**	**BDL**	**4**	**2**	**3**	**3**	**4**	**4**

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Re	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.002	0.005	0.1	0.2	0.005	0.02	0.02	0.02	0.005	0.02	0.02	1
LKSD-4A	Soil Pulp	<0.002	0.166	2.8	0.2	1.797	1.30	3.99	<0.02	0.208	<0.02	4.52	<1
LKSD-4B	Soil Pulp	<0.002	0.254	3.5	0.3	2.207	1.65	5.08	<0.02	0.261	<0.02	5.61	<1
LKSD-4C	Soil Pulp	<0.002	0.267	3.7	0.4	2.244	1.46	5.11	<0.02	0.275	<0.02	5.76	<1
LKSD-4D	Soil Pulp	<0.002	0.290	3.6	0.4	2.090	1.48	4.95	<0.02	0.242	<0.02	5.52	<1
LKSD-4E	Soil Pulp	<0.002	0.278	3.7	0.4	2.200	1.70	4.99	<0.02	0.254	<0.02	5.91	<1
	Average	**BDL**	**0.251**	**3.4**	**0.4**	**2.108**	**1.52**	**4.83**	**BDL**	**0.248**	**BDL**	**5.47**	**BDL**
	Std. Dev.	**BDL**	**0.05**	**0.38**	**0.08**	**0.18**	**0.16**	**0.47**	**BDL**	**0.03**	**BDL**	**0.55**	**BDL**
	RSD%	**BDL**	**20**	**11**	**23**	**9**	**11**	**10**	**BDL**	**10**	**BDL**	**10**	**BDL**

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Li
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.02	0.1
LKSD-4A	Soil Pulp	2.4	0.6	2.5	0.3	1.9	0.4	1.1	0.1	0.9	0.1	1.25	12.7
LKSD-4B	Soil Pulp	2.6	0.6	2.2	0.3	1.9	0.4	1.1	0.1	1.1	0.1	1.32	12.9
LKSD-4C	Soil Pulp	2.3	0.6	2.0	0.3	1.8	0.4	1.0	0.1	1.0	0.1	1.42	12.5
LKSD-4D	Soil Pulp	2.5	0.5	2.0	0.3	1.8	0.4	1.0	0.2	1.0	0.1	1.32	12.7
LKSD-4E	Soil Pulp	2.5	0.5	2.2	0.3	2.1	0.4	1.0	0.1	1.1	0.2	1.17	12.6
	Average	**2.5**	**0.6**	**2.2**	**0.3**	**1.9**	**0.4**	**1.1**	**0.1**	**1.0**	**0.1**	**1.30**	**12.7**
	Std. Dev.	**0.12**	**0.03**	**0.17**	**0.01**	**0.12**	**0.02**	**0.03**	**0.01**	**0.07**	**0.01**	**0.09**	**0.16**
	RSD%	**5**	**5**	**8**	**5**	**6**	**4**	**3**	**6**	**7**	**8**	**7**	**1**

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Tl	Tm	U	V	W	Y
	Unit	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.005	0.005	0.005	0.05	0.01	0.005
LKSD-4A	Soil Pulp	0.047	0.113	12.820	4.1	0.07	7.889
LKSD-4B	Soil Pulp	0.064	0.125	16.703	5.3	0.09	9.825
LKSD-4C	Soil Pulp	0.063	0.134	16.592	5.1	0.11	9.936
LKSD-4D	Soil Pulp	0.064	0.123	16.659	5.3	0.11	9.625
LKSD-4E	Soil Pulp	0.065	0.131	17.534	5.3	0.09	10.080
	Average	**0.061**	**0.125**	**16.062**	**5.0**	**0.09**	**9.471**
	Std. Dev.	**0.01**	**0.01**	**1.85**	**0.54**	**0.01**	**0.90**
	RSD%	**12**	**7**	**12**	**11**	**15**	**10**

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Rb	Ta	Nb	Cs	Ga	In	Re	Se	Te	Tl
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.1	0.1	0.04	0.1	0.02	0.01	0.002	0.3	0.05	0.05
LKSD-4A	Soil Pulp	24.1	0.3	4.13	1.2	8.27	0.04	0.003	2.8	0.19	0.29
LKSD-4B	Soil Pulp	25.4	0.3	4.28	1.2	8.63	0.02	0.003	2.9	0.21	0.29
LKSD-4C	Soil Pulp	24.3	0.3	3.96	1.2	8.49	0.03	<0.002	2.9	0.21	0.29
LKSD-4D	Soil Pulp	24.6	0.3	4.18	1.2	8.71	0.04	<0.002	2.8	0.17	0.32
LKSD-4E	Soil Pulp	24.8	0.3	4.09	1.3	8.41	0.02	0.004	2.7	0.29	0.30
	Average	**24.6**	**0.3**	**4.13**	**1.2**	**8.50**	**0.03**	**0.003**	**2.8**	**0.21**	**0.30**
	Std. Dev.	**0.53**	**0.01**	**0.12**	**0.04**	**0.17**	**0.01**	**0.00**	**0.08**	**0.05**	**0.01**
	RSD%	**2**	**3**	**3**	**3**	**2**	**38**	**7**	**3**	**21**	**4**

A3iii - VERTICAL PROFILE

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu
	Unit	ppb	%	ppm	ppb	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	2	0.01	0.1	0.2	1	0.1	0.1	0.02	0.01	0.01	0.01	0.01	0.1	0.005	0.01	0.02	0.02	0.02
Sample																			
NK11-037NX		<2	0.05	0.1	<0.2	13	29.3	<0.1	<0.02	0.37	0.05	9.89	0.02	1.5	0.032	7.28	0.56	0.27	0.3
NK11-060X		<2	0.05	<0.1	<0.2	13	28.6	<0.1	<0.02	0.37	0.06	9.56	0.03	1.5	0.032	7.06	0.56	0.29	0.32
NK12-021X		<2	0.05	0.1	<0.2	14	28.8	<0.1	<0.02	0.38	0.07	10.06	0.05	1.4	0.031	7.51	0.57	0.23	0.33
NK12-039X		2	0.05	<0.1	115.2	13	29.0	<0.1	<0.02	0.36	0.06	9.84	0.06	1.5	0.030	7.31	0.56	0.24	0.31
NK12-072X		<2	0.05	0.1	<0.2	13	28.0	<0.1	<0.02	0.36	0.06	9.39	0.05	1.6	0.029	6.99	0.51	0.28	0.32
	Average	**BDL**	**0.05**	**BDL**	**BDL**	**13**	**28.7**	**BDL**	**BDL**	**0.37**	**0.06**	**9.748**	**0.04**	**1.5**	**0.031**	**7.23**	**0.55**	**0.26**	**0.32**
	Std. Dev.	**BDL**	**0.00**	**BDL**	**BDL**	**0.45**	**0.49**	**BDL**	**BDL**	**0.01**	**0.01**	**0.27**	**0.02**	**0.07**	**0.00**	**0.21**	**0.02**	**0.03**	**0.01**
	%RSD	**BDL**	**0**	**BDL**	**BDL**	**3**	**2**	**BDL**	**BDL**	**2**	**12**	**3**	**39**	**5**	**4**	**3**	**4**	**10**	**4**

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Nd	Ni
	Unit	%	ppm	ppm	ppm	ppm	ppb	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm
	MDL	0.001	0.1	0.02	0.01	0.001	1	0.02	0.02	0.01	0.01	0.01	0.02	0.001	1	0.01	0.001	0.01	0.02	0.1
Sample																				
NK11-037NX		0.010	<0.1	0.98	0.02	<0.001	38	0.11	<0.02	1.68	9.65	0.05	<0.02	0.231	70	0.46	0.020	<0.01	6.91	0.5
NK11-060X		0.010	<0.1	1.11	0.02	<0.001	36	0.11	<0.02	1.68	9.23	0.07	<0.02	0.232	68	0.44	0.019	<0.01	6.55	0.5
NK12-021X		0.011	<0.1	1.09	0.02	0.001	37	0.11	<0.02	1.71	9.70	0.06	<0.02	0.235	70	0.45	0.020	<0.01	7.36	0.6
NK12-039X		0.013	<0.1	1.11	0.03	<0.001	37	0.12	<0.02	1.68	9.55	0.05	<0.02	0.237	69	0.45	0.020	<0.01	7.13	0.6
NK12-072X		0.010	<0.1	1.04	0.05	<0.001	38	0.12	<0.02	1.64	9.25	0.04	<0.02	0.228	68	0.43	0.018	<0.01	6.59	0.6
	Average	**0.011**	**BDL**	**1.07**	**0.03**	**BDL**	**37.2**	**0.11**	**BDL**	**1.68**	**9.48**	**0.05**	**BDL**	**0.233**	**69**	**0.45**	**0.0194**	**BDL**	**6.908**	**0.56**
	Std. Dev.	**0.00**	**BDL**	**0.06**	**0.01**	**BDL**	**0.84**	**0.01**	**BDL**	**0.02**	**0.22**	**0.01**	**BDL**	**0.00**	**1.00**	**0.01**	**0.00**	**BDL**	**0.35**	**0.05**
	%RSD	**12**	**BDL**	**5**	**47**	**BDL**	**2**	**5**	**BDL**	**1**	**2**	**21**	**BDL**	**2**	**1**	**3**	**5**	**BDL**	**5**	**10**

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	P	Pb	Pd	Pr	Pt	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti
	Unit	%	ppm	ppb	ppm	ppb	ppm	ppb	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.001	0.01	2	0.02	1	0.1	1	0.01	0.02	0.1	0.1	0.02	0.02	0.5	0.001	0.02	0.02	0.01	1
Sample																				
NK11-037NX		0.233	0.08	<2	1.97	<1	19.5	<1	0.19	0.03	0.2	0.3	1.05	0.07	21.2	<0.001	0.12	<0.02	<0.01	13
NK11-060X		0.232	0.08	<2	1.92	<1	18.5	<1	0.19	0.03	0.3	0.2	1.07	0.05	20.6	<0.001	0.13	<0.02	<0.01	13
NK12-021X		0.239	0.8	<2	2.02	<1	19.4	<1	0.20	0.03	0.2	0.2	1.07	0.05	21.3	<0.001	0.12	<0.02	<0.01	13
NK12-039X		0.243	0.14	<2	1.98	<1	19.6	<1	0.19	0.03	0.2	0.5	1.07	0.05	21.1	<0.001	0.13	<0.02	<0.01	15
NK12-072X		0.234	0.16	<2	1.85	<1	19.2	<1	0.17	0.03	0.2	0.4	0.99	0.04	20.7	<0.001	0.11	<0.02	<0.01	12
	Average	**0.236**	**0.25**	**BDL**	**1.95**	**BDL**	**19.2**	**BDL**	**0.19**	**0.03**	**0.22**	**0.32**	**1.05**	**0.052**	**20.98**	**BDL**	**0.122**	**BDL**	**BDL**	**13.2**
	Std. Dev.	**0.00**	**0.31**	**BDL**	**0.07**	**BDL**	**0.44**	**BDL**	**0.01**	**0.00**	**0.04**	**0.13**	**0.03**	**0.01**	**0.31**	**BDL**	**0.01**	**BDL**	**BDL**	**1.10**
	%RSD	**2**	**122**	**BDL**	**3**	**BDL**	**2**	**BDL**	**6**	**0**	**20**	**41**	**3**	**21**	**1**	**BDL**	**7**	**BDL**	**BDL**	**8**

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.02	0.01	2	0.1	0.001	0.02	0.1	0.01
Sample										
NK11-037NX		<0.02	0.04	<0.01	<2	<0.1	4.068	0.11	22.5	0.05
NK11-060X		<0.02	0.03	<0.01	<2	<0.1	3.954	0.15	22.4	0.04
NK12-021X		<0.02	0.02	<0.01	<2	<0.1	4.116	0.13	23.0	0.03
NK12-039X		<0.02	0.02	<0.01	<2	<0.1	3.919	0.09	22.3	0.10
NK12-072X		<0.02	0.02	<0.01	<2	<0.1	4.009	0.09	21.0	0.04
	Average	**BDL**	**0.026**	**BDL**	**BDL**	**BDL**	**4.013**	**0.11**	**22.24**	**0.05**
	Std. Dev.	**BDL**	**0.01**	**BDL**	**BDL**	**BDL**	**0.08**	**0.03**	**0.74**	**0.03**
	%RSD	**BDL**	**34**	**BDL**	**BDL**	**BDL**	**2**	**23**	**3**	**53**

A3iv - ASHED NORWAY SPRUCE

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.004	200	0.2	0.0004	40	1	0.2	0.04	200	0.02	0.2	0.2	1	0.04	0.02	0.04	0.04
Sample																		
NK11-010X		166	1.81	2.8	6	0.04	<10	2.4	0.67	1	96.55	2.7	0.4	<0.2	0.77	0.83	0.10	28
NK11-020X		182	1.71	2.7	5.4	<0.04	<10	2.5	0.8	1	92.95	2.9	0.4	<0.2	0.69	0.81	0.10	28
NK11-029X		156	1.64	2.6	5.6	<0.04	<10	2.4	0.69	2	100.80	2.5	0.3	<0.2	0.69	0.80	0.09	29
NK11-063X		123	1.58	2.7	4.8	0.04	<10	2.1	0.62	1	94.03	2.0	<0.2	<0.2	0.67	0.79	0.08	27
NK11-075X		173	1.58	2.7	5.7	<0.04	<10	2.2	0.66	2	91.13	2.0	0.2	<0.2	0.70	0.80	0.08	27
	Average	**160**	**2**	**2.7**	**5.5**	**BDL**	**BDL**	**2.3**	**0.69**	**1**	**95.09**	**2.4**	**0.33**	**BDL**	**0.70**	**0.81**	**0.09**	**27.8**
	Std. Dev	**22.77**	**0.10**	**0.08**	**0.45**	**BDL**	**BDL**	**0.16**	**0.07**	**0.14**	**3.75**	**0.41**	**0.10**	**BDL**	**0.04**	**0.02**	**0.01**	**0.84**
	%RSD	**14**	**6**	**3**	**8**	**BDL**	**BDL**	**7**	**10**	**10**	**4**	**17**	**29**	**BDL**	**6**	**2**	**11**	**3**

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Nd
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.04	200	0.2	0.04	0.2	0.04	0.01	0.04	0.04	200	1	0.2	0.04	200	2	0.02	20	0.04	0.04
Sample																				
NK11-010X		2.30	16	35.5	0.04	244.1	<20	0.16	1.10	0.70	6	2	625.0	0.63	0.05	0.29	309	17	3.22	0.25
NK11-020X		2.40	14	35.9	0.04	231.0	<20	0.16	1.10	0.70	6	2	530.0	0.61	0.05	0.27	281	16	3.43	0.25
NK11-029X		2.50	14	31.4	0.04	242.0	<20	0.16	1.00	0.70	6	2	523.0	0.57	<0.04	0.23	268	16	3.33	0.25
NK11-063X		1.80	12	34.6	0.03	212.1	<20	0.15	0.80	0.30	5	2	539.0	0.51	<0.04	0.24	251	13	2.68	0.23
NK11-075X		4.40	13	40.0	0.03	214.6	<20	0.15	1.00	0.70	5	2	579.0	0.56	<0.04	0.22	273	13	2.62	0.24
	Average	**2.68**	**14**	**35.5**	**0.03**	**228.8**	**BDL**	**0.16**	**1.00**	**0.62**	**5**	**2**	**559.2**	**0.58**	**BDL**	**0.25**	**276**	**15**	**3.06**	**0.244**
	Std. Dev	**1.00**	**1.29**	**3.08**	**0.01**	**14.95**	**BDL**	**0.01**	**0.12**	**0.18**	**0.67**	**0.08**	**42.70**	**0.05**	**BDL**	**0.03**	**21.28**	**1.87**	**0.38**	**0.01**
	%RSD	**37**	**9**	**9**	**17**	**7**	**BDL**	**5**	**12**	**29**	**12**	**4**	**8**	**8**	**BDL**	**12**	**8**	**12**	**12**	**4**

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Ni	P	Pb	Pd	Pr	Pt	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	0.2	20	0.02	0.02	0.02	0.004	0.2	0.002	400	0.04	0.2	0.2	0.04	0.2	1	0.1	0.04	0.04	0.2
Sample																				
NK11-010X		214	2.9	13.10	612.80	<0.1	1.7	6.0	2.220	4.99	1.38	2.0	0.2	0.05	21.7	0.67	5	0.14	11.89	34
NK11-020X		172	3.0	12.30	552.10	<0.1	1.6	6.0	2.160	4.44	1.52	2.2	0.2	0.06	22.1	0.69	4	0.14	11.72	32
NK11-029X		206	2.8	13.80	622.20	<0.1	1.7	10.0	2.340	4.98	1.23	1.9	0.1	0.05	20.6	0.62	<2	0.10	11.59	31
NK11-063X		150	2.8	12.50	508.50	<0.1	1.1	6.0	2.030	4.59	1.22	2.0	0.2	0.08	20.6	0.67	7	0.10	10.86	29
NK11-075X		158	2.8	13.80	523.30	<0.1	1.3	5.0	2.040	5.24	1.4	1.9	0.2	0.07	19.7	0.63	7	0.07	10.56	36
	Average	**180**	**2.86**	**13.1**	**563.8**	**BDL**	**1.48**	**6.6**	**2.16**	**4.85**	**1.35**	**2**	**0.17**	**0.062**	**20.9**	**0.66**	**5.75**	**0.11**	**11.3**	**32.4**
	Std. Dev	**28.64**	**0.09**	**0.70**	**51.59**	**BDL**	**0.27**	**1.95**	**0.13**	**0.33**	**0.13**	**0.11**	**0.02**	**0.01**	**0.96**	**0.03**	**1.50**	**0.03**	**0.58**	**2.70**
	%RSD	**16**	**3**	**5**	**9**	**BDL**	**18**	**30**	**6**	**7**	**9**	**5**	**13**	**21**	**5**	**5**	**26**	**27**	**5**	**8**

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
	Unit	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	MDL	20	0.04	0.04	0.2	4	0.2	0.02	0.04	0.2	0.2
Sample											
NK11-010X		0.26	774	0.3	30.6	0.38	0.1	0.95	7.78	6.9	0.59
NK11-020X		0.25	726	0.3	29.0	0.40	0.1	0.83	8.06	5.1	0.53
NK11-029X		0.24	713	0.3	28.4	0.38	0.1	0.90	7.57	4.6	0.51
NK11-063X		0.22	708	0.3	27.2	0.37	0.1	0.67	7.21	4.1	0.42
NK11-075X		0.23	739	0.3	26.1	0.38	0.1	0.76	7.44	5.1	0.43
	Average	**0.24**	**732**	**0.3**	**28.3**	**0.38**	**0.1**	**0.82**	**7.61**	**5.2**	**0.50**
	Std. Dev	**0.02**	**26.39**	**0.00**	**1.72**	**0.01**	**0.01**	**0.11**	**0.32**	**1.06**	**0.07**
	%RSD	**7**	**4**	**0**	**6**	**3**	**8**	**14**	**4**	**20**	**14**

APPENDIX A4 - Norway Spruce Ashed Weight to Dry Weight conversions

Sample_ID	sample weight (g)	ash weight	ash yield	ash yield (%)	Ag_dry	Ag_PPM	Al_dry	Al_PPM	As_dry	As_PPM	Au_dry	Au_PPM	B_dry	B_PPM
NK11-001	31.9	0.62	0.019	1.94	0.0083	0.43	30.6	1573.05	0.12	6.06	0.00013	0.01	4.8	247.10
NK11-003	16.22	0.47	0.029	2.90	0.0113	0.39	36.6	1262.83	0.20	6.77	0.00005	0.00	10.3	356.18
NK11-004	19.56	0.55	0.028	2.81	0.0058	0.21	32.3	1148.42	0.25	8.91	0.00009	0.00	7.0	250.56
NK11-005	20.22	0.49	0.024	2.42	0.0049	0.20	31.8	1310.71	0.17	7.06	0.00009	0.00	7.1	294.51
NK11-006	17.37	0.48	0.028	2.76	0.0123	0.44	61.9	2239.71	0.15	5.35	0.00006	0.00	9.5	345.09
NK11-007	20.68	0.47	0.023	2.27	0.0139	0.61	53.7	2364.11	0.17	7.29	0.00005	0.00	6.6	290.83
NK11-009	29.06	0.68	0.023	2.34	0.0039	0.17	37.2	1588.47	0.16	6.70	0.00002	0.00	5.1	216.06
NK11-010	26.36	0.57	0.022	2.16	0.0165	0.76	54.1	2500.59	0.14	6.43	0.00010	0.00	7.8	358.89
NK11-011	21.97	0.51	0.023	2.32	0.0220	0.95	62.5	2693.90	0.14	5.88	0.00010	0.00	8.0	346.56
NK11-012	26.79	0.68	0.025	2.54	0.0074	0.29	53.0	2086.64	0.14	5.34	0.00003	0.00	7.1	279.06
NK11-013	28.68	0.76	0.026	2.65	0.0152	0.57	36.3	1368.73	0.17	6.23	0.00002	0.00	5.9	223.29
NK11-014	31.04	0.72	0.023	2.32	0.0094	0.40	52.0	2241.56	0.11	4.72	0.00002	0.00	6.7	289.43
NK11-015	29.82	0.76	0.025	2.55	0.0253	0.99	78.6	3083.11	0.21	8.15	0.00005	0.00	9.2	359.09
NK11-016	30.13	0.79	0.026	2.62	0.0089	0.34	68.3	2603.52	0.23	8.80	0.00005	0.00	7.4	283.31
NK11-017	26.08	0.7	0.027	2.68	0.0223	0.83	46.5	1732.72	0.14	5.28	0.00002	0.00	5.9	219.00
NK11-018	26.27	0.75	0.029	2.85	0.0063	0.22	60.5	2118.36	0.25	8.59	0.00001	0.00	7.3	255.95
NK11-019	29	0.73	0.025	2.52	0.0063	0.25	27.5	1092.52	0.19	7.73	0.00001	0.00	6.6	260.53
NK11-020	32.55	0.78	0.024	2.40	0.0107	0.45	69.1	2884.54	0.21	8.81	0.00001	0.00	9.3	386.02
NK11-021	20.97	0.44	0.021	2.10	0.0081	0.39	98.4	4687.51	0.16	7.64	0.00001	0.00	11.0	522.42
NK11-022	22.01	0.64	0.029	2.91	0.0158	0.54	34.8	1198.42	0.28	9.59	0.00008	0.00	9.8	337.12
NK11-023	29.75	0.73	0.025	2.45	0.0044	0.18	32.7	1333.28	0.21	8.66	0.00002	0.00	7.5	305.62
NK11-024	27.99	0.54	0.019	1.93	0.0130	0.68	44.3	2296.37	0.20	10.48	0.00008	0.00	7.7	398.04
NK11-025	27.55	0.67	0.024	2.43	0.0107	0.44	74.6	3065.77	0.21	8.70	0.00005	0.00	7.8	320.18
NK11-026	30.46	0.68	0.022	2.23	0.0080	0.36	49.7	2226.51	0.15	6.76	0.00005	0.00	6.8	306.01
NK11-027	29.3	0.77	0.026	2.63	0.0047	0.18	51.9	1975.66	0.19	7.20	0.00006	0.00	6.1	230.59
NK11-028	28.06	0.68	0.024	2.42	0.0426	1.76	50.6	2086.66	0.27	10.98	0.00007	0.00	10.3	424.61
NK11-029	30.64	0.88	0.029	2.87	0.0072	0.25	34.9	1215.93	0.26	9.02	0.00000	0.00	7.4	257.50
NK11-030	18.77	0.59	0.031	3.14	0.0033	0.11	37.7	1198.47	0.31	9.88	0.00003	0.00	9.7	307.30
NK11-031	13.8	0.44	0.032	3.19	0.0034	0.11	35.4	1108.98	0.30	9.34	0.00008	0.00	9.3	291.89
NK11-032	32.11	1.01	0.031	3.15	0.0076	0.24	55.8	1773.21	0.27	8.70	0.00006	0.00	9.6	305.71
NK11-033	32.52	0.81	0.025	2.49	0.0092	0.37	22.5	903.85	0.23	9.12	0.00005	0.00	9.3	372.45

Sample_ID	sample weight (g)	ash weight	ash yield	ash yield (%)	Ag_dry	Ag_PPM	Al_dry	Al_PPM	As_dry	As_PPM	Au_dry	Au_PPM	B_dry	B_PPM
NK11-034	25.94	0.63	0.024	2.43	0.0065	0.27	42.9	1768.13	0.20	8.18	0.00005	0.00	8.1	334.12
NK11-037	25.29	0.74	0.029	2.93	0.0157	0.54	30.6	1047.33	0.26	9.06	0.00006	0.00	9.5	324.59
NK11-038	32.72	0.86	0.026	2.63	0.0058	0.22	51.1	1945.46	0.25	9.58	0.00005	0.00	7.0	265.71
NK11-041	25.9	0.74	0.029	2.86	0.0116	0.41	24.8	868.81	0.20	7.07	0.00009	0.00	7.1	246.93
NK11-045	35.38	0.89	0.025	2.52	0.0166	0.66	84.0	3337.82	0.27	10.85	0.00006	0.00	7.5	296.67
NK11-046	30.32	0.77	0.025	2.54	0.0076	0.30	32.7	1288.72	0.24	9.36	0.00006	0.00	6.8	268.79
NK11-047	28.65	0.62	0.022	2.16	0.0208	0.96	38.4	1772.25	0.20	9.26	0.00005	0.00	8.0	371.13
NK11-048	27.92	0.59	0.021	2.11	0.0057	0.27	68.1	3223.34	0.13	6.24	0.00003	0.00	7.3	343.45
NK11-052	30.35	1	0.033	3.29	0.0081	0.25	55.0	1669.77	0.16	4.96	0.00011	0.00	6.2	189.05
NK11-053	28.88	0.79	0.027	2.74	0.0127	0.47	85.7	3133.39	0.20	7.43	0.00005	0.00	11.2	408.26
NK11-056	30.93	0.82	0.027	2.65	0.0060	0.23	29.3	1104.99	0.23	8.54	0.00006	0.00	8.4	315.45
NK11-058	32.33	0.95	0.029	2.94	0.0117	0.40	41.6	1415.28	0.24	8.17	0.00006	0.00	5.9	202.09
NK11-059	32.59	1.05	0.032	3.22	0.0130	0.40	41.0	1271.73	0.23	7.16	0.00006	0.00	6.5	202.71
NK11-060	30.41	0.76	0.025	2.50	0.0150	0.60	52.3	2091.41	0.22	8.61	0.00008	0.00	7.8	311.36
NK11-062	23.88	0.6	0.025	2.51	0.0171	0.68	57.2	2277.18	0.11	4.33	0.00004	0.00	6.7	265.05
NK11-063	26.99	0.78	0.029	2.89	0.0060	0.21	53.4	1848.29	0.15	5.09	0.00008	0.00	9.0	309.82
NK11-064	28.06	0.76	0.027	2.71	0.0081	0.30	51.0	1882.66	0.16	5.95	0.00006	0.00	9.7	356.75
NK11-065	26.31	0.74	0.028	2.81	0.0046	0.16	47.7	1696.96	0.17	5.97	0.00004	0.00	8.2	291.78
NK11-066	23.88	0.67	0.028	2.81	0.0048	0.17	32.4	1155.89	0.15	5.35	0.00003	0.00	8.9	317.13
NK11-067	29.63	0.79	0.027	2.67	0.0065	0.24	59.8	2242.21	0.14	5.12	0.00003	0.00	8.6	322.53
NK11-068	31.61	0.76	0.024	2.40	0.0080	0.33	64.3	2673.07	0.28	11.45	0.00012	0.01	8.6	359.56
NK11-069	33.24	0.95	0.029	2.86	0.0066	0.23	46.1	1612.14	0.18	6.42	0.00009	0.00	7.3	256.52
NK11-070	20.29	0.54	0.027	2.66	0.0083	0.31	72.9	2740.34	0.19	7.23	0.00001	0.00	8.4	316.18
NK11-071	27.98	0.84	0.030	3.00	0.0082	0.27	43.9	1462.56	0.21	7.12	0.00000	0.00	8.7	291.17
NK11-074	30.69	0.84	0.027	2.74	0.0127	0.46	99.5	3635.44	0.26	9.37	0.00001	0.00	8.1	297.66
NK11-075	21.73	0.64	0.029	2.95	0.0041	0.14	74.9	2542.14	0.18	6.05	0.00001	0.00	9.3	317.27
NK11-081	31.56	1	0.032	3.17	0.0097	0.31	39.6	1250.52	0.33	10.41	0.00000	0.00	6.5	205.19
NK11-082	30.69	0.82	0.027	2.67	0.0044	0.17	27.7	1035.31	0.32	11.84	0.00000	0.00	9.2	343.49
NK11-083	30.77	0.8	0.026	2.60	0.0117	0.45	49.7	1913.46	0.21	8.14	0.00001	0.00	8.3	319.65

Sample_ID	Ba_dry	Ba_PPM	Be_dry	Be_PPM	Bi_dry	Bi_PPM	Ca_dry	Ca_PPM	Cd_dry	Cd_PPM	Ce_dry	Ce_PPM	Co_dry	Co_PPM	Cr_dry
NK11-001	5.3	274.00	0.0030	0.15	0.0019	0.10	2389	122927.55	0.2916	15.01	0.0658	3.38	0.16	8.39	0.0523
NK11-003	7.4	253.79	0.0011	0.04	0.0019	0.07	3835	132351.55	0.3569	12.32	0.0706	2.44	0.12	4.29	0.0904
NK11-004	10.8	383.09	0.0031	0.11	0.0027	0.10	5140	182808.24	0.1871	6.65	0.1069	3.80	0.11	3.83	0.0918
NK11-005	5.5	226.35	0.0185	0.76	0.0032	0.13	3472	143262.98	0.4243	17.51	0.2837	11.71	0.19	7.80	0.0837
NK11-006	13.4	484.74	0.0075	0.27	0.0024	0.09	2867	103747.78	0.3618	13.09	0.2046	7.41	0.64	23.09	0.0823
NK11-007	3.1	138.31	0.0057	0.25	0.0044	0.19	2940	129365.83	0.4853	21.35	0.1587	6.98	0.19	8.41	0.1233
NK11-009	9.6	410.91	0.0053	0.23	0.0028	0.12	2998	128133.33	0.3065	13.10	0.0924	3.95	0.18	7.80	0.0827
NK11-010	42.2	1952.18	0.0088	0.41	0.0038	0.18	2546	117720.36	0.1812	8.38	0.1297	6.00	0.09	4.23	0.1550
NK11-011	50.8	2188.18	0.0078	0.34	0.0043	0.18	2416	104080.29	0.1997	8.60	0.1891	8.15	0.09	3.84	0.1947
NK11-012	11.8	464.24	0.0074	0.29	0.0031	0.12	2392	94221.84	0.3245	12.78	0.1057	4.16	0.13	5.24	0.0951
NK11-013	15.6	590.43	0.0010	0.04	0.0033	0.13	3014	113742.24	0.1624	6.13	0.1324	5.00	0.07	2.74	0.1110
NK11-014	58.1	2505.02	0.0078	0.34	0.0032	0.14	2107	90853.38	0.1864	8.03	0.1081	4.66	0.13	5.63	0.0892
NK11-015	6.1	237.63	0.0081	0.32	0.0062	0.24	3621	142080.18	0.5285	20.74	0.2420	9.50	0.60	23.54	0.2118
NK11-016	7.8	299.34	0.0038	0.15	0.0055	0.21	4066	155083.54	0.4430	16.89	0.2773	10.58	0.16	6.23	0.1607
NK11-017	8.1	300.02	0.0070	0.26	0.0029	0.11	2432	90605.50	0.2895	10.79	0.0704	2.62	0.13	4.72	0.0858
NK11-018	13.3	466.35	0.0038	0.13	0.0029	0.10	4470	156579.52	0.1967	6.89	0.1616	5.66	0.13	4.67	0.1616
NK11-019	12.0	475.06	0.0100	0.40	0.0027	0.11	3582	142318.47	0.3563	14.15	0.1502	5.97	0.08	3.03	0.0787
NK11-020	6.2	257.81	0.0134	0.56	0.0034	0.14	3912	163241.64	0.1688	7.05	0.1323	5.52	0.54	22.70	0.0992
NK11-021	4.4	209.12	0.0057	0.27	0.0041	0.20	2538	120939.31	0.4278	20.39	0.1010	4.82	0.19	8.94	0.1027
NK11-022	6.4	219.80	0.0029	0.10	0.0038	0.13	4854	166933.75	0.1316	4.53	0.1252	4.31	0.09	2.94	0.1400
NK11-023	4.9	198.21	0.0025	0.10	0.0027	0.11	3842	156560.76	0.2339	9.53	0.0976	3.98	0.21	8.41	0.0820
NK11-024	3.8	195.09	0.0047	0.24	0.0042	0.22	3778	195803.54	0.3082	15.97	0.1810	9.38	0.17	9.02	0.1321
NK11-025	10.7	438.74	0.0068	0.28	0.0033	0.14	3385	139205.90	0.1586	6.52	0.1336	5.49	0.12	4.98	0.1126
NK11-026	47.9	2145.63	0.0023	0.10	0.0031	0.14	2391	107096.97	0.2022	9.06	0.0976	4.37	0.11	4.82	0.1349
NK11-027	44.4	1689.94	0.0063	0.24	0.0030	0.11	3045	115883.50	0.2494	9.49	0.1019	3.88	0.28	10.58	0.0720
NK11-028	4.9	202.40	0.0047	0.19	0.0042	0.17	4667	192574.47	0.5566	22.97	0.1653	6.82	0.16	6.43	0.1531
NK11-029	6.8	235.36	0.0010	0.04	0.0019	0.07	4101	142793.47	0.2976	10.36	0.0783	2.73	0.09	3.12	0.1023
NK11-030	15.7	499.69	0.0045	0.14	0.0017	0.05	5234	166524.32	0.2088	6.64	0.1122	3.57	0.11	3.49	0.1242
NK11-031	7.7	240.21	0.0056	0.17	0.0019	0.06	4797	150459.76	0.2224	6.98	0.1377	4.32	0.11	3.48	0.1219
NK11-032	8.3	265.11	0.0094	0.30	0.0049	0.16	4331	137691.95	0.2708	8.61	0.1995	6.34	0.18	5.74	0.1895
NK11-033	24.5	984.48	0.0024	0.10	0.0023	0.09	3644	146302.68	0.1547	6.21	0.0756	3.04	0.05	1.90	0.0720

Sample_ID	Ba_dry	Ba_PPM	Be_dry	Be_PPM	Bi_dry	Bi_PPM	Ca_dry	Ca_PPM	Cd_dry	Cd_PPM	Ce_dry	Ce_PPM	Co_dry	Co_PPM	Cr_dry
NK11-034	4.1	166.78	0.0145	0.60	0.0027	0.11	3002	123608.64	0.7163	29.49	0.1232	5.07	0.12	4.76	0.1206
NK11-037	6.1	207.85	0.0041	0.14	0.0023	0.08	3840	131239.42	1.2351	42.21	0.1310	4.48	0.11	3.86	0.1290
NK11-038	53.6	2037.41	0.0036	0.14	0.0025	0.09	3707	141053.81	0.7790	29.64	0.1141	4.34	0.11	4.27	0.0776
NK11-041	18.9	661.72	0.0014	0.05	0.0017	0.06	3357	117480.36	0.2359	8.26	0.1116	3.91	0.07	2.38	0.1109
NK11-045	4.9	196.56	0.0132	0.52	0.0069	0.27	3831	152293.41	0.4519	17.96	0.3963	15.75	0.46	18.30	0.2650
NK11-046	6.8	268.32	0.0104	0.41	0.0027	0.11	3511	138233.00	0.3233	12.73	0.2044	8.05	0.34	13.37	0.0663
NK11-047	4.3	198.60	0.0039	0.18	0.0044	0.20	2870	132610.95	0.3105	14.35	0.1821	8.42	0.17	8.01	0.1666
NK11-048	31.2	1475.96	0.0038	0.18	0.0031	0.15	1900	89932.36	0.1175	5.56	0.1171	5.54	0.36	17.20	0.0939
NK11-052	76.3	2317.08	0.0015	0.05	0.0027	0.08	2578	78249.10	0.1776	5.39	0.1419	4.31	0.26	7.74	0.1281
NK11-053	39.3	1435.46	0.0096	0.35	0.0035	0.13	3155	115343.72	0.0695	2.54	0.1683	6.15	0.14	5.09	0.1966
NK11-056	7.2	270.32	0.0026	0.10	0.0027	0.10	3317	125105.73	0.3024	11.40	0.1739	6.56	0.05	1.86	0.1314
NK11-058	65.4	2226.29	0.1618	5.51	0.0028	0.10	3553	120908.24	0.1838	6.25	0.2246	7.64	0.08	2.66	0.1536
NK11-059	18.0	558.55	0.0283	0.88	0.0039	0.12	3642	113056.07	0.2920	9.06	0.3244	10.07	0.08	2.60	0.1805
NK11-060	7.5	299.90	0.0077	0.31	0.0045	0.18	3173	126965.07	0.2271	9.09	0.2191	8.77	0.10	4.07	0.1725
NK11-062	35.4	1409.51	0.0092	0.37	0.0016	0.07	1640	65286.11	0.2296	9.14	0.1688	6.72	0.09	3.78	0.1019
NK11-063	38.3	1325.31	0.0057	0.20	0.0034	0.12	2774	95989.82	0.2996	10.37	0.1455	5.04	0.16	5.51	0.1528
NK11-064	10.7	396.49	0.0121	0.45	0.0022	0.08	2455	90659.19	0.2718	10.04	0.0879	3.24	0.05	1.70	0.0938
NK11-065	83.7	2975.45	0.0056	0.20	0.0026	0.09	2233	79407.34	0.1204	4.28	0.1141	4.06	0.07	2.53	0.1083
NK11-066	66.3	2363.30	0.0041	0.14	0.0025	0.09	2220	79119.42	0.3209	11.44	0.0738	2.63	0.07	2.47	0.0771
NK11-067	77.9	2923.14	0.0137	0.51	0.0029	0.11	2092	78478.82	0.2059	7.72	0.1084	4.07	0.20	7.36	0.1085
NK11-068	6.8	284.17	0.0091	0.38	0.0046	0.19	3544	147407.21	0.1018	4.23	0.1501	6.24	0.28	11.72	0.1241
NK11-069	18.2	636.80	0.0052	0.18	0.0028	0.10	2760	96586.65	0.0938	3.28	0.0939	3.29	0.10	3.53	0.1228
NK11-070	7.7	288.11	0.0028	0.11	0.0035	0.13	2573	96679.93	0.3046	11.45	0.1383	5.20	0.22	8.43	0.1479
NK11-071	15.4	511.33	0.0030	0.10	0.0019	0.06	3183	106008.23	0.2216	7.38	0.0800	2.66	0.16	5.22	0.0670
NK11-074	6.9	251.15	0.0066	0.24	0.0066	0.24	3418	124892.60	0.4662	17.03	0.2835	10.36	0.32	11.82	0.2073
NK11-075	8.6	293.59	0.0112	0.38	0.0030	0.10	2517	85475.59	0.2321	7.88	0.1440	4.89	0.61	20.83	0.1158
NK11-081	48.0	1515.45	0.0047	0.15	0.0023	0.07	4416	139354.39	0.2916	9.20	0.2173	6.86	0.21	6.76	0.1210
NK11-082	8.4	316.20	0.0050	0.19	0.0024	0.09	4000	149723.18	0.1733	6.49	0.1293	4.84	0.06	2.41	0.0852
NK11-083	5.6	214.85	0.0088	0.34	0.0026	0.10	2817	108349.54	0.3486	13.41	0.1202	4.62	0.40	15.42	0.0641

Sample_ID	Cr_PPM	Cs_dry	Cs_PPM	Cu_dry	Cu_PPM	Dy_dry	Dy_PPM	Er_dry	Er_PPM	Eu_dry	Eu_PPM	Fe_dry	Fe_PPM	Ga_dry	Ga_PPM
NK11-001	2.69	0.0144	0.74	5.6364	290.00	0.0038	0.20	0.0015	0.08	0.0008	0.04	34.46	1773.19	0.022	1.11
NK11-003	3.12	0.0351	1.21	4.7546	164.09	0.0039	0.14	0.0011	0.04	0.0002	0.01	42.92	1481.04	0.026	0.91
NK11-004	3.26	0.0220	0.78	4.5616	162.23	0.0053	0.19	0.0020	0.07	0.0007	0.03	46.62	1658.07	0.019	0.67
NK11-005	3.46	0.5518	22.77	4.2530	175.50	0.0196	0.81	0.0107	0.44	0.0020	0.08	51.11	2109.03	0.018	0.76
NK11-006	2.98	0.3232	11.70	4.9722	179.93	0.0139	0.50	0.0087	0.31	0.0015	0.06	54.36	1967.23	0.030	1.08
NK11-007	5.42	0.1501	6.60	4.0593	178.61	0.0085	0.38	0.0054	0.24	0.0010	0.04	58.01	2552.39	0.044	1.95
NK11-009	3.54	0.0977	4.18	4.0340	172.39	0.0043	0.18	0.0026	0.11	0.0021	0.09	45.44	1941.96	0.029	1.26
NK11-010	7.17	0.0946	4.38	3.6529	168.93	0.0090	0.41	0.0057	0.26	0.0028	0.13	53.54	2476.07	0.024	1.11
NK11-011	8.39	0.1030	4.44	4.1497	178.76	0.0118	0.51	0.0073	0.32	0.0041	0.18	67.59	2911.83	0.032	1.38
NK11-012	3.75	0.1552	6.11	3.3325	131.29	0.0050	0.20	0.0029	0.12	0.0008	0.03	41.15	1621.26	0.043	1.69
NK11-013	4.19	0.0408	1.54	4.6397	175.09	0.0097	0.37	0.0051	0.19	0.0023	0.09	59.80	2256.76	0.022	0.84
NK11-014	3.84	0.0263	1.13	3.2001	137.96	0.0084	0.36	0.0045	0.19	0.0029	0.13	50.18	2163.37	0.021	0.91
NK11-015	8.31	0.1194	4.68	4.5661	179.16	0.0122	0.48	0.0063	0.25	0.0020	0.08	94.42	3704.63	0.055	2.15
NK11-016	6.13	0.1003	3.83	4.2586	162.42	0.0317	1.21	0.0154	0.59	0.0029	0.11	93.14	3552.40	0.038	1.44
NK11-017	3.20	0.1079	4.02	3.1420	117.06	0.0033	0.12	0.0017	0.06	0.0003	0.01	39.72	1479.74	0.048	1.78
NK11-018	5.66	0.0164	0.57	3.8237	133.93	0.0105	0.37	0.0059	0.21	0.0018	0.06	63.87	2237.15	0.033	1.15
NK11-019	3.13	0.0630	2.50	3.2477	129.02	0.0081	0.32	0.0040	0.16	0.0007	0.03	49.11	1951.11	0.027	1.09
NK11-020	4.14	0.1522	6.35	4.0938	170.84	0.0066	0.28	0.0029	0.12	0.0012	0.05	50.91	2124.36	0.036	1.48
NK11-021	4.89	0.8493	40.48	4.9589	236.34	0.0048	0.23	0.0030	0.14	0.0012	0.06	55.04	2622.99	0.070	3.34
NK11-022	4.81	0.0621	2.14	4.1037	141.13	0.0068	0.23	0.0040	0.14	0.0006	0.02	58.83	2023.19	0.034	1.17
NK11-023	3.34	0.0945	3.85	3.6681	149.49	0.0043	0.18	0.0029	0.12	0.0016	0.06	52.80	2151.84	0.030	1.21
NK11-024	6.85	0.0490	2.54	4.5689	236.82	0.0083	0.43	0.0044	0.23	0.0021	0.11	66.04	3423.31	0.034	1.76
NK11-025	4.63	0.0722	2.97	3.4274	140.93	0.0063	0.26	0.0022	0.09	0.0016	0.07	56.69	2330.89	0.040	1.66
NK11-026	6.04	0.1047	4.69	3.4811	155.93	0.0045	0.20	0.0027	0.12	0.0002	0.01	59.42	2661.79	0.033	1.47
NK11-027	2.74	0.0757	2.88	3.6677	139.56	0.0046	0.17	0.0014	0.05	0.0011	0.04	44.05	1676.27	0.042	1.62
NK11-028	6.32	0.0271	1.12	4.3187	178.21	0.0079	0.32	0.0041	0.17	0.0012	0.05	79.60	3284.82	0.045	1.84
NK11-029	3.56	0.0303	1.06	5.2469	182.69	0.0032	0.11	0.0019	0.07	0.0007	0.02	47.62	1658.05	0.031	1.07
NK11-030	3.95	0.0133	0.42	3.8365	122.05	0.0046	0.15	0.0024	0.08	0.0008	0.02	44.11	1403.19	0.034	1.07
NK11-031	3.82	0.0138	0.43	4.2409	133.01	0.0042	0.13	0.0019	0.06	0.0005	0.01	44.26	1388.14	0.031	0.98
NK11-032	6.02	0.0362	1.15	4.4570	141.70	0.0124	0.40	0.0053	0.17	0.0025	0.08	76.83	2442.44	0.040	1.26
NK11-033	2.89	0.0586	2.35	3.0579	122.77	0.0053	0.21	0.0023	0.09	0.0002	0.01	33.76	1355.49	0.017	0.70

Sample_ID	Cr_PPM	Cs_dry	Cs_PPM	Cu_dry	Cu_PPM	Dy_dry	Dy_PPM	Er_dry	Er_PPM	Eu_dry	Eu_PPM	Fe_dry	Fe_PPM	Ga_dry	Ga_PPM
NK11-034	4.97	0.0112	0.46	3.3112	136.34	0.0095	0.39	0.0046	0.19	0.0009	0.04	42.99	1770.04	0.022	0.91
NK11-037	4.41	0.0258	0.88	4.2270	144.46	0.0086	0.30	0.0041	0.14	0.0003	0.01	47.53	1624.43	0.024	0.83
NK11-038	2.95	0.0641	2.44	3.7047	140.95	0.0062	0.24	0.0030	0.11	0.0003	0.01	35.58	1353.60	0.022	0.83
NK11-041	3.88	0.0160	0.56	3.4680	121.38	0.0048	0.17	0.0029	0.10	0.0001	0.00	46.20	1616.92	0.018	0.64
NK11-045	10.53	0.0589	2.34	3.4274	136.25	0.0204	0.81	0.0096	0.38	0.0027	0.11	104.08	4137.42	0.040	1.57
NK11-046	2.61	0.1450	5.71	3.4641	136.41	0.0103	0.41	0.0056	0.22	0.0011	0.04	39.96	1573.35	0.021	0.83
NK11-047	7.70	0.0987	4.56	4.0835	188.70	0.0072	0.33	0.0044	0.20	0.0016	0.07	60.65	2802.70	0.029	1.36
NK11-048	4.44	0.1354	6.41	3.0326	143.51	0.0044	0.21	0.0024	0.11	0.0002	0.01	45.17	2137.58	0.029	1.39
NK11-052	3.89	0.0176	0.53	4.5952	139.46	0.0061	0.19	0.0035	0.11	0.0003	0.01	61.94	1879.98	0.025	0.76
NK11-053	7.19	0.0793	2.90	4.5409	166.00	0.0106	0.39	0.0058	0.21	0.0014	0.05	79.88	2920.09	0.030	1.09
NK11-056	4.96	0.0597	2.25	3.3867	127.74	0.0102	0.38	0.0055	0.21	0.0011	0.04	55.19	2081.56	0.021	0.81
NK11-058	5.23	0.0276	0.94	3.9782	135.38	0.0147	0.50	0.0078	0.27	0.0003	0.01	66.97	2278.93	0.028	0.97
NK11-059	5.60	0.4768	14.80	3.7494	116.38	0.0205	0.64	0.0103	0.32	0.0023	0.07	71.01	2204.03	0.025	0.77
NK11-060	6.90	0.0478	1.91	3.6754	147.06	0.0141	0.56	0.0068	0.27	0.0017	0.07	76.58	3064.31	0.031	1.24
NK11-062	4.05	0.1222	4.86	3.1606	125.79	0.0149	0.59	0.0086	0.34	0.0003	0.01	33.49	1332.72	0.023	0.92
NK11-063	5.29	0.1555	5.38	3.8506	133.24	0.0072	0.25	0.0056	0.19	0.0003	0.01	56.07	1940.02	0.042	1.44
NK11-064	3.46	0.0328	1.21	6.3048	232.78	0.0048	0.18	0.0029	0.11	0.0002	0.01	33.20	1225.85	0.023	0.84
NK11-065	3.85	0.1382	4.91	3.7189	132.22	0.0053	0.19	0.0028	0.10	0.0000	0.00	48.50	1724.25	0.040	1.42
NK11-066	2.75	0.0820	2.92	3.2216	114.82	0.0025	0.09	0.0018	0.06	0.0003	0.01	37.24	1327.25	0.039	1.40
NK11-067	4.07	0.7887	29.58	3.3044	123.93	0.0044	0.16	0.0023	0.08	0.0003	0.01	43.75	1641.07	0.027	1.03
NK11-068	5.16	0.3256	13.54	3.6150	150.36	0.0075	0.31	0.0034	0.14	0.0017	0.07	54.33	2259.72	0.027	1.11
NK11-069	4.30	0.0233	0.82	4.7892	167.57	0.0038	0.13	0.0026	0.09	0.0001	0.00	41.84	1463.96	0.029	1.01
NK11-070	5.56	0.0443	1.66	4.2373	159.21	0.0056	0.21	0.0029	0.11	0.0016	0.06	57.47	2159.43	0.039	1.45
NK11-071	2.23	0.0560	1.87	4.3107	143.59	0.0045	0.15	0.0016	0.05	0.0008	0.03	34.31	1142.94	0.037	1.23
NK11-074	7.58	0.0396	1.45	3.7907	138.49	0.0126	0.46	0.0061	0.22	0.0025	0.09	102.56	3747.15	0.048	1.75
NK11-075	3.93	0.0548	1.86	3.3716	114.48	0.0081	0.27	0.0033	0.11	0.0007	0.02	53.39	1812.78	0.040	1.36
NK11-081	3.82	0.0144	0.45	4.0637	128.25	0.0127	0.40	0.0049	0.15	0.0016	0.05	52.27	1649.76	0.027	0.87
NK11-082	3.19	0.0294	1.10	3.4927	130.72	0.0099	0.37	0.0053	0.20	0.0014	0.05	42.05	1573.77	0.019	0.69
NK11-083	2.47	0.1682	6.47	3.8751	149.04	0.0066	0.25	0.0043	0.17	0.0015	0.06	39.76	1529.20	0.028	1.06

Sample_ID	Gd_dry	Gd_PPM	Ge_dry	Ge_PPM	Ho_dry	Ho_PPM	K_dry	K_PPM	La_dry	La_PPM	Li_dry	Li_PPM	Lu_dry	Lu_PPM	Mg_dry
NK11-001	0.005	0.25	0.0031	0.16	0.0007	0.03	3262	167838.36	0.0357	1.84	0.0345	1.77	0.0001	0.01	566
NK11-003	0.005	0.16	0.0046	0.16	0.0004	0.01	4943	170577.44	0.0395	1.36	0.0862	2.98	0.0002	0.01	859
NK11-004	0.010	0.35	0.0036	0.13	0.0013	0.05	3999	142203.26	0.0751	2.67	0.0359	1.28	0.0004	0.02	552
NK11-005	0.023	0.94	0.0030	0.12	0.0037	0.15	3761	155179.33	0.2746	11.33	0.1154	4.76	0.0011	0.04	941
NK11-006	0.009	0.34	0.0046	0.17	0.0028	0.10	4881	176623.18	0.1340	4.85	0.1678	6.07	0.0007	0.02	801
NK11-007	0.009	0.40	0.0036	0.16	0.0020	0.09	3579	157461.04	0.0893	3.93	0.0660	2.91	0.0005	0.02	573
NK11-009	0.006	0.27	0.0043	0.18	0.0010	0.04	3950	168818.50	0.0682	2.91	0.0400	1.71	0.0002	0.01	476
NK11-010	0.011	0.51	0.0042	0.19	0.0016	0.08	3753	173573.07	0.0887	4.10	0.0975	4.51	0.0008	0.04	746
NK11-011	0.014	0.60	0.0052	0.22	0.0026	0.11	4125	177692.62	0.1238	5.33	0.0887	3.82	0.0008	0.04	975
NK11-012	0.007	0.28	0.0050	0.20	0.0013	0.05	5305	208986.60	0.0960	3.78	0.0930	3.66	0.0003	0.01	557
NK11-013	0.011	0.43	0.0030	0.11	0.0017	0.06	4975	187744.75	0.0916	3.46	0.1111	4.19	0.0005	0.02	576
NK11-014	0.009	0.39	0.0048	0.21	0.0013	0.06	4603	198444.18	0.0748	3.22	0.0658	2.84	0.0004	0.02	609
NK11-015	0.015	0.61	0.0056	0.22	0.0029	0.11	3330	130650.19	0.1468	5.76	0.1045	4.10	0.0009	0.04	882
NK11-016	0.023	0.89	0.0035	0.13	0.0061	0.23	3799	144892.05	0.2298	8.77	0.0878	3.35	0.0019	0.07	577
NK11-017	0.004	0.13	0.0049	0.18	0.0006	0.02	5183	193116.13	0.0412	1.53	0.0663	2.47	0.0003	0.01	644
NK11-018	0.010	0.33	0.0048	0.17	0.0023	0.08	4527	158556.24	0.1074	3.76	0.0624	2.19	0.0006	0.02	600
NK11-019	0.009	0.36	0.0044	0.17	0.0015	0.06	4149	164821.54	0.1175	4.67	0.1259	5.00	0.0005	0.02	759
NK11-020	0.007	0.31	0.0040	0.17	0.0013	0.06	3325	138746.80	0.0875	3.65	0.1666	6.95	0.0003	0.01	588
NK11-021	0.006	0.27	0.0037	0.17	0.0009	0.04	3447	164267.52	0.0619	2.95	0.0970	4.62	0.0002	0.01	704
NK11-022	0.010	0.34	0.0049	0.17	0.0014	0.05	4667	160501.28	0.0880	3.03	0.0361	1.24	0.0002	0.01	657
NK11-023	0.007	0.30	0.0047	0.19	0.0009	0.04	4028	164137.38	0.0651	2.65	0.0382	1.56	0.0004	0.02	697
NK11-024	0.010	0.53	0.0028	0.14	0.0016	0.08	2214	114761.59	0.1153	5.98	0.0696	3.61	0.0006	0.03	650
NK11-025	0.006	0.26	0.0026	0.11	0.0012	0.05	3616	148677.75	0.0905	3.72	0.1421	5.84	0.0003	0.01	843
NK11-026	0.007	0.32	0.0039	0.18	0.0010	0.04	3972	177941.54	0.0623	2.79	0.2231	9.99	0.0004	0.02	690
NK11-027	0.006	0.23	0.0034	0.13	0.0008	0.03	4517	171891.82	0.0734	2.79	0.1931	7.35	0.0002	0.01	661
NK11-028	0.009	0.38	0.0039	0.16	0.0015	0.06	2447	100972.91	0.1042	4.30	0.1105	4.56	0.0006	0.02	779
NK11-029	0.005	0.18	0.0037	0.13	0.0008	0.03	4686	163143.58	0.0484	1.69	0.0320	1.11	0.0003	0.01	834
NK11-030	0.006	0.19	0.0042	0.13	0.0008	0.03	4672	148627.98	0.0702	2.23	0.0301	0.96	0.0001	0.00	927
NK11-031	0.007	0.23	0.0037	0.12	0.0009	0.03	5280	165585.31	0.0748	2.35	0.0403	1.26	0.0002	0.01	910
NK11-032	0.018	0.56	0.0040	0.13	0.0021	0.07	4689	149065.34	0.1602	5.09	0.0929	2.95	0.0005	0.02	771
NK11-033	0.005	0.18	0.0016	0.06	0.0007	0.03	4455	178860.06	0.0405	1.62	0.0519	2.08	0.0001	0.00	916

Sample_ID	Gd_dry	Gd_PPM	Ge_dry	Ge_PPM	Ho_dry	Ho_PPM	K_dry	K_PPM	La_dry	La_PPM	Li_dry	Li_PPM	Lu_dry	Lu_PPM	Mg_dry
NK11-034	0.011	0.43	0.0032	0.13	0.0015	0.06	4991	205510.20	0.0745	3.07	0.1189	4.90	0.0002	0.01	821
NK11-037	0.009	0.32	0.0026	0.09	0.0015	0.05	5899	201605.51	0.0817	2.79	0.0982	3.35	0.0003	0.01	851
NK11-038	0.008	0.32	0.0036	0.14	0.0015	0.06	4971	189136.41	0.0742	2.82	0.0359	1.36	0.0002	0.01	670
NK11-041	0.007	0.24	0.0057	0.20	0.0009	0.03	6888	241090.37	0.0677	2.37	0.0290	1.01	0.0001	0.00	617
NK11-045	0.029	1.15	0.0027	0.11	0.0034	0.14	2326	92447.05	0.2363	9.39	0.1070	4.25	0.0008	0.03	661
NK11-046	0.013	0.49	0.0039	0.15	0.0018	0.07	4621	181950.20	0.1434	5.65	0.0587	2.31	0.0005	0.02	677
NK11-047	0.012	0.54	0.0027	0.12	0.0017	0.08	4066	187867.91	0.1009	4.66	0.1093	5.05	0.0004	0.02	634
NK11-048	0.007	0.33	0.0029	0.14	0.0007	0.04	4378	207195.37	0.0708	3.35	0.1230	5.82	0.0002	0.01	818
NK11-052	0.011	0.34	0.0047	0.14	0.0013	0.04	8125	246586.95	0.0777	2.36	0.0559	1.70	0.0003	0.01	631
NK11-053	0.013	0.46	0.0050	0.18	0.0021	0.08	6271	229244.96	0.0993	3.63	0.0990	3.62	0.0005	0.02	746
NK11-056	0.012	0.45	0.0026	0.10	0.0021	0.08	5861	221082.56	0.1204	4.54	0.0521	1.97	0.0003	0.01	536
NK11-058	0.017	0.58	0.0039	0.13	0.0033	0.11	6242	212417.62	0.2213	7.53	0.0559	1.90	0.0006	0.02	575
NK11-059	0.025	0.78	0.0043	0.13	0.0045	0.14	6698	207894.20	0.2644	8.21	0.0577	1.79	0.0010	0.03	746
NK11-060	0.016	0.63	0.0031	0.12	0.0026	0.10	5144	205830.70	0.1486	5.95	0.1197	4.79	0.0005	0.02	661
NK11-062	0.015	0.59	0.0059	0.24	0.0033	0.13	6350	252747.23	0.1418	5.64	0.0308	1.22	0.0008	0.03	867
NK11-063	0.012	0.43	0.0045	0.15	0.0017	0.06	5567	192636.31	0.0833	2.88	0.0577	2.00	0.0005	0.02	657
NK11-064	0.005	0.19	0.0055	0.20	0.0013	0.05	7177	264980.41	0.0554	2.04	0.0502	1.85	0.0003	0.01	566
NK11-065	0.007	0.24	0.0049	0.17	0.0012	0.04	6504	231233.18	0.0643	2.28	0.0814	2.89	0.0004	0.01	615
NK11-066	0.004	0.15	0.0045	0.16	0.0006	0.02	6714	239301.62	0.0434	1.55	0.0297	1.06	0.0002	0.01	695
NK11-067	0.007	0.26	0.0034	0.13	0.0010	0.04	6258	234700.20	0.0656	2.46	0.1359	5.10	0.0002	0.01	867
NK11-068	0.009	0.38	0.0028	0.12	0.0012	0.05	3802	158143.13	0.0897	3.73	0.1276	5.31	0.0003	0.01	1007
NK11-069	0.008	0.26	0.0038	0.13	0.0008	0.03	6562	229610.37	0.0554	1.94	0.0253	0.88	0.0002	0.01	952
NK11-070	0.010	0.37	0.0031	0.12	0.0013	0.05	5977	224589.26	0.0750	2.82	0.0976	3.67	0.0004	0.01	801
NK11-071	0.005	0.17	0.0059	0.20	0.0007	0.02	6365	212017.34	0.0431	1.43	0.0954	3.18	0.0003	0.01	903
NK11-074	0.013	0.49	0.0029	0.11	0.0026	0.09	4753	173651.09	0.1421	5.19	0.0946	3.45	0.0007	0.03	693
NK11-075	0.007	0.24	0.0043	0.15	0.0010	0.04	6430	218309.34	0.0859	2.92	0.1001	3.40	0.0004	0.01	724
NK11-081	0.012	0.38	0.0037	0.12	0.0025	0.08	6320	199470.94	0.1386	4.37	0.0939	2.96	0.0006	0.02	668
NK11-082	0.011	0.43	0.0033	0.12	0.0020	0.08	4806	179863.71	0.0806	3.02	0.0697	2.61	0.0005	0.02	669
NK11-083	0.007	0.26	0.0036	0.14	0.0015	0.06	5258	202244.55	0.0692	2.66	0.1312	5.05	0.0005	0.02	873

Sample_ID	Mg_PPM	Mn_dry	Mn_PPM	Mo_dry	Mo_PPM	Na_dry	Na_PPM	Nb_dry	Nb_PPM	Nd_dry	Nd_PPM	Ni_dry	Ni_PPM	P_dry
NK11-001	29121.43	312	16077.66	0.0187	0.96	63	3219.10	0.0038	0.20	0.03	1.51	1.02	52.27	687
NK11-003	29643.19	272	9388.67	0.0262	0.90	51	1758.26	0.0051	0.18	0.03	0.99	0.71	24.52	1070
NK11-004	19622.93	187	6653.02	0.0343	1.22	99	3521.74	0.0050	0.18	0.04	1.59	0.61	21.53	670
NK11-005	38835.84	113	4672.29	0.0375	1.55	122	5039.32	0.0051	0.21	0.12	4.91	0.61	25.12	629
NK11-006	28982.26	507	18329.17	0.0355	1.28	123	4441.82	0.0055	0.20	0.06	2.34	1.59	57.56	838
NK11-007	25191.82	761	33473.49	0.0415	1.83	63	2751.34	0.0051	0.22	0.05	2.38	0.89	38.99	474
NK11-009	20354.89	334	14286.89	0.0442	1.89	43	1838.57	0.0042	0.18	0.03	1.37	1.09	46.70	675
NK11-010	34492.54	297	13724.10	0.0244	1.13	65	3027.37	0.0047	0.22	0.05	2.23	0.80	36.93	558
NK11-011	41997.41	375	16135.63	0.0304	1.31	83	3562.96	0.0064	0.28	0.08	3.31	0.75	32.11	551
NK11-012	21927.19	888	35002.81	0.0358	1.41	51	2016.41	0.0043	0.17	0.04	1.48	1.53	60.28	672
NK11-013	21750.58	58	2187.58	0.8286	31.27	127	4802.43	0.0054	0.21	0.06	2.33	0.56	21.15	621
NK11-014	26258.84	151	6499.49	0.0235	1.01	47	2025.57	0.0060	0.26	0.05	2.06	1.10	47.59	646
NK11-015	34604.96	911	35749.98	0.0594	2.33	402	15787.78	0.0077	0.30	0.10	3.95	2.11	82.76	550
NK11-016	22006.93	318	12109.36	0.0514	1.96	212	8075.62	0.0088	0.33	0.12	4.55	0.93	35.48	617
NK11-017	23983.25	825	30722.97	0.0316	1.18	51	1908.06	0.0038	0.14	0.03	1.14	1.58	58.99	820
NK11-018	21012.49	248	8670.83	0.0360	1.26	120	4213.08	0.0086	0.30	0.06	2.04	0.86	30.04	645
NK11-019	30147.01	285	11314.11	0.0371	1.47	109	4332.45	0.0054	0.22	0.06	2.37	0.83	33.06	616
NK11-020	24528.05	638	26631.95	0.0372	1.55	172	7163.88	0.0045	0.19	0.05	1.97	2.84	118.35	508
NK11-021	33548.30	1565	74578.35	0.0631	3.01	64	3064.58	0.0052	0.25	0.04	1.82	3.56	169.83	1124
NK11-022	22610.39	216	7432.04	0.0553	1.90	140	4817.81	0.0057	0.20	0.05	1.59	1.00	34.48	747
NK11-023	28385.21	191	7776.47	0.0780	3.18	112	4584.33	0.0050	0.20	0.04	1.55	1.39	56.69	812
NK11-024	33668.72	421	21844.24	0.0471	2.44	109	5671.16	0.0057	0.29	0.07	3.49	1.01	52.54	455
NK11-025	34672.86	653	26844.63	0.0338	1.39	114	4677.66	0.0046	0.19	0.04	1.83	1.52	62.32	510
NK11-026	30907.52	323	14478.77	0.0294	1.32	173	7751.64	0.0063	0.28	0.04	1.86	0.69	30.79	621
NK11-027	25158.31	601	22865.14	0.0476	1.81	61	2328.33	0.0040	0.15	0.03	1.27	2.42	91.93	887
NK11-028	32155.03	544	22439.87	0.0488	2.01	137	5643.44	0.0064	0.26	0.07	2.76	1.06	43.72	572
NK11-029	29033.97	343	11935.98	0.0333	1.16	68	2371.33	0.0057	0.20	0.03	1.12	1.13	39.40	990
NK11-030	29483.20	511	16261.67	0.0293	0.93	76	2431.72	0.0045	0.14	0.04	1.29	0.83	26.41	807
NK11-031	28545.54	441	13833.35	0.0298	0.94	109	3416.33	0.0053	0.17	0.04	1.38	0.87	27.30	831
NK11-032	24503.56	488	15521.40	0.0413	1.31	126	4019.78	0.0056	0.18	0.09	2.87	1.19	37.98	636
NK11-033	36787.62	155	6228.25	0.0485	1.95	63	2541.28	0.0048	0.19	0.03	1.24	0.31	12.45	790

Sample_ID	Mg_PPM	Mn_dry	Mn_PPM	Mo_dry	Mo_PPM	Na_dry	Na_PPM	Nb_dry	Nb_PPM	Nd_dry	Nd_PPM	Ni_dry	Ni_PPM	P_dry
NK11-034	33806.91	345	14201.09	0.0293	1.20	117	4829.32	0.0050	0.21	0.05	2.26	0.59	24.45	733
NK11-037	29068.06	221	7558.89	0.0315	1.08	54	1849.44	0.0055	0.19	0.05	1.73	0.61	21.00	1231
NK11-038	25485.48	481	18317.86	0.0339	1.29	26	984.17	0.0039	0.15	0.04	1.57	0.90	34.35	855
NK11-041	21597.15	124	4340.80	0.1903	6.66	68	2387.89	0.0045	0.16	0.05	1.60	0.32	11.31	751
NK11-045	26258.95	338	13448.65	0.0638	2.54	258	10243.88	0.0072	0.29	0.16	6.28	1.33	52.77	533
NK11-046	26651.26	381	15003.57	0.0364	1.43	89	3510.67	0.0034	0.13	0.07	2.88	0.83	32.80	783
NK11-047	29311.76	378	17480.50	0.0452	2.09	96	4413.96	0.0053	0.25	0.07	3.40	0.60	27.51	574
NK11-048	38693.23	650	30755.18	0.0355	1.68	109	5177.00	0.0048	0.23	0.04	2.00	1.51	71.33	864
NK11-052	19137.82	158	4787.85	0.0518	1.57	124	3767.15	0.0082	0.25	0.06	1.83	0.95	28.74	1088
NK11-053	27279.28	106	3875.92	0.0828	3.03	176	6447.56	0.0084	0.31	0.08	2.85	0.52	19.18	826
NK11-056	20227.16	90	3404.51	0.4814	18.16	55	2069.73	0.0061	0.23	0.08	2.95	0.73	27.46	734
NK11-058	19571.21	147	5002.57	0.1326	4.51	171	5822.87	0.0074	0.25	0.10	3.44	0.88	29.85	956
NK11-059	23153.26	172	5327.60	0.1093	3.39	102	3169.45	0.0064	0.20	0.14	4.22	0.70	21.82	684
NK11-060	26444.83	265	10622.55	0.0507	2.03	102	4084.43	0.0072	0.29	0.09	3.63	0.61	24.44	701
NK11-062	34522.49	454	18084.39	0.0277	1.10	43	1704.47	0.0049	0.20	0.06	2.44	1.88	74.67	928
NK11-063	22744.21	1449	50133.86	0.0431	1.49	90	3105.31	0.0070	0.24	0.06	1.98	0.95	32.80	1056
NK11-064	20912.22	515	19029.35	0.0284	1.05	28	1038.33	0.0040	0.15	0.03	1.18	1.14	42.06	1101
NK11-065	21862.17	970	34473.36	0.0424	1.51	93	3313.22	0.0049	0.18	0.04	1.57	0.92	32.73	1190
NK11-066	24785.82	992	35358.47	0.0437	1.56	42	1485.51	0.0051	0.18	0.03	0.98	0.93	33.04	1517
NK11-067	32500.81	527	19776.89	0.0325	1.22	71	2649.40	0.0050	0.19	0.04	1.38	1.60	59.95	1178
NK11-068	41899.77	311	12943.60	0.0445	1.85	57	2350.58	0.0061	0.26	0.06	2.48	0.90	37.27	869
NK11-069	33307.91	295	10337.05	0.0345	1.21	98	3438.69	0.0062	0.22	0.04	1.29	1.96	68.71	1556
NK11-070	30079.45	614	23070.46	0.0404	1.52	109	4110.12	0.0071	0.27	0.05	1.94	1.28	48.15	1288
NK11-071	30071.05	979	32606.20	0.0352	1.17	131	4379.84	0.0040	0.13	0.03	1.02	1.65	54.79	1399
NK11-074	25327.38	679	24801.08	0.0633	2.31	245	8967.73	0.0104	0.38	0.11	3.92	1.44	52.49	783
NK11-075	24577.92	1088	36935.22	0.0464	1.58	101	3424.97	0.0059	0.20	0.06	1.90	1.54	52.27	977
NK11-081	21084.40	400	12618.41	0.0337	1.06	187	5901.58	0.0057	0.18	0.08	2.47	0.90	28.47	734
NK11-082	25045.41	131	4911.41	0.0772	2.89	81	3023.60	0.0053	0.20	0.06	2.24	0.30	11.21	702
NK11-083	33579.83	649	24973.17	0.0376	1.45	106	4072.97	0.0043	0.17	0.05	1.79	1.25	48.20	954

