Rare Earth Element and Scandium Mineralization in the Lackner Lake Alkalic Complex, North-East Ontario

Lackner and McNaught townships, Sudbury District

2016 Assessment Work Report Filed with Ontario Geological Survey, Mines and Minerals Division (AFRI) for International Explorers and Prospectors, Ltd.

http://www.geologyontario.mndmf.gov.on.ca/mndmfiles/afri/data/imaging/temp/2_56786//Rare_Earth_Element_and_Scandium_Mineralization_in_Lackner_Lake_Alkalic_Complex_rev.pdf

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EXECUTIVE SUMMARY

The 1138±29 Ma Lackner Lake carbonatite-alkalic silicate rock complex is an ovoid, 5 km by 6 km intrusion situated within the Kapuskasing structural zone in northeastern Ontario (Percival 2007) readily accessible by road from the town of Chapleau, Ontario. A preamble includes a review of chemical properties of the rare earths, yttrium, and scandium, their geochemical characteristics and role of these metals in the critical metals group defined by the European Commission (2010, 2014).

The Lackner Lake complex is host to substantial historic resources of niobium (pyrochlore), titaniferous magnetite, apatite and interesting occurrences with total rare earth element oxides (ΣREO) up to 9.34 wt.%, and Y_2O_3 up to 0.26 wt.%, the highest known values to date in Ontario.

This study encompassed a detailed ground radiometric and geological survey that focused upon known mineralized areas of the Lackner Lake alkalic complex. The field work involved 125 localities, amassed 195 spectral assays for eU (ppm), eTh (ppm) and %K, 71 grab rock samples for lithochemistry (major, minor and trace elements) and chemical analysis of four high purity apatite mineral concentrates.

The radiometric survey, which utilized a Terraplus RS-125 gamma-ray spectrometer, documented a wide range of eTh (1.8 to 2987 ppm), eU (0.0 to 266 ppm) and air absorbed gamma dose rate (25.6 to 8300 nGy/hr). The spectrometer survey led to the discovery of old workings of magnetite-rich mineralization in dense bush.

Rock types include nepheline syenite, mafic alkalic rocks (ijolite, malignite and melteigite), ijolite breccia, glimmerite, carbonatite and rare urtite. Calcio-,silico- and ferrocarbonatite are sparsely evident at only three localities. However, carbonatite was encountered in a 15m by 200m zone that has a minimum depth of 150m in historic drilling at the Zone 2 niobium deposit of Multi-Minerals Ltd.

Summary of historic, non-43-101 compliant, resources areas in the Lackner Lake alkalic complex:

- **Zone 2:** 80 Mt averaging 0.18 wt.% Nb_2O_5 over 420 m strike and depth of 240 m
- **Zone 3-4**: 37 Mt of 13.7 % magnetite, 21.3 % apatite, 0.17 % Nb_2O_5 to the 150 m depth
- **Zone 6 Fe-P-Nb-REE-U deposit**: 5 Mt to 150 m depth averaging 70 wt.% Fe, 21.9 % apatite and 0.17 % Nb_2O_5; 2.72.wt.% ΣREO in a 90% apatite concentrate.

Rare-earth and scandium values established by 2008 to 2014 work:

- **Pole Lake REE-Ba-Th-Nb occurrence**: ΣREO+Y_2O_3 up to 9.6 wt.%
- **NE Camp Lake magnetite zone**: mean 6 grab samples: 0.15 wt.% Nb_2O_5; Scandium mean 85 ppm in range of 63 to 115 ppm
- Apatite data from this study: mean 2.80 wt.% ΣREO in range of 1.96 to 3.25 wt.%; mean Y_2O_3 1168 ppm in range of 800 to 1360 ppm.

Chemical features of the apatite-magnetite- and magnetite-rich rocks include high FeOT, MgO, and TiO_2 and variable Cr, Ni, Co and REE content. Some magnetite-rich rocks, such as at the NE Camp Lake zone, compared with phoscorites from the literature in similar MgO and FeOT contents and high Cr, however, the Lackner Lake alkalic complex rocks differ with a generally low modal carbonate.

Chondrite-normalized REE profiles on bulk rock data revealed three main patterns:

- steep negative slope pattern with smooth progression from La to Lu and high La/YbN values that characterize apatite-magnetite rich layers of the Zone 6 deposit, and some of the main lithologies (nepheline syenite, ijolite, ijolite breccia) and glimmerite enclaves
- steep negative slope pattern with prominent negative cerium anomaly only found at Pole Lake
- flatter "hockey stick" shapes with smooth progression from La to Er or Ho and thence a discontinuity marked by an upward swing due to the enrichment of heavy rare earths.

Apatite-magnetite rocks at the Zone 6 deposit contain ΣREE of 0.8 to 1.2 wt.%, the second highest values found on the property to date. Four samples revealed elevated critical rare earths with mean Eu (85 ppm), Dy (112 ppm), Tb (25 ppm), Y (395 ppm) and Nd (1923 ppm). Rare earth element mineralization has a strong association with thorium in the full lithochemical database of this work. Tantalum has elevated values, up to 647 ppm, in bulk rock samples from the niobium-rich zones where it is inferred to largely be a substituent in pyrochlore. Thorium generally strongly correlates with elevated ΣREE in the alkalic complex as a whole. At the NE Camp Lake magnetite zone, ΣREE is lower (186 to 1829 ppm) than the nearby Zone 6 apatite-magnetite zone despite having the second highest group of thorium values.

Highest rare earth element contents occur at the Pole Lake REE-Ba-Th-Nb occurrence with $\Sigma REO+Y_2O_3$ values between 0.70 to 5.30 wt.% documented in this study and up to 9.60 wt.% in the previous sampling. Late stage hydrothermal alteration generated REE mineralization at this occurrence, possibly guided by fault zones coincident with NW-SE oriented canyons in the north part of the complex. The rare earth element minerals in mineralized syenite include monazite-(Ce), britholite-(La) and Y-rich fluorapatite that are associated with abundant barite and hematite. Alteration of nepheline syenite at Pole Lake via oxidized fluids deposited hematite and depleted cerium as Ce^{4+} that led to a distinctive negative cerium anomalies in chondrite-normalized REE plots.

Strontium-bearing fluorapatite (mean 1.3 wt.% Sr) occurs in all the mineralized zones in the Lackner Lake complex and has significant mean levels of critical metals Eu (220 ppm), Dy (301 ppm), Tb (64 ppm), Nd (4850 ppm) and Y (920 ppm) and is potential ore mineral for these metals. Recent hydrometallurgical work by Ogata *et al*. (2016) demonstrated that heavy rare earth elements can be successfully leached from apatite under conditions of low concentrations of H_2SO_4 (<2mol/L) and recovered using diglycolamic acid ligands immobilized on the surface of silica gel.

Scandium priced at $15, 000/kg for 99.9% purity is the most valuable of the metals of focus in this study. Anomalous levels of scandium (mean 85 ppm, range 53 to 114 ppm) were discovered in a magnetite-rich rock not previously documented although historical work (overgrown trenches) was evident. This zone of mineralization has been named the NE Camp Lake zone for the present study. The main industrial uses of scandium are in high-strength aluminum alloys, high-intensity metal halide lamps, electronics, and laser research (EMC Metals Corp. 2014).

Hydrometallurgical experiments have been conducted by Wang *et al.* (2015) and Xi *et al.* (2015) who respectively worked on bauxite residue (red mud) and titanium-iron ores with 92 ppm scandium.

Wang *et al.* (2015) were successful in leaching of bauxite residue that extracted 99% of the scandium with almost no co-precipitated iron. Xiao *et al.* (2015) applied chloridizing roasting and wet leaching of a concentrate of iron-titanium ores with 225 ppm scandium at 83% leaching efficiency. These types of hydrometallurgical processing may be applicable to scandium recovery in the titaniferous magnetite rocks at the NE Camp Lake magnetite zone in the Lackner Lake complex.

Further exploration is recommended for the NE Camp Lake magnetite-rich zone for scandium and the rare earth elements in the Pole Lake area along the two NW-SE canyons that cross the northern part of the Lackner Lake complex. Lithochemical exploration should focus upon bulk rock barium contents and negative cerium anomalies as guides for these respective targets. Mineralogical identification work is also recommended via the electron microprobe and LA-ICP-MS (Laser Ablation Inductively Coupled Plasma Mass Spectrometry) to determine host minerals of scandium and associated minerals in the NE Camp Lake magnetite zone.

INTRODUCTION

The purpose of this report is to further evaluate the rare earth element, yttrium, niobium, scandium and the rock phosphate potential of the Lackner Lake alkalic complex and to more comprehensively define the lithologic controls in the known areas of mineralization initially defined in the 1950's and 1960's by numerous mineral exploration companies and individuals (Sage 1988a). This study also includes further investigation on the recently discovered Pole Lake REE-Ba-Th-Nb showing in the northern part of the complex (Breaks 2013) and data on a new scandium occurrence. Scandium is currently the most valuable of the metals described in this report, recently selling at USD $15, 000 per kg for 99.9% metal <http://mineralprices.com/default.aspx#rar>

The report presents the first modern comprehensive lithochemical characterization work across the Lackner Lake alkalic complex. The ensuing text will first review chemical and mineralogical properties of the rare earth elements and five of these metals (Nd, Dy, Tb, Eu, and Y) are in the critical metals category that represents the greatest concern in terms of future secure supply (European Commission 2010, 2014).

Critical Metals

In recent years, the rare-earth elements have been included in numerous metal groupings: rare metals, high technology metals, specialty metals and critical metals.

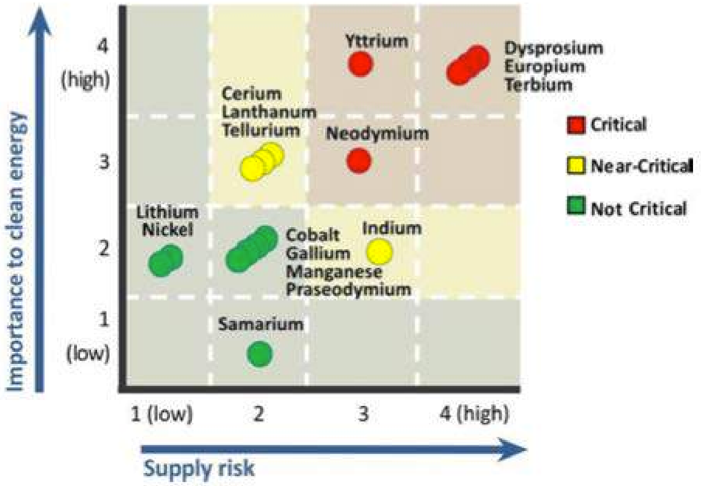

Figure 2.Various critical metals on the chart for supply risk *versus* clean energy importance.
http://energy.gov/sites/prod/files/DOE_CMS2011_FINAL_Full.pdf

The critical metals group, established by the European Union in 2010 and revised in 2014 (European Commission 2010, 2014), comprise a list of essential industrial metals that have future supply concerns as few existing deposits of a given metal are in production (Figure 1). A major international annual convention in the European Union was established in 2014 to provide updates on research relating to extraction of rare earth elements from industrial waste (ERES 2014) that could include tailings from various former mines.

The critical metals include Nd, Eu, Dy, Tb and Y, which are currently only produced in China (Bayan Obo deposit and ion-absorbed REE clays of SE China), and at a start-up mine in Australia (Mt. Weld mine of Lynas Corp: Photo 1). In 2014 China supplied 85% of global rare earth metals (Gambogi 2015) and with 2015 closure of the Mountain Pass mine of Molycorp Ltd. (Mining Media Group 2015) due to bankruptcy, China has an even greater monopoly on rare earth exports. This situation has led the European Union, for example, to evaluate secondary sources of the rare earth elements in various types of industrial waste (Binnemans *et al.* 2015).

The Canadian government affirmed in 2014 that a secure 20% of global supply of rare earths by 2018 would be a desirable goal for Canada: http://www.mining.com/canada-wants-20-of-global-rare-earth-market-by-2018-27834/ These metals are important in varied industries including green technology, automotive sector, defense systems and consumer electronics. Dysprosium is the most critical element in clean energy technology and supplies are likely to be constrained in the medium term (US Dept Energy 2012). Europium is the most expensive of the critical rare earths due to its scarcity and currently sells at $650/kg for 99.9% metal. It is used in medical imaging and in the nuclear and defense industries. The new federal government of Canada would plausibly be sympathetic to this goal as rare earths are important to developing green technologies and hopefully be supportive of new REE mine development in Canada.

Photo 1. Example of an open pit rare earth mine in carbonatite laterite at Mount Weld, Australia of Lynas Corporation that is the highest grade REE deposit currently known at 11.2 wt.% ΣREO (Castor and Hedrick 2006). Photo from https://www.lynascorp.com/Pages/How-are-Rare-Earths-Mined.aspx

Rare Earth Elements Nomenclature

The rare-earth elements (REE), as defined by the International Union of Pure and Applied Chemistry (IUPAC), consist of 15 transition elements in the periodic table that comprise the lanthanide series (La to Lu) with the common inclusion of non-lanthanide metals yttrium and scandium (Table 1, Figure 2). Alternative names such as lanthanons and lanthanoids appear in the literature (Zepf 2013).

Nomenclature in current use is summarized below.

REE - rare earth element

ΣREE: La+Ce+Pr+Nd+Sm+Eu+Gd+Tb+Dy+Ho+Er+Tm+Yb+Lu

REM - rare earth metal

REO - rare earth oxides

ΣREO, TREO - total rare earth oxides: La2O3, Ce2O3, Pr2O3, Nd2O3, Sm2O3, Eu2O3, Gd2O3, Tb2O3, Dy2O3, Ho2O3, Er2O3, Tm2O3, Yb2O3, Lu2O3

ΣLREO - total light rare earth oxides: La2O3, Ce2O3, Pr2O3, Nd2O3, Sm2O3, Eu2O3

ΣHREO - total heavy rare earth oxides: Gd2O3, Tb2O3, Dy2O3, Ho2O3, Er2O3, Tm2O3, Yb2O3, Lu2O3

Y_2O_3 - yttrium oxide

Sc_2O_3 - scandium oxide

Rare Earth Element Groups

There is variable, confusing divisions of rare-earth elements assigned to light, heavy and middle classes in the literature and media (Zepf 2013). The consensus amongst experts in the field is for the light lanthanides (LREE) represented by La to Eu and the heavy lanthanides (HREE) comprise Gd to Lu (*e.g.,* Mariano 1992, Castor and Hedrick 2006; British Geological Survey 2011). The middle rare earth division is only rarely used, mainly by chemists, and will not be mentioned further in this report.

Yttrium is not a lanthanide series metal, however, its geochemical behavior is markedly similar to the heavy lanthanide element holmium (Burt 1989) and hence it is almost universally included in the HREE, even though its atomic weight is about 50% lower than the heavy lanthanides (Table 1, Figure 2).

Scandium is not regarded as a rare earth element but can be concentrated in certain types of rare earth element deposits (*e.g.,* NYF granitic pegmatites: Ercit 2005) owing to its trivalent charge and similar ionic radius (104 pm) in 6-fold coordination. Scandium is often grouped with the REE even though several workers have argued for exclusion based upon atomic configuration (*e.g.,* Henderson 1984). Its geochemistry mostly detracts from that of the lanthanides, as scandium mainly substitutes for Mn^{2+}, Fe^{2+}, Fe^{3+}, Al^{3+}, Mg, Zr, and Sn rather than calcium and forms relatively few minerals (*e.g.,* thortveitite and pretulite *in* Chackhmouradian and Wall 2012).

Scandium exhibits a number of properties that are similar to those of the REEs, but is seldom found in the same minerals. Scandium does not selectively combine with the common ore-forming anions (Castor and Hedrick 2006).

Scandium is currently the most valuable of the metals described in this report, recently selling at $15, 000 per kg for 99.9% metal: http://mineralprices.com/default.aspx#rar

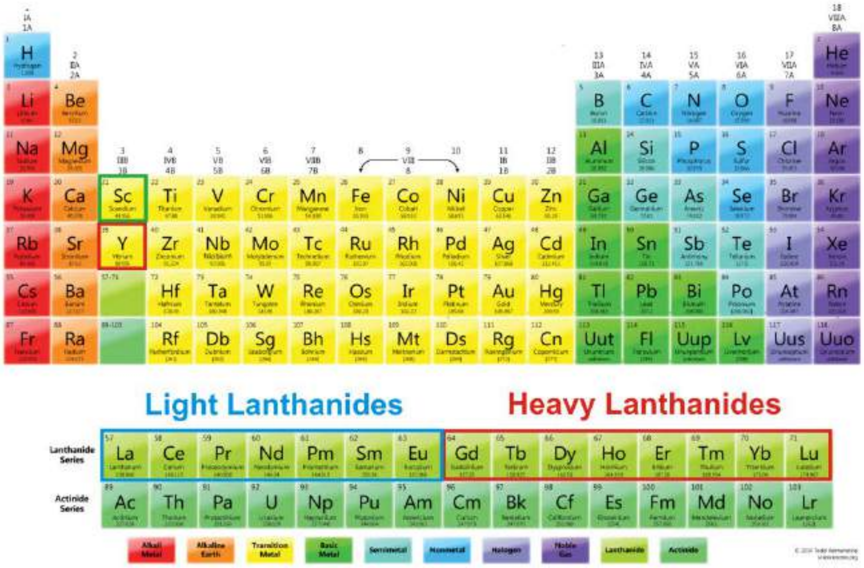

Figure 3. Periodic table with divisions of the rare earth elements into Light Lanthanides and Heavy Lanthanides. Basic periodic chart from www.sciencenotes.org

Chemical Properties of the Rare Earth Elements

The lanthanide series is characterized by the well-known lanthanide contraction in which there is decreasing ionic radius with increasing atomic number or atomic mass (Figure 3). The Oddo-Harkins effect (Figure 4) is also evident in which rare earths of even atomic number (Ce, Nd, Sm, Gd, Dy, Er, and Yb) are more abundant in the earth's crust than rare earths of odd atomic number (La, Pr, Pm, Eu, Tb, Ho, Tm, and Lu) . The Oddo-Harkins effect is most pronounced for the light rare earths La, Ce, Pr, Nd and Sm relative to the heavy rare earths (Henderson 1984).

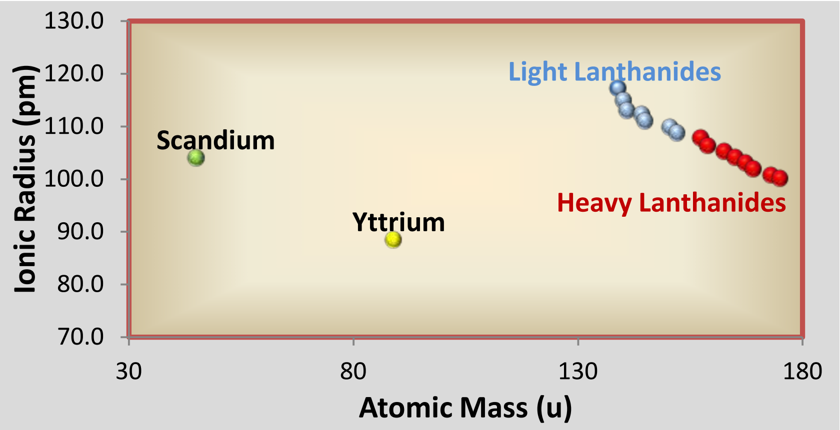

Figure 4. Trivalent ionic radium (pm) in 6-fold coordination versus atomic mass for Sc, Y and the lanthanides showing the lanthanide contraction. Data from Zepf (2013) and http:// www.webelements.com/

This feature gives rise to a saw-tooth pattern in plots of abundance *versus the* atomic number that is obviated by the employment of normalization plots in which the individual rare earths are divided by corresponding mean abundance values in various geologic materials such as the mean upper continental crust of Rudnick and Gao (2003).

Ionic state of the rare earth elements is predominantly trivalent although departures are evident such as Ce^{4+} and Eu^{2+}, respectively produced under oxidizing conditions at the earth's surface where Ce^{4+} can occur (Humphris 1984). or under reducing conditions where Eu achieves a divalent state. Promethium (Pm) only occurs in trace amounts in nature, as in pitchblende, and is largely produced by spontaneous fission of ^{238}U in nuclear reactors and hence will not be considered in this report.

Geochemical Properties of the Rare Earth Elements and Scandium

The term "rare" in rare earth elements is a historical misnomer that relates to early difficulties in chemical separation of the various rare earths (Zepf 2013). The lanthanide series elements, yttrium, and scandium are lithophile metals that are highly dispersed in the earth's crust. There relatively few economic deposits of the rare earth elements in contrast to metals such as gold and silver that have ubiquitous occurrences and producing mines. Typically the rare earths form silicate, oxide, phosphate and carbonate minerals and are never found in a native pure element state (Henderson 1984). The least abundant rare earths (Ho, Tb, Tm, and Lu) are about three to five orders of magnitude more abundant in the earth's upper continental crust than the rarest metals such as gold, platinum, palladium, iridium, rhenium, and osmium (Figure 4).

The lanthanides share very similar chemical properties and hence exhibit strong geochemical coherence in various geologic materials (Mariano 1992; Chackhmouradian and Wall 2012).

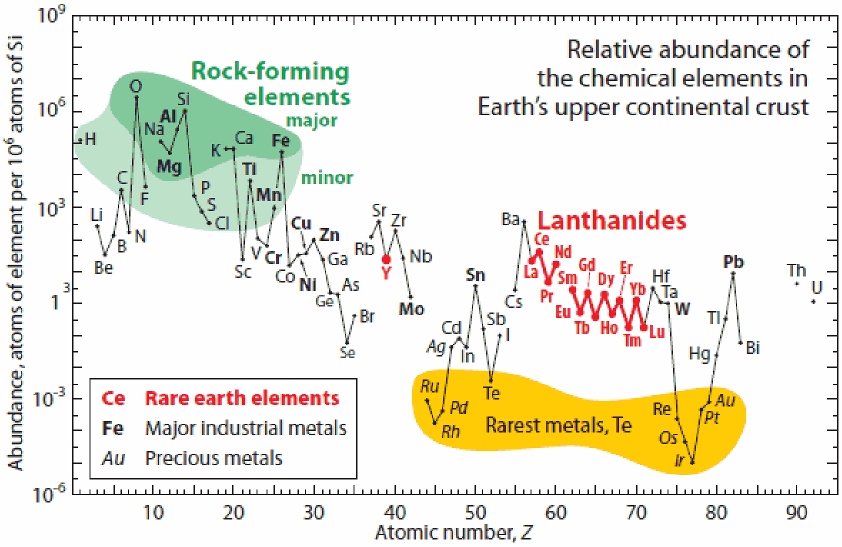

Figure 5. Element abundance *versus* atomic number for elements in the periodic table. The lanthanides are many times more abundant than the rarest metals in the earth's crust. Source - US Geological Survey.

The chemical similarity amongst the lanthanides results in numerous of its metals present in a given crystal structure, as for example, the allanite group which can contain Ce, La, Pr, Nd, Sm, Y and some of the HREE https://www.mindat.org/min-46220.html

Table 1. Selected chemical features and mean upper continental crust abundances of the rare earth elements.

Element	Symbol	Atomic Number	Atomic Mass (u)	Ionic Radius (pm) Trivalent, 6-fold coordination[1]	Atomic diameter (pm)[2]	Oxidation States	Mean Abundance ($\mu g\ g^{-1}$) Upper Continental Crust[3]
Scandium	Sc	21	45	104.0	162	+3	14
Yttrium	Y	39	89	88.5	180	+3	21
Lanthanum	La	57	139	117.2	187	+3	31
Cerium	Ce	58	140	115.0	182	+3 +4	63
Praseodymium	Pr	59	141	113.0	182	+3 +4	7.1
Neodymium	Nd	60	144	112.3	181	+2 +3 +4	27
Promethium	Pm	61	145	111.0	181	+3	no natural occurrence; product of uranium fission
Samarium	Sm	62	150	109.8	180	+2 +3	4.1
Europium	Eu	63	152	108.7	204	+2 +3	1.0
Gadolinium	Gd	64	157	107.8	179	+3	4.0
Terbium	Tb	65	159	106.3	178	+3 +4	0.7
Dysprosium	Dy	66	163	105.2	177	+3 +4	3.9
Holmium	Ho	67	165	104.1	176	+3	0.8
Erbium	Er	68	167	103.0	175	+3	2.3
Thulium	Tm	69	169	102.0	174	+2 +3	0.3
Ytterbium	Yb	70	173	100.8	193	+2 +3	2.0
Lutetium	Lu	71	175	100.1	174	+3	0.3

1. data compiled from <http://www.webelements.com/>

2. Zeft (2013)
3. Rudnick and Gao (2003)

Scandium is usually not included in the lanthanide group and it exhibits varied substitution in minerals that contain Mg, Fe^{2+}, Zr, and Sn such that enrichment occurs in a range of deposit types such as hydrothermal Sn–W, ilmenite magmatic (FTP deposits), uraniferous alkali metasomatites, bauxite (and derived red mud), biogenic phosphate deposits and some coal deposits (Chackhmouradian and Wall 2012). Scandium is a component in at least 19 different minerals, as silicates (57%), phosphates-arsenates-vanadates (21%) and oxides (21%) that include bazzite, cascandite, heftetjernite, jervisite, juonniite, kolbeckite, kristiansenite, magbasite, pretulite, Sc-Ixiolite, Sc-perrierite, scandiobabingtonite, and thortveitite (Raede 2003). Scandium content in these minerals ranges from 1.19 to 32.13 wt.% https://www.mindat.org/element/Scandium (*see* Appendix 4).

The rare earth elements exhibit a strong geochemical association with calcium. Other metals of the alkaline earth group (Ba, Sr, Ra) may be elevated in rare earth element mineral deposits (*e.g.,* carbonatite-hosted LREE mineralization). Anions that may be found in rare earth minerals include PO$_4$, CO$_3$, F, OH, and O.

Rare earth elements also have a strong affinity for Th and U and thus many radioactive mineral occurrences contain variable amounts of the rare earth elements, in addition to Y and Sc. Canada has many thousands of known radioactive mineral occurrences and deposits (Lang *et al.* 1962). Uraninite, coffinite, brannerite, and thorite are common accessory hosts for the REEs in rare earth element deposits (Krishnamurthy and Gupta 2015).

PRESENT SURVEY

This report encompasses the preliminary results of a June 5 to 19, 2014 field and geochemical investigation of the Lackner Lake alkalic silicate rock-carbonatite complex that is situated 40 km by road from Chapleau, Ontario. The field work examined 125 localities, amassed 195 gamma-ray spectral assays, 71 grab samples for lithochemistry (Bureau Veritas Mineral Labs) and four high purity apatite mineral concentrate analyses (ALS Global Labs). Locations of the lithochemistry samples can be found on the geological base in Figure 5 and NAD83 UTM coordinates in Appendix 1. Analytical data and laboratory quality control reports are given in Appendices 2 and 3.

Maximum relief of the Lackner Lake complex is 150 m within the northeastern part that is marked by two gorges that were possibly produced by Pleistocene outwash activity (Gao *et al.* 2014). Southern parts of the complex are generally of lower relief and covered by sand and gravel outwash deposits. At higher elevations above the 440 m topographic contour, basal till with abundant boulders of nepheline syenite is a dominant surficial deposit. Nepheline syenite boulders and numerous outcrops that exhibit spheroidal weathering and related talus are obvious along the Lackner Lake Road as a dull grey gravel with a pinkish tinge. Surficial geological mapping and heavy mineral analysis have recently been undertaken in the Chapleau area by Gao (2013) and Gao *et al.* (2014).

Field work focused upon the areas of known mineralization that were delineated in the historical exploration work of the 1950's and 1960's, mainly by Multi-Minerals Limited (Sage 1988a). High values of rare earth elements up to 9.6 wt.% $\Sigma REO+Y_2O_3$ were discovered in 2007 at Pole Lake in the northern part of the Lackner Lake alkalic complex (Vale Canada Exploration 2007). In addition, examination of old blast pits in massive magnetite mineralization at the NE Camp Lake magnetite zone, located with the gamma-ray spectrometer, was also undertaken as there is no record of this showing in the literature.

Summary of the historic, non-43-101-compliant resources areas in the Lackner Lake alkalic complex:

- **Zone 2:** 80 Mt averaging 0.18 wt.% Nb_2O_5 over 420 m strike and depth of 240 m
- **Zone 3-4**: 37 million tons of 13.7 % magnetite, 21.3 % apatite, 0.17 % Nb_2O_5 to the 150 m depth
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Further examination of the Pole Lake REE-Ba-Th-Nb occurrence was also undertaken (*see* Pole Lake REE-Ba-Th-Nb showing below). Previous work by Vale Exploration Canada Ltd. (2008) and Breaks (2009 and 2013) indicated elevated TREO + Y_2O_3 values, up to 9.6 wt.%, that is the highest yet reported in Ontario to the author's knowledge. The previous detailed mineralogical examination was limited to two samples from the Pole Lake REE-Ba-Th-Nb occurrence that verified the presence of britholite-(La), a britholite-like mineral, monazite, barite, and Y-rich fluorapatite in a hydrothermally altered nepheline syenite (Breaks 2013).