Sample_ID	P_PPM	Pb_dry	Pb_PPM	Pr_dry	Pr_PPM	Rb_dry	Rb_PPM	S_dry	S_PPM	Sb_dry	Sb_PPM	Sc_dry	Sc_PPM	Se_dry	Se_PPM
NK11-001	35349.64	0.31	15.89	0.007	0.36	7	365.86	221	11351.67	0.016	0.83	0.015	0.76	0.0066	0.34
NK11-003	36934.87	0.37	12.78	0.007	0.26	12	409.25	366	12639.53	0.015	0.52	0.014	0.47	0.0212	0.73
NK11-004	23825.50	0.49	17.34	0.013	0.45	9	302.33	232	8247.54	0.022	0.79	0.013	0.45	0.0151	0.54
NK11-005	25948.26	0.58	24.02	0.033	1.37	24	990.95	311	12829.56	0.021	0.86	0.018	0.73	0.0140	0.58
NK11-006	30331.62	0.47	16.92	0.020	0.71	40	1442.68	319	11542.67	0.022	0.81	0.019	0.67	0.0139	0.50
NK11-007	20836.44	0.85	37.57	0.017	0.73	14	616.97	451	19832.23	0.024	1.05	0.018	0.81	0.0293	1.29
NK11-009	28828.84	0.48	20.65	0.009	0.41	14	588.91	223	9527.31	0.019	0.80	0.016	0.69	0.0137	0.59
NK11-010	25823.43	0.61	28.15	0.014	0.66	22	997.96	276	12777.04	0.020	0.94	0.020	0.92	0.0199	0.92
NK11-011	23722.71	0.85	36.50	0.020	0.88	22	931.64	265	11412.42	0.027	1.16	0.020	0.87	0.0187	0.81
NK11-012	26463.51	0.62	24.31	0.012	0.47	44	1729.35	277	10924.92	0.018	0.69	0.025	1.00	0.0171	0.67
NK11-013	23418.08	0.35	13.19	0.017	0.66	8	297.45	311	11741.68	0.025	0.95	0.020	0.75	0.0190	0.72
NK11-014	27857.00	0.59	25.23	0.013	0.57	12	506.90	217	9361.36	0.023	0.98	0.019	0.80	0.0159	0.69
NK11-015	21582.92	1.49	58.36	0.028	1.12	19	754.96	306	12022.12	0.058	2.27	0.024	0.96	0.0235	0.92
NK11-016	23534.02	1.09	41.67	0.038	1.43	9	329.75	300	11438.89	0.042	1.59	0.024	0.93	0.0202	0.77
NK11-017	30563.77	0.38	14.09	0.008	0.30	36	1328.17	319	11895.74	0.020	0.74	0.018	0.68	0.0144	0.54
NK11-018	22593.82	0.39	13.62	0.018	0.61	7	243.70	279	9769.50	0.026	0.90	0.021	0.73	0.0170	0.60
NK11-019	24471.12	0.36	14.28	0.019	0.74	18	724.78	269	10669.97	0.020	0.81	0.016	0.63	0.0156	0.62
NK11-020	21202.54	0.90	37.73	0.014	0.57	19	790.66	299	12456.75	0.030	1.27	0.014	0.60	0.0239	1.00
NK11-021	53562.33	0.58	27.80	0.011	0.53	74	3526.21	373	17783.80	0.028	1.35	0.017	0.81	0.0141	0.67
NK11-022	25704.64	0.59	20.22	0.015	0.53	11	369.91	366	12586.50	0.028	0.95	0.015	0.51	0.0205	0.70
NK11-023	33097.39	0.46	18.77	0.011	0.43	11	429.91	377	15353.18	0.024	0.97	0.015	0.61	0.0149	0.61
NK11-024	23567.58	0.80	41.42	0.020	1.03	7	380.22	223	11541.02	0.031	1.59	0.018	0.92	0.0201	1.04
NK11-025	20959.18	0.61	25.16	0.013	0.55	33	1361.63	253	10384.67	0.022	0.89	0.019	0.78	0.0108	0.44
NK11-026	27828.02	0.30	13.27	0.011	0.51	22	987.50	263	11782.19	0.026	1.14	0.020	0.89	0.0095	0.42
NK11-027	33740.53	0.43	16.48	0.009	0.36	26	976.47	343	13044.24	0.017	0.64	0.014	0.52	0.0124	0.47
NK11-028	23590.96	0.91	37.48	0.019	0.77	7	269.18	291	11994.29	0.040	1.65	0.015	0.63	0.0210	0.87
NK11-029	34474.07	0.36	12.66	0.008	0.29	18	618.26	354	12309.22	0.021	0.74	0.014	0.49	0.0123	0.43
NK11-030	25686.21	0.22	7.03	0.012	0.37	7	222.18	369	11725.43	0.017	0.55	0.017	0.53	0.0114	0.36
NK11-031	26057.27	0.25	7.92	0.012	0.37	8	239.32	457	14343.28	0.018	0.57	0.015	0.48	0.0166	0.52
NK11-032	20219.25	0.88	27.91	0.026	0.83	13	416.78	348	11052.21	0.035	1.12	0.023	0.74	0.0271	0.86
NK11-033	31703.83	0.34	13.71	0.008	0.32	8	311.19	241	9669.40	0.017	0.68	0.007	0.30	0.0057	0.23

Sample_ID	P_PPM	Pb_dry	Pb_PPM	Pr_dry	Pr_PPM	Rb_dry	Rb_PPM	S_dry	S_PPM	Sb_dry	Sb_PPM	Sc_dry	Sc_PPM	Se_dry	Se_PPM
NK11-034	30186.88	0.47	19.25	0.015	0.60	5	216.48	322	13246.33	0.021	0.85	0.011	0.44	0.0127	0.52
NK11-037	42061.53	0.27	9.30	0.015	0.51	12	421.31	324	11063.91	0.019	0.66	0.015	0.50	0.0159	0.54
NK11-038	32535.17	0.59	22.51	0.011	0.42	26	997.89	267	10171.59	0.018	0.70	0.010	0.38	0.0110	0.42
NK11-041	26277.59	0.28	9.93	0.012	0.42	8	284.92	221	7729.49	0.027	0.94	0.009	0.32	0.0128	0.45
NK11-045	21199.15	1.48	58.90	0.044	1.75	9	343.42	247	9834.18	0.074	2.94	0.021	0.83	0.0196	0.78
NK11-046	30843.67	0.57	22.40	0.022	0.87	17	665.65	217	8543.72	0.031	1.21	0.009	0.36	0.0192	0.76
NK11-047	26508.44	0.83	38.18	0.020	0.92	15	675.30	240	11103.06	0.030	1.39	0.011	0.53	0.0226	1.04
NK11-048	40896.46	0.62	29.12	0.011	0.53	26	1232.22	243	11490.72	0.023	1.09	0.011	0.53	0.0107	0.51
NK11-052	33022.57	0.31	9.34	0.014	0.43	8	255.75	261	7908.25	0.029	0.89	0.015	0.45	0.0090	0.27
NK11-053	30178.68	0.34	12.39	0.019	0.69	12	425.91	255	9334.78	0.034	1.23	0.019	0.69	0.0206	0.75
NK11-056	27669.62	0.37	13.87	0.020	0.75	12	458.94	238	8976.30	0.021	0.79	0.012	0.46	0.0168	0.63
NK11-058	32523.18	0.30	10.15	0.030	1.02	6	201.83	254	8628.49	0.025	0.85	0.014	0.49	0.0180	0.61
NK11-059	21240.89	0.48	14.84	0.037	1.14	22	683.63	265	8234.26	0.027	0.85	0.016	0.48	0.0147	0.46
NK11-060	28047.82	0.56	22.26	0.024	0.98	10	382.76	268	10743.45	0.040	1.60	0.019	0.74	0.0235	0.94
NK11-062	36949.35	0.26	10.28	0.018	0.70	43	1705.89	354	14078.64	0.025	0.99	0.014	0.56	0.0140	0.56
NK11-063	36536.29	0.45	15.41	0.015	0.54	27	928.76	264	9139.45	0.031	1.06	0.018	0.61	0.0147	0.51
NK11-064	40653.58	0.33	12.12	0.008	0.31	18	677.98	253	9327.25	0.021	0.76	0.012	0.44	0.0114	0.42
NK11-065	42311.87	0.33	11.58	0.012	0.41	34	1209.08	276	9823.68	0.023	0.81	0.014	0.51	0.0075	0.27
NK11-066	54083.63	0.29	10.25	0.007	0.26	39	1385.43	311	11085.03	0.024	0.86	0.011	0.38	0.0110	0.39
NK11-067	44167.65	0.44	16.55	0.010	0.37	80	3013.76	225	8438.01	0.025	0.92	0.010	0.39	0.0108	0.41
NK11-068	36147.26	0.82	34.06	0.016	0.66	17	716.37	255	10599.08	0.030	1.26	0.013	0.52	0.0256	1.06
NK11-069	54429.17	0.35	12.15	0.009	0.33	43	1520.52	249	8717.39	0.021	0.73	0.014	0.48	0.0115	0.40
NK11-070	48378.41	0.56	21.20	0.014	0.52	29	1084.47	271	10200.71	0.037	1.39	0.014	0.51	0.0176	0.66
NK11-071	46603.11	0.33	11.14	0.008	0.27	22	736.29	267	8892.46	0.019	0.62	0.008	0.26	0.0105	0.35
NK11-074	28602.66	0.99	36.29	0.028	1.02	16	593.09	260	9482.87	0.059	2.17	0.020	0.74	0.0194	0.71
NK11-075	33155.25	0.41	13.87	0.015	0.51	27	918.79	279	9480.85	0.025	0.86	0.014	0.49	0.0198	0.67
NK11-081	23179.19	0.31	9.73	0.021	0.68	6	180.16	230	7261.41	0.022	0.70	0.013	0.41	0.0224	0.71
NK11-082	26255.53	0.46	17.19	0.016	0.58	8	297.05	180	6755.30	0.018	0.67	0.007	0.27	0.0132	0.49
NK11-083	36699.74	0.59	22.53	0.012	0.47	32	1214.37	284	10920.64	0.020	0.77	0.011	0.41	0.0145	0.56

Sample_ID	Sm_dry	Sm_PPM	Sn_dry	Sn_PPM	Sr_dry	Sr_PPM	Ta_dry	Ta_PPM	Tb_dry	Tb_PPM	Te_dry	Te_PPM	Th_dry	Th_PPM	Ti_dry
NK11-001	0.0052	0.27	0.066	3.40	16	814.32	0.0006	0.03	0.0006	0.03	0.0009	0.05	0.0053	0.27	5.27
NK11-003	0.0042	0.14	0.090	3.10	19	650.57	0.0001	0.00	0.0007	0.02	0.0018	0.06	0.0066	0.23	7.42
NK11-004	0.0070	0.25	0.128	4.56	28	1002.90	0.0002	0.01	0.0012	0.04	0.0016	0.06	0.0087	0.31	5.38
NK11-005	0.0201	0.83	0.084	3.48	19	798.70	0.0002	0.01	0.0033	0.13	0.0010	0.04	0.0069	0.29	5.77
NK11-006	0.0110	0.40	0.127	4.58	21	762.38	0.0002	0.01	0.0022	0.08	0.0026	0.09	0.0101	0.37	7.16
NK11-007	0.0105	0.46	0.110	4.83	12	539.07	0.0001	0.00	0.0014	0.06	0.0010	0.04	0.0070	0.31	4.85
NK11-009	0.0068	0.29	0.113	4.81	17	736.37	0.0001	0.00	0.0009	0.04	0.0002	0.01	0.0079	0.34	5.37
NK11-010	0.0113	0.52	0.049	2.26	15	680.89	0.0001	0.00	0.0015	0.07	0.0006	0.03	0.0105	0.49	5.55
NK11-011	0.0132	0.57	0.054	2.31	16	690.65	0.0003	0.01	0.0018	0.08	0.0012	0.05	0.0149	0.64	6.07
NK11-012	0.0078	0.31	0.051	2.02	19	753.59	0.0003	0.01	0.0011	0.04	0.0023	0.09	0.0068	0.27	5.70
NK11-013	0.0130	0.49	0.072	2.73	26	986.99	0.0001	0.00	0.0018	0.07	0.0012	0.04	0.0103	0.39	5.96
NK11-014	0.0100	0.43	0.079	3.40	11	483.25	0.0002	0.01	0.0015	0.07	0.0011	0.05	0.0096	0.41	5.93
NK11-015	0.0191	0.75	0.159	6.22	21	835.66	0.0003	0.01	0.0018	0.07	0.0017	0.07	0.0184	0.72	6.63
NK11-016	0.0244	0.93	0.124	4.74	14	551.94	0.0002	0.01	0.0040	0.15	0.0018	0.07	0.0189	0.72	7.02
NK11-017	0.0043	0.16	0.050	1.87	16	598.66	0.0001	0.00	0.0007	0.03	0.0007	0.02	0.0062	0.23	6.39
NK11-018	0.0120	0.42	0.075	2.64	20	687.57	0.0002	0.01	0.0017	0.06	0.0016	0.06	0.0113	0.40	6.14
NK11-019	0.0085	0.34	0.084	3.34	14	573.21	0.0001	0.00	0.0014	0.06	0.0009	0.04	0.0083	0.33	5.57
NK11-020	0.0109	0.45	0.086	3.57	24	999.25	0.0001	0.01	0.0012	0.05	0.0014	0.06	0.0084	0.35	4.83
NK11-021	0.0060	0.29	0.140	6.69	15	694.81	0.0001	0.00	0.0006	0.03	0.0018	0.08	0.0085	0.41	8.42
NK11-022	0.0097	0.33	0.109	3.76	26	893.06	0.0002	0.01	0.0011	0.04	0.0020	0.07	0.0097	0.33	6.44
NK11-023	0.0070	0.28	0.115	4.67	16	663.84	0.0001	0.01	0.0008	0.03	0.0009	0.04	0.0072	0.29	6.25
NK11-024	0.0124	0.64	0.127	6.60	16	850.20	0.0002	0.01	0.0016	0.08	0.0010	0.05	0.0119	0.62	5.13
NK11-025	0.0078	0.32	0.175	7.21	18	760.37	0.0001	0.00	0.0009	0.04	0.0018	0.07	0.0100	0.41	5.31
NK11-026	0.0083	0.37	0.059	2.65	14	617.57	0.0002	0.01	0.0008	0.04	0.0016	0.07	0.0107	0.48	6.61
NK11-027	0.0074	0.28	0.099	3.76	15	561.75	0.0001	0.00	0.0008	0.03	0.0012	0.05	0.0081	0.31	6.45
NK11-028	0.0112	0.46	0.136	5.63	20	840.40	0.0001	0.00	0.0012	0.05	0.0018	0.07	0.0134	0.55	5.63
NK11-029	0.0059	0.20	0.059	2.04	21	722.01	0.0001	0.00	0.0008	0.03	0.0022	0.08	0.0059	0.21	7.69
NK11-030	0.0086	0.27	0.064	2.04	25	798.33	0.0001	0.00	0.0007	0.02	0.0019	0.06	0.0080	0.26	6.33
NK11-031	0.0073	0.23	0.059	1.84	24	747.12	0.0002	0.01	0.0012	0.04	0.0017	0.05	0.0095	0.30	6.72
NK11-032	0.0179	0.57	0.125	3.97	22	698.03	0.0002	0.01	0.0023	0.07	0.0030	0.09	0.0138	0.44	6.62
NK11-033	0.0042	0.17	0.062	2.50	17	668.56	0.0004	0.02	0.0007	0.03	0.0020	0.08	0.0056	0.23	3.84

Sample_ID	Sm_dry	Sm_PPM	Sn_dry	Sn_PPM	Sr_dry	Sr_PPM	Ta_dry	Ta_PPM	Tb_dry	Tb_PPM	Te_dry	Te_PPM	Th_dry	Th_PPM	Ti_dry
NK11-034	0.0081	0.33	0.102	4.20	24	991.20	0.0003	0.01	0.0013	0.05	0.0012	0.05	0.0072	0.30	4.11
NK11-037	0.0103	0.35	0.107	3.67	35	1201.77	0.0002	0.01	0.0013	0.04	0.0029	0.10	0.0096	0.33	5.69
NK11-038	0.0093	0.36	0.054	2.06	20	759.01	0.0001	0.00	0.0013	0.05	0.0028	0.11	0.0066	0.25	3.79
NK11-041	0.0086	0.30	0.097	3.40	23	816.70	0.0001	0.00	0.0010	0.03	0.0035	0.12	0.0094	0.33	4.25
NK11-045	0.0291	1.16	0.157	6.25	22	858.37	0.0001	0.00	0.0037	0.15	0.0024	0.10	0.0219	0.87	5.56
NK11-046	0.0129	0.51	0.076	3.00	19	742.30	0.0001	0.00	0.0016	0.06	0.0022	0.08	0.0062	0.24	3.52
NK11-047	0.0137	0.63	0.148	6.82	18	823.42	0.0002	0.01	0.0015	0.07	0.0022	0.10	0.0108	0.50	3.77
NK11-048	0.0076	0.36	0.059	2.77	13	598.02	0.0001	0.01	0.0009	0.04	0.0013	0.06	0.0082	0.39	4.18
NK11-052	0.0102	0.31	0.119	3.60	16	486.63	0.0003	0.01	0.0010	0.03	0.0015	0.05	0.0123	0.37	5.80
NK11-053	0.0150	0.55	0.049	1.80	10	366.28	0.0003	0.01	0.0018	0.06	0.0010	0.04	0.0133	0.49	6.53
NK11-056	0.0129	0.49	0.043	1.62	26	969.89	0.0001	0.00	0.0015	0.06	0.0025	0.10	0.0096	0.36	4.41
NK11-058	0.0210	0.72	0.091	3.10	21	723.82	0.0002	0.01	0.0032	0.11	0.0021	0.07	0.0150	0.51	5.75
NK11-059	0.0298	0.93	0.052	1.63	26	813.92	0.0001	0.00	0.0038	0.12	0.0008	0.02	0.0135	0.42	4.57
NK11-060	0.0174	0.70	0.156	6.23	16	656.81	0.0001	0.01	0.0020	0.08	0.0025	0.10	0.0167	0.67	5.48
NK11-062	0.0125	0.50	0.043	1.72	11	434.80	0.0003	0.01	0.0023	0.09	0.0005	0.02	0.0053	0.21	4.59
NK11-063	0.0100	0.34	0.101	3.50	15	511.90	0.0002	0.01	0.0013	0.05	0.0017	0.06	0.0118	0.41	5.45
NK11-064	0.0062	0.23	0.087	3.21	14	521.19	0.0001	0.00	0.0009	0.03	0.0010	0.04	0.0056	0.21	4.38
NK11-065	0.0083	0.30	0.069	2.46	13	472.04	0.0001	0.00	0.0008	0.03	0.0018	0.07	0.0098	0.35	5.48
NK11-066	0.0052	0.18	0.124	4.41	9	309.76	0.0002	0.01	0.0006	0.02	0.0011	0.04	0.0076	0.27	5.64
NK11-067	0.0053	0.20	0.073	2.76	16	598.44	0.0001	0.00	0.0010	0.04	0.0027	0.10	0.0087	0.33	4.83
NK11-068	0.0107	0.44	0.081	3.38	20	850.81	0.0000	0.00	0.0012	0.05	0.0016	0.07	0.0119	0.50	4.51
NK11-069	0.0075	0.26	0.092	3.23	16	554.17	0.0001	0.00	0.0007	0.02	0.0008	0.03	0.0097	0.34	6.28
NK11-070	0.0114	0.43	0.077	2.87	16	615.06	0.0002	0.01	0.0011	0.04	0.0018	0.07	0.0121	0.45	5.98
NK11-071	0.0068	0.23	0.119	3.98	16	534.25	0.0000	0.00	0.0007	0.02	0.0021	0.07	0.0062	0.21	5.39
NK11-074	0.0176	0.64	0.213	7.78	23	829.99	0.0002	0.01	0.0021	0.08	0.0012	0.04	0.0254	0.93	7.02
NK11-075	0.0104	0.35	0.149	5.05	17	576.56	0.0001	0.00	0.0012	0.04	0.0013	0.04	0.0123	0.42	4.96
NK11-081	0.0151	0.48	0.104	3.27	23	711.09	0.0001	0.00	0.0023	0.07	0.0012	0.04	0.0127	0.40	4.63
NK11-082	0.0127	0.48	0.095	3.56	52	1938.88	0.0001	0.00	0.0018	0.07	0.0042	0.16	0.0088	0.33	3.60
NK11-083	0.0091	0.35	0.124	4.75	25	973.87	0.0000	0.00	0.0014	0.05	0.0024	0.09	0.0074	0.29	4.31

Sample_ID	Ti_PPM	Tl_dry	Tl_PPM	Tm_dry	Tm_PPM	U_dry	U_PPM	V_dry	V_PPM	W_dry	W_PPM	Y_dry	Y_PPM	Yb_dry	Yb_PPM	Zn_dry
NK11-001	270.93	0.0011	0.05	0.0002	0.01	0.0032	0.16	0.031	1.59	0.019	0.99	0.020	1.01	0.0010	0.05	49
NK11-003	255.90	0.0010	0.03	0.0002	0.01	0.0032	0.11	0.035	1.22	0.016	0.54	0.020	0.69	0.0012	0.04	119
NK11-004	191.44	0.0007	0.03	0.0002	0.01	0.0038	0.14	0.092	3.27	0.024	0.87	0.036	1.28	0.0027	0.10	63
NK11-005	238.07	0.0120	0.50	0.0011	0.05	0.0042	0.17	0.106	4.36	0.029	1.20	0.190	7.85	0.0062	0.26	36
NK11-006	259.01	0.0023	0.08	0.0011	0.04	0.0057	0.21	0.066	2.39	0.020	0.71	0.126	4.54	0.0056	0.20	47
NK11-007	213.28	0.0012	0.05	0.0006	0.02	0.0056	0.25	0.057	2.51	0.017	0.74	0.080	3.50	0.0037	0.16	78
NK11-009	229.33	0.0008	0.04	0.0003	0.01	0.0030	0.13	0.054	2.29	0.012	0.52	0.034	1.46	0.0015	0.06	47
NK11-010	256.82	0.0020	0.09	0.0006	0.03	0.0043	0.20	0.087	4.04	0.024	1.12	0.083	3.82	0.0039	0.18	55
NK11-011	261.30	0.0045	0.19	0.0008	0.04	0.0056	0.24	0.110	4.75	0.030	1.28	0.111	4.79	0.0056	0.24	63
NK11-012	224.53	0.0015	0.06	0.0005	0.02	0.0035	0.14	0.000		0.013	0.53	0.052	2.07	0.0026	0.10	56
NK11-013	224.95	0.0039	0.15	0.0006	0.02	0.0063	0.24	0.119	4.49	0.044	1.67	0.068	2.58	0.0048	0.18	48
NK11-014	255.56	0.0025	0.11	0.0004	0.02	0.0046	0.20	0.097	4.18	0.024	1.05	0.052	2.25	0.0043	0.19	39
NK11-015	260.26	0.0127	0.50	0.0007	0.03	0.0100	0.39	0.190	7.44	0.047	1.85	0.091	3.58	0.0050	0.20	56
NK11-016	267.57	0.0083	0.32	0.0020	0.07	0.0108	0.41	0.226	8.61	0.034	1.30	0.274	10.46	0.0124	0.47	62
NK11-017	238.25	0.0044	0.16	0.0002	0.01	0.0030	0.11	0.007	0.27	0.019	0.70	0.019	0.72	0.0016	0.06	37
NK11-018	215.17	0.0010	0.03	0.0007	0.03	0.0056	0.19	0.095	3.34	0.029	1.01	0.071	2.49	0.0039	0.14	64
NK11-019	221.08	0.0004	0.02	0.0006	0.02	0.0048	0.19	0.076	3.00	0.014	0.55	0.063	2.50	0.0038	0.15	40
NK11-020	201.73	0.0066	0.28	0.0004	0.02	0.0050	0.21	0.110	4.60	0.018	0.77	0.039	1.64	0.0024	0.10	41
NK11-021	401.48	0.0086	0.41	0.0002	0.01	0.0049	0.23	0.000		0.015	0.71	0.028	1.34	0.0017	0.08	78
NK11-022	221.32	0.0031	0.11	0.0004	0.01	0.0059	0.20	0.128	4.40	0.021	0.71	0.041	1.42	0.0026	0.09	46
NK11-023	254.85	0.0015	0.06	0.0003	0.01	0.0042	0.17	0.108	4.40	0.015	0.62	0.031	1.28	0.0018	0.08	35
NK11-024	266.12	0.0030	0.16	0.0004	0.02	0.0057	0.29	0.146	7.55	0.024	1.23	0.056	2.93	0.0035	0.18	44
NK11-025	218.33	0.0070	0.29	0.0005	0.02	0.0047	0.19	0.062	2.55	0.017	0.72	0.037	1.53	0.0022	0.09	60
NK11-026	295.91	0.0068	0.31	0.0004	0.02	0.0051	0.23	0.101	4.53	0.026	1.17	0.030	1.32	0.0027	0.12	49
NK11-027	245.60	0.0064	0.24	0.0002	0.01	0.0035	0.13	0.039	1.49	0.010	0.39	0.029	1.10	0.0025	0.09	43
NK11-028	232.33	0.0105	0.44	0.0003	0.01	0.0069	0.29	0.145	5.99	0.023	0.95	0.049	2.03	0.0023	0.10	72
NK11-029	267.75	0.0021	0.07	0.0003	0.01	0.0037	0.13	0.055	1.92	0.015	0.53	0.022	0.78	0.0012	0.04	74
NK11-030	201.42	0.0009	0.03	0.0003	0.01	0.0040	0.13	0.022	0.69	0.024	0.76	0.028	0.89	0.0023	0.07	45
NK11-031	210.74	0.0005	0.02	0.0003	0.01	0.0043	0.13	0.035	1.08	0.023	0.71	0.031	0.97	0.0026	0.08	44
NK11-032	210.57	0.0021	0.07	0.0005	0.02	0.0066	0.21	0.172	5.48	0.032	1.00	0.077	2.44	0.0043	0.14	46
NK11-033	154.20	0.0000	-	0.0003	0.01	0.0032	0.13	0.104	4.18	0.016	0.66	0.028	1.10	0.0029	0.12	34

Sample_ID	Ti_PPM	Tl_dry	Tl_PPM	Tm_dry	Tm_PPM	U_dry	U_PPM	V_dry	V_PPM	W_dry	W_PPM	Y_dry	Y_PPM	Yb_dry	Yb_PPM	Zn_dry
NK11-034	169.43	0.0000	-	0.0005	0.02	0.0043	0.18	0.126	5.20	0.025	1.02	0.076	3.14	0.0037	0.15	82
NK11-037	194.43	0.0000	-	0.0004	0.01	0.0047	0.16	0.099	3.37	0.025	0.85	0.073	2.48	0.0037	0.13	71
NK11-038	144.21	0.0079	0.30	0.0002	0.01	0.0024	0.09	0.092	3.48	0.013	0.51	0.073	2.77	0.0035	0.13	70
NK11-041	148.59	0.0016	0.06	0.0002	0.01	0.0036	0.13	0.104	3.63	0.029	1.01	0.039	1.35	0.0032	0.11	41
NK11-045	221.05	0.0047	0.19	0.0009	0.03	0.0106	0.42	0.398	15.84	0.051	2.02	0.134	5.33	0.0076	0.30	27
NK11-046	138.65	0.0644	2.54	0.0005	0.02	0.0039	0.15	0.133	5.26	0.017	0.67	0.077	3.03	0.0033	0.13	50
NK11-047	174.41	0.0100	0.46	0.0006	0.03	0.0052	0.24	0.192	8.88	0.022	1.02	0.052	2.40	0.0034	0.16	61
NK11-048	198.02	0.0153	0.73	0.0003	0.01	0.0034	0.16	0.120	5.66	0.017	0.80	0.034	1.59	0.0025	0.12	34
NK11-052	175.91	0.0041	0.12	0.0003	0.01	0.0047	0.14	0.122	3.69	0.055	1.68	0.047	1.43	0.0044	0.14	41
NK11-053	238.56	0.0201	0.74	0.0007	0.03	0.0060	0.22	0.184	6.72	0.058	2.13	0.076	2.78	0.0062	0.23	38
NK11-056	166.37	0.0021	0.08	0.0005	0.02	0.0068	0.26	0.119	4.50	0.036	1.37	0.076	2.88	0.0044	0.16	57
NK11-058	195.85	0.0005	0.02	0.0011	0.04	0.0092	0.31	0.132	4.48	0.032	1.10	0.144	4.89	0.0063	0.21	91
NK11-059	141.89	0.0052	0.16	0.0014	0.04	0.0066	0.20	0.158	4.90	0.047	1.45	0.187	5.81	0.0088	0.27	43
NK11-060	219.40	0.0034	0.14	0.0006	0.02	0.0068	0.27	0.195	7.81	0.043	1.73	0.110	4.41	0.0051	0.20	85
NK11-062	182.87	0.0009	0.03	0.0008	0.03	0.0025	0.10	0.065	2.57	0.014	0.54	0.219	8.70	0.0069	0.28	53
NK11-063	188.49	0.0118	0.41	0.0006	0.02	0.0050	0.17	0.065	2.25	0.038	1.31	0.069	2.38	0.0044	0.15	47
NK11-064	161.64	0.0057	0.21	0.0004	0.02	0.0023	0.08	0.067	2.46	0.010	0.37	0.058	2.12	0.0028	0.10	82
NK11-065	195.00	0.0419	1.49	0.0003	0.01	0.0041	0.15	0.109	3.86	0.033	1.17	0.051	1.83	0.0034	0.12	59
NK11-066	201.05	0.0487	1.74	0.0001	0.00	0.0029	0.10	0.076	2.70	0.013	0.47	0.021	0.74	0.0025	0.09	46
NK11-067	181.08	0.0413	1.55	0.0004	0.01	0.0036	0.13	0.088	3.31	0.019	0.69	0.039	1.47	0.0040	0.15	43
NK11-068	187.45	0.0594	2.47	0.0005	0.02	0.0052	0.22	0.174	7.24	0.023	0.96	0.052	2.16	0.0032	0.13	42
NK11-069	219.65	0.0130	0.46	0.0003	0.01	0.0033	0.11	0.092	3.20	0.025	0.87	0.027	0.96	0.0021	0.08	51
NK11-070	224.64	0.0542	2.04	0.0005	0.02	0.0055	0.21	0.147	5.51	0.023	0.85	0.040	1.51	0.0026	0.10	57
NK11-071	179.42	0.0341	1.13	0.0002	0.01	0.0031	0.10	0.088	2.91	0.014	0.47	0.024	0.80	0.0013	0.04	48
NK11-074	256.38	0.0180	0.66	0.0009	0.03	0.0109	0.40	0.346	12.65	0.119	4.35	0.066	2.43	0.0053	0.19	77
NK11-075	168.37	0.0281	0.95	0.0003	0.01	0.0049	0.17	0.140	4.76	0.045	1.52	0.043	1.46	0.0025	0.09	48
NK11-081	146.19	0.0046	0.15	0.0006	0.02	0.0058	0.18	0.119	3.76	0.047	1.48	0.086	2.71	0.0060	0.19	86
NK11-082	134.82	0.0096	0.36	0.0005	0.02	0.0044	0.16	0.124	4.64	0.026	0.96	0.065	2.43	0.0043	0.16	80
NK11-083	165.92	0.0695	2.67	0.0006	0.02	0.0039	0.15	0.133	5.12	0.021	0.82	0.064	2.48	0.0033	0.13	91

Sample_ID	Zn_PPM	Zr_dry	Zr_PPM
NK11-001	2521.66	0.0010	0.05
NK11-003	4109.91	0.0003	0.01
NK11-004	2245.49	0.0001	0.01
NK11-005	1471.52	0.0001	0.01
NK11-006	1692.40	0.0038	0.14
NK11-007	3437.82	0.0124	0.54
NK11-009	1990.86	0.0001	0.01
NK11-010	2520.78	0.0071	0.33
NK11-011	2723.06	0.0047	0.20
NK11-012	2187.09	0.0021	0.08
NK11-013	1822.84	0.0036	0.14
NK11-014	1698.42	0.0046	0.20
NK11-015	2210.45	0.0048	0.19
NK11-016	2372.08	0.0001	0.01
NK11-017	1366.32	0.0015	0.06
NK11-018	2236.50	0.0001	0.01
NK11-019	1602.05	0.0073	0.29
NK11-020	1694.66	0.0013	0.05
NK11-021	3718.44	0.0012	0.06
NK11-022	1584.22	0.0005	0.02
NK11-023	1431.45	0.0029	0.12
NK11-024	2292.11	0.0013	0.07
NK11-025	2455.49	0.0017	0.07
NK11-026	2192.61	0.0078	0.35
NK11-027	1617.43	0.0001	0.01
NK11-028	2987.24	0.0001	0.01
NK11-029	2567.10	0.0001	0.01
NK11-030	1428.28	0.0036	0.12
NK11-031	1372.29	0.0040	0.12
NK11-032	1461.17	0.0030	0.09
NK11-033	1372.26	0.0001	0.01

Sample_ID	Zn_PPM	Zr_dry	Zr_PPM
NK11-034	3366.84	0.0001	0.01
NK11-037	2414.72	0.0001	0.01
NK11-038	2672.07	0.0001	0.01
NK11-041	1428.50	0.0001	0.01
NK11-045	1066.18	0.0001	0.01
NK11-046	1986.97	0.0001	0.01
NK11-047	2807.95	0.0001	0.01
NK11-048	1598.58	0.0001	0.01
NK11-052	1241.33	0.0002	0.01
NK11-053	1389.47	0.0011	0.04
NK11-056	2144.55	0.0001	0.01
NK11-058	3093.81	0.0142	0.48
NK11-059	1330.82	0.0002	0.01
NK11-060	3408.08	0.0001	0.01
NK11-062	2119.78	0.0001	0.01
NK11-063	1628.58	0.0061	0.21
NK11-064	3034.12	0.0001	0.01
NK11-065	2093.02	0.0001	0.01
NK11-066	1652.15	0.0001	0.01
NK11-067	1617.21	0.0001	0.01
NK11-068	1760.94	0.0001	0.01
NK11-069	1796.88	0.0001	0.01
NK11-070	2160.44	0.0001	0.01
NK11-071	1599.91	0.0002	0.01
NK11-074	2799.31	0.0001	0.01
NK11-075	1641.22	0.0001	0.01
NK11-081	2720.55	0.0002	0.01
NK11-082	2977.04	0.0021	0.08
NK11-083	3516.97	0.0001	0.01

Appendix A5

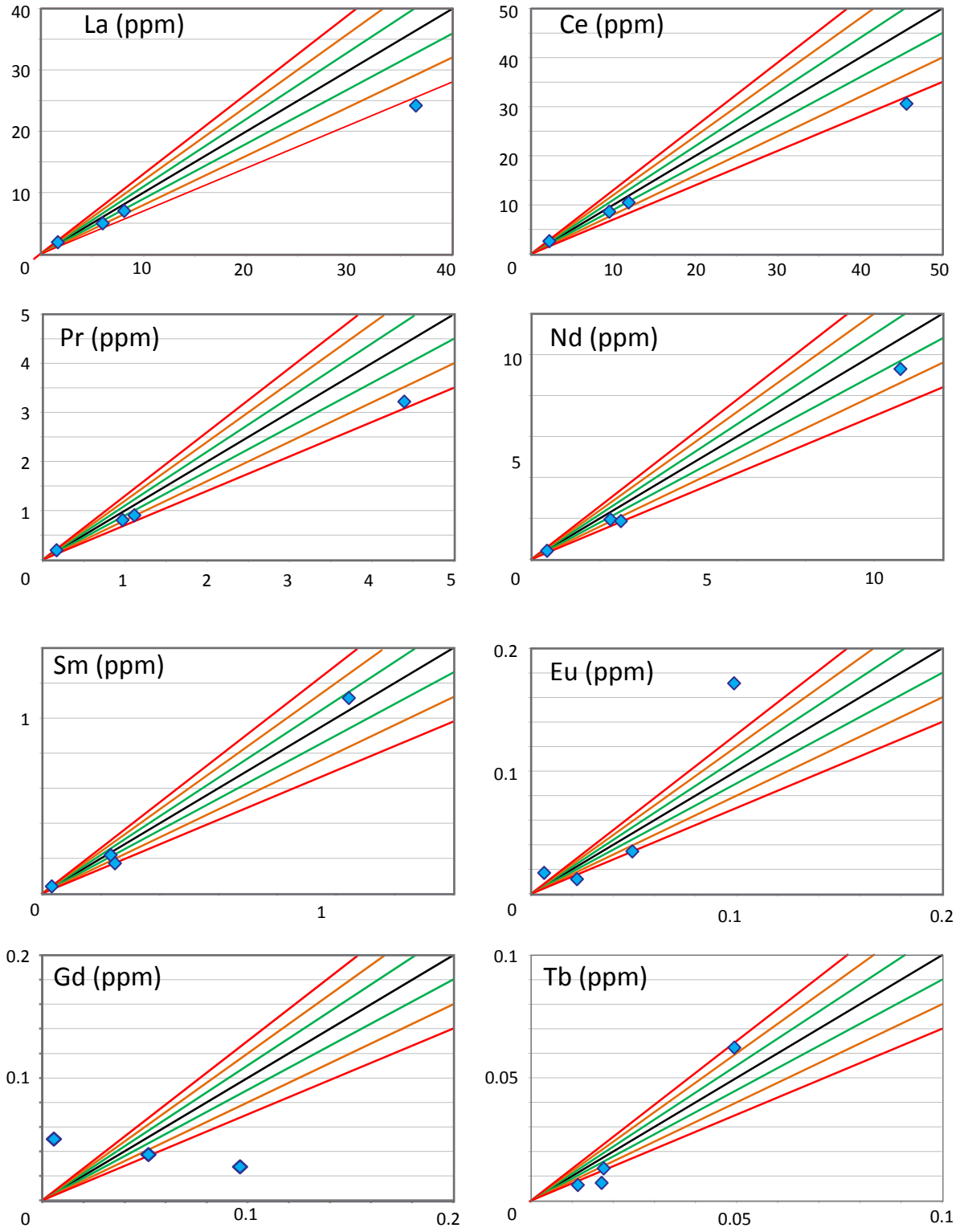
Technical Memo: Element mapping at the Canadian Light Source Synchrotron

Synchrotrons are large scale particle accelerators that emit electromagnetic radiation by accelerating electrons and then bending their trajectory radially using high strength magnets. The emitted electromagnetic radiation is in xray wavelengths, which are directed down a series of beamlines, each with its own specific properties and research applications. The synchrotron at the Canadian Light Source, located in Saskatoon, SK, has 14 different beamlines of varying strengths available for non-destructive testing of a wide range of materials, such as soils, plants, alloys, ceramics, metals, or biological materials. The main application of the synchrotron is to allow scientists to define the structural and chemical properties of a selected materials by examining the spectra resulting from interactions of that material with highly accelerated electrons.

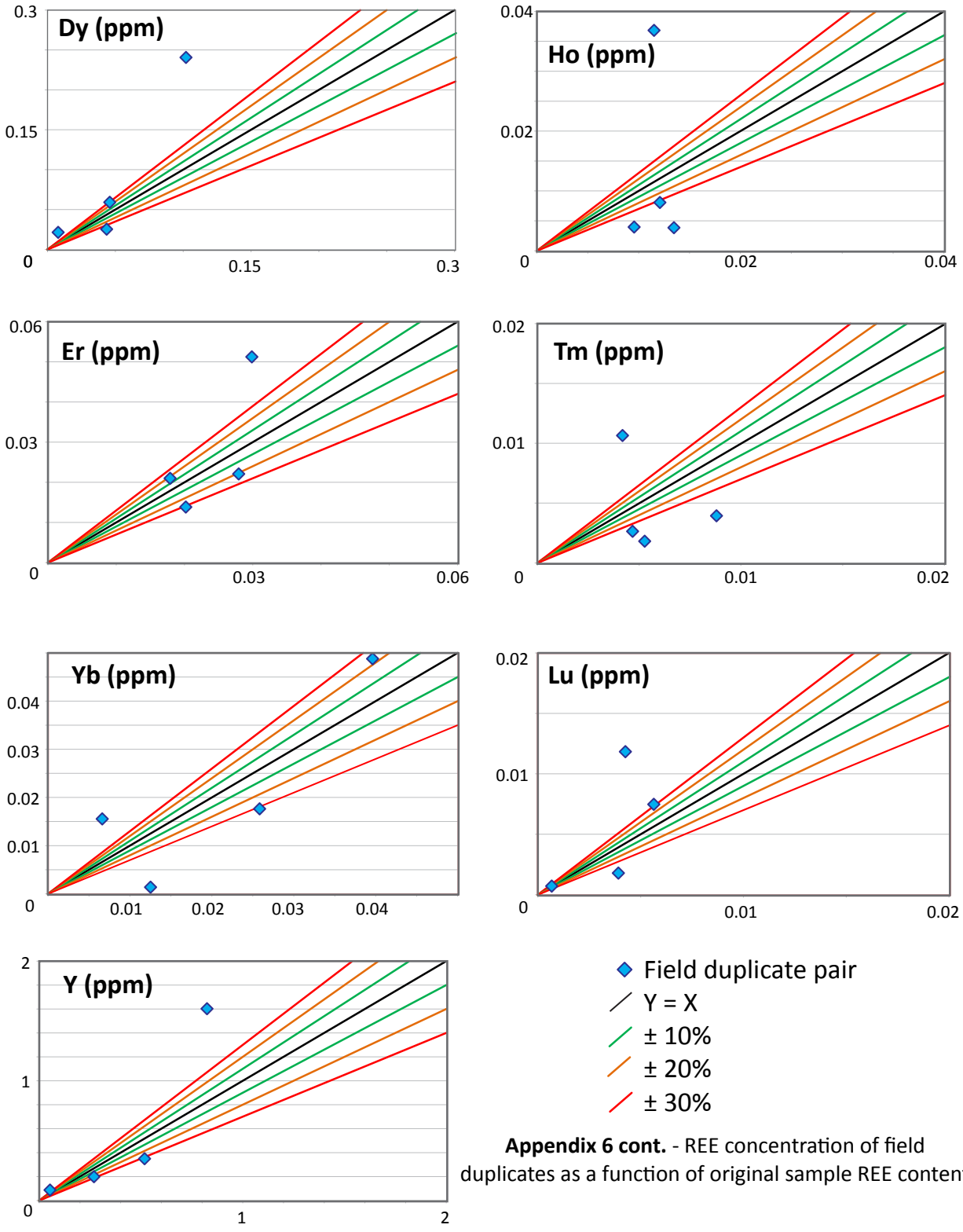
A suite of dry pressed fern samples collected above the Norra Kärr Alkaline Complex were analysed at the synchrotron, on the hard x-ray microanalysis (HXMA) beam, in October 2012, with the aim of mapping the REE variation across the leaf and stem to determine which part of the plant hosted the highest abundance of REEs. With this information, inferences could be made regarding any sequestering or enrichment of REEs within particular parts of the fern plant. Partitioning of certain elements into different parts of a plant structure has been well-documented for several elements, such as Se and Tl (Dunn, 2007), but no work had been undertaken concerning the exact location of REEs within a plant structure.

Since the HXMA beam is equipped with x-ray absorption fine structure (XFAS), microprobe, and x-ray diffraction capabilities, it was chosen as the optimal beam with which to analyse the fern samples. Research was undertaken both with point analysis, using the microprobe, as well as by scanning sections of leaves, such as below spores or at the edges of stems, to determine any variations in element content related to the physiology of the plant. Consideration during analysis was given to plant thickness resulting from plant veinlets or presence of spores.

Unfortunately, due to low REE content, the element mapping was inconclusive. In future synchrotron research, optimization of a specific beamline for REEs should be undertaken prior to analysis.



Appendix 6 - REE concentration of field duplicates as a function of original sample REE content.



Appendix 6 cont. - REE concentration of field duplicates as a function of original sample REE content.

NK12-060 A

NK12-039 A

NK12-072 A

NK12-060 B

NK12-039 B

NK12-072 B

NK12-060 C Upper

NK12-060 C Lower

Appendix 7 - Soil Reference Images

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: February 13, 2013
Report Date: March 29, 2013
Page: 1 of 3

CERTIFICATE OF ANALYSIS VAN13000509.1

CLIENT JOB INFORMATION

Project: NK 2012
Shipment ID:
P.O. Number
Number of Samples: 32

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
SPLP	32	Sorting, labeling and boxing samples received as pulps			VAN
1VE2+REEs	32	Aqua Regia digestion ICP-MS analysis	1	Completed	VAN

SAMPLE DISPOSAL

PICKUP-PLP Client to Pickup Pulps

ADDITIONAL COMMENTS

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

Invoice To: MDRU of UBC
6339 Stores Road
Vancouver BC V6T 1Z4
Canada

CC: Colin Dunn

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
Country Manager - Canada

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK11-021 DFM	Vegetation	0.13	5.65	0.16	41.7	4	2.2	0.18	734	0.008	<0.1	<0.01	<0.2	<0.01	13.4	0.24	0.02	0.03	<2	0.30	0.208
NK11-031 DFM	Vegetation	0.12	8.62	<0.01	54.2	3	1.0	0.28	256	0.011	0.1	<0.01	<0.2	<0.01	19.7	0.08	0.12	<0.02	<2	0.51	0.270
NK11-031 AUG	Vegetation	0.18	6.58	0.10	39.9	3	0.9	0.32	303	0.013	<0.1	<0.01	0.3	<0.01	16.8	0.05	0.03	<0.02	<2	0.43	0.235
NK11-037N DFM	Vegetation	0.12	5.80	<0.01	28.1	4	1.0	0.02	65	0.007	<0.1	<0.01	<0.2	<0.01	18.0	0.04	0.03	<0.02	<2	0.44	0.223
NK11-037N AUG	Vegetation	0.45	4.84	1.08	46.0	6	4.1	0.25	295	0.014	<0.1	0.03	0.2	<0.01	46.5	0.08	0.04	<0.02	<2	1.02	0.208
NK11-037NX	Vegetation	0.46	7.28	0.08	22.5	<2	0.5	0.02	70	0.010	0.1	<0.01	<0.2	<0.01	21.2	0.05	0.03	<0.02	<2	0.37	0.233
NK11-039 DFM	Vegetation	0.20	7.00	1.57	61.3	3	0.6	0.03	130	0.009	<0.1	<0.01	<0.2	<0.01	13.1	0.08	0.03	<0.02	<2	0.36	0.203
NK11-042 DFM	Vegetation	0.16	5.49	<0.01	50.6	4	1.2	0.02	206	0.007	<0.1	<0.01	<0.2	<0.01	10.5	0.07	0.02	<0.02	<2	0.33	0.223
NK11-042 AUG	Vegetation	0.73	5.31	0.09	96.3	8	1.8	0.05	573	0.013	<0.1	0.01	<0.2	<0.01	25.7	0.09	0.02	<0.02	<2	0.76	0.219
NK11-054 AFF	Vegetation	0.69	8.70	0.08	21.1	4	0.5	0.03	61	0.014	<0.1	0.02	<0.2	<0.01	10.5	0.31	0.02	<0.02	<2	0.54	0.114
NK11-060 AFF	Vegetation	0.37	5.50	0.09	13.3	3	0.4	0.02	51	0.009	<0.1	<0.01	<0.2	<0.01	10.3	0.26	0.02	<0.02	<2	0.44	0.108
NK11-060X	Vegetation	0.44	7.06	0.08	22.4	<2	0.5	0.03	68	0.010	<0.1	<0.01	<0.2	<0.01	20.6	0.06	0.03	<0.02	<2	0.37	0.232
NK11-072 DFM	Vegetation	0.09	5.56	0.18	32.6	3	0.8	0.01	134	0.007	0.2	<0.01	<0.2	<0.01	27.3	0.05	0.03	<0.02	<2	0.49	0.207
NK11-072 AUG	Vegetation	0.18	5.60	0.39	33.8	6	0.6	0.03	124	0.010	0.1	<0.01	<0.2	<0.01	45.9	0.03	0.03	<0.02	<2	1.03	0.171
NK12-088 DFM	Vegetation	0.07	3.99	0.03	46.5	3	1.4	0.16	1980	0.006	<0.1	<0.01	<0.2	<0.01	15.4	0.52	0.03	<0.02	<2	0.33	0.162
NK12-017 DFM	Vegetation	0.12	4.74	0.10	62.2	2	0.9	0.18	1311	0.008	<0.1	<0.01	<0.2	<0.01	24.7	0.21	0.03	<0.02	<2	0.53	0.249
NK12-021 DFM	Vegetation	0.08	7.61	0.12	63.0	3	1.6	0.02	529	0.011	0.2	<0.01	<0.2	<0.01	20.3	0.09	0.04	<0.02	<2	0.55	0.218
NK12-021X	Vegetation	0.45	7.51	0.80	23.0	<2	0.6	0.05	70	0.011	0.1	<0.01	<0.2	<0.01	21.3	0.07	0.03	<0.02	<2	0.38	0.239
NK12-034 AFF	Vegetation	1.41	6.32	0.05	18.9	3	0.8	0.06	97	0.012	0.1	<0.01	<0.2	<0.01	17.1	0.11	0.03	<0.02	<2	0.80	0.165
NK12-037 AFF	Vegetation	5.07	5.18	0.27	48.3	5	0.3	0.05	1088	0.007	<0.1	<0.01	<0.2	<0.01	11.0	0.31	0.03	<0.02	<2	0.53	0.151
NK12-039 LEAF	Vegetation	0.25	3.47	2.07	73.3	2	2.2	0.19	956	0.010	<0.1	<0.01	<0.2	<0.01	32.9	0.44	0.03	<0.02	<2	0.47	0.138
NK12-039 STEM	Vegetation	0.04	2.08	3.16	32.6	<2	1.4	0.13	606	0.003	<0.1	<0.01	<0.2	<0.01	25.4	0.36	0.02	<0.02	<2	0.36	0.070
NK12-039 ROOT	Vegetation	0.74	29.30	81.40	45.5	153	5.9	1.28	918	0.321	1.0	0.92	1.0	0.04	8.3	0.91	1.00	0.09	4	0.10	0.074
NK12-039X	Vegetation	0.45	7.31	0.14	22.3	2	0.6	0.06	69	0.013	<0.1	<0.01	115.2	<0.01	21.1	0.06	0.03	<0.02	<2	0.36	0.243
NK12-042 AFF	Vegetation	0.34	3.47	0.13	10.6	9	1.0	0.03	52	0.012	0.1	<0.01	<0.2	<0.01	23.2	0.21	0.05	<0.02	<2	1.09	0.116
NK12-060 LEAF	Vegetation	0.24	4.17	0.55	11.0	12	1.9	0.08	87	0.021	<0.1	0.04	0.8	<0.01	14.7	0.08	0.03	<0.02	<2	0.71	0.118
NK12-060 STEM	Vegetation	0.06	3.05	0.53	11.5	10	0.6	0.03	25	0.004	<0.1	<0.01	<0.2	<0.01	9.7	0.05	0.02	<0.02	<2	0.36	0.044
NK12-060 ROOT	Vegetation	0.41	14.08	37.75	28.3	110	4.2	0.61	73	0.160	0.6	1.52	<0.2	0.18	13.9	0.66	0.17	0.02	3	0.37	0.051
NK12-072 LEAF	Vegetation	0.16	3.80	0.21	51.6	3	0.7	0.02	120	0.009	<0.1	<0.01	<0.2	<0.01	38.3	0.02	0.03	<0.02	<2	0.76	0.121
NK12-072X	Vegetation	0.43	6.99	0.16	21.0	<2	0.6	0.05	68	0.010	0.1	<0.01	<0.2	<0.01	20.7	0.06	0.03	<0.02	<2	0.36	0.234

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK11-021 DFM	Vegetation	2.55	1.2	0.279	46.9	10	9	0.02	0.005	1.72	<0.1	0.2	<0.02	0.17	25	0.3	<0.02	<0.1	4.003	0.02	<0.001
NK11-031 DFM	Vegetation	4.66	1.1	0.332	56.4	14	11	0.02	0.014	2.14	<0.1	0.2	<0.02	0.21	13	0.3	<0.02	<0.1	0.187	0.04	<0.001
NK11-031 AUG	Vegetation	8.39	1.6	0.282	47.9	11	15	0.02	0.008	2.73	<0.1	0.1	<0.02	0.21	23	0.4	<0.02	<0.1	0.293	0.03	0.034
NK11-037N DFM	Vegetation	8.53	1.5	0.264	58.5	10	13	0.02	0.004	1.82	<0.1	0.2	<0.02	0.21	12	0.5	<0.02	<0.1	0.219	<0.01	<0.001
NK11-037N AUG	Vegetation	32.14	3.1	0.421	138.2	11	18	0.09	0.009	1.82	<0.1	0.2	<0.02	0.15	52	0.4	<0.02	<0.1	0.458	0.05	0.176
NK11-037NX	Vegetation	9.65	1.5	0.231	29.3	13	13	0.05	0.020	1.68	<0.1	0.2	<0.02	0.19	38	0.3	<0.02	<0.1	0.032	0.02	<0.001
NK11-039 DFM	Vegetation	13.43	1.3	0.259	49.7	10	11	0.04	0.007	1.65	<0.1	0.1	<0.02	0.18	13	0.4	<0.02	<0.1	0.752	0.03	0.008
NK11-042 DFM	Vegetation	7.75	1.4	0.262	44.8	11	11	0.05	0.010	1.83	<0.1	0.2	<0.02	0.15	20	0.4	<0.02	<0.1	0.045	0.03	0.001
NK11-042 AUG	Vegetation	30.85	1.8	0.316	112.5	10	21	0.17	0.017	2.00	<0.1	0.2	<0.02	0.20	41	0.5	<0.02	<0.1	0.193	0.03	0.021
NK11-054 AFF	Vegetation	26.21	1.3	0.268	80.3	6	18	<0.01	0.033	1.74	<0.1	0.2	<0.02	0.20	18	0.5	<0.02	<0.1	0.455	0.03	<0.001
NK11-060 AFF	Vegetation	44.86	1.4	0.242	71.1	5	16	<0.01	0.026	2.07	<0.1	0.4	0.02	0.17	18	0.3	<0.02	<0.1	0.272	0.03	<0.001
NK11-060X	Vegetation	9.23	1.5	0.232	28.6	13	13	0.05	0.019	1.68	<0.1	0.3	<0.02	0.19	36	0.2	<0.02	<0.1	0.032	0.02	<0.001
NK11-072 DFM	Vegetation	19.26	1.3	0.329	76.4	9	14	0.04	0.011	2.03	0.1	0.2	<0.02	0.18	12	0.4	<0.02	<0.1	2.069	<0.01	0.002
NK11-072 AUG	Vegetation	29.87	1.7	0.331	128.7	8	17	0.08	0.005	1.72	<0.1	0.2	0.04	0.24	72	0.2	<0.02	<0.1	0.553	0.02	0.032
NK12-088 DFM	Vegetation	2.18	1.0	0.282	55.2	7	13	0.03	0.012	1.17	<0.1	0.2	0.05	0.15	31	0.4	<0.02	0.1	3.869	0.02	<0.001
NK12-017 DFM	Vegetation	2.20	1.1	0.384	74.8	11	13	<0.01	0.012	2.36	<0.1	0.2	<0.02	0.16	43	0.3	<0.02	0.1	1.098	0.02	<0.001
NK12-021 DFM	Vegetation	26.35	1.4	0.247	114.7	10	13	0.08	0.004	1.06	<0.1	0.2	<0.02	0.18	23	0.2	<0.02	<0.1	2.091	<0.01	<0.001
NK12-021X	Vegetation	9.70	1.4	0.235	28.8	13	14	0.05	0.020	1.71	<0.1	0.2	<0.02	0.20	37	0.2	<0.02	<0.1	0.031	0.02	0.001
NK12-034 AFF	Vegetation	34.41	1.4	0.286	103.6	8	19	<0.01	0.081	1.92	<0.1	0.1	0.04	0.16	22	0.4	<0.02	<0.1	0.527	0.07	<0.001
NK12-037 AFF	Vegetation	1.73	1.2	0.256	59.8	7	14	<0.01	0.004	1.45	0.2	0.2	<0.02	0.17	23	0.5	<0.02	<0.1	0.460	0.01	<0.001
NK12-039 LEAF	Vegetation	19.70	1.5	0.333	161.9	7	18	0.16	0.012	1.70	<0.1	0.2	<0.02	0.14	48	0.3	<0.02	<0.1	1.491	0.02	0.007
NK12-039 STEM	Vegetation	3.68	1.3	0.215	138.0	3	8	0.01	0.005	3.15	<0.1	0.2	0.02	0.04	2	0.3	<0.02	<0.1	0.892	0.03	0.002
NK12-039 ROOT	Vegetation	24.63	6.7	0.038	114.7	81	5	0.62	0.014	0.14	0.1	0.4	0.21	0.06	134	1.0	<0.02	1.7	0.335	0.18	2.585
NK12-039X	Vegetation	9.55	1.5	0.237	29.0	15	13	0.05	0.020	1.68	<0.1	0.2	<0.02	0.19	37	0.5	<0.02	<0.1	0.030	0.03	<0.001
NK12-042 AFF	Vegetation	70.68	1.2	0.233	106.5	6	16	0.01	0.004	1.71	<0.1	0.3	0.04	0.11	27	0.5	<0.02	<0.1	0.500	0.07	0.004
NK12-060 LEAF	Vegetation	56.47	4.0	0.292	182.4	9	18	0.02	0.101	2.03	<0.1	0.3	0.14	0.09	24	0.3	<0.02	<0.1	0.974	0.06	0.030
NK12-060 STEM	Vegetation	8.49	2.3	0.211	126.1	3	7	<0.01	0.140	2.44	<0.1	0.2	0.25	0.02	8	0.3	<0.02	<0.1	0.423	0.04	0.019
NK12-060 ROOT	Vegetation	35.10	5.8	0.234	35.1	48	5	0.22	0.014	0.44	<0.1	0.5	0.18	0.06	25	0.4	<0.02	0.6	0.286	0.06	0.549
NK12-072 LEAF	Vegetation	35.13	1.5	0.381	93.9	6	20	0.05	0.011	1.88	<0.1	0.1	0.02	0.17	48	0.4	<0.02	<0.1	1.674	0.06	0.012
NK12-072X	Vegetation	9.25	1.6	0.228	28.0	12	13	0.05	0.018	1.64	<0.1	0.2	<0.02	0.17	38	0.4	<0.02	<0.1	0.029	0.05	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK11-021 DFM	Vegetation	<0.01	345.4	0.07	<0.001	0.03	0.097	4.13	<0.02	<1	<0.1	0.09	0.32	0.77	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-031 DFM	Vegetation	<0.01	75.6	0.18	<0.001	0.05	0.231	8.80	<0.02	<1	<0.1	0.21	0.82	2.54	0.19	0.02	0.09	<0.02	0.04	<0.02	0.02
NK11-031 AUG	Vegetation	0.06	86.6	0.05	0.003	1.57	0.591	16.03	<0.02	<1	<0.1	0.16	1.56	4.69	0.51	0.07	0.32	0.03	0.12	<0.02	0.05
NK11-037N DFM	Vegetation	<0.01	129.5	0.04	<0.001	0.04	1.539	12.86	<0.02	<1	<0.1	0.06	1.37	3.73	0.52	0.07	0.29	0.04	0.20	0.05	0.10
NK11-037N AUG	Vegetation	0.35	83.1	0.08	0.011	9.30	4.998	63.34	<0.02	<1	0.2	0.34	4.82	12.31	1.55	0.19	1.17	0.18	0.79	0.15	0.39
NK11-037NX	Vegetation	<0.01	19.5	0.07	<0.001	0.05	4.068	9.89	<0.02	<1	<0.1	0.05	1.97	6.91	1.05	0.30	0.98	0.12	0.56	0.11	0.27
NK11-039 DFM	Vegetation	<0.01	139.6	0.05	0.001	0.17	3.670	29.01	<0.02	<1	<0.1	0.10	2.79	8.14	1.19	0.12	0.72	0.11	0.56	0.13	0.31
NK11-042 DFM	Vegetation	<0.01	73.3	0.05	<0.001	0.03	1.320	13.17	<0.02	<1	<0.1	0.20	1.71	5.10	0.60	0.08	0.39	0.05	0.21	0.03	0.11
NK11-042 AUG	Vegetation	0.05	79.1	0.04	0.002	1.52	6.040	52.18	<0.02	1	0.2	0.54	6.80	21.26	2.79	0.31	1.69	0.24	1.06	0.20	0.44
NK11-054 AFF	Vegetation	<0.01	61.1	0.04	0.001	0.12	1.489	19.49	<0.02	<1	<0.1	0.09	4.24	12.63	1.40	0.13	1.02	0.09	0.28	0.03	0.10
NK11-060 AFF	Vegetation	<0.01	64.9	0.03	0.002	0.04	1.804	39.98	<0.02	<1	<0.1	0.06	7.32	20.65	2.50	0.21	1.28	0.10	0.34	0.04	0.13
NK11-060X	Vegetation	<0.01	18.5	0.05	<0.001	0.04	3.954	9.56	<0.02	<1	<0.1	0.07	1.92	6.55	1.07	0.32	1.11	0.13	0.56	0.11	0.29
NK11-072 DFM	Vegetation	<0.01	188.8	0.03	<0.001	0.08	8.884	28.48	<0.02	<1	<0.1	0.12	4.39	14.78	2.22	0.21	1.45	0.25	1.26	0.27	0.69
NK11-072 AUG	Vegetation	0.03	126.1	0.06	0.004	1.26	7.885	47.21	<0.02	<1	<0.1	0.04	5.41	16.20	2.02	0.24	1.53	0.22	1.02	0.22	0.54
NK12-088 DFM	Vegetation	<0.01	313.0	0.04	<0.001	0.03	0.149	3.36	<0.02	<1	<0.1	0.40	0.33	0.77	0.06	<0.02	0.04	<0.02	0.04	<0.02	<0.02
NK12-017 DFM	Vegetation	<0.01	221.2	0.03	<0.001	0.03	0.073	5.17	<0.02	<1	<0.1	0.25	0.37	0.95	0.06	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
NK12-021 DFM	Vegetation	<0.01	147.8	0.04	<0.001	0.02	1.502	33.54	<0.02	<1	0.1	0.14	3.99	10.26	0.95	0.13	0.56	0.07	0.25	0.04	0.12
NK12-021X	Vegetation	<0.01	19.4	0.05	<0.001	0.03	4.116	10.06	<0.02	<1	<0.1	0.06	2.02	7.36	1.07	0.33	1.09	0.12	0.57	0.11	0.23
NK12-034 AFF	Vegetation	<0.01	79.8	0.03	<0.001	0.13	2.363	27.69	<0.02	<1	<0.1	0.18	5.95	18.91	2.31	0.22	1.22	0.10	0.37	0.05	0.13
NK12-037 AFF	Vegetation	<0.01	52.9	0.05	<0.001	0.07	0.070	2.38	<0.02	<1	<0.1	0.05	0.26	0.72	0.05	<0.02	0.06	<0.02	<0.02	<0.02	<0.02
NK12-039 LEAF	Vegetation	0.03	212.5	0.05	0.002	0.57	19.74	37.41	<0.02	<1	0.5	0.86	3.90	11.46	2.13	0.26	1.94	0.36	2.48	0.54	1.55
NK12-039 STEM	Vegetation	<0.01	281.4	<0.02	<0.001	0.21	1.210	5.44	<0.02	<1	<0.1	0.11	0.47	1.27	0.14	0.05	0.16	0.02	0.17	0.02	0.09
NK12-039 ROOT	Vegetation	8.48	10.9	1.00	0.188	142.3	77.50	74.18	<0.02	1	0.6	1.27	7.32	26.37	7.46	1.09	9.10	2.23	14.82	3.47	9.57
NK12-039X	Vegetation	<0.01	19.6	0.05	<0.001	0.10	3.919	9.84	<0.02	<1	<0.1	0.05	1.98	7.13	1.07	0.31	1.11	0.13	0.56	0.12	0.24
NK12-042 AFF	Vegetation	<0.01	143.4	0.05	<0.001	0.11	9.040	63.39	<0.02	1	0.1	0.06	11.09	34.46	4.73	0.54	2.93	0.29	1.26	0.19	0.47
NK12-060 LEAF	Vegetation	0.15	159.6	0.07	0.001	2.23	4.483	64.21	<0.02	2	0.3	0.27	9.20	23.87	2.53	0.31	1.59	0.21	0.76	0.12	0.36
NK12-060 STEM	Vegetation	0.01	123.5	0.04	0.001	0.58	0.267	6.82	<0.02	<1	<0.1	0.08	0.81	1.80	0.16	0.04	0.09	<0.02	0.06	<0.02	0.02
NK12-060 ROOT	Vegetation	1.51	23.8	0.28	0.031	30.55	40.57	56.46	<0.02	<1	3.4	1.63	10.45	34.96	6.92	0.95	6.97	1.30	7.02	1.45	3.84
NK12-072 LEAF	Vegetation	0.02	138.7	0.04	0.003	0.73	11.43	50.98	<0.02	<1	<0.1	0.09	7.56	23.18	3.38	0.34	2.59	0.38	2.02	0.38	0.89
NK12-072X	Vegetation	<0.01	19.2	0.04	<0.001	0.04	4.009	9.39	<0.02	<1	<0.1	0.04	1.85	6.59	0.99	0.32	1.04	0.11	0.51	0.12	0.28

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.02	0.02	0.02	2	1
NK11-021 DFM	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK11-031 DFM	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK11-031 AUG	Vegetation	<0.02	0.05	<0.02	<2	<1
NK11-037N DFM	Vegetation	<0.02	0.07	<0.02	<2	<1
NK11-037N AUG	Vegetation	0.05	0.29	0.04	<2	<1
NK11-037NX	Vegetation	0.04	0.11	<0.02	<2	<1
NK11-039 DFM	Vegetation	0.04	0.19	0.02	<2	<1
NK11-042 DFM	Vegetation	<0.02	0.04	<0.02	<2	<1
NK11-042 AUG	Vegetation	0.05	0.27	0.03	<2	<1
NK11-054 AFF	Vegetation	<0.02	0.06	<0.02	<2	<1
NK11-060 AFF	Vegetation	<0.02	0.06	<0.02	<2	<1
NK11-060X	Vegetation	0.03	0.15	<0.02	<2	<1
NK11-072 DFM	Vegetation	0.08	0.37	0.05	<2	<1
NK11-072 AUG	Vegetation	0.06	0.29	0.04	<2	<1
NK12-088 DFM	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK12-017 DFM	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK12-021 DFM	Vegetation	<0.02	0.07	<0.02	<2	<1
NK12-021X	Vegetation	0.02	0.13	<0.02	<2	<1
NK12-034 AFF	Vegetation	<0.02	0.08	<0.02	<2	<1
NK12-037 AFF	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK12-039 LEAF	Vegetation	0.21	0.93	0.12	<2	<1
NK12-039 STEM	Vegetation	<0.02	0.05	<0.02	<2	<1
NK12-039 ROOT	Vegetation	1.57	8.36	1.09	142	<1
NK12-039X	Vegetation	0.02	0.09	<0.02	<2	<1
NK12-042 AFF	Vegetation	0.05	0.27	0.03	<2	<1
NK12-060 LEAF	Vegetation	0.04	0.19	0.02	<2	<1
NK12-060 STEM	Vegetation	<0.02	0.02	<0.02	<2	<1
NK12-060 ROOT	Vegetation	0.59	3.22	0.43	21	<1
NK12-072 LEAF	Vegetation	0.10	0.51	0.04	<2	<1
NK12-072X	Vegetation	0.02	0.09	<0.02	<2	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK12-072 STEM	Vegetation	0.03	2.32	0.18	23.2	<2	0.5	0.02	37	0.003	<0.1	<0.01	0.3	<0.01	21.4	0.02	0.02	<0.02	<2	0.36	0.054
NK12-072 ROOT	Vegetation	0.21	37.21	6.92	35.1	23	2.5	0.30	937	0.061	0.1	0.18	0.7	<0.01	30.9	0.46	0.20	0.03	2	0.48	0.051

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK12-072 STEM	Vegetation	3.84	1.2	0.195	62.1	3	9	<0.01	0.010	3.10	<0.1	0.1	0.04	0.02	6	0.2	<0.02	<0.1	1.126	0.02	0.008
NK12-072 ROOT	Vegetation	14.93	3.6	0.096	130.9	19	7	0.20	0.008	0.15	<0.1	0.2	0.15	0.05	55	0.4	<0.02	1.2	0.256	0.09	1.215

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK12-072 STEM	Vegetation	<0.01	197.9	0.04	<0.001	0.36	0.497	4.41	<0.02	<1	<0.1	0.06	0.56	1.43	0.21	0.04	0.16	<0.02	0.12	<0.02	0.05
NK12-072 ROOT	Vegetation	2.00	10.8	0.29	0.063	66.77	11.57	24.66	<0.02	<1	0.2	0.51	3.08	9.71	1.90	0.23	1.65	0.33	2.13	0.45	1.22

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

CERTIFICATE OF ANALYSIS VAN13000509.1

		Method	1VE	1VE	1VE	1VE	1VE
		Analyte	Tm	Yb	Lu	Pd	Pt
		Unit	ppm	ppm	ppm	ppb	ppb
		MDL	0.02	0.02	0.02	2	1
NK12-072 STEM	Vegetation		<0.02	0.02	<0.02	<2	<1
NK12-072 ROOT	Vegetation		0.18	1.08	0.13	14	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

QUALITY CONTROL REPORT VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
Pulp Duplicates																					
NK11-060 AFF	Vegetation A	0.37	5.50	0.09	13.3	3	0.4	0.02	51	0.009	<0.1	<0.01	<0.2	<0.01	10.3	0.26	0.02	<0.02	<2	0.44	0.108
REP NK11-060 AFF	QC	0.37	5.41	0.12	12.3	3	0.4	0.02	51	0.008	0.1	<0.01	<0.2	<0.01	10.2	0.28	0.02	<0.02	<2	0.43	0.108
Reference Materials																					
STD CDV-1	Standard	0.20	7.55	0.97	20.3	8	6.7	1.81	386	0.295	1.3	0.15	2.7	0.60	107.6	0.03	0.04	0.02	7	1.80	0.039
STD V16	Standard	1.62	6.10	2.70	34.1	28	8.5	1.10	705	0.467	1.6	<0.01	1.0	<0.01	10.7	0.09	0.08	<0.02	<2	0.29	0.048
STD V16 Expected		1.6	6.69	3	39.2	32	7.4	1.11	720	0.4125	1.6		0.9		11.2	0.086	0.07			0.3	0.0488
STD CDV-1 Expected		0.2	8.61	1.33	23.3	9	6.4	2	413	0.256	1.3	0.17	2.3	0.61	122	0.04	0.03	0.02	4.2	1.94	0.04
BLK	Blank	<0.01	<0.01	<0.01	0.4	<2	<0.1	<0.01	<1	<0.001	<0.1	<0.01	<0.2	<0.01	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001
BLK	Blank	<0.01	<0.01	<0.01	0.2	<2	<0.1	<0.01	<1	<0.001	<0.1	<0.01	<0.2	<0.01	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

QUALITY CONTROL REPORT VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
Pulp Duplicates																					
NK11-060 AFF	Vegetation A	44.86	1.4	0.242	71.1	5	16	<0.01	0.026	2.07	<0.1	0.4	0.02	0.17	18	0.3	<0.02	<0.1	0.272	0.03	<0.001
REP NK11-060 AFF	QC	45.00	1.5	0.239	70.4	5	14	<0.01	0.026	2.09	<0.1	0.3	0.02	0.17	20	0.3	<0.02	<0.1	0.265	0.03	<0.001
Reference Materials																					
STD CDV-1	Standard	2.28	12.7	0.122	9.1	29	11	0.14	0.005	0.17	<0.1	0.8	<0.02	0.10	40	0.6	0.02	0.6	0.126	0.03	0.060
STD V16	Standard	0.04	325.9	0.054	2.0	11	4	0.04	0.002	0.23	<0.1	0.2	<0.02	0.04	46	0.3	<0.02	0.2	0.038	0.05	0.005
STD V16 Expected		0.05	323.1	0.0525	1.9	12	5	0.0454	0.0015	0.22				0.0177	41			0.2	0.036	0.05	0.006
STD CDV-1 Expected		2.31	12.1	0.131	8.5	30	12	0.15	0.006	0.18		0.7		0.1	41	0.3	0.04	0.6	0.121	0.03	0.046
BLK	Blank	<0.01	0.1	<0.001	0.1	<1	<1	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.01	2	<0.1	<0.02	<0.1	<0.005	0.01	<0.001
BLK	Blank	<0.01	0.2	<0.001	0.1	<1	<1	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.01	<1	<0.1	<0.02	<0.1	<0.005	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

QUALITY CONTROL REPORT VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Pulp Duplicates																					
NK11-060 AFF	Vegetation A	<0.01	64.9	0.03	0.002	0.04	1.804	39.98	<0.02	<1	<0.1	0.06	7.32	20.65	2.50	0.21	1.28	0.10	0.34	0.04	0.13
REP NK11-060 AFF	QC	<0.01	65.0	0.03	<0.001	0.02	1.799	40.66	<0.02	<1	<0.1	0.04	7.48	21.00	2.34	0.24	1.17	0.10	0.31	0.06	0.11
Reference Materials																					
STD CDV-1	Standard	0.06	2.6	0.08	0.001	1.50	1.535	4.95	<0.02	<1	<0.1	0.60	0.71	2.47	0.50	0.10	0.42	0.06	0.28	0.06	0.15
STD V16	Standard	0.10	1.7	0.23	0.001	0.17	0.043	0.11	<0.02	<1	<0.1	0.10	<0.02	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
STD V16 Expected		0.11	1.7	0.23		0.18	0.043	0.1				0.07									
STD CDV-1 Expected		0.06	2.6	0.08		1.29	1.41	4.35				0.56									
BLK	Blank	<0.01	<0.1	0.03	<0.001	<0.01	<0.001	<0.01	<0.02	<1	<0.1	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
BLK	Blank	<0.01	<0.1	<0.02	<0.001	0.03	<0.001	<0.01	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **MDRU of UBC**
6339 Stores Road
Vancouver BC V6T 1Z4 Canada

Project: NK 2012
Report Date: March 29, 2013

QUALITY CONTROL REPORT VAN13000509.1

	Method	1VE	1VE	1VE	1VE	1VE
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.02	0.02	0.02	2	1
Pulp Duplicates						
NK11-060 AFF	Vegetation A	<0.02	0.06	<0.02	<2	<1
REP NK11-060 AFF	QC	<0.02	0.07	<0.02	<2	<1
Reference Materials						
STD CDV-1	Standard	0.02	0.13	<0.02	<2	<1
STD V16	Standard	<0.02	<0.02	<0.02	<2	<1
STD V16 Expected						
STD CDV-1 Expected						
BLK	Blank	<0.02	<0.02	<0.02	<2	<1
BLK	Blank	<0.02	<0.02	<0.02	<2	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: December 20, 2012
Report Date: April 05, 2013
Page: 1 of 2

CERTIFICATE OF ANALYSIS VAN12005934.2

CLIENT JOB INFORMATION

Project: NKA-2012
Shipment ID:
P.O. Number
Number of Samples: 30

SAMPLE DISPOSAL

PICKUP-PLP Client to Pickup Pulps

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
No Prep	30	Sorting of samples on arrival and labeling			VAN
1SLW	30	Sequential Leach with H2O by ICP-MS	1	Completed	VAN
1SLE	30	Squential Leach with 1 M ammonium acetate by ICP-MS	1	Completed	VAN
1SLO	30	Squential Leach with 0.1 M sodium pyrophosphate by ICP-	1	Completed	VAN
1SLM	30	Squential Leach with 0.1 M hydroxylamine HCl by ICP-MS	1	Completed	VAN
1SLF	30	Squential Leach with 0.1M hydroxylamine HCl by ICP-MS	1	Completed	VAN
1T	30	4 Acid digestion Ultratrace ICP-MS analysis	0.25	Completed	VAN

ADDITIONAL COMMENTS

Version 2: Revised 1TMS data (analyzed from leached residue).