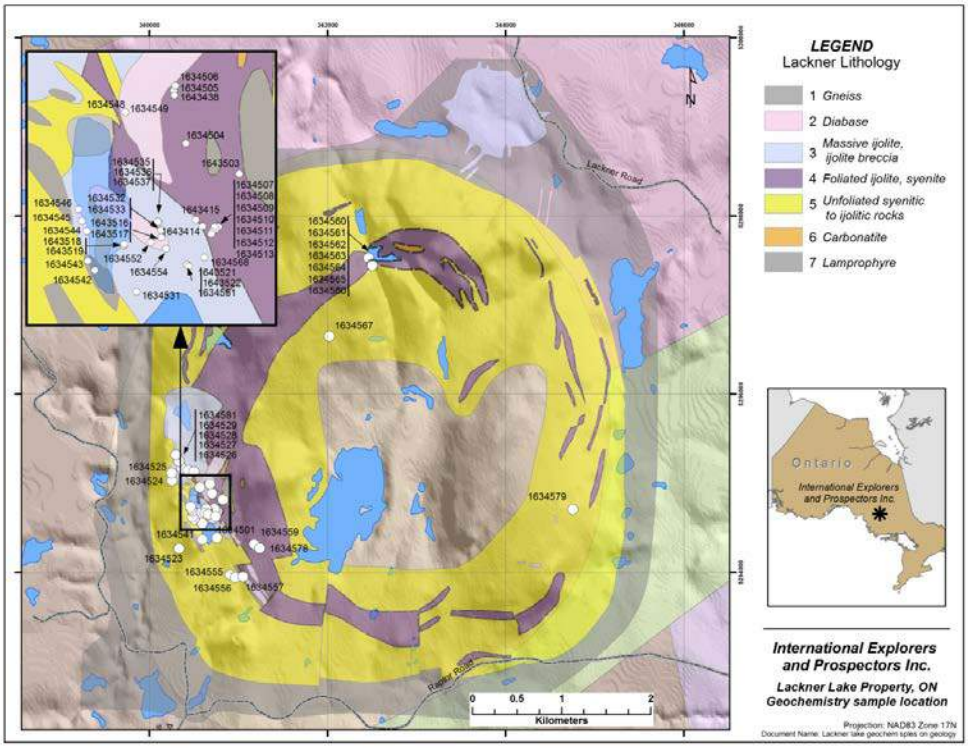


Figure 6. Location of chemically analyzed rock samples from the Lackner Lake alkalic complex in relation to digital elevation model. Geology compiled from Parsons (1961b) and Thurston *et al.* 1977). Brown area in the centre of the complex has no rock exposure.

Field and Chemical Data Analytical Procedures

Location data for all sample sites were provided using Universal Transverse Mercator (UTM) coordinates for Zone 17T in North American Datum 1983 (NAD 83) obtained with a Garmin 62S GPS device (Appendix 1). Spectral assay data, as %K, eU (ppm) and eTh (ppm), were acquired with a Terraplus RS-125 gamma-ray spectrometer from 155 bedrock and soil measurement sites. All data collected with the spectrometer including UTM locations are given in Appendix 1. Measurements in assay mode were taken on flat horizontal surfaces (*e.g.,* Frontispiece) wherever possible with counting times of 2 minutes.

Rock samples destined for chemical lab analysis were cleaned of soil and adhering organic material. Weathered surfaces were removed by a water-cooled diamond saw and a reference hand specimen was retained for each sample. Major, minor and trace element analysis of 71 rock grab samples were analyzed by Bureau Veritas Minerals Lab utilizing lithium borate fusion and four acid digestion in preparation for ICP-MS work (*see* Appendix 2).

Four high purity apatite mineral concentrates from the mineralized zones of the Lackner complex were produced by diligent grain picking under an Omax binocular microscope at 15X magnification. Between 1 and 2 grams of apatite concentrate were then ground to a fine powder with a ceramic mortar and pestle by the author. The purity of the apatite is estimated at about 99%. These concentrates were analyzed with ICP-MS by ALS Global Labs using a lithium borate fusion and 4 acid digestion preparation. Apatite mineral analytical data can be found in Appendix 3.

Bulk rock lithochemical data and uranium, thorium and potassium spectral assay data were processed with the Geochemical Data Toolkit (GCD kit) that is petrogenetic software freely available at <http://www.gla.ac.uk/gcdkit/> (Janousek, Farrow and Erban 2006). The chemical variation of the rare-earth elements was mainly assessed with chondrite-normalized plots calculated by the reference standard of Boynton (1984). The chondrite-normalized ratios La/YbN and Eu/Eu* are respectively employed to reveal the degree of the rare-earth element fractionation and the extent of repletion/depletion of europium. Various diagrams were produced by the import of metafile images from GCD kit into CorelDraw X4 graphic software.

The REE chondrite-normalized diagrams are particularly useful in assessing genetic relationships between the various rare earth element-enriched alkalic rocks on the Lackner Lake property and comparison with rare earth element mineralized carbonatite-alkalic silicate rock systems elsewhere such the Kovdor carbonatite-phoscorite complex, Russia (Krasnova *et al.* 2004; Wall 2010).

This report is prolifically illustrated with photos of all rock types and various mineralization types encountered. Earlier publications present little useful pictorial information on the diverse lithologies of the Lackner Lake complex.

Property Description and Location

The Lackner Lake property comprises 13 patented claims (85 units) and 9 unpatented claims (17 units), respectively in Lackner and McNaught townships. These contiguous claims cover an area of 1623 hectares (Figure 6).

Location of the claims with respect to a digital elevation model is presented in Figure 6. Access to the southwestern part of the complex is gained by the Serviss Lake Road that is a maintained logging road. However, vehicle access by the Lackner Lake and Camp Lake roads over the complex is hampered by beaver dam flooding of the Camp Lake Road and bushed-in sections of both roads by dense clusters of alder. Access by all-terrain vehicles, however, is feasible to the Camp Lake area and former Ontario

Dept. of Lands and Forests fire tower site near the Pole Lake REE-Ba-Th-Nb showing. Much of the property is unfortunately covered with old blow-down and dense secondary tree growth of poplar and alder that renders traversing difficult. Areas that are dominated by coniferous trees, as in the higher parts of the complex, have less blow-down and easier access via the old fire tower road.

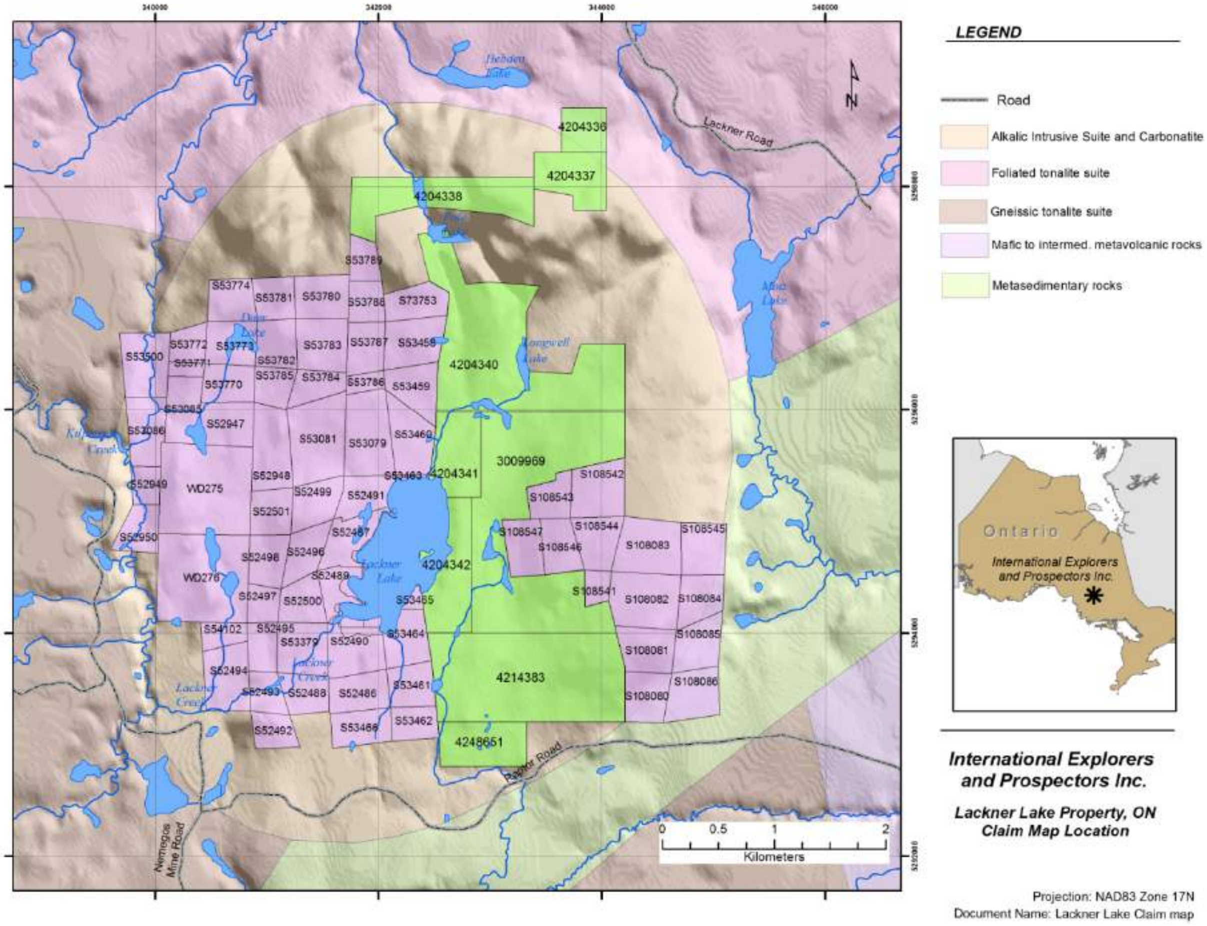


Figure 7. Claim distribution of International Explorers and Prospectors Inc. in relation to a digital elevation model for the Lackner Lake alkalic complex and surrounding terrain.

GEOPHYSICS

The Lackner Lake complex has been covered by airborne magnetic and radiometric surveys at several scales: 1:50 000 (GSC 2001) and 1: 20 000 by Fugro Geophysics (2010).

Small ovoid magnetic anomalies, that lie above 3 nT/m, are evident in Figure 7 of the first derivative of the magnetic field with Keating coefficients (GSC 2001). The magnetic anomalies occur internal and external to the main Lackner Lake alkalic plutonic mass and correlate with late magnetite masses and vein systems. Within the complex, seven anomalies are associated with the inner ijolite ring as at the Zone 6 deposit, the McVittie pit, Dare Lake and east and west of Pole Lake, and in the southern part of the complex.

The only known external ovoid anomaly occurs at Portage Lake and with a 2 km diameter is the largest late pipe-like body derived from the Lackner Lake alkalic complex. Four kilometres to the west of the Lackner Lake intrusion area, several curious ovoid to elongate magnetic anomalies are present and merit investigation as these could represent apophyses of carbonatite dykes and related metasomatic derivatives from the Lackner complex.

An elongate 1 by 5 km magnetic anomaly extends northeast from the Lackner alkalic intrusion (Figure 7) and lies in an area of metasedimentary rocks. This anomaly should be examined for carbonatite apophyses from the Lackner Lake complex.

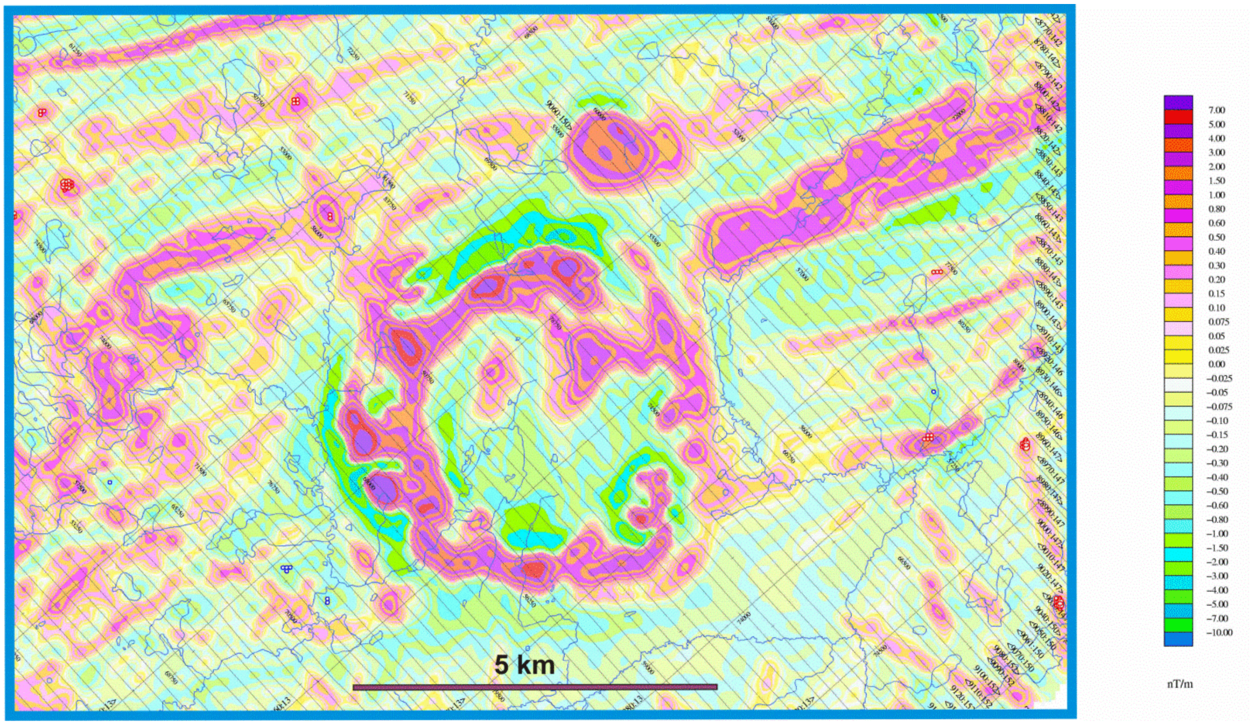


Figure 8. First derivative magnetic map of the Lackner Lake complex as extracted from the Chapleau 41O/14 sheet (GSC 2001). Values in nT/m.

Ground Radiometric Survey

A reconnaissance ground gamma-ray spectrometer survey was undertaken over all known rock types and mineralized zones in the Lackner Lake alkalic complex. This survey involved 195 sites that are tabulated in Appendix 1 and spectral assay data given as %K, eU (ppm) and eTh (ppm): IAEA 2003. Graphs of uranium *vs* thorium and thorium *vs* Th/U ratios of these lithologic groups are presented in Figures 8 and 9.

Several zones of elevated radioactivity above 7000 cps (K+U+Th) were located with the spectrometer, as for example, over heavily obscured pits that likely date from the 1950's in the Camp Lake area (UTM: 340773E, 5294697N), over the area of test pits on Beaverdam Lake and also at the Pole Lake REE-Ba-Th showing. In general, the radioactivity is mainly due to thorium. Rare earth element values generally correlate with thorium (Breaks 2013) that is plausibly related to the presence of monazite and britholite.

Elevated radioactivity is characteristic of ijolite and malignite that contain magnetite veins, as in the area around the Zone 6 deposit on Beaverdam Lake. Variable amounts of unknown orange and white minerals occur within the veins and masses that also contain pyrochlore and possible REE-bearing minerals. Thorium contents are consistently elevated compared with uranium (Figure 3) with a range of Th/U ratios between 25 and 103 that indicate extreme magmatic fractionation compared with the mean upper continental crust value of 3.8 (Figure 9 and Appendix 1).

Uranium values are generally below 50 ppm but numerous anomalous levels were found within and adjacent to the Zone 6 deposit at Beaverdam Lake (maximum: 265 ppm U) and also at the old test pits located by the present work near Camp Lake Road. The uranium mineral is possibly uranpyrochlore but electron microprobe and LA-ICP-MS analysis are needed for verification.

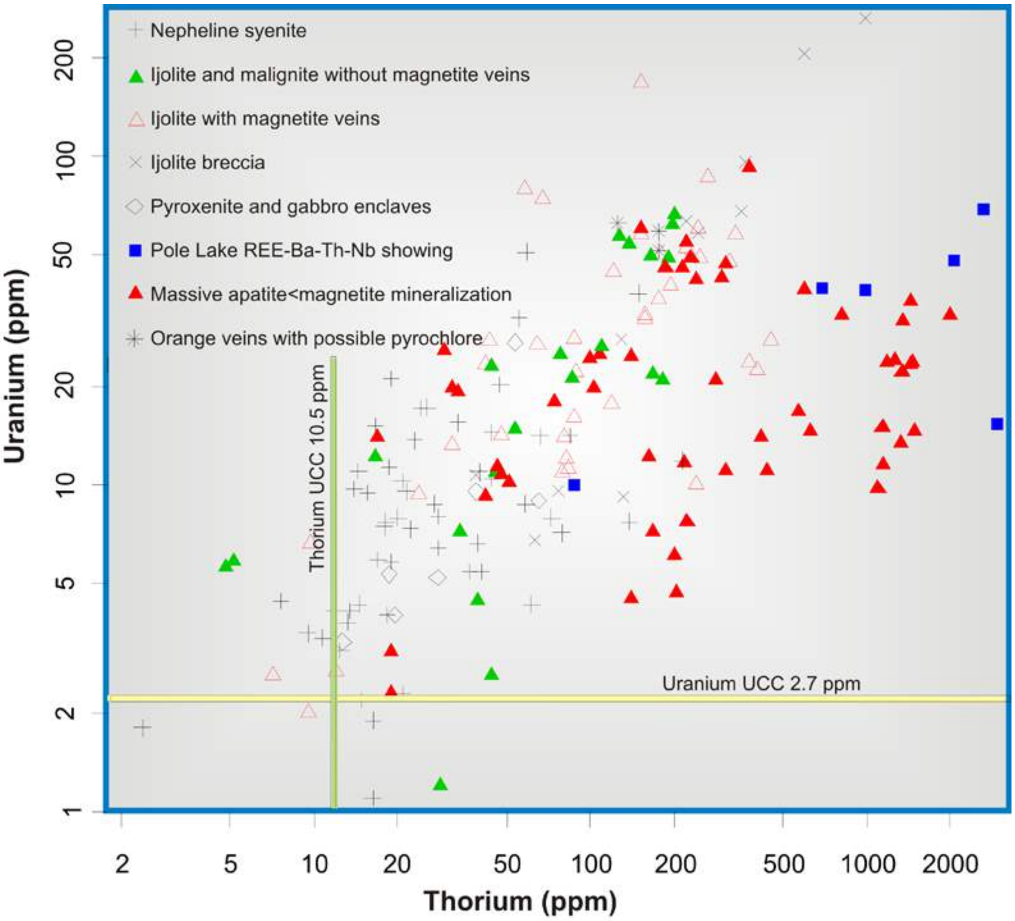


Figure 9. Uranium vs thorium for various lithologies and mineralized localities in the Lackner Lake alkalic-carbonatite complex. UCC indicates mean upper continental crust values for uranium and thorium after Rudnick and Gao (2003).

The old test pits located in this work (NE Camp Lake magnetite zone) also have elevated eTh (ppm) and eU (ppm) with mean values of 33.0 ppm eU and 1078 ppm eTh from 13 spectral analyses. Thorium, responsible for most of the radioactivity, lies in a range of 592 to 2010 ppm. Uranium has a more restricted range of 14.5 to 39.2 ppm.

Massive magnetite rock with layers and veins rich in emerald green apatite, situated at the largest test pit of Multi-Minerals Ltd. on Beaverdam Lake, has the third highest group of thorium values (mean = 1113 ppm; range = 567 to 1358 ppm).

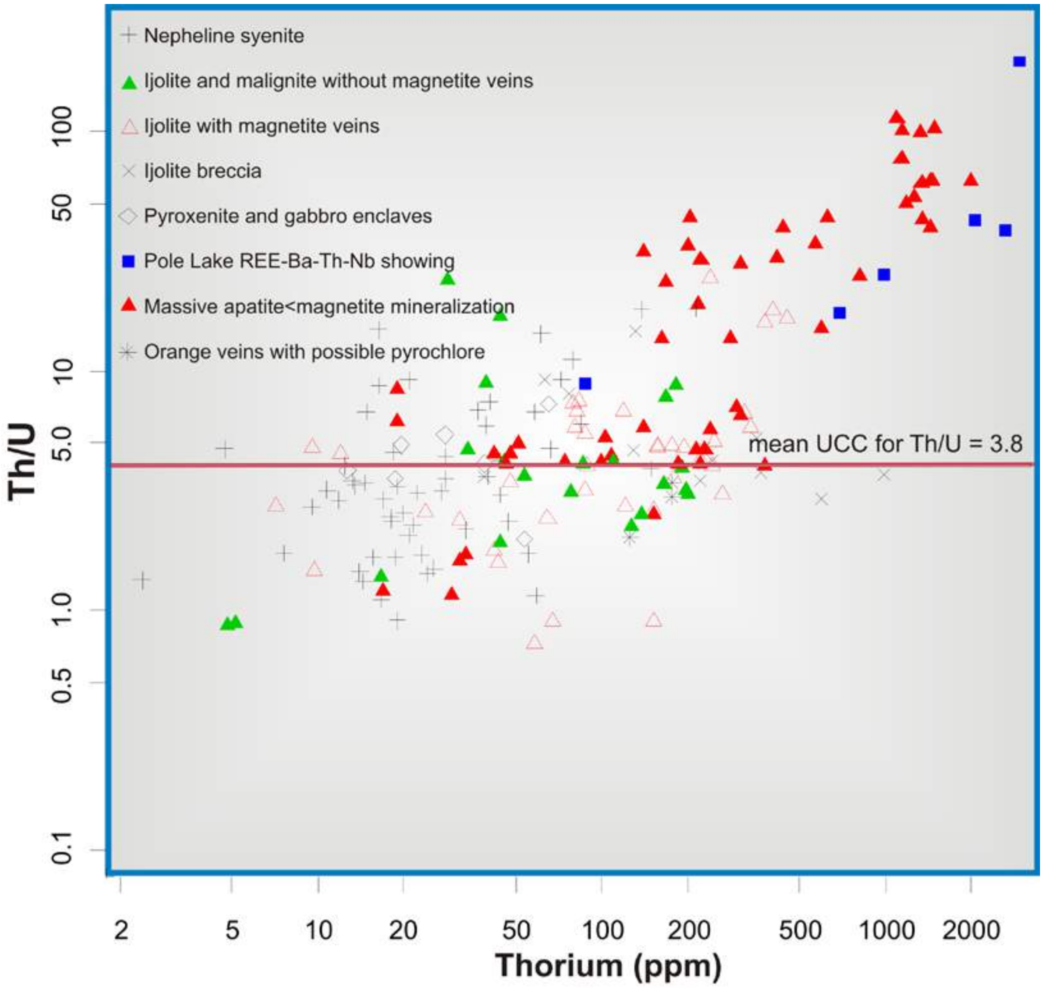


Figure 10. Th/U ratios *versus* thorium compared with average upper continental crust Th/U ratio of 3.8. UCC indicates upper continental crust mean ratio from Rudnick and Gao (2003).

GENERAL GEOLOGY

The 1138 ± 29 Ma Lackner Lake alkalic complex is situated within the Kapuskasing structural zone that also hosts several other alkalic rock-carbonatite intrusions such as at Seabrook Lake, Borden Lake, Nemegosenda Lake and in Cargill Township (Bell and Blenkinsop 1980; Sage 1988b). Woolley and Kjarsgaard (2009) assigned number 210 to the Lackner Lake complex on the world carbonatite map: *see* ftp://ftp2.cits.rncan.gc.ca/pub/geott/ess_pubs/225/225115/gscof_5796_e_2008_mn01.pdf

The Lackner Lake complex exhibits a partial ring structure (Figure 10) marked by an outer unit of nepheline syenite, an inner partial ring of ijolite and ijolite breccia and an adjacent inner mass of nepheline syenite. Late veins and masses of magnetite- and apatite-magnetite-rich rocks are well developed around the Zone 6 deposit of Multi-Minerals Ltd. and also around the McVittie pit, 650 m to the north.

The Lackner Lake alkalic complex is hosted by tonalite to granodiorite gneiss of the Kapuskasing Structural Zone and appears as a prominent ovoid anomaly in the first vertical derivative magnetic field (Figure 7 extracted from GSC 2001).

The main rock types in the Lackner Lake alkalic complex comprise foliated and massive ijolite, malignite, melteigite, ijolite breccia, leucocratic and melanocratic nepheline syenite and sparse, late dykes of carbonatite (sövite and silico-carbonatite) and apatite-magnetite masses and veins. Local fenitization of granitic gneiss host-rocks has been documented by Sage (1988a).

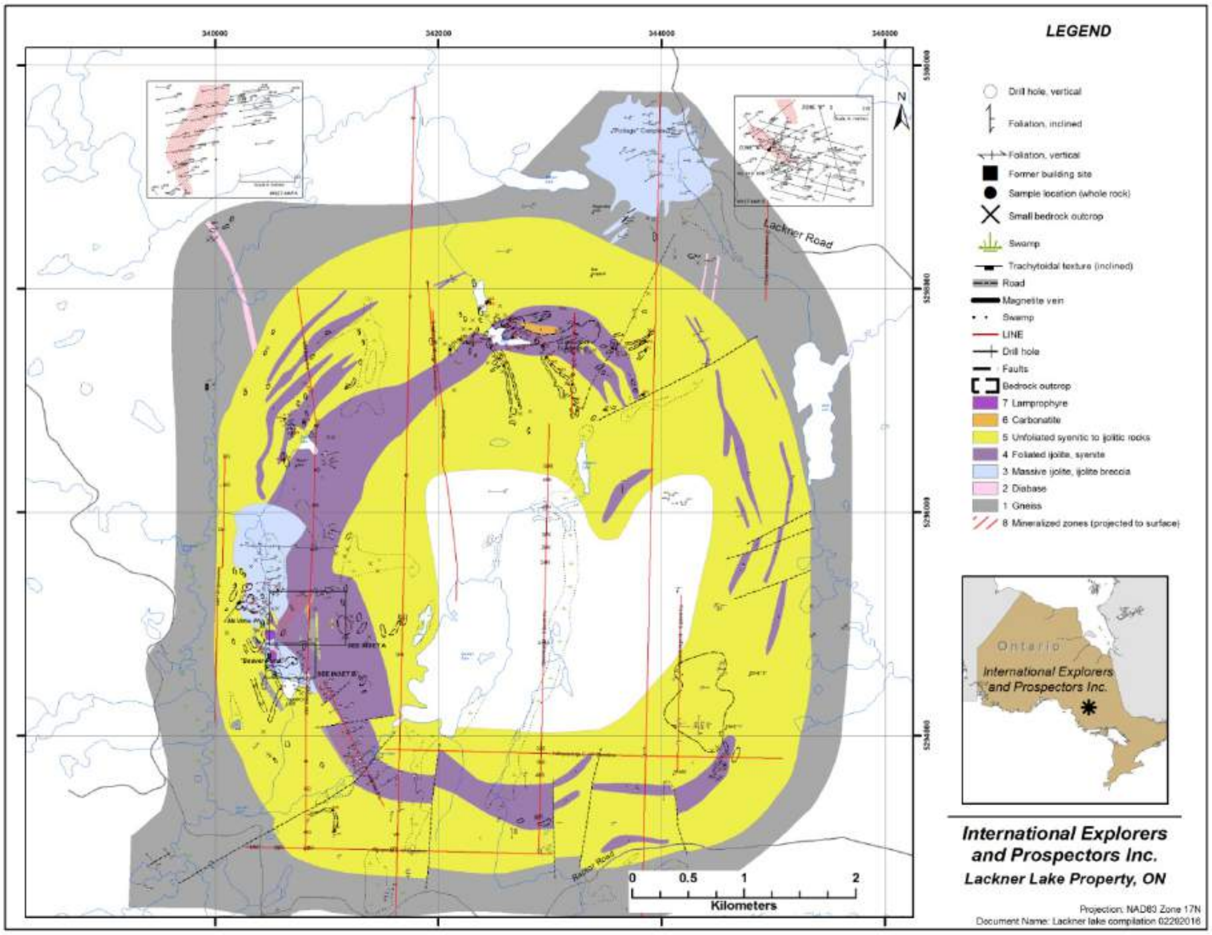


Figure 11. Geology of the Lackner Lake alkalic complex after Parsons (1961b).

Minor rock types include mafic and ultramafic alkalic enclaves in nepheline syenite, urtite and glimmerite, a phlogopite-rich rock considered to represent a metasomatic derivative as at the Araxá alkalic complex in Brazil (Traversa *et al.* 2001). Magnetite-rich veins, commonly with green apatite, represent the youngest intrusive unit in the complex and cross-cut all units. Exposed carbonatite veins are rare and cross-cut magnetite-rich mineralization at formerly undocumented historic trenches named the NE Camp Lake magnetite zone.

The centre of the complex is heavy drift covered and may contain a carbonatite core as the greatest amount of erosion has occurred in that area relative to the resistant ijolite ring structure and adjacent nepheline syenite. No drilling has investigated the possibility of a carbonatite core zone to date.

Mineral exploration conducted to 1988 has been comprehensively documented by Sage (1988a) and was also summarized by Vale Exploration Canada Limited (2007). A total of 40,101 m of drilling was amassed on various properties in the complex prior to the early 1970’s (Sage 1988a, p.39).

Minerals identified by Hodder (1961) and Sage (1988a) include pyrochlore, perovskite, cerianite, titanite, magnetite, ilmenite, aegirine-augite, diopside, olivine, melanite variety of garnet, zircon, cancrinite, sodalite, pseudoleucite, chlorite, orthoclase, albite, wollastonite, and riebeckite. Recent electron microprobe work (Breaks, in preparation) has also revealed ancylite and possible clinochlore. Sulphide minerals pyrite, chalcopyrite, pyrrhotite, and sphalerite were also verified by the past work.

Property Geology

This section will now provide brief descriptions of the main lithologies and mineralized rock types in the Lackner Lake alkalic complex**.**

Nepheline Syenite

Photo 2. Nepheline syenite on the west side of Camp Lake that reveals a trachytic texture defined by oriented K-feldspar laths embedded in a recessive weathered nepheline-rich matrix that is stained orange by weathering. Dark green pyroxene grains occur within the nepheline-rich matrix.

Nepheline syenites are spectacular rocks with coarse laths of K-feldspar that commonly exhibit a trachytic alignment and are embedded in a nepheline-rich matrix (Photo 2). Nepheline weathers recessively that ultimately leads to rock weakness and susceptibility to freezing/thawing that results in the formation of loose residual masses of nepheline syenite sand and gravel (Photo 3) as observed along old road cuts.

Photo 3. Spheroidal weathering along fractures in nepheline syenite dyke that intrudes the Zone 6 apatite-magnetite deposit near Camp Lake, former property of Multi-Minerals Ltd.

Urtite

Urtite is a relatively rare unit with more than 80% modal nepheline and is gradational into nepheline syenite. This rock type is gradational into nepheline syenite and hence may represent cumulate layers and pods. The best locality occurs near the western shore of Beaverdam Lake (Photo 4) at UTM 340499E, 5294600N.

Photo 4. Massive coarse-grained urtite from the west side of Beaver Pond that reveals an abundance of greasy grey, recessive weathered nepheline associated with minor K-feldspar and dark green pyroxene.

Ijolite and Ijolite Breccia

These black to green-black, massive and foliated, fine to coarse-grained rocks resemble amphibolite and occur mainly within the inner partial ring structure of the Lackner Lake complex. According to Sage (1988a) ijolite, malignite and melteigite represents the earliest rock unit in the complex. However, several outcrops in the Camp Lake area revealed conflicting relationships in which nepheline syenite enclaves were observed within ijolite (Photo 5). It may be that several events of ijolite magmatism are in fact the case.

The mineralogy is dominated by dark green-black diopside-hedenbergite, white to pink nepheline and subordinate K-feldspar. Some exposures contain 5 to 10 percent phenocrysts of steel black magnetite. Weathered surfaces are usually marked by the conspicuous presence of recessive, euhedral and subhedral grains of white, pink and faint blue nepheline with a porcellaneous appearance (Photo 7). Other minerals include K-feldspar, dark green pyroxene, and magnetite. Enclaves of mafic and ultramafic rock occur sporadically and may be deformed due to magmatic plastic flowage. Patches of vivid blue possible sodalite alteration occur sporadically in ijolite breccia and predate emplacement of magnetite veins (Photos 6 and 14).

Photo 5. Dark green-black ijolite intruded into nepheline syenite, with both units in turn crosscut by a magnetite-rich breccia dyke, to the left of the hammer that contains ijolite enclaves. Camp Lake Road south of the McVittie pit.

Photo 6. Patches of light blue nepheline and/or sodalite alteration in ijolite breccia, at pencil end, that is cut by a magnetite-rich vein in outcrop just west of the Zone 6 test pit.

Photo 7 . Massive, coarse-grained malignite near western shoreline of Beaverdam Lake at locality 1634548 (UTM 340450E, 5294968N) showing an abundance of white euhedral nepheline and sparse laths of K-feldspar in a matrix of dark green pyroxene.

Photo 8. Foliated ijolite in the vicinity of the Zone 3-4 apatite-niobium deposit with faint pink, sigmoidal vein fillings of carbonate and possible REE minerals, as near pencil, crosscut by planar fractures sealed with unknown minerals.

Thin veins filled with unknown white and faint pink minerals were observed at UTM 34117E, 5294317N on the Lackner Lake road near the Zone 3-4 apatite-niobium deposit (Photo 8).

Ijolite breccia with mineralization

A large mass of ijolite breccia, 0.3 to 0.5 by 1.2 km was delineated by Parsons (1961b) and is strongly associated with the massive magnetite mineralization and related magnetite veins at the Zone 6 deposit and at the McVittie pit. A wide variety of angular to rounded fragment types includes ijolite, magnetite masses, nepheline syenite and a fine-grained, felt-texture variant of K-feldspar-rich syenite (Photos 9 and 10).

Photo 9. Ijolite breccia at the Zone 6 deposit and adjacent to a pile of blasted boulders on Beaverdam Lake**.**

Photo 10. Pseudobreccia where magnetite-megacrystic ijolite has been replaced by masses of white to faint blue nepheline. Camp Lake Road at UTM 340337E, 5294268N.

Carbonatite

Carbonatite units are only sparsely evident on the surface at three known localities (Sage 1988a) but were encountered in significant intervals in drilling programs of Multi-Minerals Ltd. at the Zone 2 niobium deposit (Sage 1988a). Silico-carbonatite dykes with ΣREE of 7373 ppm and hosted in ijolite were encountered in the 2012 drilling of 6070205 Canada Inc. and 6378366 Canada Inc. in the south-central part of the Lackner Lake complex (Corstorphine 2012).

Photo 11. Silico-carbonatite pod that intrudes foliated fine-grained ijolite in a boulder near Pole Lake showing. Note brown metasomatic halo in the ijolite host due to fenitization.

Pods of silico-carbonatite cross-cut foliated ijolite as observed in talus boulders near the Pole Lake REE-Ba-Th-Nb showing (Photo 11). At the NE Camp Lake magnetite zone, silico-carbonatite crosscuts massive to subtly layered magnetite-rich rocks (Photo 18). Sage (1988a) inferred that the apatite-magnetite dykes are related to late carbonatite magmatism, however, this locality infers an episode of carbonatite activity later than the massive magnetite mineralization.

Mafic and Ultramafic Enclaves

Small enclaves, 5 cm to 1 m in length, occur sporadically in nepheline syenite and ijolite. These comprise gabbro, glimmerite, and alkalic ultramafic rocks. Glimmerite is also found as deformed veins in hydrothermally altered syenites at the Pole Lake showing (Photo 22). These rocks consist of >90% dark mica that is probably phlogopite in composition judging by the elevated MgO content in two bulk rock analyses (Appendix 2: 1634547 and 1634563). Glimmerite is a common constituent of many carbonatite-alkalic silicate rock complexes such as the Araxá complex of Brazil (Traversa *et al.* 2001; Fontana 2006). The gabbro and alkalic ultramafic enclaves are notable with the second highest scandium values in the present geochemical database at 33 and 42 ppm (Appendix 2: 1634541 and 1634543).

Apatite-Magnetite and Magnetite Veins and Masses

These intriguing rocks proliferate in the area proximal to the Zone 6 apatite-magnetite deposit on Beaverdam Lake northwards to the area around the massive magnetite mineralization at the McVittie pit. The veins, which range in width from a few cms to 1 m, cut nepheline syenite, and ijolite. Good examples can be found along the old Camp Lake Road north of the former buildings site of Multi-Minerals Ltd. on Camp Lake. Zones with the magnetite veins tend to exhibit elevated radioactivity (Figure 8).

Salient chemical features of the NE Camp Lake magnetite zone compared with the apatite-magnetite rocks from the Zone 6 test pit on Beaverdam Lake are given below in the Lithochemistry section. High MgO, and elevated trace levels of Cr, Co Ni and very low P_2O_5 (<0.01 wt.%) are other notable differences in the NE Camp Lake magnetite zone *versus* the Zone 6 deposit.

Photo 12. Magnetite-rich vein near McVittie pit that cross-cuts coarse-grained nepheline syenite.

Massive magnetite-rich rock intruded by silico-carbonatite was found by the present survey 100 m northeast of Camp Lake in a 15 by 80 m area that has not been examined since the 1950s judging by the heavy moss growth over numerous test pits. This locality has been named the "NE Camp Lake magnetite zone" by the author for ease of reference.

The magnetite-rich veins and masses have been interpreted as the youngest unit of the Lackner Lake complex (Sage 1988a) and sharply cut ijolite, malignite and nepheline syenite (Photos 6, 12, 13 and 14). Fragments of magnetite-rich rock were observed in ijolite breccia at the blasted rock pile at Beaverdam Lake (Figure 11). Late carbonatite veins and pods crosscut layering in magnetite-rich lithology at the NE Camp Lake magnetite zone (Photo 18). In some cases, dark green pyroxenite selvages envelop magnetite veins (Photos 13 and 14) and were first identified by Hodder (1961).

Photo 13. Nepheline syenite with a steel blue magnetite vein associated with dark green-black pyroxene-rich inter-connected alteration vein system. Camp Lake Road south of the McVittie pit. UTM 340337E, 5294268N.

Photo 14. Detail of vein system composed of deep green pyroxene and steel blue magnetite with local patches of faint blue nepheline as to the left of the coin. Note jagged contacts of vein system against a fine-to medium-grained, pink syenite host. Same locality as Photo 13.

Magnetite is the dominant mineral in the veins with subordinate green apatite, and several unknown white and orange minerals that could contain rare-earth elements (Photo 19). Cerianite (Ce^{4+}, ThO_2) has been verified in an apatite-magnetite unit along in the eastern part of the Lackner Lake complex (Graham 1955; Sage 1988a) but thus far not recognized in similar rocks of the present survey.

MINERALIZATION

The Lackner Lake alkalic complex has the potential for diverse commodities: niobium, rare earth elements, scandium and phosphate rock for the fertilizer industry. The important areas of mineralization will now be discussed in detail and in light of the recently acquired radiometric and lithochemical data. Detailed locations of lithochemical samples selected in the Zone 6 and nearby NE Camp Lake magnetite zone are shown in Figure 11.

Figure 12. Locations of Zone 6 apatite-magnetite deposit on Beaverdam Lake and the NE Camp Lake magnetite zone. Numbers represent individual and ranges of assay samples in Appendix 2.

Chemical and mineralogical data indicate that some of the magnetite-rich bodies in the complex compared with the chemistry of phoscorite pipe complexes but mineralogical verification work is required by electron microprobe and LA-MS-ICP (Laser Ablation-Mass Spectrometry-Inductively Coupled Plasma) analysis. A brief introduction to phoscorites is given in a section below.

Zone 6 Apatite-Magnetite Deposit

Zones rich in apatite exhibit primary layering within massive magnetite-rich and associated ijolite breccia rock at Beaverdam Lake (Photo 15). The apatite-rich rock consists of about 80% emerald green, vitreous apatite crystals that form a primary lineation due to crystallization directed normal to the primary layering. The remainder of the rock consists of titaniferous magnetite, small amounts of pyrochlore and rare diopside. Apatite may also occur as wispy veins within the massive magnetite zones (Photo 16).

Photo 15. Dark green, apatite-rich mineralization with flat-lying primary layering at least one metre thick, marked by hammer, at the east side of the Beaverdam Lake test pit of Multi-Minerals Ltd. Three chemical analyses gave respective mean values for P_2O_5 (14.5 wt.%), total rare earths (0.89 wt.%), total heavy rare earths (438 ppm) and Y (395 ppm). The ΣHREE values are the highest found to date within the Zone 6 deposit.

Photo 16. Sulfide stained massive magnetite-rich rock with wispy veins rich in green apatite as in the centre of the photo. Multi-Minerals test pit on Beaverdam Lake.

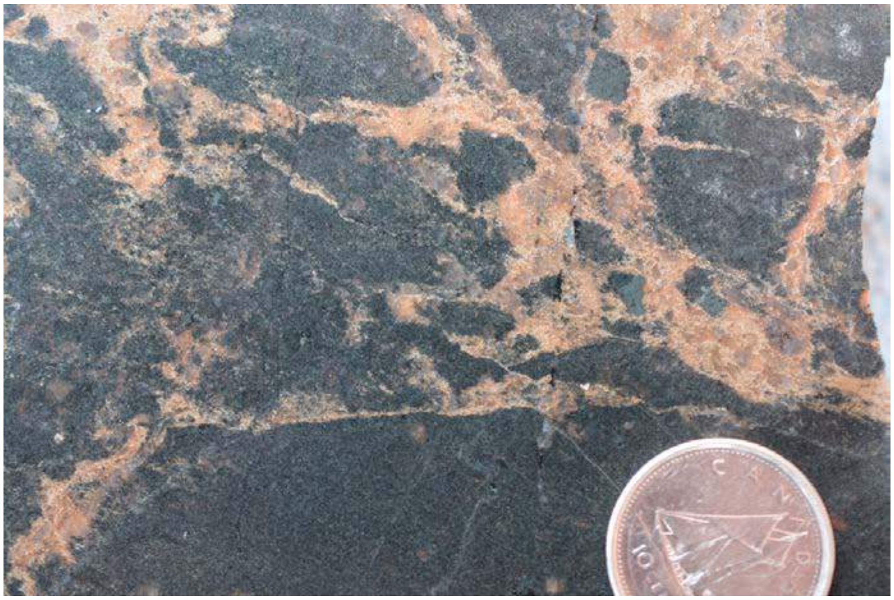


Photo 17. Niobium mineralization in ijolite breccia in boulder from a pile of blast material on Beaverdam Lake. The deep orange nepheline-rich matrix contains disseminations of masses of fine-grained, bronze coloured pyrochlore. The highest values for following elements obtained from this sample (1634554): Nb 1.73 wt.%, Ta 647 ppm, and U 754 ppm. Thorium is elevated at 2516 ppm but total REE is relatively low at 933 ppm.

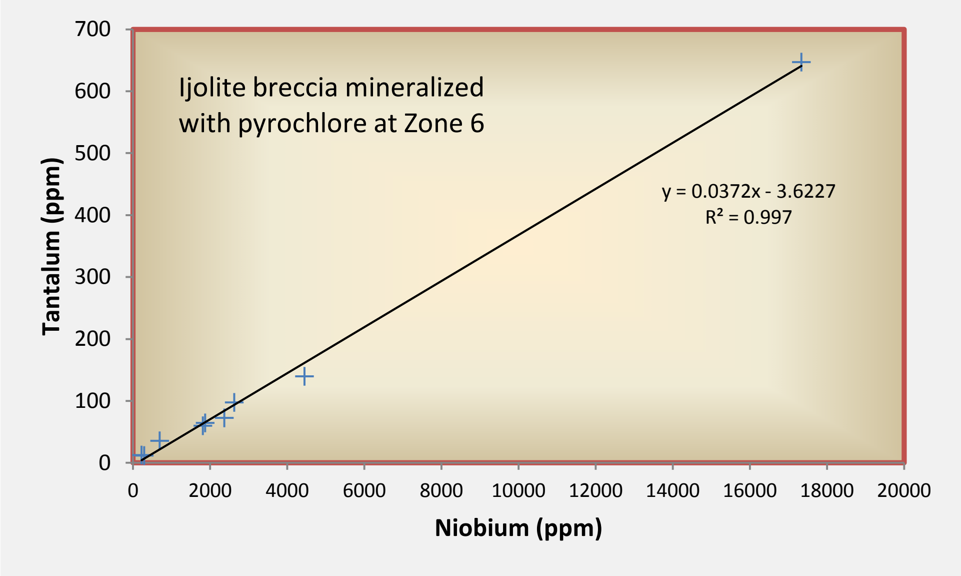


Figure 13. Tantalum *versus* niobium from samples taken from blasted boulder pile at Beaverdam Lake that shows strong correlation due to the mineralogical control of Ta and Nb in pyrochlore.

The magnetite body has a pipe-like morphology as determined by extensive drilling with a cross-section of 70 to 245 m and a minimum depth of 150 m (Mertec Resource Development Corp., 1974, p. 38). Niobium mineralization occurs within the vivid orange nepheline-rich matrix of the ijolite breccia (Photo 17).

NE Camp Lake Magnetite Zone

Magnetite-rich bodies with scant apatite also exist on the property as at a NE-oriented, 15 by 80 m low-lying elongate outcrop area situated 190 m east of the Beaverdam Lake test pit (Figure 11). This zone is apparently not part of the Zone 6 deposit which has differing chemical features.

Photo 18: Magnetite-rich rock from old test pit cut by late silico-carbonatite masses that transect subtle magmatic layering at top left corner.

Photo 19. Subtly layered, magnetite-rich material from old pits near Camp Lake Road at UTM 340773E, 5294697N. The dark brown area is rich in magnetite and disseminated white fine- to medium-grained minerals consist of calcite, pyrochlore, barite, and nepheline. Chemical analysis 1634507: FeOT 61.4 wt.%, MgO 12.2 wt.%, Ba 1626 ppm, Cr 1161 ppm, Nb 894 ppm, Th 554 ppm, and Sc 97 ppm.

Scandium values are anomalously elevated between 53 and 115 ppm (mean = 85 ppm) in a magnetite-rich rock of the NE Camp Lake zone and are distinctly higher than at the nearby Zone 6 magnetite-apatite deposit that has only <1 to 2 ppm Sc. The mean upper continental crust value for scandium is 14 ppm (Rudnick and Gao 2003).

The rock consists of 90 to 95% magnetite with the remainder consisting of calcite and unidentified pink and white minerals (possible barite). Subtle layering is due to 1-2 cm wide bands rich in fine-grained calcite (Photos 18 and 19). The second highest group of thorium values on the property were found in this zone with eTh assays up to 2020 ppm and chemical lab analyses in a range of 555 to 2002 ppm Th (Appendix 1).

Scandium, thorium and uranium minerals were not identified at this locality that would require at least electron microprobe and LA-ICP-MS work but could, in part, involve fine-grained monazite and uranpyrochlore. At the Kovdor phoscorite-carbonatite complex, interesting values up to 780 ppm Sc_2O_3 were documented in baddeleyite from an apatite-magnetite deposit (Kalashnikov *et al.* 2016). Other minerals that contain scandium at Kovdor complex include pyrochlore and ilmenite groups, zirconolite, and juonniite (Krasnova *et al.* 2004). Juonniite [$CaMgSc(PO_4)_2(OH)\bullet4(H_2O)$] with 17.76 wt.% Sc_2O_3 was identified in metasomatic calcite-phlogopite-clinohumite-magnetite ores in a calcite-dolomite carbonatite stockwork zone in the Kovdor complex (Krasnova *et al.* 2004) that could have similarity to the NE Camp Lake zone in the Lackner Lake complex where anomalous scandium values were found in this study.

Massive Magnetite-rich Rock at McVittie Pit

Magnetite-rich rocks, similar in composition to the Zone 6 deposit, are situated within an ovoid magnetic anomaly 650 m northwest of Zone 6. This 120 m by 430 m zone was delineated by 8 drill holes and was found to consist of magnetite-rich stringers, veins, and blobs with sparse pyrochlore and apatite (Mertec Development Corp. 1974).

Chemical features of the McVittie pit magnetite-rich rocks are similar to those at Zone 6 deposit as shown in horizontal bar charts (*see* Figure 15). The McVittie pit magnetite zone contains the highest total iron as FeO (77.38 wt.%) and TiO_2 (11.06 wt.%) and lowest total rare earth element content (20 ppm) in any single grab sample.

Mineralization in Phoscorite Pipe Complexes

Phoscorite is a rare derivative of carbonatite systems and is known only at 21 global localities (*e.g.*, Kovdor mine, Russia: Photo 20) with several occurrences in Russia and Brazil (Krasnova *et al.* 2004; Fontana 2006). Phoscorite is an apatite-magnetite-carbonate rock that contains essential minerals olivine and/or diopside and/or phlogopite and less than 50% carbonate minerals.

The most famous and type locality of phoscorite is the Phalaborwa alkalic-carbonatite complex in the Republic of South Africa where the rock name was derived after the Phosphate Development Corporation (FOSKOR) that mines phosphate ore (Krasnova *et al.* 2004).

Some of the apatite-magnetite and magnetite-rich rocks in the Lackner Lake complex exhibit close comparison in the Woolley-Kempe diagram of Figure 19 and also in the MgO *vs* FeOT plot (Figure 20) but differ in containing sparse carbonate minerals.

Few localities are currently known in North America and phoscorite has been inferred in the Prairie Lake carbonatite near Thunder Bay as masses of 10 to 20% coarse-grained magnetite crystals, 10 to 15% apatite in a very coarse-grained calcite matrix that occurs in silico-carbonatite from a drill intersection but phoscorite characterization minerals olivine, diopside or phlogopite were not mentioned (Giroux 2009).

Photo 20. View of open pit at Kovdor phoscorite-carbonatite complex, Russia where numerous commodities are extracted: magnetite, apatite, phlogopite, vermiculite and baddeleyite: 512 mT Fe @ 25.4 wt.% ; 35 mT apatite rock @ 7.3 % P_2O_5; 0.16 wt % ZrO_2. The dark area comprises phoscorite cut by white carbonatite dykes. Photo by Francis Wall, University of Exeter.

These apatite-magnetite rocks occur as late pipe-like bodies that crosscut earlier alkalic rocks and carbonatite units (Fontana 2006). The writer is not aware of any existing nomenclature for phoscorite sub-types but three mineralogical variants are recognized (Krasnova *et al.* 2004):

- forsterite-rich
- magnetite-rich, and,
- apatite-rich.

REE Mineralization Associated with Late Hydrothermal Alteration

Rare earth element mineralization associated with late hydrothermal activity guided by ductile deformation zones occurs at the Pole Lake occurrence and also in shears in ijolite north of the Zone 6 deposit. The hallmark chemical signatures of this style of REE mineralization applicable to mineral exploration include:

- high REE contents with pronounced negative Ce anomaly in chondrite plots (Figure 13), and,

- high barium (mean = 2.9 wt.%; range 2.09 to 3.7 wt.%).

Pole Lake REE-Ba-Th-Nb Occurrence

The rare-earth element mineralization at the main Pole Lake showing is associated with a deep pink, strongly hematite-altered, banded, fine-grained, barite-phlogopite-aegirine/augite nepheline syenite and relatively massive, deep pink, aegirine-nepheline syenite (Photos 21 and 22). Hydrothermally altered britholite-monazite-barite-enriched syenite from the mineralized zone is shown in Photo 23.

The mineralization coincides with a zone of high radioactivity, estimated at least 3 to 5 m thickness, distributed along the cliff face. The values of eTh (ppm) are the highest encountered in the entire Lackner Lake complex with a range from 692 to 2692 ppm (Figure 8). The full extent of the REE mineralization is not known as it appears that some of the Pole Lake zone could be buried under the significant talus pile. The chondrite-normalized REE chart shows the presence of distinct negative cerium anomalies that are not found elsewhere in the Lackner Lake complex. It is inferred that oxidized hydrothermal fluids scavenged Ce^{+4} from the altered syenite with redistribution into the thin silica-rich veinlet system.

Photo 21. Altered pink apatite-magnetite-aegirine syenite at the base of the cliff which comprises the only *in situ* exposure of the Pole Lake REE-Ba-Th-Nb zone. Assay 1634565 represents a 70 cm chip sample across this zone in upper left corner that returned 3.4 wt. % ΣREE, 1514 ppm ΣHREE, 5005 ppm Th, and 2.62 wt.% Ba (Appendix 2). The zone is open in width as a large talus pile covers the mineralization to the right of the hammer.

Photo 22. Strongly radioactive gneissic syenite with deep brown-black glimmerite pod marked by pencil in a large angular boulder near the cliff at Pole Lake REE-Ba-Th-Nb showing. Assay 1634561 of pink syenite to the right of pencil returned 2.9 % Ba, 5.06 wt.% ΣREE, 1445 ppm ΣHREE, 1038 ppm Y and 3958 ppm Th.

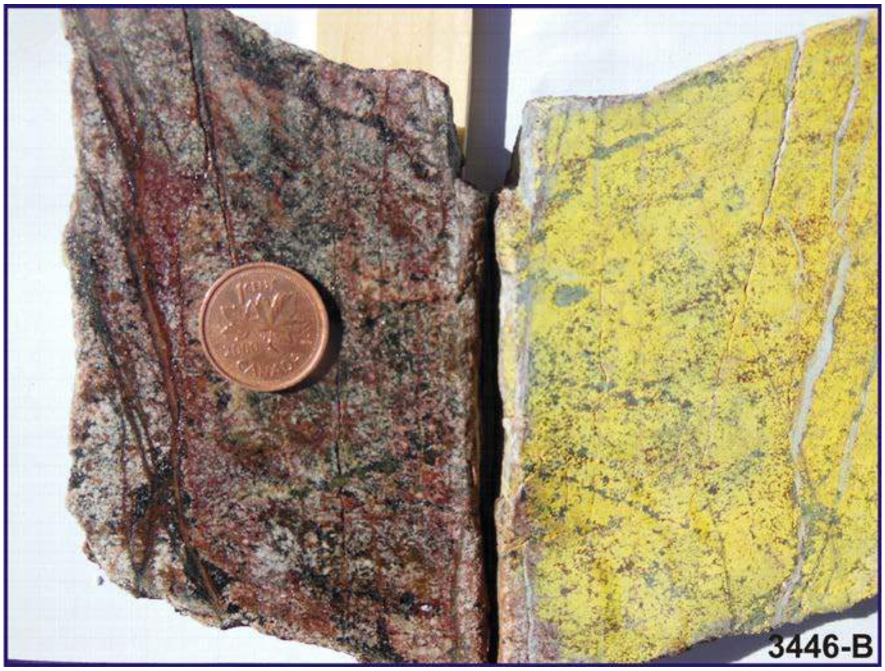


Photo 23. View of cut slab surfaces of hydrothermally altered, fine-grained barite-phlogopite-aegirine-augite nepheline syenite cut by milky quartz veinlets from Pole Lake with 6.07 wt.% total REE. Left side is a polished surface showing widespread hematization whereas right side has been etched with HF and stained for K-feldspar and nepheline (yellow area). Rare earth minerals monazite, britholite-(La) and Y-enriched fluorapatite were documented by Breaks (2013).

The ijolite and malignite host rocks in the immediate area of the mineralization are characterized by deep red, late fracture coatings of hematite and natrolite (Photo 24) that are plausibly part of the rare earth-bearing hydrothermal alteration system.

Photo 24. Fracture surface composed of brick-red natrolite, dark green clinopyroxene and niobium titanite hosted in ijolite near the Pole Lake REE-Ba-Th-Nb occurrence. The white area along the bottom consists of organic matter.

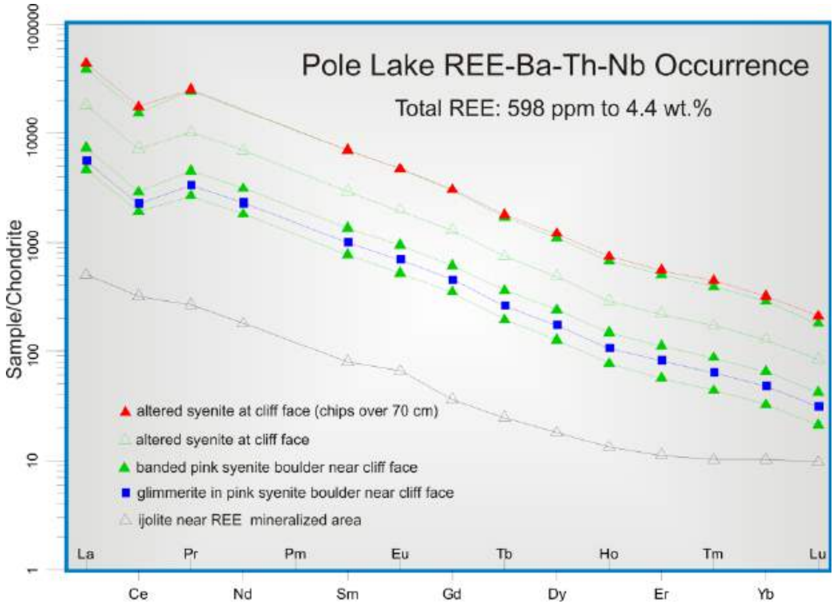


Figure 14. Chondrite-normalized REE plot for samples from the Pole Lake REE-Ba-Th-Nb occurrence.

The main REE minerals were determined to be monazite-(Ce), britholite-(La), britholite-like mineral, a secondary REE mineral not fully characterized and a Y_2O_3-LREO-bearing fluorapatite (Breaks 2013).