Invoice To: IoGlobal Solutions
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2
CANADA

CC: Magnus Leijd
Colin Dunn

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
Country Manager - Canada

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Ag	Al	As	Au	Ba	Be	Bi	Br	Ca	Cd	Ce	Cl	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga
	Unit	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb
	MDL	0.5	1	5	1	10	1	0.5	10	5	0.5	1	2	1	0.5	5	0.1	0.1	0.1	0.1	0.5
NK 12-060 C Lower Lab	Soil Pulp	0.6	25	17	1	152	11	<0.5	468	22	0.8	145	5	9	3.1	30	37.5	26.9	4.6	45.3	12.3
NK 12-060 C Upper Lab	Soil Pulp	0.8	14	6	<1	128	19	<0.5	744	27	1.3	152	10	4	1.8	29	38.1	28.6	4.7	12.4	5.8
NK 12-060 B Lab	Soil Pulp	0.6	22	21	1	214	40	<0.5	1318	46	5.1	291	17	10	1.1	54	49.7	37.9	5.9	10.0	2.6
NK 11-020 B2	Soil Pulp	<0.5	25	7	<1	148	2	<0.5	3384	9	1.1	110	15	33	0.6	20	7.4	5.7	1.4	13.1	3.2
NK 12-072 B Lab	Soil Pulp	0.7	39	22	<1	842	4	<0.5	2272	95	11.0	103	82	17	1.4	79	34.4	25.2	1.8	4.0	10.4
LKSD-4A	Soil Pulp	<0.5	98	187	1	1370	7	1.3	8134	3284	56.1	116	22	560	4.7	192	10.9	8.1	2.7	31.2	8.3
NK 12-039 B Lab	Soil Pulp	0.7	18	7	<1	266	2	<0.5	1290	15	4.4	115	51	13	0.9	54	36.5	33.3	2.8	7.0	4.0
NK 11-014 B	Soil Pulp	<0.5	26	8	<1	307	4	<0.5	2701	7	1.5	193	22	24	<0.5	38	22.5	16.6	1.9	6.4	2.1
NK 11-016 B2	Soil Pulp	2.2	38	19	<1	514	6	<0.5	1973	9	2.2	210	26	13	<0.5	41	65.8	62.5	4.1	12.1	8.8
NK 11-022 B	Soil Pulp	0.6	12	20	<1	133	4	<0.5	1458	107	1.3	65	8	4	0.5	42	9.2	5.7	2.0	6.6	2.0
NK 11-015 B	Soil Pulp	<0.5	29	15	<1	1063	4	<0.5	2051	7	2.7	179	29	46	<0.5	26	23.4	19.5	2.3	10.0	3.7
LKSD-4B	Soil Pulp	<0.5	90	174	<1	1327	3	1.2	7744	3122	54.4	110	21	525	4.7	189	9.9	7.7	2.7	28.1	8.1
NK 11-016 B	Soil Pulp	1.2	40	20	<1	504	8	<0.5	1910	13	3.2	228	25	13	<0.5	35	65.0	60.3	4.0	13.9	11.2
NK 11-081 B2	Soil Pulp	<0.5	23	8	<1	1488	29	<0.5	824	197	9.0	312	13	22	0.5	55	37.3	25.5	3.3	6.6	2.1
NK 11-020 B	Soil Pulp	<0.5	30	8	<1	172	1	<0.5	3212	9	1.8	116	15	33	0.9	23	7.9	6.2	1.8	18.5	5.5
NK 11-081 B	Soil Pulp	<0.5	23	13	<1	1456	28	<0.5	812	196	6.8	315	14	23	0.6	58	34.9	23.4	3.6	6.7	2.3
NK 12-039 root soil	Soil Pulp	1.3	32	21	<1	726	1	<0.5	1552	34	8.3	107	59	20	0.6	90	27.2	22.5	1.5	14.4	7.0
LKSD-4C	Soil Pulp	<0.5	91	178	<1	1296	3	1.0	7836	3156	51.0	107	23	529	4.5	179	11.5	8.1	2.6	28.5	7.9
NK 12-072 root soil	Soil Pulp	1.3	32	32	<1	1243	6	<0.5	2476	163	7.8	112	246	12	5.6	87	16.6	14.6	1.3	4.9	9.1
NK 11-012 Att2	Soil Pulp	<0.5	34	17	<1	482	7	<0.5	2263	54	2.7	155	41	23	<0.5	61	12.1	8.4	1.7	15.2	3.0
NK 12-060 root soil	Soil Pulp	0.5	35	22	<1	244	41	<0.5	1608	61	7.9	254	42	14	0.6	72	47.9	37.3	6.4	15.9	4.5
NK 11-016 AH	Soil Pulp	3.1	61	53	<1	2463	15	<0.5	2433	280	18.6	323	220	34	0.6	167	68.4	40.3	4.3	18.1	14.8
NK 11-015 AH	Soil Pulp	<0.5	29	41	<1	2220	4	<0.5	2152	101	7.0	91	220	27	3.8	108	6.2	3.7	0.2	16.1	7.6
LKSD-4D	Soil Pulp	<0.5	92	182	<1	1310	4	1.1	8266	3169	57.6	93	26	534	4.5	179	9.3	7.1	2.4	29.9	8.3
NK11-016 AH2	Soil Pulp	2.1	59	43	<1	2399	14	<0.5	2315	269	16.3	300	199	32	<0.5	152	66.5	42.9	4.1	18.0	15.3
NK11-014 AH	Soil Pulp	0.5	28	57	<1	1434	8	<0.5	3305	107	9.1	221	111	24	2.3	124	25.9	12.7	2.5	9.1	6.2
NK11-012 AH	Soil Pulp	<0.5	36	20	<1	489	4	<0.5	2113	52	3.1	92	37	22	0.6	58	7.7	4.7	1.0	16.8	3.7
NK11-009 AH	Soil Pulp	<0.5	33	47	<1	4711	16	<0.5	1363	1122	18.3	53	46	19	<0.5	66	7.3	7.3	<0.1	5.5	3.9
LKSD-4E	Soil Pulp	<0.5	94	177	<1	1426	6	1.1	7923	3332	56.6	92	23	536	4.7	183	8.5	7.9	2.1	29.8	8.8
NK11-006AH	Soil Pulp	0.5	26	43	<1	815	3	<0.5	1786	218	3.7	53	100	17	0.9	55	6.3	3.3	0.6	8.9	4.3

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Nd	Ni	P	Pb	Pr
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb
	MDL	0.1	0.1	0.1	1	0.05	0.05	2	2	0.1	0.05	0.1	50	1	3	0.5	1	5	0.1	3	0.5
NK 12-060 C Lower Lab	Soil Pulp	34.7	0.4	32.3	<1	8.40	<0.05	6	108	21.8	4.48	5.6	648	11	10	57.5	140	22	0.6	52	32.9
NK 12-060 C Upper Lab	Soil Pulp	37.4	0.2	31.6	<1	9.55	<0.05	5	99	15.7	4.12	4.7	310	5	11	16.9	164	11	0.6	24	35.8
NK 12-060 B Lab	Soil Pulp	53.3	0.7	37.9	<1	11.92	<0.05	20	174	9.0	5.24	7.2	966	2	19	12.5	237	17	3.3	49	54.2
NK 11-020 B2	Soil Pulp	8.0	0.6	0.8	<1	1.79	0.08	11	29	11.3	1.00	5.6	3315	2	10	3.2	44	22	1.6	17	10.0
NK 12-072 B Lab	Soil Pulp	23.1	0.3	59.8	<1	7.25	<0.05	221	36	4.6	3.49	36.8	50705	11	69	22.8	53	36	20.3	15	12.3
LKSD-4A	Soil Pulp	14.8	7.6	2.1	<1	2.35	0.16	66	72	43.9	1.44	326.1	103242	33	37	5.3	71	1082	22.8	331	16.3
NK 12-039 B Lab	Soil Pulp	24.5	0.7	51.8	<1	9.30	<0.05	74	34	5.7	6.20	6.5	25154	3	17	29.3	60	14	5.5	37	12.7
NK 11-014 B	Soil Pulp	18.2	0.4	10.5	<1	5.26	<0.05	11	51	9.2	2.46	6.9	1171	<1	7	4.7	74	21	1.9	8	16.0
NK 11-016 B2	Soil Pulp	47.3	1.9	91.7	<1	17.27	<0.05	21	79	11.9	10.12	5.5	3662	6	11	53.7	127	15	3.7	43	26.2
NK 11-022 B	Soil Pulp	12.3	0.6	1.2	<1	2.11	<0.05	9	48	5.0	0.78	8.8	1053	10	18	1.9	68	32	6.2	<3	14.9
NK 11-015 B	Soil Pulp	18.2	0.4	35.0	<1	6.26	<0.05	13	51	21.1	3.10	9.0	26384	<1	21	7.9	73	24	2.8	<3	17.0
LKSD-4B	Soil Pulp	13.9	8.1	2.4	<1	2.22	0.07	62	66	47.3	1.35	304.5	100787	29	33	4.9	68	993	21.7	290	15.6
NK 11-016 B	Soil Pulp	44.9	1.6	95.8	<1	17.29	<0.05	20	81	12.3	10.02	5.8	3490	7	11	62.1	127	18	3.9	48	28.4
NK 11-081 B2	Soil Pulp	30.0	0.7	2.8	<1	7.75	<0.05	29	57	29.0	2.94	32.2	14353	2	18	1.9	120	25	4.4	<3	24.1
NK 11-020 B	Soil Pulp	8.2	1.2	0.9	<1	1.80	0.06	10	33	21.6	0.95	5.8	3207	4	10	6.3	48	25	1.7	17	10.5
NK 11-081 B	Soil Pulp	32.2	0.8	2.6	<1	8.19	<0.05	28	61	29.2	3.04	31.5	14432	2	17	4.7	122	32	4.2	<3	25.1
NK 12-039 root soil	Soil Pulp	18.4	1.1	86.9	<1	6.53	0.05	157	30	11.2	3.59	11.7	27426	9	23	55.3	47	25	14.4	102	9.7
LKSD-4C	Soil Pulp	13.9	7.8	2.6	<1	2.45	0.09	61	67	44.1	1.41	318.5	101524	28	34	5.3	70	944	21.3	294	15.0
NK 12-072 root soil	Soil Pulp	14.3	0.3	50.3	<1	4.32	<0.05	522	59	2.6	1.78	59.6	53779	9	34	26.6	54	49	49.8	11	12.9
NK 11-012 Att2	Soil Pulp	13.0	0.7	8.0	<1	2.56	0.08	52	50	24.6	1.18	18.4	11999	5	9	6.0	60	39	14.9	20	14.3
NK 12-060 root soil	Soil Pulp	50.4	0.8	59.8	<1	11.86	<0.05	78	138	18.3	5.35	14.1	2462	3	25	23.2	214	20	7.0	35	49.6
NK 11-016 AH	Soil Pulp	48.8	0.4	75.3	<1	15.11	<0.05	346	205	16.0	4.11	61.6	25199	8	83	119.5	126	76	125.1	132	32.8
NK 11-015 AH	Soil Pulp	6.5	0.5	17.9	<1	1.33	<0.05	251	47	63.8	0.28	30.6	48474	6	32	23.5	26	81	210.3	231	6.4
LKSD-4D	Soil Pulp	11.0	8.6	2.2	<1	1.69	0.18	63	56	43.8	1.42	306.5	103567	30	33	4.4	61	997	22.0	284	13.8
NK11-016 AH2	Soil Pulp	47.7	0.3	77.1	<1	14.69	0.18	331	193	17.8	4.16	61.2	24506	9	82	115.2	121	84	124.1	129	32.6
NK11-014 AH	Soil Pulp	28.6	0.7	3.1	<1	5.33	<0.05	183	126	38.9	1.10	23.4	3470	10	35	12.6	87	69	252.2	300	20.3
NK11-012 AH	Soil Pulp	7.1	0.8	8.4	<1	1.57	<0.05	52	29	27.8	0.76	18.7	11596	3	9	6.3	37	36	14.8	28	8.7
NK11-009 AH	Soil Pulp	6.8	0.6	13.6	<1	1.54	<0.05	211	19	80.0	0.97	189.9	78504	2	23	9.9	26	32	32.0	10	5.7
LKSD-4E	Soil Pulp	10.6	8.7	2.5	<1	2.20	0.18	65	55	40.3	1.34	332.0	107812	29	35	6.4	60	1016	21.9	302	13.1
NK11-006AH	Soil Pulp	6.2	0.4	2.7	<1	1.29	0.06	206	30	34.8	0.31	40.4	17826	5	33	7.7	18	51	140.0	71	4.9

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y
	Unit	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	2	0.05	10	1	20	5	0.5	1	10	0.5	0.05	1	2	0.05	0.2	0.05	0.1	50	2	1
NK 12-060 C Lower Lab	Soil Pulp	53	<0.05	<10	2	<20	<5	32.1	5	57	3.2	5.26	<1	29	1.15	0.9	3.85	14.1	126	<2	249
NK 12-060 C Upper Lab	Soil Pulp	40	<0.05	<10	1	<20	<5	36.4	2	58	1.2	5.93	<1	23	0.47	0.5	3.99	14.4	58	<2	252
NK 12-060 B Lab	Soil Pulp	103	0.06	12	2	<20	8	51.0	2	105	0.9	7.89	<1	28	0.20	1.2	5.81	21.3	56	<2	367
NK 11-020 B2	Soil Pulp	40	0.06	<10	2	<20	7	9.0	<1	54	<0.5	1.27	<1	20	0.56	0.6	0.84	16.4	<50	<2	47
NK 12-072 B Lab	Soil Pulp	667	<0.05	47	6	<20	9	19.8	2	554	1.4	5.19	<1	13	0.19	4.1	3.53	6.0	<50	3	182
LKSD-4A	Soil Pulp	241	1.20	3462	82	24	52	13.5	5	9095	<0.5	1.79	1	46	0.56	23.5	1.25	185.7	433	7	81
NK 12-039 B Lab	Soil Pulp	140	<0.05	22	2	<20	13	18.4	1	61	1.9	4.95	<1	14	0.23	1.3	5.18	4.6	<50	<2	240
NK 11-014 B	Soil Pulp	49	<0.05	11	3	<20	14	17.0	<1	45	0.6	3.06	<1	14	0.28	1.4	2.45	10.2	<50	<2	142
NK 11-016 B2	Soil Pulp	37	0.15	19	3	<20	5	32.3	1	39	5.8	9.40	<1	17	0.32	1.5	10.36	10.8	58	<2	428
NK 11-022 B	Soil Pulp	12	0.08	19	2	<20	<5	12.7	<1	139	<0.5	1.72	<1	17	0.27	0.3	0.84	26.1	56	<2	53
NK 11-015 B	Soil Pulp	13	<0.05	<10	2	<20	11	17.4	<1	54	0.6	3.37	<1	18	0.38	0.3	3.11	7.9	<50	<2	155
LKSD-4B	Soil Pulp	241	1.22	3263	82	22	49	13.6	6	8708	<0.5	1.82	2	41	0.47	23.3	0.97	174.4	420	6	75
NK 11-016 B	Soil Pulp	38	0.19	15	3	<20	6	35.9	2	43	5.9	9.49	<1	17	0.40	1.4	9.83	11.3	61	<2	428
NK 11-081 B2	Soil Pulp	48	0.06	<10	2	20	10	30.2	<1	819	<0.5	5.59	<1	14	0.28	0.8	3.30	15.7	<50	<2	200
NK 11-020 B	Soil Pulp	43	<0.05	<10	2	<20	<5	9.4	<1	51	0.6	1.28	<1	21	0.90	0.6	0.81	15.4	57	<2	48
NK 11-081 B	Soil Pulp	50	0.08	<10	2	22	7	30.7	<1	804	<0.5	5.44	<1	14	0.31	0.6	3.44	15.7	<50	<2	208
NK 12-039 root soil	Soil Pulp	298	<0.05	11	6	<20	13	14.3	2	163	3.6	3.77	<1	25	0.29	2.1	3.28	7.0	73	<2	175
LKSD-4C	Soil Pulp	238	1.06	3308	76	<20	53	12.6	6	9024	<0.5	1.83	2	36	0.47	23.4	1.02	174.5	417	7	75
NK 12-072 root soil	Soil Pulp	2361	0.05	53	5	<20	10	10.3	3	595	1.7	2.61	<1	12	0.28	6.4	2.04	4.4	<50	3	116
NK 11-012 Att2	Soil Pulp	52	<0.05	39	3	<20	10	11.8	<1	168	<0.5	2.11	<1	94	0.35	0.5	1.07	10.6	56	<2	66
NK 12-060 root soil	Soil Pulp	178	<0.05	10	2	<20	10	49.5	<1	130	1.2	7.68	<1	48	0.20	1.4	5.46	32.3	65	<2	350
NK 11-016 AH	Soil Pulp	668	0.09	123	2	<20	15	37.0	2	841	7.1	10.98	<1	60	0.82	9.5	5.10	5.0	78	4	442
NK 11-015 AH	Soil Pulp	1620	0.08	83	2	<20	<5	6.6	2	577	1.4	1.30	<1	51	1.08	10.3	0.40	1.7	100	5	41
LKSD-4D	Soil Pulp	238	1.23	3332	81	24	55	11.7	6	9083	<0.5	1.46	<1	26	0.46	23.3	1.00	166.3	413	6	72
NK11-016 AH2	Soil Pulp	666	0.13	115	2	<20	12	33.7	3	832	6.5	10.05	<1	49	0.85	9.3	5.67	4.6	76	4	429
NK11-014 AH	Soil Pulp	1309	0.11	68	4	<20	10	20.9	2	452	0.7	4.65	<1	57	1.05	5.7	1.67	3.1	104	8	192
NK11-012 AH	Soil Pulp	56	<0.05	21	2	<20	15	9.0	<1	157	<0.5	1.19	<1	91	0.41	0.5	0.66	10.3	55	<2	40
NK11-009 AH	Soil Pulp	175	<0.05	83	<1	<20	7	5.9	<1	2678	0.7	0.95	<1	37	0.26	3.7	0.89	3.4	<50	<2	52
LKSD-4E	Soil Pulp	256	1.15	3434	80	21	50	10.5	5	9306	<0.5	1.59	<1	24	0.47	24.5	1.14	171.5	420	7	72
NK11-006AH	Soil Pulp	909	0.07	123	2	<20	10	4.9	1	617	<0.5	0.96	<1	36	0.67	10.4	0.40	3.6	64	3	50

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Yb	Zn	Zr	Ag	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe
	Unit	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm
	MDL	0.5	10	1	3	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5
NK 12-060 C Lower Lab	Soil Pulp	29.8	134	1772	<3	24	629	<1	12595	330	<5	322	<20	2361	21	14	41	516	298	71	11
NK 12-060 C Upper Lab	Soil Pulp	28.9	233	1715	<3	59	<100	2	15708	616	6	327	<20	4940	<20	37	81	924	493	131	16
NK 12-060 B Lab	Soil Pulp	40.3	164	2033	3	212	299	<1	14737	848	9	569	173	11197	116	36	103	1678	924	244	74
NK 11-020 B2	Soil Pulp	6.6	52	30	<3	376	238	<1	11159	<20	7	70	26	2359	297	7	85	148	85	25	71
NK 12-072 B Lab	Soil Pulp	24.0	747	2652	3	176	849	<1	62714	143	<5	1834	844	2309	120	39	97	657	365	44	<5
LKSD-4A	Soil Pulp	8.3	11725	93	<3	238	374	6	17660	<20	30	2783	494	1142	923	60	293	111	71	34	114
NK 12-039 B Lab	Soil Pulp	42.7	189	2456	<3	291	<100	<1	22977	79	6	182	341	5039	163	15	121	1706	1210	96	54
NK 11-014 B	Soil Pulp	18.3	96	427	3	521	<100	<1	9916	80	<5	27	<20	2207	134	16	129	262	131	23	48
NK 11-016 B2	Soil Pulp	73.4	69	3479	15	534	768	16	32530	253	8	118	109	3156	143	11	76	1025	696	71	96
NK 11-022 B	Soil Pulp	6.1	45	39	<3	57	382	<1	21669	<20	<5	1431	82	1473	49	6	43	176	93	39	11
NK 11-015 B	Soil Pulp	23.6	138	1312	9	445	<100	1	40772	<20	<5	35	65	1814	266	<5	175	241	175	19	57
LKSD-4B	Soil Pulp	9.2	11249	86	<3	245	134	<1	18177	<20	34	2815	505	1185	913	63	300	103	64	38	114
NK 11-016 B	Soil Pulp	75.4	108	3604	10	560	<100	2	35842	<20	6	121	77	3265	162	9	78	1160	725	67	103
NK 11-081 B2	Soil Pulp	24.6	243	98	<3	141	403	2	45117	647	<5	686	156	26528	236	12	173	2833	1460	311	49
NK 11-020 B	Soil Pulp	6.7	84	25	<3	380	<100	<1	11144	124	<5	74	32	2427	308	<5	27	185	74	32	72
NK 11-081 B	Soil Pulp	24.4	253	95	5	145	<100	<1	45342	235	<5	672	273	26093	220	10	186	2868	1447	324	50
NK 12-039 root soil	Soil Pulp	24.3	576	3725	3	209	704	10	30207	<20	17	428	301	2998	233	9	187	779	513	53	75
LKSD-4C	Soil Pulp	8.2	11160	89	5	237	403	<1	18886	<20	40	2794	484	1138	943	63	331	83	45	45	114
NK 12-072 root soil	Soil Pulp	14.0	991	2358	<3	62	<100	<1	66484	<20	<5	3904	644	1215	78	65	52	168	106	8	<5
NK 11-012 Att2	Soil Pulp	7.8	468	312	<3	252	152	<1	24220	229	<5	389	57	1865	197	9	91	128	83	27	88
NK 12-060 root soil	Soil Pulp	39.3	257	2890	12	175	<100	<1	14389	520	<5	733	389	8563	207	20	129	1357	675	185	59
NK 11-016 AH	Soil Pulp	33.9	1984	3014	<3	52	500	<1	48614	<20	<5	2425	388	354	112	7	99	108	60	<5	9
NK 11-015 AH	Soil Pulp	2.5	1033	695	<3	16	<100	<1	64209	<20	<5	1584	164	63	139	36	107	10	<5	<5	<5
LKSD-4D	Soil Pulp	7.8	11689	88	6	238	404	<1	20176	<20	38	2776	512	1113	923	57	255	105	57	40	116
NK11-016 AH2	Soil Pulp	33.4	1917	2933	<3	50	<100	2	50283	103	<5	2505	407	325	171	6	101	95	63	<5	10
NK11-014 AH	Soil Pulp	9.1	1487	127	<3	12	<100	6	61555	<20	<5	2403	252	123	104	13	45	19	11	<5	<5
NK11-012 AH	Soil Pulp	6.5	427	303	4	248	<100	2	26310	99	<5	382	92	1806	172	6	56	148	70	24	94
NK11-009 AH	Soil Pulp	7.4	2938	520	<3	54	<100	<1	39322	41	<5	2758	241	749	84	13	91	137	86	8	7
LKSD-4E	Soil Pulp	8.4	11818	83	<3	236	<100	<1	20247	96	25	2855	574	1178	942	56	326	145	61	34	118
NK11-006AH	Soil Pulp	3.2	610	102	<3	16	304	<1	23623	<20	<5	2472	131	100	95	7	51	13	11	<5	<5

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb
	MDL	20	5	50	20	5	20	10	5	5	20	5	1	50	10	10	5	50	5	20	5
NK 12-060 C Lower Lab	Soil Pulp	<20	664	<50	49	<5	108	<10	<5	3102	<20	32	19	3206	<10	<10	2560	<50	<5	1387	628
NK 12-060 C Upper Lab	Soil Pulp	<20	1133	<50	90	<5	181	<10	<5	5108	<20	48	29	2610	<10	10	4830	54	<5	2506	1076
NK 12-060 B Lab	Soil Pulp	<20	2139	<50	146	<5	337	<10	8	8447	<20	79	47	11821	<10	24	9082	207	<5	6603	1937
NK 11-020 B2	Soil Pulp	<20	185	<50	<20	<5	28	<10	6	1094	<20	8	17	21892	<10	<10	872	150	<5	1637	211
NK 12-072 B Lab	Soil Pulp	40	570	<50	167	<5	137	<10	56	1022	<20	28	322	1.04075	<10	25	1385	95	11	1535	264
LKSD-4A	Soil Pulp	<20	189	<50	<20	<5	25	14	12	717	<20	7	167	115107	57	<10	669	2164	24	15913	168
NK 12-039 B Lab	Soil Pulp	<20	1433	<50	212	<5	414	<10	29	2218	24	124	45	414331	<10	49	2934	94	14	6524	532
NK 11-014 B	Soil Pulp	<20	236	<50	83	<5	54	<10	<5	807	<20	13	11	4562	<10	17	816	169	6	1262	154
NK 11-016 B2	Soil Pulp	21	812	<50	447	<5	232	<10	11	1535	<20	81	34	48746	<10	186	1718	129	11	4185	384
NK 11-022 B	Soil Pulp	<20	304	<50	<20	<5	37	<10	6	1456	<20	7	59	24700	<10	<10	1326	141	<5	710	304
NK 11-015 B	Soil Pulp	<20	247	<50	192	<5	57	<10	8	706	<20	23	18	86744	<10	20	744	174	9	1031	162
LKSD-4B	Soil Pulp	<20	188	<50	<20	<5	24	10	12	744	<20	6	169	115159	54	<10	760	2014	21	17015	173
NK 11-016 B	Soil Pulp	<20	769	<50	559	<5	255	<10	11	1737	22	78	33	51499	30	224	2030	122	10	4592	409
NK 11-081 B2	Soil Pulp	<20	3067	<50	<20	<5	583	<10	9	7129	<20	93	64	63071	<10	<10	8930	211	<5	1210	2004
NK 11-020 B	Soil Pulp	<20	196	<50	<20	<5	28	<10	5	1080	<20	8	19	22522	<10	<10	888	147	<5	1766	211
NK 11-081 B	Soil Pulp	<20	2951	<50	<20	<5	551	<10	9	6902	<20	108	60	62586	<10	<10	9185	163	<5	1293	1950
NK 12-039 root soil	Soil Pulp	<20	578	<50	312	<5	182	<10	36	1185	<20	50	68	382454	<10	116	1336	147	14	13626	285
LKSD-4C	Soil Pulp	<20	141	<50	<20	<5	24	11	11	724	<20	10	161	113946	19	<10	824	1828	21	17637	160
NK 12-072 root soil	Soil Pulp	40	175	<50	97	<5	40	<10	126	796	<20	13	811	1.35061	<10	15	668	63	22	1414	131
NK 11-012 Att2	Soil Pulp	<20	177	<50	31	<5	29	<10	18	716	<20	9	66	89286	19	12	749	171	9	3190	169
NK 12-060 root soil	Soil Pulp	<20	1766	<50	136	<5	296	<10	20	6617	<20	74	79	27616	<10	32	6902	99	5	6707	1536
NK 11-016 AH	Soil Pulp	<20	85	<50	66	<5	24	<10	52	205	<20	10	362	211370	<10	53	168	<50	35	2297	44
NK 11-015 AH	Soil Pulp	<20	<5	<50	<20	<5	<20	<10	56	33	23	<5	345	637902	<10	10	30	138	53	1891	7
LKSD-4D	Soil Pulp	<20	200	<50	<20	<5	24	<10	12	741	23	8	160	115367	56	<10	751	1739	20	17077	165
NK11-016 AH2	Soil Pulp	<20	91	<50	67	<5	25	<10	52	189	<20	5	372	218994	<10	57	202	<50	34	2207	43
NK11-014 AH	Soil Pulp	<20	21	<50	<20	<5	<20	<10	52	63	<20	<5	368	62879	<10	<10	71	128	44	3010	13
NK11-012 AH	Soil Pulp	<20	166	<50	22	<5	31	<10	19	718	<20	<5	66	88329	<10	<10	670	202	11	2941	162
NK11-009 AH	Soil Pulp	<20	125	<50	37	<5	28	<10	21	344	<20	10	229	240263	20	<10	372	55	16	1585	76
LKSD-4E	Soil Pulp	<20	179	<50	<20	<5	23	13	13	768	<20	9	162	114484	44	<10	795	1996	22	17662	169
NK11-006AH	Soil Pulp	<20	14	<50	<20	<5	<20	<10	32	56	<20	<5	251	193528	<10	<10	47	<50	44	2358	8

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Rb	Re	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	5	2	5	100	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5
NK 12-060 C Lower Lab	Soil Pulp	190	2	<5	154	<200	583	<20	876	<20	90	<20	130	<1	<5	31	147	<50	<10	3484	252
NK 12-060 C Upper Lab	Soil Pulp	213	<2	<5	279	<200	1041	<20	933	<20	161	<20	220	<1	<5	59	289	<50	<10	5747	348
NK 12-060 B Lab	Soil Pulp	476	<2	<5	273	<200	1998	<20	1783	<20	319	<20	327	<1	11	109	700	<50	<10	10746	671
NK 11-020 B2	Soil Pulp	300	<2	<5	<100	<200	175	<20	576	<20	32	26	283	<1	9	11	202	<50	<10	825	61
NK 12-072 B Lab	Soil Pulp	1817	3	9	<100	<200	430	<20	15838	<20	114	<20	24	<1	128	42	156	<50	<10	3810	252
LKSD-4A	Soil Pulp	485	<2	72	171	<200	190	<20	12114	<20	22	<20	131	<1	184	6	7935	<50	<10	773	50
NK 12-039 B Lab	Soil Pulp	820	<2	7	<100	<200	863	<20	1418	<20	270	<20	109	<1	42	160	239	<50	11	10997	940
NK 11-014 B	Soil Pulp	284	<2	<5	<100	<200	161	<20	272	<20	44	<20	221	<1	19	16	150	<50	<10	1317	91
NK 11-016 B2	Soil Pulp	203	<2	5	127	<200	504	<20	798	27	150	<20	151	<1	26	91	166	<50	<10	5694	574
NK 11-022 B	Soil Pulp	66	<2	<5	<100	<200	247	<20	2649	<20	35	<20	106	<1	5	7	747	210	<10	1166	58
NK 11-015 B	Soil Pulp	101	<2	<5	163	<200	207	<20	319	<20	36	<20	186	<1	11	17	133	<50	<10	1429	145
LKSD-4B	Soil Pulp	507	3	67	105	<200	180	<20	12501	<20	18	<20	135	<1	178	9	8135	203	<10	747	43
NK 11-016 B	Soil Pulp	224	3	<5	<100	<200	582	<20	874	31	138	<20	136	<1	23	102	196	270	<10	6464	684
NK 11-081 B2	Soil Pulp	352	3	8	348	<200	2234	<20	3911	<20	500	<20	364	<1	12	146	726	195	<10	13914	858
NK 11-020 B	Soil Pulp	334	2	<5	<100	<200	191	<20	625	<20	37	<20	314	<1	10	6	205	<50	<10	846	77
NK 11-081 B	Soil Pulp	326	3	6	311	<200	2530	<20	3833	<20	485	<20	357	<1	12	152	746	<50	<10	13945	896
NK 12-039 root soil	Soil Pulp	922	<2	13	179	<200	349	<20	3015	<20	123	<20	92	<1	28	66	250	<50	<10	5144	372
LKSD-4C	Soil Pulp	524	<2	77	<100	<200	204	<20	12514	<20	23	<20	118	<1	196	<5	8403	<50	<10	754	53
NK 12-072 root soil	Soil Pulp	4248	<2	<5	126	<200	146	<20	18705	<20	29	<20	<20	<1	152	10	75	<50	<10	1102	70
NK 11-012 Att2	Soil Pulp	250	4	<5	318	<200	216	<20	1730	<20	28	<20	207	<1	5	11	192	<50	<10	766	55
NK 12-060 root soil	Soil Pulp	659	<2	<5	217	<200	1597	<20	2364	<20	268	<20	291	<1	13	87	696	<50	<10	9129	566
NK 11-016 AH	Soil Pulp	851	2	<5	243	<200	66	<20	9847	<20	19	<20	23	<1	51	11	36	<50	<10	621	51
NK 11-015 AH	Soil Pulp	2485	<2	6	107	<200	<5	<20	10279	<20	<5	<20	<20	<1	79	<5	7	<50	<10	39	<5
LKSD-4D	Soil Pulp	508	<2	62	269	<200	163	<20	12483	<20	19	<20	131	<1	182	8	7663	<50	<10	778	52
NK11-016 AH2	Soil Pulp	876	<2	<5	122	<200	58	<20	10471	<20	17	<20	<20	<1	60	8	49	<50	<10	582	59
NK11-014 AH	Soil Pulp	2314	<2	<5	104	<200	15	<20	13943	<20	5	<20	<20	<1	41	<5	19	<50	<10	121	11
NK11-012 AH	Soil Pulp	243	<2	<5	<100	<200	115	<20	1834	<20	30	<20	221	<1	8	6	186	<50	<10	710	65
NK11-009 AH	Soil Pulp	340	<2	<5	<100	<200	83	<20	9085	<20	16	<20	62	<1	49	11	106	<50	<10	729	41
LKSD-4E	Soil Pulp	527	2	72	272	<200	150	<20	12716	<20	20	<20	141	<1	187	6	7955	<50	<10	805	37
NK11-006AH	Soil Pulp	1097	<2	<5	<100	<200	<5	<20	10411	<20	<5	<20	<20	<1	46	<5	48	<50	<10	94	13

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLE	1SLE	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Zn	Zr	Ag	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga
	Unit	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb
	MDL	100	20	3	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5	50
NK 12-060 C Lower Lab	Soil Pulp	467	2176	32	446	367	13	1534	261	20	33	52	5123	135	33	2109	764	570	95	813	252
NK 12-060 C Upper Lab	Soil Pulp	13229	3533	38	906	435	20	3048	234	51	43	40	11412	192	66	1432	1780	1115	268	1002	484
NK 12-060 B Lab	Soil Pulp	3299	6723	80	2002	992	29	6815	1081	95	130	145	43328	297	80	1731	5373	3169	742	2281	1032
NK 11-020 B2	Soil Pulp	418	104	24	3718	2254	15	10161	206	137	32	30	19272	761	174	507	739	442	117	7202	1670
NK 12-072 B Lab	Soil Pulp	22354	6191	125	3856	246	59	30125	296	60	610	814	30134	484	42	1381	6093	3905	441	886	1472
LKSD-4A	Soil Pulp	42256	123	18	2134	3397	5	17172	178	171	838	417	14974	698	8	1949	1132	735	390	2254	189
NK 12-039 B Lab	Soil Pulp	4451	9192	203	2883	792	119	16110	388	210	64	424	27792	503	122	1629	5720	4048	370	3004	1688
NK 11-014 B	Soil Pulp	715	2493	68	3446	1946	38	7533	300	170	19	46	16335	309	80	397	1531	983	165	4872	1795
NK 11-016 B2	Soil Pulp	1047	14838	251	4445	1718	187	29419	512	379	49	92	41722	537	72	<20	4846	3659	298	4332	4000
NK 11-022 B	Soil Pulp	<100	118	19	976	832	4	9717	61	49	326	34	15345	272	15	446	1416	658	318	1438	235
NK 11-015 B	Soil Pulp	1030	5954	116	3603	2460	41	53077	91	152	28	85	19026	1107	103	1393	1499	1171	112	6024	2172
LKSD-4B	Soil Pulp	45042	147	25	2639	4408	<1	19987	153	232	1070	534	18614	787	12	3748	1625	943	460	2909	280
NK 11-016 B	Soil Pulp	1100	16627	261	4806	1840	169	30632	245	360	56	226	44937	582	88	615	4739	3767	347	4509	4031
NK 11-081 B2	Soil Pulp	2666	313	31	1249	1678	9	12921	433	93	121	52	71767	784	24	2289	5020	2839	567	2735	376
NK 11-020 B	Soil Pulp	271	92	30	3999	2738	19	11183	123	137	29	23	20511	838	202	791	737	457	114	7339	1746
NK 11-081 B	Soil Pulp	2494	353	33	1208	2234	4	12373	404	90	123	59	69259	772	19	1836	5435	2784	553	2708	331
NK 12-039 root soil	Soil Pulp	9008	10810	255	2516	1674	113	17341	186	270	114	283	27814	558	135	2089	3645	2528	230	3105	1450
LKSD-4C	Soil Pulp	44396	139	26	2567	4574	4	20828	60	206	1037	483	19208	823	9	3573	1497	933	475	2819	256
NK 12-072 root soil	Soil Pulp	25890	3314	97	3439	551	55	32270	314	51	1543	659	30031	439	38	<20	3633	2605	284	775	979
NK 11-012 Att2	Soil Pulp	4797	624	62	2712	2995	22	16853	187	182	103	46	26158	575	88	422	980	522	112	6157	1254
NK 12-060 root soil	Soil Pulp	6011	5416	87	1526	1054	31	6240	1212	63	181	178	43579	214	34	1183	4953	3248	787	2039	714
NK 11-016 AH	Soil Pulp	16189	1867	71	1463	519	40	34911	381	93	1098	214	13054	234	<5	395	1529	1027	92	1380	708
NK 11-015 AH	Soil Pulp	10825	439	24	732	434	7	37214	59	23	756	148	2646	233	16	164	172	123	14	1059	193
LKSD-4D	Soil Pulp	48771	117	28	2581	4943	5	21289	123	202	989	462	18397	809	11	3523	1472	910	430	2824	247
NK11-016 AH2	Soil Pulp	16557	1914	66	1530	467	53	36715	253	91	1132	345	12895	235	6	<20	1541	1041	102	1411	716
NK11-014 AH	Soil Pulp	16095	64	11	856	185	<1	33573	90	<5	1199	236	4485	207	<5	<20	658	367	64	649	<50
NK11-012 AH	Soil Pulp	5448	577	57	2663	2925	14	16615	57	196	89	40	25604	560	95	668	857	493	115	6062	1161
NK11-009 AH	Soil Pulp	19495	780	50	1581	769	24	26909	156	82	1038	167	18517	408	13	416	1602	1093	177	1960	514
LKSD-4E	Soil Pulp	47350	109	38	2648	5067	<1	20606	222	227	1064	531	19055	884	11	3493	1579	924	429	2829	245
NK11-006AH	Soil Pulp	6606	68	8	722	464	3	11621	56	<5	1096	126	2637	215	10	<20	328	237	39	583	54

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Re
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	5	50	20	5	20	10	5	5	20	5	1	50	10	10	5	50	20	5	5	2
NK 12-060 C Lower Lab	Soil Pulp	792	<50	700	<5	188	<10	8	5222	302	78	31	13702	277	1340	3912	408	1832	965	352	<2
NK 12-060 C Upper Lab	Soil Pulp	1989	<50	1152	<5	386	<10	12	11184	756	153	57	12804	239	1808	9856	587	3132	2473	565	2
NK 12-060 B Lab	Soil Pulp	5858	<50	2777	7	1139	<10	12	35474	912	413	63	12722	320	4003	29512	701	10084	7317	588	5
NK 11-020 B2	Soil Pulp	709	74	95	9	152	13	44	6260	1382	43	186	60191	1466	1911	4202	1144	6531	1118	2515	<2
NK 12-072 B Lab	Soil Pulp	4361	<50	9673	21	1319	<10	9	13534	206	457	54	1.24155	341	3045	12610	829	8788	3117	446	<2
LKSD-4A	Soil Pulp	1579	<50	122	10	271	23	<5	10438	50	122	32	43368	643	148	8923	3178	25878	2130	58	<2
NK 12-039 B Lab	Soil Pulp	3545	<50	7670	23	1242	<10	17	11194	586	555	59	572506	1275	10929	9859	660	27046	2256	1843	7
NK 11-014 B	Soil Pulp	1274	<50	928	11	344	<10	23	6192	666	110	72	17302	1068	3206	4949	945	5867	1242	1213	2
NK 11-016 B2	Soil Pulp	3019	55	5482	15	1115	<10	17	12785	1092	454	88	69766	1198	14989	9571	1018	13537	2461	909	10
NK 11-022 B	Soil Pulp	1887	<50	99	9	261	<10	<5	16568	72	80	21	77695	156	234	11078	520	2714	2874	172	<2
NK 11-015 B	Soil Pulp	1133	60	2346	13	358	<10	23	6175	1173	131	123	318783	1020	4069	4480	893	7245	1127	1549	<2
LKSD-4B	Soil Pulp	2025	<50	99	5	298	28	<5	13275	107	147	43	52659	763	79	10713	3881	31623	2677	83	<2
NK 11-016 B	Soil Pulp	3296	68	5528	13	1112	<10	19	13396	1365	437	111	71058	1068	15094	10209	1029	14521	2507	1081	5
NK 11-081 B2	Soil Pulp	4673	<50	308	12	1027	<10	8	19469	439	275	37	121018	527	644	18609	587	4549	4562	488	2
NK 11-020 B	Soil Pulp	773	83	54	11	156	<10	49	6769	1805	59	226	63154	1580	1930	4099	1314	6678	1087	2823	3
NK 11-081 B	Soil Pulp	4526	<50	279	<5	1034	<10	7	19773	469	283	37	120927	671	703	19427	787	4570	4555	446	3
NK 12-039 root soil	Soil Pulp	2367	<50	7164	24	833	15	18	9381	641	281	65	363696	1270	12298	6690	777	32142	1672	1670	3
LKSD-4C	Soil Pulp	1908	<50	120	7	314	20	<5	13758	74	145	41	48883	741	158	10691	4033	30747	2707	81	<2
NK 12-072 root soil	Soil Pulp	3060	<50	7429	17	844	<10	22	17318	74	276	176	2.19724	191	2407	10962	677	10936	2878	751	4
NK 11-012 Att2	Soil Pulp	881	<50	464	21	178	<10	20	6786	1267	54	77	113046	1596	2337	4458	840	9826	1143	1468	<2
NK 12-060 root soil	Soil Pulp	5748	<50	2466	8	1105	<10	<5	37187	371	369	33	10870	205	3099	28360	365	9534	7329	321	<2
NK 11-016 AH	Soil Pulp	961	<50	1528	<5	325	<10	5	4573	197	108	67	98496	227	3485	3123	412	6266	822	154	<2
NK 11-015 AH	Soil Pulp	144	<50	283	<5	38	<10	8	943	71	11	81	338854	97	372	703	534	5985	185	401	<2
LKSD-4D	Soil Pulp	1968	<50	97	13	326	22	<5	13587	54	143	41	47158	699	51	10373	3859	31667	2616	95	<2
NK11-016 AH2	Soil Pulp	1005	<50	1556	6	331	<10	6	4752	132	119	73	105271	248	3574	3080	538	6244	776	170	6
NK11-014 AH	Soil Pulp	482	<50	78	5	137	<10	7	2702	<20	44	98	43951	76	<10	2138	474	9871	529	269	<2
NK11-012 AH	Soil Pulp	869	<50	389	14	180	12	21	6525	760	46	77	107691	1403	2320	4119	957	9854	1108	1558	<2
NK11-009 AH	Soil Pulp	1455	<50	984	8	370	<10	<5	8386	240	127	43	436583	389	1762	5693	403	6989	1481	150	<2
LKSD-4E	Soil Pulp	1868	<50	107	10	335	30	<5	13977	51	138	42	47831	809	45	10818	3713	31502	2717	73	<2
NK11-006AH	Soil Pulp	283	<50	64	15	77	<10	<5	1712	66	30	55	101199	111	42	1219	539	6641	301	187	<2

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

		Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
		Analyte	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
		Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
		MDL	5	100	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5	100	20
NK 12-060 C Lower Lab	Soil Pulp		16	430	263	761	181	148	93	129	<20	1704	<1	8	85	215	1247	46	5217	578	1731	26148
NK 12-060 C Upper Lab	Soil Pulp		15	814	<200	2068	323	269	147	315	<20	2699	<1	12	171	461	1566	47	11848	1139	5094	39942
NK 12-060 B Lab	Soil Pulp		45	1401	298	6222	814	521	304	849	<20	6269	<1	18	425	1247	2810	100	32678	2847	5672	98488
NK 11-020 B2	Soil Pulp		93	1682	<200	804	740	531	163	135	<20	3941	<1	44	60	499	6797	125	3880	415	9262	2138
NK 12-072 B Lab	Soil Pulp		52	487	254	3625	486	4087	396	920	<20	1225	<1	78	552	680	483	122	33947	3390	25890	258106
LKSD-4A	Soil Pulp		166	2785	244	1797	1301	3987	<20	208	<20	4523	<1	47	113	12820	4063	74	7889	703	37205	2810
NK 12-039 B Lab	Soil Pulp		79	1124	<200	2759	1407	484	1235	780	<20	2890	<1	41	637	607	2397	155	33539	4184	7264	218985
NK 11-014 B	Soil Pulp		72	749	<200	1155	697	372	419	239	<20	3072	<1	31	142	413	4776	119	8256	861	5541	24503
NK 11-016 B2	Soil Pulp		93	919	<200	2442	1836	538	1954	690	<20	2498	<1	34	541	449	3242	244	26862	3658	7935	154521
NK 11-022 B	Soil Pulp		19	1214	<200	2060	169	749	26	262	<20	4307	<1	7	80	1442	2004	33	8238	551	1401	1746
NK 11-015 B	Soil Pulp		102	880	<200	944	813	470	436	231	<20	3171	<1	33	160	421	4755	149	8141	1032	11900	64137
LKSD-4B	Soil Pulp		254	3453	294	2207	1645	5080	<20	261	<20	5611	<1	64	125	16703	5305	93	9825	1011	46676	1630
NK 11-016 B	Soil Pulp		66	991	<200	2598	1907	566	2066	714	<20	2704	<1	41	544	529	3317	288	28287	3519	9081	158458
NK 11-081 B2	Soil Pulp		55	2490	<200	4540	249	689	80	850	<20	8148	<1	13	371	956	2590	79	25427	2387	5730	6497
NK 11-020 B	Soil Pulp		79	1602	<200	909	819	611	183	150	<20	4148	<1	45	67	546	7220	110	3789	406	9868	941
NK 11-081 B	Soil Pulp		24	2682	<200	4514	293	751	86	820	<20	7861	<1	8	378	944	2587	71	25966	2370	5420	6102
NK 12-039 root soil	Soil Pulp		129	644	338	1919	1871	870	1287	516	<20	2602	<1	41	361	692	2545	210	21357	2150	9003	205856
LKSD-4C	Soil Pulp		267	3676	398	2244	1457	5113	<20	275	<20	5765	<1	63	134	16592	5117	109	9936	961	43757	2154
NK 12-072 root soil	Soil Pulp		46	187	<200	2475	343	5324	371	536	<20	910	<1	97	334	523	340	31	22665	2247	43290	193638
NK 11-012 Att2	Soil Pulp		96	563	284	991	813	666	218	158	<20	4873	<1	21	75	531	4987	138	4023	500	9345	10507
NK 12-060 root soil	Soil Pulp		41	900	<200	6227	708	585	246	861	<20	5851	<1	14	440	1194	2141	87	32442	2865	4299	84892
NK 11-016 AH	Soil Pulp		19	225	<200	805	613	3781	574	205	<20	900	<1	22	138	193	824	52	8214	874	18004	43310
NK 11-015 AH	Soil Pulp		10	219	<200	132	597	3542	83	26	<20	622	<1	31	14	90	993	17	767	91	17757	7101
LKSD-4D	Soil Pulp		290	3606	420	2090	1482	4954	<20	242	<20	5524	<1	64	123	16659	5310	107	9625	873	44180	938
NK11-016 AH2	Soil Pulp		16	223	<200	772	592	4015	584	210	29	900	<1	20	142	235	809	68	8600	983	18156	44113
NK11-014 AH	Soil Pulp		<5	194	<200	494	224	4564	32	93	<20	552	<1	14	53	158	768	20	3695	282	35273	1275
NK11-012 AH	Soil Pulp		87	706	<200	906	822	667	231	146	<20	4795	<1	26	75	533	5007	128	3852	431	8632	9413
NK11-009 AH	Soil Pulp		<5	402	217	1360	456	3257	257	264	<20	3797	<1	28	152	531	1468	84	9208	902	19432	25065
LKSD-4E	Soil Pulp		278	3723	414	2200	1703	4994	<20	254	<20	5907	<1	65	131	17534	5279	90	10080	928	46611	1094
NK11-006AH	Soil Pulp		9	414	226	263	242	3700	27	36	<20	633	<1	25	32	277	672	25	2372	248	10471	1352

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Ag	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge
	Unit	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb
	MDL	3	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5	20	5	50
NK 12-060 C Lower Lab	Soil Pulp	7	868	<100	<1	3763	152	<5	232	63	4419	547	51	504	545	323	70	1004	80	533	<50
NK 12-060 C Upper Lab	Soil Pulp	9	1046	<100	3	5756	440	<5	118	23	4512	451	124	459	562	304	86	1039	114	562	<50
NK 12-060 B Lab	Soil Pulp	53	1414	<100	2	9190	287	<5	144	43	9598	438	126	513	981	503	119	1115	149	1131	<50
NK 11-020 B2	Soil Pulp	<3	1561	<100	2	8078	<20	13	97	28	2796	554	33	398	152	89	20	1349	108	148	<50
NK 12-072 B Lab	Soil Pulp	<3	1351	<100	<1	116178	359	<5	282	593	4431	1208	30	128	265	189	7	452	142	228	<50
LKSD-4A	Soil Pulp	10	787	1194	3	82035	54	<5	740	488	947	1063	57	199	22	25	<5	1032	26	52	<50
NK 12-039 B Lab	Soil Pulp	20	1069	144	2	54680	129	<5	342	316	17207	2416	56	361	1605	1077	104	1267	221	1053	<50
NK 11-014 B	Soil Pulp	8	1123	<100	<1	8842	<20	15	47	32	2490	308	73	560	193	128	15	838	146	197	<50
NK 11-016 B2	Soil Pulp	<3	1199	<100	<1	24658	51	14	63	51	3856	353	41	229	598	445	39	811	276	448	<50
NK 11-022 B	Soil Pulp	<3	1322	109	<1	14761	<20	22	409	34	3444	603	8	483	284	157	56	1168	93	358	<50
NK 11-015 B	Soil Pulp	8	2103	<100	1	112020	200	<5	177	47	3493	1081	15	492	211	172	14	1717	130	242	<50
LKSD-4B	Soil Pulp	<3	756	1363	1	79445	<20	<5	732	493	866	1056	53	321	29	31	<5	922	28	51	<50
NK 11-016 B	Soil Pulp	<3	1243	<100	<1	26491	46	7	65	46	4039	326	43	276	633	433	40	841	300	450	<50
NK 11-081 B2	Soil Pulp	4	1426	137	<1	20501	272	9	376	51	22056	1174	25	1067	1310	648	153	1731	61	1210	<50
NK 11-020 B	Soil Pulp	4	1536	<100	<1	8568	<20	7	100	29	2618	552	32	408	122	75	17	1326	122	112	<50
NK 11-081 B	Soil Pulp	<3	1491	169	<1	20376	117	9	394	44	22374	1186	22	1213	1336	619	138	1754	81	1275	<50
NK 12-039 root soil	Soil Pulp	15	838	124	<1	40437	<20	<5	78	170	9108	2091	66	394	641	495	37	993	268	470	<50
LKSD-4C	Soil Pulp	<3	808	1264	1	78675	38	<5	708	476	844	1034	57	293	29	32	<5	954	28	41	<50
NK 12-072 root soil	Soil Pulp	<3	269	305	<1	52985	37	6	816	206	546	41	35	226	41	29	<5	43	170	42	<50
NK 11-012 Att2	Soil Pulp	<3	1238	<100	<1	15223	<20	<5	58	21	2825	437	12	312	124	64	11	1219	118	101	<50
NK 12-060 root soil	Soil Pulp	<3	1301	<100	1	10218	719	<5	139	91	7796	425	62	353	632	445	104	1009	140	838	<50
NK 11-016 AH	Soil Pulp	5	438	<100	<1	39831	<20	10	370	73	205	155	9	178	38	24	<5	293	159	21	<50
NK 11-015 AH	Soil Pulp	<3	145	107	2	52935	108	<5	334	50	36	110	19	229	<5	<5	<5	186	38	<5	<50
LKSD-4D	Soil Pulp	6	595	1253	1	74886	<20	<5	699	494	596	1061	46	306	19	22	<5	848	24	51	<50
NK11-016 AH2	Soil Pulp	15	436	<100	<1	41071	<20	<5	358	55	217	148	11	217	25	13	<5	314	153	16	<50
NK11-014 AH	Soil Pulp	<3	162	<100	<1	52959	105	<5	580	88	26	56	<5	206	<5	<5	<5	66	38	5	<50
NK11-012 AH	Soil Pulp	<3	1237	104	<1	16190	28	<5	53	20	2699	464	10	380	114	65	22	1216	110	137	<50
NK11-009 AH	Soil Pulp	6	489	137	<1	34505	26	<5	359	57	271	336	31	173	20	15	<5	472	59	17	<50
LKSD-4E	Soil Pulp	<3	686	1150	1	75087	25	<5	707	487	620	940	52	319	24	24	<5	870	26	39	<50
NK11-006AH	Soil Pulp	<3	198	<100	<1	19088	176	<5	353	25	29	122	<5	136	<5	<5	<5	157	29	<5	<50

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	Sb
	Unit	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb
	MDL	20	5	20	10	5	5	20	5	1	50	10	10	5	50	5	20	5	5	2	5
NK 12-060 C Lower Lab	Soil Pulp	<20	<5	112	<10	<5	3308	1475	29	344	39308	<10	17	3044	527	123	7067	837	453	<2	<5
NK 12-060 C Upper Lab	Soil Pulp	<20	<5	113	<10	<5	3600	1760	32	317	21953	15	17	3112	462	91	7784	879	460	<2	<5
NK 12-060 B Lab	Soil Pulp	<20	<5	202	<10	<5	7018	1813	40	330	21908	<10	25	5906	656	295	11124	1518	714	<2	<5
NK 11-020 B2	Soil Pulp	<20	<5	26	<10	<5	1148	1425	<5	404	29066	<10	16	775	643	139	5219	210	798	<2	<5
NK 12-072 B Lab	Soil Pulp	<20	<5	70	<10	<5	1342	158	18	12	2.82943	48	26	719	332	354	11189	215	376	<2	<5
LKSD-4A	Soil Pulp	<20	<5	<20	<10	<5	837	580	<5	164	24714	<10	<10	395	5130	731	9225	115	252	<2	22
NK 12-039 B Lab	Soil Pulp	25	<5	361	<10	5	4298	624	93	123	2.25782	72	111	3747	446	355	83371	914	1955	<2	<5
NK 11-014 B	Soil Pulp	<20	<5	40	<10	<5	882	784	11	207	14700	14	37	731	358	383	4013	186	753	<2	12
NK 11-016 B2	Soil Pulp	43	<5	163	<10	<5	1930	1045	43	248	29833	<10	73	1410	415	268	8095	418	417	<2	11
NK 11-022 B	Soil Pulp	<20	<5	59	<10	5	2719	1106	14	372	53503	<10	13	2207	933	384	3675	584	543	<2	12
NK 11-015 B	Soil Pulp	<20	<5	61	<10	<5	1444	1518	15	734	190510	<10	19	1104	509	333	5446	294	410	<2	6
LKSD-4B	Soil Pulp	<20	<5	<20	<10	<5	724	580	<5	148	21150	<10	<10	337	5543	792	8557	85	251	<2	10
NK 11-016 B	Soil Pulp	64	<5	144	<10	<5	2025	1042	40	259	28010	24	89	1619	390	285	7898	412	416	<2	<5
NK 11-081 B2	Soil Pulp	<20	<5	260	<10	6	5631	2415	46	429	119095	<10	25	5562	732	244	5874	1445	968	<2	<5
NK 11-020 B	Soil Pulp	<20	<5	26	<10	<5	1149	1866	5	401	27906	<10	19	815	591	168	4811	221	809	<2	<5
NK 11-081 B	Soil Pulp	<20	<5	276	<10	6	5753	2526	37	442	118750	<10	17	5517	625	257	5888	1472	1017	<2	9
NK 12-039 root soil	Soil Pulp	22	<5	173	<10	6	2464	814	34	145	1.31148	23	112	1486	477	383	72977	407	2064	<2	17
LKSD-4C	Soil Pulp	<20	<5	<20	<10	<5	750	511	<5	152	21451	<10	<10	313	5080	739	7260	101	255	<2	15
NK 12-072 root soil	Soil Pulp	82	<5	<20	<10	8	252	106	<5	40	1.11019	18	109	148	<50	4172	1008	41	444	<2	<5
NK 11-012 Att2	Soil Pulp	<20	<5	21	<10	6	1181	1432	<5	282	45845	<10	25	840	596	230	6170	232	989	<2	<5
NK 12-060 root soil	Soil Pulp	<20	<5	158	<10	<5	6046	1435	37	329	20729	<10	30	4456	700	545	8691	1213	827	2	<5
NK 11-016 AH	Soil Pulp	<20	<5	<20	<10	<5	89	620	<5	74	13865	12	66	61	321	2029	1202	16	346	<2	<5
NK 11-015 AH	Soil Pulp	<20	<5	<20	<10	<5	8	161	<5	26	42414	12	12	<5	267	3265	659	<5	345	<2	<5
LKSD-4D	Soil Pulp	<20	<5	<20	<10	<5	501	316	<5	146	20295	<10	<10	264	4617	698	6058	70	230	<2	12
NK11-016 AH2	Soil Pulp	<20	<5	<20	<10	5	110	368	<5	76	14060	12	66	43	305	1948	1493	14	370	<2	<5
NK11-014 AH	Soil Pulp	<20	<5	<20	<10	<5	15	60	<5	22	6636	11	<10	9	71	4056	607	<5	190	2	<5
NK11-012 AH	Soil Pulp	<20	<5	22	<10	5	1191	1610	<5	284	48488	<10	15	738	639	225	6300	213	948	<2	<5
NK11-009 AH	Soil Pulp	<20	<5	<20	<10	<5	201	2286	<5	213	94941	<10	18	105	390	1188	1551	29	752	<2	<5
LKSD-4E	Soil Pulp	<20	<5	<20	<10	<5	558	425	<5	137	18567	<10	<10	296	4533	687	6237	82	232	<2	12
NK11-006AH	Soil Pulp	<20	<5	<20	<10	<5	15	115	<5	23	10910	<10	<10	<5	246	2431	807	<5	270	<2	<5

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLF
	Analyte	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr	Ag
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	100	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5	100	20	3
NK 12-060 C Lower Lab	Soil Pulp	189	<200	533	<20	481	<20	83	<20	<20	2	13	34	64	1906	<10	2883	216	10359	227	8
NK 12-060 C Upper Lab	Soil Pulp	155	<200	671	<20	387	<20	93	<20	<20	2	14	41	87	1969	<10	3009	216	14132	299	29
NK 12-060 B Lab	Soil Pulp	140	<200	1183	21	532	<20	158	<20	<20	3	21	55	110	2418	<10	5405	292	14655	515	50
NK 11-020 B2	Soil Pulp	<100	<200	154	<20	295	<20	21	<20	<20	2	22	<5	36	2044	<10	682	71	6885	20	55
NK 12-072 B Lab	Soil Pulp	890	<200	179	<20	5554	<20	48	<20	<20	2	206	27	6	162	<10	2394	119	20607	668	36
LKSD-4A	Soil Pulp	<100	<200	46	<20	7967	<20	7	<20	<20	2	49	<5	92	1140	<10	295	24	23486	<20	92
NK 12-039 B Lab	Soil Pulp	<100	<200	874	<20	7850	<20	230	<20	<20	2	123	125	28	1965	<10	8923	723	14241	993	78
NK 11-014 B	Soil Pulp	114	<200	166	<20	205	<20	35	23	<20	3	28	13	27	1517	<10	925	60	5966	549	31
NK 11-016 B2	Soil Pulp	<100	<200	354	<20	274	<20	96	<20	<20	3	24	56	32	1248	<10	3855	292	7111	1843	34
NK 11-022 B	Soil Pulp	101	<200	375	<20	804	<20	50	<20	<20	3	18	16	164	2405	<10	1579	82	7828	120	38
NK 11-015 B	Soil Pulp	262	<200	154	<20	366	<20	42	<20	<20	5	19	20	28	3231	<10	1571	130	9916	897	22
LKSD-4B	Soil Pulp	<100	<200	51	<20	8126	<20	5	<20	<20	2	49	<5	81	1091	<10	247	13	21988	<20	98
NK 11-016 B	Soil Pulp	111	<200	380	<20	272	<20	96	22	<20	3	31	59	37	1432	<10	3899	326	8057	1930	23
NK 11-081 B2	Soil Pulp	125	<200	1127	<20	1139	<20	208	<20	<20	2	21	65	145	3183	<10	6140	382	16935	502	46
NK 11-020 B	Soil Pulp	124	<200	187	<20	294	<20	12	<20	<20	2	19	<5	34	2127	<10	670	36	7140	25	41
NK 11-081 B	Soil Pulp	150	<200	1185	<20	1057	<20	239	<20	<20	3	23	74	146	3083	<10	6200	330	17447	571	68
NK 12-039 root soil	Soil Pulp	<100	<200	330	<20	1065	<20	81	<20	<20	2	105	51	29	2094	<10	4069	265	10328	638	41
LKSD-4C	Soil Pulp	<100	<200	51	<20	7602	<20	11	<20	<20	2	51	<5	82	906	<10	261	13	22009	<20	83
NK 12-072 root soil	Soil Pulp	<100	<200	35	31	6499	<20	6	22	<20	11	110	<5	18	140	<10	258	20	5444	3104	12
NK 11-012 Att2	Soil Pulp	191	<200	175	<20	345	<20	20	<20	<20	3	16	6	21	1905	<10	636	31	11302	101	9
NK 12-060 root soil	Soil Pulp	<100	<200	865	<20	729	<20	139	<20	<20	3	27	47	72	1954	<10	4474	208	13872	401	82
NK 11-016 AH	Soil Pulp	<100	<200	<5	22	2929	<20	<5	<20	<20	6	19	<5	11	316	<10	194	32	4950	241	57
NK 11-015 AH	Soil Pulp	<100	<200	<5	<20	3785	<20	<5	<20	<20	9	22	<5	<5	235	<10	8	<5	2668	52	16
LKSD-4D	Soil Pulp	<100	<200	53	<20	7324	<20	7	<20	<20	2	51	<5	78	817	<10	225	16	21666	<20	80
NK11-016 AH2	Soil Pulp	<100	<200	12	<20	3059	<20	<5	<20	<20	5	19	<5	12	381	<10	191	29	5218	294	25
NK11-014 AH	Soil Pulp	<100	<200	<5	<20	5613	<20	<5	<20	<20	10	10	<5	6	83	<10	36	<5	3020	26	20
NK11-012 AH	Soil Pulp	<100	<200	132	<20	361	<20	23	<20	<20	2	16	8	30	1960	<10	622	41	11254	109	81
NK11-009 AH	Soil Pulp	<100	<200	<5	<20	2773	<20	<5	22	<20	4	27	<5	19	319	<10	172	12	10707	151	32
LKSD-4E	Soil Pulp	<100	<200	39	<20	7599	<20	<5	<20	<20	2	45	<5	67	808	<10	229	14	21098	<20	73
NK11-006AH	Soil Pulp	<100	<200	<5	<20	3319	<20	<5	<20	<20	7	13	<5	<5	185	<10	28	<5	2413	<20	<3

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf
	Unit	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb
	MDL	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5	20	5	50	20
NK 12-060 C Lower Lab	Soil Pulp	164	244	<1	838	225	<5	15	<20	859	307	54	205	54	31	6	935	22	59	<50	<20
NK 12-060 C Upper Lab	Soil Pulp	241	184	1	1674	134	6	24	<20	665	322	121	157	54	42	17	957	44	88	<50	<20
NK 12-060 B Lab	Soil Pulp	315	<100	2	2621	189	8	28	<20	1593	330	129	119	125	77	26	1254	78	192	<50	<20
NK 11-020 B2	Soil Pulp	244	<100	3	1810	53	8	15	<20	562	279	60	62	10	12	<5	1150	35	13	<50	<20
NK 12-072 B Lab	Soil Pulp	1534	<100	3	22989	178	10	43	112	7845	355	61	47	607	338	39	979	333	553	<50	<20
LKSD-4A	Soil Pulp	465	1100	<1	18020	68	11	158	84	1456	778	105	410	61	36	13	2236	49	103	<50	<20
NK 12-039 B Lab	Soil Pulp	183	188	2	8509	49	11	44	22	2889	314	105	181	221	155	19	1782	133	198	<50	<20
NK 11-014 B	Soil Pulp	272	<100	1	4762	<20	<5	21	<20	339	261	72	171	18	10	<5	1304	49	31	<50	<20
NK 11-016 B2	Soil Pulp	295	<100	3	9453	81	15	26	<20	763	229	60	108	77	59	<5	913	141	70	<50	<20
NK 11-022 B	Soil Pulp	270	<100	<1	4250	<20	14	47	<20	482	383	20	84	55	21	7	1223	41	55	<50	<20
NK 11-015 B	Soil Pulp	319	<100	1	57928	<20	11	20	<20	530	337	22	123	33	16	<5	1472	70	35	<50	<20
LKSD-4B	Soil Pulp	463	1135	1	17626	<20	6	173	75	1320	742	93	391	57	49	12	2169	40	101	<50	<20
NK 11-016 B	Soil Pulp	300	<100	1	9783	63	8	24	<20	748	205	51	52	103	51	6	921	129	58	<50	<20
NK 11-081 B2	Soil Pulp	294	114	<1	6061	206	<5	45	34	3313	535	51	219	166	77	22	1845	30	186	<50	<20
NK 11-020 B	Soil Pulp	279	<100	<1	1734	<20	<5	17	<20	526	286	46	112	16	<5	<5	1185	45	18	<50	<20
NK 11-081 B	Soil Pulp	332	168	<1	5952	<20	<5	43	<20	3397	566	30	200	144	84	22	1811	41	219	<50	<20
NK 12-039 root soil	Soil Pulp	193	278	<1	6656	27	22	17	<20	2248	293	113	118	138	100	12	1525	146	94	<50	<20
LKSD-4C	Soil Pulp	518	1374	2	18303	53	13	164	71	1264	733	99	353	56	30	14	2196	42	93	<50	<20
NK 12-072 root soil	Soil Pulp	265	192	<1	82785	<20	<5	658	288	2044	103	95	<20	109	62	<5	423	119	101	<50	28
NK 11-012 Att2	Soil Pulp	275	<100	2	4152	<20	<5	15	<20	754	305	26	107	23	18	<5	1608	52	37	<50	<20
NK 12-060 root soil	Soil Pulp	356	<100	<1	2452	127	<5	26	21	1820	276	106	70	173	88	23	1300	70	204	<50	<20
NK 11-016 AH	Soil Pulp	223	<100	<1	14843	28	5	90	<20	460	73	26	<20	22	21	<5	665	70	24	<50	<20
NK 11-015 AH	Soil Pulp	131	192	<1	41302	<20	6	135	27	181	76	46	76	9	<5	<5	704	35	11	<50	<20
LKSD-4D	Soil Pulp	491	1328	<1	20805	68	9	179	95	1367	742	92	388	61	38	13	2219	42	107	<50	<20
NK11-016 AH2	Soil Pulp	225	127	<1	13537	<20	19	79	<20	453	89	27	68	46	20	<5	679	62	26	<50	<20
NK11-014 AH	Soil Pulp	102	164	<1	47238	<20	5	367	56	176	72	27	55	19	5	<5	325	20	12	<50	<20
NK11-012 AH	Soil Pulp	274	<100	<1	4012	<20	<5	16	<20	757	313	24	104	19	8	<5	1608	48	31	<50	<20
NK11-009 AH	Soil Pulp	390	223	<1	12399	77	<5	93	<20	530	175	96	<20	49	21	<5	1301	52	22	<50	<20
LKSD-4E	Soil Pulp	497	1131	<1	18042	<20	<5	170	84	1156	745	83	338	64	32	15	2070	42	88	<50	<20
NK11-006AH	Soil Pulp	111	365	<1	7837	<20	5	107	<20	79	52	25	36	<5	<5	<5	368	<20	<5	<50	<20