Britholite-(La) and its altered equivalents occur in two textural settings:

- primary grains enveloped by later phlogopite, nepheline and K, Na feldspar, and,
- late-stage micro-vein infillings.

Beaverdam Lake Niobium-Mineralized Shears

Brittle shears in ijolite were encountered 450 m north of the Zone 6 test pit and are obvious by a distinctive orange associated alteration with increased radioactivity possibly due to fine-grained uranpyrochlore (Photo 25).

Photo 25. Sub-parallel shears with attendant alteration by abundant unknown, fine-grained orange minerals hosted in strongly deformed ijolite, 450 m north of Zone 6 test pit of Multi-Minerals Ltd. Assay 1634549 comprised a concentrate of orange altered material.

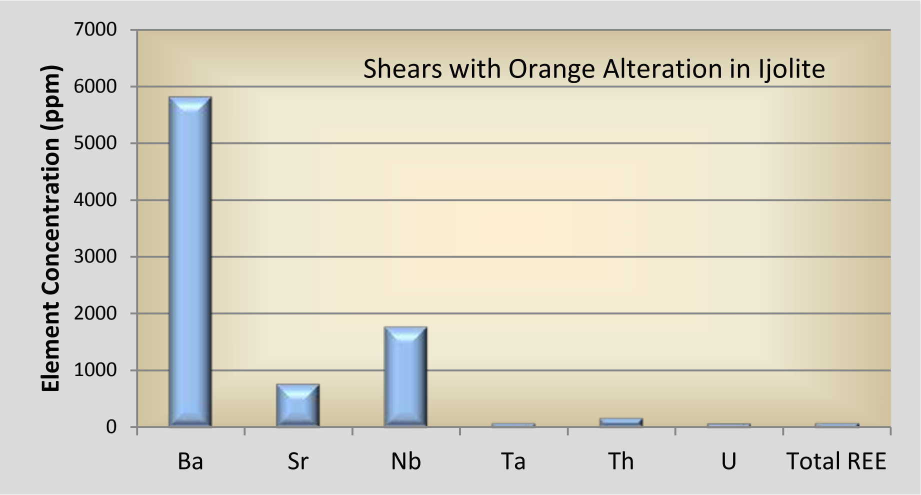


Figure 15. Chip sample composite of orange altered and sheared ijolite for sample 1634549 showing the content of Ba, Sr, Nb, Ta, Th, U, and total REE.

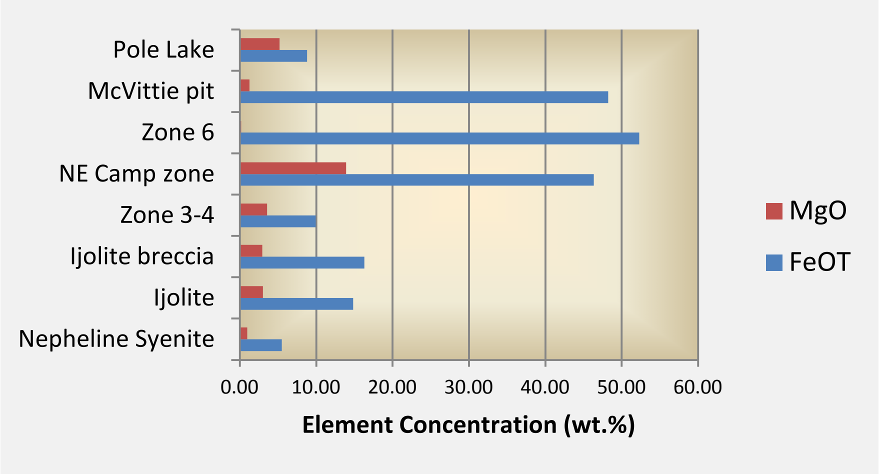
The orientation of N-S shears is parallel to the valley that contains Camp and Beaverdam lakes. A concentrate of orange alteration material was amassed for chemical analysis (Appendix 2: 1634549) and revealed high barium (5814 ppm), niobium (1765 ppm), tantalum (73 ppm), uranium (69 ppm), thorium (165 ppm) and very low total REE (73 ppm) as shown in Figure 14.

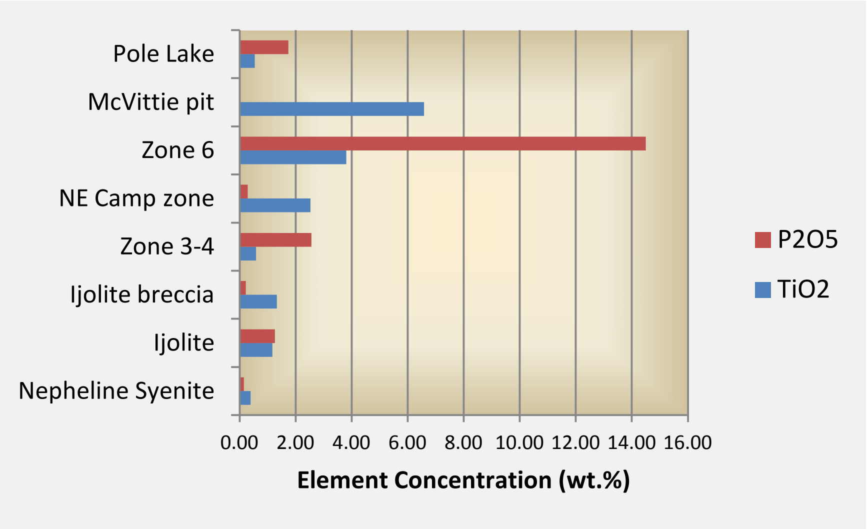
LITHOCHEMISTRY

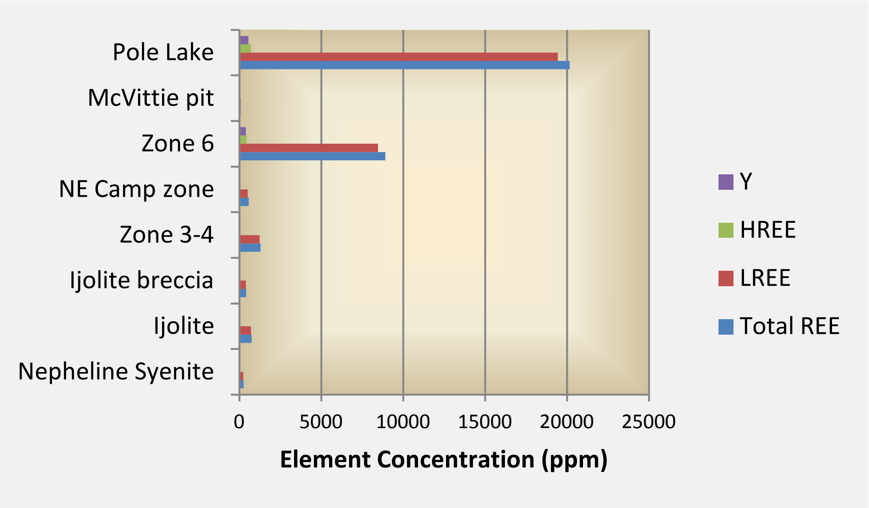
Significant chemical variation was found amongst various general lithologic groups and associated mineralization. Horizontal bar charts of the mean values for MgO, FeOT, P_2O_5, Ba, Sr, Ta, Nb, U, Th, total REE, total LREE, total HREE, Y and the five critical rare earth elements Nd, Eu, Tb, Dy and Y allow quick comparison between the eight major lithologic groups. The groupings used for the seven charts below are as follows:

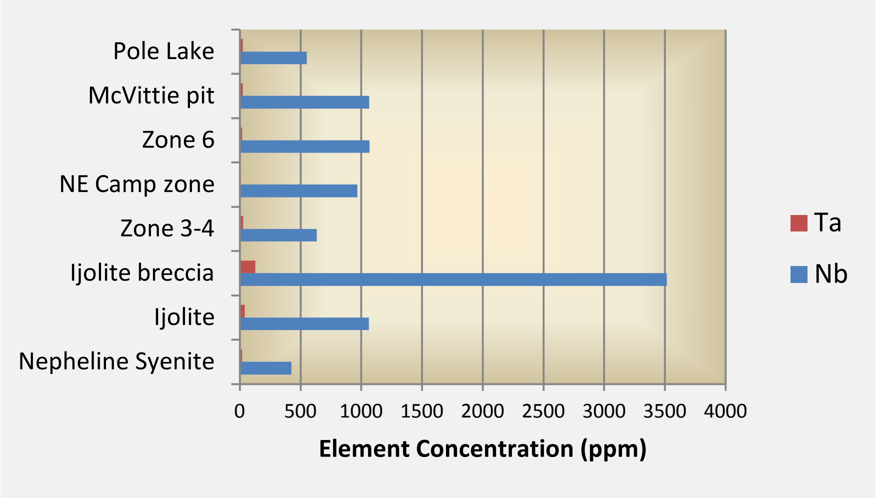
- nepheline syenite
- ijolite and malignite
- ijolite breccia
- Zone 3-4 P_2O_5-Nb deposit
- Zone 6 Fe-TiO_2 -P_2O_5-Nb deposit
- NE Camp Lake magnetite zone
- McVittie magnetite zone, and,
- Pole Lake REE-Ba-Th-Nb occurrence.

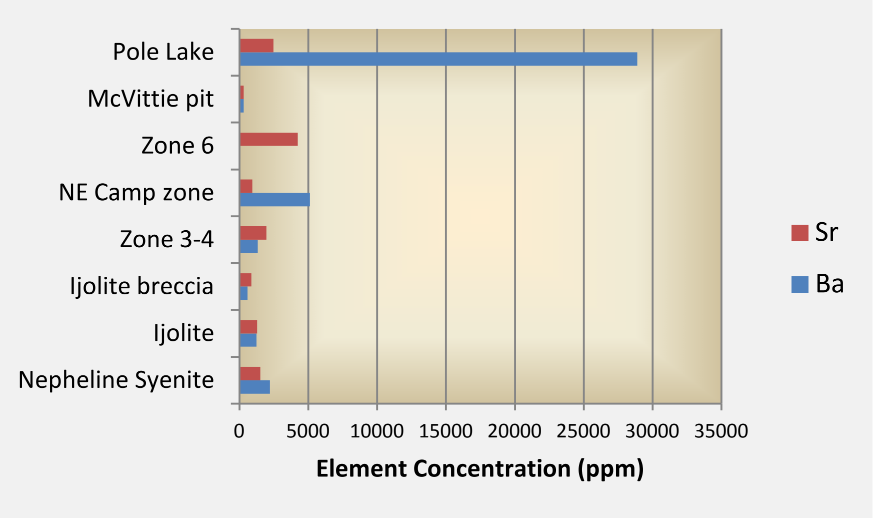
Figure 16. Horizontal bar charts for mean values of MgO, FeOT, P_2O_5 , Ba, Sr, Ta, Nb, U, Th, total REE, total LREE, total HREE, Y and the five critical rare earth elements Nd, Eu, Tb, Dy and Y in various lithologic and mineralized groups of the Lackner Lake complex.

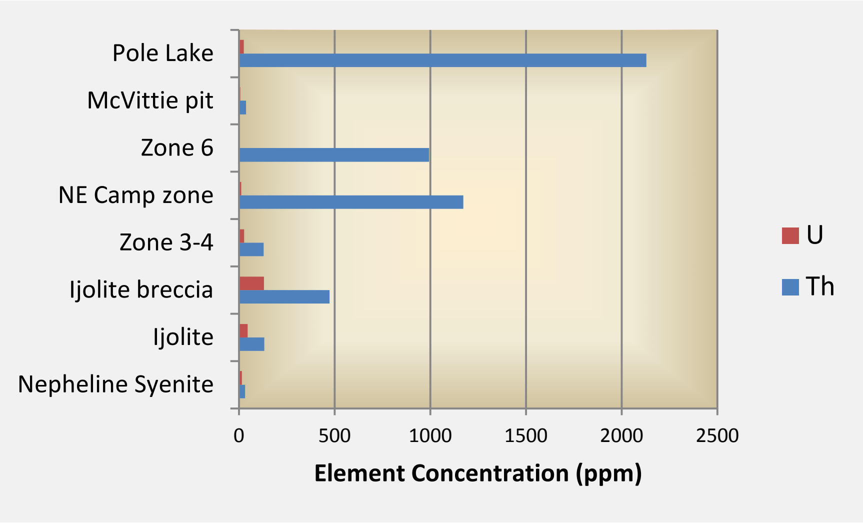





Pole Lake
McVittie pit
Zone 6
NE Camp zone
Zone 3-4
Ijolite breccia
Ijolite
Nepheline Syenite
0
5000
10000
15000
20000
25000
Element Concentration (ppm)
Y
HREE
LREE
Total REE


Pole Lake
McVittie pit
Zone 6
NE Camp zone
Zone 3-4
Ijolite breccia
Ijolite
Nepheline Syenite
0
500
1000
1500
2000
2500
3000
3500
4000
Element Concentration (ppm)
Ta
Nb


Pole Lake
McVittie pit
Zone 6
NE Camp zone
Zone 3-4
Ijolite breccia
Ijolite
Nepheline Syenite
0
5000
10000
15000
20000
25000
30000
35000
Element Concentration (ppm)
Sr
Ba



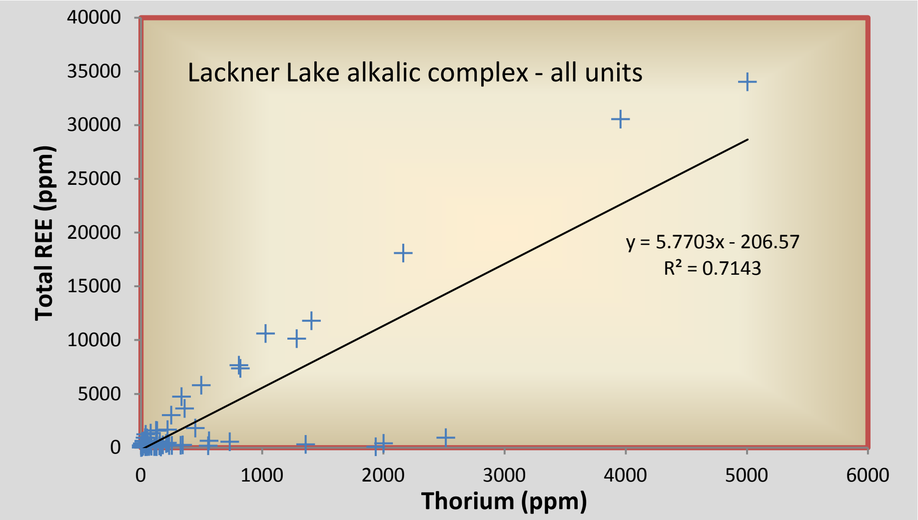


Figure 17. Thorium *versus* total rare earth elements for all analyses from Lackner Lake alkalic complex (see Appendix 2).

Thorium in general strongly correlates with total REE (Figure 16) with exception of analyses from the NE Camp Lake magnetite-rich zone that have very low total REE and very high thorium and consequently analyses plot along the x-axis and off the main trend-line.

There is a strong positive association between Ta and Nb (R^2= 0.97) in all lithochemical data and implies that pyrochlore is the main mineralogical control for these elements (Figure 17). Means and ranges for Ta and Nb in eight lithologic groups in the complex are given in Table 2 and Figures 18 and 19. Figure 20 presents mean values and ranges of ΣREE, ΣHREE, and yttrium in the various lithologic groups. Mean contents and ranges for the critical rare earths (Dy, Eu, Tb, and Nd) in these groups are presented in Figure 21.

Table 2. Tantalum and niobium mean values and ranges (ppm) for lithologic groups of the Lackner Lake alkalic complex

Lithology	**Nb (ppm)**		**Ta (ppm)**		**N**
	mean	range	mean	range	
Nepheline syenite	426	62.2 -1237	18.2	2.4 - 50.5	13
Ijolite	1061	227 - 2321	40.6	8.3 77.9	14
Ijolite breccia	3515	218 - 17335	18	12.2 - 647	9
Zone 6 apatite-magnetite rock	633	240 - 1181	26	12.4 - 37.3	4
NE Camp Lake magnetite rock	1067	904 - 1268	19.6	19.2 - 21.4	6
Zone 3-4	633	240 - 1181	26	12.4 - 37.3	5
McVittie pit magnetite rock	1064	781 - 1131	25.3	20.4 - 31.6	4
Pole Lake REE-Ba-Th-Nb occurrence	505	340 - 840	22.2	8.3 - 24.6	7

N = number of analyses

Table 3. Mean values and ranges for ΣREE, HREE and yttrium (ppm) in various lithologic groups of the Lackner Lake alkalic complex.

Lithology	**ΣREE (ppm)**		**ΣHREE (ppm)**		**Y(ppm)**		**N**
	mean	range	mean	range	mean	range	
Nepheline syenite	255	140-364	12.4	4.1-24	13.9	5.2-21	13
Ijolite	749	139-3652	39.7	12-176	38.1	9-152	14
Ijolite breccias	411	156-934	25.8	17-37	22.2	15-32	9
Zone 6 apatite-magnetite rock	8904	3032-11811	437.6	150-585	395	137-508	5
NE Camp Lake magnetite rock	564	91-1829	58.8	10-183	45.9	7-148	6
Zone 3-4	1299	97-3652	64.5	12-176	62.8	9-152	4
McVittie pit magnetite rock	80.9	20-139	8.1	1.1-15	6.9	1.1-13	4
Pole Lake REE-Ba-Th-Nb occurrence	20159	7677-44038	713	224-1514	544	146-1173	7

N = number of analyses

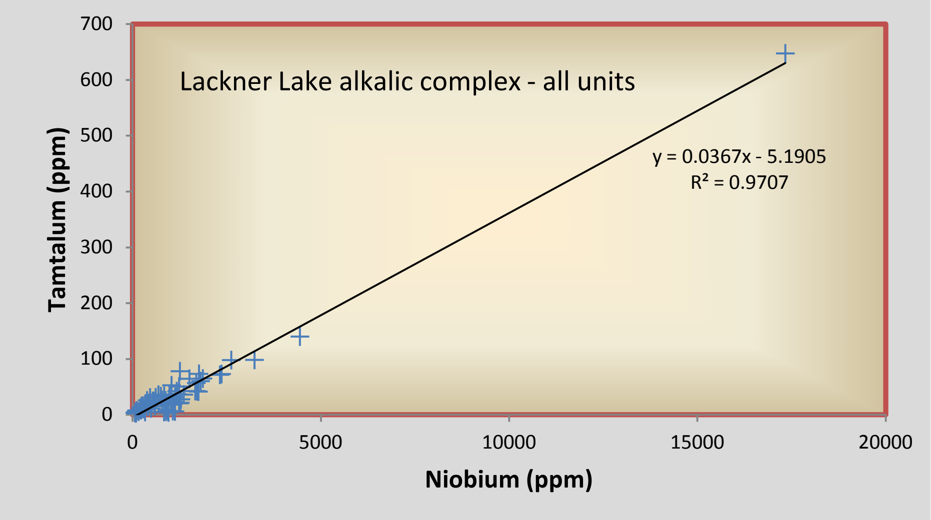


Figure 18. Tantalum versus niobium (ppm) for all lithochemical analyses from the Lackner Lake alkalic complex.

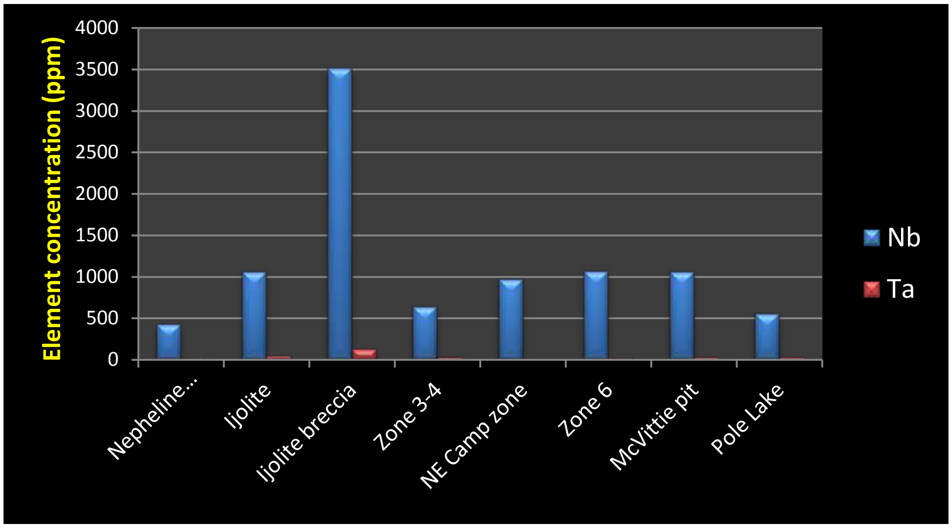


Figure 19. Mean tantalum and niobium (ppm) in various lithologic groups of the Lackner Lake alkalic complex.

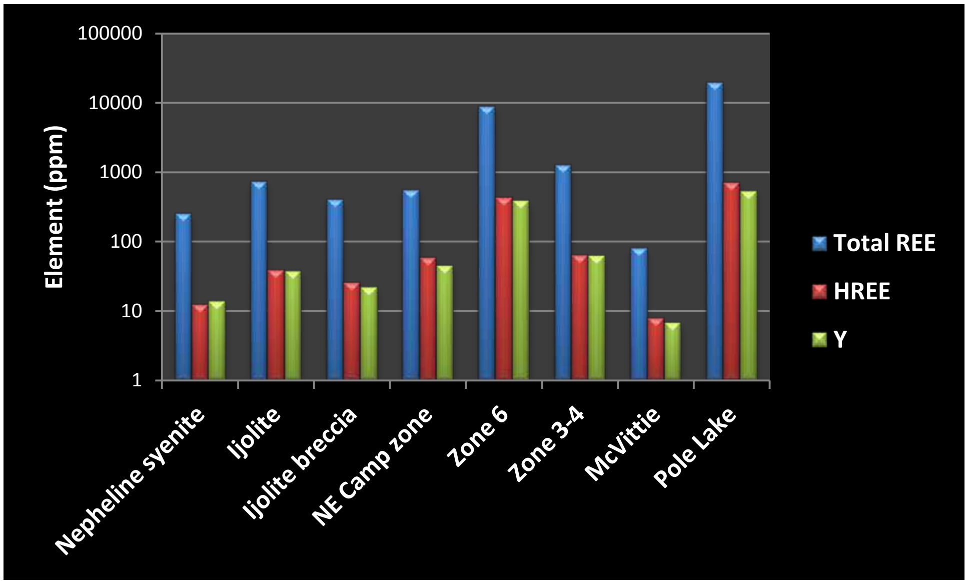


Figure 20. Mean values on a logarithmic scale for ΣREE, ΣHREE and Y (ppm) in various lithologic groups of the Lackner Lake alkalic complex.

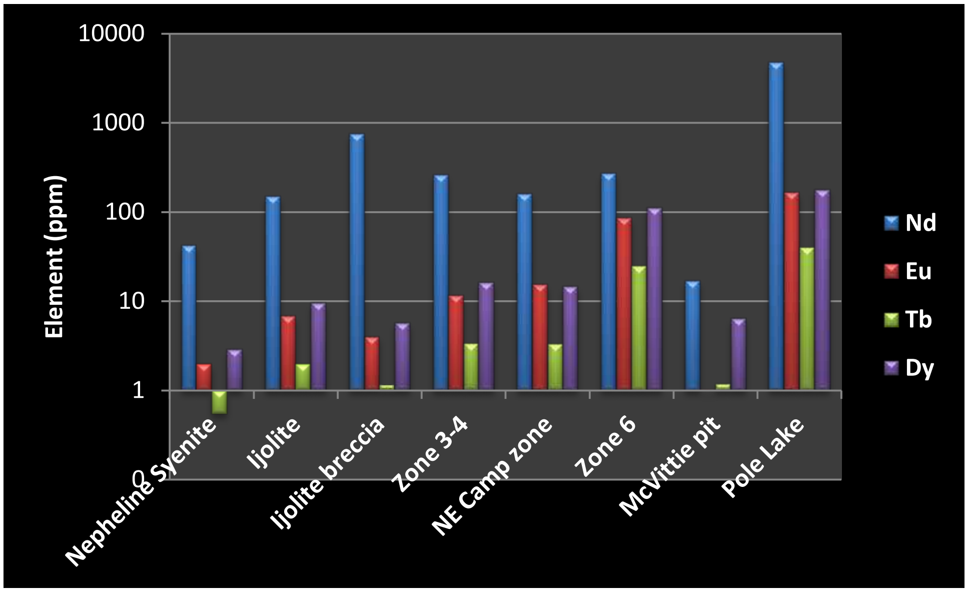


Figure 21. Mean values (ppm) on a logarithmic scale for critical rare earths in various lithologic groups of the Lackner Lake alkalic complex.

Apatite-Magnetite- and Magnetite-Rich Lithologies

Analyses from magnetite- and apatite-magnetite-rich mineralization from the Lackner Lake complex are plotted in the CaO-MgO-FeOT+MnO carbonatite classification diagram of Woolley and Kempe (1991) and in the MgO *vs* FeOT plot (Figures 21 and 22).

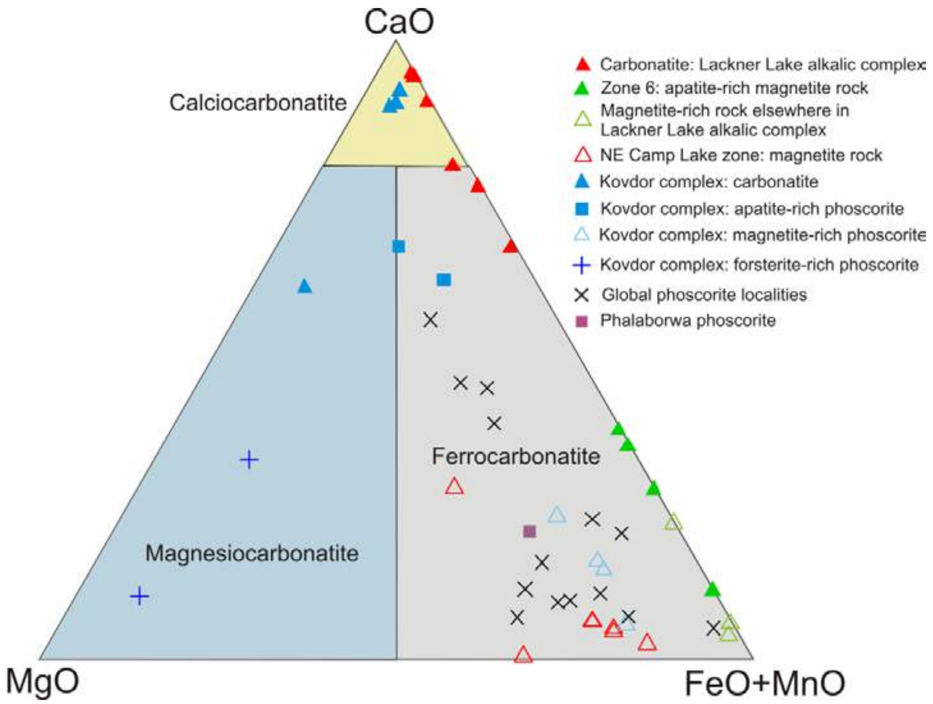


Figure 22. Woolley-Kempe diagram for magnetite- and apatite-magnetite-rich rocks of the Lackner Lake alkalic complex compared with the Kovdor carbonatite complex and other global phoscorite localities (Krasnova *et al.* 2004).

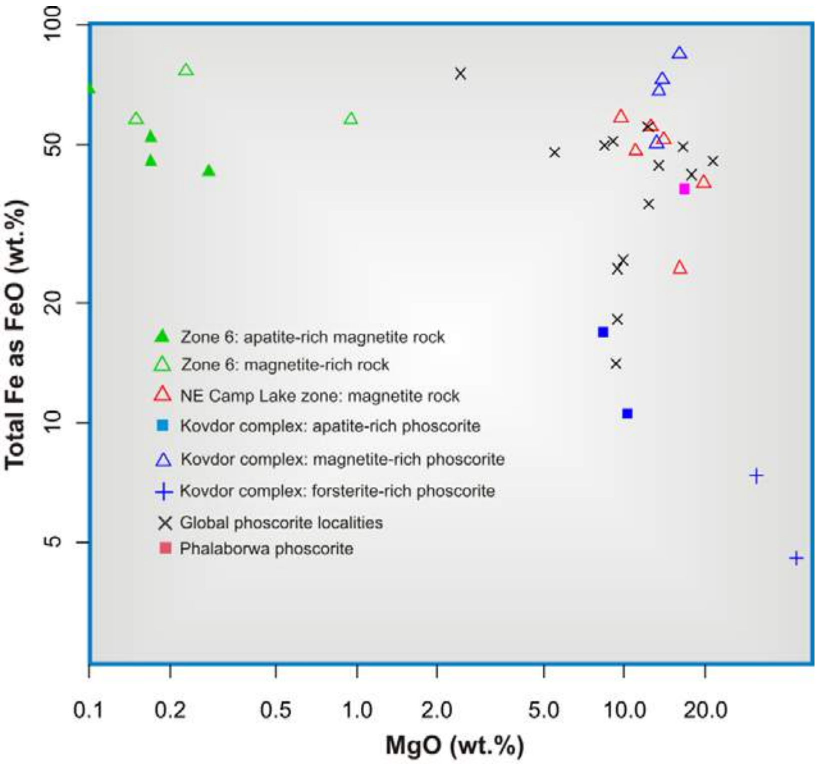


Figure 23. MgO *vs* Total iron as FeO for apatite-magnetite- and magnetite-rich rocks from the Lackner Lake alkalic complex compared with global phoscorite localities (Krasnova *et al.* 2004).