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	Sb	Sc
	Unit	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	5	20	10	5	5	20	5	1	50	10	10	5	50	5	20	5	5	2	5	100
NK 12-060 C Lower Lab	Soil Pulp	<5	<20	<10	<5	532	1173	<5	103	25911	41	186	414	444	40	2168	118	266	<2	<5	274
NK 12-060 C Upper Lab	Soil Pulp	<5	<20	<10	<5	553	1603	<5	135	14476	21	196	388	387	39	2024	107	239	<2	7	188
NK 12-060 B Lab	Soil Pulp	<5	34	<10	<5	1061	2311	<5	196	14356	21	135	1009	554	74	2982	276	428	3	<5	216
NK 11-020 B2	Soil Pulp	<5	<20	<10	<5	196	2078	<5	142	15326	89	70	112	606	62	958	38	573	3	<5	156
NK 12-072 B Lab	Soil Pulp	8	133	<10	<5	1933	533	33	5	627380	14	78	1621	269	174	20603	375	339	2	<5	848
LKSD-4A	Soil Pulp	11	<20	<10	<5	1032	1214	<5	293	23141	18	<10	615	2814	314	9450	161	496	<2	23	272
NK 12-039 B Lab	Soil Pulp	<5	48	<10	<5	681	1558	12	140	216591	180	586	606	294	193	18194	147	1989	<2	<5	<100
NK 11-014 B	Soil Pulp	<5	<20	<10	<5	151	1531	<5	139	8807	31	115	123	380	112	1087	34	499	<2	<5	107
NK 11-016 B2	Soil Pulp	<5	<20	<10	<5	284	1944	<5	158	14291	74	401	260	388	74	1664	63	298	2	9	158
NK 11-022 B	Soil Pulp	5	<20	<10	<5	362	1631	<5	217	18468	18	48	355	708	86	1172	84	422	2	<5	197
NK 11-015 B	Soil Pulp	<5	<20	<10	<5	209	1746	<5	228	51426	36	136	153	369	107	1355	32	341	<2	<5	183
LKSD-4B	Soil Pulp	8	<20	<10	5	997	1296	8	294	22873	<10	<10	579	2775	335	8945	166	457	<2	21	227
NK 11-016 B	Soil Pulp	8	<20	<10	<5	291	1821	<5	165	14284	30	393	226	427	72	1702	51	272	4	<5	<100
NK 11-081 B2	Soil Pulp	27	31	<10	<5	873	4424	7	213	38471	29	60	852	553	110	1321	208	725	2	9	160
NK 11-020 B	Soil Pulp	<5	<20	<10	<5	169	2055	<5	146	15550	41	58	126	467	77	982	33	568	<2	<5	<100
NK 11-081 B	Soil Pulp	13	25	<10	<5	914	4124	7	206	37551	40	66	927	644	130	1237	198	717	<2	7	104
NK 12-039 root soil	Soil Pulp	<5	31	<10	<5	516	1085	9	118	161885	131	426	395	208	205	18595	94	2103	<2	7	<100
LKSD-4C	Soil Pulp	10	<20	<10	<5	984	1240	5	292	22388	21	<10	612	2672	337	8369	177	478	<2	21	160
NK 12-072 root soil	Soil Pulp	13	26	<10	<5	1241	499	6	53	984243	15	72	518	246	937	9642	146	784	<2	7	<100
NK 11-012 Att2	Soil Pulp	20	<20	<10	<5	298	2492	<5	165	34527	45	71	220	620	117	1535	58	1137	<2	9	<100
NK 12-060 root soil	Soil Pulp	<5	31	<10	<5	1324	2591	8	245	16080	14	64	901	525	116	3266	271	601	<2	<5	<100
NK 11-016 AH	Soil Pulp	<5	<20	<10	<5	171	680	<5	120	9216	<10	65	99	380	384	2199	20	494	<2	<5	<100
NK 11-015 AH	Soil Pulp	14	<20	<10	<5	48	448	<5	52	22027	<10	34	28	521	475	3133	<5	611	<2	<5	<100
LKSD-4D	Soil Pulp	10	<20	<10	<5	950	1320	<5	295	22023	<10	<10	665	3193	366	8958	169	496	<2	17	151
NK11-016 AH2	Soil Pulp	8	<20	<10	<5	170	1191	<5	116	9370	<10	76	78	377	326	2128	17	452	<2	<5	<100
NK11-014 AH	Soil Pulp	8	<20	<10	<5	101	192	<5	30	8579	13	13	79	379	634	4821	14	394	<2	5	<100
NK11-012 AH	Soil Pulp	12	<20	<10	<5	303	2351	<5	169	31623	54	66	233	559	106	1654	57	1082	<2	<5	<100
NK11-009 AH	Soil Pulp	6	<20	<10	<5	323	4832	<5	282	31688	<10	19	142	457	318	2403	41	1356	<2	<5	<100
LKSD-4E	Soil Pulp	8	<20	<10	<5	865	1039	6	270	20495	18	<10	572	2692	304	8294	131	445	<2	19	209
NK11-006AH	Soil Pulp	12	<20	<10	<5	41	178	<5	45	4122	18	<10	25	462	318	2282	<5	496	<2	<5	<100

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1T	1T
	Analyte	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr	Mo	Cu
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppm
	MDL	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5	100	20	0.05	0.02
NK 12-060 C Lower Lab	Soil Pulp	<200	71	<20	75	<20	7	<20	<20	1	10	<5	30	1511	<10	359	45	3808	612	0.72	3.63
NK 12-060 C Upper Lab	Soil Pulp	<200	87	<20	71	<20	12	<20	<20	2	8	<5	37	1511	<10	460	38	6764	630	0.71	3.06
NK 12-060 B Lab	Soil Pulp	<200	169	<20	98	<20	24	<20	<20	2	12	10	49	1505	<10	913	63	10457	556	1.00	6.60
NK 11-020 B2	Soil Pulp	<200	17	<20	89	<20	<5	37	<20	2	17	<5	15	1738	<10	92	14	5621	<20	2.08	5.93
NK 12-072 B Lab	Soil Pulp	<200	344	<20	685	<20	94	<20	<20	1	54	45	21	604	<10	4131	204	8859	998	1.38	8.66
LKSD-4A	Soil Pulp	<200	102	<20	1429	<20	16	<20	<20	2	30	7	137	1512	<10	554	46	16136	<20	1.44	31.09
NK 12-039 B Lab	Soil Pulp	<200	134	<20	820	<20	40	<20	<20	2	40	19	19	1652	<10	1469	143	9318	876	2.46	9.84
NK 11-014 B	Soil Pulp	<200	26	<20	67	<20	<5	<20	<20	2	24	<5	14	1545	<10	142	<5	5618	137	1.89	5.41
NK 11-016 B2	Soil Pulp	<200	60	<20	78	<20	13	<20	<20	2	16	6	23	1157	<10	559	53	7425	795	1.37	5.97
NK 11-022 B	Soil Pulp	<200	66	<20	153	<20	6	38	<20	3	12	<5	55	2034	<10	227	19	6358	21	0.70	6.54
NK 11-015 B	Soil Pulp	<200	26	<20	27	<20	<5	<20	<20	4	10	<5	20	2373	<10	190	16	9583	435	1.28	7.19
LKSD-4B	Soil Pulp	239	96	<20	1458	<20	9	<20	<20	2	27	<5	119	1354	<10	508	40	16577	<20	1.33	30.89
NK 11-016 B	Soil Pulp	<200	40	<20	65	<20	9	<20	<20	2	19	5	19	1231	<10	573	32	7437	851	1.11	5.25
NK 11-081 B2	Soil Pulp	<200	172	<20	187	<20	37	<20	<20	3	14	10	58	2152	<10	1057	51	17004	86	1.63	10.05
NK 11-020 B	Soil Pulp	<200	21	<20	48	<20	<5	<20	<20	2	19	<5	24	1953	<10	85	6	4820	<20	2.31	6.25
NK 11-081 B	Soil Pulp	<200	183	<20	230	<20	37	38	<20	3	12	10	48	2031	<10	1135	45	16591	83	1.69	10.19
NK 12-039 root soil	Soil Pulp	<200	68	<20	85	<20	22	<20	<20	2	49	9	21	1569	<10	885	73	8710	643	2.34	8.59
LKSD-4C	Soil Pulp	<200	84	<20	1442	<20	10	<20	<20	2	26	<5	108	1716	<10	483	32	15618	<20	1.28	32.16
NK 12-072 root soil	Soil Pulp	<200	87	<20	5063	<20	16	<20	<20	3	95	8	13	391	<10	793	49	17547	1309	1.55	10.82
NK 11-012 Att2	Soil Pulp	<200	19	<20	82	<20	<5	<20	<20	2	21	<5	11	1696	<10	169	5	11201	40	1.92	7.99
NK 12-060 root soil	Soil Pulp	<200	200	<20	89	<20	24	<20	<20	2	16	13	39	1163	<10	961	52	11316	361	1.10	7.86
NK 11-016 AH	Soil Pulp	<200	17	<20	625	<20	6	<20	<20	2	20	<5	12	447	<10	220	16	4581	406	1.09	7.34
NK 11-015 AH	Soil Pulp	<200	<5	<20	1329	<20	<5	<20	<20	2	15	<5	6	529	<10	36	5	4397	105	0.88	7.90
LKSD-4D	Soil Pulp	<200	102	<20	1553	<20	13	<20	<20	2	26	<5	112	1260	<10	475	19	17431	<20	1.51	33.47
NK11-016 AH2	Soil Pulp	<200	9	<20	522	<20	<5	<20	<20	2	15	<5	15	200	<10	217	16	4680	372	1.25	7.99
NK11-014 AH	Soil Pulp	<200	<5	<20	3454	<20	<5	<20	<20	2	17	<5	9	142	<10	133	8	4980	56	1.21	8.42
NK11-012 AH	Soil Pulp	<200	48	<20	73	<20	9	39	<20	2	22	<5	14	1222	<10	175	10	9965	46	1.94	8.26
NK11-009 AH	Soil Pulp	<200	37	<20	532	<20	7	<20	<20	1	26	<5	10	367	<10	268	21	12987	117	1.58	9.50
LKSD-4E	Soil Pulp	<200	90	<20	1496	<20	15	<20	<20	1	28	5	105	1315	<10	452	32	15823	<20	1.33	33.19
NK11-006AH	Soil Pulp	<200	7	<20	891	<20	<5	<20	<20	1	16	<5	<5	278	<10	38	<5	2020	<20	0.99	5.92

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

AcmeLabs™
A Bureau Veritas Group Company

www.acmelab.com

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P	La	Cr
	Unit	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm
	MDL	0.02	0.2	20	0.1	0.2	2	0.02	0.2	0.1	0.1	0.1	1	0.02	0.02	0.04	1	0.02	0.001	0.1	1
NK 12-060 C Lower Lab	Soil Pulp	15.46	29.8	93	5.1	2.4	210	1.07	3.2	1.8	<0.1	3.8	131	0.20	0.21	0.18	23	0.77	0.014	18.2	9
NK 12-060 C Upper Lab	Soil Pulp	17.34	41.1	92	5.6	2.7	242	1.14	2.7	1.8	<0.1	3.9	134	0.18	0.17	0.11	23	0.78	0.014	18.9	10
NK 12-060 B Lab	Soil Pulp	24.57	106.0	191	10.3	4.1	349	1.59	3.3	3.4	<0.1	5.5	129	0.43	0.27	0.21	36	0.72	0.046	28.7	23
NK 11-020 B2	Soil Pulp	13.28	38.4	79	6.8	3.1	262	1.47	4.3	2.5	<0.1	4.3	139	0.20	0.32	0.14	38	0.78	0.037	16.7	18
NK 12-072 B Lab	Soil Pulp	47.55	90.2	1609	5.6	2.2	405	3.09	3.3	4.1	<0.1	2.9	49	3.76	0.70	0.42	24	0.36	0.342	30.4	13
LKSD-4A	Soil Pulp	24.83	59.4	141	24.6	8.7	188	2.48	10.2	7.0	<0.1	3.3	94	0.09	1.43	0.45	37	0.49	0.290	12.8	35
NK 12-039 B Lab	Soil Pulp	37.14	71.1	513	5.9	3.1	333	1.77	4.5	2.5	<0.1	4.6	106	1.17	0.66	0.42	28	0.54	0.135	17.2	17
NK 11-014 B	Soil Pulp	13.38	51.7	39	7.1	2.7	217	1.31	3.2	2.7	<0.1	4.6	125	0.12	0.26	0.16	39	0.68	0.055	15.9	21
NK 11-016 B2	Soil Pulp	12.58	77.5	99	7.7	2.9	238	1.75	2.9	2.1	<0.1	4.2	118	0.32	0.39	0.21	31	0.67	0.038	18.5	19
NK 11-022 B	Soil Pulp	12.87	47.2	127	9.4	3.9	226	1.26	2.8	3.0	<0.1	4.8	127	0.13	0.24	0.13	41	0.78	0.034	17.4	22
NK 11-015 B	Soil Pulp	14.72	82.1	94	6.2	3.1	341	1.89	3.4	2.2	<0.1	4.9	183	0.22	0.30	0.15	41	1.07	0.074	18.3	20
LKSD-4B	Soil Pulp	26.70	60.9	163	24.5	8.4	199	2.55	10.0	7.0	<0.1	3.3	96	0.10	1.31	0.43	38	0.53	0.290	13.1	35
NK 11-016 B	Soil Pulp	11.95	70.7	106	8.9	2.7	241	1.86	2.6	2.0	<0.1	3.7	117	0.34	0.32	0.18	30	0.73	0.032	17.7	22
NK 11-081 B2	Soil Pulp	14.74	117.7	103	14.3	4.5	301	1.81	4.2	2.9	<0.1	6.4	173	0.14	0.33	0.13	48	1.02	0.064	19.1	26
NK 11-020 B	Soil Pulp	13.60	40.8	80	7.5	3.1	271	1.55	3.9	2.8	<0.1	4.8	141	0.17	0.34	0.12	41	0.80	0.042	18.6	23
NK 11-081 B	Soil Pulp	14.46	122.6	153	14.3	5.0	301	1.82	3.8	3.1	<0.1	6.4	168	0.17	0.35	0.14	49	0.99	0.063	21.0	28
NK 12-039 root soil	Soil Pulp	37.26	55.3	507	6.0	2.3	296	1.74	4.1	2.1	<0.1	3.6	94	1.35	0.81	0.40	27	0.55	0.105	21.0	18
LKSD-4C	Soil Pulp	28.52	64.3	165	25.6	8.2	194	2.50	9.3	6.9	<0.1	3.1	88	0.08	1.37	0.42	36	0.51	0.266	12.5	34
NK 12-072 root soil	Soil Pulp	62.05	55.4	565	7.1	3.3	413	1.46	2.3	1.9	<0.1	1.7	30	1.64	0.63	0.38	13	0.21	0.414	32.3	12
NK 11-012 Att2	Soil Pulp	14.66	70.7	141	9.1	3.3	283	1.71	3.8	2.9	<0.1	5.0	122	0.12	0.38	0.15	38	0.71	0.066	18.8	25
NK 12-060 root soil	Soil Pulp	25.14	103.5	178	10.2	4.3	321	1.51	3.4	3.4	<0.1	4.9	117	0.43	0.31	0.22	36	0.65	0.062	28.1	21
NK 11-016 AH	Soil Pulp	11.35	42.3	51	5.5	1.8	132	1.09	1.7	1.4	<0.1	4.3	65	0.17	0.36	0.18	18	0.41	0.080	15.4	13
NK 11-015 AH	Soil Pulp	10.37	22.1	36	5.3	1.1	76	0.46	1.3	0.7	<0.1	1.3	43	0.06	0.51	0.12	13	0.25	0.051	5.3	11
LKSD-4D	Soil Pulp	31.15	61.9	171	25.6	8.8	191	2.56	9.5	7.6	<0.1	3.4	89	0.09	1.43	0.43	37	0.48	0.371	13.6	35
NK11-016 AH2	Soil Pulp	10.84	44.0	71	5.9	1.8	119	0.99	1.9	1.3	<0.1	2.1	59	0.15	0.65	0.20	19	0.38	0.082	10.5	15
NK11-014 AH	Soil Pulp	17.87	14.6	129	5.9	1.3	45	0.32	1.3	0.7	<0.1	1.0	25	0.06	0.81	0.13	9	0.17	0.063	4.2	10
NK11-012 AH	Soil Pulp	14.89	71.6	111	9.6	3.2	294	1.71	3.8	2.9	<0.1	4.7	121	0.12	0.39	0.15	38	0.72	0.066	17.7	25
NK11-009 AH	Soil Pulp	15.73	75.8	85	9.6	3.8	259	1.35	2.1	2.3	<0.1	3.4	79	0.16	0.35	0.19	27	0.53	0.169	11.8	18
LKSD-4E	Soil Pulp	32.56	65.0	200	26.1	8.3	188	2.48	9.0	7.5	<0.1	3.4	89	0.09	1.37	0.42	36	0.50	0.303	13.9	34
NK11-006AH	Soil Pulp	10.93	13.8	112	5.2	1.4	84	0.46	1.6	1.2	<0.1	1.6	48	0.06	0.54	0.12	16	0.31	0.044	7.2	14

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Mg	Ba	Ti	Al	Na	K	W	Zr	Sn	Be	Sc	S	Y	Ce	Pr	Nd	Sm	Eu	Gd	Tb
	Unit	%	ppm	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	1	0.001	0.02	0.002	0.02	0.1	0.2	0.1	1	0.1	0.04	0.1	0.02	0.1	0.1	0.1	0.1	0.1	0.1
NK 12-060 C Lower Lab	Soil Pulp	0.22	576	0.205	4.33	1.868	2.43	0.4	265.3	3.7	2	4.6	<0.04	21.0	35.07	4.2	17.2	3.3	0.5	2.9	0.5
NK 12-060 C Upper Lab	Soil Pulp	0.25	615	0.214	4.50	1.921	2.54	0.4	317.4	6.7	2	4.6	<0.04	30.2	39.93	4.7	17.6	3.6	0.8	3.3	0.6
NK 12-060 B Lab	Soil Pulp	0.38	522	0.265	4.87	1.840	2.25	0.7	687.9	12.9	3	6.0	<0.04	76.7	67.94	7.5	28.1	7.2	1.1	7.9	1.6
NK 11-020 B2	Soil Pulp	0.25	519	0.295	4.16	1.660	2.24	0.6	223.1	2.3	1	6.1	<0.04	13.9	37.54	3.9	15.1	2.8	0.5	2.8	0.4
NK 12-072 B Lab	Soil Pulp	0.13	235	0.120	4.50	2.620	1.09	0.7	>2000	41.2	2	4.9	0.06	122.1	96.89	8.0	30.8	8.7	1.2	10.1	2.4
LKSD-4A	Soil Pulp	0.49	218	0.202	2.18	0.663	0.74	0.5	53.5	3.6	<1	4.5	0.71	9.8	24.60	3.4	13.2	2.4	0.6	2.5	0.3
NK 12-039 B Lab	Soil Pulp	0.26	525	0.258	4.19	1.799	2.28	0.9	>2000	10.5	2	5.0	<0.04	44.6	67.08	4.6	18.1	4.8	0.8	5.2	1.1
NK 11-014 B	Soil Pulp	0.25	488	0.306	4.29	1.644	2.13	0.8	237.4	3.0	1	5.7	<0.04	16.0	33.08	3.9	15.8	3.2	0.5	2.9	0.4
NK 11-016 B2	Soil Pulp	0.24	420	0.246	4.36	2.046	1.86	0.7	573.3	9.7	1	6.0	<0.04	32.1	48.19	4.5	18.7	3.7	0.7	4.0	0.8
NK 11-022 B	Soil Pulp	0.33	507	0.334	4.42	1.548	2.24	0.7	173.3	1.9	1	6.7	<0.04	14.6	33.73	4.2	16.5	3.1	0.7	2.7	0.4
NK 11-015 B	Soil Pulp	0.26	810	0.307	4.59	1.776	1.96	0.6	329.9	3.5	2	7.7	<0.04	19.7	43.67	4.6	17.5	3.4	0.6	3.0	0.5
LKSD-4B	Soil Pulp	0.50	227	0.208	2.34	0.666	0.75	0.5	47.9	3.4	<1	4.7	0.70	10.4	26.58	3.6	14.1	2.6	0.6	2.2	0.3
NK 11-016 B	Soil Pulp	0.23	415	0.234	4.48	2.121	1.94	0.7	541.1	9.8	1	5.6	<0.04	32.3	44.92	4.6	17.4	4.2	0.7	4.1	0.8
NK 11-081 B2	Soil Pulp	0.40	528	0.367	5.15	1.715	2.19	0.8	182.1	2.3	2	8.4	<0.04	18.4	44.19	4.8	18.2	3.5	0.7	3.3	0.5
NK 11-020 B	Soil Pulp	0.27	502	0.322	4.23	1.584	2.16	0.7	229.7	2.4	1	6.6	<0.04	14.5	42.44	4.4	17.6	3.1	0.6	2.7	0.4
NK 11-081 B	Soil Pulp	0.40	516	0.363	5.13	1.655	2.14	0.8	192.5	2.3	2	8.1	<0.04	18.5	48.45	5.1	18.9	3.6	0.8	3.6	0.5
NK 12-039 root soil	Soil Pulp	0.17	427	0.197	3.81	1.830	2.14	0.8	>2000	16.3	1	4.7	<0.04	54.3	67.91	5.5	21.5	5.1	0.8	6.5	1.2
LKSD-4C	Soil Pulp	0.50	213	0.199	2.22	0.663	0.74	0.5	49.8	3.2	<1	4.4	0.71	9.9	25.33	3.3	14.4	2.3	0.6	2.0	0.3
NK 12-072 root soil	Soil Pulp	0.09	178	0.080	1.81	1.084	0.66	0.7	>2000	13.5	<1	2.4	0.12	51.0	70.44	6.7	23.8	5.3	0.7	5.1	1.1
NK 11-012 Att2	Soil Pulp	0.28	477	0.285	4.28	1.589	1.97	0.7	217.5	3.0	1	6.0	<0.04	19.0	50.18	4.9	19.3	3.8	0.6	2.9	0.5
NK 12-060 root soil	Soil Pulp	0.36	461	0.270	4.48	1.689	1.91	0.7	713.5	11.2	10	5.5	<0.04	84.9	70.21	7.3	28.4	7.1	1.2	8.5	1.6
NK 11-016 AH	Soil Pulp	0.13	254	0.141	2.50	1.234	1.14	0.5	286.4	5.9	<1	3.0	0.08	19.1	38.33	3.8	14.5	3.1	0.4	2.9	0.6
NK 11-015 AH	Soil Pulp	0.06	200	0.085	1.23	0.494	0.52	0.5	82.1	1.5	<1	1.8	0.13	5.6	12.07	1.2	4.5	0.9	0.1	0.8	0.1
LKSD-4D	Soil Pulp	0.49	223	0.206	2.15	0.649	0.73	0.6	48.2	3.4	<1	4.4	0.72	9.9	26.04	3.5	13.6	2.5	0.5	2.0	0.3
NK11-016 AH2	Soil Pulp	0.14	227	0.135	2.31	1.074	1.01	0.7	264.0	5.2	<1	2.9	0.09	15.5	29.58	2.6	9.4	2.1	0.3	2.1	0.4
NK11-014 AH	Soil Pulp	0.05	113	0.066	0.83	0.372	0.40	0.5	44.8	1.3	<1	1.3	0.15	4.4	8.40	1.0	3.6	0.8	0.1	0.7	0.1
NK11-012 AH	Soil Pulp	0.28	478	0.289	4.34	1.554	1.97	0.7	213.2	3.0	2	6.3	<0.04	20.1	47.41	4.5	17.6	3.6	0.6	2.8	0.6
NK11-009 AH	Soil Pulp	0.27	274	0.205	3.23	1.519	1.12	0.5	227.4	5.3	2	4.5	0.10	19.9	31.00	2.9	11.3	2.1	0.3	2.6	0.4
LKSD-4E	Soil Pulp	0.48	222	0.197	2.27	0.611	0.73	0.6	42.8	3.1	<1	4.3	0.74	10.3	26.40	3.6	14.3	2.5	0.5	2.2	0.3
NK11-006AH	Soil Pulp	0.09	227	0.126	1.74	0.663	0.91	0.5	82.3	1.5	<1	2.2	0.11	5.9	13.68	1.7	5.8	1.2	0.2	0.8	0.1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

CERTIFICATE OF ANALYSIS VAN12005934.2

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Dy	Ho	Er	Tm	Yb	Lu	Hf	Li	Rb	Ta	Nb	Cs	Ga	In	Re	Se	Te	Tl
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.1	0.1	0.1	0.1	0.1	0.1	0.02	0.1	0.1	0.1	0.04	0.1	0.02	0.01	0.002	0.3	0.05	0.05
NK 12-060 C Lower Lab	Soil Pulp	3.6	0.7	2.3	0.3	2.3	0.3	6.47	18.4	80.0	0.7	12.63	1.3	11.96	0.06	0.002	0.9	0.07	0.53
NK 12-060 C Upper Lab	Soil Pulp	4.6	1.0	3.0	0.4	3.3	0.4	7.51	24.7	87.9	0.9	17.05	1.5	13.96	<0.01	0.003	0.6	<0.05	0.56
NK 12-060 B Lab	Soil Pulp	12.1	2.3	7.6	1.1	7.4	1.0	15.40	49.5	96.0	2.0	39.58	4.1	21.13	<0.01	0.004	1.4	<0.05	0.73
NK 11-020 B2	Soil Pulp	2.5	0.5	1.5	0.3	1.8	0.3	6.08	13.2	74.3	0.7	11.46	1.8	11.78	0.04	0.003	0.6	<0.05	0.58
NK 12-072 B Lab	Soil Pulp	21.0	5.1	18.7	3.4	25.2	3.6	150.6	103.7	66.5	8.3	96.62	3.0	39.67	<0.01	0.002	2.1	<0.05	0.46
LKSD-4A	Soil Pulp	1.9	0.4	1.1	0.1	0.9	0.1	1.25	12.7	24.1	0.3	4.13	1.2	8.27	0.04	0.003	2.8	0.19	0.29
NK 12-039 B Lab	Soil Pulp	8.1	1.7	5.7	0.8	6.0	0.7	45.04	33.8	122.4	4.8	65.35	3.8	19.01	0.01	0.002	1.0	<0.05	0.63
NK 11-014 B	Soil Pulp	3.0	0.6	1.9	0.3	2.1	0.3	6.41	16.1	77.7	1.0	14.79	2.4	14.63	0.04	<0.002	0.6	<0.05	0.80
NK 11-016 B2	Soil Pulp	5.8	1.2	3.8	0.6	4.3	0.6	14.39	30.1	79.9	2.2	24.39	2.3	20.44	<0.01	0.003	1.3	<0.05	0.69
NK 11-022 B	Soil Pulp	2.7	0.5	1.6	0.2	1.9	0.3	4.74	15.0	78.7	0.7	11.34	2.2	11.63	0.05	0.006	0.6	<0.05	0.78
NK 11-015 B	Soil Pulp	3.7	0.8	2.5	0.4	2.8	0.4	8.92	22.0	68.3	1.0	14.34	1.7	15.31	0.03	<0.002	0.5	<0.05	0.52
LKSD-4B	Soil Pulp	1.9	0.4	1.1	0.1	1.1	0.1	1.32	12.9	25.4	0.3	4.28	1.2	8.63	0.02	0.003	2.9	0.21	0.29
NK 11-016 B	Soil Pulp	5.7	1.2	4.0	0.6	4.2	0.6	13.85	28.0	78.3	1.9	21.84	2.1	20.89	0.01	<0.002	1.0	<0.05	0.63
NK 11-081 B2	Soil Pulp	3.5	0.7	2.1	0.3	2.3	0.3	5.00	38.0	86.6	0.8	12.34	2.3	13.17	0.03	<0.002	0.6	0.11	0.72
NK 11-020 B	Soil Pulp	2.6	0.5	1.7	0.3	2.1	0.3	6.13	12.6	76.0	0.8	12.71	2.0	12.62	0.02	<0.002	0.7	<0.05	0.64
NK 11-081 B	Soil Pulp	3.5	0.7	2.0	0.3	2.1	0.3	5.28	36.8	87.3	0.8	12.29	2.4	13.50	0.04	<0.002	0.5	<0.05	0.73
NK 12-039 root soil	Soil Pulp	9.9	2.0	6.5	1.0	6.9	0.9	51.87	28.5	97.9	4.7	64.11	2.7	17.71	<0.01	<0.002	0.8	<0.05	0.59
LKSD-4C	Soil Pulp	1.8	0.4	1.0	0.1	1.0	0.1	1.42	12.5	24.3	0.3	3.96	1.2	8.49	0.03	<0.002	2.9	0.21	0.29
NK 12-072 root soil	Soil Pulp	9.1	1.8	6.4	1.1	7.6	1.1	45.98	42.3	44.8	2.3	32.21	2.7	18.18	<0.01	<0.002	2.0	<0.05	0.34
NK 11-012 Att2	Soil Pulp	3.7	0.7	2.2	0.4	2.6	0.4	5.91	22.3	99.2	0.9	14.87	3.0	14.15	0.05	0.003	1.1	<0.05	0.80
NK 12-060 root soil	Soil Pulp	12.9	2.6	8.4	1.3	8.4	1.1	15.80	43.9	89.5	2.0	40.61	4.1	19.15	<0.01	0.003	1.4	<0.05	0.72
NK 11-016 AH	Soil Pulp	3.6	0.7	2.2	0.3	2.3	0.3	7.31	17.1	48.9	1.4	15.07	1.4	13.32	<0.01	0.002	1.5	<0.05	0.42
NK 11-015 AH	Soil Pulp	1.1	0.2	0.7	0.1	0.8	<0.1	2.03	5.1	22.3	0.4	4.46	0.9	4.74	<0.01	0.003	0.7	<0.05	0.19
LKSD-4D	Soil Pulp	1.8	0.4	1.0	0.2	1.0	0.1	1.32	12.7	24.6	0.3	4.18	1.2	8.71	0.04	<0.002	2.8	0.17	0.32
NK11-016 AH2	Soil Pulp	2.9	0.6	1.8	0.3	2.1	0.3	6.99	16.5	44.8	1.4	15.54	1.5	12.42	0.02	<0.002	1.0	<0.05	0.43
NK11-014 AH	Soil Pulp	0.9	0.2	0.5	<0.1	0.5	<0.1	1.23	3.1	17.0	0.2	3.01	0.7	3.23	0.01	<0.002	1.6	<0.05	0.20
NK11-012 AH	Soil Pulp	3.9	0.8	2.4	0.4	2.6	0.4	5.77	21.4	100.2	1.0	15.47	3.2	14.04	0.05	<0.002	0.8	<0.05	0.82
NK11-009 AH	Soil Pulp	3.5	0.7	2.5	0.4	2.7	0.4	6.59	27.6	56.6	1.3	18.45	3.8	15.22	0.02	<0.002	1.2	<0.05	0.52
LKSD-4E	Soil Pulp	2.1	0.4	1.0	0.1	1.1	0.2	1.17	12.6	24.8	0.3	4.09	1.3	8.41	0.02	0.004	2.7	0.29	0.30
NK11-006AH	Soil Pulp	1.0	0.2	0.6	0.1	0.8	<0.1	2.11	5.1	35.9	0.3	4.92	1.2	5.16	0.02	<0.002	0.9	<0.05	0.39

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Ag	Al	As	Au	Ba	Be	Bi	Br	Ca	Cd	Ce	Cl	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga
	Unit	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb
	MDL	0.5	1	5	1	10	1	0.5	10	5	0.5	1	2	1	0.5	5	0.1	0.1	0.1	0.1	0.5
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	0.6	25	17	1	152	11	<0.5	468	22	0.8	145	5	9	3.1	30	37.5	26.9	4.6	45.3	12.3
REP NK 12-060 C Lower	QC	0.9	20	26	1	121	12	<0.5	524	21	0.9	124	<2	7	2.1	32	32.8	25.1	3.8	37.8	10.2
LKSD-4B	Soil Pulp	<0.5	90	174	<1	1327	3	1.2	7744	3122	54.4	110	21	525	4.7	189	9.9	7.7	2.7	28.1	8.1
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard	<0.5	40	240	2	894	6	13.0	3989	475	62.8	40	542	22	17.3	963	4.0	3.0	0.9	41.0	12.4
STD DS3	Standard	<0.5	48	228	1	916	5	15.5	3962	462	63.6	41	529	23	18.6	904	3.9	2.8	0.7	49.0	14.2
STD DS3	Standard	0.7	64	225	<1	1058	8	20.9	3884	471	61.9	39	522	28	23.2	945	3.6	2.5	0.6	67.5	19.9
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank	<0.5	<1	<5	<1	<10	<1	<0.5	<10	<5	<0.5	<1	<2	<1	<0.5	<5	<0.1	<0.1	<0.1	<0.1	<0.5
BLK	Blank	<0.5	<1	<5	<1	<10	<1	<0.5	<10	<5	<0.5	<1	<2	<1	<0.5	<5	<0.1	<0.1	<0.1	<0.1	<0.5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Nd	Ni	P	Pb	Pr
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb
	MDL	0.1	0.1	0.1	1	0.05	0.05	2	2	0.1	0.05	0.1	50	1	3	0.5	1	5	0.1	3	0.5
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	34.7	0.4	32.3	<1	8.40	<0.05	6	108	21.8	4.48	5.6	648	11	10	57.5	140	22	0.6	52	32.9
REP NK 12-060 C Lower	QC	32.9	0.9	29.8	<1	7.91	<0.05	5	92	18.3	4.29	4.2	547	13	10	44.4	129	16	0.5	45	32.1
LKSD-4B	Soil Pulp	13.9	8.1	2.4	<1	2.22	0.07	62	66	47.3	1.35	304.5	100787	29	33	4.9	68	993	21.7	290	15.6
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard	5.5	36.2	20.3	<1	0.71	5.61	79	18	13.3	0.37	91.4	22945	349	91	7.3	27	50	3.0	50	4.9
STD DS3	Standard	4.9	34.9	19.2	<1	0.84	6.50	77	18	15.8	0.38	93.4	21880	325	84	7.1	22	52	3.0	66	5.2
STD DS3	Standard	3.3	37.1	19.2	<1	0.81	8.12	79	15	20.8	0.38	92.6	22868	315	85	9.0	28	63	3.8	68	4.6
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank	<0.1	<0.1	<0.1	<1	<0.05	<0.05	<2	<2	<0.1	<0.05	<0.1	<50	<1	<3	<0.5	<1	<5	<0.1	<3	<0.5
BLK	Blank	0.2	<0.1	<0.1	<1	<0.05	<0.05	<2	<2	<0.1	<0.05	<0.1	<50	<1	<3	<0.5	<1	<5	<0.1	<3	<0.5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW	1SLW
	Analyte	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y
	Unit	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	2	0.05	10	1	20	5	0.5	1	10	0.5	0.05	1	2	0.05	0.2	0.05	0.1	50	2	1
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	53	<0.05	<10	2	<20	<5	32.1	5	57	3.2	5.26	<1	29	1.15	0.9	3.85	14.1	126	<2	249
REP NK 12-060 C Lower	QC	45	<0.05	<10	1	<20	<5	28.2	2	51	2.8	5.23	<1	27	0.92	0.7	3.86	13.4	111	<2	236
LKSD-4B	Soil Pulp	241	1.22	3263	82	22	49	13.6	6	8708	<0.5	1.82	2	41	0.47	23.3	0.97	174.4	420	6	75
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard	114	0.20	<10	181	30	29	4.6	20	1205	0.5	0.55	4	18	2.12	17.0	0.34	61.5	151	73	26
STD DS3	Standard	122	0.20	<10	178	37	26	5.1	23	1198	0.6	0.53	4	15	2.55	17.5	0.42	61.4	164	69	28
STD DS3	Standard	133	0.22	<10	178	35	25	3.5	26	1134	0.6	0.51	6	22	3.27	18.3	0.31	61.8	192	72	22
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank	<2	<0.05	<10	<1	<20	<5	<0.5	<1	<10	<0.5	<0.05	<1	<2	<0.05	<0.2	<0.05	<0.1	<50	<2	<1
BLK	Blank	<2	<0.05	<10	<1	<20	<5	<0.5	<1	<10	<0.5	<0.05	<1	<2	<0.05	<0.2	<0.05	<0.1	<50	<2	<1
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLW	1SLW	1SLW	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Yb	Zn	Zr	Ag	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe
	Unit	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm
	MDL	0.5	10	1	3	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	29.8	134	1772	<3	24	629	<1	12595	330	<5	322	<20	2361	21	14	41	516	298	71	11
REP NK 12-060 C Lower	QC	27.9	94	1626	4	26	843	<1	13313	549	<5	345	<20	2483	21	12	46	548	302	70	9
LKSD-4B	Soil Pulp	9.2	11249	86	<3	245	134	<1	18177	<20	34	2815	505	1185	913	63	300	103	64	38	114
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard	2.4	229	89																	
STD DS3	Standard	3.4	241	93																	
STD DS3	Standard	3.0	356	107																	
STD DS3	Standard				<3	147	300	<1	42394	561	367	1789	3221	508	164	1230	8202	46	28	6	33
STD DS3	Standard				<3	163	239	<1	44335	377	408	1847	3301	605	150	1271	9008	67	48	18	34
STD DS3	Standard				<3	161	636	3	46994	493	463	1872	3642	595	193	1311	9183	86	37	14	36
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank	<0.5	16	1																	
BLK	Blank	<0.5	<10	6																	
BLK	Blank				3	2	<100	<1	<50	25	<5	<5	<20	<5	<20	<5	<20	<5	<5	<5	<5
BLK	Blank				<3	3	<100	<1	<50	<20	<5	<5	<20	<5	<20	<5	<20	<5	<5	<5	<5
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb
	MDL	20	5	50	20	5	20	10	5	5	20	5	1	50	10	10	5	50	5	20	5
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	<20	664	<50	49	<5	108	<10	<5	3102	<20	32	19	3206	<10	<10	2560	<50	<5	1387	628
REP NK 12-060 C Lower	QC	<20	719	<50	58	<5	103	<10	<5	3222	<20	38	22	3237	<10	<10	2647	111	<5	1443	636
LKSD-4B	Soil Pulp	<20	188	<50	<20	<5	24	10	12	744	<20	6	169	115159	54	<10	760	2014	21	17015	173
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	<20	111	<50	66	<5	<20	408	28	423	<20	<5	181	131237	74	<10	427	206	<5	1000	87
STD DS3	Standard	<20	121	<50	83	<5	<20	432	29	451	<20	5	194	139754	105	<10	499	141	<5	1123	90
STD DS3	Standard	<20	141	<50	132	<5	<20	494	29	439	<20	<5	188	144619	74	<10	541	281	<5	1167	93
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<20	<5	<50	<20	<5	<20	<10	<5	<5	<20	<5	<1	<50	<10	<10	<5	<50	<5	<20	<5
BLK	Blank	<20	<5	<50	<20	<5	<20	<10	<5	<5	<20	<5	<1	71	<10	<10	<5	<50	<5	<20	<5
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE	1SLE
	Analyte	Rb	Re	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	5	2	5	100	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	190	2	<5	154	<200	583	<20	876	<20	90	<20	130	<1	<5	31	147	<50	<10	3484	252
REP NK 12-060 C Lower	QC	184	2	<5	186	<200	590	<20	915	<20	101	<20	129	<1	<5	34	154	<50	<10	3801	248
LKSD-4B	Soil Pulp	507	3	67	105	<200	180	<20	12501	<20	18	<20	135	<1	178	9	8135	203	<10	747	43
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	666	2	280	191	<200	90	45	7439	<20	12	<20	129	<1	532	<5	2561	<50	89	410	30
STD DS3	Standard	700	2	285	230	<200	70	<20	7775	<20	16	<20	137	<1	569	<5	2871	<50	110	499	23
STD DS3	Standard	712	3	273	196	<200	129	23	8320	<20	12	<20	128	<1	610	<5	2860	<50	130	492	45
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<5	3	<5	<100	<200	<5	<20	<20	<20	<5	25	<20	<1	<5	<5	<5	<50	<10	<5	<5
BLK	Blank	<5	<2	<5	<100	<200	<5	<20	<20	<20	<5	<20	<20	<1	<5	<5	6	<50	<10	10	<5
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLE	1SLE	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Zn	Zr	Ag	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga
	Unit	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb
	MDL	100	20	3	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5	50
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	467	2176	32	446	367	13	1534	261	20	33	52	5123	135	33	2109	764	570	95	813	252
REP NK 12-060 C Lower	QC	254	2341	26	490	331	8	1644	549	35	33	20	5744	187	35	3028	900	607	104	881	268
LKSD-4B	Soil Pulp	45042	147	25	2639	4408	<1	19987	153	232	1070	534	18614	787	12	3748	1625	943	460	2909	280
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	1737	152																		
STD DS3	Standard	1984	149																		
STD DS3	Standard	2066	181																		
STD DS3	Standard			58	2828	8424	26	18274	580	2266	459	1130	4917	792	297	34882	412	228	112	3178	574
STD DS3	Standard			20	2849	8037	23	17224	719	2294	435	1070	5076	774	286	31860	406	227	123	3120	549
STD DS3	Standard			25	2972	9186	24	18650	1091	2469	431	1010	4919	877	333	31403	401	255	126	3198	577
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<100	<20																		
BLK	Blank	<100	91																		
BLK	Blank			<3	<1	<100	<1	<50	<20	<5	<5	<20	<5	<20	<5	<20	<5	<5	<5	<5	<50

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	Pb	Pr	Rb	Re
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	5	50	20	5	20	10	5	5	20	5	1	50	10	10	5	50	20	5	5	2
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	792	<50	700	<5	188	<10	8	5222	302	78	31	13702	277	1340	3912	408	1832	965	352	<2
REP NK 12-060 C Lower	QC	846	<50	795	5	200	<10	10	5174	326	87	35	14368	284	1531	4687	346	2027	1071	388	<2
LKSD-4B	Soil Pulp	2025	<50	99	5	298	28	<5	13275	107	147	43	52659	763	79	10713	3881	31623	2677	83	<2
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	505	228	651	23	78	674	31	3418	411	33	175	93986	3611	270	2397	1544	3379	625	883	<2
STD DS3	Standard	611	238	621	15	72	735	31	3726	516	33	180	94919	3185	98	2658	1549	3443	686	929	<2
STD DS3	Standard	481	270	652	22	81	736	36	3812	631	25	198	95889	3489	149	2787	1880	3658	635	1105	<2
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<5	<50	<20	<5	<20	<10	<5	<5	<20	<5	<1	<50	<10	<10	<5	<50	<20	8	<5	<2

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO	1SLO
	Analyte	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	5	100	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5	100	20
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	16	430	263	761	181	148	93	129	<20	1704	<1	8	85	215	1247	46	5217	578	1731	26148
REP NK 12-060 C Lower	QC	20	486	<200	842	138	173	117	158	<20	1866	<1	6	85	250	1429	41	6065	594	1658	27918
LKSD-4B	Soil Pulp	254	3453	294	2207	1645	5080	<20	261	<20	5611	<1	64	125	16703	5305	93	9825	1011	46676	1630
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	1541	1928	303	554	2941	2245	24	73	273	2170	<1	153	30	2230	4585	3509	2526	204	9100	2377
STD DS3	Standard	1394	1902	373	549	2946	2132	21	76	274	2043	<1	163	33	2213	4491	3555	2354	194	9456	2461
STD DS3	Standard	1461	2086	298	570	3232	2303	29	72	422	2287	<1	178	30	2315	5067	3290	2480	216	11222	2847
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<5	<100	<200	<5	<20	<20	<20	<5	<20	<20	<1	<5	<5	<5	<50	<10	<5	<5	178	<20

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Ag	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge
	Unit	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb
	MDL	3	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5	20	5	50
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	7	868	<100	<1	3763	152	<5	232	63	4419	547	51	504	545	323	70	1004	80	533	<50
REP NK 12-060 C Lower	QC	12	928	160	1	3859	62	<5	238	33	4693	567	55	589	586	353	71	1072	82	535	<50
LKSD-4B	Soil Pulp	<3	756	1363	1	79445	<20	<5	732	493	866	1056	53	321	29	31	<5	922	28	51	<50
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	103	2525	2399	3	40645	456	189	1009	1025	4695	3039	532	15968	303	156	70	4067	56	401	136
STD DS3	Standard	93	2590	2100	<1	42643	496	163	980	898	4553	2809	389	14972	264	180	61	4086	61	373	158
STD DS3	Standard	102	2569	2016	<1	40813	479	156	987	902	4587	2888	321	14681	312	180	61	4142	65	385	130
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM
	Analyte	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	Sb
	Unit	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb
	MDL	20	5	20	10	5	5	20	5	1	50	10	10	5	50	5	20	5	5	2	5
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	<20	<5	112	<10	<5	3308	1475	29	344	39308	<10	17	3044	527	123	7067	837	453	<2	<5
REP NK 12-060 C Lower	QC	<20	<5	112	<10	<5	3638	1313	35	363	40479	<10	17	3294	636	143	8022	866	494	<2	<5
LKSD-4B	Soil Pulp	<20	<5	<20	<10	<5	724	580	<5	148	21150	<10	<10	337	5543	792	8557	85	251	<2	10
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	<20	<5	60	292	20	2252	1170	20	439	217784	293	<10	2078	10089	407	10053	544	814	<2	159
STD DS3	Standard	<20	<5	58	298	18	2308	1106	20	401	207639	364	<10	2085	10448	397	9475	512	793	<2	146
STD DS3	Standard	<20	<5	60	284	18	2381	1052	19	413	205055	273	<10	1956	10749	349	9324	519	758	<2	153
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLM	1SLF
	Analyte	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr	Ag
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	100	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5	100	20	3
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	189	<200	533	<20	481	<20	83	<20	<20	2	13	34	64	1906	<10	2883	216	10359	227	8
REP NK 12-060 C Lower	QC	165	<200	572	<20	449	<20	96	<20	<20	2	15	46	78	2148	<10	3140	229	11688	271	12
LKSD-4B	Soil Pulp	<100	<200	51	<20	8126	<20	5	<20	<20	2	49	<5	81	1091	<10	247	13	21988	<20	98
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	356	<200	447	51	4487	<20	50	109	<20	2	184	23	170	6480	28	1850	105	18758	114	
STD DS3	Standard	273	<200	387	50	4298	<20	50	70	<20	2	162	19	161	5983	27	1904	109	18801	123	
STD DS3	Standard	238	<200	375	43	4375	<20	55	88	24	2	149	16	168	6712	25	1859	130	19573	130	
STD DS3	Standard																				113
STD DS3	Standard																				118
STD DS3	Standard																				89
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Al	As	Au	Ba	Be	Bi	Ca	Cd	Ce	Co	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf
	Unit	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb
	MDL	1	100	1	50	20	5	5	20	5	20	5	20	5	5	5	5	20	5	50	20
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	164	244	<1	838	225	<5	15	<20	859	307	54	205	54	31	6	935	22	59	<50	<20
REP NK 12-060 C Lower	QC	176	391	<1	986	189	<5	21	<20	906	318	60	210	69	40	8	1058	28	69	<50	<20
LKSD-4B	Soil Pulp	463	1135	1	17626	<20	6	173	75	1320	742	93	391	57	49	12	2169	40	101	<50	<20
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	526	1888	12	8871	79	301	74	129	1163	1020	674	10208	83	34	14	2600	48	105	128	<20
STD DS3	Standard	541	1608	13	8666	52	305	79	153	1051	1014	508	8408	75	39	18	2458	50	110	123	<20
STD DS3	Standard	576	1747	10	8732	90	323	76	126	1161	972	416	7755	62	31	13	2611	60	90	125	<20
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF
	Analyte	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	Sb	Sc
	Unit	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb
	MDL	5	20	10	5	5	20	5	1	50	10	10	5	50	5	20	5	5	2	5	100
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	<5	<20	<10	<5	532	1173	<5	103	25911	41	186	414	444	40	2168	118	266	<2	<5	274
REP NK 12-060 C Lower	QC	<5	<20	<10	<5	591	1149	<5	109	26372	71	206	421	434	43	2224	125	287	<2	<5	215
LKSD-4B	Soil Pulp	8	<20	<10	5	997	1296	8	294	22873	<10	<10	579	2775	335	8945	166	457	<2	21	227
REP LKSD-4B	QC																				
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	<5	<20	105	11	495	1485	<5	254	65399	789	32	478	2730	117	4701	116	678	<2	157	177
STD DS3	Standard	<5	<20	89	8	460	1403	<5	264	62283	836	27	480	2797	126	4401	114	661	<2	135	184
STD DS3	Standard	<5	<20	96	5	461	1597	<5	269	57930	802	26	507	2607	124	4544	119	675	<2	164	165
STD OREAS24P	Standard																				
STD OREAS24P	Standard																				
STD OREAS24P Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1SLF	1T	1T
	Analyte	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr	Mo	Cu
	Unit	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppm	ppm
	MDL	200	5	20	20	20	5	20	20	1	5	5	5	50	10	5	5	100	20	0.05	0.02
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	<200	71	<20	75	<20	7	<20	<20	1	10	<5	30	1511	<10	359	45	3808	612	0.72	3.63
REP NK 12-060 C Lower	QC	<200	79	<20	77	<20	8	<20	<20	2	13	6	34	1445	<10	444	45	3995	617		
LKSD-4B	Soil Pulp	239	96	<20	1458	<20	9	<20	<20	2	27	<5	119	1354	<10	508	40	16577	<20	1.33	30.89
REP LKSD-4B	QC																			1.44	31.12
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard	<200	103	<20	1199	<20	12	<20	<20	2	102	<5	108	5112	22	395	31	14255	73		
STD DS3	Standard	<200	122	<20	1093	<20	9	<20	<20	1	102	<5	105	4787	19	394	30	13649	63		
STD DS3	Standard	<200	129	<20	1095	<20	11	<20	<20	1	114	<5	101	4928	24	397	37	13443	81		
STD OREAS24P	Standard																			1.55	49.42
STD OREAS24P	Standard																			1.37	50.67
STD OREAS24P Expected																				1.5	52
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
	Analyte	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P	La	Cr
	Unit	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm
	MDL	0.02	0.2	20	0.1	0.2	2	0.02	0.2	0.1	0.1	0.1	1	0.02	0.02	0.04	1	0.02	0.001	0.1	1
Pulp Duplicates																					
NK 12-060 C Lower Lab	Soil Pulp	15.46	29.8	93	5.1	2.4	210	1.07	3.2	1.8	<0.1	3.8	131	0.20	0.21	0.18	23	0.77	0.014	18.2	9
REP NK 12-060 C Lower	QC																				
LKSD-4B	Soil Pulp	26.70	60.9	163	24.5	8.4	199	2.55	10.0	7.0	<0.1	3.3	96	0.10	1.31	0.43	38	0.53	0.290	13.1	35
REP LKSD-4B	QC	27.03	60.5	144	24.1	8.2	194	2.53	9.5	7.0	<0.1	3.2	94	0.09	1.43	0.45	36	0.51	0.291	13.1	34
Reference Materials																					
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD DS3	Standard																				
STD OREAS24P	Standard	2.81	113.1	55	148.0	44.3	1060	7.27	1.9	0.6	<0.1	2.8	382	0.10	0.10	0.06	160	5.67	0.133	18.0	214
STD OREAS24P	Standard	2.72	109.7	63	151.2	45.4	1047	7.20	2.8	0.6	<0.1	2.8	367	0.12	0.07	<0.04	160	5.67	0.131	17.9	208
STD OREAS24P Expected		2.9	119	60	141	44	1100	7.53	1.2	0.75		2.85	403	0.15	0.09		158	5.83	0.136	17.4	196
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T
		Analyte	Mg	Ba	Ti	Al	Na	K	W	Zr	Sn	Be	Sc	S	Y	Ce	Pr	Nd	Sm	Eu	Gd	Tb
		Unit	%	ppm	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
		MDL	0.02	1	0.001	0.02	0.002	0.02	0.1	0.2	0.1	1	0.1	0.04	0.1	0.02	0.1	0.1	0.1	0.1	0.1	0.1
Pulp Duplicates																						
NK 12-060 C Lower Lab	Soil Pulp		0.22	576	0.205	4.33	1.868	2.43	0.4	265.3	3.7	2	4.6	<0.04	21.0	35.07	4.2	17.2	3.3	0.5	2.9	0.5
REP NK 12-060 C Lower	QC																					
LKSD-4B	Soil Pulp		0.50	227	0.208	2.34	0.666	0.75	0.5	47.9	3.4	<1	4.7	0.70	10.4	26.58	3.6	14.1	2.6	0.6	2.2	0.3
REP LKSD-4B	QC		0.50	215	0.201	2.31	0.675	0.72	0.6	49.5	3.3	<1	4.4	0.73	10.0	25.47	3.5	14.3	2.6	0.5	1.9	0.3
Reference Materials																						
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD DS3	Standard																					
STD OREAS24P	Standard		3.97	276	1.079	7.50	2.522	0.64	0.4	130.9	1.8	<1	19.6	<0.04	21.9	35.88	4.6	20.6	4.6	1.7	5.1	0.8
STD OREAS24P	Standard		3.91	274	1.076	7.54	2.491	0.64	0.4	127.5	1.5	1	18.9	<0.04	21.5	35.06	4.7	20.2	4.8	1.7	4.8	0.8
STD OREAS24P Expected			4.13	285	1.1	7.66	2.34	0.7	0.5	141	1.6		20		21.3	37.6	4.7	22	4.7	1.6	5.3	0.81
BLK	Blank																					
BLK	Blank																					
BLK	Blank																					
BLK	Blank																					
BLK	Blank																					

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

	Method	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T	1T					1T
	Analyte	Dy	Ho	Er	Tm	Yb	Lu	Hf	Li	Rb	Ta	Nb	Cs	Ga	In	Re	Se	Te	Tl
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.1	0.1	0.1	0.1	0.1	0.1	0.02	0.1	0.1	0.1	0.04	0.1	0.02	0.01	0.002	0.3	0.05	0.05
Pulp Duplicates																			
NK 12-060 C Lower Lab	Soil Pulp	3.6	0.7	2.3	0.3	2.3	0.3	6.47	18.4	80.0	0.7	12.63	1.3	11.96	0.06	0.002	0.9	0.07	0.53
REP NK 12-060 C Lower	QC																		
LKSD-4B	Soil Pulp	1.9	0.4	1.1	0.1	1.1	0.1	1.32	12.9	25.4	0.3	4.28	1.2	8.63	0.02	0.003	2.9	0.21	0.29
REP LKSD-4B	QC	1.8	0.4	1.1	0.2	1.1	0.1	1.41	12.7	24.9	0.3	4.21	1.2	8.31	0.02	<0.002	2.7	0.21	0.28
Reference Materials																			
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD DS3	Standard																		
STD OREAS24P	Standard	4.6	0.8	2.1	0.3	1.9	0.2	3.35	7.8	21.3	1.0	18.44	0.8	18.42	0.05	0.003	<0.3	1.42	<0.05
STD OREAS24P	Standard	4.4	0.8	2.1	0.3	1.8	0.2	3.20	8.3	20.4	1.1	17.60	0.8	18.65	0.08	<0.002	<0.3	1.38	<0.05
STD OREAS24P Expected		4.6	0.8	2.2	0.3	1.83	0.25	3.6	8.7	22.4	1.04	21	0.8	19.43					
BLK	Blank																		
BLK	Blank																		
BLK	Blank																		
BLK	Blank																		
BLK	Blank																		

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLW Ag ppb 0.5	1SLW Al ppm 1	1SLW As ppb 5	1SLW Au ppb 1	1SLW Ba ppb 10	1SLW Be ppb 1	1SLW Bi ppb 0.5	1SLW Br ppb 10	1SLW Ca ppm 5	1SLW Cd ppb 0.5	1SLW Ce ppb 1	1SLW Cl ppm 2	1SLW Co ppb 1	1SLW Cs ppb 0.5	1SLW Cu ppb 5	1SLW Dy ppb 0.1	1SLW Er ppb 0.1	1SLW Eu ppb 0.1	1SLW Fe ppm 0.1	1SLW Ga ppb 0.5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLW Gd ppb 0.1	1SLW Ge ppb 0.1	1SLW Hf ppb 0.1	1SLW Hg ppb 1	1SLW Ho ppb 0.05	1SLW In ppb 0.05	1SLW K ppm 2	1SLW La ppb 2	1SLW Li ppb 0.1	1SLW Lu ppb 0.05	1SLW Mg ppm 0.1	1SLW Mn ppb 50	1SLW Mo ppb 1	1SLW Na ppm 3	1SLW Nb ppb 0.5	1SLW Nd ppb 1	1SLW Ni ppb 5	1SLW P ppm 0.1	1SLW Pb ppb 3	1SLW Pr ppb 0.5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLW Rb ppb 2	1SLW Re ppb 0.05	1SLW S ppm 10	1SLW Sb ppb 1	1SLW Sc ppb 20	1SLW Se ppb 5	1SLW Sm ppb 0.5	1SLW Sn ppb 1	1SLW Sr ppb 10	1SLW Ta ppb 0.5	1SLW Tb ppb 0.05	1SLW Te ppb 1	1SLW Th ppb 2	1SLW Ti ppm 0.05	1SLW Tl ppb 0.2	1SLW Tm ppb 0.05	1SLW U ppb 0.1	1SLW V ppb 50	1SLW W ppb 2	1SLW Y ppb 1
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLW Yb ppb 0.5	1SLW Zn ppb 10	1SLW Zr ppb 1	1SLE Ag ppb 3	1SLE Al ppm 1	1SLE As ppb 100	1SLE Au ppb 1	1SLE Ba ppb 50	1SLE Be ppb 20	1SLE Bi ppb 5	1SLE Ca ppm 5	1SLE Cd ppb 20	1SLE Ce ppb 5	1SLE Co ppb 20	1SLE Cs ppb 5	1SLE Cu ppb 20	1SLE Dy ppb 5	1SLE Er ppb 5	1SLE Eu ppb 5	1SLE Fe ppm 5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLE Ga ppb 20	1SLE Gd ppb 5	1SLE Ge ppb 50	1SLE Hf ppb 20	1SLE Hg ppb 5	1SLE Ho ppb 20	1SLE In ppb 10	1SLE K ppm 5	1SLE La ppb 5	1SLE Li ppb 20	1SLE Lu ppb 5	1SLE Mg ppm 1	1SLE Mn ppb 50	1SLE Mo ppb 10	1SLE Nb ppb 10	1SLE Nd ppb 5	1SLE Ni ppb 50	1SLE P ppm 5	1SLE Pb ppb 20	1SLE Pr ppb 5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLE Rb ppb 5	1SLE Re ppb 2	1SLE Sb ppb 5	1SLE Sc ppb 100	1SLE Se ppb 200	1SLE Sm ppb 5	1SLE Sn ppb 20	1SLE Sr ppb 20	1SLE Ta ppb 20	1SLE Tb ppb 5	1SLE Te ppb 20	1SLE Th ppb 20	1SLE Ti ppm 1	1SLE Tl ppb 5	1SLE Tm ppb 5	1SLE U ppb 5	1SLE V ppb 50	1SLE W ppb 10	1SLE Y ppb 5	1SLE Yb ppb 5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLE Zn ppb 100	1SLE Zr ppb 20	1SLO Ag ppb 3	1SLO Al ppm 1	1SLO As ppb 100	1SLO Au ppb 1	1SLO Ba ppb 50	1SLO Be ppb 20	1SLO Bi ppb 5	1SLO Ca ppm 5	1SLO Cd ppb 20	1SLO Ce ppb 5	1SLO Co ppb 20	1SLO Cs ppb 5	1SLO Cu ppb 20	1SLO Dy ppb 5	1SLO Er ppb 5	1SLO Eu ppb 5	1SLO Fe ppm 5	1SLO Ga ppb 50
BLK	Blank			10	<1	<100	<1	<50	<20	<5	<5	<20	<5	<20	<5	<20	9	5	<5	<5	<50
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLO Gd ppb 5	1SLO Ge ppb 50	1SLO Hf ppb 20	1SLO Hg ppb 5	1SLO Ho ppb 20	1SLO In ppb 10	1SLO K ppm 5	1SLO La ppb 5	1SLO Li ppb 20	1SLO Lu ppb 5	1SLO Mg ppm 1	1SLO Mn ppb 50	1SLO Mo ppb 10	1SLO Nb ppb 10	1SLO Nd ppb 5	1SLO Ni ppb 50	1SLO Pb ppb 20	1SLO Pr ppb 5	1SLO Rb ppb 5	1SLO Re ppb 2
BLK	Blank	<5	<50	34	<5	<20	<10	<5	<5	<20	<5	<1	<50	<10	<10	<5	63	<20	15	<5	<2
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLO Sb ppb 5	1SLO Sc ppb 100	1SLO Se ppb 200	1SLO Sm ppb 5	1SLO Sn ppb 20	1SLO Sr ppb 20	1SLO Ta ppb 20	1SLO Tb ppb 5	1SLO Te ppb 20	1SLO Th ppb 20	1SLO Ti ppm 1	1SLO Tl ppb 5	1SLO Tm ppb 5	1SLO U ppb 5	1SLO V ppb 50	1SLO W ppb 10	1SLO Y ppb 5	1SLO Yb ppb 5	1SLO Zn ppb 100	1SLO Zr ppb 20
BLK	Blank	<5	<100	221	10	<20	<20	<20	<5	<20	<20	<1	<5	<5	<5	<50	11	<5	15	116	<20
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLM Ag ppb 3	1SLM Al ppm 1	1SLM As ppb 100	1SLM Au ppb 1	1SLM Ba ppb 50	1SLM Be ppb 20	1SLM Bi ppb 5	1SLM Ca ppm 5	1SLM Cd ppb 20	1SLM Ce ppb 5	1SLM Co ppb 20	1SLM Cs ppb 5	1SLM Cu ppb 20	1SLM Dy ppb 5	1SLM Er ppb 5	1SLM Eu ppb 5	1SLM Fe ppm 5	1SLM Ga ppb 20	1SLM Gd ppb 5	1SLM Ge ppb 50
BLK	Blank																				
BLK	Blank	<3	2	<100	<1	<50	<20	<5	<5	<20	9	<20	<5	<20	<5	<5	<5	<5	<20	<5	<50
BLK	Blank	<3	2	<100	<1	<50	45	<5	<5	<20	8	<20	<5	<20	<5	<5	<5	<5	<20	<5	<50
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLM Hf ppb 20	1SLM Hg ppb 5	1SLM Ho ppb 20	1SLM In ppb 10	1SLM K ppm 5	1SLM La ppb 5	1SLM Li ppb 20	1SLM Lu ppb 5	1SLM Mg ppm 1	1SLM Mn ppb 50	1SLM Mo ppb 10	1SLM Nb ppb 10	1SLM Nd ppb 5	1SLM Ni ppb 50	1SLM P ppm 5	1SLM Pb ppb 20	1SLM Pr ppb 5	1SLM Rb ppb 5	1SLM Re ppb 2	1SLM Sb ppb 5
BLK	Blank																				
BLK	Blank	<20	<5	<20	<10	<5	<5	<20	<5	<1	<50	<10	<10	<5	<50	<5	<20	<5	<5	<2	<5
BLK	Blank	<20	<5	<20	<10	<5	<5	<20	<5	<1	<50	<10	<10	<5	<50	<5	<20	<5	<5	<2	<5
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLM Sc ppb 100	1SLM Se ppb 200	1SLM Sm ppb 5	1SLM Sn ppb 20	1SLM Sr ppb 20	1SLM Ta ppb 20	1SLM Tb ppb 5	1SLM Te ppb 20	1SLM Th ppb 20	1SLM Ti ppm 1	1SLM Tl ppb 5	1SLM Tm ppb 5	1SLM U ppb 5	1SLM V ppb 50	1SLM W ppb 10	1SLM Y ppb 5	1SLM Yb ppb 5	1SLM Zn ppb 100	1SLM Zr ppb 20	1SLF Ag ppb 3
BLK	Blank																				
BLK	Blank	<100	<200	<5	<20	<20	<20	<5	<20	<20	<1	<5	<5	<5	<50	<10	<5	<5	<100	<20	
BLK	Blank	<100	<200	<5	<20	<20	<20	<5	<20	<20	<1	<5	<5	<5	<50	<10	9	<5	<100	<20	
BLK	Blank																				3
BLK	Blank																				5
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLF Al ppm 1	1SLF As ppb 100	1SLF Au ppb 1	1SLF Ba ppb 50	1SLF Be ppb 20	1SLF Bi ppb 5	1SLF Ca ppm 5	1SLF Cd ppb 20	1SLF Ce ppb 5	1SLF Co ppb 20	1SLF Cs ppb 5	1SLF Cu ppb 20	1SLF Dy ppb 5	1SLF Er ppb 5	1SLF Eu ppb 5	1SLF Fe ppm 5	1SLF Ga ppb 20	1SLF Gd ppb 5	1SLF Ge ppb 50	1SLF Hf ppb 20
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<1	<100	<1	<50	<20	<5	<5	<20	<5	<20	<5	<20	<5	<5	<5	<5	<20	<5	<50	<20
BLK	Blank	<1	<100	<1	<50	<20	<5	<5	<20	<5	<20	<5	<20	<5	<5	<5	<5	<20	<5	<50	<20
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLF Hg ppb 5	1SLF Ho ppb 20	1SLF In ppb 10	1SLF K ppm 5	1SLF La ppb 5	1SLF Li ppb 20	1SLF Lu ppb 5	1SLF Mg ppm 1	1SLF Mn ppb 50	1SLF Mo ppb 10	1SLF Nb ppb 10	1SLF Nd ppb 5	1SLF Ni ppb 50	1SLF P ppm 5	1SLF Pb ppb 20	1SLF Pr ppb 5	1SLF Rb ppb 5	1SLF Re ppb 2	1SLF Sb ppb 5	1SLF Sc ppb 100
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<5	<20	<10	<5	<5	<20	<5	<1	<50	<10	<10	<5	<50	6	<20	<5	<5	<2	<5	<100
BLK	Blank	<5	<20	<10	<5	<5	<20	<5	<1	<50	<10	<10	<5	<50	8	31	<5	<5	2	<5	<100
BLK	Blank																				

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1SLF Se ppb 200	1SLF Sm ppb 5	1SLF Sn ppb 20	1SLF Sr ppb 20	1SLF Ta ppb 20	1SLF Tb ppb 5	1SLF Te ppb 20	1SLF Th ppb 20	1SLF Ti ppm 1	1SLF Tl ppb 5	1SLF Tm ppb 5	1SLF U ppb 5	1SLF V ppb 50	1SLF W ppb 10	1SLF Y ppb 5	1SLF Yb ppb 5	1SLF Zn ppb 100	1SLF Zr ppb 20	1T Mo ppm 0.05	1T Cu ppm 0.02
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<200	<5	<20	<20	<20	<5	<20	<20	<1	<5	<5	<5	<50	<10	<5	6	<100	<20		
BLK	Blank	<200	<5	<20	<20	<20	<5	<20	<20	<1	<5	<5	<5	226	<10	<5	<5	<100	<20		
BLK	Blank																			<0.05	0.16

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1T Pb ppm 0.02	1T Zn ppm 0.2	1T Ag ppb 20	1T Ni ppm 0.1	1T Co ppm 0.2	1T Mn ppm 2	1T Fe % 0.02	1T As ppm 0.2	1T U ppm 0.1	1T Au ppm 0.1	1T Th ppm 0.1	1T Sr ppm 1	1T Cd ppm 0.02	1T Sb ppm 0.02	1T Bi ppm 0.04	1T V ppm 1	1T Ca % 0.02	1T P % 0.001	1T La ppm 0.1	1T Cr ppm 1
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank	0.07	<0.2	<20	0.5	<0.2	<2	<0.02	0.3	<0.1	<0.1	<0.1	<1	<0.02	<0.02	<0.04	<1	<0.02	<0.001	<0.1	2

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1T Mg % 0.02	1T Ba ppm 1	1T Ti % 0.001	1T Al % 0.02	1T Na % 0.002	1T K % 0.02	1T W ppm 0.1	1T Zr ppm 0.2	1T Sn ppm 0.1	1T Be ppm 1	1T Sc ppm 0.1	1T S % 0.04	1T Y ppm 0.1	1T Ce ppm 0.02	1T Pr ppm 0.1	1T Nd ppm 0.1	1T Sm ppm 0.1	1T Eu ppm 0.1	1T Gd ppm 0.1	1T Tb ppm 0.1
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<0.02	<1	<0.001	<0.02	<0.002	<0.02	<0.1	0.6	<0.1	<1	<0.1	<0.04	<0.1	<0.02	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
9050 Shaughnessy St Vancouver BC V6P 6E5 CANADA
PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: April 05, 2013

QUALITY CONTROL REPORT VAN12005934.2

		1T Dy ppm 0.1	1T Ho ppm 0.1	1T Er ppm 0.1	1T Tm ppm 0.1	1T Yb ppm 0.1	1T Lu ppm 0.1	1T Hf ppm 0.02	1T Li ppm 0.1	1T Rb ppm 0.1	1T Ta ppm 0.1	1T Nb ppm 0.04	1T Cs ppm 0.1	1T Ga ppm 0.02	In ppm 0.01	Re ppm 0.002	Se ppm 0.3	Te ppm 0.05	1T Tl ppm 0.05
BLK	Blank																		
BLK	Blank																		
BLK	Blank																		
BLK	Blank																		
BLK	Blank																		
BLK	Blank	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.02	<0.1	0.1	<0.1	<0.04	<0.1	0.04	<0.01	<0.002	0.9	<0.05	<0.05

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: December 20, 2012
Report Date: January 25, 2013
Page: 1 of 2

CERTIFICATE OF ANALYSIS VAN12005933.1

CLIENT JOB INFORMATION

Project: NKA-2012
Shipment ID:
P.O. Number
Number of Samples: 7

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
R200-250	5	Crush, split and pulverize 250 g rock to 200 mesh			VAN
4A4B	7	Whole Rock Analysis Majors and Trace Elements	0.2	Completed	VAN

SAMPLE DISPOSAL

PICKUP-PLP Client to Pickup Pulps

ADDITIONAL COMMENTS

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

Invoice To: IoGlobal Solutions
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2
CANADA

CC: Magnus Leijd
Colin Dunn

BRITISH COLUMBIA CERTIFIED ASSAYER
RAYMOND CHAN
CHIEF ASSAYER

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.

PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

CERTIFICATE OF ANALYSIS VAN12005933.1

Method		WGHT	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B
Analyte		Wgt	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ni	Sc	LOI	Sum	Ba	Be	Co	Cs
Unit		kg	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	%	%	ppm	ppm	ppm	ppm
MDL		0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002	20	1	-5.1	0.01	1	1	0.2	0.1
G1	Prep Blank		67.16	16.09	3.43	0.98	3.55	3.75	3.77	0.41	0.19	0.10	0.002	<20	5	0.3	99.72	1107	<1	3.9	3.2
NKR-01	Rock	0.04	61.83	13.07	5.84	1.41	2.05	11.09	0.86	0.24	0.01	0.54	0.006	<20	6	0.4	97.33	92	9	5.1	1.1
NKR-02	Rock	0.15	53.72	18.49	5.57	0.03	1.22	10.27	4.94	0.07	0.01	0.24	<0.002	<20	<1	2.3	96.87	78	15	0.2	6.4
NK12-039	Rock	0.18	53.45	14.94	11.90	0.08	0.66	11.46	4.05	0.08	0.01	0.10	0.002	<20	44	1.1	97.87	56	6	0.5	3.3
NK12-060	Rock	0.19	74.33	13.15	1.67	0.42	0.96	3.52	4.84	0.27	0.07	0.03	<0.002	<20	4	0.6	99.88	564	6	1.6	2.1
NK12-072	Rock	0.26	56.30	18.46	6.62	0.03	0.63	12.91	2.10	0.04	0.01	0.14	0.003	<20	<1	0.8	98.03	16	15	0.2	2.8
NKA-01	Rock Pulp	0.03	54.24	17.12	8.46	0.57	1.61	9.57	3.71	0.12	0.03	0.22	0.003	<20	2	2.3	97.93	122	12	2.1	12.4
NKA-02	Rock Pulp	0.04	54.45	17.18	7.22	0.27	1.28	10.28	3.40	0.08	0.01	0.25	0.003	<20	<1	3.3	97.69	83	15	0.5	8.9

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

www.acmelab.com

PHONE (604) 253-3158

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

CERTIFICATE OF ANALYSIS VAN12005933.1

	Method	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B
	Analyte	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W	Zr	Y	La	Ce	Pr	Nd	Sm	Eu	Gd
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.5	0.1	0.1	0.1	1	0.5	0.1	0.2	0.1	8	0.5	0.1	0.1	0.1	0.1	0.02	0.3	0.05	0.02	0.05
G1	Prep Blank	18.7	3.5	22.2	123.0	<1	802.6	1.2	9.8	3.3	45	4.0	149.0	15.3	33.6	64.6	7.28	25.8	4.46	1.11	3.30
NKR-01	Rock	44.3	228.1	566.0	24.9	46	150.7	10.7	28.4	18.9	32	7.9	11625	1823	777.7	1966	282.3	1173	267.4	29.59	267.3
NKR-02	Rock	87.1	335.5	509.9	363.2	100	144.1	22.5	5.4	15.8	<8	2.6	17142	1992	506.5	1122	153.3	631.0	184.5	21.82	224.5
NK12-039	Rock	67.4	322.4	103.3	269.5	132	12.7	8.7	2.1	7.5	<8	1.6	14117	377.2	75.8	152.1	19.42	76.6	23.11	3.01	32.62
NK12-060	Rock	13.0	5.5	13.0	120.0	1	170.6	0.8	12.0	1.8	14	1.3	204.3	14.0	11.0	22.9	2.60	9.2	2.02	0.46	1.87
NK12-072	Rock	68.7	285.8	331.1	126.5	63	22.1	29.1	2.2	6.5	<8	1.2	11908	997.3	229.2	450.3	56.28	223.6	69.68	9.34	96.78
NKA-01	Rock Pulp	69.4	279.7	251.2	293.4	81	160.4	21.6	7.2	12.5	<8	2.8	11871	1013	296.4	589.8	71.47	275.9	78.37	9.93	102.1
NKA-02	Rock Pulp	81.6	271.9	385.2	260.7	103	135.7	24.0	7.1	15.1	<8	4.0	12162	1444	480.0	1030	129.0	529.4	134.4	15.96	160.5

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

CERTIFICATE OF ANALYSIS VAN12005933.1

	Method	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	2A Leco	2A Leco	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX
	Analyte	Tb	Dy	Ho	Er	Tm	Yb	Lu	TOT/C	TOT/S	Mo	Cu	Pb	Zn	Ag	Ni	As	Au	Cd	Sb	Bi
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm
	MDL	0.01	0.05	0.02	0.03	0.01	0.05	0.01	0.02	0.02	0.1	0.1	0.1	1	0.1	0.1	0.5	0.5	0.1	0.1	0.1
G1	Prep Blank	0.49	2.39	0.58	1.67	0.26	1.72	0.27	<0.02	<0.02	0.1	2.3	3.3	45	<0.1	1.4	<0.5	0.6	<0.1	<0.1	<0.1
NKR-01	Rock	45.40	273.6	53.67	150.8	21.00	126.6	15.99	0.03	<0.02	0.5	3.0	468.6	37	3.8	1.2	<0.5	<0.5	12.6	0.1	1.0
NKR-02	Rock	44.17	290.7	63.12	189.6	27.59	170.4	22.73	0.03	<0.02	0.3	3.3	441.3	44	1.1	0.5	2.1	<0.5	6.6	<0.1	0.2
NK12-039	Rock	7.73	57.08	14.42	49.04	7.81	52.28	8.12	<0.02	<0.02	<0.1	2.6	528.8	23	1.2	0.7	1.3	<0.5	6.9	<0.1	1.4
NK12-060	Rock	0.35	2.11	0.47	1.65	0.27	1.93	0.29	<0.02	<0.02	0.2	1.4	4.5	29	<0.1	2.1	1.3	0.6	<0.1	0.1	0.1
NK12-072	Rock	23.06	167.1	40.85	133.7	20.89	131.4	18.24	<0.02	<0.02	0.2	0.6	15.9	24	1.1	1.3	2.0	<0.5	4.3	<0.1	<0.1
NKA-01	Rock Pulp	22.80	161.2	38.02	126.1	19.49	123.1	16.94	0.06	<0.02	1.5	6.3	200.9	64	1.5	7.5	3.7	<0.5	5.5	0.1	0.5
NKA-02	Rock Pulp	32.56	215.3	48.87	153.9	22.98	140.7	19.10	0.06	<0.02	0.7	3.1	301.8	41	1.0	2.5	3.4	<0.5	5.9	<0.1	0.3

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

www.acmelab.com

PHONE (604) 253-3158

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

CERTIFICATE OF ANALYSIS VAN12005933.1

Method		1DX	1DX	1DX
Analyte		Hg	Tl	Se
Unit		ppm	ppm	ppm
MDL		0.01	0.1	0.5
G1	Prep Blank	<0.01	0.4	<0.5
NKR-01	Rock	<0.01	0.3	<0.5
NKR-02	Rock	<0.01	1.8	1.3
NK12-039	Rock	<0.01	1.1	1.0
NK12-060	Rock	0.01	0.1	<0.5
NK12-072	Rock	<0.01	1.3	1.7
NKA-01	Rock Pulp	<0.01	0.7	1.0
NKA-02	Rock Pulp	<0.01	0.9	2.0

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

QUALITY CONTROL REPORT VAN12005933.1

	Method	WGHT	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B
	Analyte	Wgt	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ni	Sc	LOI	Sum	Ba	Be	Co	Cs
	Unit	kg	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	%	%	ppm	ppm	ppm	ppm
	MDL	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002	20	1	-5.1	0.01	1	1	0.2	0.1
Pulp Duplicates																					
NK12-060	Rock	0.19	74.33	13.15	1.67	0.42	0.96	3.52	4.84	0.27	0.07	0.03	<0.002	<20	4	0.6	99.88	564	6	1.6	2.1
REP NK12-060	QC		74.12	13.28	1.68	0.42	0.95	3.57	4.87	0.27	0.06	0.03	<0.002	<20	4	0.6	99.88	570	3	1.2	2.2
NKA-02	Rock Pulp	0.04	54.45	17.18	7.22	0.27	1.28	10.28	3.40	0.08	0.01	0.25	0.003	<20	<1	3.3	97.69	83	15	0.5	8.9
REP NKA-02	QC																				
Reference Materials																					
STD DS9	Standard																				
STD DS9	Standard																				
STD GS311-1	Standard																				
STD GS910-4	Standard																				
STD OREAS45EA	Standard																				
STD OREAS45EA	Standard																				
STD SO-18	Standard		57.94	14.10	7.74	3.42	6.37	3.68	2.14	0.68	0.80	0.40	0.550	49	24	1.9	99.73	496	3	26.0	7.2
STD SO-18	Standard		58.15	14.04	7.64	3.39	6.37	3.67	2.14	0.69	0.80	0.40	0.550	49	24	1.9	99.74	503	<1	26.0	6.8
STD GS311-1 Expected																					
STD GS910-4 Expected																					
STD SO-18 Expected			58.47	14.23	7.67	3.35	6.42	3.71	2.17	0.69	0.83	0.39	0.55	44	25			514		26.2	7.1
STD DS9 Expected																					
STD OREAS45EA Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank		<0.01	<0.01	<0.04	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<20	<1	0.0	<0.01	<1	<1	0.3	<0.1
BLK	Blank																				
Prep Wash																					
G1	Prep Blank		67.16	16.09	3.43	0.98	3.55	3.75	3.77	0.41	0.19	0.10	0.002	<20	5	0.3	99.72	1107	<1	3.9	3.2

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

QUALITY CONTROL REPORT VAN12005933.1

	Method	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B
	Analyte	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W	Zr	Y	La	Ce	Pr	Nd	Sm	Eu	Gd
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.5	0.1	0.1	0.1	1	0.5	0.1	0.2	0.1	8	0.5	0.1	0.1	0.1	0.1	0.02	0.3	0.05	0.02	0.05
Pulp Duplicates																					
NK12-060	Rock	13.0	5.5	13.0	120.0	1	170.6	0.8	12.0	1.8	14	1.3	204.3	14.0	11.0	22.9	2.60	9.2	2.02	0.46	1.87
REP NK12-060	QC	13.3	6.1	12.0	118.1	1	176.2	0.6	11.8	1.7	13	0.7	211.4	13.2	11.0	22.6	2.58	8.1	2.04	0.55	2.07
NKA-02	Rock Pulp	81.6	271.9	385.2	260.7	103	135.7	24.0	7.1	15.1	<8	4.0	12162	1444	480.0	1030	129.0	529.4	134.4	15.96	160.5
REP NKA-02	QC																				
Reference Materials																					
STD DS9	Standard																				
STD DS9	Standard																				
STD GS311-1	Standard																				
STD GS910-4	Standard																				
STD OREAS45EA	Standard																				
STD OREAS45EA	Standard																				
STD SO-18	Standard	15.9	9.5	21.3	26.1	14	411.1	7.1	9.1	15.3	193	13.4	289.4	29.7	11.8	26.2	3.22	13.7	2.82	0.88	2.94
STD SO-18	Standard	16.5	8.9	19.3	26.6	13	395.6	6.6	9.3	15.0	185	14.6	278.9	28.8	11.6	25.6	3.18	14.3	2.86	0.82	2.80
STD GS311-1 Expected																					
STD GS910-4 Expected																					
STD SO-18 Expected		17.6	9.8	21.3	28.7	15	407.4	7.4	9.9	16.4	200	14.8	280	31	12.3	27.1	3.45	14	3	0.89	2.93
STD DS9 Expected																					
STD OREAS45EA Expected																					
BLK	Blank																				
BLK	Blank																				
BLK	Blank	<0.5	<0.1	0.6	0.1	<1	<0.5	0.2	<0.2	<0.1	<8	<0.5	0.9	<0.1	<0.1	<0.1	<0.02	<0.3	<0.05	<0.02	<0.05
BLK	Blank																				
Prep Wash																					
G1	Prep Blank	18.7	3.5	22.2	123.0	<1	802.6	1.2	9.8	3.3	45	4.0	149.0	15.3	33.6	64.6	7.28	25.8	4.46	1.11	3.30

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

QUALITY CONTROL REPORT VAN12005933.1

	Method	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	4A-4B	2A Leco	2A Leco	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX
	Analyte	Tb	Dy	Ho	Er	Tm	Yb	Lu	TOT/C	TOT/S	Mo	Cu	Pb	Zn	Ag	Ni	As	Au	Cd	Sb	Bi
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm
	MDL	0.01	0.05	0.02	0.03	0.01	0.05	0.01	0.02	0.02	0.1	0.1	0.1	1	0.1	0.1	0.5	0.5	0.1	0.1	0.1
Pulp Duplicates																					
NK12-060	Rock	0.35	2.11	0.47	1.65	0.27	1.93	0.29	<0.02	<0.02	0.2	1.4	4.5	29	<0.1	2.1	1.3	0.6	<0.1	0.1	0.1
REP NK12-060	QC	0.35	1.86	0.48	1.45	0.23	1.60	0.27													
NKA-02	Rock Pulp	32.56	215.3	48.87	153.9	22.98	140.7	19.10	0.06	<0.02	0.7	3.1	301.8	41	1.0	2.5	3.4	<0.5	5.9	<0.1	0.3
REP NKA-02	QC								0.06	<0.02											
Reference Materials																					
STD DS9	Standard										12.0	117.5	126.6	311	1.9	39.9	27.8	132.2	2.4	5.2	6.2
STD DS9	Standard										13.0	115.9	132.0	347	2.1	44.7	31.8	109.4	2.7	5.2	6.2
STD GS311-1	Standard								1.05	2.34											
STD GS910-4	Standard								2.83	8.21											
STD OREAS45EA	Standard										1.5	715.1	14.6	30	0.3	399.8	9.3	66.3	<0.1	0.2	0.2
STD OREAS45EA	Standard										1.4	752.5	14.6	32	0.4	412.1	10.6	66.8	<0.1	0.2	0.4
STD SO-18	Standard	0.49	3.11	0.61	1.92	0.27	1.70	0.29													
STD SO-18	Standard	0.46	2.88	0.49	1.84	0.23	1.71	0.26													
STD GS311-1 Expected									1.02	2.35											
STD GS910-4 Expected									2.65	8.27											
STD SO-18 Expected		0.53	3	0.62	1.84	0.27	1.79	0.27													
STD DS9 Expected											12.84	108	126	317	1.83	40.3	25.5	118	2.4	4.94	6.32
STD OREAS45EA Expected											1.78	709	14.3	30.6	0.311	357	11.4	53	0.03	0.64	0.26
BLK	Blank								<0.02	<0.02											
BLK	Blank										<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.5	<0.5	<0.1	<0.1	<0.1
BLK	Blank	<0.01	<0.05	<0.02	<0.03	<0.01	<0.05	<0.01													
BLK	Blank										<0.1	<0.1	0.4	<1	<0.1	<0.1	1.3	<0.5	<0.1	<0.1	<0.1
Prep Wash																					
G1	Prep Blank	0.49	2.39	0.58	1.67	0.26	1.72	0.27	<0.02	<0.02	0.1	2.3	3.3	45	<0.1	1.4	<0.5	0.6	<0.1	<0.1	<0.1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.

PHONE (604) 253-3158

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 CANADA

Project: NKA-2012
Report Date: January 25, 2013

QUALITY CONTROL REPORT VAN12005933.1

	Method	1DX	1DX	1DX
	Analyte	Hg	Tl	Se
	Unit	ppm	ppm	ppm
	MDL	0.01	0.1	0.5
Pulp Duplicates				
NK12-060	Rock	0.01	0.1	<0.5
REP NK12-060	QC			
NKA-02	Rock Pulp	<0.01	0.9	2.0
REP NKA-02	QC			
Reference Materials				
STD DS9	Standard	0.23	5.5	5.1
STD DS9	Standard	0.21	5.9	6.3
STD GS311-1	Standard			
STD GS910-4	Standard			
STD OREAS45EA	Standard	<0.01	<0.1	0.6
STD OREAS45EA	Standard	<0.01	<0.1	<0.5
STD SO-18	Standard			
STD SO-18	Standard			
STD GS311-1 Expected				
STD GS910-4 Expected				
STD SO-18 Expected				
STD DS9 Expected		0.2	5.3	5.2
STD OREAS45EA Expected		0.34	0.072	2.09
BLK	Blank			
BLK	Blank	<0.01	<0.1	<0.5
BLK	Blank			
BLK	Blank	<0.01	<0.1	<0.5
Prep Wash				
G1	Prep Blank	<0.01	0.4	<0.5

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: September 04, 2012
Report Date: November 27, 2012
Page: 1 of 3

CERTIFICATE OF ANALYSIS VAN12004250.1

CLIENT JOB INFORMATION

Project: Norra Karr 2012
Shipment ID:
P.O. Number
Number of Samples: 45

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
No Prep	44	Sorting of samples on arrival and labeling			VAN
1F04-1F09	44	1:1:1 Aqua Regia digestion Ultratrace ICP-MS analysis	0.5	Completed	VAN

SAMPLE DISPOSAL

STOR-PLP Store After 90 days Invoice for Storage

ADDITIONAL COMMENTS

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

Invoice To: IoGlobal Solutions
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2
Canada

CC:

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
GENERAL MANAGER

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.01	0.02	0.02	2	0.01	0.001
NK12-01-A.FF	Vegetation	0.48	8.15	0.23	13.4	5	0.6	<0.1	146	<0.01	0.4	<0.1	2.0	<0.1	12.9	0.08	<0.02	0.13	<2	0.61	0.120
NK12-02-D.FM	Vegetation	0.22	7.19	0.64	21.9	7	1.5	<0.1	99	<0.01	0.2	<0.1	<0.2	<0.1	19.6	0.02	<0.02	0.05	<2	0.70	0.168
NK12-03-A.FF	Vegetation	0.20	7.67	0.17	16.1	8	0.3	<0.1	59	<0.01	0.2	<0.1	<0.2	<0.1	9.2	0.05	<0.02	0.03	<2	0.64	0.173
NK12-04-A.FF	Vegetation	0.71	11.32	0.28	20.4	4	0.6	<0.1	176	<0.01	0.1	<0.1	<0.2	<0.1	20.9	0.27	<0.02	0.02	<2	0.85	0.140
NK12-05-D.FM	Vegetation	0.13	5.17	0.40	41.1	3	1.7	0.1	780	<0.01	0.3	<0.1	<0.2	<0.1	35.2	0.10	<0.02	<0.02	<2	0.83	0.298
NK12-06-D.FM	Vegetation	0.07	5.34	0.27	45.4	2	1.2	0.1	500	<0.01	<0.1	<0.1	<0.2	<0.1	18.8	0.05	<0.02	<0.02	<2	0.39	0.197
NK12-07-A.FF	Vegetation	0.71	6.65	0.27	22.2	6	1.9	<0.1	401	<0.01	0.2	<0.1	<0.2	<0.1	20.3	0.03	<0.02	<0.02	<2	0.96	0.193
NK12-08-D.FM	Vegetation	0.03	4.11	0.09	45.1	3	1.3	0.2	1865	<0.01	0.2	<0.1	<0.2	<0.1	13.3	0.51	<0.02	<0.02	<2	0.32	0.134
NK12-09-D.FM	Vegetation	0.19	5.22	0.29	67.8	3	3.0	0.1	389	<0.01	<0.1	<0.1	<0.2	<0.1	34.1	0.06	<0.02	<0.02	<2	0.54	0.177
NK12-10-D.FM	Vegetation	0.14	5.15	0.23	38.9	3	2.3	<0.1	194	<0.01	0.1	<0.1	<0.2	<0.1	62.1	0.02	<0.02	<0.02	<2	0.93	0.134
NK12-11-D.FM	Vegetation	0.18	5.56	0.37	49.7	8	1.2	0.1	1459	<0.01	<0.1	<0.1	<0.2	<0.1	28.1	0.13	<0.02	<0.02	<2	0.71	0.174
NK12-12-D.FM	Vegetation	0.18	7.77	0.17	35.0	7	2.8	<0.1	169	<0.01	<0.1	<0.1	<0.2	<0.1	40.1	0.04	<0.02	<0.02	<2	0.76	0.154
NK12-13-A.FF	Vegetation	0.41	6.29	0.27	16.2	8	2.3	<0.1	94	<0.01	<0.1	<0.1	<0.2	<0.1	25.4	0.11	<0.02	<0.02	<2	0.99	0.159
NK12-14-A.FF	Vegetation	0.29	7.10	0.17	12.6	11	2.8	<0.1	82	<0.01	0.2	<0.1	<0.2	<0.1	12.9	0.08	<0.02	<0.02	<2	0.54	0.155
NK12-15-D.FM	Vegetation	0.50	6.08	0.28	35.8	5	0.9	<0.1	134	<0.01	<0.1	<0.1	<0.2	<0.1	20.3	0.07	<0.02	<0.02	<2	1.06	0.279
NK12-16-A.FF	Vegetation	0.59	9.52	0.21	21.5	5	3.9	<0.1	146	<0.01	0.1	<0.1	<0.2	<0.1	17.0	0.04	<0.02	<0.02	<2	0.87	0.203
NK12-17-D.FM	Vegetation	0.09	5.46	0.27	69.9	5	0.8	0.2	1256	<0.01	<0.1	<0.1	<0.2	<0.1	24.1	0.22	<0.02	<0.02	<2	0.54	0.257
NK12-18-D.FM	Vegetation	0.28	5.77	0.34	71.4	5	1.3	0.1	908	<0.01	<0.1	<0.1	<0.2	<0.1	18.4	0.23	<0.02	<0.02	<2	0.62	0.281
NK12-19-A.FF	Vegetation	0.33	5.81	0.18	15.0	5	1.6	<0.1	102	<0.01	<0.1	<0.1	<0.2	<0.1	23.0	0.05	<0.02	<0.02	<2	0.88	0.128
NK12-20-D.FM	Vegetation	0.27	6.35	0.43	38.4	5	2.1	0.5	572	<0.01	<0.1	<0.1	<0.2	<0.1	20.0	0.06	<0.02	<0.02	<2	0.51	0.166
NK12-21-D.FM	Vegetation	0.07	8.82	0.16	70.5	4	1.8	<0.1	556	<0.01	0.2	<0.1	<0.2	<0.1	20.3	0.10	<0.02	<0.02	<2	0.60	0.236
NK12-22-D.FM	Vegetation	0.33	6.90	0.13	53.6	5	1.9	<0.1	565	<0.01	<0.1	<0.1	<0.2	<0.1	27.5	0.06	<0.02	<0.02	<2	0.64	0.173
SF-2	Rock Pulp	0.43	8.15	0.19	22.6	2	0.5	<0.1	58	<0.01	<0.1	<0.1	<0.2	<0.1	18.4	0.06	<0.02	<0.02	<2	0.35	0.231
NK12-23-DFM	Vegetation	0.18	5.79	0.48	36.3	7	1.2	0.4	982	<0.01	0.1	<0.1	<0.2	<0.1	22.0	0.14	<0.02	<0.02	<2	0.59	0.177
NK12-24-A.FF	Vegetation	0.26	6.54	0.24	16.1	7	0.7	<0.1	172	<0.01	0.3	<0.1	<0.2	<0.1	24.0	0.38	<0.02	<0.02	<2	0.83	0.190
NK12-25-D.FM	Vegetation	0.05	6.09	0.38	87.3	7	2.7	<0.1	554	<0.01	0.1	<0.1	<0.2	<0.1	40.8	0.14	<0.02	<0.02	<2	0.70	0.260
NK12-26-D.FM	Vegetation	0.12	4.38	0.27	213.3	9	5.7	<0.1	451	<0.01	0.3	<0.1	0.8	<0.1	43.9	0.06	<0.02	<0.02	<2	0.80	0.275
NK12-27-A.FF	Vegetation	0.06	4.58	0.31	10.8	9	2.4	<0.1	74	<0.01	<0.1	<0.1	<0.2	<0.1	21.2	0.05	<0.02	<0.02	<2	1.00	0.132
NK12-28-A.FF	Vegetation	0.39	8.06	0.20	14.2	7	1.0	<0.1	118	<0.01	0.1	<0.1	0.5	<0.1	15.3	0.16	<0.02	<0.02	<2	0.76	0.140
NK12-29-A.FF	Vegetation	0.39	9.55	0.19	18.8	13	3.2	0.1	165	<0.01	<0.1	<0.1	<0.2	<0.1	15.9	0.02	<0.02	<0.02	<2	0.82	0.280

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.1	0.02	0.02	5	0.1	0.02	0.1	0.02	0.1	0.02
NK12-01-A.FF	Vegetation	19.2	1.2	0.23	170.7	<0.001	36	<0.01	0.002	1.74	<0.1	0.2	0.04	0.11	18	0.1	<0.02	<0.1	0.13	<0.1	<0.02
NK12-02-D.FM	Vegetation	13.1	1.3	0.31	81.4	<0.001	23	0.03	0.010	1.34	<0.1	<0.1	0.03	0.21	32	0.1	<0.02	<0.1	0.35	<0.1	<0.02
NK12-03-A.FF	Vegetation	17.0	1.5	0.29	98.2	<0.001	23	<0.01	0.009	1.42	<0.1	0.2	<0.02	0.13	16	0.2	<0.02	<0.1	0.21	<0.1	<0.02
NK12-04-A.FF	Vegetation	58.7	1.5	0.36	184.8	<0.001	31	<0.01	0.015	1.67	<0.1	0.3	0.06	0.15	22	<0.1	0.03	<0.1	0.36	<0.1	<0.02
NK12-05-D.FM	Vegetation	6.2	1.4	0.39	132.7	<0.001	21	0.04	0.004	1.69	<0.1	0.2	<0.02	0.19	31	0.2	<0.02	<0.1	1.80	<0.1	<0.02
NK12-06-D.FM	Vegetation	1.9	1.2	0.30	45.1	<0.001	<20	0.05	0.004	0.95	<0.1	0.1	<0.02	0.15	16	<0.1	<0.02	<0.1	5.80	<0.1	<0.02
NK12-07-A.FF	Vegetation	43.0	1.5	0.40	131.9	<0.001	27	0.01	0.002	1.67	<0.1	0.2	0.10	0.21	33	0.1	<0.02	0.2	2.15	<0.1	<0.02
NK12-08-D.FM	Vegetation	2.2	1.2	0.24	51.6	<0.001	<20	0.03	0.011	1.07	<0.1	0.1	0.04	0.13	25	0.1	<0.02	<0.1	3.29	<0.1	<0.02
NK12-09-D.FM	Vegetation	12.3	1.3	0.33	148.4	<0.001	<20	0.16	0.006	1.28	<0.1	<0.1	<0.02	0.13	29	0.1	<0.02	<0.1	0.79	<0.1	<0.02
NK12-10-D.FM	Vegetation	12.8	1.4	0.35	127.8	<0.001	36	0.08	0.005	1.24	<0.1	0.2	0.03	0.19	31	<0.1	<0.02	<0.1	2.31	<0.1	<0.02
NK12-11-D.FM	Vegetation	1.8	1.3	0.29	104.3	<0.001	27	0.01	0.004	1.44	<0.1	0.1	0.33	0.14	34	0.2	<0.02	<0.1	1.91	<0.1	<0.02
NK12-12-D.FM	Vegetation	16.1	1.5	0.35	107.7	<0.001	23	0.04	0.003	1.56	<0.1	0.1	<0.02	0.19	39	<0.1	<0.02	<0.1	0.26	<0.1	<0.02
NK12-13-A.FF	Vegetation	55.1	1.6	0.28	258.6	<0.001	31	0.02	0.014	1.65	<0.1	0.2	0.07	0.13	13	0.1	<0.02	0.1	0.26	<0.1	<0.02
NK12-14-A.FF	Vegetation	26.2	1.4	0.41	143.4	<0.001	23	<0.01	0.013	1.53	<0.1	0.2	<0.02	0.13	16	0.3	<0.02	<0.1	0.22	<0.1	<0.02
NK12-15-D.FM	Vegetation	15.8	1.8	0.16	87.5	<0.001	31	0.02	0.011	2.30	<0.1	0.2	<0.02	0.21	46	0.1	<0.02	<0.1	0.11	<0.1	<0.02
NK12-16-A.FF	Vegetation	18.0	1.6	0.39	69.9	<0.001	33	0.01	0.020	1.27	<0.1	0.2	0.07	0.22	24	<0.1	<0.02	0.1	0.36	<0.1	<0.02
NK12-17-D.FM	Vegetation	2.5	1.7	0.39	78.4	<0.001	22	0.01	0.012	2.31	<0.1	<0.1	<0.02	0.15	34	<0.1	<0.02	<0.1	1.03	<0.1	<0.02
NK12-18-D.FM	Vegetation	10.4	1.7	0.31	97.6	<0.001	25	0.04	0.002	2.39	<0.1	0.1	<0.02	0.16	31	0.3	0.03	<0.1	0.27	<0.1	<0.02
NK12-19-A.FF	Vegetation	39.9	1.7	0.43	278.2	<0.001	31	0.01	0.047	2.46	<0.1	0.3	0.11	0.16	31	<0.1	<0.02	0.2	0.34	<0.1	<0.02
NK12-20-D.FM	Vegetation	9.2	1.5	0.53	70.3	<0.001	35	0.09	0.010	1.72	<0.1	0.1	0.03	0.31	41	<0.1	<0.02	<0.1	5.55	<0.1	<0.02
NK12-21-D.FM	Vegetation	29.1	1.7	0.26	126.7	<0.001	43	0.09	0.005	1.06	<0.1	0.1	<0.02	0.16	34	<0.1	<0.02	0.1	2.04	<0.1	<0.02
NK12-22-D.FM	Vegetation	11.6	1.5	0.34	113.2	<0.001	36	0.06	0.007	0.98	<0.1	0.2	<0.02	0.17	26	0.2	<0.02	<0.1	4.61	<0.1	<0.02
SF-2	Rock Pulp	9.2	1.7	0.21	27.3	<0.001	29	0.05	0.019	1.65	<0.1	0.2	<0.02	0.18	26	<0.1	<0.02	<0.1	0.03	<0.1	<0.02
NK12-23-DFM	Vegetation	7.8	1.3	0.35	75.8	<0.001	21	0.11	0.004	1.41	<0.1	0.1	<0.02	0.16	43	0.3	<0.02	<0.1	1.45	<0.1	<0.02
NK12-24-A.FF	Vegetation	53.2	1.6	0.54	248.5	<0.001	30	<0.01	0.034	0.87	<0.1	0.3	0.10	0.14	28	0.3	<0.02	0.1	1.24	<0.1	<0.02
NK12-25-D.FM	Vegetation	17.3	1.7	0.43	182.6	<0.001	31	0.07	0.004	2.04	<0.1	0.1	<0.02	0.19	50	<0.1	<0.02	<0.1	0.60	<0.1	<0.02
NK12-26-D.FM	Vegetation	59.2	1.6	0.48	227.1	<0.001	38	0.10	0.005	1.47	<0.1	0.2	0.03	0.21	45	0.3	<0.02	0.1	3.20	<0.1	<0.02
NK12-27-A.FF	Vegetation	67.4	1.4	0.27	234.6	<0.001	23	0.02	0.059	1.24	<0.1	0.3	0.17	0.14	20	0.3	<0.02	0.2	0.53	0.1	<0.02
NK12-28-A.FF	Vegetation	75.8	1.5	0.36	138.7	<0.001	42	<0.01	0.020	1.89	<0.1	0.3	<0.02	0.13	28	0.3	<0.02	0.1	0.13	<0.1	<0.02
NK12-29-A.FF	Vegetation	31.3	1.5	0.30	139.2	<0.001	34	0.01	0.004	2.17	<0.1	0.3	<0.02	0.19	11	0.2	<0.02	<0.1	0.26	<0.1	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F		1F		1F	1F			1F
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pd	Pt	Tb	Dy	Pr	Ho	Er	Nd	Sm
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppb	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.1	0.1	0.05	0.1	0.01	0.1	0.02	1	0.1	0.1	10	2	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK12-01-A.FF	Vegetation	<0.02	56.3	<0.1	<0.05	<0.1	0.71	26.1	<0.02	<1	<0.1	0.2	<10	<2	0.02	0.13	2.52	<0.02	0.04	8.03	0.96
NK12-02-D.FM	Vegetation	<0.02	70.6	<0.1	<0.05	<0.1	0.45	17.0	<0.02	<1	<0.1	0.1	<10	<2	0.03	0.08	1.64	<0.02	0.02	5.07	0.38
NK12-03-A.FF	Vegetation	<0.02	45.0	<0.1	<0.05	<0.1	2.33	22.7	<0.02	<1	<0.1	<0.1	<10	<2	0.08	0.27	2.98	0.06	0.10	10.86	1.52
NK12-04-A.FF	Vegetation	<0.02	55.9	<0.1	<0.05	<0.1	1.55	51.4	<0.02	2	<0.1	0.1	<10	<2	0.06	0.23	7.80	0.03	0.08	25.97	2.82
NK12-05-D.FM	Vegetation	<0.02	199.1	<0.1	<0.05	<0.1	0.15	8.0	<0.02	<1	<0.1	0.2	<10	<2	<0.02	<0.02	0.66	<0.02	<0.02	1.70	0.18
NK12-06-D.FM	Vegetation	<0.02	303.2	<0.1	<0.05	<0.1	0.05	2.6	<0.02	<1	0.2	0.2	<10	<2	<0.02	<0.02	0.23	<0.02	<0.02	0.61	0.09
NK12-07-A.FF	Vegetation	<0.02	119.0	<0.1	<0.05	<0.1	1.34	61.2	<0.02	<1	<0.1	0.1	<10	<2	0.07	0.22	7.12	0.03	0.08	24.23	2.42
NK12-08-D.FM	Vegetation	<0.02	289.0	<0.1	<0.05	<0.1	0.12	3.0	<0.02	<1	<0.1	0.3	<10	<2	<0.02	<0.02	0.23	<0.02	<0.02	0.65	0.07
NK12-09-D.FM	Vegetation	<0.02	169.0	<0.1	<0.05	<0.1	0.51	19.6	<0.02	<1	0.2	0.5	<10	<2	0.02	0.08	1.67	<0.02	0.03	4.93	0.55
NK12-10-D.FM	Vegetation	<0.02	269.0	<0.1	<0.05	<0.1	0.26	18.5	<0.02	<1	<0.1	0.2	<10	<2	<0.02	0.09	1.46	<0.02	<0.02	4.31	0.36
NK12-11-D.FM	Vegetation	<0.02	214.3	<0.1	<0.05	<0.1	0.05	2.9	<0.02	2	<0.1	<0.1	<10	<2	<0.02	<0.02	0.26	<0.02	<0.02	0.61	0.04
NK12-12-D.FM	Vegetation	<0.02	109.6	<0.1	<0.05	<0.1	0.61	20.9	<0.02	<1	<0.1	<0.1	<10	<2	0.03	0.07	1.92	0.02	0.04	5.27	0.34
NK12-13-A.FF	Vegetation	<0.02	106.6	<0.1	<0.05	<0.1	3.17	125.2	<0.02	<1	<0.1	<0.1	<10	<2	0.15	0.65	7.65	0.10	0.21	24.71	3.19
NK12-14-A.FF	Vegetation	<0.02	110.4	<0.1	<0.05	<0.1	1.35	44.4	<0.02	<1	<0.1	<0.1	<10	<2	0.07	0.25	3.83	0.04	0.10	12.53	1.50
NK12-15-D.FM	Vegetation	<0.02	78.6	<0.1	<0.05	<0.1	0.65	15.7	<0.02	<1	<0.1	0.1	<10	<2	0.03	0.11	2.14	<0.02	0.04	6.84	0.69
NK12-16-A.FF	Vegetation	<0.02	78.8	<0.1	<0.05	<0.1	1.67	36.7	<0.02	<1	<0.1	<0.1	<10	<2	0.05	0.32	2.81	0.04	0.11	9.82	1.18
NK12-17-D.FM	Vegetation	<0.02	223.8	<0.1	<0.05	<0.1	0.06	5.5	<0.02	<1	<0.1	<0.1	<10	<2	<0.02	<0.02	0.40	<0.02	<0.02	0.92	0.04
NK12-18-D.FM	Vegetation	<0.02	140.3	<0.1	<0.05	<0.1	0.17	18.2	<0.02	<1	<0.1	0.1	<10	<2	<0.02	0.05	1.14	<0.02	<0.02	2.81	0.19
NK12-19-A.FF	Vegetation	<0.02	156.4	<0.1	<0.05	<0.1	1.06	73.5	<0.02	<1	<0.1	<0.1	<10	<2	0.05	0.22	5.51	0.03	0.13	16.47	1.72
NK12-20-D.FM	Vegetation	<0.02	322.6	<0.1	<0.05	<0.1	0.45	15.3	<0.02	<1	0.1	0.9	<10	<2	<0.02	0.05	1.10	<0.02	<0.02	2.71	0.23
NK12-21-D.FM	Vegetation	<0.02	150.9	<0.1	<0.05	0.1	1.42	33.0	<0.02	<1	<0.1	0.1	<10	<2	0.04	0.14	3.44	0.03	0.06	10.60	0.88
NK12-22-D.FM	Vegetation	<0.02	146.5	<0.1	<0.05	<0.1	0.57	15.7	<0.02	<1	<0.1	0.4	<10	<2	<0.02	0.07	1.58	<0.02	0.04	4.61	0.43
SF-2	Rock Pulp	<0.02	16.5	<0.1	<0.05	<0.1	3.22	8.5	<0.02	<1	<0.1	<0.1	<10	<2	0.10	0.52	1.48	0.08	0.17	6.12	0.93
NK12-23-DFM	Vegetation	<0.02	107.1	<0.1	<0.05	<0.1	0.56	13.3	<0.02	<1	<0.1	0.2	<10	<2	<0.02	0.06	0.97	<0.02	0.03	2.66	0.20
NK12-24-A.FF	Vegetation	<0.02	66.2	<0.1	<0.05	<0.1	1.63	50.5	<0.02	<1	<0.1	<0.1	<10	2	0.06	0.34	6.83	0.03	0.07	22.79	2.48
NK12-25-D.FM	Vegetation	<0.02	84.1	<0.1	<0.05	<0.1	1.31	18.9	<0.02	<1	2.7	0.2	<10	<2	0.03	0.22	1.77	0.03	0.06	5.41	0.48
NK12-26-D.FM	Vegetation	<0.02	142.4	<0.1	<0.05	<0.1	4.54	67.0	<0.02	<1	16.1	0.5	<10	<2	0.13	0.69	6.18	0.12	0.35	16.73	1.63
NK12-27-A.FF	Vegetation	<0.02	81.3	<0.1	<0.05	<0.1	4.49	67.2	<0.02	1	0.3	1.5	<10	<2	0.16	0.73	8.07	0.10	0.30	24.68	2.99
NK12-28-A.FF	Vegetation	<0.02	52.3	<0.1	<0.05	<0.1	1.44	38.3	<0.02	<1	<0.1	<0.1	<10	<2	0.06	0.31	10.07	0.04	0.08	31.70	2.78
NK12-29-A.FF	Vegetation	<0.02	58.6	<0.1	<0.05	<0.1	1.17	68.3	<0.02	<1	<0.1	0.2	<10	<2	0.06	0.16	4.57	0.03	0.09	13.97	1.53

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

	Method		1F		1F	1F
	Analyte	Eu	Tm	Gd	Yb	Lu
	Unit	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.02	0.02	0.02	0.02
NK12-01-A.FF	Vegetation	0.13	<0.02	0.47	0.02	<0.02
NK12-02-D.FM	Vegetation	0.04	<0.02	0.14	0.02	<0.02
NK12-03-A.FF	Vegetation	0.24	<0.02	0.90	0.11	<0.02
NK12-04-A.FF	Vegetation	0.43	<0.02	1.00	0.08	<0.02
NK12-05-D.FM	Vegetation	0.03	<0.02	0.06	<0.02	<0.02
NK12-06-D.FM	Vegetation	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-07-A.FF	Vegetation	0.23	<0.02	0.64	0.04	<0.02
NK12-08-D.FM	Vegetation	<0.02	<0.02	0.08	<0.02	<0.02
NK12-09-D.FM	Vegetation	0.04	<0.02	0.13	0.03	<0.02
NK12-10-D.FM	Vegetation	0.04	<0.02	0.15	<0.02	<0.02
NK12-11-D.FM	Vegetation	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-12-D.FM	Vegetation	0.05	<0.02	0.22	0.03	<0.02
NK12-13-A.FF	Vegetation	0.33	0.02	1.37	0.12	<0.02
NK12-14-A.FF	Vegetation	0.17	<0.02	0.68	0.04	<0.02
NK12-15-D.FM	Vegetation	0.06	<0.02	0.31	<0.02	<0.02
NK12-16-A.FF	Vegetation	0.17	<0.02	0.60	0.07	<0.02
NK12-17-D.FM	Vegetation	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-18-D.FM	Vegetation	<0.02	<0.02	<0.02	<0.02	<0.02
NK12-19-A.FF	Vegetation	0.18	<0.02	0.79	0.06	<0.02
NK12-20-D.FM	Vegetation	<0.02	<0.02	0.10	0.02	<0.02
NK12-21-D.FM	Vegetation	0.09	<0.02	0.55	0.06	<0.02
NK12-22-D.FM	Vegetation	0.03	<0.02	0.17	0.03	<0.02
SF-2	Rock Pulp	0.24	0.02	0.88	0.09	<0.02
NK12-23-DFM	Vegetation	0.02	<0.02	0.05	<0.02	<0.02
NK12-24-A.FF	Vegetation	0.17	<0.02	0.84	0.07	<0.02
NK12-25-D.FM	Vegetation	0.04	<0.02	0.24	0.06	<0.02
NK12-26-D.FM	Vegetation	0.17	0.04	1.24	0.20	<0.02
NK12-27-A.FF	Vegetation	0.28	0.04	1.60	0.20	0.03
NK12-28-A.FF	Vegetation	0.30	<0.02	0.97	0.06	<0.02
NK12-29-A.FF	Vegetation	0.14	<0.02	0.49	0.05	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.01	0.02	0.02	2	0.01	0.001
NK12-30-A.FF	Vegetation	0.33	6.31	0.33	17.9	20	2.9	<0.1	130	<0.01	<0.1	<0.1	0.4	<0.1	27.1	0.04	<0.02	<0.02	<2	0.95	0.161
NK12-31-A.FF	Vegetation	0.51	6.89	0.30	25.2	8	2.9	<0.1	184	<0.01	<0.1	<0.1	<0.2	<0.1	25.8	0.09	<0.02	<0.02	<2	0.91	0.244
NK12-32-D.FM	Vegetation	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK12-33-A.FF	Vegetation	0.14	7.95	0.20	18.2	18	0.4	<0.1	74	<0.01	<0.1	<0.1	<0.2	<0.1	14.1	0.07	<0.02	<0.02	<2	0.69	0.129
NK12-34-A.FF	Vegetation	2.72	6.55	0.18	20.2	4	0.5	<0.1	81	<0.01	<0.1	<0.1	<0.2	<0.1	17.1	0.12	<0.02	<0.02	<2	0.90	0.155
NK12-35-D.FM	Vegetation	0.31	6.10	0.45	51.3	3	0.2	<0.1	67	<0.01	0.1	<0.1	<0.2	<0.1	17.5	0.02	<0.02	<0.02	<2	0.62	0.107
NK12-36-A.FF	Vegetation	1.21	7.42	0.26	71.4	<2	0.2	<0.1	758	<0.01	<0.1	<0.1	0.4	<0.1	7.1	0.29	<0.02	<0.02	<2	0.60	0.301
NK12-37-A.FF	Vegetation	4.40	6.01	0.27	44.8	<2	1.1	<0.1	929	0.02	0.5	<0.1	4.8	<0.1	9.5	0.31	0.07	0.14	<2	0.42	0.128
NK12-38-D.FM	Vegetation	0.44	15.23	1.26	36.9	12	0.9	0.2	72	<0.01	0.5	<0.1	2.9	<0.1	27.9	0.04	0.02	0.08	<2	0.94	0.127
NK12-38-A.FF	Vegetation	0.80	6.81	0.24	15.9	<2	0.5	<0.1	74	0.02	0.4	<0.1	0.5	<0.1	11.6	0.18	<0.02	<0.02	<2	0.61	0.080
NK12-39-D.FM	Vegetation	0.50	5.24	0.30	59.1	<2	0.8	0.2	490	0.02	0.8	<0.1	1.6	<0.1	18.0	0.11	0.02	<0.02	<2	0.56	0.132
NK12-40-D.FM	Vegetation	0.11	3.52	0.32	43.7	<2	3.0	0.1	349	0.02	0.7	<0.1	<0.2	<0.1	28.5	0.08	<0.02	<0.02	<2	0.53	0.081
NK12-41-D.FM	Vegetation	0.18	5.30	0.57	54.0	10	1.9	<0.1	290	0.03	0.6	<0.1	<0.2	<0.1	41.2	0.03	<0.02	<0.02	<2	0.67	0.160
NK12-42-A.FF	Vegetation	0.35	4.34	0.17	12.8	11	1.7	0.2	57	0.03	0.9	<0.1	0.8	<0.1	23.2	0.23	0.02	<0.02	<2	1.06	0.115
NK12-43-A.FF	Vegetation	4.64	9.47	0.17	18.9	<2	1.5	0.1	77	0.02	0.2	<0.1	<0.2	<0.1	9.7	0.29	<0.02	<0.02	<2	0.66	0.101

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.1	0.02	0.02	5	0.1	0.02	0.1	0.02	0.1	0.02
NK12-30-A.FF	Vegetation	35.8	1.5	0.54	301.2	<0.001	44	0.01	0.022	1.55	<0.1	0.4	0.23	0.18	25	0.3	<0.02	<0.1	1.12	<0.1	<0.02
NK12-31-A.FF	Vegetation	20.2	1.5	0.59	251.6	<0.001	32	0.01	0.002	1.39	<0.1	0.2	<0.02	0.15	16	0.2	<0.02	<0.1	0.20	<0.1	<0.02
NK12-32-D.FM	Vegetation	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK12-33-A.FF	Vegetation	45.3	1.3	0.21	166.5	<0.001	41	<0.01	0.003	2.16	<0.1	0.2	<0.02	0.14	27	0.2	<0.02	0.1	0.11	<0.1	<0.02
NK12-34-A.FF	Vegetation	46.2	1.6	0.28	133.1	<0.001	33	<0.01	0.131	1.66	<0.1	0.3	0.05	0.19	20	0.1	<0.02	0.1	0.70	<0.1	<0.02
NK12-35-D.FM	Vegetation	16.2	1.5	0.27	37.2	<0.001	48	0.01	0.011	1.65	<0.1	<0.1	<0.02	0.19	18	0.1	<0.02	<0.1	2.05	<0.1	<0.02
NK12-36-A.FF	Vegetation	2.6	1.3	0.39	44.0	<0.001	39	<0.01	0.002	1.50	<0.1	0.1	<0.02	0.15	22	0.2	<0.02	<0.1	0.22	<0.1	<0.02
NK12-37-A.FF	Vegetation	1.6	6.1	0.22	50.2	0.002	<20	<0.01	0.003	1.31	0.3	0.5	0.03	0.14	41	0.8	0.03	0.9	0.40	<0.1	<0.02
NK12-38-D.FM	Vegetation	69.3	4.8	0.28	74.7	0.002	34	0.07	0.006	1.56	<0.1	<0.1	0.02	0.23	35	<0.1	<0.02	0.5	1.56	0.2	<0.02
NK12-38-A.FF	Vegetation	65.3	3.9	0.22	178.7	0.001	36	0.02	0.001	1.93	<0.1	1.1	0.04	0.13	22	0.3	<0.02	0.4	0.50	0.1	<0.02
NK12-39-D.FM	Vegetation	5.1	4.0	0.37	60.5	0.002	36	0.01	0.008	0.95	<0.1	0.3	0.14	0.14	46	0.3	<0.02	0.4	4.48	<0.1	<0.02
NK12-40-D.FM	Vegetation	20.0	4.4	0.25	60.7	0.001	34	0.06	0.007	1.42	<0.1	0.3	0.11	0.11	47	0.8	0.09	0.4	2.32	<0.1	<0.02
NK12-41-D.FM	Vegetation	29.0	5.3	0.35	94.6	0.002	26	0.06	0.003	1.15	<0.1	0.5	<0.02	0.16	64	0.9	<0.02	0.6	0.75	<0.1	<0.02
NK12-42-A.FF	Vegetation	83.2	4.4	0.25	106.9	0.001	22	0.01	0.002	1.55	<0.1	1.3	0.04	0.10	51	0.7	<0.02	0.6	0.47	<0.1	<0.02
NK12-43-A.FF	Vegetation	62.2	6.4	0.28	106.0	0.001	40	<0.01	0.037	2.07	<0.1	1.3	0.39	0.18	22	1.2	<0.02	0.3	1.74	<0.1	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F		1F		1F	1F			1F
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pd	Pt	Tb	Dy	Pr	Ho	Er	Nd	Sm
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppb	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.1	0.1	0.05	0.1	0.01	0.1	0.02	1	0.1	0.1	10	2	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK12-30-A.FF	Vegetation	<0.02	449.5	<0.1	<0.05	<0.1	1.37	65.4	<0.02	<1	<0.1	2.4	<10	<2	0.06	0.24	4.91	0.03	0.11	15.60	2.00
NK12-31-A.FF	Vegetation	<0.02	130.5	<0.1	<0.05	<0.1	1.79	37.2	<0.02	<1	<0.1	<0.1	<10	<2	0.06	0.27	3.39	0.04	0.15	11.50	1.49
NK12-32-D.FM	Vegetation	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK12-33-A.FF	Vegetation	<0.02	48.3	<0.1	<0.05	<0.1	0.98	69.7	<0.02	<1	<0.1	0.3	<10	<2	0.04	0.21	5.98	0.02	0.09	17.89	1.71
NK12-34-A.FF	Vegetation	<0.02	79.0	<0.1	<0.05	<0.1	2.48	33.7	<0.02	<1	<0.1	0.3	<10	<2	0.10	0.40	6.63	0.04	0.13	21.76	2.82
NK12-35-D.FM	Vegetation	<0.02	45.4	<0.1	<0.05	<0.1	3.71	26.8	<0.02	<1	<0.1	0.1	<10	<2	0.11	0.73	2.80	0.12	0.32	9.58	1.37
NK12-36-A.FF	Vegetation	<0.02	62.1	<0.1	<0.05	<0.1	0.05	2.7	<0.02	<1	<0.1	<0.1	<10	<2	<0.02	<0.02	0.32	<0.02	<0.02	0.87	0.07
NK12-37-A.FF	Vegetation	<0.02	47.3	<0.1	<0.05	0.1	0.07	2.0	<0.02	<1	<0.1	0.4	<10	2	<0.02	<0.02	0.21	<0.02	<0.02	0.68	0.11
NK12-38-D.FM	Vegetation	<0.02	70.5	0.2	<0.05	0.2	8.97	79.8	<0.02	4	0.4	<0.1	<10	7	0.24	1.32	8.28	0.16	0.42	21.24	2.34
NK12-38-A.FF	Vegetation	0.02	42.3	<0.1	<0.05	0.4	3.47	68.5	<0.02	<1	<0.1	21.9	<10	6	0.09	0.35	7.28	0.13	0.19	19.17	2.44
NK12-39-D.FM	Vegetation	<0.02	114.8	<0.1	<0.05	0.1	0.10	8.2	<0.02	<1	0.2	0.4	<10	2	<0.02	0.02	0.69	<0.02	0.03	1.94	0.03
NK12-40-D.FM	Vegetation	<0.02	502.8	<0.1	<0.05	<0.1	3.66	27.6	<0.02	<1	0.8	0.2	<10	2	0.10	0.64	2.51	0.11	0.32	7.80	0.94
NK12-41-D.FM	Vegetation	<0.02	72.4	<0.1	<0.05	0.4	4.12	35.7	<0.02	<1	0.7	0.4	<10	7	0.10	0.48	3.46	0.07	0.22	10.91	0.79
NK12-42-A.FF	Vegetation	<0.02	155.0	<0.1	<0.05	<0.1	8.31	63.4	<0.02	<1	0.4	<0.1	<10	<2	0.26	1.03	10.82	0.23	0.34	34.15	4.44
NK12-43-A.FF	Vegetation	0.14	114.2	<0.1	<0.05	<0.1	5.47	50.8	<0.02	1	<0.1	0.4	<10	4	0.17	0.78	7.50	0.11	0.22	24.72	3.07

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

CERTIFICATE OF ANALYSIS VAN12004250.1

		Method		1F		1F	1F
		Analyte	Eu	Tm	Gd	Yb	Lu
		Unit	ppm	ppm	ppm	ppm	ppm
		MDL	0.02	0.02	0.02	0.02	0.02
NK12-30-A.FF	Vegetation		0.19	<0.02	0.81	0.06	<0.02
NK12-31-A.FF	Vegetation		0.19	<0.02	0.88	0.08	<0.02
NK12-32-D.FM	Vegetation		L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK12-33-A.FF	Vegetation		0.13	<0.02	0.50	0.03	<0.02
NK12-34-A.FF	Vegetation		0.26	<0.02	1.30	0.05	<0.02
NK12-35-D.FM	Vegetation		0.12	0.04	0.71	0.20	0.03
NK12-36-A.FF	Vegetation		<0.02	<0.02	0.03	<0.02	<0.02
NK12-37-A.FF	Vegetation		0.05	<0.02	0.05	<0.02	<0.02
NK12-38-D.FM	Vegetation		0.21	0.05	1.53	0.27	0.04
NK12-38-A.FF	Vegetation		0.34	0.05	1.22	0.14	<0.02
NK12-39-D.FM	Vegetation		0.04	<0.02	<0.02	<0.02	<0.02
NK12-40-D.FM	Vegetation		0.09	0.02	0.57	0.13	<0.02
NK12-41-D.FM	Vegetation		0.16	<0.02	0.43	0.13	<0.02
NK12-42-A.FF	Vegetation		0.51	0.04	1.88	0.25	0.03
NK12-43-A.FF	Vegetation		0.27	0.02	1.65	0.11	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

QUALITY CONTROL REPORT VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.01	0.02	0.02	2	0.01	0.001
Pulp Duplicates																					
NK12-23-DFM	Vegetation Pu	0.18	5.79	0.48	36.3	7	1.2	0.4	982	<0.01	0.1	<0.1	<0.2	<0.1	22.0	0.14	<0.02	<0.02	<2	0.59	0.177
REP NK12-23-DFM	QC	0.17	5.57	0.36	34.3	7	1.0	0.3	906	<0.01	0.3	<0.1	<0.2	<0.1	20.4	0.10	<0.02	<0.02	<2	0.54	0.173
NK12-43-A.FF	Vegetation Pu	4.64	9.47	0.17	18.9	<2	1.5	0.1	77	0.02	0.2	<0.1	<0.2	<0.1	9.7	0.29	<0.02	<0.02	<2	0.66	0.101
REP NK12-43-A.FF	QC	4.24	8.54	0.15	19.6	<2	1.5	<0.1	77	0.02	0.6	<0.1	1.2	<0.1	9.1	0.31	<0.02	<0.02	<2	0.65	0.097
Reference Materials																					
STD DS9	Standard	12.00	110.7	131.1	308.9	1777	40.1	7.9	582	2.24	30.0	2.5	106.7	5.8	69.8	2.64	5.18	6.36	37	0.68	0.096
STD DS9	Standard	11.76	107.7	127.8	307.9	1766	40.5	7.8	631	2.39	27.0	2.8	100.2	5.6	75.4	2.37	3.80	6.64	40	0.74	0.084
STD OREAS45EA	Standard	1.27	671.4	14.29	28.1	241	373.9	50.0	398	22.95	9.8	1.7	55.8	9.8	3.4	0.04	0.17	0.21	277	0.03	0.030
STD OREAS45EA	Standard	1.23	667.5	13.65	32.3	278	400.1	52.1	438	22.63	9.5	1.7	80.9	9.7	3.7	0.04	0.12	0.27	313	0.20	0.031
STD OREAS45EA Expected		1.78	709	14.3	30.6	311	357	52	400	22.65	11.4	1.73	53	10.7	4.05	0.03	0.64	0.26	295	0.032	0.029
STD DS9 Expected		12.84	108	126	317	1830	40.3	7.6	575	2.33	25.5	2.69	118	6.38	69.6	2.4	4.94	6.32	40	0.7201	0.0819
BLK	Blank	<0.01	0.01	<0.01	<0.1	<2	<0.1	<0.1	<1	<0.01	<0.1	<0.1	<0.2	<0.1	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001
BLK	Blank	<0.01	0.08	<0.01	<0.1	<2	<0.1	<0.1	<1	<0.01	0.2	<0.1	0.3	<0.1	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

QUALITY CONTROL REPORT VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.1	0.02	0.02	5	0.1	0.02	0.1	0.02	0.1	0.02
Pulp Duplicates																					
NK12-23-DFM	Vegetation Pu	7.8	1.3	0.35	75.8	<0.001	21	0.11	0.004	1.41	<0.1	0.1	<0.02	0.16	43	0.3	<0.02	<0.1	1.45	<0.1	<0.02
REP NK12-23-DFM	QC	7.5	1.5	0.32	75.9	<0.001	28	0.11	0.004	1.49	<0.1	0.1	<0.02	0.17	42	0.3	<0.02	<0.1	1.40	<0.1	<0.02
NK12-43-A.FF	Vegetation Pu	62.2	6.4	0.28	106.0	0.001	40	<0.01	0.037	2.07	<0.1	1.3	0.39	0.18	22	1.2	<0.02	0.3	1.74	<0.1	<0.02
REP NK12-43-A.FF	QC	59.9	5.7	0.27	114.3	0.001	39	<0.01	0.036	2.00	<0.1	0.8	0.35	0.18	48	<0.1	0.09	0.4	1.78	0.1	<0.02
Reference Materials																					
STD DS9	Standard	11.6	109.2	0.59	342.6	0.100	<20	0.89	0.076	0.38	3.0	2.5	5.62	0.15	186	5.4	5.29	4.2	2.43	0.1	0.07
STD DS9	Standard	13.4	116.8	0.63	321.6	0.111	<20	1.00	0.086	0.40	2.6	3.2	5.66	0.16	160	6.5	5.38	5.4	2.34	<0.1	0.10
STD OREAS45EA	Standard	6.5	791.3	0.09	162.0	0.084	<20	2.97	0.023	0.05	<0.1	78.9	<0.02	0.04	9	0.6	0.09	11.0	0.65	0.2	0.67
STD OREAS45EA	Standard	6.5	806.6	0.11	140.1	0.090	<20	3.28	0.015	0.05	<0.1	79.1	<0.02	0.03	<5	1.3	0.02	13.3	0.66	2.1	0.55
STD OREAS45EA Expected		8.19	849	0.095	148	0.106		3.32	0.027	0.053		78	0.072	0.044	340	2.09	0.11	11.7	0.77	0.26	0.82
STD DS9 Expected		13.3	121	0.6165	330	0.1108		0.9577	0.0853	0.395	2.89	2.5	5.3	0.1615	200	5.2	5.02	4.59	2.37	0.1	0.08
BLK	Blank	<0.5	<0.5	<0.01	<0.5	<0.001	<20	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.02	<5	<0.1	<0.02	<0.1	<0.02	<0.1	<0.02
BLK	Blank	<0.5	<0.5	<0.01	<0.5	<0.001	<20	<0.01	<0.001	<0.01	<0.1	0.3	<0.02	<0.02	<5	<0.1	0.11	<0.1	<0.02	<0.1	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

QUALITY CONTROL REPORT VAN12004250.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F		1F		1F	1F			1F
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pd	Pt	Tb	Dy	Pr	Ho	Er	Nd	Sm
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppb	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.1	0.1	0.05	0.1	0.01	0.1	0.02	1	0.1	0.1	10	2	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Pulp Duplicates																					
NK12-23-DFM	Vegetation Pu	<0.02	107.1	<0.1	<0.05	<0.1	0.56	13.3	<0.02	<1	<0.1	0.2	<10	<2	<0.02	0.06	0.97	<0.02	0.03	2.66	0.20
REP NK12-23-DFM	QC	<0.02	102.6	<0.1	<0.05	<0.1	0.51	12.9	<0.02	<1	<0.1	0.1	<10	<2	<0.02	0.09	0.96	<0.02	<0.02	2.51	0.18
NK12-43-A.FF	Vegetation Pu	0.14	114.2	<0.1	<0.05	<0.1	5.47	50.8	<0.02	1	<0.1	0.4	<10	4	0.17	0.78	7.50	0.11	0.22	24.72	3.07
REP NK12-43-A.FF	QC	0.10	111.6	<0.1	<0.05	<0.1	5.12	50.6	<0.02	<1	<0.1	0.3	<10	4	0.17	0.55	7.72	0.09	0.25	22.92	3.26
Reference Materials																					
STD DS9	Standard	0.93	35.1	5.0	<0.05	1.7	5.34	23.4	2.18	53	5.1	26.2	119	333	0.17	1.02	2.61	0.21	0.62	9.51	1.67
STD DS9	Standard	0.80	34.2	5.1	<0.05	1.8	5.67	25.3	2.17	50	5.5	24.5	107	351	0.18	1.10	2.95	0.24	0.46	10.41	1.83
STD OREAS45EA	Standard	0.07	7.1	0.6	<0.05	20.5	4.87	17.6	0.08	<1	0.3	2.3	68	91	0.21	1.58	1.90	0.27	0.91	7.59	1.81
STD OREAS45EA	Standard	0.07	7.6	0.7	<0.05	19.3	4.98	17.5	0.05	<1	0.4	2.8	117	126	0.28	1.40	1.77	0.33	0.78	6.89	1.82
STD OREAS45EA Expected		0.43	7.93	0.97		26.6	5.74	17.7	0.1		0.47	7.63	66	108	0.26	1.54	1.91	0.29	0.82	6.67	1.65
STD DS9 Expected		0.96	33.8	6.4	0.004	2	5.97	25.4	2.2	61	5.4	25.2	120	350	0.18	1.1	2.72	0.2	0.6	10	1.74
BLK	Blank	<0.02	<0.1	<0.1	<0.05	<0.1	<0.01	<0.1	<0.02	<1	<0.1	<0.1	<10	<2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
BLK	Blank	<0.02	<0.1	<0.1	<0.05	<0.1	0.01	<0.1	<0.02	2	<0.1	<0.1	<10	<2	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2012
Report Date: November 27, 2012

QUALITY CONTROL REPORT VAN12004250.1

	Method		1F		1F	1F
	Analyte	Eu	Tm	Gd	Yb	Lu
	Unit	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.02	0.02	0.02	0.02
Pulp Duplicates						
NK12-23-DFM	Vegetation Pu	0.02	<0.02	0.05	<0.02	<0.02
REP NK12-23-DFM	QC	<0.02	<0.02	0.13	0.02	<0.02
NK12-43-A.FF	Vegetation Pu	0.27	0.02	1.65	0.11	<0.02
REP NK12-43-A.FF	QC	0.39	<0.02	1.49	0.03	0.03
Reference Materials						
STD DS9	Standard	0.33	0.07	1.41	0.52	0.09
STD DS9	Standard	0.68	0.08	1.41	0.60	0.09
STD OREAS45EA	Standard	0.46	0.10	1.61	0.81	0.10
STD OREAS45EA	Standard	0.58	0.11	1.36	0.80	0.10
STD OREAS45EA Expected		0.45	0.1	1.67	0.86	0.11
STD DS9 Expected		0.36	0.08	1.4	0.61	0.09
BLK	Blank	<0.02	<0.02	<0.02	<0.02	<0.02
BLK	Blank	<0.02	<0.02	<0.02	<0.02	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: December 21, 2011
Report Date: January 09, 2012
Page: 1 of 2

CERTIFICATE OF ANALYSIS VAN11007028.1

CLIENT JOB INFORMATION

Project: Norra Karr 2011
Shipment ID:
P.O. Number
Number of Samples: 14

SAMPLE DISPOSAL

STOR-PLP Store After 90 days Invoice for Storage
DISP-RJT-SOIL Immediate Disposal of Soil Reject

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
Dry at 60C	14	Dry at 60C			VAN
SS80	14	Dry at 60C sieve 100g to -80 mesh			VAN
1F04-1F09	14	1:1:1 Aqua Regia digestion Ultratrace ICP-MS analysis	0.5	Completed	VAN
2A05	14	Loss on Ignition at 1000 C		Completed	VAN

ADDITIONAL COMMENTS

Invoice To: IoGlobal Solutions
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2
Canada

CC: Colin Dunn
Magnus Leijd

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
GENERAL MANAGER

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

CERTIFICATE OF ANALYSIS VAN11007028.1

		Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
		Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
		Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
		MDL	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.01	0.02	0.02	2	0.01	0.001
NK11-006 AH	Soil		0.91	4.79	20.11	30.3	130	4.2	1.1	368	0.30	1.8	0.6	2.7	0.1	22.5	0.31	0.42	0.13	8	0.45	0.067
NK11-009 AH	Soil		1.18	6.73	20.26	99.3	85	5.9	2.8	941	0.97	2.0	1.3	1.6	0.6	21.3	0.50	0.18	0.17	13	0.53	0.053
NK11-012 AH	Soil		2.34	6.99	25.60	69.1	136	5.5	3.0	360	1.72	4.4	1.5	1.1	1.5	7.5	0.17	0.22	0.18	21	0.10	0.039
NK11-014 AH	Soil		1.05	7.03	34.73	70.3	152	4.7	1.3	150	0.26	1.2	0.4	1.3	<0.1	29.3	0.75	0.62	0.15	6	0.49	0.089
NK11-014 B	Soil		2.24	5.57	17.60	43.9	72	4.2	2.3	86	1.31	3.8	1.2	0.2	0.8	5.5	0.14	0.15	0.18	20	0.06	0.024
NK11-015 AH	Soil		0.76	6.51	18.71	48.6	49	3.9	1.3	1099	0.43	1.3	0.3	0.7	0.1	19.7	0.38	0.33	0.11	8	0.27	0.069
NK11-015 B	Soil		1.76	6.90	20.24	96.1	69	4.8	4.5	843	1.75	4.2	1.2	<0.2	1.6	8.1	0.22	0.19	0.18	22	0.08	0.034
NK11-016 AH	Soil		0.93	6.06	18.72	62.0	60	3.4	1.6	396	0.52	1.6	0.6	<0.2	0.1	20.8	0.87	0.22	0.20	8	0.43	0.067
NK11-016 B	Soil		2.06	6.10	36.34	70.5	66	6.3	3.1	279	1.28	3.8	1.4	<0.2	0.7	7.3	0.55	0.31	0.41	16	0.08	0.036
NK11-020 B	Soil		3.00	5.70	18.36	44.3	106	5.5	3.2	193	1.78	5.2	1.5	0.4	2.4	7.4	0.13	0.21	0.15	24	0.07	0.026
NK11-021 AH	Soil		0.90	7.46	18.12	92.7	145	5.4	2.2	5176	0.42	1.7	0.4	0.6	0.1	43.6	0.53	0.32	0.07	9	0.72	0.122
NK11-021 B	Soil		2.57	5.88	19.45	67.6	71	4.5	4.3	628	1.71	4.3	2.0	<0.2	1.8	8.5	0.17	0.19	0.15	25	0.05	0.037
NK11-022 B	Soil		0.71	4.76	12.30	47.2	137	7.0	3.2	230	0.95	2.4	3.2	<0.2	1.0	11.2	0.20	0.10	0.10	19	0.29	0.043
NK11-081 B	Soil		1.66	11.38	18.75	129.0	152	9.9	5.5	479	1.52	4.4	2.9	<0.2	2.7	17.2	0.38	0.15	0.15	21	0.22	0.036

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

CERTIFICATE OF ANALYSIS VAN11007028.1

		Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
		Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
		Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
		MDL	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.1	0.02	0.02	5	0.1	0.02	0.1	0.02	0.1	0.02
NK11-006 AH	Soil		4.6	4.7	0.07	68.9	0.014	44	0.28	0.005	0.05	0.3	0.5	0.27	0.11	242	0.6	<0.02	1.4	0.75	<0.1	0.05
NK11-009 AH	Soil		12.8	5.4	0.17	111.4	0.037	24	0.73	0.004	0.06	0.2	0.8	0.32	0.10	143	0.5	<0.02	4.8	2.63	<0.1	0.32
NK11-012 AH	Soil		14.4	7.2	0.14	62.8	0.046	<20	0.91	0.002	0.06	0.2	1.1	0.37	0.04	76	0.4	<0.02	4.9	1.69	<0.1	0.13
NK11-014 AH	Soil		4.5	4.3	0.06	191.7	0.010	<20	0.22	0.007	0.05	0.3	0.4	0.17	0.15	284	0.6	0.02	1.1	0.44	<0.1	0.11
NK11-014 B	Soil		13.2	7.0	0.12	35.7	0.043	<20	0.99	0.002	0.04	0.1	1.0	0.41	0.03	61	0.4	<0.02	5.7	1.47	<0.1	0.36
NK11-015 AH	Soil		3.1	4.2	0.07	239.0	0.018	<20	0.22	0.006	0.06	0.2	0.3	0.20	0.12	205	0.4	<0.02	1.7	0.61	<0.1	0.29
NK11-015 B	Soil		14.3	7.4	0.21	486.4	0.067	<20	1.09	0.003	0.03	0.1	1.2	0.25	0.03	60	0.6	<0.02	6.4	1.20	<0.1	0.80
NK11-016 AH	Soil		9.0	4.2	0.10	139.3	0.018	<20	0.49	0.013	0.07	0.3	0.3	0.25	0.09	130	0.5	<0.02	3.7	0.68	<0.1	1.99
NK11-016 B	Soil		24.6	6.9	0.15	119.6	0.040	<20	1.21	0.006	0.03	0.3	1.1	0.37	0.04	94	1.3	<0.02	9.9	1.65	<0.1	5.35
NK11-020 B	Soil		17.0	7.4	0.16	37.2	0.064	<20	0.95	0.003	0.04	<0.1	1.5	0.28	<0.02	49	0.5	<0.02	4.5	1.29	<0.1	0.04
NK11-021 AH	Soil		3.2	3.9	0.09	164.6	0.016	24	0.27	0.008	0.10	0.2	0.5	0.55	0.14	359	0.5	<0.02	1.5	1.33	<0.1	<0.02
NK11-021 B	Soil		13.7	8.3	0.12	54.4	0.054	<20	0.92	0.002	0.03	<0.1	1.5	0.31	0.02	67	0.5	0.04	5.1	1.34	<0.1	0.03
NK11-022 B	Soil		24.1	8.4	0.20	57.4	0.031	<20	0.88	0.005	0.04	<0.1	1.7	0.36	0.03	62	0.3	<0.02	3.3	1.21	<0.1	0.02
NK11-081 B	Soil		37.0	9.6	0.25	96.1	0.051	<20	1.20	0.004	0.07	<0.1	3.1	0.34	0.02	71	1.2	0.02	4.2	1.26	0.1	0.10