In these diagrams, twenty-three phoscorite compositions from various global localities, including the Kovdor mine and the Phalaborwa phoscorite deposit, are compared with the Lackner Fe-Ti-P_2O_5 mineralized zones. Amongst the trace elements, there is distinctive elevated Cr, Ni, and Co in the NE Camp Lake magnetite zone *versus* the nearby Zone 6 deposit.

Crushed Rock Pile from Zone 6 Test Pit

Three samples were taken randomly from a large pile of crushed material likely derived from the nearby Zone 6 test pit (Photo 26). These analyses may possibly provide an average composition of mineralization exposed in the now submerged Zone 6 test pit on Beaverdam Lake.

Photo 26. Pile of crushed magnetite-rich material from Multi-Minerals test pit at the Zone 6 apatite-magnetite deposit. Grab samples for assay were taken from three different parts of the pile (Appendix 1: 1634521, 1634522 and 1634551**).**

Chemical analyses are given in Appendix 2 and location of the pile is shown in Figure 11. Mean values for various elements are depicted in the vertical bar charts of Figures 23 and 24 with niobium (2203 ppm) and zirconium (786 ppm) having the highest values and fairly low total REE at 154 ppm. Amongst the major elements, FeOT has the highest concentration at 58.5 wt.%.

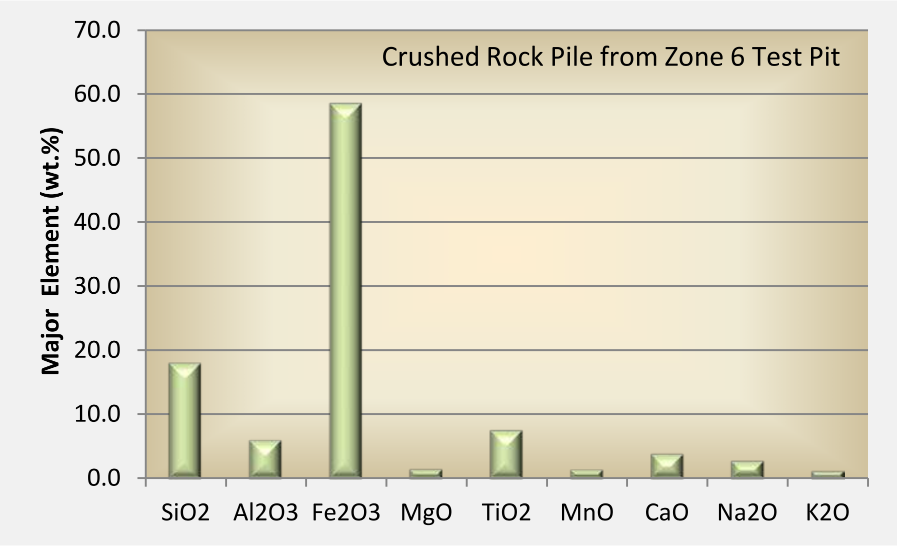


Figure 24. Mean compositions of major elements in wt.% from pile of crushed material neat the Zone 6 test pit.

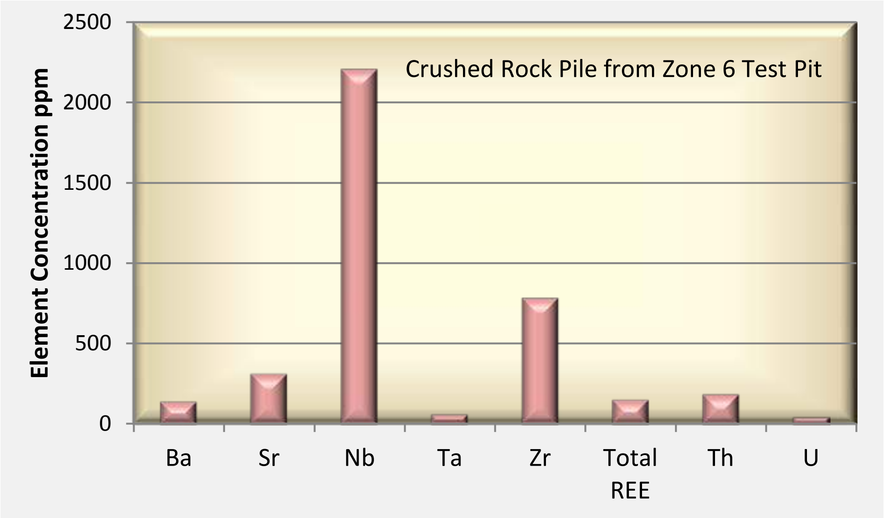


Figure 25. Mean compositions of Ba, Sr, Nb, Ta, Zr, Total REE, Th and U in ppm from a pile of crushed material near the Zone 6 test pit.

Rare Earth Element Chondrite Patterns of Various Units and Mineralized Zones

Chondrite-normalized REE plots for various lithologic groups and mineralization deposit types of the Lackner Lake complex are presented in Figures 26, 27, 28, 29, 30 and 31.

A curious inflection occurs in many lithologies where there is a slight enrichment in some of the heavy rare earths Er, Tm, Yb and Lu relative to the chondrite reference of Boynton (1984). This results in an unusual upward swing in the REE chondrite profiles at inflection points either at Ho or Er and gives the profiles a "hockey stick" shape.

This pattern is particularly characteristic of the nepheline syenites, massive and foliated ijolites, and many of the ijolite breccia samples but also for some of the magnetite-rich mineralization as at the McVittie pit (Figures 25, 26, 27, and 30). The mineralogical causes of the heavy REE enrichment are not known and a similar pattern for other localities in the literature could not be found in an internet search.

Nepheline Syenite

This lithologic group contains the lowest levels of rare earth elements with an average ΣREE of 243 ppm in a range of 140 to 364 ppm. Chondrite-normalized profiles have moderate slopes (La/YbN: mean = 29.04; range 9.3 to 77.9) and several positive Eu anomalies (Eu/Eu* 1.1 to 1.31). Most of the patterns reveal an interesting inflection at erbium beyond which there is an enrichment in heavy rare earths Tm, Yb and Lu (Figure 25).

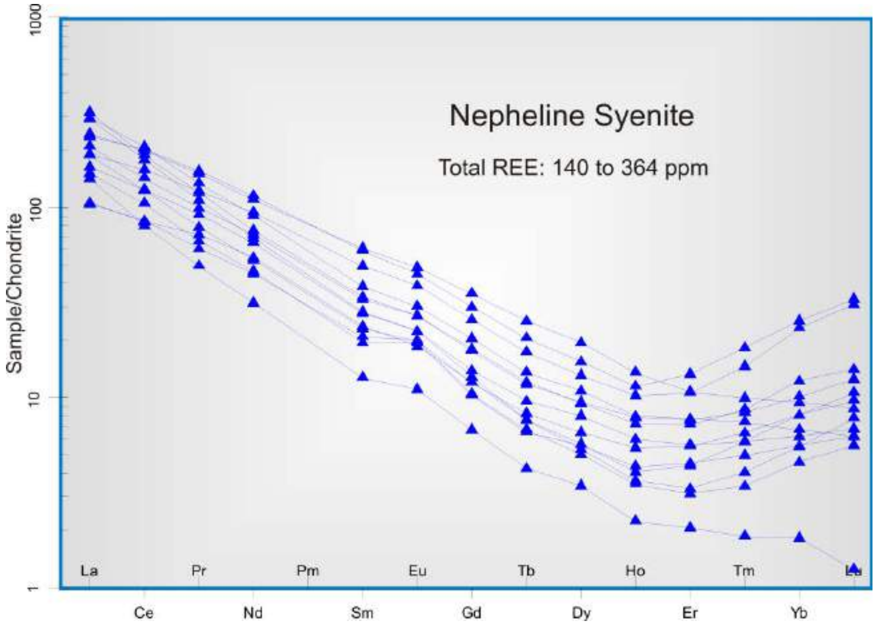


Figure 26. Chondrite-normalized REE diagram for nepheline syenite from the Lackner Lake alkalic complex.

Ijolite and Malignite

Massive and foliated ijolite and malignite from the inner ring of the Lackner Lake complex exhibit much higher total REE *versus* adjacent nepheline syenite rocks. Average ΣREE is 749 ppm within a range of 97 to 3653 ppm. The rare earth chondrite profiles (La/YbN: mean = 19.7; range 2.67 to 49.2) show a similar slope to the nepheline syenite group and with the same upward inflection at Ho with enrichment of Er, Tm, Yb and Lu (Figure 26).

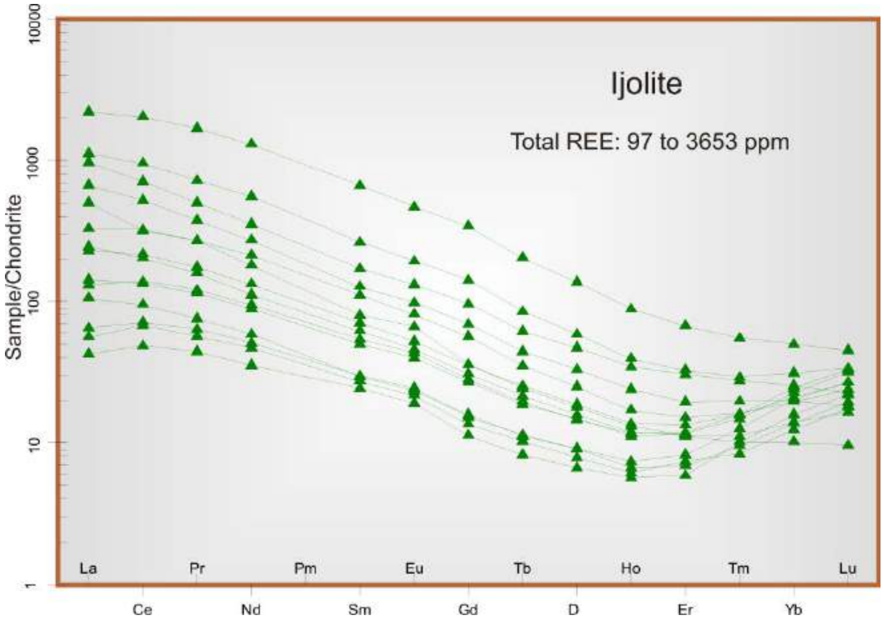


Figure 27. Chondrite-normalized REE diagram for massive and foliated ijolite from the Lackner Lake alkalic complex.

Ijolite Breccia

Ijolite breccias reveal chondrite patterns (Figure 28) with a more limited range of REE (mean = 411 ppm; range 190 to 933 ppm; La/YbN: mean = 11.5; range 3.2 to 38.5) compared to the massive and foliated ijolite that have similar rare earth patterns (Figure 27).

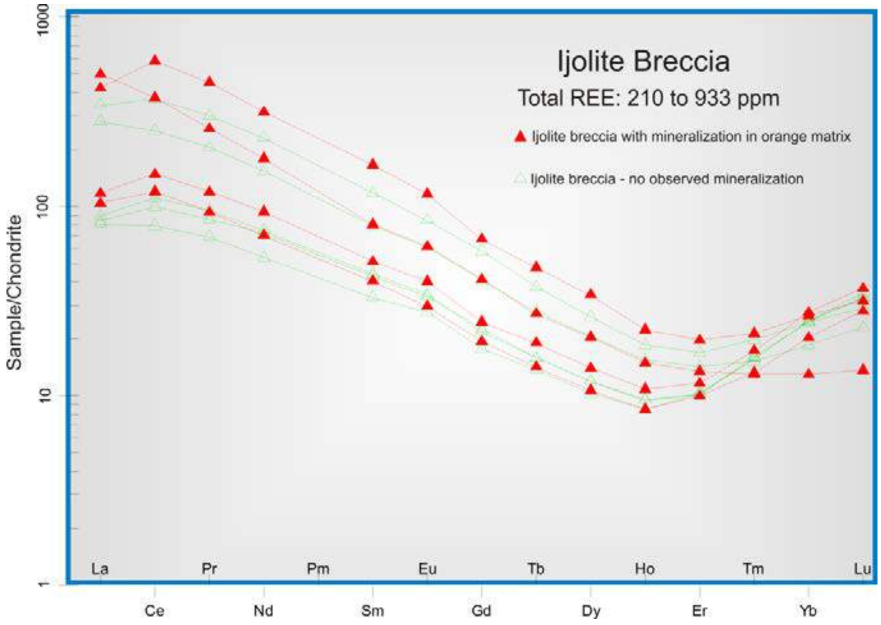


Figure 28. Chondrite-normalized REE diagram for ijolite breccia from the Lackner Lake alkalic complex.

The ijolite breccia is likely mineralized with uranpyrochlore which in the literature may accommodate modest amounts of barium, strontium, light rare earths, thorium, uranium, and zirconium. At the Aley carbonatite in British Columbia, for example, Chackhmouradian *et al.* (2015) reported the following median values in pyrochlore: ΣREE 1.8 wt.%, Th 5.1 wt.%, U 1.6 wt.% and Zr 0.76 wt. %.

Mafic and Ultramafic Enclaves

Three samples of a broad range of mafic to ultramafic enclave compositions hosted in nepheline syenite were examined. The chondrite-normalized profiles are approximately similar in a range of ΣREE between 210 and 933 ppm (Figure 28). The gabbro and glimmerite enclaves reveal the same previously described inflection at Er with enrichment of Tm, Yb, and Lu.

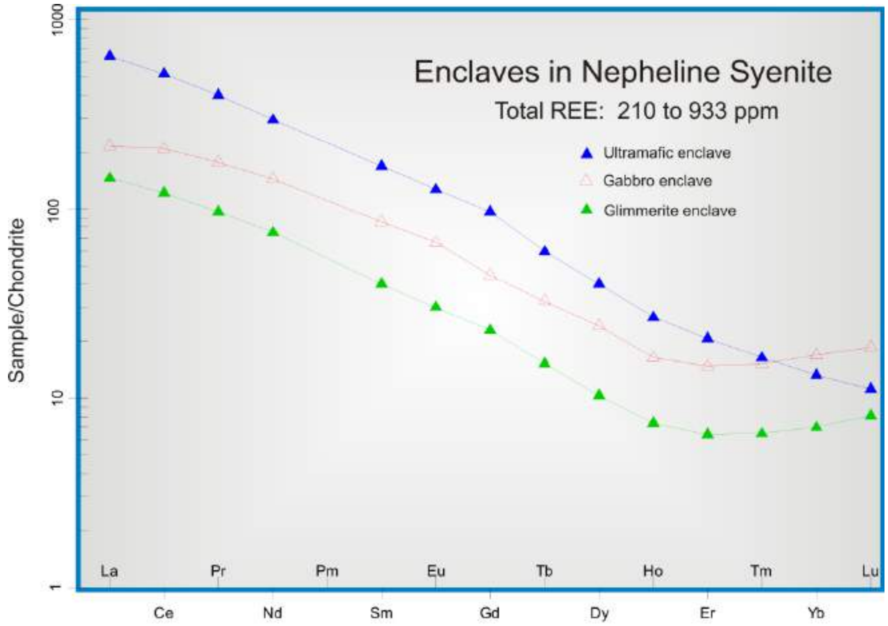


Figure 29. Chondrite-normalized REE plot for mafic and ultramafic enclaves hosted in nepheline syenite.

Apatite-Magnetite- and Magnetite-rich Rocks

Chondrite-normalized REE plots in Figure 29 show striking differences in profile shapes between the three magnetite-rich mineralized zones. Zone 6 apatite-magnetite rocks have the highest total REE contents in the area (3032 ppm to 1.2 wt.%) with smooth steep curves in a range in a range of La/YbN of 12.2 to 60 (mean = 57.2).

Chondrite-normalized profiles also show substantial variation in shapes and slope. Highly fractionated rocks such as the apatite-rich layer at Zone 6 exhibit a smooth profile with steep slope marked by La/YbN mean of 57.2 within a range of 52.9 to 60.0. In contrast, chondrite profiles from the NE Camp exhibit flatter, sinuous patterns (La/YbN mean = 12.2; range 4.9 to 18.3) marked by very flat distributions of the light REE and curvate distributions of the heavy rare earth elements.

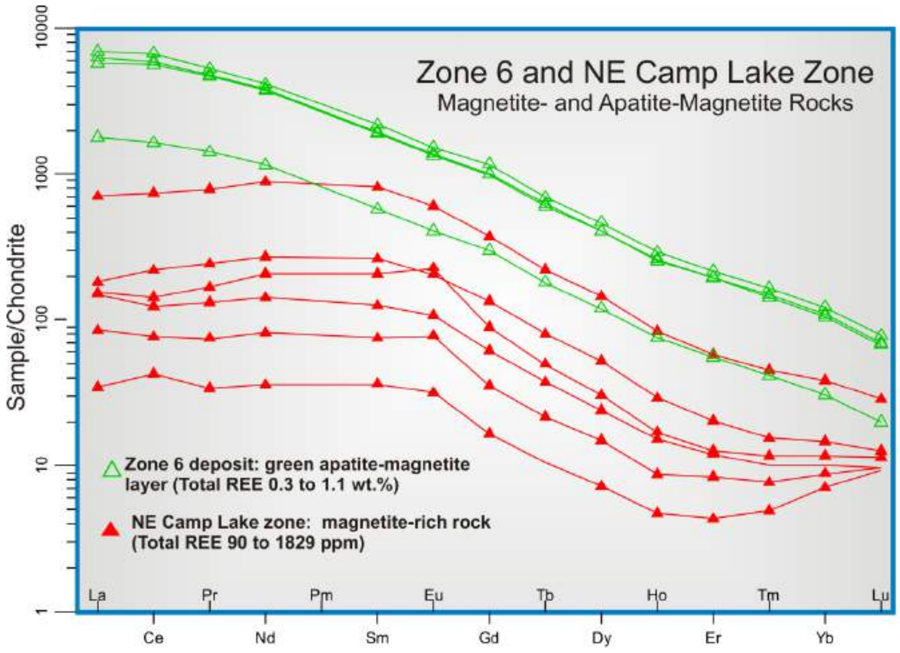


Figure 30. Chondrite-normalized rare earth element profiles for the Zone 6 apatite-magnetite units compared with the magnetite-rich rocks at the NE Camp Lake zone.

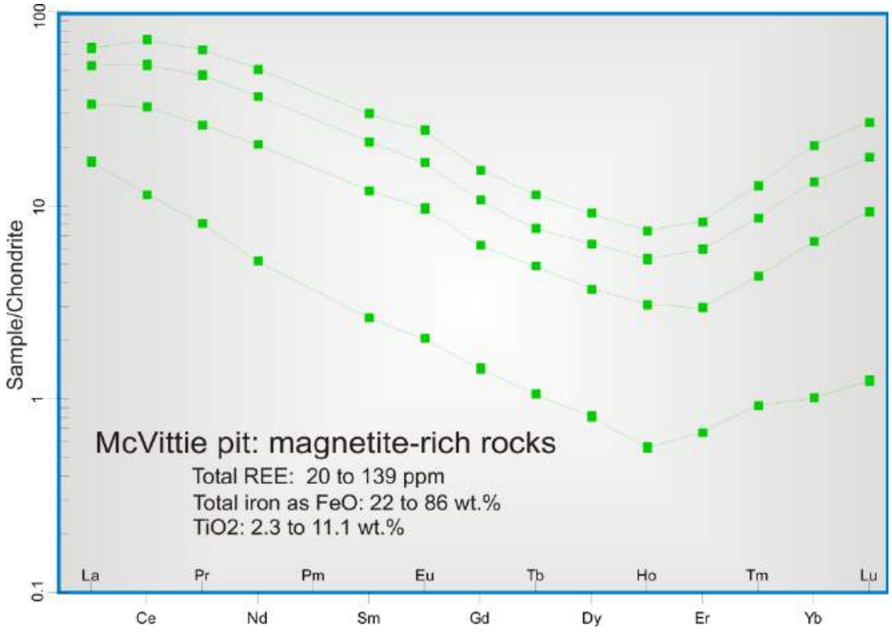


Figure 31. Chondrite-normalized REE diagram for magnetite-rich mineralization at the McVittie pit.

The third type of rare earth chondrite pattern in the magnetite rocks is found at the McVittie magnetite zone that is similar to the "hockey stick" shape found in the main lithologic units of the complex (Figure 30). The magnetite-rich units are marked by low values of La/YbN (mean = 7.3) in a range 3.2 to 16. Segments of the profile have a positive slope beyond Ho or Er and point to fractionation that produced modest enrichments of Ho, Er, Tm, Yb, and Lu.

APATITE MINERAL CHEMISTRY

The apatite supergroup [$(Ca, Sr, REE, Th, Y)_5(PO_4)_3(F, OH)$] has the potential to be a viable ore mineral of the rare earth elements. This mineral can accommodate significant amounts of both LREE and HREE by various substitution mechanisms as documented by Hughes *et al.* (1991). These workers reported structures of four REE-enriched apatites that contained up to 25 wt.% TREO. The following coupled substitutions were proposed:

$Si^{4+} + REE^{3+} \rightarrow P^{5+} + Ca^{2+}$

$Na^{+} + REE^{3+} \rightarrow 2Ca^{2+}$

The LREE show an M1 site preference whereas the HREE prefer the M2 site. Rare earth elements close to neodymium in ionic radii have no apatite structural site preference. Tetravalent substituents such as Th^{+4} and U^{+4} do not show site preferences (Hughes *et al.* 1991).

Currently, there is no global known production of rare earth elements from this mineral even though TREO contents vary considerably between a few ppm to 25 wt.% ΣREO. Apatite from marine phosphorite deposits in Florida and carbonatite-hosted phosphate deposits such as at the Kovdor mine in Russia and the Phalaborwa phoscorite deposit in the Republic of South Africa are largely destined for phosphate fertilizer production.

Photo 27. View of Agrium phosphate processing plant at Redwater, Alberta. The background shows phosphogypsum tailing ponds that possibly contain 70-85 % of rare earths originally present in phosphate ore. Source: http://www.miningandexploration.ca/alberta/article/albertas_industrial_heartland/

Processing of the apatite-rich ore material by sulfuric acid produces phosphoric acid and an insoluble residue called phosphogypsum. Binnemans *et al.* (2015) noted that approximately 70 to 85% of the rare earth elements originally present in the phosphate ore end up in the phosphogypsum stacks as could be the case at the Redwater, Alberta plant of Agrium Corp. (Photo 27). The fate of radionuclides U and Th, which may be present in the apatite structure or as small mineral inclusions such as thorite or monazite, was not reported in the Binnemans study.

Rare Earth Elements and Radionuclides in Apatite

Apatite has variable amounts of the rare earth elements, Y and also can host radionuclides U and Th. Roeder *et al.* (1987), in a study of 21 apatite samples from a variety of geologic environments including the Blue River carbonatite of British Columbia, found a range of TREO from a few ppm to 19 wt.% and generally low levels of ThO_2 (0.001 to 0.26 wt.%). Della Ventura *et al.* (1999) and Oberti *et al.* (2001) reported high levels of radionuclides in natural apatites with respective maximum levels of ThO_2 and UO_2 of 15.95 wt.% and 2.88 wt.%.

The apatite structure generally favours entry of the light rare earth elements (Hughes *et al.* 1991) but in rare cases elevated heavy rare earths of value such as Dy, Tb and Y are concentrated. The best example of heavy rare earth-enriched apatite is at the Mineville iron deposit in the Adirondack district of New York state once mined by Republic Steel (Lindberg and Ingram 1964). In 1980 Molycorp Inc. assessed that the apatite-rich tailings contained 8 to 9 million kgs with an average grade of 0.12 wt.% Y_2O_3 and 0.6 wt.% ΣREO (Mariano and Mariano 2012). Roeder *et al.* (1987) determined 3.89 wt % ΣLREO, 1.26 wt % ΣHREO and 1.89 wt.% Y_2O_3 on one apatite sample from the Mineville tailings.

Apatite occurrences in Canada with significant rare earth element concentrations have been documented at various carbonatites in the Ottawa-Gatineau Hills district by Hogarth (1988) who found a range of total REE of 0.5 to 7.7 wt.%. At the Hoidas Lake rare earth deposit of the Great Western Minerals Group in Saskatchewan, abundant apatite mineralization occurs in phosphate-rich veins possibly related to an alkalic magmatic source (Halpin 2010). Apatite contributes significantly to an NI 43-101 compliant measured + indicated resource estimate of 2,560,835 tonnes averaging 2.431 wt.% TREO (Star Minerals Group 2014). Halpin (2010) documented a range of 0.5 to 5 wt.% TREO coupled with low ThO_2 (<0.01 to 0.47 wt.%) in the deposit.

Rare Earth Elements in Apatite from Lackner Lake Alkalic Complex

Four high purity apatite concentrates from three areas of the complex were submitted for chemical analysis to ALS Global Labs (Figure 31). The localities include a carbonatite dyke in ijolite and biotite-apatite-syenite at Pole Lake, the main apatite-rich layer at the Zone 6 deposit and apatite-rich veins in ijolite at the Zone 3-4 deposit. The data are summarized in Table 4 and all data can be found in Appendix 3.

Pole Lake carbonatite dyke

Pole Lake biotite-apatite-Kspar syenite

Multi-Minerals Zone 6

Multi-Minerals Zone 3-4

Figure 32. Apatite mineral concentrates from various mineralized areas of the Lackner Lake alkalic complex submitted for chemical analysis to ALS Global Labs.

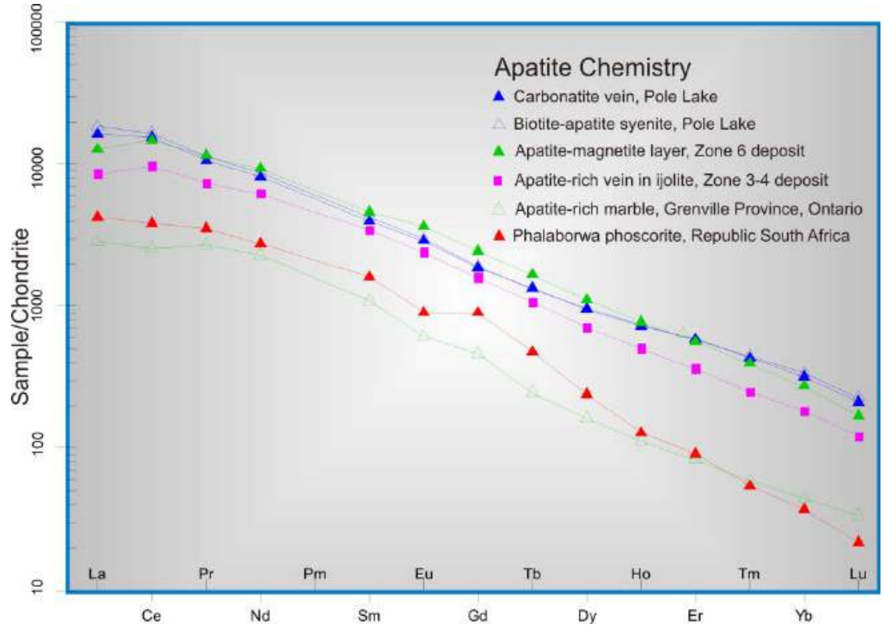


Figure 33. Chondrite-normalized rare earth element profiles for apatite from the Pole Lake REE-Ba-Th-Nb occurrence compared to apatite from the Phalaborwa phoscorite deposit (Ogata *et al.* 2016.). Apatite chemistry from Hinchinbrooke Township, Grenville Province of Ontario - unpublished data of the author.

Chondrite-normalized patterns (Figure 32) for the Lackner Lake apatites reveal similar, steeply sloped (La/YbN 46.9 to 55.0) smooth curves with no discontinuities. Lackner Lake apatites contain about 3.5 times higher total REE than the Phalaborwa apatite of Ogata *et al.* (2016) and considerably higher than apatite (0.08 to 0.6 wt.% ΣREO) from the Kovdor phoscorite-carbonatite complex (Krasnova *et al.* 2004b). For comparison, apatite from marble in the Grenville Province of Ontario is plotted in Figure 32 and differs in lower ΣREE (5107 ppm) and presence of a negative europium anomaly (Eu/Eu* = 0.86).