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

CERTIFICATE OF ANALYSIS VAN11007028.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.1	0.1	0.05	0.1	0.01	0.1	0.02	1	0.1	0.1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK11-006 AH	Soil	1.37	9.3	1.0	<0.05	2.6	3.86	8.9	0.03	<1	0.2	2.0	0.99	3.90	0.77	0.11	0.62	0.09	0.66	0.14	0.39
NK11-009 AH	Soil	7.29	17.1	2.5	<0.05	17.6	14.69	35.2	<0.02	<1	1.0	17.6	2.86	10.84	2.44	0.32	2.24	0.39	2.80	0.57	1.60
NK11-012 AH	Soil	4.63	25.6	1.5	<0.05	6.7	9.73	55.8	<0.02	1	0.6	13.2	3.48	13.52	2.47	0.37	2.19	0.41	2.30	0.45	1.17
NK11-014 AH	Soil	1.23	6.3	0.9	<0.05	5.0	5.73	9.9	<0.02	<1	0.4	1.3	1.12	4.48	0.88	0.12	0.92	0.17	1.01	0.22	0.61
NK11-014 B	Soil	5.61	12.8	1.3	<0.05	19.5	13.82	34.9	0.02	<1	0.4	10.6	3.18	12.68	2.76	0.38	2.42	0.44	2.86	0.59	1.65
NK11-015 AH	Soil	2.30	8.0	0.9	<0.05	14.4	2.17	9.1	<0.02	<1	0.2	2.5	0.66	2.64	0.50	0.05	0.44	0.07	0.43	0.09	0.27
NK11-015 B	Soil	5.78	9.9	1.4	<0.05	52.7	14.79	47.0	0.02	<1	0.8	14.8	3.34	12.81	2.71	0.36	2.39	0.46	2.97	0.63	1.79
NK11-016 AH	Soil	11.06	5.9	1.6	0.09	105.3	18.37	30.4	<0.02	1	0.5	5.3	2.04	8.33	1.91	0.25	2.14	0.46	3.14	0.75	2.11
NK11-016 B	Soil	23.53	8.1	3.4	<0.05	304.9	55.63	84.1	<0.02	<1	1.3	12.0	5.83	23.27	6.51	0.82	6.72	1.41	10.86	2.35	7.07
NK11-020 B	Soil	3.37	12.6	1.3	<0.05	2.1	7.91	48.0	<0.02	<1	0.4	11.3	3.52	12.62	2.40	0.34	1.94	0.28	1.71	0.32	0.86
NK11-021 AH	Soil	0.86	21.5	0.7	<0.05	0.2	1.08	7.0	<0.02	1	<0.1	2.1	0.63	2.20	0.36	0.03	0.25	0.04	0.25	0.03	0.11
NK11-021 B	Soil	2.42	11.3	1.3	<0.05	1.1	4.22	29.5	0.03	<1	0.4	8.4	2.70	9.07	1.73	0.26	1.22	0.17	0.97	0.16	0.46
NK11-022 B	Soil	1.24	12.5	0.7	<0.05	0.9	12.45	34.6	<0.02	<1	0.5	11.3	5.76	22.14	4.26	0.63	3.35	0.45	2.57	0.44	1.20
NK11-081 B	Soil	2.20	19.4	1.0	<0.05	5.5	50.61	148.6	<0.02	<1	2.0	32.3	10.48	42.17	10.45	1.46	9.95	1.86	11.50	2.20	5.70

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

CERTIFICATE OF ANALYSIS VAN11007028.1

	Method	1F	1F	1F	1F	1F	LOI
	Analyte	Tm	Yb	Lu	Pd	Pt	LOI
	Unit	ppm	ppm	ppm	ppb	ppb	%
	MDL	0.02	0.02	0.02	10	2	0.1
NK11-006 AH	Soil	0.06	0.35	0.05	<10	<2	57.7
NK11-009 AH	Soil	0.24	1.46	0.20	<10	<2	39.3
NK11-012 AH	Soil	0.16	1.05	0.15	<10	<2	15.6
NK11-014 AH	Soil	0.08	0.45	0.06	<10	<2	77.9
NK11-014 B	Soil	0.25	1.40	0.19	<10	<2	10.5
NK11-015 AH	Soil	0.04	0.24	0.03	<10	<2	67.0
NK11-015 B	Soil	0.27	1.76	0.23	<10	<2	11.6
NK11-016 AH	Soil	0.33	1.98	0.26	<10	<2	46.7
NK11-016 B	Soil	1.10	7.00	0.87	<10	<2	14.8
NK11-020 B	Soil	0.13	0.68	0.11	<10	<2	8.8
NK11-021 AH	Soil	<0.02	0.09	<0.02	<10	<2	66.5
NK11-021 B	Soil	0.07	0.40	0.05	<10	<2	10.6
NK11-022 B	Soil	0.16	0.97	0.15	<10	<2	8.5
NK11-081 B	Soil	0.75	4.24	0.53	<10	<2	8.8

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

QUALITY CONTROL REPORT VAN11007028.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.01	0.02	0.02	2	0.01	0.001
Pulp Duplicates																					
NK11-081 B	Soil	1.66	11.38	18.75	129.0	152	9.9	5.5	479	1.52	4.4	2.9	<0.2	2.7	17.2	0.38	0.15	0.15	21	0.22	0.036
REP NK11-081 B	QC	1.59	10.01	17.23	121.3	144	9.5	5.2	464	1.43	4.4	2.7	<0.2	2.6	17.0	0.37	0.16	0.14	21	0.20	0.034
Reference Materials																					
STD DOLOMITE-2	Standard																				
STD DS8	Standard	13.33	104.1	120.1	286.3	1521	37.7	7.8	611	2.39	24.5	2.8	171.3	7.1	60.8	2.29	4.36	6.39	38	0.68	0.077
STD OREAS45CA	Standard	0.76	488.3	20.00	58.9	244	244.3	86.8	864	16.05	3.0	1.1	37.9	6.7	15.0	0.11	0.07	0.15	193	0.39	0.037
STD DOLOMITE-2 Expected																					
STD DS8 Expected		13.44	110	123	312	1690	38.1	7.5	615	2.46	26	2.8	107	6.89	67.7	2.38	4.8	6.67	41.1	0.7	0.08
STD OREAS45CA Expected		1	494	20	60	275	240	92	943	15.69	3.8	1.2	43	7	15	0.1	0.13	0.19	215	0.4265	0.0385
BLK	Blank	<0.01	<0.01	<0.01	<0.1	<2	<0.1	<0.1	<1	<0.01	<0.1	<0.1	<0.2	<0.1	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

QUALITY CONTROL REPORT VAN11007028.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.1	0.02	0.02	5	0.1	0.02	0.1	0.02	0.1	0.02
Pulp Duplicates																					
NK11-081 B	Soil	37.0	9.6	0.25	96.1	0.051	<20	1.20	0.004	0.07	<0.1	3.1	0.34	0.02	71	1.2	0.02	4.2	1.26	0.1	0.10
REP NK11-081 B	QC	35.2	9.8	0.24	89.3	0.053	<20	1.18	0.004	0.07	0.1	3.1	0.33	0.02	61	1.0	<0.02	3.9	1.24	<0.1	0.11
Reference Materials																					
STD DOLOMITE-2	Standard																				
STD DS8	Standard	15.0	120.5	0.59	281.0	0.109	<20	0.89	0.079	0.39	2.9	2.5	5.12	0.15	183	4.7	4.77	4.4	2.33	<0.1	0.08
STD OREAS45CA	Standard	16.0	729.3	0.13	161.5	0.124	<20	3.80	0.006	0.06	<0.1	42.2	0.08	0.02	27	0.5	0.04	16.8	1.07	<0.1	0.49
STD DOLOMITE-2 Expected																					
STD DS8 Expected		14.6	115	0.6045	279	0.113	2.6	0.93	0.0883	0.41	3	2.3	5.4	0.1679	192	5.23	5	4.7	2.48	0.13	0.08
STD OREAS45CA Expected		15.9	709	0.1358	164	0.128		3.592	0.0075	0.0717		39.7	0.07	0.021	30	0.5	0.06	18.4	1.03	0.11	0.5
BLK	Blank	<0.5	<0.5	<0.01	<0.5	<0.001	<20	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.02	<5	<0.1	<0.02	<0.1	<0.02	<0.1	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

QUALITY CONTROL REPORT VAN11007028.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.02	0.1	0.1	0.05	0.1	0.01	0.1	0.02	1	0.1	0.1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Pulp Duplicates																					
NK11-081 B	Soil	2.20	19.4	1.0	<0.05	5.5	50.61	148.6	<0.02	<1	2.0	32.3	10.48	42.17	10.45	1.46	9.95	1.86	11.50	2.20	5.70
REP NK11-081 B	QC	2.16	19.2	1.0	<0.05	4.9	48.89	137.1	<0.02	<1	1.8	29.7	9.70	39.37	10.06	1.29	9.32	1.64	10.62	1.99	5.25
Reference Materials																					
STD DOLOMITE-2	Standard																				
STD DS8	Standard	1.01	33.7	6.5	<0.05	2.6	5.87	26.2	2.15	50	5.0	25.9	2.76	10.21	1.75	0.41	1.42	0.18	1.04	0.20	0.59
STD OREAS45CA	Standard	0.16	7.9	1.8	<0.05	20.5	7.58	34.0	0.09	<1	0.6	7.4	3.66	13.65	2.96	0.76	2.48	0.38	2.15	0.38	0.97
STD DOLOMITE-2 Expected																					
STD DS8 Expected		1.1	39	6.7	0.003	2.1	6.1	29.8	2.19	55	5.2	26.34	2.87	10.6	1.65	0.31	1.29	0.18	1.05	0.2	0.57
STD OREAS45CA Expected		0.22	8.2	1.8		21.6	7.84	35	0.09			6.2	3.51	14	2.7	0.66	2.36	0.35	2.11	0.37	0.95
BLK	Blank	<0.02	<0.1	<0.1	<0.05	<0.1	<0.01	<0.1	<0.02	<1	<0.1	<0.1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: January 09, 2012

QUALITY CONTROL REPORT VAN11007028.1

	Method	1F	1F	1F	1F	1F	LOI
	Analyte	Tm	Yb	Lu	Pd	Pt	LOI
	Unit	ppm	ppm	ppm	ppb	ppb	%
	MDL	0.02	0.02	0.02	10	2	0.1
Pulp Duplicates							
NK11-081 B	Soil	0.75	4.24	0.53	<10	<2	8.8
REP NK11-081 B	QC	0.67	3.97	0.49	<10	<2	
Reference Materials							
STD DOLOMITE-2	Standard						46.0
STD DS8	Standard	0.07	0.61	0.10	104	331	
STD OREAS45CA	Standard	0.14	0.84	0.10	31	57	
STD DOLOMITE-2 Expected							46
STD DS8 Expected		0.08	0.57	0.09	110	339	
STD OREAS45CA Expected		0.12	0.8	0.115	36	61	
BLK	Blank	<0.02	<0.02	<0.02	<10	<2	

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: October 14, 2011
Report Date: November 16, 2011
Page: 1 of 2

CERTIFICATE OF ANALYSIS VAN11005529.1

CLIENT JOB INFORMATION

Project: None Given
Shipment ID:
P.O. Number
Number of Samples: 26

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
No Prep	26	Sorting of samples on arrival and labeling			VAN
1VE2+REEs	26	Aqua Regia digestion ICP-MS analysis	1	Completed	VAN

SAMPLE DISPOSAL

RTRN-PLP Return

ADDITIONAL COMMENTS

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

Invoice To: IoGlobal Solutions
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2
Canada

CC: Colin Dunn

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
GENERAL MANAGER

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

CERTIFICATE OF ANALYSIS VAN11005529.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
Unit		ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
MDL		0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK1	Vegetation	1.26	8.02	23.22	50.9	75	19.1	1.05	227	0.284	0.7	0.85	<0.2	0.06	19.6	1.69	0.11	0.07	4	0.33	0.115
NK1A	Vegetation	0.45	7.47	0.17	22.2	<2	0.6	0.05	68	0.009	0.1	<0.01	<0.2	<0.01	20.4	0.07	<0.02	<0.02	<2	0.33	0.246
NK2	Vegetation	0.19	5.52	0.46	33.7	7	0.4	0.02	122	0.006	0.1	<0.01	<0.2	<0.01	45.0	0.04	0.02	<0.02	<2	0.98	0.165
NK3	Vegetation	0.51	5.81	59.11	38.3	865	26.1	0.62	527	0.182	0.6	3.66	<0.2	0.33	12.1	3.79	0.24	0.14	2	0.19	0.045
NK4	Vegetation	0.44	4.73	1.22	44.4	5	3.9	0.23	289	0.010	0.1	0.03	0.2	<0.01	48.0	0.08	0.03	<0.02	<2	0.98	0.207
NK5	Vegetation	0.37	9.82	8.58	42.6	22	9.7	0.83	214	0.206	0.2	0.22	<0.2	<0.01	16.1	0.48	0.17	0.04	3	0.38	0.115
NK6	Vegetation	0.12	3.92	0.48	24.0	12	0.5	0.05	365	0.008	0.2	<0.01	<0.2	<0.01	88.5	0.10	<0.02	<0.02	<2	0.67	0.193
NK7	Vegetation	0.19	5.21	0.44	62.6	7	1.2	0.05	306	0.009	<0.1	<0.01	<0.2	<0.01	53.4	0.07	0.05	<0.02	<2	1.15	0.169
NK8	Vegetation	0.17	3.64	4.78	54.2	10	1.7	0.19	280	0.034	0.1	0.04	<0.2	<0.01	15.9	0.52	0.13	0.02	<2	0.34	0.095
NK9	Vegetation	0.10	6.68	0.27	71.2	4	1.4	0.04	277	0.008	<0.1	<0.01	0.2	<0.01	46.1	0.18	0.03	<0.02	<2	0.78	0.177
NK10	Vegetation	0.50	4.24	16.57	74.3	32	8.4	0.46	845	0.094	0.5	0.23	<0.2	<0.01	18.5	0.60	0.26	0.08	<2	0.33	0.107
NK11	Vegetation	0.79	5.42	0.20	99.5	7	1.6	0.05	591	0.010	<0.1	0.01	0.3	<0.01	25.4	0.08	0.03	<0.02	<2	0.72	0.226
NK11A	Vegetation	0.45	7.28	0.16	22.5	<2	0.5	0.03	69	0.009	<0.1	<0.01	<0.2	<0.01	20.6	0.07	0.02	<0.02	<2	0.34	0.247
NK12	Vegetation	0.60	9.47	15.84	63.6	32	13.4	1.18	691	0.373	0.7	0.82	<0.2	<0.01	14.9	0.34	0.34	0.09	7	0.36	0.156
NK13	Vegetation	0.20	5.50	0.31	24.9	6	2.1	0.05	1313	0.008	<0.1	<0.01	0.2	<0.01	18.2	0.12	0.02	<0.02	<2	0.87	0.244
NK14	Vegetation	0.17	6.42	1.70	29.1	9	1.4	0.12	724	0.025	<0.1	0.05	<0.2	<0.01	9.5	0.16	0.10	<0.02	<2	0.35	0.163
NK15	Vegetation	0.05	5.64	0.35	57.1	3	1.7	0.10	518	0.006	<0.1	<0.01	0.5	<0.01	27.5	0.28	0.02	<0.02	<2	0.49	0.153
NK16	Vegetation	0.19	6.53	0.18	41.6	<2	0.8	0.27	319	0.012	<0.1	<0.01	0.8	<0.01	16.4	0.06	0.03	<0.02	<2	0.42	0.244
YB1	Vegetation	0.17	8.64	0.35	44.8	15	2.2	0.28	429	0.018	<0.1	0.01	1.5	<0.01	19.0	0.06	0.03	<0.02	<2	1.03	0.349
YB2	Vegetation	0.88	12.31	18.14	84.5	61	5.1	1.18	169	0.220	0.8	0.83	6.1	0.02	15.9	0.43	0.57	0.09	5	0.43	0.163
YB3	Vegetation	0.08	3.86	3.02	17.4	5	0.4	0.14	15	0.022	<0.1	0.04	<0.2	0.03	5.3	0.18	0.08	<0.02	<2	0.21	0.012
YB4	Vegetation	2.25	5.72	0.38	49.8	2	0.6	0.05	28	0.008	0.1	0.06	1.1	0.01	24.7	0.01	0.04	<0.02	<2	1.45	0.315
YB4A	Vegetation	0.41	8.16	0.18	24.0	<2	0.6	0.05	72	0.009	<0.1	<0.01	0.3	<0.01	19.7	0.07	0.02	<0.02	<2	0.34	0.264
BAST1	Vegetation	5.39	6.82	0.35	19.0	5	0.7	0.10	104	0.035	<0.1	0.08	0.3	0.03	8.3	0.12	0.03	0.02	<2	0.66	0.174
BAST2	Vegetation	5.18	6.26	0.49	66.3	4	0.9	0.45	1223	0.010	<0.1	0.02	0.5	<0.01	15.1	0.33	0.03	<0.02	<2	0.62	0.105
BAST3	Vegetation	1.93	11.09	3.04	30.1	41	1.0	1.10	65	0.016	<0.1	0.02	0.4	0.02	8.9	0.07	0.05	0.13	<2	0.37	0.044

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

CERTIFICATE OF ANALYSIS VAN11005529.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
Unit		ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK1	Vegetation	16.93	43.0	0.128	41.5	124	2	0.24	0.055	0.51	0.4	0.2	0.08	0.07	20	0.1	<0.02	1.1	0.391	0.04	2.337
NK1A	Vegetation	9.26	0.7	0.245	28.0	18	13	0.05	0.018	1.69	<0.1	0.1	<0.02	0.18	29	0.1	<0.02	<0.1	0.028	0.05	<0.001
NK2	Vegetation	28.78	1.0	0.338	117.8	11	16	0.08	0.004	1.72	<0.1	0.1	0.04	0.22	50	<0.1	<0.02	<0.1	0.519	0.03	0.012
NK3	Vegetation	44.60	77.5	0.052	34.7	6	1	0.57	0.380	0.19	0.6	0.7	0.20	0.02	43	0.2	<0.02	5.1	0.923	0.01	89.49
NK4	Vegetation	32.29	2.3	0.443	128.5	14	18	0.09	0.008	1.78	<0.1	0.2	<0.02	0.12	33	0.2	<0.02	<0.1	0.439	0.06	<0.001
NK5	Vegetation	3.41	27.0	0.130	42.6	79	3	0.11	0.014	0.37	0.2	0.3	0.05	0.10	63	0.3	<0.02	0.5	0.205	<0.01	0.439
NK6	Vegetation	6.33	1.2	0.289	697.0	12	13	<0.01	0.001	1.31	<0.1	0.3	<0.02	0.12	45	0.1	<0.02	<0.1	0.168	0.04	0.051
NK7	Vegetation	26.25	1.9	0.349	185.8	11	17	0.09	0.009	1.84	<0.1	0.1	<0.02	0.23	56	0.2	<0.02	<0.1	0.428	0.05	0.089
NK8	Vegetation	0.72	3.2	0.085	51.5	14	2	0.03	0.016	0.42	<0.1	0.2	0.02	0.06	41	0.3	<0.02	0.3	0.063	0.01	0.073
NK9	Vegetation	16.38	1.3	0.420	210.1	11	14	0.13	0.007	1.79	<0.1	0.1	0.05	0.15	49	0.2	<0.02	<0.1	1.788	0.07	0.026
NK10	Vegetation	9.10	17.1	0.106	90.2	20	3	0.23	0.022	0.45	0.2	0.2	0.10	0.12	93	0.3	<0.02	1.0	0.344	0.03	0.934
NK11	Vegetation	31.75	1.1	0.346	102.1	13	23	0.17	0.015	2.03	<0.1	0.2	<0.02	0.18	35	0.2	<0.02	<0.1	0.184	<0.01	0.023
NK11A	Vegetation	9.11	0.7	0.241	26.4	17	12	0.05	0.018	1.74	<0.1	0.2	<0.02	0.18	25	0.1	<0.02	<0.1	0.034	0.03	<0.001
NK12	Vegetation	2.29	38.9	0.151	50.6	61	2	0.18	0.008	0.36	0.2	0.3	0.12	0.14	75	0.5	<0.02	1.2	1.032	0.05	0.006
NK13	Vegetation	0.35	1.7	0.090	48.3	16	7	0.01	0.009	1.02	<0.1	0.3	<0.02	0.14	34	0.3	<0.02	0.2	0.253	<0.01	0.013
NK14	Vegetation	0.44	3.6	0.124	29.8	17	4	0.02	0.015	0.48	<0.1	0.3	<0.02	0.08	36	0.2	<0.02	0.2	0.099	0.02	0.013
NK15	Vegetation	0.11	1.0	0.116	113.9	11	6	<0.01	0.003	0.73	<0.1	0.2	<0.02	0.08	10	0.2	<0.02	<0.1	0.021	<0.01	0.006
NK16	Vegetation	8.43	1.0	0.291	45.1	16	15	0.02	0.006	2.77	<0.1	0.1	<0.02	0.22	22	0.2	<0.02	<0.1	0.291	0.03	0.023
YB1	Vegetation	0.33	1.7	0.133	21.9	21	13	<0.01	0.006	0.99	<0.1	0.2	0.03	0.15	26	<0.1	<0.02	<0.1	0.564	0.02	0.026
YB2	Vegetation	1.73	8.1	0.111	27.3	31	3	0.10	0.007	0.41	1.2	0.3	0.05	0.15	151	0.5	<0.02	0.5	0.187	0.15	0.001
YB3	Vegetation	0.16	0.9	0.009	2.9	8	3	0.04	0.003	0.03	0.2	0.2	0.04	0.02	41	0.2	<0.02	<0.1	0.027	0.03	0.006
YB4	Vegetation	2.96	1.1	0.242	38.2	21	43	<0.01	0.011	2.71	43.3	0.2	<0.02	0.32	50	0.2	<0.02	<0.1	0.144	0.04	0.010
YB4A	Vegetation	9.54	0.8	0.263	30.2	19	40	0.05	0.019	1.75	<0.1	0.2	<0.02	0.22	27	<0.1	<0.02	<0.1	0.037	0.03	0.004
BAST1	Vegetation	40.49	1.9	0.438	106.9	12	32	0.02	0.019	2.30	<0.1	0.1	<0.02	0.24	73	0.1	<0.02	<0.1	0.175	0.12	0.008
BAST2	Vegetation	8.45	1.0	0.478	82.9	7	20	0.03	0.010	2.25	0.2	<0.1	<0.02	0.19	88	0.2	<0.02	0.2	0.112	0.01	0.003
BAST3	Vegetation	2.96	2.0	0.087	321.1	7	10	<0.01	0.002	0.52	0.1	0.3	<0.02	0.05	33	0.2	<0.02	<0.1	0.028	0.02	0.004

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

CERTIFICATE OF ANALYSIS VAN11005529.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK1	Vegetation	12.52	20.8	0.92	0.026	129.5	41.34	46.52	<0.02	<1	0.6	2.06	5.97	23.64	5.11	0.63	5.55	0.99	7.08	1.56	4.35
NK1A	Vegetation	<0.01	20.1	0.06	<0.001	0.13	3.751	9.60	<0.02	<1	<0.1	0.04	1.65	6.36	1.01	0.28	0.98	0.12	0.58	0.12	0.24
NK2	Vegetation	0.03	132.1	0.06	0.002	0.87	7.680	44.98	<0.02	1	<0.1	0.09	4.79	14.70	1.86	0.18	1.21	0.21	1.10	0.21	0.51
NK3	Vegetation	63.61	12.6	4.00	0.412	>2000	228.3	119.5	<0.02	3	1.0	4.40	15.78	65.40	20.34	2.63	24.66	5.77	42.55	10.26	31.18
NK4	Vegetation	0.26	85.8	0.06	0.005	11.57	4.797	61.70	<0.02	<1	0.1	0.35	4.43	12.21	1.26	0.13	0.80	0.13	0.79	0.15	0.37
NK5	Vegetation	1.71	14.8	0.46	0.012	31.48	5.531	7.94	<0.02	<1	<0.1	0.75	0.94	3.53	0.76	0.13	0.82	0.15	1.05	0.24	0.75
NK6	Vegetation	0.10	86.7	0.03	0.001	2.91	0.955	10.49	<0.02	1	<0.1	0.04	0.88	2.49	0.24	<0.02	0.15	0.02	0.18	0.02	0.08
NK7	Vegetation	0.13	90.5	0.04	0.005	4.85	8.245	44.60	<0.02	1	0.1	0.17	3.84	11.87	1.56	0.16	1.23	0.19	1.22	0.24	0.61
NK8	Vegetation	0.56	12.7	0.17	0.012	4.65	1.738	1.83	<0.02	<1	<0.1	0.14	0.20	0.86	0.17	<0.02	0.22	0.06	0.33	0.08	0.20
NK9	Vegetation	0.08	157.3	0.04	0.003	1.62	11.59	26.90	<0.02	<1	0.6	0.29	2.73	8.88	1.41	0.12	0.98	0.19	1.33	0.28	0.83
NK10	Vegetation	5.31	24.8	0.63	0.063	67.10	41.25	25.93	<0.02	<1	0.4	0.99	3.15	13.00	3.51	0.50	4.55	1.05	8.03	1.81	5.92
NK11	Vegetation	0.05	82.5	0.03	0.001	1.60	6.029	52.93	<0.02	<1	<0.1	0.50	6.51	21.33	2.63	0.26	1.78	0.19	1.08	0.17	0.41
NK11A	Vegetation	<0.01	20.6	0.04	<0.001	0.07	3.733	9.28	<0.02	<1	<0.1	0.03	1.69	5.88	0.96	0.25	1.05	0.11	0.55	0.10	0.20
NK12	Vegetation	0.90	33.0	0.76	0.003	0.41	3.167	5.72	<0.02	<1	<0.1	3.24	0.75	2.90	0.58	0.07	0.65	0.09	0.63	0.13	0.37
NK13	Vegetation	0.09	43.9	0.03	<0.001	1.25	0.429	0.61	<0.02	<1	<0.1	0.04	0.06	0.28	0.04	<0.02	0.08	<0.02	0.04	<0.02	0.06
NK14	Vegetation	0.07	22.0	0.14	0.002	0.48	0.265	0.93	<0.02	<1	<0.1	0.12	0.09	0.31	0.06	<0.02	0.09	<0.02	0.05	<0.02	0.03
NK15	Vegetation	0.03	16.7	0.05	<0.001	0.40	0.065	0.24	<0.02	<1	<0.1	0.04	0.03	0.05	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
NK16	Vegetation	0.05	86.1	<0.02	0.002	1.37	0.542	15.40	<0.02	<1	<0.1	0.20	1.40	4.28	0.44	0.07	0.21	0.03	0.13	<0.02	0.06
YB1	Vegetation	0.04	26.2	0.06	<0.001	1.29	0.281	0.52	<0.02	<1	<0.1	0.09	0.06	0.22	0.03	<0.02	0.02	<0.02	0.04	<0.02	0.03
YB2	Vegetation	1.48	6.0	0.93	0.013	0.05	3.296	3.93	<0.02	<1	0.2	0.52	0.50	1.79	0.39	0.04	0.42	0.07	0.52	0.13	0.40
YB3	Vegetation	0.05	0.9	0.13	0.016	0.18	0.228	0.35	<0.02	<1	<0.1	0.04	0.04	0.17	0.03	<0.02	0.04	<0.02	0.02	<0.02	0.03
YB4	Vegetation	0.04	46.0	0.12	0.004	0.39	1.748	2.75	<0.02	2	<0.1	0.65	0.46	1.62	0.27	0.02	0.30	0.04	0.16	0.04	0.10
YB4A	Vegetation	0.01	21.9	0.05	<0.001	0.09	3.655	9.16	<0.02	<1	<0.1	0.06	1.77	6.25	1.09	0.26	0.95	0.10	0.62	0.09	0.19
BAST1	Vegetation	0.05	77.1	0.05	0.002	0.30	1.909	47.54	<0.02	<1	0.2	0.15	7.92	25.38	3.10	0.45	1.35	0.11	0.45	0.05	0.12
BAST2	Vegetation	0.02	129.3	0.04	<0.001	0.26	1.082	8.07	<0.02	<1	0.5	0.64	1.47	4.22	0.53	0.06	0.36	0.04	0.17	0.02	0.05
BAST3	Vegetation	0.04	12.9	0.11	0.002	0.22	0.422	3.32	<0.02	<1	<0.1	0.75	0.41	1.18	0.20	<0.02	0.16	<0.02	0.09	<0.02	0.03

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

CERTIFICATE OF ANALYSIS VAN11005529.1

Method		1VE	1VE	1VE	1VE	1VE
Analyte		Tm	Yb	Lu	Pd	Pt
Unit		ppm	ppm	ppm	ppb	ppb
MDL		0.02	0.02	0.02	2	1
NK1	Vegetation	0.62	3.89	0.51	<2	2
NK1A	Vegetation	0.03	0.10	<0.02	<2	<1
NK2	Vegetation	0.06	0.25	0.03	<2	<1
NK3	Vegetation	4.68	29.88	4.22	<2	<1
NK4	Vegetation	0.05	0.20	0.03	9	3
NK5	Vegetation	0.11	0.67	0.09	9	<1
NK6	Vegetation	<0.02	0.08	<0.02	2	<1
NK7	Vegetation	0.08	0.34	0.04	<2	<1
NK8	Vegetation	0.04	0.19	0.03	3	<1
NK9	Vegetation	0.09	0.53	0.07	<2	<1
NK10	Vegetation	0.88	5.76	0.79	<2	1
NK11	Vegetation	0.05	0.26	0.03	2	<1
NK11A	Vegetation	<0.02	0.12	<0.02	<2	<1
NK12	Vegetation	0.04	0.31	0.04	<2	<1
NK13	Vegetation	<0.02	0.04	<0.02	<2	<1
NK14	Vegetation	<0.02	0.02	<0.02	<2	<1
NK15	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK16	Vegetation	<0.02	0.03	<0.02	<2	<1
YB1	Vegetation	<0.02	<0.02	<0.02	<2	<1
YB2	Vegetation	0.07	0.45	0.07	4	<1
YB3	Vegetation	<0.02	0.03	<0.02	<2	<1
YB4	Vegetation	<0.02	0.10	<0.02	<2	<1
YB4A	Vegetation	0.03	0.13	<0.02	<2	<1
BAST1	Vegetation	<0.02	0.08	<0.02	3	<1
BAST2	Vegetation	<0.02	0.04	<0.02	4	<1
BAST3	Vegetation	<0.02	0.02	<0.02	<2	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

QUALITY CONTROL REPORT VAN11005529.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
Pulp Duplicates																					
NK7	Vegetation Pu	0.19	5.21	0.44	62.6	7	1.2	0.05	306	0.009	<0.1	<0.01	<0.2	<0.01	53.4	0.07	0.05	<0.02	<2	1.15	0.169
REP NK7	QC	0.19	5.19	0.44	63.1	6	1.0	0.05	298	0.009	<0.1	0.01	<0.2	<0.01	52.8	0.06	0.03	<0.02	<2	1.09	0.171
Reference Materials																					
STD V14	Standard	0.06	4.94	0.91	15.9	18	1.3	0.78	2154	0.018	12.0	<0.01	8.6	<0.01	6.5	0.20	0.06	0.10	<2	0.64	0.090
STD V16	Standard	1.38	5.74	3.01	39.0	24	5.7	0.99	744	0.367	1.4	<0.01	1.8	<0.01	11.3	0.08	0.07	<0.02	<2	0.30	0.048
STD V14 Expected		0.06	4.8	0.881	14.5	24	1.4	0.75	2094	0.016	11.038		8		6.668	0.21	0.06	0.089		0.6082	0.087
STD V16 Expected		1.6	6.92	3.11	39.2	32	7.8	1.17	732	0.4367	1.6		1.1		11.6	0.093	0.07			0.302	0.0498
FLOUR	Blank	0.62	3.46	0.09	25.8	<2	0.2	0.02	39	0.005	<0.1	<0.01	<0.2	<0.01	1.3	0.03	<0.02	0.05	<2	0.03	0.366
BLK	Blank	<0.01	<0.01	<0.01	<0.1	<2	<0.1	<0.01	<1	<0.001	<0.1	<0.01	<0.2	<0.01	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

QUALITY CONTROL REPORT VAN11005529.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
Pulp Duplicates																					
NK7	Vegetation Pu	26.25	1.9	0.349	185.8	11	17	0.09	0.009	1.84	<0.1	0.1	<0.02	0.23	56	0.2	<0.02	<0.1	0.428	0.05	0.089
REP NK7	QC	25.32	2.1	0.339	184.5	11	18	0.09	0.008	1.78	<0.1	0.2	<0.02	0.21	54	0.2	<0.02	<0.1	0.423	0.04	0.079
Reference Materials																					
STD V14	Standard	0.04	0.7	0.081	1.5	9	12	0.15	<0.001	0.55	<0.1	0.2	0.04	0.05	51	0.1	<0.02	0.3	0.033	<0.01	<0.001
STD V16	Standard	0.05	245.5	0.052	1.9	12	5	0.05	0.001	0.23	<0.1	0.2	<0.02	0.02	37	0.3	0.02	0.2	0.037	0.04	0.003
STD V14 Expected		0.03	1.2	0.079	1.3	6.699	10.7	0.147		0.509		0.117	0.038	0.064	52	0.15			0.029		
STD V16 Expected		0.05	345.2	0.0543	1.9	12	5	0.0498	0.0015	0.231				0.0174	41			0.2	0.037	0.05	0.006
FLOUR	Blank	0.04	0.6	0.136	3.3	23	<1	<0.01	0.001	0.36	<0.1	0.3	<0.02	0.20	<1	0.8	<0.02	<0.1	<0.005	0.02	0.011
BLK	Blank	<0.01	<0.1	<0.001	<0.1	<1	<1	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.01	<1	<0.1	<0.02	<0.1	<0.005	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

QUALITY CONTROL REPORT VAN11005529.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Pulp Duplicates																					
NK7	Vegetation Pu	0.13	90.5	0.04	0.005	4.85	8.245	44.60	<0.02	1	0.1	0.17	3.84	11.87	1.56	0.16	1.23	0.19	1.22	0.24	0.61
REP NK7	QC	0.17	87.9	0.05	0.005	4.74	8.110	43.64	<0.02	<1	0.2	0.19	3.85	11.08	1.59	0.14	1.42	0.20	1.24	0.23	0.63
Reference Materials																					
STD V14	Standard	<0.01	2.0	0.07	<0.001	0.08	0.018	0.08	<0.02	<1	<0.1	0.09	<0.02	0.03	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
STD V16	Standard	0.09	1.9	0.21	<0.001	0.13	0.042	0.13	<0.02	<1	<0.1	0.06	<0.02	0.06	<0.02	<0.02	0.03	<0.02	0.02	<0.02	<0.02
STD V14 Expected			1.8	0.04																	
STD V16 Expected		0.11	1.7	0.23		0.18	0.043	0.09				0.07									
FLOUR	Blank	<0.01	2.9	0.05	<0.001	<0.01	<0.001	0.01	<0.02	1	<0.1	0.15	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
BLK	Blank	<0.01	<0.1	<0.02	<0.001	<0.01	<0.001	<0.01	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: None Given
Report Date: November 16, 2011

QUALITY CONTROL REPORT VAN11005529.1

	Method	1VE	1VE	1VE	1VE	1VE
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.02	0.02	0.02	2	1
Pulp Duplicates						
NK7	Vegetation Pu	0.08	0.34	0.04	<2	<1
REP NK7	QC	0.07	0.33	0.05	<2	<1
Reference Materials						
STD V14	Standard	<0.02	<0.02	<0.02	<2	<1
STD V16	Standard	<0.02	<0.02	<0.02	<2	<1
STD V14 Expected						
STD V16 Expected						
FLOUR	Blank	<0.02	<0.02	<0.02	<2	<1
BLK	Blank	<0.02	<0.02	<0.02	<2	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: October 14, 2011
Report Date: December 23, 2011
Page: 1 of 4

CERTIFICATE OF ANALYSIS VAN11005519.1

CLIENT JOB INFORMATION

Project: Norra Karr 2011
Shipment ID:
P.O. Number
Number of Samples: 69

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
No Prep	68	Sorting of samples on arrival and labeling			VAN
1F04 + REEs	68	1:1:1 Aqua Regia digestion Ultratrace ICP-MS analysis	0.25	Completed	VAN

SAMPLE DISPOSAL

RTRN-PLP Return

ADDITIONAL COMMENTS

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

Invoice To: IoGlobal Solutions
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2
Canada

CC: Colin Dunn
Magnus Leijd

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
GENERAL MANAGER

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.02	0.02	0.02	0.2	4	0.2	0.2	2	0.02	0.2	0.2	0.4	0.2	1	0.02	0.04	0.04	4	0.02	0.002
NK11-001	Ash	0.96	290.0	15.89	2522	429	52.3	8.4	>10000	0.18	6.1	<0.2	6.5	0.3	814	15.01	0.83	0.10	<4	12.29	3.535
NK11-003	Ash	0.90	164.1	12.78	4110	390	24.5	4.3	9389	0.15	6.8	<0.2	1.7	0.2	651	12.32	0.52	0.07	<4	13.24	3.693
NK11-004	Ash	1.22	162.2	17.34	2245	207	21.5	3.8	6653	0.17	8.9	<0.2	3.3	0.3	1003	6.65	0.79	0.10	<4	18.28	2.383
NK11-005	Ash	1.55	175.5	24.02	1472	201	25.1	7.8	4672	0.21	7.1	<0.2	3.6	0.3	799	17.51	0.86	0.13	4	14.33	2.595
NK11-006	Ash	1.28	179.9	16.92	1692	444	57.6	23.1	>10000	0.20	5.3	0.2	2.3	0.4	762	13.09	0.81	0.09	<4	10.37	3.033
NK11-006 WASH	Ash	1.30	183.0	16.46	1860	377	54.7	25.4	>10000	0.17	5.2	<0.2	1.9	0.3	758	13.09	0.76	0.10	<4	10.57	3.305
NK11-007	Ash	1.83	178.6	37.57	3438	610	39.0	8.4	>10000	0.26	7.3	0.2	2.0	0.3	539	21.35	1.05	0.19	<4	12.94	2.084
NK11-007WASH	Ash	1.55	153.5	26.70	2174	523	59.8	7.4	>10000	0.21	5.4	0.2	3.6	0.3	458	23.20	0.86	0.16	<4	10.81	2.249
NK11-009	Ash	1.89	172.4	20.65	1991	168	46.7	7.8	>10000	0.19	6.7	<0.2	0.9	0.3	736	13.10	0.80	0.12	<4	12.81	2.883
NK11-010	Ash	1.13	168.9	28.15	2521	762	36.9	4.2	>10000	0.25	6.4	<0.2	4.4	0.5	681	8.38	0.94	0.18	4	11.77	2.582
NK11-010X	Ash	4.99	96.55	244.1	612.8	309	35.5	6.0	774	1.45	13.1	1.1	6.9	2.3	625	2.82	0.95	0.29	28	15.54	0.772
NK11-011	Ash	1.31	178.8	36.50	2723	949	32.1	3.8	>10000	0.29	5.9	0.2	4.2	0.6	691	8.60	1.16	0.18	5	10.41	2.372
NK11-012	Ash	1.41	131.3	24.31	2187	293	60.3	5.2	>10000	0.16	5.3	<0.2	1.2	0.3	754	12.78	0.69	0.12	<4	9.42	2.646
NK11-013	Ash	31.27	175.1	13.19	1823	575	21.2	2.7	2188	0.23	6.2	0.2	0.8	0.4	987	6.13	0.95	0.13	4	11.37	2.342
NK11-014	Ash	1.01	138.0	25.23	1698	404	47.6	5.6	6499	0.22	4.7	<0.2	0.7	0.4	483	8.03	0.98	0.14	4	9.09	2.786
NK11-015	Ash	2.33	179.2	58.36	2210	992	82.8	23.5	>10000	0.37	8.2	0.4	2.1	0.7	836	20.74	2.27	0.24	7	14.21	2.158
NK11-016	Ash	1.96	162.4	41.67	2372	339	35.5	6.2	>10000	0.36	8.8	0.4	1.8	0.7	552	16.89	1.59	0.21	9	15.51	2.353
NK11-017	Ash	1.18	117.1	14.09	1366	831	59.0	4.7	>10000	0.15	5.3	<0.2	0.9	0.2	599	10.79	0.74	0.11	<4	9.06	3.056
NK11-018	Ash	1.26	133.9	13.62	2236	222	30.0	4.7	8671	0.22	8.6	<0.2	0.5	0.4	688	6.89	0.90	0.10	<4	15.66	2.259
NK11-019	Ash	1.47	129.0	14.28	1602	250	33.1	3.0	>10000	0.20	7.7	<0.2	0.5	0.3	573	14.15	0.81	0.11	<4	14.23	2.447
NK11-020	Ash	1.55	170.8	37.73	1695	448	118.3	22.7	>10000	0.21	8.8	0.2	0.5	0.4	999	7.05	1.27	0.14	5	16.32	2.120
NK11-020X	Ash	4.44	92.95	231.0	552.1	281	35.9	5.4	726	1.35	12.3	1.1	5.1	2.4	530	2.68	0.83	0.27	28	13.95	0.691
NK11-021	Ash	3.01	236.3	27.80	3718	385	169.8	8.9	>10000	0.26	7.6	0.2	0.5	0.4	695	20.39	1.35	0.20	<4	12.09	>5
NK11-022	Ash	1.90	141.1	20.22	1584	544	34.5	2.9	7432	0.20	9.6	0.2	2.6	0.3	893	4.53	0.95	0.13	4	16.69	2.570
NK11-023	Ash	3.18	149.5	18.77	1431	179	56.7	8.4	7776	0.22	8.7	<0.2	0.7	0.3	664	9.53	0.97	0.11	4	15.66	3.310
NK11-024	Ash	2.44	236.8	41.42	2292	675	52.5	9.0	>10000	0.34	10.5	0.3	4.2	0.6	850	15.97	1.59	0.22	8	19.58	2.357
NK11-025	Ash	1.39	140.9	25.16	2455	440	62.3	5.0	>10000	0.23	8.7	<0.2	1.9	0.4	760	6.52	0.89	0.14	<4	13.92	2.096
NK11-026	Ash	1.32	155.9	13.27	2193	356	30.8	4.8	>10000	0.27	6.8	0.2	2.1	0.5	618	9.06	1.14	0.14	5	10.71	2.783
NK11-027	Ash	1.81	139.6	16.48	1617	180	91.9	10.6	>10000	0.17	7.2	<0.2	2.3	0.3	562	9.49	0.64	0.11	<4	11.59	3.374
NK11-027WASH	Ash	1.94	141.7	18.00	1634	204	91.4	11.3	>10000	0.19	7.1	<0.2	2.3	0.3	629	10.84	0.72	0.12	<4	11.52	3.327

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	1	1	0.02	1	0.002	40	0.02	0.002	0.02	0.2	0.2	0.04	0.04	10	0.2	0.04	0.2	0.04	0.2	0.04
NK11-001	Ash	2	3	2.91	274	0.027	247	0.16	0.322	>10	1.0	0.8	0.05	1.14	<10	0.3	0.05	1.1	0.74	<0.2	<0.04
NK11-003	Ash	1	3	2.96	254	0.026	356	0.13	0.176	>10	0.5	0.5	<0.04	1.26	<10	0.7	0.06	0.9	1.21	<0.2	<0.04
NK11-004	Ash	3	3	1.96	383	0.019	251	0.11	0.352	>10	0.9	0.5	<0.04	0.82	<10	0.5	0.06	0.7	0.78	<0.2	<0.04
NK11-005	Ash	11	3	3.88	226	0.024	295	0.13	0.504	>10	1.2	0.7	0.50	1.28	<10	0.6	0.04	0.8	22.77	<0.2	<0.04
NK11-006	Ash	5	3	2.90	485	0.026	345	0.22	0.444	>10	0.7	0.7	0.08	1.15	<10	0.5	0.09	1.1	11.70	<0.2	<0.04
NK11-006 WASH	Ash	5	3	3.20	446	0.024	327	0.22	0.544	>10	0.6	0.9	0.12	1.13	<10	0.6	0.09	1.2	11.59	<0.2	<0.04
NK11-007	Ash	4	5	2.52	138	0.021	291	0.24	0.275	>10	0.7	0.8	0.05	1.98	<10	1.3	0.04	1.9	6.60	<0.2	<0.04
NK11-007WASH	Ash	4	4	2.57	275	0.021	219	0.19	0.295	>10	0.6	0.9	0.10	1.43	<10	0.8	<0.04	1.8	7.25	0.2	<0.04
NK11-009	Ash	3	4	2.04	411	0.023	216	0.16	0.184	>10	0.5	0.7	<0.04	0.95	<10	0.6	<0.04	1.3	4.18	<0.2	<0.04
NK11-010	Ash	4	7	3.45	1952	0.026	359	0.25	0.303	>10	1.1	0.9	0.09	1.28	<10	0.9	<0.04	1.1	4.38	<0.2	<0.04
NK11-010X	Ash	17	34	1.98	214	0.037	166	0.83	0.163	1.81	0.3	2.7	0.14	0.59	<10	0.7	0.05	2.9	0.67	<0.2	0.05
NK11-011	Ash	5	8	4.20	2188	0.026	347	0.27	0.356	>10	1.3	0.9	0.19	1.14	<10	0.8	0.05	1.4	4.44	0.2	<0.04
NK11-012	Ash	4	4	2.19	464	0.022	279	0.21	0.202	>10	0.5	1.0	0.06	1.09	<10	0.7	0.09	1.7	6.11	<0.2	<0.04
NK11-013	Ash	3	4	2.18	590	0.022	223	0.14	0.480	>10	1.7	0.7	0.15	1.17	<10	0.7	0.04	0.8	1.54	<0.2	<0.04
NK11-014	Ash	3	4	2.63	2505	0.026	289	0.22	0.203	>10	1.0	0.8	0.11	0.94	<10	0.7	0.05	0.9	1.13	0.2	<0.04
NK11-015	Ash	6	8	3.46	238	0.026	359	0.31	1.579	>10	1.8	1.0	0.50	1.20	<10	0.9	0.07	2.2	4.68	0.2	<0.04
NK11-016	Ash	9	6	2.20	299	0.027	283	0.26	0.808	>10	1.3	0.9	0.32	1.14	<10	0.8	0.07	1.4	3.83	<0.2	<0.04
NK11-017	Ash	2	3	2.40	300	0.024	219	0.17	0.191	>10	0.7	0.7	0.16	1.19	<10	0.5	<0.04	1.8	4.02	<0.2	<0.04
NK11-018	Ash	4	6	2.10	466	0.022	256	0.21	0.421	>10	1.0	0.7	<0.04	0.98	<10	0.6	0.06	1.1	0.57	<0.2	<0.04
NK11-019	Ash	5	3	3.01	475	0.022	261	0.11	0.433	>10	0.6	0.6	<0.04	1.07	<10	0.6	<0.04	1.1	2.50	<0.2	<0.04
NK11-020	Ash	4	4	2.45	258	0.020	386	0.29	0.716	>10	0.8	0.6	0.28	1.25	<10	1.0	0.06	1.5	6.35	<0.2	<0.04
NK11-020X	Ash	16	32	2.18	172	0.041	182	0.81	0.161	1.71	0.3	2.9	0.14	0.53	<10	0.7	0.06	3.0	0.69	<0.2	0.05
NK11-021	Ash	3	5	3.35	209	0.040	522	0.47	0.306	>10	0.7	0.8	0.41	1.78	<10	0.7	0.08	3.3	40.48	<0.2	<0.04
NK11-022	Ash	3	5	2.26	220	0.022	337	0.12	0.482	>10	0.7	0.5	0.11	1.26	<10	0.7	0.07	1.2	2.14	<0.2	<0.04
NK11-023	Ash	3	3	2.84	198	0.025	306	0.13	0.458	>10	0.6	0.6	0.06	1.54	<10	0.6	<0.04	1.2	3.85	<0.2	<0.04
NK11-024	Ash	6	7	3.37	195	0.027	398	0.23	0.567	>10	1.2	0.9	0.16	1.15	<10	1.0	0.05	1.8	2.54	<0.2	<0.04
NK11-025	Ash	4	5	3.47	439	0.022	320	0.31	0.468	>10	0.7	0.8	0.29	1.04	<10	0.4	0.07	1.7	2.97	<0.2	<0.04
NK11-026	Ash	3	6	3.09	2146	0.030	306	0.22	0.775	>10	1.2	0.9	0.31	1.18	<10	0.4	0.07	1.5	4.69	<0.2	<0.04
NK11-027	Ash	3	3	2.52	1690	0.025	231	0.20	0.233	>10	0.4	0.5	0.24	1.30	<10	0.5	0.05	1.6	2.88	<0.2	<0.04
NK11-027WASH	Ash	3	4	2.78	1589	0.024	218	0.21	0.280	>10	0.5	0.6	0.36	1.38	<10	0.5	0.04	1.6	3.51	0.2	<0.04

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

Method		1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.04	0.2	0.2	0.1	0.2	0.02	0.2	0.04	2	0.2	0.2	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.04
NK11-001	Ash	0.20	365.9	3.4	<0.1	<0.2	1.01	3.4	<0.04	<2	<0.2	1.8	0.36	1.51	0.27	<0.04	0.25	<0.04	0.20	0.03	0.08
NK11-003	Ash	0.18	409.2	3.1	<0.1	<0.2	0.69	2.4	<0.04	<2	<0.2	3.0	0.26	0.99	0.14	<0.04	0.16	<0.04	0.14	<0.02	<0.04
NK11-004	Ash	0.18	302.3	4.6	<0.1	<0.2	1.28	3.8	<0.04	<2	<0.2	1.3	0.45	1.59	0.25	<0.04	0.35	0.04	0.19	0.05	0.07
NK11-005	Ash	0.21	991.0	3.5	<0.1	<0.2	7.85	11.7	<0.04	<2	0.8	4.8	1.37	4.91	0.83	0.08	0.94	0.13	0.81	0.15	0.44
NK11-006	Ash	0.20	1443	4.6	<0.1	<0.2	4.54	7.4	<0.04	<2	0.3	6.1	0.71	2.34	0.40	0.06	0.34	0.08	0.50	0.10	0.31
NK11-006 WASH	Ash	0.19	1418	3.0	<0.1	0.2	4.27	7.2	<0.04	3	0.3	6.1	0.70	2.36	0.41	0.05	0.38	0.08	0.42	0.10	0.23
NK11-007	Ash	0.22	617.0	4.8	<0.1	0.5	3.50	7.0	<0.04	<2	0.3	2.9	0.73	2.38	0.46	0.04	0.40	0.06	0.38	0.09	0.24
NK11-007WASH	Ash	0.19	734.7	3.3	<0.1	<0.2	3.19	7.0	<0.04	<2	0.2	2.6	0.60	2.05	0.33	0.05	0.28	0.06	0.32	0.09	0.20
NK11-009	Ash	0.18	588.9	4.8	<0.1	<0.2	1.46	3.9	<0.04	3	0.2	1.7	0.41	1.37	0.29	0.09	0.27	<0.04	0.18	0.04	0.11
NK11-010	Ash	0.22	998.0	2.3	<0.1	0.3	3.82	6.0	<0.04	<2	0.4	4.5	0.66	2.23	0.52	0.13	0.51	0.07	0.41	0.08	0.26
NK11-010X	Ash	0.18	21.7	2.4	<0.1	1.7	7.78	30.6	0.04	5	0.4	5.9	3.22	11.89	2.22	0.38	1.85	0.25	1.38	0.26	0.67
NK11-011	Ash	0.28	931.6	2.3	<0.1	0.2	4.79	8.1	<0.04	<2	0.3	3.8	0.88	3.31	0.57	0.18	0.60	0.08	0.51	0.11	0.32
NK11-012	Ash	0.17	1729	2.0	<0.1	<0.2	2.07	4.2	<0.04	<2	0.3	3.7	0.47	1.48	0.31	<0.04	0.28	0.04	0.20	0.05	0.12
NK11-013	Ash	0.21	297.4	2.7	<0.1	<0.2	2.58	5.0	<0.04	7	<0.2	4.2	0.66	2.33	0.49	0.09	0.43	0.07	0.37	0.06	0.19
NK11-014	Ash	0.26	506.9	3.4	<0.1	<0.2	2.25	4.7	<0.04	<2	0.3	2.8	0.57	2.06	0.43	0.13	0.39	0.07	0.36	0.06	0.19
NK11-015	Ash	0.30	755.0	6.2	<0.1	<0.2	3.58	9.5	<0.04	<2	0.3	4.1	1.12	3.95	0.75	0.08	0.61	0.07	0.48	0.11	0.25
NK11-016	Ash	0.33	329.8	4.7	<0.1	<0.2	10.46	10.6	<0.04	<2	<0.2	3.3	1.43	4.55	0.93	0.11	0.89	0.15	1.21	0.23	0.59
NK11-017	Ash	0.14	1328	1.9	<0.1	<0.2	0.72	2.6	<0.04	<2	0.3	2.5	0.30	1.14	0.16	<0.04	0.13	<0.04	0.12	0.02	0.06
NK11-018	Ash	0.30	243.7	2.6	<0.1	<0.2	2.49	5.7	<0.04	<2	<0.2	2.2	0.61	2.04	0.42	0.06	0.33	0.06	0.37	0.08	0.21
NK11-019	Ash	0.22	724.8	3.3	<0.1	0.3	2.50	6.0	<0.04	3	0.4	5.0	0.74	2.37	0.34	<0.04	0.36	0.06	0.32	0.06	0.16
NK11-020	Ash	0.19	790.7	3.6	<0.1	<0.2	1.64	5.5	<0.04	<2	0.6	7.0	0.57	1.97	0.45	0.05	0.31	0.05	0.28	0.06	0.12
NK11-020X	Ash	0.20	22.1	2.5	<0.1	1.6	8.06	29.0	<0.04	4	0.4	6.3	3.43	11.72	2.16	0.40	1.74	0.25	1.52	0.25	0.80
NK11-021	Ash	0.25	>2000	6.7	<0.1	<0.2	1.34	4.8	<0.04	<2	0.3	4.6	0.53	1.82	0.29	0.06	0.27	<0.04	0.23	0.04	0.14
NK11-022	Ash	0.20	369.9	3.8	<0.1	<0.2	1.42	4.3	<0.04	<2	<0.2	1.2	0.53	1.59	0.33	<0.04	0.34	<0.04	0.23	0.05	0.14
NK11-023	Ash	0.20	429.9	4.7	<0.1	<0.2	1.28	4.0	<0.04	<2	<0.2	1.6	0.43	1.55	0.28	0.06	0.30	<0.04	0.18	0.04	0.12
NK11-024	Ash	0.29	380.2	6.6	<0.1	<0.2	2.93	9.4	<0.04	<2	0.2	3.6	1.03	3.49	0.64	0.11	0.53	0.08	0.43	0.08	0.23
NK11-025	Ash	0.19	1362	7.2	<0.1	<0.2	1.53	5.5	<0.04	<2	0.3	5.8	0.55	1.83	0.32	0.07	0.26	<0.04	0.26	0.05	0.09
NK11-026	Ash	0.28	987.5	2.7	<0.1	0.3	1.32	4.4	<0.04	<2	<0.2	10.0	0.51	1.86	0.37	<0.04	0.32	<0.04	0.20	0.04	0.12
NK11-027	Ash	0.15	976.5	3.8	<0.1	<0.2	1.10	3.9	<0.04	<2	0.2	7.3	0.36	1.27	0.28	0.04	0.23	<0.04	0.17	0.03	0.05
NK11-027WASH	Ash	0.15	1001	2.1	<0.1	<0.2	1.34	4.5	<0.04	<2	<0.2	7.1	0.45	1.48	0.28	0.07	0.16	0.04	0.18	0.05	0.07

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

	Method	1F	1F	1F	1F	1F
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.04	0.04	0.04	20	4
NK11-001	Ash	<0.04	0.05	<0.04	<20	<4
NK11-003	Ash	<0.04	0.04	<0.04	<20	<4
NK11-004	Ash	<0.04	0.10	<0.04	<20	<4
NK11-005	Ash	0.05	0.26	0.04	<20	<4
NK11-006	Ash	<0.04	0.20	<0.04	<20	<4
NK11-006 WASH	Ash	<0.04	0.17	<0.04	<20	<4
NK11-007	Ash	<0.04	0.16	<0.04	<20	<4
NK11-007WASH	Ash	<0.04	0.17	<0.04	<20	<4
NK11-009	Ash	<0.04	0.06	<0.04	<20	<4
NK11-010	Ash	<0.04	0.18	<0.04	<20	<4
NK11-010X	Ash	0.10	0.63	0.09	<20	6
NK11-011	Ash	<0.04	0.24	<0.04	<20	<4
NK11-012	Ash	<0.04	0.10	<0.04	<20	<4
NK11-013	Ash	<0.04	0.18	<0.04	<20	<4
NK11-014	Ash	<0.04	0.19	<0.04	<20	<4
NK11-015	Ash	<0.04	0.20	<0.04	<20	<4
NK11-016	Ash	0.07	0.47	0.07	<20	<4
NK11-017	Ash	<0.04	0.06	<0.04	<20	<4
NK11-018	Ash	<0.04	0.14	<0.04	<20	<4
NK11-019	Ash	<0.04	0.15	<0.04	<20	<4
NK11-020	Ash	<0.04	0.10	<0.04	<20	<4
NK11-020X	Ash	0.10	0.61	0.10	<20	6
NK11-021	Ash	<0.04	0.08	<0.04	<20	<4
NK11-022	Ash	<0.04	0.09	<0.04	<20	<4
NK11-023	Ash	<0.04	0.08	<0.04	<20	<4
NK11-024	Ash	<0.04	0.18	<0.04	<20	<4
NK11-025	Ash	<0.04	0.09	<0.04	<20	<4
NK11-026	Ash	<0.04	0.12	<0.04	<20	<4
NK11-027	Ash	<0.04	0.09	<0.04	<20	<4
NK11-027WASH	Ash	<0.04	0.07	<0.04	<20	<4

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.02	0.02	0.02	0.2	4	0.2	0.2	2	0.02	0.2	0.2	0.4	0.2	1	0.02	0.04	0.04	4	0.02	0.002
NK11-028	Ash	2.01	178.2	37.48	2987	1757	43.7	6.4	>10000	0.33	11.0	0.3	3.0	0.6	840	22.97	1.65	0.17	6	19.26	2.359
NK11-029	Ash	1.16	182.7	12.66	2567	251	39.4	3.1	>10000	0.17	9.0	<0.2	<0.4	0.2	722	10.36	0.74	0.07	<4	14.28	3.447
NK11-029X	Ash	4.98	100.8	242.0	622.2	268	31.4	5.6	713	1.51	13.8	1.0	4.6	2.5	523	2.61	0.90	0.23	29	13.66	0.687
NK11-030	Ash	0.93	122.1	7.03	1428	105	26.4	3.5	>10000	0.14	9.9	<0.2	0.8	0.3	798	6.64	0.55	0.05	<4	16.65	2.569
NK11-031	Ash	0.94	133.0	7.92	1372	108	27.3	3.5	>10000	0.14	9.3	<0.2	2.6	0.3	747	6.98	0.57	0.06	<4	15.05	2.606
NK11-032	Ash	1.31	141.7	27.91	1461	243	38.0	5.7	>10000	0.24	8.7	0.2	2.1	0.4	698	8.61	1.12	0.16	5	13.77	2.022
NK11-033	Ash	1.95	122.8	13.71	1372	371	12.5	1.9	6228	0.14	9.1	<0.2	1.8	0.2	669	6.21	0.68	0.09	4	14.63	3.170
NK11-034	Ash	1.20	136.3	19.25	3367	268	24.4	4.8	>10000	0.18	8.2	<0.2	2.2	0.3	991	29.49	0.85	0.11	5	12.36	3.019
NK11-037	Ash	1.08	144.5	9.30	2415	537	21.0	3.9	7559	0.16	9.1	<0.2	2.1	0.3	1202	42.21	0.66	0.08	<4	13.12	4.206
NK11-038	Ash	1.29	141.0	22.51	2672	222	34.4	4.3	>10000	0.14	9.6	<0.2	2.0	0.3	759	29.64	0.70	0.09	<4	14.11	3.254
NK11-041	Ash	6.66	121.4	9.93	1429	407	11.3	2.4	4341	0.16	7.1	<0.2	3.0	0.3	817	8.26	0.94	0.06	<4	11.75	2.628
NK11-045	Ash	2.54	136.3	58.90	1066	659	52.8	18.3	>10000	0.41	10.9	0.4	2.4	0.9	858	17.96	2.94	0.27	16	15.23	2.120
NK11-046	Ash	1.43	136.4	22.40	1987	301	32.8	13.4	>10000	0.16	9.4	<0.2	2.4	0.2	742	12.73	1.21	0.11	5	13.82	3.084
NK11-046X	Ash	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK11-047	Ash	2.09	188.7	38.18	2808	962	27.5	8.0	>10000	0.28	9.3	0.2	2.5	0.5	823	14.35	1.39	0.20	9	13.26	2.651
NK11-048	Ash	1.68	143.5	29.12	1599	271	71.3	17.2	>10000	0.21	6.2	<0.2	1.6	0.4	598	5.56	1.09	0.15	6	8.99	4.090
NK11-052	Ash	1.57	139.5	9.34	1241	245	28.7	7.7	4788	0.19	5.0	<0.2	3.3	0.4	487	5.39	0.89	0.08	<4	7.82	3.302
NK11-053	Ash	3.03	166.0	12.39	1389	466	19.2	5.1	3876	0.29	7.4	0.2	1.8	0.5	366	2.54	1.23	0.13	7	11.53	3.018
NK11-056	Ash	18.16	127.7	13.87	2145	225	27.5	1.9	3405	0.21	8.5	0.3	2.2	0.4	970	11.40	0.79	0.10	4	12.51	2.767
NK11-058	Ash	4.51	135.4	10.15	3094	399	29.9	2.7	5003	0.23	8.2	0.3	2.0	0.5	724	6.25	0.85	0.10	4	12.09	3.252
NK11-059	Ash	3.39	116.4	14.84	1331	403	21.8	2.6	5328	0.22	7.2	0.2	1.9	0.4	814	9.06	0.85	0.12	5	11.31	2.124
NK11-060	Ash	2.03	147.1	22.26	3408	601	24.4	4.1	>10000	0.31	8.6	0.3	3.1	0.7	657	9.09	1.60	0.18	8	12.70	2.805
NK11-062	Ash	1.10	125.8	10.28	2120	680	74.7	3.8	>10000	0.13	4.3	<0.2	1.6	0.2	435	9.14	0.99	0.07	<4	6.53	3.695
NK11-063	Ash	1.49	133.2	15.41	1629	208	32.8	5.5	>10000	0.19	5.1	<0.2	2.7	0.4	512	10.37	1.06	0.12	<4	9.60	3.654
NK11-063X	Ash	4.59	94.03	212.1	508.5	251	34.6	4.8	708	1.20	12.5	0.8	4.1	1.8	539	2.73	0.67	0.24	27	12.10	0.669
NK11-064	Ash	1.05	232.8	12.12	3034	300	42.1	1.7	>10000	0.12	5.9	<0.2	2.2	0.2	521	10.04	0.76	0.08	<4	9.07	4.065
NK11-065	Ash	1.51	132.2	11.58	2093	163	32.7	2.5	>10000	0.17	6.0	<0.2	1.6	0.3	472	4.28	0.81	0.09	<4	7.94	4.231
NK11-066	Ash	1.56	114.8	10.25	1652	172	33.0	2.5	>10000	0.13	5.4	<0.2	0.9	0.3	310	11.44	0.86	0.09	<4	7.91	>5
NK11-067	Ash	1.22	123.9	16.55	1617	243	60.0	7.4	>10000	0.16	5.1	<0.2	1.3	0.3	598	7.72	0.92	0.11	<4	7.85	4.417
NK11-068	Ash	1.85	150.4	34.06	1761	331	37.3	11.7	>10000	0.23	11.5	0.2	5.2	0.5	851	4.23	1.26	0.19	7	14.74	3.615

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

Method		1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
Analyte		La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
Unit		ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
MDL		1	1	0.02	1	0.002	40	0.02	0.002	0.02	0.2	0.2	0.04	0.04	10	0.2	0.04	0.2	0.04	0.2	0.04
NK11-028	Ash	4	6	3.22	202	0.023	425	0.21	0.564	>10	1.0	0.6	0.44	1.20	<10	0.9	0.07	1.8	1.12	<0.2	<0.04
NK11-029	Ash	2	4	2.90	235	0.027	257	0.12	0.237	>10	0.5	0.5	0.07	1.23	<10	0.4	0.08	1.1	1.06	<0.2	<0.04
NK11-029X	Ash	16	31	1.91	206	0.038	156	0.80	0.156	1.64	0.3	2.5	0.10	0.51	<10	0.7	0.05	2.8	0.62	<0.2	<0.04
NK11-030	Ash	2	4	2.95	500	0.020	307	0.12	0.243	>10	0.8	0.5	<0.04	1.17	<10	0.4	0.06	1.1	0.42	<0.2	<0.04
NK11-031	Ash	2	4	2.85	240	0.021	292	0.11	0.342	>10	0.7	0.5	<0.04	1.43	<10	0.5	0.05	1.0	0.43	<0.2	<0.04
NK11-032	Ash	5	6	2.45	265	0.021	306	0.18	0.402	>10	1.0	0.7	0.07	1.11	<10	0.9	0.09	1.3	1.15	<0.2	<0.04
NK11-033	Ash	2	3	3.68	984	0.015	372	0.09	0.254	>10	0.7	0.3	<0.04	0.97	<10	0.2	0.08	0.7	2.35	<0.2	<0.04
NK11-034	Ash	3	5	3.38	167	0.017	334	0.18	0.483	>10	1.0	0.4	<0.04	1.32	<10	0.5	0.05	0.9	0.46	<0.2	<0.04
NK11-037	Ash	3	4	2.91	208	0.019	325	0.10	0.185	>10	0.8	0.5	<0.04	1.11	<10	0.5	0.10	0.8	0.88	<0.2	<0.04
NK11-038	Ash	3	3	2.55	2037	0.014	266	0.19	0.098	>10	0.5	0.4	0.30	1.02	<10	0.4	0.11	0.8	2.44	<0.2	<0.04
NK11-041	Ash	2	4	2.16	662	0.015	247	0.09	0.239	>10	1.0	0.3	0.06	0.77	<10	0.4	0.12	0.6	0.56	0.2	<0.04
NK11-045	Ash	9	11	2.63	197	0.022	297	0.33	1.024	9.24	2.0	0.8	0.19	0.98	<10	0.8	0.10	1.6	2.34	<0.2	<0.04
NK11-046	Ash	6	3	2.67	268	0.014	269	0.13	0.351	>10	0.7	0.4	2.54	0.85	<10	0.8	0.08	0.8	5.71	<0.2	<0.04
NK11-046X	Ash	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK11-047	Ash	5	8	2.93	199	0.017	371	0.18	0.441	>10	1.0	0.5	0.46	1.11	<10	1.0	0.10	1.4	4.56	<0.2	<0.04
NK11-048	Ash	3	4	3.87	1476	0.020	343	0.32	0.518	>10	0.8	0.5	0.73	1.15	<10	0.5	0.06	1.4	6.41	<0.2	<0.04
NK11-052	Ash	2	4	1.91	2317	0.018	189	0.17	0.377	>10	1.7	0.4	0.12	0.79	<10	0.3	0.05	0.8	0.53	<0.2	<0.04
NK11-053	Ash	4	7	2.73	1435	0.024	408	0.31	0.645	>10	2.1	0.7	0.74	0.93	<10	0.8	<0.04	1.1	2.90	<0.2	<0.04
NK11-056	Ash	5	5	2.02	270	0.017	315	0.11	0.207	>10	1.4	0.5	0.08	0.90	<10	0.6	0.10	0.8	2.25	<0.2	<0.04
NK11-058	Ash	8	5	1.96	2226	0.020	202	0.14	0.582	>10	1.1	0.5	<0.04	0.86	<10	0.6	0.07	1.0	0.94	<0.2	<0.04
NK11-059	Ash	8	6	2.32	559	0.014	203	0.13	0.317	>10	1.4	0.5	0.16	0.82	<10	0.5	<0.04	0.8	14.80	<0.2	<0.04
NK11-060	Ash	6	7	2.64	300	0.022	311	0.21	0.408	>10	1.7	0.7	0.14	1.07	<10	0.9	0.10	1.2	1.91	<0.2	<0.04
NK11-062	Ash	6	4	3.45	1410	0.018	265	0.23	0.170	>10	0.5	0.6	<0.04	1.41	<10	0.6	<0.04	0.9	4.86	0.2	<0.04
NK11-063	Ash	3	5	2.27	1325	0.019	310	0.18	0.311	>10	1.3	0.6	0.41	0.91	<10	0.5	0.06	1.4	5.38	<0.2	<0.04
NK11-063X	Ash	13	29	1.99	150	0.029	123	0.79	0.146	1.58	0.3	2.0	0.10	0.42	<10	0.3	0.08	2.8	0.67	<0.2	<0.04
NK11-064	Ash	2	3	2.09	396	0.016	357	0.19	0.104	>10	0.4	0.4	0.21	0.93	<10	0.4	<0.04	0.8	1.21	0.2	<0.04
NK11-065	Ash	2	4	2.19	2975	0.019	292	0.17	0.331	>10	1.2	0.5	1.49	0.98	<10	0.3	0.07	1.4	4.91	<0.2	<0.04
NK11-066	Ash	2	3	2.48	2363	0.020	317	0.12	0.149	>10	0.5	0.4	1.74	1.11	<10	0.4	<0.04	1.4	2.92	<0.2	<0.04
NK11-067	Ash	2	4	3.25	2923	0.018	323	0.22	0.265	>10	0.7	0.4	1.55	0.84	<10	0.4	0.10	1.0	29.58	<0.2	<0.04
NK11-068	Ash	4	5	4.19	284	0.019	360	0.27	0.235	>10	1.0	0.5	2.47	1.06	<10	1.1	0.07	1.1	13.54	<0.2	<0.04