Strontium levels are elevated with a mean value of 1.29 wt.% within a range of 1.06 to 1.47 wt.%. The Pole Lake occurrence samples have the highest values of 1.47 and 1.42 wt.% Sr. Figures 33 and 34 present column charts for the rare earth elements in apatite from the Lackner Lake alkalic complex compared with apatites from Phalaborwa phoscorite and apatite in skarn from Hinchinbrooke Township, Grenville Province of southern Ontario.

Total REO varies from 1.96 wt.% to 3.25 wt.% with a mean value of 2.80 wt.% that is very similar to the historical value of 2.72 wt.% obtained from an apatite concentrate by Multi-Minerals Ltd (Sage 1988a, p. 40). Slightly higher values were found at the Pole Lake occurrence respectively in carbonatite vein (3.03 wt.%) and in the biotite-apatite-syenite (3.25 wt.%) compared with the apatite vein in ijolite at the Zone 3-4 deposit (1.96 wt.%). The ΣREO value for apatite at the Zone 6 deposit (2.96 wt.%) is virtually identical to those from the Pole Lake apatite (3.03 to 3.25 wt.%).

Yttrium contents reach the highest levels in the Pole Lake samples (1220 and 1550 ppm) whereas lower values are found at Zone 6 apatite-magnetite layer (930 ppm) and the lowest yttrium value (630 ppm) occurs in apatite-rich vein at Zone 3-4 deposit.

Radionuclides in the Lackner apatites have mean thorium and uranium values respectively at 1775 ppm and 16.7 ppm. The highest thorium is found at the Zone 6 deposit with 2980 ppm and lowest in the apatite vein at the Zone 3-4 deposit (1200 ppm).

Table 4. Rare earth element contents, strontium, thorium, and uranium in Lackner Lake apatite compared with apatite from the Phalaborwa phosphate deposit. Values in ppm except for TREO in wt.% oxide.

Sample	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	ΣREE	TREO
R175468	5090	12500	1300	4900	774	213	485	63.6	308	52.1	123	14	66.6	6.83	25896	3.03%
R175469	5740	13300	1400	5200	830	220	493	63	310	52.7	122.5	14.5	70.4	7.3	27823	3.25%
R175470	3970	11900	1400	5600	900	269	631	78.8	357	55.5	118.5	12.8	57.1	5.44	25355	2.96%
R175471	2650	7800	900	3700	672	176	410	50.7	227	36	75.8	8.04	38	3.9	16747	1.96%
mean	**4362.5**	**11375**	**1250**	**4850**	**794**	**219.5**	**505**	**64**	**301**	**49.08**	**110**	**12.3**	**58.03**	**5.87**	**23956**	**2.80%**
Phalaborwa	1320	3100	432	1660	314	66.6	233	77.3	23	19.2	9.19	1.75	7.7	0.7	7264.1	0.85%

Sample	ΣLREE	ΣHREE	Y	Y2O3	Sr	Th	U
R175468	24777	1119	1070	1360	14750	1220	46.6
R175469	26690	1133	1050	1330	14150	1550	9.9
R175470	24039	1316	930	1180	10600	2980	0.9
R175471	15898	849	630	800	12200	1200	9.2
mean	**22851**	**1104**	**920**	**1168**	**12925**	**1738**	**16.7**
Phalaborwa	6893		288	370			

j

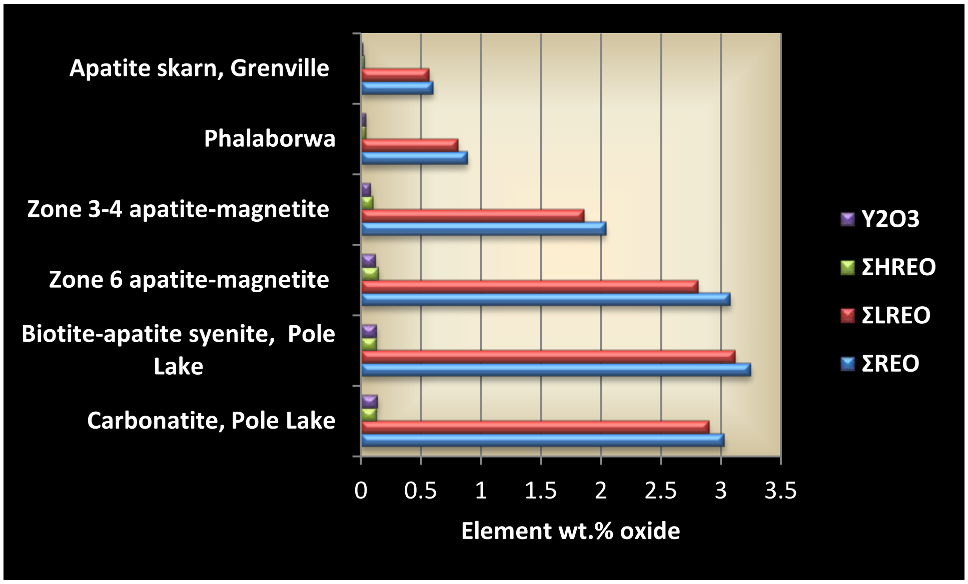


Figure 34. ΣREO, ΣLREO, ΣHREO, and Y2O3 in apatite from the Lackner Lake alkalic complex compared with apatite from the Phalaborwa phoscorite deposit and apatite in skarn from Hinchinbrooke Township, Grenville Province of Ontario.

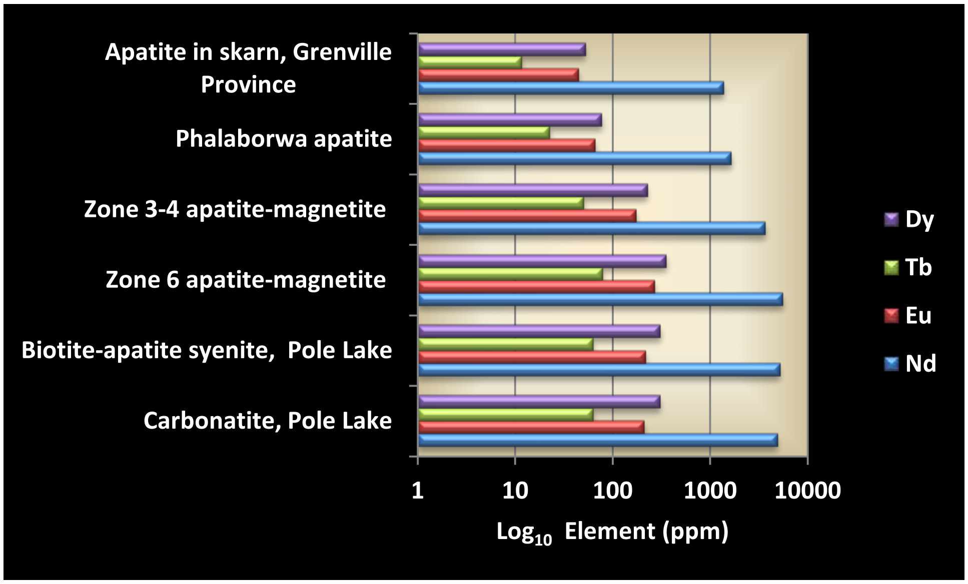


Figure 35. Critical rare earth elements Dy, Tb, Eu and Nd in apatite from the Lackner Lake alkalic complex compared with apatite from the Phalaborwa phoscorite and apatite in skarn from Hinchibrooke Township, Grenville Province of Ontario.

Hydrometallurgical Processing of Apatite as a Source of Rare Earth Elements

Recent work by Ogata *et al.* (2016) showed promising recovery of heavy rare earth elements from apatite using a low concentration of sulfuric acid at <2 mol/L. Apatite from the Phalaborwa alkalic complex (Table 4) was utilized in the experiments and 70 to 80% of HREE in the pregnant leachate was recovered by columns packed with EDASiDGA that consists of diglycolamic acid ligands immobilized on the surface of silica gel. The adsorbed rare earth elements in the column were easily desorbed with 1 mol/L H_2SO_4. The heavy rare earths, particularly Dy, Er, Yb and Y, were enriched by a factor of 10 to 30 relative to the feed solution.

ROCK PHOSPHATE POTENTIAL

The Lackner alkalic complex contains substantial historic resources of apatite-rich rock that have potential use of phosphorus for the fertilizer industry. The sole source of apatite in Ontario for phosphoric acid production had been the Cargill Mine of Agrium Inc. near Kapuskasing, however, this deposit was closed in 2013: http://www.northernontariobusiness.com/Industry-News/mining/Agrium-prepares-to-pack-up-inKap.aspx

Zones 3 and 4, situated about 0.8 km southeast of Camp Lake, contain a historic resource of 37 million tons of 21.9% apatite (approx. 9.2 wt.% P_2O_5) to a 500-foot depth (Parsons 1961b) that could possibly be extracted in an open pit. This is a higher level of P_2O_5 than the Kovdor mine in Russia where the phosphate ore averages 7.3 wt.% P_2O_5 (Wall 2010).

This commodity will possibly become in short supply according to a presentation of Arianne Resources, who have delineated an apatite resource in an iron-titanium-phosphorus (FTP-type) deposit with a lower grade than Lackner Lake zone 3-4 but with a substantial tonnage (Lac á Paul Quebec) at 462 mT averaging 6.2% P_2O_5. http://beta.arianne-inc.com/wp-content/uploads/2014/06/DAN-V-Investor-Presentation-June-19-2014.pdf

CONCLUSIONS AND RECOMMENDATIONS

Further exploration in the Lackner Lake alkalic complex is recommended for rare earth elements and scandium. The gamma-ray spectrometer is very useful in locating rare earth mineralization associated with radioactivity. The instrument discovered magnetite-rich mineralization in old trench workings from the 1950's in dense bush, named in this study as the NE Camp Lake magnetite zone.

Several exploration tools have emerged in the present study that may facilitate in the development of exploration targets:

- negative cerium anomalies in rare earth element chondrite-normalized plots, and,
- barium anomalies that exceed 2 wt.%

Negative cerium anomalies are evident in ten samples from the Pole Lake showing (Figure 14 and Breaks 2013) and to date, this pattern has only been found at this showing. This pattern may thus be employed as a tool to further explore for hydrothermally altered REE mineralization of the Pole Lake type.

Cerium may have been preferentially extracted, *vis-a-vis* the other rare earth elements during alteration by oxidized hydrothermal fluids as this element can achieve a valence change from Ce^{3+} to Ce^{4+} that can also be achieved by Pr, Nd, Tb and Dy (Table 1). Textural evidence indicates that monazite and britholite have been altered and plausibly may have contributed to Ce^{4+} scavenged by hydrothermal fluids. It is interesting to note that cerium is normally dominant in britholite-(Ce) but compositions at Pole Lake almost always show a slight excess of lanthalum over cerium, *i.e.*, britholite-(La).

It is suspected that late hydrothermal activity perhaps controlled by NW-SE ductile shear zones was a factor in localizing the REE and introducing barium into the altered rocks. Obvious avenues of hydrothermal fluid interaction are the local extensional fractures sealed with quartz (Photo 23).

The presence of oxidized fluids is indicated by widespread hematite and negative cerium anomalies in some samples (Figure 14). Cerium in a +4 valence state could have conceivably been extracted in coursing hydrothermal fluids. The fate of the released Ce^{4+} into a hydrothermal fluid is uncertain, however, cerianite is rare earth element mineral that could incorporate Ce^{4+} (Geier 1996) and interestingly was first documented in apatite-magnetite rocks of the SE part of the Lackner Lake complex (Graham 1955).

Barium exceeds 2 wt.% in hydrothermally altered syenites at the Pole Lake occurrence. Further exploration should more closely examine the anomalously high barium (2 to 3.8 wt.%) associated with very high ΣREE at this occurrence. Electron microprobe work identified barite associated with the monazite-britholite-bearing rare earth mineralization (Breaks 2013). Barium could, therefore, be a useful pathfinder element in future exploration that is focused upon the two NW-SE lineaments in the Pole Lake area that may be the structural control for the mineralization.

The present work focused on the Camp Lake and Pole Lake areas as these are the most accessible zones with rare earth mineralization. A number of recommendations ensue from the present work.

1. Further work should be undertaken elsewhere in the complex over the magnetic highs associated with apatite-magnetite mineralization as, for example, at Daer Lake, to investigate possible zones of rare earth element and scandium mineralization.

2. Improved access is needed in light of difficult bush conditions and is recommended that access trails be cut and, as for example, a north-south trail between the McVittie pit and Daer Lake to facilitate geological examination.

3. Old blast pits in the NE Camp Lake area zone present a new target that has elevated scandium not previously known. This magnetite-rich unit should be the subject of follow-up work to determine its dimensions and whether there are zones with further elevated scandium contents. A ground magnetic survey is recommended to delineate this magnetite-rich body. Scandium is a rare and valuable metal currently priced at $15, 000 USD per kg of 99.9% metal. It is also recommended that surface stripping of the old overgrown trenches on this magnetite body be undertaken to better understand geological relations.

4. The rock phosphate potential of the complex also merits further investigation. Apatite from the Pole Lake showing contains 3.56 wt.% $TREO+Y_2O_3$ in a high purity mineral concentrate (Breaks 2013, p.18). Such levels of $TREO+Y_2O_3$ would enhance the value of apatite mineralization if a method of REE separation could coincide with the extraction of phosphorus.

5. Lithochemical sampling around the Pole Lake occurrence with focus on the NW-SE canyons that could coincide with fault controls on hydrothermal REE-Ba-Th-Nb mineralization.

6. Wajax® power washing of a lower part of the cliff face and angular mineralized boulders to more clearly discern the zone of hematite-rich, fine-grained syenite that hosts the high values of total REEs. Localized bleaching may be useful for areas where the organic staining cannot be removed via the initial Wajax work and aid in field mineralogical identification.

7. Establishment of a grid for combined geological-radiometric survey mapping to determine the areal extent of the REE-rich hydrothermally altered, rare earth element mineralized, fine-grained syenite at Pole Lake. It should be noted that a nearby exposure of carbonatite and possibly related boulders, previously documented by Parsons (1961b), situated 100 m north of Pole Lake, is a plausible source of silico-carbonatite veins that intrude ijolite at the Pole Lake showing. REE mineralization strongly correlates with elevated thorium at the Pole Lake occurrence.

8. Detailed mineralogical study of apatite-magnetite-rich rocks at Zone 6 and NE Camp Lake zones to better understand mineralogical controls on Sc and critical rare earths Nd, Eu, Dy, Tb, and Y. Tantalum content of pyrochlore also appears significant at Zone 6 (bulk rock values up to 647 ppm) and EMP and LA-ICP-MS analysis should also be included.

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Appendix 1. Gamma-ray spectrometer assay data, (%K, eU ppm and eTh ppm and air absorbed dose rate nGy/hr) and location of chemical analyses and site descriptions.

Abbreviations

cg	coarse-grained
cps	counts per second
fg	fine-grained
CWS	clean weathered surface
FS	fresh surface
RA	radioactivity

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
812		Ijolite breccia cut by apatite-magnetite veins	17	340250	5295166	Nice outcrop of ijolite, massive, fg, black about 50 cm from apatite-magnetite veins. Exposure on west part of Camp Lake Road.	Ijolite	319.6	2.8	11.1	82.6
812						Apatite-magnetite vein about 30 cm width	Apatite-magnetite vein	512.4	1.4	7.2	168.9
812						nepheline syenite enclave in massive ijolite	Nepheline syenite	236.2	3.0	14.4	43.8
812						area of highest radioactivity - ijolite crosscut by delicate veinlets near apatite-magnetite vein (1100 cps)	Ijolite	732.6	1.8	10.0	243.0
812						Ijolite, massive, fg, second spot near apatite-magnetite vein	Ijolite	357.0	2.6	16.0	87.5
812						Ijolite, massive, fg-mg about 3 m from apatite-magnetite vein	Ijolite	79.4	2.5	2.7	12.1
825	1634501	Nepheline syenite	17	340757	5294389	Massive, light pink (FS, cg to locally pegmatitic with radioactive zone up to 1 m width. Minerals = nepheline, kspar, aegirine. Outcrop on west side of Camp Lake.	Nepheline syenite	511.9	5.7	51.3	58.7
825							Nepheline syenite	181.8	5.3	10.2	20.9
825							Nepheline syenite	291.7	4.2	20.2	47.2
826	1634502	Nepheline syenite	17	340718	3294393	Small outcrop on east shore Camp Lake. Leucocratic nepheline syenite cg that grades into pegmatite patches. Small patches contain enrichment in phlogopite. Sparse sulphides. CI = 5	Nepheline syenite	262.3	7.6	17.2	25.7
827		Nepheline syenite	17	340817	5294810	Small outcrop in sand pit along Camp Lake Road. Grey fg massive to vaguely foliated nepheline syenite	Nepheline syenite	292.2	4.2	7.9	72.3
827							Nepheline syenite	246.4	4.4	4.3	61.3
828		Ijolite	17	340824	5294817	Massive, fg-mg, black on CWS, that are sharpely cut by magnetite-rich 1-5 cm wide veins and pods.Outcrop on nearby road contains high % randomly oriented and delicate Kspar laths in layers 20 cm width that appears to have segregated from enclosing ijolite	Ijolite	367.9	0.9	21.9	88.2
828							Ijolite		2.9	50.6	179.4
828	1643503	Feldspar-rich rock	17	340824	5294817	Small smooth outcrop on south side of Camp Lake Road.	Feldspar-rich rock	492.6	3.9	25.2	113.2

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
829		Nepheline syenite	17	340745	5294874	Massive mg-cg, with pods of coarser material	Nepheline syenite	135.9	6.2	1.9	16.4
830	1634504	Nepheline syenite	17	340704	5294885	Leucocratic syenite with CI approx 5, white porcellanous appearance on WS, looks altered with thin en-echelon fg black veins with local calcite	Altered nepheline syenite	251	7.1	17.1	24.3
831		Ijolite	17	340665	5294935	Small smooth outcrop of massive, fg-mg ijolite cut by thin calcite veinlets	Ijolite	166.3	2.8	7.2	33.7
832	1634505	Ijolite	17	340677	5295003	Smooth outcrop of ijolite in sand pit. Rock is fg-mg, Kspar porphyritic. RA up to 1700 cpm locally	Ijolite	931	4.7	62.1	197.7
832							Ijolite	954.2	3.3	66.9	203.0
833	1634506	Ijolite breccia	17	340680	5295014	Massive black porphyritic ijolite with sparse enclaves of nepheline syenite. Nice texture on clean surface showing nepheline, aegirine and Kspar. Enclaves only 2-3 % and include a single enclave	Ijolite	843.7	4.4	49.3	192.4
834	1634507	Magnetite-rich rock	17	340773	5294697	Series of old blast pits that appear to have been untouched since 1960's. Very heavy moss but spectometer values up to 7500 cps. Assay sample consists of sulfide stained pieces from bottom of pit.	Magnetite-rich rock	4100		23.7	1465.0
834						Note highest thorium value thus far from this pit.	Magnetite-rich rock	5600	3.4	32.7	2010.0
834							Magnetite-rich rock	2400		33.0	817.2
834	1634508	Magnetite-rich rock		340775	5294699	Assay sample taken under this reading	Magnetite-rich rock			36.2	1434.0
834							Magnetite-rich rock				
835	1634509	Magnetite-rich rock	17	340777	5294698	Old test pit completely grown over. Rust stained magnetite-rich rock at bottom	Magnetite-rich rock	4000	0.0	23.2	1447
836	1634510	Magnetite-rich rock	17	340771	5294693	Test pit #2 (3 X 4 X 1.5m) and heavily overgrown. Several pieces of sulfide stained material obtained from bottom of pit	Magnetite-rich rock	3600	3	23.9	1258
837	1634511	Magnetite-rich rock	17	340768	5294698	Old test 2X4X2m pit grown over with exposed bedrock	Magnetite-rich rock	4100	2.1	14.5	1496
838	1634512	Magnetite-rich rock	17	340763	5294687	Old test pit completely grown over.	Magnetite-rich rock	1800	2.8	39.2	592.5
839	1643513	Ijolite	17	340761	5294682	Massive, mg, black on CWS, homogeneous	Ijolite	211.2	1.5	10.2	50.7
840	1643514	Ijolite	17	340741	5294699	Massive, mg, black on CWS, homogeneous.	Ijolite	245.5	2.4	14.7	53.4

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
841	**1643515**	Magnetite-rich rock	17	340726	5294713	Small outcrop of magnetite-rich rock with increased RA = 1500 cpm. Vaguely foliated with 15 degree dip	Magnetite-rich rock	764.4	1.8	60.7	152.6
842		Ijolite	17	340663	5294706	Large outcrop area at southern end of "Beaverpond" on Parsons map. Pile of blasted magnetite-rich rock. No sample. Mainly black massive mg ijolite	Ijolite	711.5	2.7	36.6	177.7
843		Apatite-magnetite rock	17	340663	5294690	Apatite-magnetite assemblage in black ijolite host. Sulfide staining. No sample taken.	Ijolite	681.0	1.9	11.6	220.4
844		Ijolite	17	340675	5294673	Flat outcrop near lake with 2500 cps. No sample.	Ijolite		1.5	17.7	118.7
845		Massive magnetite rich zone	17	340649	5294674	Blasted pile of magnetite rich material at old test pit that forms a SE bay of lake due to beaver dam flooding. Zones 30-50 cm thick are rust stained with fg pyrite and tarnish due to trace copper minerals.	Magnetite-rich rock	1800	0.2	14.5	626.8
845						Second reading on rust stained layer	Magnetite-rich rock	1200	0.5	11.0	433.3
845	**1643517**	Massive magnetite rich zone	17	340649	5294674	Magnetite-rich zone adjacent to rust stained sulfide layer.	Magnetite-rich rock	1200	0.9	14.0	413.2
		Ijolite breccia and nepheline syenite	17	340640	5294664	Host to west of magnetite-rich zone that consists of 3m wide ijolite breccia This unit grades into nepheline syenite.Two readings on nepheline syenite but no sample taken.	Nepheline syenite		6.0	7.7	138.4
846							Nepheline syenite		3.0	11.8	215.4
847		Ijolite	17	340588	5294671	Kspar-porphyritic ijolite near lake. Small flat exposure. No sample taken.	Ijolite	312.1	3.0	10.8	79.3
848	**1643518**	Ijolite breccia	17	340564	5294656	Large pile of blasted rock with abundant ijolite breccia characterized by fg grey leucocratic fragments. Magnetite, apatite and unidentified white and orange minerals occur in breccia matrix. Variable radioactivity. Sample of apatite-rich material with abundant orange minerals from boulderwith highest RA to help follow-up mineralogical identification work. Highest uranium value thus far at 205.7 ppm	Ijolite	2800	3.3	205.7	598.3

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
849	**1643520**	Ijolite breccia	17	340565	5294659	Massive, fg, holo-leucocratic breccia fragments in small piece from ijolite breccia	Ijolite breccia		2.4	96.0	360.7
						Second analysis site over fg breccia fragment	Ijolite breccia	961.6	1.2	63.7	222.6
850		Ijolite cut by magnetite veins	17	340647	5294638	Small smooth outcrop patch on road.Massive mg black ijolite cut by 2 cm wide magnetite vein.No sample taken.	Ijolite	625.3	2.2	32.2	156.7
851	**1643521**	Magnetite-rich material in pile of blasted boulders	17	340706	5294613	Massive, coarse magnetite-rich rock with brown-black colouration on blast surfaces. Assay sample from spectrometer site.	Magnetite-rich rock	439.7	0.9	24.8	108.9
852		Nepheline syenite	17	340346	5293979	Small glacially smoothed outcrop on road. Massive to vaguely flow foliated syenite. 45% nepheline, 40% kspar, 15 % aegirine. No sample taken.	Nepheline syenite	133.1	5.7	4.1	13.6
	1643522	Split duplicate from Magnetite-rich concentate pile sample 1643521	17	340706	5294613	Massive, coarse magnetite-rich rock with brown-black colouration on blast surfaces. Assay sample from spectrometer site.					
853	**1634523**	Nepheline syenite and ijolite	17	340333	5294268	Massive cg ijolite with nepheline syenite enclaves up to 5 by 15 cm. Ijolite grades into ultramafic patches.	Nepheline syenite	138.2	4.2	5.8	19.1
853						Second spectrometer assay site in nepheline syenite	Nepheline syenite	137.2	3.7	7.4	18
854		Nepheline syenite	17	340159	5294837	Massive cg syenite with kspar laths up to 0.5 by 3 cm. Aegirine 10 to 15%, minor phlogopite.	Nepheline syenite	189.9	5.3	8.7	27.2
854						second spectrometer assay site on nepheline syenite	Nepheline syenite	167.8	5.7	9.4	15.7
855	**1634524**	Ijolite breccia	17	340253	5295031	Massive cg, slightly RA at 1000 cps. 60% aegirine and 40% nepheline that has bluish cast on CWS. Contains 40% enclaves of pink nepheline syenite that typically have diffuse contacts with host.	Ijolite	536.9	3	27.7	128.7
855						Nepheline syenite enclave	Nepheline syenite	181.9	4.8	8	28.2
856		Nepheline syenite breccia	17	340248	5295118	Pink fg syenite with trachytic texture. Contains 20-30% enclaves of ijolite that have elevated RA. Spectrometer assay on ijolite.	Ijolite enclave	314.4	3.7	27.4	43.5
856						Second spectrometer on ijolite next to magnetite-rich vein that cuts breccia.	Ijolite	302.9	4.9	23.4	41.5

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
856	**1634525**			340248	5295118	Assay sample from fg nepheline syenite matrix					
812		Ijolite breccia				Revisit of station 812. Ijolite breccia, RA, cut by apatite-pink unknown mineral-magnetite veins. Two surfaces of fracture filling					
857	**1634526**	Ijolite	17	340359	5295171	Small outcrop of ijolite cut by magnetite veins (5%). RA with up to 1500 cpm. Individual blebs and veins of magnetite. Assay sample consists of magnetite-rich ijolite	Ijolite		2.7	168.9	152.2
857									2.4	74.3	67.3
858	**1634527**	Ijolite	17	340435	5295145	Massive black ijolite with magnetite-rich veins. Assay on magnetite-rich ijolite	Ijolite		1.9	80.0	58.3
858							Ijolite	1300	3.4	57.7	335.3
858							Ijolite	907.4	1.6	52.7	223.0
858							Ijolite	637.9	2.4	33.1	158.5
859	**1634528**	Ijolite	17	340500	5295135	West side of extensive beaver dam system that obliterates road. Black fg ijolite cut by 1 cm thick fracture-filled veins of cg white and light orange minerals	Ijolite	549.9	2.7	24.6	141.2
859						Massive fg-mg ijolite with no enclaves	Ijolite	596.9	2.1	21.7	167.5
859							Cross-cutting late stage possible hydrothermal vein. Surface that exposes unknown white and light orange minerals	707.5	2.0	63.0	126.0
859						Magnetite-rich ijolite that contains magnetite veins and individual crystals not connected to veins that suggest metasomatic development	Ijolite		2.2	86.7	265.4
859							Ijolite in area where unknown orange mineral is abundant	618.6	4.0	44.6	120.6
860	**1634529**	Magnetite-rich veins in nepheline syenite	17	340333	5295250	Initial search for McVittie pit in area of bad bush. Located several old trenches up to 10 m in length. Magnetite-rich veins up to 1 m width in cg nepheline syenite. RA relatively low at 200 - 500 cps	Magnetite-rich mass	91.8	1.8	3.1	19
860							Magnetite-rich vein	88.3	1.8	2.3	19.1
860	**1634530**			340333	5295250		Nepheline syenite host		4.2	9.5	21.6

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
861		Ijolite breccia cut by magnetite-rich veins	17	340542	5294589	Massive black (CWS) ijolite cut by magnetite-rich vein, 1-2 cm thick. Enclaves of fg-mg nepheline syenite occur in ijolite. Hand specimen taken but no assay sample.	Ijolite	62.7	2.0	2.0	9.5
861							Nepheline syenite enclave	151.8	4.1	11.0	14.5
861							Ijolite with cluster of magnetite veins	86.4	1.9	6.6	9.7
862		Nepheline syenite breccia	17	340555	5294563	Small outcrop just below beaver dam. Mostly nepheline syenite with ijolite enclaves all cut by sparse (1%) 1-2 cm wide magnetite veins. No samples taken.	Nepheline syenite	158.2	4.5	7.3	22.5
863		Ijolite breccia and nepheline syenite	17	340572	5294549	Outcrop along creek. Approx 50% of each unit but outcrop is highly obscured by moss and deadfall. Nepheline syenite shows well developed trachytic texture (see photos).Magnetite veins cut all units and clusters of euhedral to subhedral magnetite crystals appear to have developed by metasomatism.	Ijolite with cluster of metasomatic magnetite (no mag veinlets)	62.8	2.3	2.6	7.1
863							Nepheline syenite adjacent to magnetite veins.	154.6	4.9	9.7	14.0
	1634531	Nepheline syenite with ijolite enclaves	17	340593	5294552	Mostly mg-cg, light pink nepheline syenite. 20% nepheline, 70% Kspar, 10% aegirine+phlogopite. Assay sample of nepheline syenite.	Ijolite clast	193.1	4.0	6.6	39.0
864							Nepheline syenite	128.7	6.4	3.5	9.5
866	1634532	Magnetite-apatite-rich zone		340648	5294690	Same locality as in Photo of Vale 2008 report. Rust stained friable exposure on top of small cliff and adjacent to Multi Minerals test pit. Note flat dip of primary layering [310/25].Assay sample taken directly under spectrometer reading. Large test pit largely submerged due to beaver dams at south end of lake.	Magnetite-apatite-rich rock, friable material		0.9	16.8	567.4
866	1634533	Magnetite-apatite-rich zone		340648	5294690		Magnetite-apatite-rich rock on vertical face near 1634532. Also quite friable.	3200	0.0	11.5	1150.0

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
866		Magnetite-apatite-rich zone					Magnetite-apatite-rich rock, relatively unweathered	3800	0.2	13.3	**1323.0**
866	**1634534**	Magnetite-apatite-rich zone		340648	5294690	Consider as duplicate sample of 1634533	Loose apatite-magnetite sand on slope below unit. One intact piece of green apatite material for assay.		0.3	9.7	**1099.0**
866	**1634535**	Magnetite-apatite-rich zone		340642	5294707		Vertical face heavily rust stained of relatively intact rock near shoreline at base of cliff. Wispy veins of apatite-magnetite are hosted in rust stained magnetite-rich host.	3300	0.0	23.7	**1181.0**
866	**1634536**	Magnetite-apatite-rich zone		340642	5294707		Wispy band of apatite-magnetite in massive magnetite-rich host	3000	0.0	31.5	**1358.0**
866							Magnetite-rich rock		0.2	17.8	**1113.1**
866	**1634537**	Nepheline syenite host of magnetite-apatite zone		340640	5294710	Cg, massive, leucocratic (CI = 5) nepheline syenite host about 2m above mineralized zone. Note spheroidal weathering along fractures in nepheline syenite on cliff face.	Nepheline syenite	324.1	5.7	7.1	78.6
866		Nepheline-apatite-magnetite				Top of cliff where fg-mg nepheline-apatite-magnetite rock occurs. Massive unweathered compared to rock in the cliff face.	Nepheline-apatite-magnetite	3200	2.3	14.9	**1136.0**
867		Ijolite breccia	17	340696	5294629	Small smooth outcrop behind milled ore pile. 5% nepheline syenite enclaves	Ijolite	269.5	4.8	6.8	62.9
868		Ijolite	17	340804	5294864	Small outcrop on road. Black fg-mg ijolite. No sample taken.	Ijolite	377.1	2.6	24.9	77.4
869	**1643438**	Ijolite	17	340678	5294993	Massive, black on clean weathered surface, ijolite with sploches and veins of sulfide staining	Ijolite	707.9	4.6	56.9	126.5
870	**1634539**	Nepheline syenite	17	341075	5291964	Large outcrop area on hill. Strongly foliated nepheline syenite with sparse, flattened ultramafic enclaves. 40-50% nepheline uo to 4 by 5 mm with bluish cast on CWS. One 10 by 50 cm enclave of a light coloured 50:50 Kspar+nepheline rock shows evidence of flattening as well due to plastic flow.	Nepheline syenite	204.2	5.6	23.2	1.8

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
870	1634540			341075	5291964	Assay of ultramafic enclaves	Nepheline syenite	81.2	5.0	1.8	2.4
870							Nepheline syenite		5.1	1.0	4.7
871		Nepheline syenite	17	340736	5294359	Pink cg nepheline syenite that shows good flow foliation re parallel alignment of Kspar laths. Kspar up to 0.5 by 3 cm. No assay sample taken but nice slab with weathered surface selected for display	Nepheline syenite	139.5	4.7	5.9	17.1
872		Nepheline syenite	17	340673	5294306	Similar to 871. Lovely cg nepheline syenite with Kspar laths up to 2 by 6 cm. Rock has 60% Kspar, 30% nepheline and 10% aegirine. No sample taken	Nepheline syenite	147.5	4.3	7.7	18.2
872							Nepheline syenite	110.3	4.6	3.1	12.5
873	1634541	Nepheline syenite with alkalic gabbro enclaves	17	340594	5294370	Large boulder from adjacent cliff. Massive cg nepheline syenite with sparse mafic enclaves up to 1 by 2m. Gabbro is black to green-black, mg, massive with diffuse patches rich in Kspar. One miarolitic cavity 3 cm diameter lined with Kspar occurs in the gabbro. Assay sample of gabbro taken.	Gabbro enclave		3.3	4.0	19.6
874		Nepheline syenite with ultramafic enclaves	17	340581	5294392	Nepheline syenite similar to 873 with enclaves of biotite-bearing ultramafic rock up top 1 by 1 by 2 m	Alkalic ultramafic enclave		4.7	5.3	18.8
875		Nepheline syenite and urtite	17	340499	5294600	Angular boulders of nepheline syenite and urtite near cliff. Significant: cg crystals of primary magnetite (2 by 3 cm) occur in the nepheline syenite. No vein concentrations of magnetite observed.	Urtite				
876	1634543	Nepheline syenite and mafic to ultramafic enclaves	17	340484	5294621	Massive, fg alkalic ultramafic enclave in nepheline syenite and ijolite in large angular boulder from nearby cliff. Assay sample from ultramafic enclave	Ultramafic enclave	167.0	4.8	5.2	28.0
876							Ijolite	289.8	3.7	22.8	43.8
877		Ijolite breccia	17	340475	5294675	Outcrop on small point into Beaverdam lake on west side.		203.8	3.1	10.7	38.5
878	1634544	Ijolite breccia	17	340481	5294688	Ijolite cut by magnetite-rich veins. Elevated radioactivity at 500-700 cps in veins	Ijolite	249.2	2.4	25.5	29.6

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
879	1634545	Ijolite breccia and syenite	17	340470	5294711	Ijolite breccia and pink syenite breccia cut by magnetite-rich veins. Note also 30 by 50 cm ovoid cluster of coarse magnetite crystals with no apparent linkage with the cross-cutting veins. Ijolite is Kspar-porphyritic and encloses nepheline syenite and fg pink syenite rock types. The pink syenite is identical to that found in large test pit area on opposite shore of Beaverdam Lake.	Pink syenite	238.8	5.8	15.4	33.3
880	1634546	Ijolite breccia and apatite-magnetite veins	17	340463	5294737	Assay sample of ijolite taken.					
881		Nepheline syenite cut by late Kspar-rich zoned veins	17	340455	5294810	Well foliated syenite, fg, only sparse nepheline observed cut by late stage veins, 5-10 cm wide, rich in cg euhedral Kspar (80%). Centre of zoned vein contains yellow stained carbonate. Relatively higher radioactivity over veins.	Nepheline syenite	220.6	7.0	5.4	36.8
881							Kspar-rich vein	307.0	6.5	21.4	39.4
	1634547	Nepheline syenite and enclaves of glimmerite	17	34055	5294810	Nepheline syenite, cg identical to stops 871 and 872. Enclaves, 20 by 30 cm, of black fg alkalic ultramafic rock, possibly a glimmerite, with mg phlogopite present and assay sample taken of this rock.	Nepheline syenite	123.7	5.2	3.8	13.2
882											
882							Phlogopite alkalic ultramafic rock	115.5	4.8	3.3	12.7
883		Porphyritic ijolite	17	340450	5294968	Massive to flow banded. Mg-cg, Kspar-porphyritic. Very nice exposure showing Kspar megacrysts up to 2 cm diameter. Ovoid enclaves of the distinctive pink trachytoidal syenite are present and up to 6 by 12 cm.	Porphyritic ijolite	156.8	3.5	12.2	16.8
884	1634549		17	340568	5294955	A careful hand-picked concentrate was produced for assay 1634549 of the brick-orange vein material	Spectrometer positioned over two closely spaced orange veins		5.1	51.6	175.6
884							Ijolite host	792.2	5.8	49.6	166.2
884							5 cm thick brick orange vein	866.3	5.3	59.2	176.4
884							Ijolite host 30 cm from brick-orange veins	709.2	3.4	54.4	137.4

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
885	**1634551**	Pile of Fe-rich concentrate, near test pit	17	340710	5294609	Dark grey pile of milled concentrate approx. 10 cm mesh. Sample taken under spectrometer assay site.			1.0	24.2	100.3
886	**1634552**	orange mineral-rich rocks from boulder pile near lake	17	340710	5294609	Several boulders were selected for slab work as have high RA and thus possible elevated REE.	Boulder #1 - black rock rich in magnetite with orange mineral between cg	911.3	2.2	42.3	242.3
886		orange mineral-rich rocks from boulder pile near lake					Boulder #2 - black rock rich in magnetite with orange mineral between cg magnetite. Highest cpm at 3800	1500	1.6	93.6	374.8
887	**1634553**	Boulder pile near hopper. high RA	17	340625	5294664	Outcrop near test pit on lake.	Light pink to white felsic unit		5.8	9.5	76.8
887							Ijolite next to magnetite veins	614.9	2.8	6.1	202.3
887							Ijolite in area of apatite-magnetite veins up to 10 cm width. Also note patches of nepheline-rich alteration cut by the veins. Distinct bluish cast on clean weathered surfaces of nepheline-rich masses.	407.5	1.9	19.6	102.3
		Ijolite breccia	17	340578	5294668	Large 2 by 2.5 m blast piece from test pit. Several apatite-magnetite veins that cut across breccia	Ijolite breccia clast		1.9	58.5	247.2
888											
888							Ijolite breccia clast	1400	3.1	67.8	352.9
888							Ijolite breccia clast	440.4	2.7	9.1	132.0
888							Magnetite-rich vein	900.4	1.0	54.8	221.8
889	**1634552**	Ijolite in boulder pile	17	340568	5294662	Distinctive dark grey (FS) fg unit that occurs as breccia fragments. Possible variant of ijolite but require lab analysis.	Ijolite, fg dark grey variant	928.1	2.9	49.1	231.6
890	**1634553**	Rust stained boulder from pile near hopper	17	340659	5294649	Several boulders were selected for analysis and slab work.	Rust stained boulder #1.Possibly a fg ijolite with sparse sulfides (cpy and py + copper stain)	1100	3.3	42.7	300.4

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
890	**1634554**	Boulder with orange mineral-rich vein system in fg ijolite host	17	340659	5294649		Good sample of fg dark grey ijolite breccia and veins of magnetite and unknown Radioactive orange mineral. High RA at 7000 cpm and highest uranium value to date.	4200	6.0	265.5	981.8
890							Rust stained boulder #2	1100	2.1	47.3	309.8
890							Rust stained boulder #3	854.6	1.6	46.1	216.3
891		Nepheline syenite with gabbro enclaves	17	340785	5294087	Nepheline syenite cg massive in small outcrop on north side of Lackner Lake Road. Possibly a boulder but with smooth surface by glacial smoothing. 35% nepheline, 50% Kspar, 15% mafic minerals	Nepheline syenite	202.2	5.0	13.6	23.2
891							Nepheline syenite	162.7	5.0	7.9	20.1
892	1634555	Nepheline syenite on Lackner Lake road	17	340907	5293971	Flat smooth outcrop on north side of road. Light pink (CWS) cg nepheline syenite. 40% nepheline, 40% Kspar, 20 mafics	Nepheline syenite	113.4	4.9	1.1	16.3
892							Nepheline syenite	182.5	4.3	15.1	16.7
893	1634556	Ijolite cut by apatite-magnetite veins. Outcrop in Zone 2-3 of Multiminerals	17	340963	5293942	Ijolite is fg, weakly foliated with enclaves of gabbro and tonalite-diorite. Cut by fracture coatings of fg pink unknown mineral. The vivid green apatite-magnetite veins also contain an unknown orange mineral. Assay samples taken for ijolite (1634556). Large specimen selected for slab work and extraction of apatite concentrate for analysis of REEs	Spectrometer normal to pink mineral fracture surface	277.2	6.4	19.3	33.0
893							Spectrometer normal to pink mineral fracture surface	211.5	6.9	14.0	17.0
893							Spectrometer normal to surface of apatite-rich vein	358.6	4.7	17.8	74.4
							Ijolite	277.3	6.5	19.6	31.8
894		Ijolite		340972	5293929	Outcrop near 893. Location site 895 inadvertently entered for this site and thus not used. Complex assortment of rock types: nepheline syenite, with	Nepheline syenite	182.2	5.4	11.3	18.8
894							Streaked white granitic rock	137.9	5.7	4.7	14.1

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
896		Nepheline syenite	17	341015	5293923	Massive, cg, equigranular. Absence of usual tabular Kspar crystals. Small smooth outcrop in sand pit and no sample taken.	Nepheline syenite	119.1	5.1	2.2	14.8
		Ijolite	17	341050	5293951	Small outcrop in trees along south side of road. Appears blasted and has abundant rust spots. Elevated RA at 2200 cps.	Ijolite	958.8	1.6	48.9	249.7
896											
897							Ijolite	788.5	3.5	40.7	193.8
897	1634557	Ijolite		341050	5293951	Assay sample of ijolite	Ijolite		3.5	60.3	243.9
897	1634558	Green apatite-rich ijolite		341050	5293951	Assay sample of green apatite-rich material for REE in concentrate, Radioactivity 2200 total counts per sec					
898		Nepheline syenite	17	341114	5294099	Small outcrop on road and possibly a boulder	Nepheline syenite	122.6	4.1	2.3	20.9
899	1634559	Ijolite	17	341177	5294317	Outcrop near north side of road.Green black ijolite that has been invaded by numerous thin veins of white to faint orange felsic minerals. The pattern suggests vein flattening with sigmoidal forms on several generations of these veins. Possible REE-rich veins. Should be channel cut as outcrop is entirely glacially smoothed. Piece of ijolite with vein material was collected for mineral ID work.	Ijolite, absence of magnetite veins	159.1	2.3	4.4	39.1
899							Ijolite in area of abundant felsic veins	210.5	2.8	10.9	45.7
900		Ijolite	17	341237	5294495	Small outcrop of fg black massive ijolite on road. No sample taken.		172.5	3.0	2.6	44.0
818		Syenite, inner core	17			Massive, mg-cg, nepheline syenite in glacially smoothed outcrop within foundation of old fire tower house. 20% mafics, 20% nepheline, 60% Kspar. Sparse mafic enclaves up to 20 by 40 cm occur within syenite.	syenite	331.0	6.0	14.0	65.8
818							syenite	291.7	6.7	8.7	58.4
818							syenite	262.0	6.7	10.4	43.9
818							Mafic enclave		5.0	8.9	64.9
902		Ijolite	17	342349	5297558	Massive, fg, black (CWS), elevated radioactivity	ijolite	419.2	5.5	21.0	86.6

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
913		Nepheline syenite	17	342047	5295872	Massive pink mg-cg syenite on Fire Tower Road.		216.2	6.0	5.4	40.2
915	1634568	Magnetite-rich rock	17	340745	5294629	Small blast pit that consists mainly of magnetite rock.	Magnetite-rich rock	522.2	1.2	12.1	163.7
915							Magnetite-rich rock (boulder)	659.1	1.0	7.7	224.1
915							Magnetite-rich rock	906.0	0.9	11.0	310.0
915							Magnetite-rich rock	419.0	1.0	4.5	141.3
923							Alkalic gabbro enclave	351.0	4.5	27.1	53.6
925			17	340752	5294721	Small outcrop that reveals contact relations between black ijolite and later massive cg nepheline syenite. Magnetite crystals, 1-2 cm diameter, and veins occur in the ijolite.	Nepheline syenite	402.3	7.4	14.1	84.9
925							Ijolite		2.9	20.7	182.0
926			17	341195	5293958	Small outcrop of black ijolite in bad bush near area of Multi-Minerals zones 3-4	Ijolite	432.2	4.0	27.7	87.5
927	1634578		17	341239	5294269	Small outcrop in bad bush in area of very poor exposure re search for exposures over Zone 3-4. Gabbro is cut by 20-50 cm wide felsic dyke of syenite	Gabbro	226.8	5.4	9.5	38.8
927							Syenite	433.5	8.4	32.1	55.2
928			17	341219	5294261		Ijolite in small outcrop	107.4	1.8	1.2	28.7
929		Tonalite host rocks	17	342323	5292384	Massive to weakly foliated fg-mg tonalite to granodiorite. Late veins of potassic pegmatite cut tonalite	Tonalite	25.6	1.0	0.2	4.2
929							Potassic pegmatite	88.8	2.7	3.3	13.4
930-A		Fenitized diorite host rocks	17			Boulder, subrounded, 1 by 1 by 2 at entrance of long north trending logging road that ends at topographic highs in SE part of Lackner complex. Vivid blue riebeckite occur in veins and replacement in adjacent diorite. Best example of Na-K fenitization found to date for Lackner complex host rocks.	Fenite vein surface	37.5	1.2	0.7	6.9

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose	%K	U ppm	Th ppm
930-A							Fenite vein 1cm thick and adjacent biotite-rich alteration	58.6	1.9	0.9	10.7
930-B		Nepheline syenite	17	344808	5294140	Logging road into SE part of Lackner complex. Good for ATV to topographic high. Large angular boulder probably from upslope source. Massive cg nepheline syenite. Road travels over outwast sand and then boulder till at higher elevation.	Nepheline syenite	226.5	4.7	10.9	39.5
931	1634579	Nepheline syenite	17	344754	5294706	Massive, light pink on CWS, cg, very low mafics (2%). Small glacially smoothed outcrop in ditch along west side of road.	Nepheline syenite	159.7	8.8	4.4	7.6
931							Nepheline syenite	160.1	8.6	3.4	10.8
931							Nepheline syenite near assay sample site.	165.4	7.9	4.3	14.6
932, 933						Waypoints on logging road					
934						Intersection of logging road with main E-W road					
935		Nepheline syenite in outer ring of Lackner complex	17	340189	5295267	Massive to vaguely layered, cg, light pink (CWS) nepheline syenite 20% nepheline, 10% aegirine, Kspar 70%, sparse phologopite. Outcrop on small hill just west of McVittie Pit	Nepheline syenite	150.3	6.0	4.0	18.4
936		Nepheline syenite in outer ring of Lackner complex	17	340226	5295283	Similar to 935. No sample taken					
938							Nepheline syenite	114.8	4.7	4.1	11.8
937: Samples from McVittie Pit		Magnetite-rich veins in ijolite	17	340296	529320	Old overgrown pit in ijolite, 3m depth, 3 to 7m width and 15 m length. Pit was cleaned out with a sandvik brush axe. Massive fg, light black (CWS) ijolite with numerous magnetite-rich veins, 2 cm to 30 cm width. Relatively low RA compared with other magnetite-rich veins exposures to the south-east in Number 3 zone.	Ijolite	168.1	4.1	9.3	23.9
937							Ijolite near magnetite-rich vein	222.1	5.0	13.2	31.4
937	1634581	Magnetite-rich veins in ijolite	17	340296	529320	Massive,ijolite from vertical face of north side of pit. Sample taken 1 m from 30 cm wide magnetite-rich vein	Magnetite-rich vein	197.3	2.7	9.2	41.5
937							Magnetite-rich vein	220.6	2.6	11.4	46.2
937							Ijolite near magnetite-rich vein	452	4.4	27.5	452.0
937							Magnetite-rich vein	285.6	2.6	20.9	285.6

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
937	1634582	Magnetite-rich veins in ijolite	17	340296	529320	Massive magnetite-rich mineralization, 1% unknown orange mineral and sparse sulfides. Assay sample contains mostly magnetite with 10% ijolite host rocks	Magnetite-rich vein	221.2	2.6	10.7	48.0
937	1634583	Ijolite	17	340296	529320	Foliated fg ijolite in area of relatively higher radioactivity at bottom of rock face on north side of trench	Ijolite	379.4	4.6	26.9	64.5
937							Ijolite	374.1	4.9	23.7	374.1
937							Ijolite	268.9	4.8	14.1	48.0
937	1634584	Ijolite and magnetite-rich veins	17	340296	529320	Sample with sulfide staining in magnetite-rich vein. Sparse unknown orange mineral present. Radioactivity approx 1000 cps	Ijolite and magnetite-rich vein	403.3	3.9	22.4	403.3
937	1634585	Magnetite-rich veins in ijolite	17	340296	529320	Magnetite vein in ijolite, rust stained and possible sparse chalcopyrite	Ijolite and magnetite-rich vein				
939		Ijolite				Massive, fg, light black on clean weathered surfaces.		349.5	4.6	13.9	80.3
940		Ijolite, nepheline syenite cut by magnetite vein				Nepheline syenite, cg, massive intrudes ijolite but both cross-cut by magnetite vein. Nepheline in ijolite weathers a distinct bluish colour. Outcrop immediately south of McVittie pit.	Nepheline syenite	177.1	5.1	6.4	28.1
940							Ijolite	322.2	2.8	12.0	81.9

Field ID	Assay #	Geologic Unit	Zone	Easting	Northing	Sample Description	Spectrometer Site	Air absorbed dose nGy/hr	%K	U ppm	Th ppm
812		Ijolite breccia cut by apatite-magnetite veins	17	340250	5295166	Nice outcrop of ijolite, massive, fg, black about 50 cm from apatite-magnetite veins. Exposure on west part of Camp Lake Road.	Ijolite	319.6	2.8	11.1	82.6
812						Apatite-magnetite vein about 30 cm width	Apatite-magnetite vein	512.4	1.4	7.2	168.9
812						nepheline syenite enclave in massive ijolite	Nepheline syenite	236.2	3.0	14.4	43.8
812						area of highest radioactivity - ijolite crosscut by delicate veinlets near apatite-magnetite vein (1100 cps)	Ijolite	732.6	1.8	10.0	243.0
812						Ijolite, massive, fg, second spot near apatite-magnetite vein	Ijolite	357.0	2.6	16.0	87.5
812						Ijolite, massive, fg-mg about 3 m from apatite-magnetite vein	Ijolite	79.4	2.5	2.7	12.1
825	**1634501**	Nepheline syenite	17	340757	5294389	Massive, light pink (FS, cg to locally pegmatitic with radioactive zone up to 1 m width. Minerals = nepheline, kspar, aegirine. Outcrop on west side of Camp Lake.	Nepheline syenite	511.9	5.7	51.3	58.7
825							Nepheline syenite	181.8	5.3	10.2	20.9
825							Nepheline syenite	291.7	4.2	20.2	47.2
826	**1634502**	Nepheline syenite	17	340718	3294393	Small outcrop on east shore Camp Lake. Leucocratic nepheline syenite cg that grades into pegmatite patches. Small patches contain enrichment in phlogopite. Sparse sulphides. CI = 5	Nepheline syenite	262.3	7.6	17.2	25.7
827		Nepheline syenite	17	340817	5294810	Small outcrop in sand pit along Camp Lake Road. Grey fg massive to vaguely foliated nepheline syenite	Nepheline syenite	292.2	4.2	7.9	72.3
827							Nepheline syenite	246.4	4.4	4.3	61.3
828		Ijolite	17	340824	5294817	Massive, fg-mg, black on CWS, that are sharpely cut by magnetite-rich 1-5 cm wide veins and pods.Outcrop on nearby road contains high % randomly oriented and delicate Kspar laths in layers 20 cm width that appears to have segregated from enclosing ijolite	Ijolite	367.9	0.9	21.9	88.2
828							Ijolite		2.9	50.6	179.4
828	**1643503**	Feldspar-rich rock	17	340824	5294817	Small smooth outcrop on south side of Camp Lake Road.	Feldspar-rich rock	492.6	3.9	25.2	113.2

Appendix 2. Major, minor and trace element analyses of bulk rock samples from the Lackner Lake complex. Analytical certificate and lab quality control work by Bureau Veritas Mineral Laboratories, Vancouver, B.C.

BUREAU VERITAS MINERAL LABORATORIES
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Client: **Gold Crossing Exploration**
35 Kristi Court
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Submitted By:	Frederick Breaks
Receiving Lab:	Canada-Val-d'Or
Received:	June 23, 2014
Report Date:	September 22, 2015
Page:	1 of 4

CERTIFICATE OF ANALYSIS YVO14000011.1

CLIENT JOB INFORMATION

Project:	Lackner
Shipment ID:	
P.O. Number	
Number of Samples:	85

SAMPLE DISPOSAL

RTRN-PLP	Return
RTRN-RJT	Return

Bureau Veritas 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

Procedure Code	Number of Samples	Code Description	Test Wgt (g)	Report Status	Lab
PRP70-250	71	Crush, split and pulverize 250 g rock to 200 mesh			YVO
FA130	71	Fire assay fusion Au Pt Pd by ICP-MS	30	Completed	VAN
LF300	71	LiBO2/Li2B4O7 fusion ICP-ES analysis	0.2	Completed	VAN
LF100	71	Refractory and REEs by fusion and ICP-MS analysis	0.2	Completed	VAN

ADDITIONAL COMMENTS

Invoice To: International Explorers and Prospectors Inc.
168 Algonquin Blvd E
Timmins ON P4N 1A9
CANADA

CC:

BRITISH COLUMBIA CERTIFIED ASSAYER
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Project: Lackner
Report Date: September 22, 2015

Page: 2 of 4 Part: 1 of 3

CERTIFICATE OF ANALYSIS YVO14000011.1

	Method	WGHT	FA130	FA130	FA130	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300
	Analyte	Wgt	Au	Pt	Pd	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y
	Unit	kg	ppb	ppb	ppb	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	1	0.1	0.5	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002	5	20	2	5	3
1634501	Rock	3.27	2	0.2	0.5	53.66	21.13	3.40	0.46	1.87	6.92	8.19	0.32	0.03	0.12	<0.002	2146	<20	1901	816	13
1634502	Rock	3.11	3	0.3	0.6	46.66	14.24	11.69	3.28	8.05	4.50	5.85	2.96	0.42	0.32	0.010	1026	28	1026	591	25
1634503	Rock	1.85	2	0.3	0.6	46.59	17.54	10.88	1.84	8.05	7.79	4.64	0.19	0.45	0.50	<0.002	894	<20	1131	969	21
1634504	Rock	1.62	2	0.3	0.6	56.77	19.48	1.41	0.32	2.43	4.53	10.46	0.07	0.28	0.06	<0.002	5856	<20	2951	955	16
1634505	Rock	0.83	5	0.9	1.7	47.98	13.75	14.71	2.03	6.95	6.00	4.83	0.80	0.53	0.54	0.003	1970	<20	980	1677	23
1634506	Rock	0.69	9	0.9	1.6	48.07	13.76	14.66	2.12	7.35	5.80	4.85	0.80	0.70	0.47	<0.002	2200	<20	1062	1702	25
1634507	Rock	1.87	17	0.8	1.6	13.14	1.28	61.64	12.58	3.70	0.03	0.41	1.63	<0.01	1.82	0.099	1561	107	753	480	16
1634508	Rock	2.41	9	0.4	0.8	16.33	2.33	27.07	16.19	16.13	0.05	1.18	2.98	1.65	1.18	0.051	3624	199	3191	970	137
1634509	Rock	2.80	17	0.8	1.5	11.90	1.62	57.20	14.13	4.56	0.02	0.21	2.06	<0.01	2.68	0.095	6549	111	782	1044	32
1634510	Rock	1.68	20	1.0	1.7	22.78	2.69	44.46	19.86	0.41	0.04	1.34	3.79	<0.01	1.98	0.095	9146	221	101	417	8
1634511	Rock	1.62	14	0.8	1.7	12.33	1.51	65.05	9.71	1.89	0.04	0.73	2.24	<0.01	1.77	0.087	4050	143	353	459	24
1634512	Rock	2.92	17	1.0	1.6	20.55	2.73	53.60	11.06	2.93	0.13	2.27	2.47	<0.01	1.77	0.082	4852	148	306	512	46
1634513	Rock	1.55	3	0.3	0.6	45.85	14.17	11.57	4.17	11.42	7.21	2.72	0.18	0.24	0.57	<0.002	241	<20	848	913	18
1634514	Rock	1.93	2	0.2	0.5	46.11	15.54	10.87	3.59	10.40	8.49	2.59	0.14	0.16	0.54	<0.002	73	<20	554	885	19
1634515	Rock	2.61	265	1.6	3.6	1.19	0.22	64.20	0.15	16.66	0.20	0.05	3.53	11.94	0.79	<0.002	70	34	3389	619	316
1634516	Rock	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.
1634517	Rock	3.86	63	1.5	3.8	0.58	0.29	85.26	0.23	4.94	0.07	0.03	5.56	3.41	1.16	<0.002	20	82	1072	105	68
1634518	Rock	1.64	15	0.6	1.5	30.35	9.91	37.08	2.28	7.96	5.15	1.97	3.10	0.66	0.90	<0.002	129	31	699	1111	31
1634519	Rock	1.50	3	0.2	<0.5	53.07	19.82	4.36	1.03	3.72	6.47	8.87	0.07	0.06	0.22	<0.002	2694	<20	1095	442	14
1634520	Rock	0.44	2	0.2	0.5	46.02	16.27	10.46	3.55	10.18	8.57	3.09	0.18	<0.01	0.55	<0.002	94	<20	598	1137	15
1634521	Rock	1.49	14	1.7	3.4	13.57	4.70	66.04	1.10	2.69	1.97	0.93	8.74	<0.01	1.53	0.006	157	25	249	666	8
1634522	Rock	0.75	11	1.4	3.1	24.14	7.96	47.82	1.97	5.71	3.98	1.54	5.69	<0.01	1.20	0.003	90	22	401	1054	13
1634523	Rock	1.88	2	1.2	1.4	47.15	18.16	9.25	3.47	6.60	6.92	5.54	0.72	0.57	0.26	0.021	1896	47	1954	301	26
1634524	Rock	1.33	1	0.3	<0.5	45.81	15.85	11.01	3.85	10.56	8.19	3.21	0.22	0.04	0.56	<0.002	38	<20	519	878	16
1634525	Rock	2.02	2	0.2	0.5	50.18	16.66	8.87	2.15	7.69	7.33	5.23	0.12	0.17	0.46	<0.002	1181	<20	1004	842	18
1634526	Rock	2.78	10	1.5	3.4	29.71	11.21	38.91	2.23	5.68	6.18	1.67	3.87	<0.01	0.89	<0.002	24	<20	370	660	10
1634527	Rock	1.62	8	1.5	2.0	34.36	9.79	25.90	3.30	12.70	5.11	1.81	2.09	2.95	0.77	0.002	79	<20	1640	745	70
1634528	Rock	1.45	4	0.6	1.3	35.45	11.11	29.96	3.61	7.09	4.55	3.10	2.92	<0.01	0.77	<0.002	728	<20	596	1182	12
1634529	Rock	2.34	13	1.5	3.1	14.66	5.92	64.19	0.95	2.49	2.60	1.10	7.94	<0.01	1.24	0.003	177	23	207	824	5
1634530	Rock	1.81	1	0.2	<0.5	50.51	22.80	5.09	0.54	1.96	9.00	6.92	0.26	0.03	0.14	<0.002	2917	<20	2272	463	8