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

Method		1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.04	0.2	0.2	0.1	0.2	0.02	0.2	0.04	2	0.2	0.2	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.04
NK11-028	Ash	0.26	269.2	5.6	<0.1	<0.2	2.03	6.8	<0.04	<2	<0.2	4.6	0.77	2.76	0.46	0.05	0.38	0.05	0.32	0.06	0.17
NK11-029	Ash	0.20	618.3	2.0	<0.1	<0.2	0.78	2.7	<0.04	2	<0.2	1.1	0.29	1.12	0.20	<0.04	0.18	<0.04	0.11	0.03	0.07
NK11-029X	Ash	0.14	20.6	2.4	<0.1	1.7	7.57	28.4	<0.04	<2	0.3	5.6	3.33	11.59	2.34	0.38	1.75	0.25	1.23	0.24	0.69
NK11-030	Ash	0.14	222.2	2.0	<0.1	<0.2	0.89	3.6	<0.04	<2	<0.2	1.0	0.37	1.29	0.27	<0.04	0.19	<0.04	0.15	0.03	0.08
NK11-031	Ash	0.17	239.3	1.8	<0.1	<0.2	0.97	4.3	<0.04	<2	<0.2	1.3	0.37	1.38	0.23	<0.04	0.23	<0.04	0.13	0.03	0.06
NK11-032	Ash	0.18	416.8	4.0	<0.1	<0.2	2.44	6.3	<0.04	<2	0.3	3.0	0.83	2.87	0.57	0.08	0.56	0.07	0.40	0.07	0.17
NK11-033	Ash	0.19	311.2	2.5	<0.1	<0.2	1.10	3.0	<0.04	<2	<0.2	2.1	0.32	1.24	0.17	<0.04	0.18	<0.04	0.21	0.03	0.09
NK11-034	Ash	0.21	216.5	4.2	<0.1	<0.2	3.14	5.1	<0.04	<2	0.6	4.9	0.60	2.26	0.33	<0.04	0.43	0.05	0.39	0.06	0.19
NK11-037	Ash	0.19	421.3	3.7	<0.1	<0.2	2.48	4.5	<0.04	2	<0.2	3.4	0.51	1.73	0.35	<0.04	0.32	0.04	0.30	0.05	0.14
NK11-038	Ash	0.15	997.9	2.1	<0.1	<0.2	2.77	4.3	<0.04	<2	<0.2	1.4	0.42	1.57	0.36	<0.04	0.32	0.05	0.24	0.06	0.11
NK11-041	Ash	0.16	284.9	3.4	<0.1	<0.2	1.35	3.9	<0.04	<2	<0.2	1.0	0.42	1.60	0.30	<0.04	0.24	<0.04	0.17	0.03	0.10
NK11-045	Ash	0.29	343.4	6.3	<0.1	<0.2	5.33	15.8	<0.04	4	0.5	4.3	1.75	6.28	1.16	0.11	1.15	0.15	0.81	0.14	0.38
NK11-046	Ash	0.13	665.7	3.0	<0.1	<0.2	3.03	8.0	<0.04	<2	0.4	2.3	0.87	2.88	0.51	0.04	0.49	0.06	0.41	0.07	0.22
NK11-046X	Ash	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK11-047	Ash	0.25	675.3	6.8	<0.1	<0.2	2.40	8.4	<0.04	<2	<0.2	5.1	0.92	3.40	0.63	0.07	0.54	0.07	0.33	0.08	0.20
NK11-048	Ash	0.23	1232	2.8	<0.1	<0.2	1.59	5.5	<0.04	<2	<0.2	5.8	0.53	2.00	0.36	<0.04	0.33	0.04	0.21	0.04	0.11
NK11-052	Ash	0.25	255.8	3.6	<0.1	<0.2	1.43	4.3	<0.04	3	<0.2	1.7	0.43	1.83	0.31	<0.04	0.34	<0.04	0.19	0.04	0.11
NK11-053	Ash	0.31	425.9	1.8	<0.1	<0.2	2.78	6.2	<0.04	<2	0.4	3.6	0.69	2.85	0.55	0.05	0.46	0.06	0.39	0.08	0.21
NK11-056	Ash	0.23	458.9	1.6	<0.1	<0.2	2.88	6.6	<0.04	<2	<0.2	2.0	0.75	2.95	0.49	0.04	0.45	0.06	0.38	0.08	0.21
NK11-058	Ash	0.25	201.8	3.1	<0.1	0.5	4.89	7.6	<0.04	6	5.5	1.9	1.02	3.44	0.72	<0.04	0.58	0.11	0.50	0.11	0.27
NK11-059	Ash	0.20	683.6	1.6	<0.1	<0.2	5.81	10.1	<0.04	3	0.9	1.8	1.14	4.22	0.93	0.07	0.78	0.12	0.64	0.14	0.32
NK11-060	Ash	0.29	382.8	6.2	<0.1	<0.2	4.41	8.8	<0.04	<2	0.3	4.8	0.98	3.63	0.70	0.07	0.63	0.08	0.56	0.10	0.27
NK11-062	Ash	0.20	1706	1.7	<0.1	<0.2	8.70	6.7	<0.04	<2	0.4	1.2	0.70	2.44	0.50	<0.04	0.59	0.09	0.59	0.13	0.34
NK11-063	Ash	0.24	928.8	3.5	<0.1	0.2	2.38	5.0	<0.04	<2	<0.2	2.0	0.54	1.98	0.34	<0.04	0.43	0.05	0.25	0.06	0.19
NK11-063X	Ash	0.17	20.6	2.1	<0.1	1.1	7.21	27.2	0.04	7	<0.2	4.7	2.68	10.86	2.03	0.37	1.77	0.23	1.22	0.22	0.62
NK11-064	Ash	0.15	678.0	3.2	<0.1	<0.2	2.12	3.2	<0.04	<2	0.4	1.9	0.31	1.18	0.23	<0.04	0.19	<0.04	0.18	0.05	0.11
NK11-065	Ash	0.18	1209	2.5	<0.1	<0.2	1.83	4.1	<0.04	<2	0.2	2.9	0.41	1.57	0.30	<0.04	0.24	<0.04	0.19	0.04	0.10
NK11-066	Ash	0.18	1385	4.4	<0.1	<0.2	0.74	2.6	<0.04	<2	<0.2	1.1	0.26	0.98	0.18	<0.04	0.15	<0.04	0.09	0.02	0.06
NK11-067	Ash	0.19	>2000	2.8	<0.1	<0.2	1.47	4.1	<0.04	<2	0.5	5.1	0.37	1.38	0.20	<0.04	0.26	<0.04	0.16	0.04	0.08
NK11-068	Ash	0.26	716.4	3.4	<0.1	<0.2	2.16	6.2	<0.04	<2	0.4	5.3	0.66	2.48	0.44	0.07	0.38	0.05	0.31	0.05	0.14

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

	Method	1F	1F	1F	1F	1F
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.04	0.04	0.04	20	4
NK11-028	Ash	<0.04	0.10	<0.04	<20	5
NK11-029	Ash	<0.04	0.04	<0.04	<20	<4
NK11-029X	Ash	0.09	0.57	0.08	<20	10
NK11-030	Ash	<0.04	0.07	<0.04	<20	<4
NK11-031	Ash	<0.04	0.08	<0.04	<20	<4
NK11-032	Ash	<0.04	0.14	<0.04	<20	<4
NK11-033	Ash	<0.04	0.12	<0.04	<20	<4
NK11-034	Ash	<0.04	0.15	<0.04	<20	<4
NK11-037	Ash	<0.04	0.13	<0.04	<20	<4
NK11-038	Ash	<0.04	0.13	<0.04	<20	<4
NK11-041	Ash	<0.04	0.11	<0.04	<20	<4
NK11-045	Ash	<0.04	0.30	<0.04	<20	5
NK11-046	Ash	<0.04	0.13	<0.04	<20	<4
NK11-046X	Ash	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
NK11-047	Ash	<0.04	0.16	<0.04	<20	<4
NK11-048	Ash	<0.04	0.12	<0.04	<20	<4
NK11-052	Ash	<0.04	0.14	<0.04	<20	<4
NK11-053	Ash	<0.04	0.23	<0.04	<20	<4
NK11-056	Ash	<0.04	0.16	<0.04	<20	<4
NK11-058	Ash	<0.04	0.21	<0.04	<20	<4
NK11-059	Ash	0.04	0.27	<0.04	<20	<4
NK11-060	Ash	<0.04	0.20	<0.04	<20	<4
NK11-062	Ash	<0.04	0.28	<0.04	<20	<4
NK11-063	Ash	<0.04	0.15	<0.04	<20	<4
NK11-063X	Ash	0.08	0.51	0.09	<20	6
NK11-064	Ash	<0.04	0.10	<0.04	<20	<4
NK11-065	Ash	<0.04	0.12	<0.04	<20	<4
NK11-066	Ash	<0.04	0.09	<0.04	<20	<4
NK11-067	Ash	<0.04	0.15	<0.04	<20	<4
NK11-068	Ash	<0.04	0.13	<0.04	<20	<4

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

Method		1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
Analyte		Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
Unit		ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
MDL		0.02	0.02	0.02	0.2	4	0.2	0.2	2	0.02	0.2	0.2	0.4	0.2	1	0.02	0.04	0.04	4	0.02	0.002
NK11-069	Ash	1.21	167.6	12.15	1797	229	68.7	3.5	>10000	0.15	6.4	<0.2	3.3	0.3	554	3.28	0.73	0.10	<4	9.66	>5
NK11-070	Ash	1.52	159.2	21.20	2160	310	48.2	8.4	>10000	0.22	7.2	0.2	0.5	0.5	615	11.45	1.39	0.13	6	9.67	4.838
NK11-071	Ash	1.17	143.6	11.14	1600	273	54.8	5.2	>10000	0.11	7.1	<0.2	<0.4	0.2	534	7.38	0.62	0.06	<4	10.60	4.660
NK11-074	Ash	2.31	138.5	36.29	2799	462	52.5	11.8	>10000	0.37	9.4	0.4	0.4	0.9	830	17.03	2.17	0.24	13	12.49	2.860
NK11-075	Ash	1.58	114.5	13.87	1641	140	52.3	20.8	>10000	0.18	6.0	<0.2	0.4	0.4	577	7.88	0.86	0.10	5	8.55	3.316
NK11-075X	Ash	5.24	91.13	214.6	523.3	273	40.0	5.7	739	1.55	13.8	1.0	5.1	4.4	579	2.65	0.76	0.22	27	12.87	0.696
NK11-081	Ash	1.06	128.3	9.73	2721	307	28.5	6.8	>10000	0.16	10.4	<0.2	<0.4	0.4	711	9.20	0.70	0.07	<4	13.94	2.318
NK11-082	Ash	2.89	130.7	17.19	2977	166	11.2	2.4	4911	0.16	11.8	<0.2	<0.4	0.3	1939	6.49	0.67	0.09	5	14.97	2.626
NK11-083	Ash	1.45	149.0	22.53	3517	449	48.2	15.4	>10000	0.15	8.1	<0.2	<0.4	0.3	974	13.41	0.77	0.10	5	10.83	3.670

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	1	1	0.02	1	0.002	40	0.02	0.002	0.02	0.2	0.2	0.04	0.04	10	0.2	0.04	0.2	0.04	0.2	0.04
NK11-069	Ash	2	4	3.33	637	0.022	257	0.16	0.344	>10	0.9	0.5	0.46	0.87	<10	0.4	<0.04	1.0	0.82	<0.2	<0.04
NK11-070	Ash	3	6	3.01	288	0.022	316	0.27	0.411	>10	0.9	0.5	2.04	1.02	<10	0.7	0.07	1.4	1.66	<0.2	<0.04
NK11-071	Ash	1	2	3.01	511	0.018	291	0.15	0.438	>10	0.5	0.3	1.13	0.89	<10	0.4	0.07	1.2	1.87	<0.2	<0.04
NK11-074	Ash	5	8	2.53	251	0.026	298	0.36	0.897	>10	4.4	0.7	0.66	0.95	<10	0.7	0.04	1.8	1.45	<0.2	<0.04
NK11-075	Ash	3	4	2.46	294	0.017	317	0.25	0.342	>10	1.5	0.5	0.95	0.95	<10	0.7	0.04	1.4	1.86	<0.2	<0.04
NK11-075X	Ash	13	36	1.93	158	0.028	173	0.80	0.149	1.58	0.3	2.0	0.07	0.43	<10	0.7	0.07	2.8	0.63	<0.2	<0.04
NK11-081	Ash	4	4	2.11	1515	0.015	205	0.13	0.590	>10	1.5	0.4	0.15	0.73	<10	0.7	<0.04	0.9	0.45	<0.2	<0.04
NK11-082	Ash	3	3	2.50	316	0.013	343	0.10	0.302	>10	1.0	0.3	0.36	0.68	<10	0.5	0.16	0.7	1.10	<0.2	<0.04
NK11-083	Ash	3	2	3.36	215	0.017	320	0.19	0.407	>10	0.8	0.4	2.67	1.09	<10	0.6	0.09	1.1	6.47	<0.2	<0.04

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

Method		1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.04	0.2	0.2	0.1	0.2	0.02	0.2	0.04	2	0.2	0.2	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.04
NK11-069	Ash	0.22	1521	3.2	<0.1	<0.2	0.96	3.3	<0.04	<2	<0.2	0.9	0.33	1.29	0.26	<0.04	0.26	<0.04	0.13	0.03	0.09
NK11-070	Ash	0.27	1084	2.9	<0.1	<0.2	1.51	5.2	<0.04	<2	<0.2	3.7	0.52	1.94	0.43	0.06	0.37	0.04	0.21	0.05	0.11
NK11-071	Ash	0.13	736.3	4.0	<0.1	<0.2	0.80	2.7	<0.04	<2	<0.2	3.2	0.27	1.02	0.23	<0.04	0.17	<0.04	0.15	0.02	0.05
NK11-074	Ash	0.38	593.1	7.8	<0.1	<0.2	2.43	10.4	<0.04	<2	0.2	3.5	1.02	3.92	0.64	0.09	0.49	0.08	0.46	0.09	0.22
NK11-075	Ash	0.20	918.8	5.0	<0.1	<0.2	1.46	4.9	<0.04	3	0.4	3.4	0.51	1.90	0.35	<0.04	0.24	0.04	0.27	0.04	0.11
NK11-075X	Ash	0.17	19.7	2.2	<0.1	1.3	7.44	26.1	<0.04	7	0.2	4.9	2.62	10.56	2.04	0.38	1.64	0.24	1.40	0.23	0.66
NK11-081	Ash	0.18	180.2	3.3	<0.1	<0.2	2.71	6.9	<0.04	<2	<0.2	3.0	0.68	2.47	0.48	0.05	0.38	0.07	0.40	0.08	0.15
NK11-082	Ash	0.20	297.1	3.6	<0.1	<0.2	2.43	4.8	<0.04	<2	<0.2	2.6	0.58	2.24	0.48	0.05	0.43	0.07	0.37	0.08	0.20
NK11-083	Ash	0.17	1214	4.8	<0.1	<0.2	2.48	4.6	<0.04	<2	0.3	5.0	0.47	1.79	0.35	0.06	0.26	0.05	0.25	0.06	0.17

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

CERTIFICATE OF ANALYSIS VAN11005519.1

		Method	1F	1F	1F	1F	1F
		Analyte	Tm	Yb	Lu	Pd	Pt
		Unit	ppm	ppm	ppm	ppb	ppb
		MDL	0.04	0.04	0.04	20	4
NK11-069	Ash		<0.04	0.08	<0.04	<20	<4
NK11-070	Ash		<0.04	0.10	<0.04	<20	<4
NK11-071	Ash		<0.04	0.04	<0.04	<20	<4
NK11-074	Ash		<0.04	0.19	<0.04	<20	<4
NK11-075	Ash		<0.04	0.09	<0.04	<20	<4
NK11-075X	Ash		0.08	0.56	0.09	<20	5
NK11-081	Ash		<0.04	0.19	<0.04	<20	<4
NK11-082	Ash		<0.04	0.16	<0.04	<20	<4
NK11-083	Ash		<0.04	0.13	<0.04	<20	<4

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

QUALITY CONTROL REPORT VAN11005519.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.02	0.02	0.02	0.2	4	0.2	0.2	2	0.02	0.2	0.2	0.4	0.2	1	0.02	0.04	0.04	4	0.02	0.002
Pulp Duplicates																					
NK11-014	Ash	1.01	138.0	25.23	1698	404	47.6	5.6	6499	0.22	4.7	<0.2	0.7	0.4	483	8.03	0.98	0.14	4	9.09	2.786
REP NK11-014	QC	1.03	141.9	24.42	1692	374	47.7	5.8	6634	0.21	5.2	<0.2	1.9	0.4	469	7.58	0.88	0.14	<4	9.11	2.827
NK11-083	Ash	1.45	149.0	22.53	3517	449	48.2	15.4	>10000	0.15	8.1	<0.2	<0.4	0.3	974	13.41	0.77	0.10	5	10.83	3.670
REP NK11-083	QC	1.37	144.0	22.80	3417	422	47.4	14.9	>10000	0.15	7.6	<0.2	1.9	0.3	939	13.12	0.75	0.09	5	10.78	3.670
Reference Materials																					
STD DS8	Standard	14.41	116.9	128.7	339.1	1757	37.0	7.3	638	2.57	25.8	2.8	110.7	6.7	73	2.46	5.93	7.34	40	0.65	0.083
STD DS8	Standard	14.02	116.3	144.0	334.8	2086	38.7	7.8	637	2.65	26.6	3.1	87.6	7.8	79	2.56	6.23	7.57	42	0.71	0.083
STD DS8	Standard	13.25	102.9	118.1	314.4	1719	39.6	7.9	610	2.50	26.2	2.6	84.0	6.2	67	2.34	4.59	6.48	39	0.67	0.084
STD DS8	Standard	15.56	111.5	124.0	333.3	1747	41.0	7.8	642	2.55	29.3	2.7	100.4	6.5	68	2.57	4.67	6.63	39	0.71	0.086
STD DS8 Expected		13.44	110	123	312	1690	38.1	7.5	615	2.46	26	2.8	107	6.89	67.7	2.38	4.8	6.67	41.1	0.7	0.08
BLK	Blank	<0.02	<0.02	<0.02	<0.2	<4	<0.2	<0.2	<2	<0.02	<0.2	<0.2	<0.4	<0.2	<1	<0.02	<0.04	<0.04	<4	<0.02	<0.002
BLK	Blank	<0.02	<0.02	<0.02	<0.2	<4	<0.2	<0.2	<2	<0.02	<0.2	<0.2	<0.4	<0.2	<1	<0.02	<0.04	<0.04	<4	<0.02	<0.002
BLK	Blank	<0.02	<0.02	<0.02	<0.2	<4	<0.2	<0.2	<2	<0.02	<0.2	<0.2	<0.4	<0.2	<1	<0.02	<0.04	<0.04	<4	<0.02	<0.002

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

QUALITY CONTROL REPORT VAN11005519.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	1	1	0.02	1	0.002	40	0.02	0.002	0.02	0.2	0.2	0.04	0.04	10	0.2	0.04	0.2	0.04	0.2	0.04
Pulp Duplicates																					
NK11-014	Ash	3	4	2.63	2505	0.026	289	0.22	0.203	>10	1.0	0.8	0.11	0.94	<10	0.7	0.05	0.9	1.13	0.2	<0.04
REP NK11-014	QC	3	4	2.66	2526	0.025	310	0.22	0.208	>10	0.9	0.9	0.08	0.94	<10	0.4	<0.04	0.9	1.10	<0.2	<0.04
NK11-083	Ash	3	2	3.36	215	0.017	320	0.19	0.407	>10	0.8	0.4	2.67	1.09	<10	0.6	0.09	1.1	6.47	<0.2	<0.04
REP NK11-083	QC	3	3	3.29	219	0.016	261	0.19	0.389	>10	0.9	0.4	3.15	1.07	<10	0.7	0.06	1.1	6.45	<0.2	<0.04
Reference Materials																					
STD DS8	Standard	17	122	0.62	308	0.144	<40	0.84	0.085	0.39	3.1	2.8	5.47	0.17	215	5.4	5.69	4.9	2.77	<0.2	0.08
STD DS8	Standard	18	125	0.64	316	0.154	<40	0.90	0.089	0.40	3.4	3.0	5.86	0.18	186	5.5	6.34	5.1	2.78	<0.2	0.07
STD DS8	Standard	16	124	0.56	297	0.118	<40	0.83	0.093	0.41	2.6	2.1	5.18	0.16	172	5.1	5.37	4.8	2.62	<0.2	0.09
STD DS8	Standard	16	122	0.60	317	0.122	<40	0.89	0.097	0.41	3.3	2.2	5.33	0.16	204	5.5	5.57	5.0	2.76	<0.2	0.09
STD DS8 Expected		14.6	115	0.6045	279	0.113	2.6	0.93	0.0883	0.41	3	2.3	5.4	0.1679	192	5.23	5	4.7	2.48	0.13	0.08
BLK	Blank	<1	<1	<0.02	<1	<0.002	<40	<0.02	<0.002	<0.02	<0.2	<0.2	<0.04	<0.04	<10	<0.2	<0.04	<0.2	<0.04	<0.2	<0.04
BLK	Blank	<1	<1	<0.02	<1	<0.002	<40	<0.02	<0.002	<0.02	<0.2	<0.2	<0.04	<0.04	<10	<0.2	<0.04	<0.2	<0.04	<0.2	<0.04
BLK	Blank	<1	<1	<0.02	<1	<0.002	<40	<0.02	<0.002	<0.02	<0.2	<0.2	<0.04	<0.04	<10	<0.2	<0.04	<0.2	<0.04	<0.2	<0.04

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

QUALITY CONTROL REPORT VAN11005519.1

	Method	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F	1F
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.04	0.2	0.2	0.1	0.2	0.02	0.2	0.04	2	0.2	0.2	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.04
Pulp Duplicates																					
NK11-014	Ash	0.26	506.9	3.4	<0.1	<0.2	2.25	4.7	<0.04	<2	0.3	2.8	0.57	2.06	0.43	0.13	0.39	0.07	0.36	0.06	0.19
REP NK11-014	QC	0.21	503.4	3.4	<0.1	0.2	2.09	4.2	<0.04	<2	0.4	3.1	0.52	2.08	0.41	0.05	0.38	0.05	0.32	0.06	0.12
NK11-083	Ash	0.17	1214	4.8	<0.1	<0.2	2.48	4.6	<0.04	<2	0.3	5.0	0.47	1.79	0.35	0.06	0.26	0.05	0.25	0.06	0.17
REP NK11-083	QC	0.18	1196	4.7	<0.1	<0.2	2.41	4.5	<0.04	<2	<0.2	4.8	0.48	1.83	0.37	0.05	0.28	0.06	0.30	0.05	0.12
Reference Materials																					
STD DS8	Standard	1.48	39.1	7.7	<0.1	2.1	6.65	27.9	2.57	54	4.4	24.1	3.11	10.27	1.96	0.31	1.58	0.21	1.21	0.20	0.64
STD DS8	Standard	1.66	40.7	7.9	<0.1	2.2	7.25	31.1	2.66	61	4.7	26.4	3.37	11.98	2.23	0.40	1.61	0.21	1.17	0.22	0.68
STD DS8	Standard	1.39	34.6	6.6	<0.1	2.2	6.74	30.0	2.16	53	3.7	17.6	2.98	11.02	2.05	0.37	1.32	0.21	1.04	0.24	0.57
STD DS8	Standard	1.43	37.3	7.0	<0.1	2.4	7.04	31.4	2.33	61	4.4	19.9	3.13	12.14	2.17	0.35	1.45	0.23	1.26	0.24	0.62
STD DS8 Expected		1.1	39	6.7	0.003	1.1	6.1	29.8	2.19	55	5.2	26.34	2.87	10.6	1.65	0.31	1.29	0.18	1.05	0.2	0.57
BLK	Blank	<0.04	<0.2	<0.2	<0.1	<0.2	<0.02	<0.2	<0.04	<2	<0.2	<0.2	<0.02	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.02	<0.04
BLK	Blank	<0.04	<0.2	<0.2	<0.1	<0.2	<0.02	<0.2	<0.04	<2	<0.2	<0.2	<0.02	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.02	<0.04
BLK	Blank	<0.04	<0.2	<0.2	<0.1	<0.2	<0.02	<0.2	<0.04	<2	<0.2	<0.2	<0.02	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.02	<0.04

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: December 23, 2011

QUALITY CONTROL REPORT VAN11005519.1

	Method	1F	1F	1F	1F	1F
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.04	0.04	0.04	20	4
Pulp Duplicates						
NK11-014	Ash	<0.04	0.19	<0.04	<20	<4
REP NK11-014	QC	<0.04	0.20	<0.04	<20	<4
NK11-083	Ash	<0.04	0.13	<0.04	<20	<4
REP NK11-083	QC	<0.04	0.13	<0.04	<20	<4
Reference Materials						
STD DS8	Standard	0.08	0.55	0.08	105	360
STD DS8	Standard	0.11	0.63	0.10	101	361
STD DS8	Standard	0.08	0.64	0.09	94	338
STD DS8	Standard	0.09	0.68	0.08	99	348
STD DS8 Expected		0.08	0.57	0.09	110	339
BLK	Blank	<0.04	<0.04	<0.04	<20	<4
BLK	Blank	<0.04	<0.04	<0.04	<20	<4
BLK	Blank	<0.04	<0.04	<0.04	<20	<4

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada

www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Submitted By: Britt Bluemel
Receiving Lab: Canada-Vancouver
Received: July 21, 2011
Report Date: August 16, 2011
Page: 1 of 6

CERTIFICATE OF ANALYSIS VAN11003337.1

CLIENT JOB INFORMATION

Project: Norra Karr 2011
Shipment ID:
P.O. Number
Number of Samples: 128

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Method Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
No Prep	128	Sorting of samples on arrival and labeling			VAN
1VE2+REEs	128	Aqua Regia digestion ICP-MS analysis	1	Completed	VAN

SAMPLE DISPOSAL

STOR-PLP Store After 90 days Invoice for Storage

ADDITIONAL COMMENTS

Acme does not accept responsibility for samples left at the laboratory after 90 days without prior written instructions for sample storage or return.

Invoice To: IoGlobal Solutions
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2
Canada

CC: Colin Dunn
Magnus Leijd

BRITISH COLUMBIA CERTIFIED ASSAYER
CLARENCE LEONG
GENERAL MANAGER

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.
All results are considered the confidential property of the client. Acme assumes the liabilities for actual cost of analysis only. Results apply to samples as submitted.
"*" asterisk indicates that an analytical result could not be provided due to unusually high levels of interference from other elements.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK11-001 FS2	Vegetation	0.09	5.81	0.27	36.3	6	0.2	0.03	119	0.008	<0.1	<0.01	<0.2	<0.01	32.6	0.08	<0.02	0.02	<2	0.70	0.282
NK11-002 F2	Vegetation	0.04	7.64	0.20	40.4	8	0.4	0.04	152	0.009	<0.1	<0.01	<0.2	<0.01	20.9	0.17	0.03	0.02	<2	0.64	0.334
NK11-003 F2S	Vegetation	0.08	8.85	0.18	56.4	6	0.9	0.06	92	0.007	0.1	<0.01	0.3	<0.01	17.1	0.03	<0.02	<0.02	<2	0.57	0.315
NK11-004 F2S	Vegetation	0.10	8.02	0.13	44.9	5	0.4	0.06	135	0.008	<0.1	<0.01	<0.2	<0.01	26.6	0.10	<0.02	<0.02	<2	0.70	0.289
NK11-005 FS2	Vegetation	0.15	5.37	0.32	22.3	<2	0.2	0.06	102	0.007	0.3	<0.01	<0.2	<0.01	22.9	0.06	0.02	<0.02	<2	0.56	0.208
NK11-006 F3_WASH	Vegetation	0.11	6.20	0.22	18.0	17	0.6	0.33	141	0.005	<0.1	<0.01	<0.2	<0.01	55.3	0.07	0.05	<0.02	<2	0.27	0.210
NK11-006 F3	Vegetation	0.08	6.29	0.12	18.0	19	0.3	0.44	154	0.005	0.2	<0.01	0.3	<0.01	64.1	0.04	<0.02	<0.02	<2	0.28	0.214
NK11-007 FS2	Vegetation	0.21	6.69	0.33	42.1	3	1.1	0.27	307	0.006	0.2	<0.01	<0.2	<0.01	10.0	0.11	<0.02	<0.02	<2	0.27	0.203
NK11-008 FS2	Vegetation	0.13	8.53	0.02	54.3	5	2.1	0.03	312	0.006	0.3	<0.01	<0.2	<0.01	18.9	0.19	<0.02	<0.02	<2	0.32	0.264
NK11-009 FS1	Vegetation	0.14	7.28	0.05	20.5	5	0.1	0.03	134	0.006	0.1	<0.01	0.2	<0.01	13.8	0.31	<0.02	<0.02	<2	0.49	0.316
NK11-009X SF-2 STD.	Rock Pulp	0.49	8.89	0.14	26.6	2	0.5	0.06	82	0.013	0.1	0.01	<0.2	<0.01	24.1	0.07	<0.02	<0.02	2	0.40	0.290
NK11-010 F3	Vegetation	0.20	7.93	0.04	28.0	12	9.6	0.12	48	0.007	<0.1	<0.01	<0.2	<0.01	10.1	0.12	<0.02	<0.02	<2	0.13	0.396
NK11-011 F3	Vegetation	0.17	7.65	0.02	30.3	13	9.2	0.08	76	0.008	0.2	<0.01	<0.2	<0.01	9.4	0.13	<0.02	<0.02	<2	0.14	0.391
NK11-012 FS2	Vegetation	0.20	5.72	0.14	74.0	<2	3.1	0.25	818	0.006	<0.1	0.03	0.6	<0.01	21.6	0.18	<0.02	<0.02	<2	0.26	0.238
NK11-012 BIRCH	Vegetation	0.14	6.63	0.06	214.7	4	4.0	0.36	3892	0.006	0.2	<0.01	0.3	<0.01	26.9	0.78	0.02	<0.02	<2	0.66	0.221
NK11-013 F2S	Vegetation	0.08	9.74	0.01	32.6	2	0.4	0.03	41	0.007	<0.1	<0.01	0.5	<0.01	7.3	0.10	<0.02	<0.02	<2	0.62	0.256
NK11-014 F2S A	Vegetation	0.33	6.42	<0.01	34.6	4	0.9	0.08	138	0.006	<0.1	<0.01	0.3	<0.01	10.0	0.06	<0.02	<0.02	<2	0.27	0.267
NK11-014 FERN 2 B	Vegetation	0.06	5.96	<0.01	27.4	3	0.3	0.18	94	0.007	0.2	<0.01	<0.2	<0.01	12.4	0.17	<0.02	<0.02	2	0.37	0.230
NK11-016 F2S	Vegetation	0.10	8.15	0.07	39.9	7	0.7	0.05	179	0.010	0.3	<0.01	0.5	<0.01	19.9	0.22	0.03	<0.02	<2	0.49	0.252
NK11-017 FS2	Vegetation	0.04	7.43	0.06	43.9	3	3.8	0.41	338	0.008	<0.1	<0.01	0.3	<0.01	15.5	0.17	<0.02	<0.02	<2	0.35	0.374
NK11-018 F3 NS	Vegetation	0.09	6.09	<0.01	21.5	18	1.2	0.04	58	0.007	<0.1	<0.01	0.4	<0.01	45.3	0.21	<0.02	<0.02	<2	0.21	0.226
NK11-018X SF-2 STD.	Rock Pulp	0.53	8.96	0.08	27.8	<2	0.5	0.07	81	0.014	<0.1	0.01	0.8	<0.01	23.6	0.05	<0.02	<0.02	<2	0.39	0.279
NK11-018 OAK	Vegetation	0.03	8.38	0.06	26.3	17	0.9	0.08	789	0.008	<0.1	<0.01	<0.2	<0.01	27.8	0.09	0.02	<0.02	<2	0.94	0.187
NK11-018 BIRCH	Vegetation	0.05	4.69	0.18	188.5	<2	1.8	0.15	828	0.008	<0.1	<0.01	<0.2	<0.01	42.2	0.26	0.03	<0.02	<2	1.08	0.156
NK11-019 F2S	Vegetation	0.11	9.34	<0.01	31.0	4	1.1	0.04	111	0.006	0.2	<0.01	0.6	<0.01	8.0	0.21	<0.02	<0.02	<2	0.33	0.243
NK11-020 F3	Vegetation	0.09	8.59	<0.01	31.5	29	7.7	0.43	145	0.010	0.2	<0.01	0.3	<0.01	44.3	0.07	<0.02	<0.02	<2	0.30	0.321
NK11-021 F2NS	Vegetation	0.14	5.79	<0.01	47.2	6	2.4	0.23	800	0.007	<0.1	<0.01	0.8	<0.01	14.8	0.25	<0.02	<0.02	<2	0.31	0.240
NK11-021 OAK	Vegetation	0.05	6.83	<0.01	23.3	5	1.0	0.09	2108	0.006	0.1	<0.01	0.4	<0.01	12.4	0.05	0.02	<0.02	<2	0.51	0.259
NK11-022 F2	Vegetation	0.28	8.48	<0.01	35.1	7	0.7	0.06	121	0.009	<0.1	<0.01	1.3	<0.01	12.2	0.04	<0.02	<0.02	<2	0.55	0.295
NK11-022 HZL	Vegetation	0.14	11.25	0.08	26.2	5	3.2	0.40	945	0.012	0.2	<0.01	0.7	<0.01	32.1	0.02	0.03	<0.02	<2	1.50	0.265

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
Unit		ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK11-001 FS2	Vegetation	15.99	1.0	0.350	101.0	11	15	0.02	0.006	2.30	<0.1	<0.1	<0.02	0.14	31	<0.1	<0.02	<0.1	0.066	<0.01	<0.001
NK11-002 F2	Vegetation	10.40	1.1	0.398	72.8	12	14	0.01	0.012	2.58	<0.1	<0.1	<0.02	0.16	23	0.2	<0.02	<0.1	0.082	0.02	0.002
NK11-003 F2S	Vegetation	5.83	1.1	0.301	51.1	11	13	0.02	0.005	2.04	<0.1	<0.1	<0.02	0.26	29	<0.1	0.04	<0.1	0.354	<0.01	0.001
NK11-004 F2S	Vegetation	11.90	0.9	0.358	54.6	10	10	0.02	0.006	1.68	<0.1	<0.1	<0.02	0.19	17	0.1	0.04	<0.1	0.053	0.02	<0.001
NK11-005 FS2	Vegetation	11.54	1.1	0.318	92.6	8	11	0.01	0.006	1.20	<0.1	0.1	<0.02	0.18	15	<0.1	<0.02	<0.1	0.656	<0.01	0.004
NK11-006 F3_WASH	Vegetation	1.68	1.2	0.257	287.4	7	7	<0.01	0.006	1.39	<0.1	<0.1	<0.02	0.14	15	0.2	<0.02	<0.1	0.817	<0.01	0.002
NK11-006 F3	Vegetation	1.92	1.0	0.262	303.5	8	9	<0.01	0.004	1.47	<0.1	0.2	<0.02	0.15	22	<0.1	<0.02	<0.1	0.785	0.02	0.001
NK11-007 FS2	Vegetation	3.31	1.0	0.331	57.1	7	9	0.03	0.004	1.51	<0.1	0.1	<0.02	0.19	18	0.2	<0.02	<0.1	1.317	<0.01	<0.001
NK11-008 FS2	Vegetation	9.83	1.2	0.229	72.0	9	9	0.04	0.003	1.26	<0.1	<0.1	<0.02	0.23	15	<0.1	<0.02	<0.1	3.817	0.01	<0.001
NK11-009 FS1	Vegetation	19.24	1.2	0.263	107.8	11	17	<0.01	0.011	2.29	<0.1	0.3	<0.02	0.21	15	0.2	<0.02	<0.1	0.131	0.04	<0.001
NK11-009X SF-2 STD.	Rock Pulp	10.27	1.5	0.260	34.1	14	16	0.06	0.022	1.84	<0.1	0.1	<0.02	0.22	50	0.2	<0.02	<0.1	0.032	0.07	0.005
NK11-010 F3	Vegetation	1.65	1.2	0.252	89.0	13	10	<0.01	0.003	2.43	<0.1	0.2	<0.02	0.21	13	<0.1	<0.02	<0.1	2.537	0.02	<0.001
NK11-011 F3	Vegetation	1.91	1.2	0.231	90.0	13	9	<0.01	0.004	2.52	<0.1	0.3	<0.02	0.20	7	<0.1	<0.02	<0.1	2.116	0.04	<0.001
NK11-012 FS2	Vegetation	2.60	1.1	0.472	81.5	9	9	0.06	0.005	1.69	<0.1	0.1	0.02	0.19	18	0.2	<0.02	<0.1	2.109	<0.01	<0.001
NK11-012 BIRCH	Vegetation	0.03	1.5	0.202	90.1	8	10	<0.01	0.003	1.07	<0.1	0.1	<0.02	0.16	11	0.4	<0.02	<0.1	0.351	<0.01	<0.001
NK11-013 F2S	Vegetation	3.98	1.3	0.214	15.6	10	9	<0.01	0.009	1.87	<0.1	0.1	<0.02	0.32	13	<0.1	<0.02	<0.1	0.028	0.03	<0.001
NK11-014 F2S A	Vegetation	5.30	1.3	0.234	47.5	9	11	<0.01	0.005	1.74	<0.1	<0.1	<0.02	0.22	12	0.3	<0.02	<0.1	0.218	<0.01	<0.001
NK11-014 FERN 2 B	Vegetation	4.67	1.2	0.265	45.3	8	10	0.01	0.005	1.48	<0.1	<0.1	<0.02	0.18	18	<0.1	<0.02	<0.1	0.030	<0.01	0.004
NK11-016 F2S	Vegetation	5.45	1.3	0.307	84.8	10	10	0.02	0.009	2.61	<0.1	0.1	<0.02	0.22	20	0.3	<0.02	<0.1	0.757	<0.01	0.006
NK11-017 FS2	Vegetation	2.90	1.2	0.266	48.4	12	10	0.04	0.005	1.61	<0.1	<0.1	<0.02	0.22	16	<0.1	<0.02	<0.1	0.807	<0.01	0.004
NK11-018 F3 NS	Vegetation	5.12	1.2	0.206	273.7	8	7	<0.01	0.004	1.52	<0.1	0.2	<0.02	0.14	14	0.2	<0.02	<0.1	0.233	<0.01	<0.001
NK11-018X SF-2 STD.	Rock Pulp	10.25	1.6	0.255	32.9	14	15	0.06	0.021	1.82	<0.1	0.2	<0.02	0.21	44	0.3	<0.02	<0.1	0.030	<0.01	<0.001
NK11-018 OAK	Vegetation	0.20	1.1	0.217	81.3	7	12	<0.01	0.008	1.26	<0.1	0.1	<0.02	0.16	11	0.2	<0.02	<0.1	0.134	<0.01	<0.001
NK11-018 BIRCH	Vegetation	0.15	1.1	0.268	122.4	7	13	<0.01	0.004	0.74	<0.1	<0.1	<0.02	0.12	8	0.3	<0.02	<0.1	0.035	<0.01	0.002
NK11-019 F2S	Vegetation	6.28	1.3	0.242	23.4	9	9	<0.01	0.004	1.50	<0.1	<0.1	<0.02	0.20	12	0.1	<0.02	<0.1	0.247	<0.01	<0.001
NK11-020 F3	Vegetation	5.14	1.4	0.228	260.0	11	9	<0.01	0.004	2.21	<0.1	0.2	<0.02	0.20	11	0.1	<0.02	<0.1	1.238	<0.01	<0.001
NK11-021 F2NS	Vegetation	2.67	1.0	0.300	52.8	9	10	0.02	0.006	1.87	<0.1	0.1	<0.02	0.20	16	<0.1	<0.02	<0.1	3.908	<0.01	<0.001
NK11-021 OAK	Vegetation	0.06	1.0	0.196	22.7	9	13	<0.01	0.002	1.03	<0.1	<0.1	<0.02	0.17	8	0.3	<0.02	<0.1	0.703	<0.01	<0.001
NK11-022 F2	Vegetation	9.39	1.5	0.315	80.8	11	10	<0.01	0.006	1.59	<0.1	<0.1	0.02	0.27	14	0.2	<0.02	<0.1	0.843	<0.01	<0.001
NK11-022 HZL	Vegetation	0.43	1.1	0.306	55.7	10	11	<0.01	0.003	0.97	<0.1	<0.1	<0.02	0.20	8	0.2	0.03	<0.1	0.452	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK11-001 FS2	Vegetation	<0.01	70.4	0.04	0.002	0.04	0.309	21.85	<0.02	<1	<0.1	0.12	2.11	4.96	0.34	0.04	0.06	0.02	0.07	0.02	0.04
NK11-002 F2	Vegetation	<0.01	31.4	<0.02	<0.001	0.02	0.652	10.89	<0.02	<1	<0.1	0.12	1.34	3.28	0.31	0.05	0.13	0.03	0.08	<0.02	0.05
NK11-003 F2S	Vegetation	<0.01	143.6	0.02	<0.001	0.01	0.156	11.17	<0.02	<1	<0.1	0.06	0.79	1.81	0.14	<0.02	<0.02	<0.02	0.02	<0.02	0.02
NK11-004 F2S	Vegetation	<0.01	55.8	0.08	0.002	0.03	0.643	20.26	<0.02	<1	<0.1	0.17	2.12	5.33	0.51	0.04	0.25	0.04	0.09	0.02	0.06
NK11-005 FS2	Vegetation	<0.01	79.6	0.02	<0.001	0.03	0.934	14.52	<0.02	<1	<0.1	0.07	1.71	3.94	0.37	0.02	0.17	0.03	0.11	0.03	0.06
NK11-006 F3_WASH	Vegetation	<0.01	123.9	0.04	<0.001	0.01	0.065	4.25	<0.02	3	<0.1	0.05	0.20	0.62	0.04	<0.02	0.05	<0.02	<0.02	<0.02	<0.02
NK11-006 F3	Vegetation	<0.01	136.1	<0.02	0.001	<0.01	0.086	4.66	<0.02	2	<0.1	0.06	0.22	0.66	0.05	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
NK11-007 FS2	Vegetation	<0.01	133.6	<0.02	<0.001	0.02	0.573	6.55	<0.02	<1	<0.1	0.03	0.55	1.33	0.14	0.02	0.08	<0.02	0.08	<0.02	0.05
NK11-008 FS2	Vegetation	<0.01	200.1	<0.02	<0.001	0.02	4.517	20.45	<0.02	<1	<0.1	0.08	1.83	5.24	0.80	0.08	0.56	0.11	0.58	0.14	0.32
NK11-009 FS1	Vegetation	<0.01	47.8	0.02	0.002	0.02	0.988	29.00	<0.02	<1	<0.1	0.06	2.27	6.19	0.67	0.04	0.23	0.04	0.11	0.03	0.08
NK11-009X SF-2 STD.	Rock Pulp	<0.01	19.5	0.02	0.002	0.04	4.047	9.81	<0.02	<1	0.1	0.03	1.84	6.70	0.93	0.33	0.92	0.12	0.42	0.10	0.18
NK11-010 F3	Vegetation	<0.01	261.4	<0.02	<0.001	<0.01	0.053	2.22	<0.02	<1	<0.1	0.06	0.17	0.45	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
NK11-011 F3	Vegetation	<0.01	264.9	<0.02	0.001	0.02	0.087	2.60	<0.02	<1	<0.1	0.02	0.19	0.41	0.04	<0.02	0.05	<0.02	0.02	<0.02	<0.02
NK11-012 FS2	Vegetation	<0.01	233.1	<0.02	<0.001	0.02	0.471	3.57	<0.02	<1	0.3	0.25	0.28	0.80	0.07	<0.02	0.07	<0.02	0.05	<0.02	0.04
NK11-012 BIRCH	Vegetation	<0.01	112.8	0.06	<0.001	<0.01	0.016	0.04	<0.02	<1	<0.1	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-013 F2S	Vegetation	<0.01	18.3	<0.02	<0.001	0.10	0.509	2.19	<0.02	<1	<0.1	0.06	0.59	1.82	0.23	0.02	0.11	0.03	0.08	<0.02	<0.02
NK11-014 F2S A	Vegetation	<0.01	74.4	0.02	<0.001	0.03	0.433	7.39	<0.02	1	<0.1	0.18	0.93	2.19	0.18	<0.02	0.04	<0.02	0.05	<0.02	0.03
NK11-014 FERN 2 B	Vegetation	<0.01	36.3	<0.02	<0.001	0.37	0.432	6.26	<0.02	<1	<0.1	0.15	0.69	1.61	0.11	<0.02	0.04	<0.02	<0.02	<0.02	0.03
NK11-016 F2S	Vegetation	0.01	164.0	0.02	0.001	0.10	1.312	7.86	<0.02	<1	<0.1	0.14	0.87	2.67	0.25	<0.02	0.20	0.04	0.14	0.04	0.12
NK11-017 FS2	Vegetation	<0.01	212.7	0.03	<0.001	0.04	0.132	5.45	<0.02	1	<0.1	0.07	0.44	0.86	0.08	<0.02	0.03	<0.02	<0.02	<0.02	0.02
NK11-018 F3 NS	Vegetation	<0.01	114.6	<0.02	<0.001	0.03	0.242	6.37	<0.02	1	<0.1	0.06	0.54	1.49	0.15	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
NK11-018X SF-2 STD.	Rock Pulp	<0.01	19.3	<0.02	<0.001	0.05	4.023	9.88	<0.02	<1	<0.1	0.09	1.88	6.25	1.08	0.30	0.84	0.14	0.53	0.12	0.21
NK11-018 OAK	Vegetation	<0.01	36.7	0.03	<0.001	0.03	0.059	0.24	<0.02	<1	<0.1	0.05	0.02	0.11	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
NK11-018 BIRCH	Vegetation	<0.01	20.7	0.05	0.001	0.03	0.117	0.21	<0.02	<1	<0.1	0.02	0.03	0.08	0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
NK11-019 F2S	Vegetation	<0.01	85.0	<0.02	<0.001	0.03	0.583	7.46	<0.02	<1	<0.1	0.11	1.04	2.97	0.22	0.03	0.07	<0.02	0.06	0.02	0.04
NK11-020 F3	Vegetation	<0.01	228.5	<0.02	<0.001	0.03	0.119	9.73	<0.02	<1	<0.1	0.04	0.62	1.45	0.07	<0.02	0.04	<0.02	0.02	<0.02	<0.02
NK11-021 F2NS	Vegetation	<0.01	327.5	0.04	<0.001	0.04	0.100	4.02	<0.02	<1	<0.1	0.14	0.32	0.78	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-021 OAK	Vegetation	<0.01	134.0	<0.02	<0.001	0.02	0.021	0.09	<0.02	<1	<0.1	0.03	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-022 F2	Vegetation	<0.01	221.1	<0.02	<0.001	<0.01	0.149	8.85	<0.02	<1	<0.1	0.06	1.23	2.96	0.20	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
NK11-022 HZL	Vegetation	<0.01	84.3	0.04	<0.001	0.03	0.193	0.62	<0.02	<1	<0.1	0.06	0.04	0.19	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE
Analyte		Tm	Yb	Lu	Pd	Pt
Unit		ppm	ppm	ppm	ppb	ppb
MDL		0.02	0.02	0.02	2	1
NK11-001 FS2	Vegetation	<0.02	0.03	<0.02	5	<1
NK11-002 F2	Vegetation	<0.02	0.03	<0.02	7	<1
NK11-003 F2S	Vegetation	<0.02	<0.02	<0.02	9	<1
NK11-004 F2S	Vegetation	<0.02	0.02	<0.02	6	<1
NK11-005 FS2	Vegetation	<0.02	0.03	<0.02	2	<1
NK11-006 F3_WASH	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-006 F3	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK11-007 FS2	Vegetation	<0.02	0.04	<0.02	7	<1
NK11-008 FS2	Vegetation	0.05	0.22	0.02	9	<1
NK11-009 FS1	Vegetation	<0.02	0.04	<0.02	5	<1
NK11-009X SF-2 STD.	Rock Pulp	<0.02	0.10	<0.02	3	<1
NK11-010 F3	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-011 F3	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-012 FS2	Vegetation	<0.02	0.03	<0.02	13	<1
NK11-012 BIRCH	Vegetation	<0.02	<0.02	<0.02	36	<1
NK11-013 F2S	Vegetation	<0.02	0.03	<0.02	5	<1
NK11-014 F2S A	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-014 FERN 2 B	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK11-016 F2S	Vegetation	<0.02	0.07	<0.02	6	<1
NK11-017 FS2	Vegetation	<0.02	<0.02	<0.02	7	<1
NK11-018 F3 NS	Vegetation	<0.02	<0.02	<0.02	4	<1
NK11-018X SF-2 STD.	Rock Pulp	<0.02	0.12	<0.02	5	<1
NK11-018 OAK	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-018 BIRCH	Vegetation	<0.02	<0.02	<0.02	32	<1
NK11-019 F2S	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-020 F3	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-021 F2NS	Vegetation	<0.02	<0.02	<0.02	7	<1
NK11-021 OAK	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-022 F2	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-022 HZL	Vegetation	<0.02	<0.02	<0.02	5	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
Unit		ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
MDL		0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK11-023 F1	Vegetation	0.17	12.44	<0.01	25.4	9	1.9	0.03	102	0.008	0.2	<0.01	1.0	<0.01	11.1	0.43	<0.02	<0.02	<2	0.46	0.371
NK11-024 FS1	Vegetation	0.24	10.20	<0.01	21.2	4	0.4	0.05	103	0.009	<0.1	<0.01	0.2	<0.01	17.7	0.51	<0.02	<0.02	<2	0.83	0.184
NK11-024X SF-2 STD.	Rock Pulp	0.51	8.63	<0.01	26.5	2	0.5	0.04	83	0.011	<0.1	<0.01	1.3	<0.01	23.3	0.10	<0.02	<0.02	<2	0.38	0.276
NK11-026 F3_WASH	Vegetation	0.19	4.89	<0.01	24.9	14	0.6	0.07	137	0.005	0.1	<0.01	0.5	<0.01	31.1	<0.01	<0.02	<0.02	<2	0.22	0.179
NK11-026 F3	Vegetation	0.19	5.54	<0.01	30.2	19	0.7	0.11	165	0.007	0.2	<0.01	0.6	<0.01	28.0	<0.01	<0.02	<0.02	<2	0.24	0.189
NK11-027 F2S	Vegetation	0.07	5.21	0.40	40.6	3	1.1	0.30	508	0.007	0.1	<0.01	<0.2	<0.01	22.6	0.14	<0.02	<0.02	<2	0.45	0.264
NK11-028 FS2	Vegetation	0.07	9.94	0.39	39.9	6	1.0	0.06	182	0.008	<0.1	<0.01	<0.2	<0.01	18.8	0.14	<0.02	<0.02	<2	0.53	0.275
NK11-029 FS2	Vegetation	0.08	5.90	0.27	47.1	6	2.4	0.03	137	0.011	<0.1	<0.01	<0.2	0.02	22.4	0.08	<0.02	<0.02	<2	0.39	0.438
NK11-030 FS2	Vegetation	0.10	9.28	0.28	62.7	<2	0.8	0.25	293	0.011	0.3	<0.01	<0.2	<0.01	22.5	0.08	<0.02	<0.02	<2	0.55	0.307
NK11-031 F2	Vegetation	0.12	9.14	0.21	61.3	3	0.9	0.32	295	0.010	<0.1	<0.01	<0.2	<0.01	21.2	0.10	0.13	<0.02	<2	0.52	0.309
NK11-032 F1	Vegetation	0.14	13.07	0.35	31.9	13	0.7	0.06	91	0.010	0.2	<0.01	<0.2	<0.01	12.7	0.18	0.03	<0.02	<2	0.47	0.309
NK11-032 F2S	Vegetation	0.07	12.74	0.37	34.4	5	1.1	0.11	102	0.009	<0.1	<0.01	0.3	<0.01	13.2	0.12	0.04	<0.02	<2	0.34	0.324
NK11-033 FS1	Vegetation	0.41	13.79	0.26	22.4	4	0.3	0.03	82	0.012	<0.1	<0.01	0.5	<0.01	16.3	0.63	0.03	<0.02	<2	0.69	0.250
NK11-033X SF-2 STD.	Rock Pulp	0.52	9.99	0.30	28.6	3	0.4	0.10	85	0.021	0.2	0.01	0.8	<0.01	22.5	0.09	<0.02	<0.02	<2	0.38	0.289
NK11-034 FS2	Vegetation	0.13	7.17	0.27	33.1	4	1.1	0.07	100	0.008	<0.1	<0.01	1.1	<0.01	25.4	0.10	<0.02	<0.02	<2	0.43	0.241
NK11-035 FS1	Vegetation	0.24	7.83	0.21	28.3	<2	0.6	0.07	211	0.008	0.2	<0.01	<0.2	<0.01	11.6	0.23	<0.02	<0.02	<2	0.41	0.195
NK11-035 OAK	Vegetation	0.10	10.73	0.19	18.3	15	1.0	0.09	655	0.017	0.2	<0.01	<0.2	<0.01	12.4	0.02	<0.02	<0.02	<2	0.67	0.199
NK11-035 BIRCH	Vegetation	0.13	7.48	0.34	389.8	<2	1.4	0.79	2352	0.009	0.2	<0.01	0.3	<0.01	38.1	1.35	0.05	<0.02	<2	0.76	0.266
NK11-036 FS2	Vegetation	0.10	5.82	0.35	44.8	4	1.5	0.13	202	0.007	<0.1	<0.01	0.2	<0.01	15.2	0.06	<0.02	<0.02	<2	0.32	0.200
NK11-036 OAK	Vegetation	0.06	7.91	0.20	19.2	14	0.8	0.10	790	0.007	0.2	<0.01	<0.2	<0.01	12.8	0.05	0.03	<0.02	<2	0.40	0.257
NK11-036 BIRCH	Vegetation	0.03	5.30	0.13	139.5	3	2.6	0.19	1140	0.007	0.2	<0.01	0.6	<0.01	28.1	0.36	<0.02	<0.02	<2	0.69	0.233
NK11-037 FS2	Vegetation	0.25	8.16	0.13	34.0	3	0.7	0.01	66	0.006	<0.1	<0.01	<0.2	<0.01	25.7	0.13	<0.02	<0.02	<2	0.63	0.269
NK11-037 ASH	Vegetation	0.12	6.51	0.20	15.9	<2	0.7	0.04	325	0.009	<0.1	<0.01	0.3	<0.01	44.2	0.16	0.07	<0.02	<2	1.20	0.239
NK11-037N FS2	Vegetation	0.13	6.74	0.24	32.1	6	0.9	0.03	77	0.006	<0.1	<0.01	<0.2	<0.01	20.2	0.05	<0.02	<0.02	<2	0.47	0.260
NK11-037X SF-2 STD.	Rock Pulp	0.54	9.11	0.21	28.8	<2	0.6	0.07	82	0.013	0.2	<0.01	0.3	<0.01	23.6	0.10	<0.02	<0.02	<2	0.39	0.276
NK11-038 FS2	Vegetation	0.13	6.94	0.24	62.9	4	0.9	0.03	129	0.007	0.1	<0.01	<0.2	<0.01	16.8	0.07	<0.02	<0.02	<2	0.42	0.247
NK11-038 BIRCH	Vegetation	0.06	7.49	0.22	160.2	<2	2.5	0.28	943	0.007	<0.1	<0.01	<0.2	<0.01	22.8	0.72	<0.02	<0.02	<2	0.51	0.242
NK11-038N FS2	Vegetation	0.15	4.99	0.32	35.6	2	1.6	0.17	156	0.007	<0.1	<0.01	<0.2	<0.01	18.4	0.10	<0.02	<0.02	<2	0.37	0.243
NK11-038N F3 BRACK	Vegetation	0.08	6.27	0.10	30.3	9	0.9	0.02	117	0.005	0.1	<0.01	<0.2	<0.01	20.1	0.23	<0.02	<0.02	<2	0.18	0.282
NK11-039 FS2	Vegetation	0.21	7.73	1.68	69.5	2	0.6	0.03	151	0.008	<0.1	<0.01	0.3	<0.01	14.3	0.08	<0.02	<0.02	<2	0.38	0.223

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK11-023 F1	Vegetation	36.78	1.1	0.412	130.0	13	16	<0.01	0.026	2.78	<0.1	0.1	0.11	0.31	15	0.2	<0.02	<0.1	0.266	0.03	<0.001
NK11-024 FS1	Vegetation	21.26	1.2	0.388	209.3	7	11	<0.01	0.028	2.68	<0.1	<0.1	<0.02	0.20	12	0.4	<0.02	<0.1	0.171	<0.01	<0.001
NK11-024X SF-2 STD.	Rock Pulp	9.91	1.4	0.255	30.7	13	15	0.06	0.021	1.83	<0.1	<0.1	<0.02	0.22	39	<0.1	<0.02	<0.1	0.030	<0.01	0.001
NK11-026 F3_WASH	Vegetation	1.94	1.2	0.211	207.0	6	8	<0.01	0.006	1.62	<0.1	<0.1	<0.02	0.12	7	0.2	<0.02	<0.1	1.395	<0.01	0.003
NK11-026 F3	Vegetation	3.74	1.2	0.231	166.2	7	8	<0.01	0.015	1.83	<0.1	0.2	<0.02	0.14	13	0.2	<0.02	<0.1	1.180	<0.01	<0.001
NK11-027 F2S	Vegetation	3.29	0.8	0.374	47.7	9	9	0.02	0.008	2.04	<0.1	<0.1	<0.02	0.19	21	0.1	<0.02	<0.1	0.878	0.03	<0.001
NK11-028 FS2	Vegetation	6.58	1.2	0.345	51.6	10	11	0.02	0.006	2.07	<0.1	<0.1	0.02	0.24	22	0.1	<0.02	<0.1	0.861	0.07	<0.001
NK11-029 FS2	Vegetation	9.06	1.1	0.390	103.3	15	12	0.03	0.015	2.47	<0.1	0.1	<0.02	0.30	29	0.2	<0.02	<0.1	0.494	0.02	<0.001
NK11-030 FS2	Vegetation	6.02	1.2	0.385	61.4	11	11	0.02	0.007	2.19	<0.1	0.1	<0.02	0.25	23	0.3	<0.02	<0.1	0.175	0.05	<0.001
NK11-031 F2	Vegetation	4.99	1.4	0.370	56.3	12	10	0.02	0.016	2.26	<0.1	0.2	<0.02	0.26	21	0.2	<0.02	<0.1	0.191	<0.01	<0.001
NK11-032 F1	Vegetation	32.10	1.4	0.388	128.4	11	11	<0.01	0.007	2.98	<0.1	0.2	0.05	0.25	18	<0.1	<0.02	<0.1	0.360	0.03	<0.001
NK11-032 F2S	Vegetation	10.73	1.4	0.296	17.8	11	10	0.02	0.003	1.93	<0.1	<0.1	<0.02	0.29	19	<0.1	<0.02	<0.1	0.331	0.04	<0.001
NK11-033 FS1	Vegetation	41.50	1.6	0.604	176.5	9	17	<0.01	0.062	3.14	<0.1	0.1	0.04	0.34	28	0.1	<0.02	<0.1	0.258	0.04	<0.001
NK11-033X SF-2 STD.	Rock Pulp	9.97	1.9	0.270	30.5	23	15	0.06	0.021	1.78	<0.1	0.2	<0.02	0.22	41	0.2	<0.02	<0.1	0.032	0.03	<0.001
NK11-034 FS2	Vegetation	4.55	1.4	0.271	45.6	8	11	0.02	0.003	1.85	<0.1	0.3	<0.02	0.29	18	0.3	<0.02	<0.1	0.290	0.04	<0.001
NK11-035 FS1	Vegetation	12.54	1.4	0.358	79.9	7	15	<0.01	0.003	1.72	<0.1	0.2	0.06	0.19	18	0.3	<0.02	<0.1	0.720	0.08	<0.001
NK11-035 OAK	Vegetation	0.11	1.2	0.179	105.2	8	14	<0.01	0.006	0.81	<0.1	0.2	0.02	0.18	12	0.2	<0.02	<0.1	0.153	0.03	<0.001
NK11-035 BIRCH	Vegetation	0.04	1.2	0.402	148.9	11	19	<0.01	0.003	0.70	<0.1	0.2	<0.02	0.20	8	0.4	<0.02	<0.1	0.128	<0.01	<0.001
NK11-036 FS2	Vegetation	9.48	1.2	0.294	66.8	7	8	0.06	0.006	1.56	<0.1	0.2	<0.02	0.19	19	0.3	<0.02	<0.1	0.114	0.04	<0.001
NK11-036 OAK	Vegetation	0.18	1.0	0.133	23.5	9	7	<0.01	0.004	1.26	<0.1	0.2	0.04	0.20	9	0.2	<0.02	<0.1	0.055	0.02	<0.001
NK11-036 BIRCH	Vegetation	0.04	1.2	0.323	73.8	8	16	<0.01	0.007	0.57	<0.1	0.2	<0.02	0.19	12	0.2	<0.02	<0.1	0.054	<0.01	<0.001
NK11-037 FS2	Vegetation	11.97	1.4	0.312	62.5	9	11	0.01	0.004	1.68	<0.1	0.2	<0.02	0.24	15	0.3	<0.02	<0.1	0.056	0.01	<0.001
NK11-037 ASH	Vegetation	0.63	1.4	0.265	76.2	11	17	<0.01	0.008	1.26	<0.1	0.2	<0.02	0.15	16	0.1	<0.02	<0.1	0.022	<0.01	<0.001
NK11-037N FS2	Vegetation	9.11	1.6	0.285	62.7	10	13	0.03	0.004	1.98	<0.1	0.3	<0.02	0.26	17	0.2	<0.02	<0.1	0.227	<0.01	<0.001
NK11-037X SF-2 STD.	Rock Pulp	10.50	1.7	0.261	31.4	13	16	0.06	0.022	1.81	<0.1	0.1	<0.02	0.24	41	0.3	<0.02	<0.1	0.031	0.04	0.001
NK11-038 FS2	Vegetation	14.84	1.2	0.296	97.8	8	14	0.03	0.004	1.42	<0.1	0.1	<0.02	0.24	11	0.2	<0.02	<0.1	0.104	0.06	0.003
NK11-038 BIRCH	Vegetation	<0.01	1.0	0.336	64.9	9	11	<0.01	0.004	0.85	<0.1	0.2	<0.02	0.22	8	0.1	<0.02	<0.1	0.043	0.02	<0.001
NK11-038N FS2	Vegetation	9.98	1.3	0.292	73.5	10	13	0.03	0.010	1.83	<0.1	0.2	<0.02	0.19	20	0.3	<0.02	<0.1	0.138	0.04	0.001
NK11-038N F3 BRACK	Vegetation	1.61	1.5	0.167	144.1	9	7	<0.01	0.003	1.84	<0.1	0.2	<0.02	0.19	4	0.3	<0.02	<0.1	0.043	0.01	<0.001
NK11-039 FS2	Vegetation	13.93	1.4	0.274	54.6	8	12	0.04	0.007	1.69	<0.1	0.2	<0.02	0.22	17	0.2	<0.02	<0.1	0.738	0.07	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK11-023 F1	Vegetation	<0.01	157.3	<0.02	<0.001	0.02	1.403	51.49	<0.02	1	<0.1	0.05	5.64	15.43	1.36	0.16	0.41	0.07	0.13	<0.02	0.09
NK11-024 FS1	Vegetation	<0.01	114.9	<0.02	<0.001	0.02	1.600	18.73	<0.02	<1	<0.1	0.03	3.58	10.83	1.19	0.09	0.44	0.07	0.23	0.03	0.05
NK11-024X SF-2 STD.	Rock Pulp	<0.01	18.9	0.03	0.001	0.04	3.919	9.59	<0.02	<1	<0.1	0.06	1.82	6.09	0.87	0.30	0.86	0.13	0.41	0.08	0.16
NK11-026 F3_WASH	Vegetation	<0.01	178.4	<0.02	<0.001	<0.01	0.029	2.57	<0.02	<1	<0.1	0.11	0.19	0.44	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-026 F3	Vegetation	<0.01	161.7	<0.02	<0.001	<0.01	0.046	4.78	<0.02	<1	<0.1	0.09	0.36	0.74	0.08	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-027 F2S	Vegetation	<0.01	255.3	<0.02	<0.001	0.02	0.159	4.70	<0.02	<1	<0.1	0.23	0.43	0.83	0.09	<0.02	0.08	<0.02	0.03	<0.02	<0.02
NK11-028 FS2	Vegetation	<0.01	150.3	<0.02	<0.001	0.03	0.281	8.94	<0.02	<1	<0.1	0.08	0.94	2.01	0.21	0.03	0.06	<0.02	0.05	<0.02	0.02
NK11-029 FS2	Vegetation	<0.01	227.9	0.02	<0.001	0.02	0.605	16.30	<0.02	<1	<0.1	0.06	1.39	3.36	0.37	0.05	0.28	0.03	0.10	0.02	0.04
NK11-030 FS2	Vegetation	<0.01	78.2	<0.02	<0.001	0.02	0.269	9.51	<0.02	<1	0.1	0.13	0.97	2.30	0.23	0.05	0.10	<0.02	0.04	<0.02	<0.02
NK11-031 F2	Vegetation	<0.01	74.9	0.12	<0.001	0.05	0.199	8.61	<0.02	<1	<0.1	0.16	0.81	1.94	0.22	0.03	0.03	<0.02	0.03	<0.02	0.02
NK11-032 F1	Vegetation	<0.01	180.9	0.02	<0.001	0.03	1.095	50.87	<0.02	<1	<0.1	0.09	4.81	11.82	1.26	0.14	0.59	0.07	0.24	0.03	0.06
NK11-032 F2S	Vegetation	<0.01	145.3	0.05	<0.001	0.02	1.959	15.53	<0.02	<1	0.2	0.07	1.78	4.29	0.53	0.04	0.44	0.06	0.24	0.06	0.11
NK11-033 FS1	Vegetation	<0.01	49.4	<0.02	0.002	0.05	2.918	25.26	<0.02	<1	<0.1	0.13	6.46	20.18	2.45	0.22	0.88	0.10	0.30	0.06	0.15
NK11-033X SF-2 STD.	Rock Pulp	0.03	19.4	0.05	0.001	0.07	3.977	9.66	<0.02	<1	<0.1	0.13	1.95	6.21	0.98	0.30	0.81	0.12	0.46	0.11	0.21
NK11-034 FS2	Vegetation	<0.01	156.7	<0.02	<0.001	0.03	0.329	7.96	<0.02	<1	0.2	0.07	0.64	1.57	0.12	<0.02	0.06	<0.02	0.03	<0.02	0.02
NK11-035 FS1	Vegetation	<0.01	97.0	<0.02	<0.001	0.02	0.271	19.71	<0.02	<1	<0.1	0.07	1.78	4.35	0.39	0.04	0.13	<0.02	0.03	<0.02	0.03
NK11-035 OAK	Vegetation	<0.01	32.3	<0.02	<0.001	0.02	0.038	0.16	<0.02	<1	<0.1	0.10	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-035 BIRCH	Vegetation	<0.01	32.5	0.05	<0.001	0.04	0.020	0.09	<0.02	<1	<0.1	<0.01	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-036 FS2	Vegetation	<0.01	81.2	0.04	<0.001	0.04	1.775	19.58	<0.02	<1	<0.1	0.13	1.46	3.58	0.43	0.05	0.26	0.05	0.15	0.04	0.09
NK11-036 OAK	Vegetation	<0.01	51.7	0.02	<0.001	0.02	0.163	0.22	<0.02	<1	<0.1	0.02	0.03	0.13	<0.02	<0.02	0.02	<0.02	0.03	<0.02	<0.02
NK11-036 BIRCH	Vegetation	<0.01	26.0	0.05	<0.001	0.02	0.037	0.09	<0.02	<1	<0.1	0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-037 FS2	Vegetation	<0.01	104.3	<0.02	<0.001	0.03	0.925	15.45	<0.02	<1	<0.1	0.04	1.74	4.17	0.49	0.04	0.23	0.04	0.10	0.02	0.03
NK11-037 ASH	Vegetation	<0.01	55.5	0.04	<0.001	0.06	0.301	0.56	<0.02	<1	<0.1	0.03	0.07	0.23	0.03	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
NK11-037N FS2	Vegetation	<0.01	140.3	<0.02	<0.001	0.02	1.470	13.00	<0.02	<1	<0.1	0.06	1.42	3.56	0.41	0.05	0.19	0.04	0.20	0.04	0.07
NK11-037X SF-2 STD.	Rock Pulp	<0.01	19.6	0.04	<0.001	0.04	4.136	10.21	<0.02	<1	<0.1	0.02	1.98	6.55	0.98	0.31	0.82	0.11	0.53	0.09	0.19
NK11-038 FS2	Vegetation	<0.01	97.1	<0.02	<0.001	<0.01	2.568	26.67	<0.02	<1	<0.1	0.03	2.47	6.46	0.81	0.07	0.42	0.06	0.27	0.06	0.13
NK11-038 BIRCH	Vegetation	0.01	71.3	0.04	<0.001	0.09	0.037	<0.01	<0.02	<1	<0.1	0.01	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-038N FS2	Vegetation	<0.01	76.8	<0.02	<0.001	0.04	0.864	18.85	<0.02	<1	<0.1	0.08	1.28	3.12	0.29	0.06	0.14	0.03	0.10	0.02	0.05
NK11-038N F3 BRACK	Vegetation	<0.01	86.6	<0.02	<0.001	<0.01	0.151	2.18	<0.02	<1	<0.1	0.04	0.17	0.52	0.04	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
NK11-039 FS2	Vegetation	<0.01	150.2	<0.02	<0.001	0.15	3.533	27.56	<0.02	<1	<0.1	0.11	2.50	7.34	1.04	0.09	0.62	0.10	0.46	0.11	0.17

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE
Analyte		Tm	Yb	Lu	Pd	Pt
Unit		ppm	ppm	ppm	ppb	ppb
MDL		0.02	0.02	0.02	2	1
NK11-023 F1	Vegetation	<0.02	0.04	<0.02	4	<1
NK11-024 FS1	Vegetation	<0.02	0.05	<0.02	3	<1
NK11-024X SF-2 STD.	Rock Pulp	<0.02	0.10	<0.02	3	<1
NK11-026 F3_WASH	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-026 F3	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-027 F2S	Vegetation	<0.02	<0.02	<0.02	8	<1
NK11-028 FS2	Vegetation	<0.02	<0.02	<0.02	8	<1
NK11-029 FS2	Vegetation	<0.02	0.03	<0.02	10	<1
NK11-030 FS2	Vegetation	<0.02	<0.02	<0.02	12	<1
NK11-031 F2	Vegetation	<0.02	<0.02	<0.02	10	<1
NK11-032 F1	Vegetation	<0.02	0.02	<0.02	8	<1
NK11-032 F2S	Vegetation	<0.02	0.04	<0.02	5	<1
NK11-033 FS1	Vegetation	0.02	0.09	0.02	4	<1
NK11-033X SF-2 STD.	Rock Pulp	0.03	0.11	<0.02	4	<1
NK11-034 FS2	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-035 FS1	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-035 OAK	Vegetation	<0.02	<0.02	<0.02	4	<1
NK11-035 BIRCH	Vegetation	<0.02	<0.02	<0.02	68	<1
NK11-036 FS2	Vegetation	<0.02	0.08	<0.02	8	<1
NK11-036 OAK	Vegetation	<0.02	<0.02	<0.02	3	2
NK11-036 BIRCH	Vegetation	<0.02	<0.02	<0.02	25	<1
NK11-037 FS2	Vegetation	<0.02	<0.02	<0.02	4	<1
NK11-037 ASH	Vegetation	<0.02	<0.02	<0.02	2	<1
NK11-037N FS2	Vegetation	<0.02	0.03	<0.02	5	<1
NK11-037X SF-2 STD.	Rock Pulp	0.03	0.09	<0.02	4	<1
NK11-038 FS2	Vegetation	0.03	0.05	<0.02	11	<1
NK11-038 BIRCH	Vegetation	<0.02	<0.02	<0.02	27	<1
NK11-038N FS2	Vegetation	<0.02	0.05	<0.02	5	<1
NK11-038N F3 BRACK	Vegetation	<0.02	<0.02	<0.02	4	<1
NK11-039 FS2	Vegetation	0.04	0.15	<0.02	11	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK11-039 BIRCH	Vegetation	0.05	6.69	0.28	208.5	5	1.9	0.06	1316	0.007	<0.1	<0.01	<0.2	<0.01	40.5	0.76	0.04	<0.02	<2	0.74	0.228
NK11-039N FS2	Vegetation	0.11	6.53	0.25	43.3	2	1.3	0.05	115	0.005	<0.1	<0.01	<0.2	<0.01	17.5	0.05	<0.02	<0.02	<2	0.40	0.246
NK11-040 FS2	Vegetation	0.05	6.99	0.19	39.6	2	0.9	0.11	284	0.007	0.1	<0.01	<0.2	<0.01	21.3	0.18	<0.02	<0.02	<2	0.41	0.239
NK11-040 OAK	Vegetation	0.06	8.21	0.10	22.8	19	0.4	0.02	301	0.005	<0.1	<0.01	<0.2	<0.01	9.9	0.07	0.02	<0.02	<2	0.51	0.281
NK11-040 MOSS	Vegetation	1.34	10.88	33.89	95.4	69	4.3	2.15	458	0.810	3.0	1.00	0.5	0.01	41.5	1.44	0.52	0.15	14	0.81	0.227
NK11-040X SF-2 STD.	Rock Pulp	0.51	9.14	0.16	26.9	<2	0.6	0.08	82	0.012	0.2	0.01	0.3	<0.01	22.9	0.08	<0.02	<0.02	<2	0.37	0.270
NK11-040N FS2	Vegetation	0.08	7.51	0.14	47.3	3	1.7	0.01	155	0.006	<0.1	<0.01	<0.2	<0.01	19.6	0.14	<0.02	<0.02	<2	0.39	0.225
NK11-040N OAK	Vegetation	0.03	10.18	0.10	30.5	18	0.8	0.02	1331	0.007	<0.1	<0.01	<0.2	<0.01	15.2	0.17	0.03	<0.02	<2	0.60	0.282
NK11-041 FS1	Vegetation	0.43	12.80	0.07	21.4	3	0.3	0.02	70	0.007	<0.1	<0.01	<0.2	<0.01	8.3	1.80	<0.02	<0.02	<2	0.41	0.198
NK11-042 FS2	Vegetation	0.17	6.57	0.08	63.2	6	1.0	0.04	257	0.007	<0.1	<0.01	<0.2	<0.01	11.5	0.07	<0.02	<0.02	<2	0.34	0.253
NK11-042 OAK	Vegetation	0.07	8.05	0.14	20.7	11	0.4	0.01	914	0.005	0.3	<0.01	0.3	<0.01	12.8	0.13	0.10	<0.02	<2	0.65	0.277
NK11-043 F3	Vegetation	0.12	5.55	0.10	21.7	8	0.5	0.03	52	0.004	0.2	<0.01	<0.2	<0.01	26.1	0.15	0.03	<0.02	<2	0.20	0.265
NK11-043 FS2	Vegetation	0.31	6.99	0.21	31.2	4	0.8	0.03	75	0.005	0.3	<0.01	<0.2	<0.01	22.5	0.05	<0.02	<0.02	<2	0.55	0.264
NK11-044 FS2 A	Vegetation	0.19	6.45	0.18	31.5	2	1.5	0.07	246	0.005	0.1	<0.01	<0.2	<0.01	16.2	0.11	<0.02	<0.02	<2	0.34	0.255
NK11-044 FS2 B	Vegetation	0.36	12.48	0.21	24.9	10	2.3	0.12	200	0.012	0.3	<0.01	3.1	<0.01	10.7	0.24	0.03	<0.02	<2	0.61	0.212
NK11-046 FS2	Vegetation	0.11	9.09	0.23	32.0	<2	0.6	0.02	117	0.009	0.2	<0.01	<0.2	<0.01	16.3	0.09	<0.02	<0.02	<2	0.56	0.283
NK11-046X SF-2 STD.	Rock Pulp	0.52	9.12	0.12	28.1	3	0.6	0.07	86	0.013	0.3	0.01	0.2	<0.01	23.1	0.09	<0.02	<0.02	<2	0.39	0.283
NK11-047 F1	Vegetation	0.24	10.20	0.02	22.4	3	0.6	0.06	150	0.006	0.2	<0.01	0.7	<0.01	10.9	0.29	<0.02	<0.02	<2	0.48	0.214
NK11-047 F2 IL	Vegetation	0.26	11.89	0.10	25.5	3	1.2	0.06	176	0.009	0.2	<0.01	0.5	<0.01	15.2	0.83	0.07	<0.02	<2	0.47	0.225
NK11-048 FS2	Vegetation	0.06	8.42	0.17	43.7	7	2.9	0.04	176	0.008	0.3	<0.01	0.4	<0.01	24.6	0.08	<0.02	<0.02	<2	0.43	0.300
NK11-049 FS2	Vegetation	0.10	10.00	0.21	69.4	3	1.5	0.36	573	0.007	0.3	<0.01	0.4	<0.01	16.9	0.44	<0.02	<0.02	<2	0.33	0.308
NK11-050 FS1	Vegetation	0.32	8.49	0.07	18.9	6	0.4	0.02	107	0.007	0.1	<0.01	0.6	<0.01	14.2	0.14	<0.02	<0.02	<2	0.48	0.171
NK11-051 FS1	Vegetation	0.09	10.14	0.08	20.4	6	0.5	0.03	56	0.007	<0.1	<0.01	0.3	<0.01	12.2	0.19	<0.02	<0.02	<2	0.41	0.175
NK11-052 FS1	Vegetation	0.21	9.02	0.03	25.1	4	0.5	0.04	77	0.011	0.2	<0.01	<0.2	<0.01	24.8	0.31	<0.02	<0.02	<2	0.55	0.187
NK11-053 F3 BRACKEN	Vegetation	0.16	7.95	0.13	26.7	7	1.0	0.13	77	0.005	0.1	<0.01	<0.2	<0.01	15.7	0.48	<0.02	<0.02	<2	0.22	0.244
NK11-053 ALDER	Vegetation	1.48	21.47	0.11	46.8	11	0.5	0.06	404	0.011	0.3	<0.01	<0.2	<0.01	10.6	0.02	0.04	<0.02	<2	0.70	0.274
NK11-054 FS1	Vegetation	0.72	9.73	0.10	25.1	5	0.4	0.03	69	0.012	0.3	0.02	<0.2	<0.01	11.8	0.36	<0.02	<0.02	<2	0.55	0.135
NK11-054X SF-2 STD.	Rock Pulp	0.49	8.80	0.12	26.7	3	0.6	0.07	80	0.012	0.4	<0.01	<0.2	<0.01	22.8	0.07	<0.02	<0.02	<2	0.40	0.273
NK11-055 FS1	Vegetation	0.80	10.24	0.03	21.1	6	1.5	0.02	51	0.007	0.4	<0.01	<0.2	<0.01	12.6	0.38	<0.02	<0.02	<2	0.41	0.160
NK11-056 FS2	Vegetation	0.58	7.24	0.10	40.5	7	0.4	0.02	58	0.006	0.3	<0.01	<0.2	<0.01	12.0	0.10	<0.02	<0.02	<2	0.52	0.172

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK11-039 BIRCH	Vegetation	0.03	1.3	0.266	110.1	8	11	<0.01	0.008	0.77	<0.1	0.3	<0.02	0.20	16	0.3	<0.02	<0.1	0.036	0.02	<0.001
NK11-039N FS2	Vegetation	5.79	1.3	0.227	63.2	8	11	0.02	0.007	1.49	<0.1	0.2	<0.02	0.21	12	0.3	<0.02	<0.1	0.153	0.03	<0.001
NK11-040 FS2	Vegetation	7.83	1.3	0.288	79.4	8	12	0.02	0.013	1.75	<0.1	<0.1	<0.02	0.21	20	0.5	<0.02	<0.1	0.386	0.02	<0.001
NK11-040 OAK	Vegetation	0.10	1.2	0.180	32.5	9	16	<0.01	0.003	1.23	<0.1	0.2	<0.02	0.22	10	0.2	<0.02	<0.1	0.031	<0.01	<0.001
NK11-040 MOSS	Vegetation	21.94	7.1	0.249	112.7	58	8	0.70	0.041	0.92	0.2	0.2	0.25	0.20	144	0.6	<0.02	3.9	0.973	0.07	0.216
NK11-040X SF-2 STD.	Rock Pulp	9.71	1.5	0.254	29.6	13	18	0.06	0.021	1.82	<0.1	0.2	<0.02	0.21	42	0.3	<0.02	<0.1	0.027	0.01	<0.001
NK11-040N FS2	Vegetation	5.90	1.4	0.286	84.3	8	12	0.04	0.004	1.23	<0.1	0.2	<0.02	0.17	23	0.2	<0.02	<0.1	0.802	<0.01	0.001
NK11-040N OAK	Vegetation	0.14	1.0	0.189	59.5	10	17	<0.01	0.005	1.13	<0.1	0.1	<0.02	0.19	14	0.4	<0.02	<0.1	0.234	0.01	<0.001
NK11-041 FS1	Vegetation	27.59	1.6	0.299	90.7	7	18	<0.01	0.004	2.87	<0.1	0.2	<0.02	0.21	16	0.3	<0.02	<0.1	0.277	0.04	<0.001
NK11-042 FS2	Vegetation	8.16	1.3	0.288	48.0	10	11	0.06	0.011	1.92	<0.1	0.3	<0.02	0.18	15	0.4	<0.02	<0.1	0.044	<0.01	0.002
NK11-042 OAK	Vegetation	0.04	1.1	0.183	41.0	10	10	<0.01	0.006	1.33	<0.1	<0.1	<0.02	0.15	4	0.1	<0.02	<0.1	0.109	0.04	<0.001
NK11-043 F3	Vegetation	2.75	1.1	0.165	123.5	9	6	<0.01	0.003	1.88	<0.1	<0.1	<0.02	0.16	5	<0.1	<0.02	<0.1	0.014	0.02	<0.001
NK11-043 FS2	Vegetation	8.74	1.4	0.272	89.9	10	15	0.03	0.006	1.76	<0.1	0.2	<0.02	0.21	15	<0.1	<0.02	<0.1	0.037	<0.01	<0.001
NK11-044 FS2 A	Vegetation	6.75	1.3	0.268	62.8	9	12	0.03	0.006	1.81	<0.1	<0.1	<0.02	0.20	6	0.3	0.04	<0.1	0.155	0.03	<0.001
NK11-044 FS2 B	Vegetation	23.34	1.2	0.684	156.1	9	12	<0.01	0.132	2.28	<0.1	0.1	0.21	0.33	13	0.2	<0.02	<0.1	0.822	0.05	<0.001
NK11-046 FS2	Vegetation	9.22	1.5	0.309	89.4	10	13	<0.01	0.005	1.85	<0.1	0.1	<0.02	0.19	14	0.1	0.03	<0.1	0.379	<0.01	<0.001
NK11-046X SF-2 STD.	Rock Pulp	9.98	1.7	0.257	30.7	14	16	0.06	0.021	1.84	<0.1	0.1	<0.02	0.20	38	0.2	0.04	<0.1	0.030	<0.01	<0.001
NK11-047 F1	Vegetation	14.18	1.4	0.431	85.6	7	13	<0.01	0.021	2.38	<0.1	<0.1	<0.02	0.20	14	<0.1	0.02	<0.1	0.175	0.03	<0.001
NK11-047 F2 IL	Vegetation	14.79	1.3	0.407	116.3	8	13	<0.01	0.004	2.10	<0.1	<0.1	0.03	0.25	15	0.2	<0.02	<0.1	0.610	<0.01	<0.001
NK11-048 FS2	Vegetation	6.02	1.2	0.422	56.4	10	12	0.03	0.005	1.95	<0.1	0.2	<0.02	0.21	21	0.1	<0.02	<0.1	3.484	<0.01	0.004
NK11-049 FS2	Vegetation	2.29	1.3	0.308	60.2	11	14	0.06	0.004	1.93	<0.1	0.1	<0.02	0.18	14	0.5	<0.02	<0.1	0.934	0.02	<0.001
NK11-050 FS1	Vegetation	36.51	1.3	0.301	149.8	6	7	<0.01	0.030	2.00	<0.1	0.1	0.04	0.22	8	0.5	<0.02	<0.1	0.092	0.08	<0.001
NK11-051 FS1	Vegetation	24.19	1.4	0.239	106.7	7	18	<0.01	0.009	2.52	<0.1	0.2	0.02	0.19	9	0.4	<0.02	<0.1	0.025	0.06	<0.001
NK11-052 FS1	Vegetation	34.49	1.4	0.341	231.8	8	18	<0.01	0.077	2.61	<0.1	<0.1	0.03	0.19	12	<0.1	0.04	<0.1	0.242	0.09	<0.001
NK11-053 F3 BRACKEN	Vegetation	1.85	1.5	0.200	160.3	8	12	<0.01	0.006	2.01	<0.1	0.1	<0.02	0.19	4	0.2	0.04	<0.1	0.639	0.05	<0.001
NK11-053 ALDER	Vegetation	0.14	1.4	0.204	8.3	11	14	<0.01	0.004	1.18	<0.1	0.1	<0.02	0.21	4	0.2	0.02	<0.1	0.046	0.03	0.002
NK11-054 FS1	Vegetation	27.43	1.3	0.294	90.3	6	19	<0.01	0.035	1.89	<0.1	0.2	<0.02	0.22	17	<0.1	0.02	<0.1	0.442	0.08	<0.001
NK11-054X SF-2 STD.	Rock Pulp	10.08	1.8	0.253	31.2	14	15	0.06	0.021	1.83	<0.1	0.1	<0.02	0.22	36	0.2	<0.02	<0.1	0.031	0.05	<0.001
NK11-055 FS1	Vegetation	29.99	1.2	0.289	161.3	6	13	<0.01	0.042	1.91	<0.1	0.1	0.08	0.19	7	0.2	0.04	<0.1	0.715	0.05	<0.001
NK11-056 FS2	Vegetation	15.53	1.2	0.280	54.5	7	16	<0.01	0.003	1.58	<0.1	0.2	<0.02	0.24	19	0.1	<0.02	<0.1	0.976	0.03	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK11-039 BIRCH	Vegetation	<0.01	42.0	0.04	<0.001	0.03	0.050	<0.01	<0.02	1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-039N FS2	Vegetation	<0.01	86.5	<0.02	<0.001	0.03	1.253	9.48	<0.02	<1	<0.1	0.04	0.85	2.15	0.31	0.03	0.19	0.04	0.14	0.03	0.08
NK11-040 FS2	Vegetation	<0.01	162.9	<0.02	<0.001	0.02	1.459	11.49	<0.02	<1	<0.1	0.05	1.09	2.65	0.35	0.05	0.17	0.03	0.21	0.04	0.10
NK11-040 OAK	Vegetation	<0.01	46.4	0.04	<0.001	0.02	0.050	0.04	<0.02	<1	<0.1	0.03	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-040 MOSS	Vegetation	10.44	80.0	1.59	0.024	18.38	48.23	58.10	<0.02	<1	0.8	7.40	5.86	21.05	4.78	0.75	6.16	1.39	7.75	1.96	5.41
NK11-040X SF-2 STD.	Rock Pulp	<0.01	19.3	0.03	0.001	0.04	3.736	9.31	<0.02	<1	<0.1	0.04	1.85	5.85	0.89	0.29	0.86	0.10	0.49	0.09	0.19
NK11-040N FS2	Vegetation	<0.01	119.5	<0.02	<0.001	0.03	3.363	10.11	<0.02	<1	0.2	0.07	1.04	2.89	0.48	0.03	0.33	0.08	0.29	0.07	0.22
NK11-040N OAK	Vegetation	<0.01	65.4	<0.02	<0.001	0.03	0.165	0.18	<0.02	<1	<0.1	0.09	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
NK11-041 FS1	Vegetation	<0.01	102.6	<0.02	<0.001	0.03	1.060	18.80	<0.02	2	<0.1	0.01	3.78	9.71	1.01	0.11	0.47	0.06	0.15	<0.02	0.04
NK11-042 FS2	Vegetation	<0.01	78.0	0.03	<0.001	0.03	1.261	13.25	<0.02	<1	0.1	0.22	1.60	4.65	0.58	0.06	0.33	0.04	0.21	0.03	0.07
NK11-042 OAK	Vegetation	<0.01	55.7	0.08	<0.001	0.01	0.018	0.07	<0.02	2	<0.1	0.03	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-043 F3	Vegetation	<0.01	79.2	0.08	<0.001	0.01	0.175	3.06	<0.02	<1	<0.1	0.02	0.26	0.73	0.06	<0.02	0.03	<0.02	0.03	<0.02	<0.02
NK11-043 FS2	Vegetation	<0.01	80.6	0.03	<0.001	0.03	0.978	15.86	<0.02	<1	<0.1	<0.01	1.34	3.87	0.39	0.04	0.18	0.03	0.17	<0.02	0.07
NK11-044 FS2 A	Vegetation	<0.01	108.0	0.03	<0.001	0.02	0.294	12.91	<0.02	<1	0.5	0.37	1.02	2.58	0.26	0.02	0.06	<0.02	0.04	<0.02	<0.02
NK11-044 FS2 B	Vegetation	<0.01	134.0	0.05	<0.001	0.05	0.749	29.33	<0.02	<1	<0.1	0.25	3.72	10.13	1.03	0.09	0.41	0.03	0.09	<0.02	0.06
NK11-046 FS2	Vegetation	<0.01	117.5	0.03	<0.001	0.02	0.202	9.83	<0.02	<1	<0.1	0.01	1.45	3.68	0.22	<0.02	<0.02	<0.02	0.07	<0.02	<0.02
NK11-046X SF-2 STD.	Rock Pulp	<0.01	19.1	0.04	<0.001	0.06	4.028	9.48	<0.02	<1	<0.1	0.03	1.80	6.40	0.96	0.24	0.82	0.12	0.47	0.08	0.17
NK11-047 F1	Vegetation	<0.01	112.7	<0.02	<0.001	0.01	0.246	15.48	<0.02	<1	<0.1	0.02	2.25	5.86	0.57	0.05	0.18	<0.02	0.04	<0.02	<0.02
NK11-047 F2 IL	Vegetation	<0.01	132.4	0.09	<0.001	0.03	0.319	15.14	<0.02	<1	<0.1	0.04	2.17	5.84	0.62	0.04	0.16	<0.02	0.08	<0.02	<0.02
NK11-048 FS2	Vegetation	<0.01	401.8	0.03	<0.001	0.12	0.217	8.54	<0.02	<1	0.1	0.18	0.83	2.10	0.16	<0.02	0.07	<0.02	0.03	<0.02	<0.02
NK11-049 FS2	Vegetation	<0.01	156.6	0.03	<0.001	<0.01	0.065	3.75	<0.02	<1	<0.1	0.10	0.29	0.64	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-050 FS1	Vegetation	<0.01	53.3	<0.02	<0.001	0.05	0.824	45.68	<0.02	<1	<0.1	0.03	4.40	10.77	1.04	0.10	0.18	0.05	0.10	<0.02	0.03
NK11-051 FS1	Vegetation	<0.01	41.7	0.04	<0.001	0.02	1.602	30.61	<0.02	<1	<0.1	0.21	3.22	9.30	1.11	0.17	0.55	0.06	0.24	0.04	0.05
NK11-052 FS1	Vegetation	<0.01	80.8	0.03	<0.001	0.06	0.805	54.75	<0.02	<1	<0.1	0.02	5.06	13.78	1.41	0.15	0.32	0.04	0.08	<0.02	0.04
NK11-053 F3 BRACKEN	Vegetation	<0.01	69.7	<0.02	<0.001	0.01	0.019	1.61	<0.02	<1	<0.1	<0.01	0.30	0.49	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-053 ALDER	Vegetation	<0.01	22.4	0.05	<0.001	0.06	0.111	0.15	<0.02	<1	<0.1	0.04	0.04	0.09	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
NK11-054 FS1	Vegetation	<0.01	62.8	0.02	<0.001	0.08	1.410	19.51	<0.02	<1	<0.1	0.04	4.01	11.77	1.31	0.11	0.52	0.05	0.19	0.02	0.07
NK11-054X SF-2 STD.	Rock Pulp	<0.01	18.4	0.04	<0.001	0.06	4.083	9.72	<0.02	<1	<0.1	<0.01	1.76	6.38	0.85	0.28	0.85	0.12	0.39	0.10	0.21
NK11-055 FS1	Vegetation	<0.01	104.1	0.04	<0.001	0.03	1.343	22.93	<0.02	<1	<0.1	0.06	4.65	13.77	1.59	0.13	0.46	0.05	0.19	0.02	0.05
NK11-056 FS2	Vegetation	<0.01	92.8	0.03	<0.001	0.03	0.732	13.72	<0.02	<1	<0.1	<0.01	2.20	5.57	0.45	0.04	0.22	<0.02	0.09	<0.02	0.03

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.02	0.02	0.02	2	1
NK11-039 BIRCH	Vegetation	<0.02	<0.02	<0.02	38	1
NK11-039N FS2	Vegetation	<0.02	0.04	<0.02	9	<1
NK11-040 FS2	Vegetation	<0.02	0.04	<0.02	8	<1
NK11-040 OAK	Vegetation	<0.02	<0.02	<0.02	4	<1
NK11-040 MOSS	Vegetation	0.96	5.41	0.85	<2	<1
NK11-040X SF-2 STD.	Rock Pulp	0.03	0.08	<0.02	<2	<1
NK11-040N FS2	Vegetation	0.03	0.13	<0.02	6	<1
NK11-040N OAK	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-041 FS1	Vegetation	<0.02	0.04	<0.02	4	<1
NK11-042 FS2	Vegetation	<0.02	0.04	<0.02	10	<1
NK11-042 OAK	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-043 F3	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-043 FS2	Vegetation	<0.02	0.03	<0.02	6	<1
NK11-044 FS2 A	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-044 FS2 B	Vegetation	<0.02	0.04	<0.02	4	<1
NK11-046 FS2	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-046X SF-2 STD.	Rock Pulp	<0.02	0.09	0.02	5	<1
NK11-047 F1	Vegetation	<0.02	<0.02	<0.02	2	<1
NK11-047 F2 IL	Vegetation	<0.02	<0.02	<0.02	2	<1
NK11-048 FS2	Vegetation	<0.02	<0.02	<0.02	8	<1
NK11-049 FS2	Vegetation	<0.02	<0.02	<0.02	10	<1
NK11-050 FS1	Vegetation	<0.02	0.04	<0.02	2	<1
NK11-051 FS1	Vegetation	<0.02	0.05	<0.02	5	<1
NK11-052 FS1	Vegetation	<0.02	0.03	<0.02	3	<1
NK11-053 F3 BRACKEN	Vegetation	<0.02	<0.02	<0.02	4	<1
NK11-053 ALDER	Vegetation	<0.02	<0.02	<0.02	7	<1
NK11-054 FS1	Vegetation	<0.02	0.03	<0.02	3	<1
NK11-054X SF-2 STD.	Rock Pulp	0.02	0.07	<0.02	4	<1
NK11-055 FS1	Vegetation	<0.02	0.03	<0.02	5	<1
NK11-056 FS2	Vegetation	<0.02	<0.02	<0.02	7	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
Unit		ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
MDL		0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK11-057 FS2	Vegetation	0.29	7.36	0.18	73.8	4	0.3	0.08	119	0.006	<0.1	<0.01	<0.2	<0.01	12.7	0.08	<0.02	<0.02	<2	0.40	0.213
NK11-058 F2	Vegetation	0.40	8.99	0.05	82.5	4	0.3	<0.01	56	0.006	<0.1	<0.01	0.3	<0.01	12.5	0.06	<0.02	<0.02	<2	0.41	0.240
NK11-059 FS1	Vegetation	0.32	41.22	<0.01	40.7	12	0.3	<0.01	69	0.008	0.6	<0.01	1.2	<0.01	11.2	4.76	<0.02	<0.02	<2	0.54	0.329
NK11-060 FS1	Vegetation	0.40	6.52	0.03	13.6	3	0.2	0.02	57	0.007	0.5	<0.01	0.6	<0.01	10.8	0.25	<0.02	<0.02	<2	0.44	0.125
NK11-061 FS1	Vegetation	0.27	8.31	0.04	20.1	4	0.3	0.01	54	0.006	<0.1	<0.01	0.3	<0.01	9.9	0.40	<0.02	<0.02	<2	0.30	0.146
NK11-061 ALDER	Vegetation	0.27	25.91	0.47	107.1	35	2.3	0.08	571	0.012	0.4	<0.01	<0.2	<0.01	26.3	0.06	0.04	<0.02	<2	1.11	0.201
NK11-062 FS1	Vegetation	0.21	9.15	0.15	18.5	4	0.8	0.10	191	0.008	0.2	<0.01	0.8	<0.01	13.4	0.07	<0.02	<0.02	<2	0.54	0.236
NK11-063 FS2	Vegetation	0.16	7.36	0.26	56.8	3	1.3	0.26	669	0.008	0.2	<0.01	0.2	<0.01	19.0	0.10	<0.02	<0.02	<2	0.39	0.215
NK11-063X SF-2 STD.	Rock Pulp	0.51	9.30	0.15	27.3	2	0.5	0.08	84	0.013	0.1	<0.01	0.5	<0.01	24.1	0.08	0.02	<0.02	<2	0.40	0.283
NK11-064 FS2	Vegetation	0.05	5.90	0.13	39.3	4	2.1	0.01	297	0.007	0.3	<0.01	0.2	<0.01	10.9	0.06	<0.02	<0.02	<2	0.25	0.255
NK11-065 FS2	Vegetation	0.06	4.81	0.07	43.9	3	1.0	0.02	700	0.004	0.2	<0.01	<0.2	<0.01	11.7	0.14	<0.02	<0.02	<2	0.32	0.223
NK11-066 FS2	Vegetation	0.06	7.53	0.04	41.5	4	1.0	0.06	414	0.007	0.5	<0.01	0.5	<0.01	12.8	0.17	<0.02	<0.02	<2	0.35	0.284
NK11-066 F3 BRACKEN	Vegetation	0.11	5.83	<0.01	20.3	17	2.0	<0.01	143	0.005	0.3	<0.01	0.5	<0.01	7.0	0.07	<0.02	<0.02	<2	0.12	0.260
NK11-067 FS2	Vegetation	0.04	5.33	0.06	28.3	6	4.4	0.13	378	0.007	0.2	<0.01	0.6	<0.01	15.2	0.13	<0.02	<0.02	<2	0.37	0.235
NK11-068 FS1	Vegetation	0.37	8.42	<0.01	14.6	6	1.3	0.08	70	0.007	0.4	<0.01	<0.2	<0.01	11.5	0.11	<0.02	<0.02	<2	0.47	0.319
NK11-069 FS2	Vegetation	0.16	7.52	0.16	24.1	3	2.3	0.10	218	0.007	<0.1	<0.01	0.3	<0.01	18.7	0.06	<0.02	0.02	<2	0.63	0.360
NK11-069 OAK	Vegetation	0.04	4.77	0.12	22.7	9	1.0	0.05	1301	0.006	<0.1	<0.01	0.3	<0.01	10.8	0.06	<0.02	<0.02	<2	0.52	0.207
NK11-069 BIRCH	Vegetation	0.06	6.33	0.19	90.9	<2	5.0	0.26	992	0.006	<0.1	<0.01	0.4	<0.01	16.8	0.23	<0.02	<0.02	<2	0.56	0.272
NK11-069 HZL	Vegetation	0.12	8.09	0.33	24.4	4	2.9	0.17	1733	0.009	0.1	<0.01	0.8	<0.01	45.8	0.03	0.05	<0.02	<2	1.38	0.285
NK11-069X SF-2 STD.	Rock Pulp	0.54	8.91	0.19	27.2	2	0.6	0.08	87	0.012	<0.1	0.01	0.3	<0.01	25.3	0.09	<0.02	<0.02	<2	0.42	0.296
NK11-070 FS2	Vegetation	0.06	6.26	0.13	37.0	5	2.6	0.06	373	0.007	<0.1	<0.01	0.6	<0.01	12.3	0.18	<0.02	<0.02	<2	0.37	0.312
NK11-071 FS2	Vegetation	0.09	5.99	0.08	39.7	4	2.6	0.05	515	0.007	<0.1	<0.01	0.8	<0.01	12.8	0.24	<0.02	<0.02	<2	0.37	0.330
NK11-072 FS2	Vegetation	0.10	5.86	0.25	38.9	<2	1.0	0.03	174	0.006	<0.1	<0.01	<0.2	<0.01	34.5	0.06	<0.02	<0.02	<2	0.56	0.241
NK11-072 BIRCH	Vegetation	0.04	5.83	0.30	238.6	4	1.7	0.05	1647	0.007	<0.1	<0.01	0.5	<0.01	65.2	0.97	<0.02	<0.02	<2	1.06	0.317
NK11-072 OAK	Vegetation	0.03	6.29	0.09	15.2	8	1.2	0.01	1404	0.006	<0.1	<0.01	0.6	<0.01	15.9	0.09	0.03	<0.02	<2	0.61	0.211
NK11-074 F2NOS	Vegetation	0.06	9.07	0.24	49.0	4	0.9	0.05	314	0.010	<0.1	<0.01	0.4	<0.01	27.9	0.10	<0.02	<0.02	<2	0.60	0.297
NK11-074 F2 W.S.	Vegetation	0.07	9.44	0.23	53.4	6	1.1	0.07	358	0.010	0.1	<0.01	0.5	<0.01	28.4	0.09	<0.02	<0.02	<2	0.63	0.269
NK11-075 F2S	Vegetation	0.09	6.32	0.35	59.1	4	1.1	0.25	610	0.010	<0.1	<0.01	0.4	<0.01	18.4	0.24	0.02	<0.02	<2	0.48	0.247
NK11-076 FS1	Vegetation	0.24	10.66	0.14	24.4	5	0.4	0.03	56	0.008	<0.1	<0.01	0.6	<0.01	8.9	0.17	<0.02	<0.02	<2	0.36	0.236
NK11-076 BIRCH	Vegetation	0.15	5.10	0.29	198.7	<2	1.0	0.13	801	0.010	<0.1	<0.01	0.5	<0.01	28.0	0.82	<0.02	<0.02	<2	0.85	0.180

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK11-057 FS2	Vegetation	9.45	1.2	0.252	35.9	9	9	<0.01	0.008	1.40	<0.1	0.2	<0.02	0.19	10	<0.1	<0.02	<0.1	1.273	<0.01	<0.001
NK11-058 F2	Vegetation	19.30	1.4	0.258	40.9	9	13	0.01	0.010	1.98	<0.1	0.2	<0.02	0.22	17	0.2	0.04	<0.1	0.032	<0.01	0.002
NK11-059 FS1	Vegetation	16.00	1.6	0.278	24.5	12	19	<0.01	0.142	3.88	<0.1	0.3	0.02	0.31	11	<0.1	0.05	<0.1	1.319	0.06	<0.001
NK11-060 FS1	Vegetation	48.23	1.4	0.256	76.5	5	16	<0.01	0.028	2.18	<0.1	0.2	0.02	0.18	9	0.1	0.03	<0.1	0.265	0.07	<0.001
NK11-061 FS1	Vegetation	21.58	1.3	0.300	89.6	5	13	<0.01	0.032	2.28	<0.1	0.2	<0.02	0.19	4	0.2	0.04	<0.1	0.167	0.02	<0.001
NK11-061 ALDER	Vegetation	0.52	1.2	0.269	17.1	9	17	<0.01	0.008	1.20	<0.1	0.1	<0.02	0.21	<1	<0.1	0.07	<0.1	0.029	<0.01	<0.001
NK11-062 FS1	Vegetation	30.43	1.4	0.300	41.4	9	21	<0.01	0.031	2.51	<0.1	0.2	0.15	0.16	15	0.2	0.04	<0.1	2.099	0.14	<0.001
NK11-063 FS2	Vegetation	3.58	1.2	0.376	41.7	8	16	0.05	0.005	1.81	<0.1	0.1	<0.02	0.21	14	0.3	<0.02	<0.1	2.432	<0.01	<0.001
NK11-063X SF-2 STD.	Rock Pulp	10.63	1.6	0.255	31.1	14	16	0.06	0.022	1.79	<0.1	0.2	<0.02	0.19	38	0.4	<0.02	<0.1	0.031	0.03	<0.001
NK11-064 FS2	Vegetation	4.42	1.4	0.223	49.4	9	12	0.03	0.004	1.24	<0.1	0.2	<0.02	0.17	17	0.3	<0.02	<0.1	0.331	0.02	0.003
NK11-065 FS2	Vegetation	2.03	1.2	0.303	31.3	8	12	0.02	0.004	1.57	<0.1	0.1	<0.02	0.14	10	0.2	0.03	<0.1	4.470	<0.01	<0.001
NK11-066 FS2	Vegetation	3.26	1.2	0.302	48.0	9	11	0.01	0.009	1.73	<0.1	0.2	<0.02	0.17	13	0.4	<0.02	<0.1	0.712	0.03	<0.001
NK11-066 F3 BRACKEN	Vegetation	1.02	1.3	0.155	144.8	9	7	<0.01	0.003	1.62	<0.1	0.1	<0.02	0.13	7	<0.1	0.05	<0.1	1.166	<0.01	<0.001
NK11-067 FS2	Vegetation	2.97	1.9	0.334	50.0	9	11	0.03	0.008	1.82	<0.1	0.1	<0.02	0.19	10	0.4	0.03	<0.1	1.502	0.03	<0.001
NK11-068 FS1	Vegetation	23.49	1.3	0.556	96.5	11	12	<0.01	0.044	1.79	<0.1	<0.1	0.17	0.20	11	0.3	<0.02	<0.1	5.699	0.06	<0.001
NK11-069 FS2	Vegetation	7.81	1.0	0.364	51.8	12	13	0.03	0.007	2.16	<0.1	<0.1	<0.02	0.26	19	0.3	<0.02	<0.1	0.322	0.02	<0.001
NK11-069 OAK	Vegetation	0.11	1.0	0.176	44.4	7	23	<0.01	0.007	0.97	<0.1	<0.1	<0.02	0.19	10	0.3	<0.02	<0.1	0.024	<0.01	0.001
NK11-069 BIRCH	Vegetation	0.03	1.0	0.253	56.4	9	10	<0.01	0.004	0.77	<0.1	<0.1	<0.02	0.18	11	0.3	<0.02	<0.1	0.122	<0.01	0.001
NK11-069 HZL	Vegetation	0.21	0.9	0.384	91.4	10	15	<0.01	0.007	1.12	<0.1	0.1	<0.02	0.18	13	0.5	<0.02	<0.1	0.067	<0.01	0.001
NK11-069X SF-2 STD.	Rock Pulp	10.97	1.4	0.278	34.8	12	17	0.06	0.023	1.89	<0.1	0.1	<0.02	0.23	46	0.5	<0.02	<0.1	0.032	0.06	0.004
NK11-070 FS2	Vegetation	8.11	1.0	0.297	61.8	11	11	0.05	0.008	2.02	<0.1	<0.1	<0.02	0.23	21	0.2	<0.02	<0.1	0.153	<0.01	0.003
NK11-071 FS2	Vegetation	7.01	1.1	0.302	54.7	11	10	0.04	0.007	2.10	<0.1	0.1	<0.02	0.21	16	0.3	<0.02	<0.1	0.147	<0.01	<0.001
NK11-072 FS2	Vegetation	23.87	1.1	0.388	100.1	8	16	0.04	0.013	2.31	<0.1	<0.1	<0.02	0.20	14	0.6	<0.02	<0.1	2.314	<0.01	0.007
NK11-072 BIRCH	Vegetation	<0.01	0.9	0.445	239.7	10	14	<0.01	0.004	0.74	<0.1	0.1	<0.02	0.22	9	0.1	<0.02	<0.1	0.273	<0.01	<0.001
NK11-072 OAK	Vegetation	0.10	1.0	0.235	38.7	7	15	<0.01	0.003	1.09	<0.1	<0.1	<0.02	0.20	8	0.3	0.03	<0.1	1.186	<0.01	0.001
NK11-074 F2NOS	Vegetation	10.15	1.1	0.365	76.3	10	19	0.02	0.015	2.70	<0.1	<0.1	<0.02	0.33	27	0.5	<0.02	<0.1	0.187	<0.01	<0.001
NK11-074 F2 W.S.	Vegetation	10.83	1.2	0.401	82.4	10	19	0.02	0.014	2.42	<0.1	<0.1	<0.02	0.30	21	0.4	<0.02	<0.1	0.226	<0.01	<0.001
NK11-075 F2S	Vegetation	6.41	1.3	0.338	78.5	8	11	0.02	0.006	2.09	<0.1	0.2	<0.02	0.24	24	0.5	<0.02	<0.1	0.195	0.03	0.003
NK11-076 FS1	Vegetation	15.54	1.3	0.349	78.0	7	15	<0.01	0.026	2.02	<0.1	0.1	<0.02	0.23	12	0.3	<0.02	<0.1	0.112	0.03	<0.001
NK11-076 BIRCH	Vegetation	<0.01	1.3	0.288	161.0	7	25	<0.01	0.010	0.69	<0.1	<0.1	<0.02	0.18	13	0.2	<0.02	<0.1	0.016	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

Method		1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
Analyte		Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MDL		0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK11-057 FS2	Vegetation	<0.01	95.5	0.03	<0.001	0.04	0.549	9.68	<0.02	<1	1.0	0.14	1.05	2.29	0.25	<0.02	<0.02	<0.02	0.06	<0.02	<0.02
NK11-058 F2	Vegetation	<0.01	36.9	0.03	<0.001	0.04	0.791	14.92	<0.02	<1	1.2	0.07	1.83	4.04	0.27	0.02	0.11	0.03	0.10	<0.02	0.04
NK11-059 FS1	Vegetation	<0.01	157.1	0.03	<0.001	0.04	0.610	10.77	<0.02	<1	<0.1	0.03	1.90	5.27	0.50	0.04	0.29	<0.02	0.13	<0.02	0.02
NK11-060 FS1	Vegetation	<0.01	64.6	<0.02	<0.001	0.03	1.759	39.38	<0.02	<1	<0.1	<0.01	7.14	19.78	2.24	0.22	0.61	0.06	0.18	0.03	0.06
NK11-061 FS1	Vegetation	<0.01	74.1	<0.02	<0.001	0.03	0.910	27.39	<0.02	<1	<0.1	<0.01	3.16	8.85	0.95	0.10	0.51	0.04	0.13	<0.02	0.06
NK11-061 ALDER	Vegetation	<0.01	22.6	0.03	<0.001	0.07	0.382	0.68	<0.02	<1	<0.1	0.03	0.08	0.16	0.04	<0.02	0.02	<0.02	0.04	<0.02	<0.02
NK11-062 FS1	Vegetation	<0.01	241.3	0.04	<0.001	0.04	0.621	41.83	<0.02	<1	<0.1	0.04	4.11	9.99	0.82	0.06	0.26	0.03	0.11	<0.02	0.03
NK11-063 FS2	Vegetation	<0.01	195.0	0.02	<0.001	0.03	0.249	6.24	<0.02	<1	<0.1	0.12	0.46	0.83	0.13	<0.02	0.02	<0.02	0.04	<0.02	<0.02
NK11-063X SF-2 STD.	Rock Pulp	<0.01	20.2	0.05	<0.001	0.04	4.076	10.46	<0.02	<1	<0.1	0.02	2.01	6.84	1.03	0.31	0.93	0.13	0.53	0.09	0.19
NK11-064 FS2	Vegetation	<0.01	93.1	0.02	<0.001	0.28	0.377	8.68	<0.02	<1	0.2	0.04	0.68	1.60	0.17	<0.02	0.05	<0.02	0.05	<0.02	0.02
NK11-065 FS2	Vegetation	<0.01	232.7	<0.02	<0.001	0.02	0.123	3.01	<0.02	<1	<0.1	0.10	0.28	0.66	0.06	<0.02	0.04	<0.02	0.03	<0.02	<0.02
NK11-066 FS2	Vegetation	<0.01	204.7	<0.02	<0.001	0.04	0.567	4.83	<0.02	<1	<0.1	0.05	0.42	1.21	0.16	0.03	0.09	<0.02	0.09	<0.02	0.04
NK11-066 F3 BRACKEN	Vegetation	<0.01	156.5	0.02	<0.001	0.01	0.062	1.88	<0.02	<1	<0.1	<0.01	0.14	0.25	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-067 FS2	Vegetation	<0.01	274.4	0.05	<0.001	0.03	0.125	5.67	<0.02	<1	<0.1	0.15	0.38	0.89	0.05	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
NK11-068 FS1	Vegetation	<0.01	211.2	0.02	<0.001	0.02	0.451	28.75	<0.02	<1	<0.1	0.04	3.06	8.00	0.70	0.06	0.26	0.02	0.09	<0.02	0.04
NK11-069 FS2	Vegetation	<0.01	261.1	<0.02	0.002	0.03	0.412	12.29	<0.02	<1	0.1	0.04	1.14	2.97	0.30	0.06	0.14	0.02	0.09	<0.02	0.02
NK11-069 OAK	Vegetation	<0.01	32.2	<0.02	<0.001	0.02	0.063	0.21	<0.02	<1	<0.1	0.03	<0.02	0.06	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-069 BIRCH	Vegetation	<0.01	61.7	0.05	<0.001	0.02	0.016	0.03	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-069 HZL	Vegetation	<0.01	104.5	0.08	0.002	0.03	0.091	0.26	<0.02	<1	0.1	<0.01	0.04	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-069X SF-2 STD.	Rock Pulp	<0.01	21.6	0.04	<0.001	0.08	4.345	10.70	<0.02	<1	<0.1	0.05	2.03	6.99	0.98	0.31	0.87	0.14	0.55	0.11	0.26
NK11-070 FS2	Vegetation	<0.01	158.1	<0.02	<0.001	0.04	0.517	11.87	<0.02	<1	<0.1	0.13	1.11	2.61	0.25	0.02	0.05	<0.02	0.05	<0.02	0.03
NK11-071 FS2	Vegetation	<0.01	141.3	<0.02	<0.001	0.02	0.349	10.49	<0.02	<1	0.1	0.06	0.90	1.86	0.17	<0.02	0.04	<0.02	0.06	<0.02	0.02
NK11-072 FS2	Vegetation	<0.01	213.7	<0.02	<0.001	0.07	9.709	33.54	<0.02	<1	<0.1	0.12	5.11	15.16	2.23	0.22	1.24	0.28	1.21	0.26	0.67
NK11-072 BIRCH	Vegetation	<0.01	35.0	0.03	<0.001	0.04	0.265	<0.01	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02
NK11-072 OAK	Vegetation	<0.01	98.3	0.15	<0.001	<0.01	0.148	0.09	<0.02	<1	<0.1	0.03	0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-074 F2NOS	Vegetation	<0.01	134.3	0.05	<0.001	0.03	0.403	14.23	<0.02	<1	<0.1	0.11	1.38	3.26	0.34	<0.02	0.14	<0.02	0.06	<0.02	0.02
NK11-074 F2 W.S.	Vegetation	<0.01	179.7	<0.02	<0.001	0.03	0.338	17.22	<0.02	<1	<0.1	0.09	1.46	3.45	0.26	0.03	0.07	0.02	0.07	<0.02	<0.02
NK11-075 F2S	Vegetation	<0.01	187.8	0.02	<0.001	0.04	0.364	9.72	<0.02	<1	<0.1	0.21	0.81	1.91	0.16	0.03	0.07	<0.02	0.07	<0.02	0.03
NK11-076 FS1	Vegetation	<0.01	55.7	<0.02	<0.001	0.02	1.523	27.83	<0.02	<1	<0.1	<0.01	2.63	7.32	0.96	0.15	0.54	0.07	0.15	0.05	0.07
NK11-076 BIRCH	Vegetation	<0.01	14.5	0.06	<0.001	0.06	0.027	<0.01	<0.02	<1	<0.1	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.02	0.02	0.02	2	1
NK11-057 FS2	Vegetation	<0.02	0.03	<0.02	13	<1
NK11-058 F2	Vegetation	<0.02	0.02	<0.02	15	<1
NK11-059 FS1	Vegetation	<0.02	<0.02	<0.02	<2	<1
NK11-060 FS1	Vegetation	<0.02	0.05	<0.02	4	<1
NK11-061 FS1	Vegetation	<0.02	0.03	<0.02	5	<1
NK11-061 ALDER	Vegetation	<0.02	<0.02	<0.02	19	<1
NK11-062 FS1	Vegetation	<0.02	0.02	<0.02	3	<1
NK11-063 FS2	Vegetation	<0.02	<0.02	<0.02	10	<1
NK11-063X SF-2 STD.	Rock Pulp	0.02	0.12	0.02	5	<1
NK11-064 FS2	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-065 FS2	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-066 FS2	Vegetation	<0.02	<0.02	<0.02	8	<1
NK11-066 F3 BRACKEN	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-067 FS2	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-068 FS1	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-069 FS2	Vegetation	<0.02	<0.02	<0.02	5	<1
NK11-069 OAK	Vegetation	<0.02	<0.02	<0.02	3	2
NK11-069 BIRCH	Vegetation	<0.02	<0.02	<0.02	15	<1
NK11-069 HZL	Vegetation	<0.02	<0.02	<0.02	4	<1
NK11-069X SF-2 STD.	Rock Pulp	0.03	0.09	<0.02	4	<1
NK11-070 FS2	Vegetation	<0.02	0.03	<0.02	6	<1
NK11-071 FS2	Vegetation	<0.02	<0.02	<0.02	7	<1
NK11-072 FS2	Vegetation	0.09	0.39	0.04	7	<1
NK11-072 BIRCH	Vegetation	<0.02	<0.02	<0.02	42	<1
NK11-072 OAK	Vegetation	<0.02	<0.02	<0.02	2	<1
NK11-074 F2NOS	Vegetation	<0.02	0.02	<0.02	9	<1
NK11-074 F2 W.S.	Vegetation	<0.02	<0.02	<0.02	9	<1
NK11-075 F2S	Vegetation	<0.02	0.02	<0.02	9	<1
NK11-076 FS1	Vegetation	<0.02	0.05	<0.02	5	<1
NK11-076 BIRCH	Vegetation	<0.02	<0.02	<0.02	33	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
NK11-076X SF-2 STD.	Rock Pulp	0.51	9.01	0.19	28.5	3	0.5	0.07	90	0.012	0.3	0.01	0.6	<0.01	24.7	0.09	<0.02	<0.02	<2	0.42	0.279
NK11-077 FS2	Vegetation	0.08	7.72	0.14	36.8	4	1.1	0.05	157	0.011	<0.1	<0.01	0.8	<0.01	29.9	0.08	<0.02	<0.02	<2	0.75	0.265
NK11-078 FS2	Vegetation	0.08	8.09	0.21	40.0	7	1.2	0.04	206	0.008	<0.1	<0.01	0.5	<0.01	22.8	0.05	<0.02	<0.02	<2	0.50	0.269
NK11-079 FS2	Vegetation	0.36	4.97	0.28	48.3	3	4.3	1.37	350	0.006	<0.1	<0.01	0.4	<0.01	31.9	0.09	<0.02	<0.02	<2	0.60	0.243
NK11-079 ASH	Vegetation	0.35	4.26	0.18	11.8	<2	1.8	0.22	1245	0.006	<0.1	<0.01	0.6	<0.01	39.3	0.14	<0.02	<0.02	<2	0.83	0.267
NK11-080 FS2	Vegetation	0.40	6.26	0.19	78.5	<2	1.3	0.27	603	0.010	<0.1	<0.01	0.3	<0.01	14.8	0.09	<0.02	<0.02	<2	0.34	0.305
NK11-081 FS2	Vegetation	0.08	6.82	0.26	34.9	11	1.2	0.06	134	0.008	0.1	<0.01	0.6	<0.01	30.1	0.05	<0.02	<0.02	<2	0.65	0.185
NK11-082 FS1	Vegetation	0.64	11.34	0.29	26.7	6	0.2	0.01	137	0.010	0.3	<0.01	0.2	<0.01	12.9	0.94	<0.02	<0.02	<2	0.53	0.236

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
NK11-076X SF-2 STD.	Rock Pulp	10.86	1.2	0.266	31.5	12	15	0.06	0.023	1.85	<0.1	<0.1	<0.02	0.25	33	0.3	0.02	<0.1	0.037	<0.01	<0.001
NK11-077 FS2	Vegetation	10.10	1.3	0.404	114.3	10	17	0.03	0.007	2.36	<0.1	<0.1	<0.02	0.27	22	0.5	<0.02	<0.1	0.082	0.05	<0.001
NK11-078 FS2	Vegetation	7.40	1.2	0.340	102.9	9	12	0.04	0.005	1.86	<0.1	0.2	<0.02	0.23	12	0.3	<0.02	<0.1	0.386	0.01	<0.001
NK11-079 FS2	Vegetation	8.42	1.2	0.421	103.1	8	13	0.04	0.006	2.00	<0.1	0.1	<0.02	0.32	15	0.5	<0.02	<0.1	0.823	0.01	<0.001
NK11-079 ASH	Vegetation	0.12	1.2	0.443	163.8	10	9	<0.01	0.003	1.11	<0.1	0.1	<0.02	0.12	14	0.4	0.04	<0.1	0.049	<0.01	<0.001
NK11-080 FS2	Vegetation	3.69	1.3	0.418	83.5	10	12	<0.01	0.004	1.08	<0.1	0.1	0.08	0.27	23	0.5	0.03	<0.1	0.522	<0.01	<0.001
NK11-081 FS2	Vegetation	17.23	1.4	0.280	122.1	7	13	0.03	0.004	2.06	<0.1	0.2	<0.02	0.31	18	0.6	<0.02	<0.1	0.096	<0.01	<0.001
NK11-082 FS1	Vegetation	39.62	1.2	0.319	111.0	8	14	<0.01	0.004	2.40	<0.1	0.2	<0.02	0.35	16	0.5	<0.02	<0.1	0.134	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NK11-076X SF-2 STD.	Rock Pulp	<0.01	19.9	0.03	<0.001	0.03	4.319	10.02	<0.02	<1	<0.1	0.03	1.98	6.45	1.00	0.30	0.94	0.12	0.55	0.11	0.18
NK11-077 FS2	Vegetation	<0.01	90.4	<0.02	<0.001	0.02	0.340	14.39	<0.02	<1	<0.1	0.04	1.41	3.85	0.27	<0.02	0.10	0.02	<0.02	<0.02	<0.02
NK11-078 FS2	Vegetation	<0.01	197.7	<0.02	<0.001	0.02	0.168	11.48	<0.02	<1	<0.1	0.19	0.91	2.22	0.14	0.03	<0.02	<0.02	0.04	<0.02	<0.02
NK11-079 FS2	Vegetation	<0.01	155.7	0.02	<0.001	0.01	0.104	11.25	<0.02	<1	<0.1	0.29	0.75	1.50	0.09	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-079 ASH	Vegetation	<0.01	32.7	0.13	<0.001	0.02	0.025	0.14	<0.02	<1	<0.1	0.19	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-080 FS2	Vegetation	<0.01	50.6	<0.02	<0.001	0.02	0.065	5.90	<0.02	<1	<0.1	0.01	0.44	1.10	0.08	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
NK11-081 FS2	Vegetation	<0.01	65.7	<0.02	<0.001	0.03	2.561	42.58	<0.02	<1	0.3	0.02	3.33	8.41	0.76	0.06	0.24	0.08	0.33	0.07	0.16
NK11-082 FS1	Vegetation	<0.01	81.4	<0.02	<0.001	0.02	1.918	46.15	<0.02	<1	<0.1	0.09	6.51	19.42	2.39	0.21	0.72	0.09	0.33	0.05	0.10

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

CERTIFICATE OF ANALYSIS VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.02	0.02	0.02	2	1
NK11-076X SF-2 STD.	Rock Pulp	0.02	0.12	<0.02	4	<1
NK11-077 FS2	Vegetation	<0.02	<0.02	<0.02	6	<1
NK11-078 FS2	Vegetation	<0.02	<0.02	<0.02	7	<1
NK11-079 FS2	Vegetation	<0.02	<0.02	<0.02	8	<1
NK11-079 ASH	Vegetation	<0.02	<0.02	<0.02	3	<1
NK11-080 FS2	Vegetation	<0.02	<0.02	<0.02	14	<1
NK11-081 FS2	Vegetation	<0.02	0.08	<0.02	6	<1
NK11-082 FS1	Vegetation	<0.02	0.06	<0.02	<2	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

QUALITY CONTROL REPORT VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P
	Unit	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%	%
	MDL	0.01	0.01	0.01	0.1	2	0.1	0.01	1	0.001	0.1	0.01	0.2	0.01	0.5	0.01	0.02	0.02	2	0.01	0.001
Pulp Duplicates																					
NK11-022 HZL	Vegetation Pu	0.14	11.25	0.08	26.2	5	3.2	0.40	945	0.012	0.2	<0.01	0.7	<0.01	32.1	0.02	0.03	<0.02	<2	1.50	0.265
REP NK11-022 HZL	QC	0.18	10.99	<0.01	25.5	5	3.3	0.40	967	0.011	0.1	<0.01	0.7	<0.01	31.9	0.01	0.05	<0.02	<2	1.47	0.264
NK11-035 FS1	Vegetation Pu	0.24	7.83	0.21	28.3	<2	0.6	0.07	211	0.008	0.2	<0.01	<0.2	<0.01	11.6	0.23	<0.02	<0.02	<2	0.41	0.195
REP NK11-035 FS1	QC	0.24	7.66	0.23	27.7	<2	0.8	0.03	215	0.009	0.3	<0.01	0.5	<0.01	12.0	0.26	<0.02	<0.02	<2	0.41	0.198
NK11-046 FS2	Vegetation Pu	0.11	9.09	0.23	32.0	<2	0.6	0.02	117	0.009	0.2	<0.01	<0.2	<0.01	16.3	0.09	<0.02	<0.02	<2	0.56	0.283
REP NK11-046 FS2	QC	0.09	8.55	0.21	31.8	5	0.5	0.02	114	0.009	0.1	<0.01	0.2	<0.01	16.2	0.08	0.02	<0.02	<2	0.55	0.275
NK11-076 FS1	Vegetation Pu	0.24	10.66	0.14	24.4	5	0.4	0.03	56	0.008	<0.1	<0.01	0.6	<0.01	8.9	0.17	<0.02	<0.02	<2	0.36	0.236
REP NK11-076 FS1	QC	0.28	10.21	0.10	24.3	3	0.5	0.02	60	0.008	<0.1	<0.01	0.2	<0.01	9.1	0.18	<0.02	<0.02	<2	0.36	0.231
Reference Materials																					
STD V14	Standard	0.06	5.02	0.97	15.7	23	1.4	0.79	2292	0.018	12.5	<0.01	6.2	<0.01	7.0	0.20	0.06	0.10	<2	0.65	0.098
STD V14	Standard	0.07	5.22	0.81	15.0	19	1.3	0.90	2361	0.021	12.6	<0.01	4.9	<0.01	7.1	0.25	0.05	0.10	<2	0.67	0.102
STD V14	Standard	0.09	4.95	0.73	14.8	20	1.3	0.81	2270	0.018	13.2	<0.01	4.3	<0.01	7.1	0.22	0.10	0.09	<2	0.65	0.096
STD V14	Standard	0.08	5.00	1.04	16.3	15	1.4	0.78	2249	0.019	12.8	<0.01	6.3	<0.01	7.0	0.22	0.06	0.10	<2	0.65	0.098
STD V16	Standard	1.72	7.07	2.97	43.1	26	7.0	1.16	813	0.471	2.0	<0.01	1.2	<0.01	12.3	0.10	0.06	<0.02	<2	0.32	0.060
STD V16	Standard	1.31	6.85	3.22	45.6	26	6.4	1.07	827	0.440	1.8	<0.01	0.8	<0.01	13.3	0.11	0.05	<0.02	<2	0.34	0.055
STD V16	Standard	2.29	7.10	2.48	39.7	28	8.8	1.32	780	0.559	1.6	<0.01	1.2	<0.01	11.9	0.04	0.08	<0.02	<2	0.32	0.054
STD V16	Standard	2.21	7.58	3.06	40.0	24	7.3	1.20	786	0.474	1.6	<0.01	1.0	<0.01	11.9	0.09	0.06	<0.02	<2	0.32	0.055
STD V14 Expected		0.06	4.8	0.881	14.5	24	1.4	0.75	2094	0.016	11.038		8		6.668	0.21	0.06	0.089		0.6082	0.087
STD V16 Expected		1.6	6.92	3.11	39.2	32	7.8	1.17	732	0.4367	1.6		1.1		11.6	0.093	0.07			0.302	0.0498
FLOUR	Blank	0.57	3.38	0.19	27.2	<2	0.1	0.02	36	0.004	<0.1	<0.01	<0.2	<0.01	1.2	0.02	<0.02	0.03	<2	0.03	0.371
BLK	Blank	<0.01	<0.01	<0.01	<0.1	<2	<0.1	<0.01	<1	<0.001	<0.1	<0.01	<0.2	<0.01	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001
FLOUR	Blank	0.52	3.06	0.03	23.3	<2	0.3	0.01	35	0.004	<0.1	<0.01	<0.2	<0.01	1.0	0.03	<0.02	0.04	<2	0.03	0.356
BLK	Blank	<0.01	<0.01	<0.01	<0.1	<2	<0.1	<0.01	<1	<0.001	<0.1	<0.01	<0.2	<0.01	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001
FLOUR	Blank	0.53	3.53	0.06	25.2	<2	0.1	0.02	36	0.004	<0.1	<0.01	<0.2	<0.01	1.1	0.02	<0.02	0.04	<2	0.03	0.392
BLK	Blank	<0.01	<0.01	<0.01	<0.1	<2	<0.1	<0.01	<1	<0.001	<0.1	<0.01	<0.2	<0.01	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001
FLOUR	Blank	0.58	3.63	0.34	26.9	<2	<0.1	0.02	35	0.005	0.1	<0.01	<0.2	<0.01	1.1	0.03	<0.02	0.04	<2	0.03	0.392
BLK	Blank	<0.01	<0.01	<0.01	<0.1	<2	<0.1	<0.01	<1	<0.001	<0.1	<0.01	<0.2	<0.01	<0.5	<0.01	<0.02	<0.02	<2	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

QUALITY CONTROL REPORT VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga	Cs	Ge	Hf
	Unit	ppm	ppm	%	ppm	ppm	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.001	0.1	1	1	0.01	0.001	0.01	0.1	0.1	0.02	0.01	1	0.1	0.02	0.1	0.005	0.01	0.001
Pulp Duplicates																					
NK11-022 HZL	Vegetation Pu	0.43	1.1	0.306	55.7	10	11	<0.01	0.003	0.97	<0.1	<0.1	<0.02	0.20	8	0.2	0.03	<0.1	0.452	<0.01	<0.001
REP NK11-022 HZL	QC	0.49	1.1	0.309	55.1	10	12	<0.01	0.003	0.95	<0.1	0.1	<0.02	0.20	10	0.1	<0.02	<0.1	0.464	<0.01	<0.001
NK11-035 FS1	Vegetation Pu	12.54	1.4	0.358	79.9	7	15	<0.01	0.003	1.72	<0.1	0.2	0.06	0.19	18	0.3	<0.02	<0.1	0.720	0.08	<0.001
REP NK11-035 FS1	QC	12.61	1.4	0.374	83.0	7	16	<0.01	0.003	1.76	<0.1	0.3	0.06	0.20	23	0.1	<0.02	<0.1	0.728	0.03	0.001
NK11-046 FS2	Vegetation Pu	9.22	1.5	0.309	89.4	10	13	<0.01	0.005	1.85	<0.1	0.1	<0.02	0.19	14	0.1	0.03	<0.1	0.379	<0.01	<0.001
REP NK11-046 FS2	QC	9.04	1.5	0.311	87.1	10	13	<0.01	0.006	1.79	<0.1	<0.1	<0.02	0.19	9	0.4	0.02	<0.1	0.382	<0.01	<0.001
NK11-076 FS1	Vegetation Pu	15.54	1.3	0.349	78.0	7	15	<0.01	0.026	2.02	<0.1	0.1	<0.02	0.23	12	0.3	<0.02	<0.1	0.112	0.03	<0.001
REP NK11-076 FS1	QC	16.08	1.2	0.349	80.3	8	15	<0.01	0.025	2.08	<0.1	<0.1	<0.02	0.24	16	0.2	<0.02	<0.1	0.111	<0.01	0.002
Reference Materials																					
STD V14	Standard	0.01	1.3	0.086	1.4	7	10	0.16	<0.001	0.54	<0.1	<0.1	0.04	0.06	46	0.1	0.02	<0.1	0.036	<0.01	<0.001
STD V14	Standard	0.03	1.1	0.088	1.7	6	11	0.16	<0.001	0.53	<0.1	0.1	0.05	0.08	57	0.4	<0.02	<0.1	0.033	<0.01	0.002
STD V14	Standard	0.03	1.2	0.084	1.8	8	11	0.15	<0.001	0.53	<0.1	<0.1	0.04	0.07	59	0.1	<0.02	<0.1	0.034	0.02	0.002
STD V14	Standard	<0.01	1.5	0.084	1.7	7	12	0.15	<0.001	0.52	<0.1	0.2	0.04	0.09	54	0.1	<0.02	<0.1	0.030	0.02	<0.001
STD V16	Standard	<0.01	362.3	0.059	2.1	14	6	0.05	0.002	0.25	<0.1	0.2	<0.02	<0.01	44	0.1	<0.02	0.1	0.042	0.03	0.002
STD V16	Standard	<0.01	308.8	0.064	2.5	13	6	0.06	0.002	0.26	<0.1	0.2	<0.02	0.08	46	0.3	0.02	0.1	0.036	0.02	0.004
STD V16	Standard	0.05	434.9	0.058	2.1	13	5	0.05	0.001	0.24	<0.1	0.2	<0.02	0.02	49	0.3	0.02	0.1	0.032	0.01	0.006
STD V16	Standard	0.04	354.1	0.060	2.0	13	6	0.05	0.001	0.24	<0.1	0.2	<0.02	0.02	45	0.3	<0.02	0.2	0.038	0.01	0.005
STD V14 Expected		0.03	1.2	0.079	1.3	6.699	10.7	0.147		0.509		0.117	0.038	0.064	52	0.15			0.029		
STD V16 Expected		0.05	345.2	0.0543	1.9	12	5	0.0498	0.0015	0.231				0.0174	41			0.2	0.037	0.05	0.006
FLOUR	Blank	<0.01	1.1	0.132	2.3	12	<1	<0.01	0.001	0.33	<0.1	<0.1	<0.02	0.17	<1	0.7	<0.02	<0.1	<0.005	0.01	<0.001
BLK	Blank	<0.01	<0.1	<0.001	<0.1	<1	<1	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.01	<1	<0.1	<0.02	<0.1	<0.005	<0.01	<0.001
FLOUR	Blank	<0.01	0.7	0.120	2.8	12	<1	<0.01	<0.001	0.30	<0.1	<0.1	<0.02	0.20	2	0.8	<0.02	<0.1	<0.005	<0.01	0.001
BLK	Blank	<0.01	<0.1	<0.001	<0.1	<1	<1	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.01	<1	<0.1	<0.02	<0.1	<0.005	<0.01	<0.001
FLOUR	Blank	0.02	1.1	0.139	3.6	13	<1	<0.01	<0.001	0.33	<0.1	<0.1	<0.02	0.15	6	0.5	<0.02	<0.1	<0.005	<0.01	<0.001
BLK	Blank	<0.01	<0.1	<0.001	<0.1	<1	<1	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.01	6	<0.1	<0.02	<0.1	<0.005	<0.01	<0.001
FLOUR	Blank	0.02	1.2	0.135	3.2	13	<1	<0.01	<0.001	0.32	<0.1	<0.1	<0.02	0.17	8	0.7	<0.02	<0.1	<0.005	0.01	<0.001
BLK	Blank	<0.01	<0.1	<0.001	<0.1	<1	<1	<0.01	<0.001	<0.01	<0.1	<0.1	<0.02	<0.01	<1	<0.1	<0.02	<0.1	<0.005	<0.01	<0.001

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

QUALITY CONTROL REPORT VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE	1VE
	Analyte	Nb	Rb	Sn	Ta	Zr	Y	Ce	In	Re	Be	Li	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	0.1	0.02	0.001	0.01	0.001	0.01	0.02	1	0.1	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Pulp Duplicates																					
NK11-022 HZL	Vegetation Pu	<0.01	84.3	0.04	<0.001	0.03	0.193	0.62	<0.02	<1	<0.1	0.06	0.04	0.19	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
REP NK11-022 HZL	QC	<0.01	81.2	0.06	<0.001	0.03	0.201	0.61	<0.02	<1	<0.1	<0.01	0.05	0.25	0.03	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
NK11-035 FS1	Vegetation Pu	<0.01	97.0	<0.02	<0.001	0.02	0.271	19.71	<0.02	<1	<0.1	0.07	1.78	4.35	0.39	0.04	0.13	<0.02	0.03	<0.02	0.03
REP NK11-035 FS1	QC	<0.01	98.5	<0.02	<0.001	0.04	0.247	19.59	<0.02	<1	<0.1	0.02	1.74	4.35	0.49	0.04	0.12	<0.02	0.04	<0.02	<0.02
NK11-046 FS2	Vegetation Pu	<0.01	117.5	0.03	<0.001	0.02	0.202	9.83	<0.02	<1	<0.1	0.01	1.45	3.68	0.22	<0.02	<0.02	<0.02	0.07	<0.02	<0.02
REP NK11-046 FS2	QC	<0.01	115.3	0.04	<0.001	0.05	0.219	9.33	<0.02	<1	<0.1	<0.01	1.47	3.60	0.28	<0.02	0.15	<0.02	0.06	<0.02	<0.02
NK11-076 FS1	Vegetation Pu	<0.01	55.7	<0.02	<0.001	0.02	1.523	27.83	<0.02	<1	<0.1	<0.01	2.63	7.32	0.96	0.15	0.54	0.07	0.15	0.05	0.07
REP NK11-076 FS1	QC	<0.01	56.4	<0.02	<0.001	0.01	1.491	27.32	<0.02	<1	<0.1	<0.01	2.66	7.84	0.87	0.13	0.50	0.06	0.22	0.04	0.09
Reference Materials																					
STD V14	Standard	<0.01	1.9	0.05	<0.001	0.04	0.028	0.03	<0.02	<1	<0.1	0.09	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
STD V14	Standard	<0.01	2.0	<0.02	<0.001	0.04	0.038	0.03	<0.02	<1	<0.1	0.07	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
STD V14	Standard	<0.01	1.8	0.04	<0.001	0.04	0.030	0.06	<0.02	<1	<0.1	0.09	<0.02	0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
STD V14	Standard	<0.01	1.9	0.03	<0.001	0.04	0.017	0.02	<0.02	<1	<0.1	0.11	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
STD V16	Standard	0.13	1.8	0.25	<0.001	0.25	0.051	0.02	<0.02	<1	<0.1	0.04	0.03	0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
STD V16	Standard	0.08	1.7	0.23	<0.001	0.14	0.050	<0.01	<0.02	<1	<0.1	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
STD V16	Standard	0.12	1.7	0.23	<0.001	0.36	0.034	0.11	<0.02	<1	<0.1	0.06	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
STD V16	Standard	0.13	1.8	0.19	<0.001	0.17	0.032	0.10	<0.02	<1	<0.1	0.04	<0.02	0.11	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
STD V14 Expected			1.8	0.04																	
STD V16 Expected		0.11	1.7	0.23		0.18	0.043	0.09				0.07									
FLOUR	Blank	<0.01	2.2	0.04	<0.001	<0.01	0.011	<0.01	<0.02	2	<0.1	0.08	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
BLK	Blank	<0.01	<0.1	<0.02	<0.001	<0.01	<0.001	<0.01	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
FLOUR	Blank	<0.01	2.1	<0.02	<0.001	<0.01	0.002	<0.01	<0.02	<1	<0.1	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
BLK	Blank	<0.01	<0.1	<0.02	<0.001	<0.01	<0.001	<0.01	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
FLOUR	Blank	<0.01	2.2	0.06	<0.001	0.01	0.008	0.02	<0.02	2	<0.1	0.12	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
BLK	Blank	<0.01	<0.1	<0.02	<0.001	<0.01	<0.001	<0.01	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
FLOUR	Blank	<0.01	2.1	<0.02	<0.001	0.01	<0.001	0.03	<0.02	2	<0.1	0.01	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
BLK	Blank	<0.01	<0.1	<0.02	<0.001	<0.01	<0.001	<0.01	<0.02	<1	<0.1	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.

Acme Analytical Laboratories (Vancouver) Ltd.
1020 Cordova St. East Vancouver BC V6A 4A3 Canada
Phone (604) 253-3158 Fax (604) 253-1716
www.acmelab.com

Client: **IoGlobal Solutions**
630 - 1188 West Georgia Street
Vancouver BC V6E 4A2 Canada

Project: Norra Karr 2011
Report Date: August 16, 2011

QUALITY CONTROL REPORT VAN11003337.1

	Method	1VE	1VE	1VE	1VE	1VE
	Analyte	Tm	Yb	Lu	Pd	Pt
	Unit	ppm	ppm	ppm	ppb	ppb
	MDL	0.02	0.02	0.02	2	1
Pulp Duplicates						
NK11-022 HZL	Vegetation Pu	<0.02	<0.02	<0.02	5	<1
REP NK11-022 HZL	QC	<0.02	<0.02	<0.02	4	<1
NK11-035 FS1	Vegetation Pu	<0.02	<0.02	<0.02	5	<1
REP NK11-035 FS1	QC	<0.02	<0.02	<0.02	4	<1
NK11-046 FS2	Vegetation Pu	<0.02	<0.02	<0.02	6	<1
REP NK11-046 FS2	QC	<0.02	<0.02	<0.02	5	<1
NK11-076 FS1	Vegetation Pu	<0.02	0.05	<0.02	5	<1
REP NK11-076 FS1	QC	<0.02	0.06	<0.02	5	<1
Reference Materials						
STD V14	Standard	<0.02	<0.02	<0.02	3	<1
STD V14	Standard	<0.02	<0.02	<0.02	<2	<1
STD V14	Standard	<0.02	<0.02	<0.02	2	<1
STD V14	Standard	<0.02	<0.02	<0.02	3	<1
STD V16	Standard	<0.02	<0.02	<0.02	5	<1
STD V16	Standard	<0.02	<0.02	<0.02	8	<1
STD V16	Standard	<0.02	<0.02	<0.02	3	<1
STD V16	Standard	<0.02	<0.02	<0.02	4	<1
STD V14 Expected						
STD V16 Expected						
FLOUR	Blank	<0.02	<0.02	<0.02	5	<1
BLK	Blank	<0.02	<0.02	<0.02	<2	<1
FLOUR	Blank	<0.02	<0.02	<0.02	2	<1
BLK	Blank	<0.02	<0.02	<0.02	<2	<1
FLOUR	Blank	<0.02	<0.02	<0.02	3	<1
BLK	Blank	<0.02	<0.02	<0.02	<2	<1
FLOUR	Blank	<0.02	<0.02	<0.02	4	<1
BLK	Blank	<0.02	<0.02	<0.02	<2	<1

This report supersedes all previous preliminary and final reports with this file number dated prior to the date on this certificate. Signature indicates final approval; preliminary reports are unsigned and should be used for reference only.