Client: **Gold Crossing Exploration**
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Sudbury ON P3E 5R4 CANADA

Project: Lackner
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	Method	LF300	LF300	LF300	LF300	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
	Analyte	Nb	Sc	LOI	Sum	Ba	Be	Co	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W	Zr
	Unit	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	5	1	-5.1	0.01	1	1	0.2	0.1	0.5	0.1	0.1	0.1	1	0.5	0.1	0.2	0.1	8	0.5	0.1
1634501	Rock	1075	<1	3.1	99.94	2257	4	3.0	2.1	22.8	7.6	1036.3	192.2	2	1930.6	52.7	77.2	63.4	38	3.0	713.0
1634502	Rock	509	9	1.5	99.85	1072	8	22.1	2.7	22.9	9.0	494.9	252.7	5	1056.4	11.3	15.5	2.7	345	<0.5	593.2
1634503	Rock	941	1	0.9	99.91	909	19	8.2	1.7	19.4	10.5	878.1	141.4	7	1194.2	25.7	79.9	15.1	22	<0.5	947.5
1634504	Rock	1307	<1	2.9	99.97	5939	<1	1.5	2.9	15.3	8.2	1237.3	330.5	2	3025.6	50.5	51.6	41.8	<8	1.5	927.6
1634505	Rock	1807	3	0.9	99.86	2087	15	11.8	1.1	20.2	16.1	1694.6	127.5	13	1014.8	56.9	208.2	54.0	41	1.1	1641.4
1634506	Rock	1924	2	0.4	99.86	2275	16	12.1	0.9	20.0	15.8	1808.5	124.0	13	1121.1	60.2	218.5	58.9	41	1.7	1636.3
1634507	Rock	940	97	2.7	99.44	1626	2	45.6	0.1	7.6	5.9	894.3	13.7	160	787.8	5.6	554.9	5.0	301	<0.5	448.7
1634508	Rock	916	68	13.2	99.41	3887	3	65.3	0.3	16.1	25.7	913.7	44.4	62	3281.3	8.4	448.6	9.4	285	<0.5	985.4
1634509	Rock	908	98	3.6	99.17	6899	<1	35.4	<0.1	9.7	10.5	838.7	7.7	154	789.8	4.8	2002.3	18.6	338	<0.5	945.3
1634510	Rock	1168	53	0.3	99.03	9183	4	63.8	0.4	11.1	6.8	1071.1	30.5	79	104.3	6.5	1937.5	9.2	303	0.6	319.9
1634511	Rock	1029	80	3.2	99.29	4222	6	54.1	0.3	7.8	6.6	954.4	15.4	92	365.0	4.1	1359.3	8.5	313	1.0	386.1
1634512	Rock	1196	114	0.9	99.35	4862	21	46.3	1.3	12.6	7.8	1126.9	85.2	41	312.8	5.8	732.9	18.2	335	1.2	469.9
1634513	Rock	595	3	1.4	99.88	258	13	12.3	1.4	18.3	10.8	565.7	96.1	7	913.0	23.8	58.5	25.6	49	<0.5	924.3
1634514	Rock	1591	3	1.0	99.86	73	8	10.1	0.5	16.6	8.9	1511.8	80.4	9	590.4	64.4	180.8	80.9	39	<0.5	877.2
1634515	Rock	1135	2	-0.5	99.16	79	<1	41.0	<0.1	10.4	2.2	1064.3	1.5	29	3366.9	21.2	820.7	1.3	337	<0.5	540.4
1634516	Rock	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.
1634517	Rock	904	<1	-2.3	99.57	29	<1	62.3	<0.1	14.6	0.5	864.2	1.4	35	1048.0	20.2	125.2	0.3	448	<0.5	99.7
1634518	Rock	5586	3	-0.7	99.70	123	5	27.5	0.4	14.8	9.1	4445.2	64.5	16	710.1	140.0	562.1	151.8	206	<0.5	1056.6
1634519	Rock	483	<1	1.7	99.95	2854	12	3.6	2.4	14.7	5.0	467.0	320.1	2	1161.0	20.8	52.8	10.3	12	<0.5	435.9
1634520	Rock	1899	4	0.5	99.87	102	11	10.7	0.6	15.2	10.0	1868.4	103.2	6	643.4	64.8	232.9	55.7	46	<0.5	1123.9
1634521	Rock	1987	2	-2.1	99.64	170	4	41.1	0.4	16.0	5.1	1704.2	33.8	28	250.4	42.1	109.7	23.3	465	<0.5	651.6
1634522	Rock	3928	3	-1.1	99.69	82	4	30.4	0.4	15.4	8.0	3240.2	52.2	20	403.8	98.2	328.0	81.2	321	<0.5	1004.2
1634523	Rock	264	8	0.7	99.87	1958	<1	18.9	1.3	13.8	3.9	279.4	137.4	2	1983.9	10.2	23.7	6.8	69	<0.5	295.7
1634524	Rock	706	2	0.3	99.89	38	13	10.8	0.4	15.5	10.3	688.3	65.0	5	537.2	35.9	84.9	29.6	33	<0.5	864.3
1634525	Rock	468	<1	0.6	99.92	1241	9	8.3	0.6	16.4	10.5	466.7	167.8	4	1059.9	30.9	53.6	29.5	14	<0.5	854.3
1634526	Rock	1370	4	-0.9	99.77	23	11	24.5	0.4	15.6	6.0	1259.0	50.9	16	383.6	77.9	113.7	127.3	262	<0.5	650.2
1634527	Rock	1232	4	0.4	99.70	76	12	18.8	0.6	13.2	6.3	1174.5	58.9	12	1683.8	42.1	219.7	51.2	136	<0.5	734.2
1634528	Rock	2501	4	0.6	99.79	728	20	20.3	4.3	16.4	11.0	2321.2	169.9	16	628.3	71.5	152.8	62.7	192	<0.5	1131.5
1634529	Rock	1162	1	-1.7	99.71	191	3	35.3	0.3	17.7	7.0	1131.5	31.2	24	217.6	31.6	9.0	2.2	452	1.2	803.1
1634530	Rock	217	<1	2.0	99.98	2990	4	4.1	1.8	15.5	5.3	209.0	169.1	3	2462.4	8.8	12.8	5.6	15	1.3	466.8

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35 Kristi Court
Sudbury ON P3E 5R4 CANADA

Project: Lackner
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	Method	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
	Analyte	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.1	0.1	0.1	0.02	0.3	0.05	0.02	0.05	0.01	0.05	0.02	0.03	0.01	0.05	0.01
1634501	Rock	12.4	91.0	143.9	13.37	41.4	5.48	1.63	3.58	0.45	2.57	0.43	1.18	0.19	1.30	0.22
1634502	Rock	26.0	75.4	160.2	18.40	65.8	11.85	3.54	9.10	1.19	6.24	0.97	2.24	0.32	1.96	0.28
1634503	Rock	21.0	73.3	164.2	19.01	68.9	11.56	3.27	7.72	0.97	4.93	0.82	2.78	0.59	5.30	1.06
1634504	Rock	17.0	91.8	168.2	16.39	54.3	7.47	2.21	5.29	0.64	3.47	0.57	1.61	0.24	1.41	0.20
1634505	Rock	22.7	70.8	175.3	21.47	79.5	13.83	3.84	9.24	1.20	6.06	0.98	2.81	0.51	4.39	0.86
1634506	Rock	25.4	87.0	203.2	24.98	91.5	15.40	4.47	10.56	1.32	6.62	1.10	2.98	0.49	3.87	0.74
1634507	Rock	17.0	26.4	61.8	9.11	49.1	14.66	5.72	9.20	1.03	4.82	0.63	1.76	0.25	1.84	0.31
1634508	Rock	148.2	218.1	599.6	95.98	529.5	158.71	44.43	96.78	10.46	46.72	6.01	12.15	1.47	8.04	0.92
1634509	Rock	31.5	47.8	115.7	20.43	124.4	40.54	16.63	23.08	2.35	9.83	1.22	2.66	0.38	2.44	0.37
1634510	Rock	7.2	10.8	34.4	4.14	21.6	7.09	2.33	4.30	0.50	2.33	0.34	0.91	0.16	1.48	0.30
1634511	Rock	25.3	46.5	100.1	16.07	85.1	24.57	7.87	15.97	1.77	7.72	1.10	2.52	0.33	2.10	0.31
1634512	Rock	45.9	56.5	176.7	29.55	162.1	51.51	15.03	34.78	3.80	16.83	2.10	4.27	0.50	3.07	0.41
1634513	Rock	20.0	44.5	109.0	14.00	53.1	9.83	2.92	6.97	0.89	4.76	0.80	2.44	0.48	4.74	1.03
1634514	Rock	18.7	40.7	112.3	14.65	57.0	10.53	3.20	7.31	0.93	4.71	0.84	2.49	0.51	5.09	1.06
1634515	Rock	315.1	1375.3	3384.6	407.94	1527.3	259.41	69.87	184.56	20.10	90.40	12.89	28.41	3.24	15.36	1.53
1634516	Rock	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.
1634517	Rock	65.9	307.0	730.3	89.44	340.6	56.70	15.33	40.01	4.46	19.68	2.81	5.97	0.66	2.99	0.30
1634518	Rock	29.8	106.3	299.2	36.58	138.0	22.84	6.21	15.03	1.78	8.41	1.33	3.54	0.64	5.13	0.94
1634519	Rock	13.9	65.0	115.4	12.12	43.2	6.42	1.98	4.63	0.57	2.97	0.52	1.51	0.28	2.54	0.45
1634520	Rock	16.8	27.6	89.3	11.66	44.8	8.58	2.52	5.64	0.75	3.84	0.68	2.14	0.52	5.10	1.07
1634521	Rock	7.4	19.5	52.7	5.84	20.9	3.75	1.10	2.48	0.33	1.72	0.31	0.97	0.20	1.82	0.36
1634522	Rock	14.4	33.8	108.6	12.61	44.9	8.04	2.22	5.14	0.64	3.45	0.59	1.95	0.41	3.77	0.72
1634523	Rock	26.7	140.2	277.8	28.90	98.5	14.23	4.20	9.96	1.20	5.80	1.04	2.60	0.36	2.41	0.39
1634524	Rock	16.8	25.9	80.7	10.42	43.1	8.37	2.46	5.83	0.75	3.84	0.69	2.15	0.51	5.17	1.05
1634525	Rock	18.4	58.9	127.9	14.90	56.5	9.59	2.84	6.61	0.82	4.21	0.73	2.22	0.47	4.84	0.99
1634526	Rock	10.2	17.4	55.1	6.92	28.4	5.32	1.60	3.52	0.49	2.53	0.44	1.55	0.27	2.60	0.57
1634527	Rock	74.3	345.5	771.3	87.85	334.2	51.31	14.19	36.69	4.03	18.94	2.84	6.89	0.95	6.55	1.09
1634528	Rock	13.1	32.8	77.3	9.22	35.1	5.76	1.71	4.13	0.53	2.94	0.48	1.45	0.31	2.90	0.63
1634529	Rock	4.9	10.4	26.0	3.18	12.4	2.32	0.71	1.61	0.23	1.19	0.22	0.62	0.14	1.36	0.30
1634530	Rock	9.0	46.8	84.8	8.08	27.7	3.78	1.43	2.65	0.31	1.81	0.31	0.94	0.16	1.16	0.20

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Project: Lackner
Report Date: September 22, 2015

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	Method	WGHT	FA130	FA130	FA130	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300
	Analyte	Wgt	Au	Pt	Pd	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y
	Unit	kg	ppb	ppb	ppb	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	1	0.1	0.5	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002	5	20	2	5	3
1634531	Rock	1.31	1	0.2	<0.5	53.79	20.02	5.08	0.58	2.31	6.25	9.29	0.18	0.04	0.17	<0.002	2165	<20	1387	309	11
1634532	Rock	4.09	75	1.5	3.5	0.84	0.25	76.45	0.10	8.91	0.10	0.02	5.62	6.71	1.03	<0.002	51	23	1928	304	140
1634533	Rock	1.49	40	0.6	1.5	1.42	0.21	57.95	0.17	20.18	0.28	0.06	2.93	14.82	0.74	0.003	102	20	4104	669	471
1634534	Rock	1.60	49	1.5	2.9	1.28	0.17	50.45	0.17	24.50	0.11	<0.01	3.53	17.79	0.73	0.003	34	<20	5474	616	446
1634535	Rock	2.89	48	0.7	1.4	2.11	0.17	47.57	0.28	25.84	0.15	<0.01	3.15	18.66	0.72	0.003	29	<20	5811	970	510
1634536	Rock	0.43	12	1.2	2.9	14.97	5.18	63.22	1.22	3.19	2.36	1.01	8.52	<0.01	1.55	0.006	141	24	260	718	9
1634537	Rock	1.96	2	0.2	<0.5	52.51	21.40	6.66	0.34	1.73	7.73	7.81	0.25	0.11	0.16	<0.002	1330	<20	1548	166	7
1634538	Rock	1.54	5	0.7	1.4	48.19	13.61	14.65	2.31	6.66	4.75	5.84	0.65	0.59	0.37	0.002	3160	<20	1293	1164	20
1634539	Rock	2.77	1	0.3	<0.5	51.01	20.94	7.22	0.58	3.22	7.88	7.37	0.26	0.18	0.21	<0.002	1863	<20	1507	241	6
1634540	Rock	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.
1634541	Rock	1.37	1	0.5	0.7	48.51	9.20	9.63	7.34	15.13	4.30	2.25	1.09	0.05	0.44	0.070	271	59	1114	861	28
1634542	Rock	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.
1634543	Rock	1.18	1	0.6	0.6	37.64	6.54	20.00	9.61	11.44	0.81	4.71	4.44	2.52	0.48	0.088	1389	172	1063	913	49
1634544	Rock	2.18	2	0.3	0.5	46.18	16.99	10.84	2.90	9.11	8.63	3.46	0.27	<0.01	0.54	<0.002	415	<20	667	834	14
1634545	Rock	1.21	1	0.2	<0.5	54.43	20.02	4.78	0.82	2.25	5.98	9.21	0.15	0.05	0.19	<0.002	2712	<20	1183	322	15
1634546	Rock	3.15	24	1.3	2.7	13.18	3.65	66.89	1.38	3.50	1.58	0.65	9.23	<0.01	1.51	0.003	62	29	228	609	6
1634547	Rock	0.12	2	0.3	<0.5	39.00	9.95	20.01	10.48	6.16	0.87	5.94	3.02	0.41	0.45	0.016	3512	71	590	341	13
1634548	Rock	2.21	2	1.2	1.2	47.48	18.17	9.27	3.28	6.19	6.66	5.94	0.65	0.54	0.29	0.018	1975	45	2049	293	28
1634549	Rock	0.11	1	0.7	0.8	57.18	16.16	9.83	0.33	0.61	2.90	10.06	0.76	0.01	0.15	0.005	5797	<20	709	307	<3
1634550	Rock	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.
1634551	Rock	1.40	7	1.1	0.7	16.17	5.41	61.50	1.27	3.26	2.38	1.05	8.27	<0.01	1.52	0.010	164	28	273	724	9
1634552	Rock	0.66	13	1.8	3.5	26.79	7.65	45.30	2.36	6.76	4.00	1.43	5.37	<0.01	1.24	0.004	82	23	442	1211	14
1634553	Rock	1.99	2	0.9	0.6	44.53	15.05	13.15	3.47	10.24	7.94	2.81	0.53	<0.01	0.63	<0.002	76	<20	623	1193	17
1634554	Rock	4.10	4	0.6	1.5	41.12	18.24	11.40	2.51	8.02	9.37	3.55	0.85	<0.01	0.47	<0.002	51	<20	713	1296	30
1634555	Rock	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.
1634556	Rock	1.52	2	0.3	0.6	51.22	18.46	7.50	1.67	6.02	7.00	6.62	0.12	<0.01	0.34	<0.002	1134	<20	774	677	8
1634557	Rock	2.66	2	0.2	0.6	45.94	16.65	9.46	2.83	10.23	7.87	4.21	0.16	1.10	0.42	<0.002	691	<20	964	607	27
1634558	Rock	1.06	2	0.3	0.7	37.72	10.07	10.03	3.35	20.60	5.27	2.01	0.17	8.13	0.48	0.002	225	<20	3409	751	146
1634559	Rock	0.78	2	1.0	1.2	41.27	16.08	13.13	3.79	10.10	7.65	3.46	0.97	1.16	0.40	0.004	2268	28	2076	217	45
1634560	Rock	0.99	6	6.4	9.1	37.24	12.65	15.16	6.25	13.98	4.47	3.31	1.51	2.43	0.39	0.003	1881	55	2168	357	66

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Project: Lackner
Report Date: September 22, 2015

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CERTIFICATE OF ANALYSIS YVO14000011.1

	Method	LF300	LF300	LF300	LF300	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
	Analyte	Nb	Sc	LOI	Sum	Ba	Be	Co	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W	Zr
	Unit	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	5	1	-5.1	0.01	1	1	0.2	0.1	0.5	0.1	0.1	0.1	1	0.5	0.1	0.2	0.1	8	0.5	0.1
1634531	Rock	84	<1	1.8	99.98	2143	5	3.6	2.9	14.9	3.7	86.4	359.7	3	1453.0	2.4	8.4	0.6	11	1.0	314.9
1634532	Rock	1003	<1	-0.9	99.55	52	<1	19.2	<0.1	14.4	1.5	904.8	1.7	27	1894.7	19.5	250.1	0.4	480	0.8	269.0
1634533	Rock	1152	2	-0.7	98.94	111	1	32.4	<0.1	9.2	2.3	1081.7	1.2	26	3883.3	19.2	1285.5	1.7	299	<0.5	557.6
1634534	Rock	1063	2	-0.7	98.98	36	<1	24.1	<0.1	9.1	2.6	1015.4	<0.1	21	5527.9	18.1	1028.5	1.7	315	<0.5	567.8
1634535	Rock	1333	2	-0.9	98.84	31	<1	23.9	<0.1	10.9	3.4	1268.2	0.8	23	5607.6	21.4	1407.2	2.0	291	<0.5	840.8
1634536	Rock	2094	2	-2.0	99.64	146	4	39.1	0.3	17.3	5.5	1751.3	34.2	30	263.9	41.4	129.4	26.8	454	<0.5	678.4
1634537	Rock	158	<1	0.9	99.98	1373	<1	4.5	1.0	15.8	2.1	163.3	182.9	2	1608.9	5.6	9.5	1.9	11	0.5	166.4
1634538	Rock	2215	8	1.3	99.86	3164	18	13.3	1.4	19.7	16.3	2154.4	180.7	16	1339.8	66.0	153.7	73.7	69	6.2	1164.7
1634539	Rock	99	<1	0.7	99.99	1907	<1	4.7	0.7	16.4	3.7	89.8	188.6	2	1529.5	5.5	2.1	2.6	20	<0.5	241.2
1634540	Rock	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.
1634541	Rock	456	33	1.4	99.79	277	7	17.9	1.0	16.7	13.2	446.3	60.4	6	1190.5	19.4	11.4	4.4	275	<0.5	874.8
1634542	Rock	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.
1634543	Rock	597	42	0.8	99.65	1457	6	44.9	1.6	20.9	20.2	597.4	176.9	5	1124.4	15.5	34.0	2.8	441	<0.5	912.7
1634544	Rock	214	2	0.7	99.91	447	8	10.8	1.1	14.8	8.6	217.8	127.7	5	724.4	12.9	17.4	8.7	45	<0.5	859.6
1634545	Rock	227	<1	1.6	99.95	2765	9	3.9	2.8	15.9	3.7	230.3	344.0	2	1303.8	11.3	23.2	12.0	16	1.4	330.8
1634546	Rock	1375	1	-2.2	99.67	63	3	40.8	0.2	18.4	5.3	1360.3	23.5	24	230.4	36.0	7.8	2.6	479	<0.5	593.3
1634547	Rock	348	8	2.8	99.69	3705	7	48.7	3.7	39.7	4.6	333.4	290.8	2	628.3	4.9	10.8	1.4	290	<0.5	347.0
1634548	Rock	287	7	0.8	99.86	2050	6	17.2	1.4	13.7	4.2	286.7	145.7	2	2165.5	12.1	25.1	10.3	63	<0.5	302.1
1634549	Rock	1849	<1	0.9	99.95	5814	<1	5.8	1.3	20.3	3.3	1765.5	274.5	3	768.7	73.2	164.9	68.6	35	2.8	304.0
1634550	Rock	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.
1634551	Rock	1901	2	-1.6	99.63	170	7	40.8	0.4	16.7	5.8	1665.5	38.4	28	286.0	42.5	124.6	25.6	448	0.5	701.4
1634552	Rock	2890	3	-1.8	99.70	91	12	30.3	0.6	15.9	11.2	2365.4	48.3	22	471.3	72.9	255.2	58.8	318	<0.5	1191.4
1634553	Rock	2645	3	0.9	99.84	90	12	13.1	0.5	15.2	11.0	2623.0	98.8	8	701.8	97.9	344.5	48.9	74	<0.5	1214.5
1634554	Rock	17610	4	1.1	99.43	56	12	11.9	0.7	17.9	11.8	17334.6	124.4	13	792.2	647.3	2516.0	754.5	60	0.7	1238.0
1634555	Rock	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.
1634556	Rock	287	<1	0.7	99.94	1208	11	6.8	0.9	18.0	9.0	386.2	218.6	5	827.0	25.6	37.2	20.5	18	<0.5	679.6
1634557	Rock	1003	1	0.6	99.87	732	12	10.8	1.2	15.1	6.3	981.2	118.7	4	1036.5	35.4	155.9	43.7	27	<0.5	618.4
1634558	Rock	1193	3	1.1	99.63	254	9	12.5	0.7	10.0	7.4	1181.3	58.5	5	3509.0	37.3	360.4	49.0	37	<0.5	758.7
1634559	Rock	384	5	1.2	99.82	2446	8	29.8	1.7	13.3	3.6	377.6	81.6	2	2192.3	19.5	49.8	11.4	85	<0.5	225.2
1634560	Rock	240	13	1.8	99.72	1986	5	44.6	1.8	11.5	5.8	240.3	123.3	3	2269.0	12.4	39.2	11.2	222	<0.5	371.5

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35 Kristi Court
Sudbury ON P3E 5R4 CANADA

Project: Lackner
Report Date: September 22, 2015

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CERTIFICATE OF ANALYSIS YVO14000011.1

	Method	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
	Analyte	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.1	0.1	0.1	0.02	0.3	0.05	0.02	0.05	0.01	0.05	0.02	0.03	0.01	0.05	0.01
1634531	Rock	11.1	58.3	100.4	9.58	31.5	4.50	1.44	3.09	0.39	2.10	0.39	1.16	0.21	1.68	0.31
1634532	Rock	137.3	557.6	1318.2	173.22	690.7	112.04	30.11	77.65	8.55	38.52	5.45	11.69	1.34	6.40	0.64
1634533	Rock	473.9	1791.8	4576.5	567.81	2238.6	367.93	98.07	257.72	28.52	130.08	18.77	41.19	4.80	22.85	2.25
1634534	Rock	460.6	1954.7	4796.9	588.06	2295.7	379.88	101.68	260.70	29.44	130.71	18.34	40.80	4.66	21.93	2.17
1634535	Rock	508.4	2161.6	5416.1	643.53	2468.3	424.49	111.65	303.54	32.83	149.44	20.97	45.23	5.34	25.52	2.53
1634536	Rock	8.2	21.7	45.1	5.35	17.7	3.93	1.15	2.14	0.35	1.94	0.33	1.12	0.24	2.14	0.41
1634537	Rock	6.3	32.4	68.5	7.36	26.8	4.06	1.47	2.69	0.32	1.62	0.25	0.65	0.11	0.95	0.18
1634538	Rock	22.1	75.5	165.0	19.46	67.2	12.09	3.37	8.01	1.02	5.07	0.86	2.38	0.36	2.95	0.53
1634539	Rock	5.4	50.6	99.6	11.16	39.0	5.36	1.63	3.31	0.36	1.72	0.26	0.69	0.13	1.14	0.25
1634540	Rock	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.
1634541	Rock	30.0	66.7	168.1	21.51	86.8	16.67	4.89	11.58	1.54	7.76	1.17	3.07	0.49	3.55	0.60
1634542	Rock	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.
1634543	Rock	49.3	199.7	419.2	48.72	177.5	32.75	9.29	25.07	2.83	12.92	1.92	4.34	0.53	2.76	0.36
1634544	Rock	15.4	25.0	63.8	8.43	32.1	6.44	2.03	4.56	0.65	3.33	0.61	2.18	0.51	5.22	1.12
1634545	Rock	16.3	97.9	152.1	14.66	45.3	6.58	1.98	4.54	0.55	3.03	0.56	1.60	0.27	2.11	0.40
1634546	Rock	6.2	13.2	31.4	3.84	14.2	2.74	0.82	1.96	0.27	1.39	0.26	0.82	0.17	1.83	0.37
1634547	Rock	13.9	45.0	98.1	11.81	45.0	7.85	2.21	5.92	0.72	3.34	0.53	1.35	0.21	1.46	0.26
1634548	Rock	28.7	154.7	302.3	31.47	107.3	15.63	4.51	10.68	1.28	6.57	1.07	2.83	0.42	2.71	0.44
1634549	Rock	2.7	13.7	37.9	3.76	12.1	2.13	0.62	1.19	0.15	0.72	0.11	0.24	0.04	0.31	0.06
1634550	Rock	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.
1634551	Rock	8.9	20.8	55.9	6.44	23.8	4.31	1.18	2.75	0.37	1.97	0.33	1.13	0.23	2.05	0.43
1634552	Rock	15.2	32.2	97.0	11.37	42.2	7.87	2.18	5.01	0.67	3.44	0.61	2.09	0.43	4.24	0.90
1634553	Rock	19.9	36.3	119.7	14.55	56.2	9.95	2.96	6.37	0.90	4.51	0.78	2.45	0.56	5.77	1.19
1634554	Rock	32.0	130.4	475.0	55.05	188.7	32.25	8.52	17.38	2.25	10.97	1.61	4.13	0.69	5.54	1.02
1634555	Rock	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.
1634556	Rock	9.1	13.2	39.6	5.43	21.3	4.73	1.41	2.92	0.39	2.15	0.41	1.24	0.33	3.33	0.71
1634557	Rock	30.6	101.7	260.3	33.02	127.8	21.61	5.96	14.72	1.67	8.08	1.22	3.17	0.52	4.11	0.77
1634558	Rock	151.7	682.4	1646.2	206.00	778.4	128.86	34.27	88.40	9.67	44.10	6.38	14.14	1.79	10.39	1.46
1634559	Rock	50.3	206.5	422.6	46.00	163.7	24.89	7.22	17.88	2.11	10.66	1.72	4.11	0.64	4.13	0.59
1634560	Rock	72.5	299.8	573.3	60.99	211.5	33.35	9.68	24.95	2.93	15.22	2.48	6.37	0.89	5.33	0.72

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CERTIFICATE OF ANALYSIS YVO14000011.1

	Method	WGHT	FA130	FA130	FA130	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300
	Analyte	Wgt	Au	Pt	Pd	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y
	Unit	kg	ppb	ppb	ppb	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	1	0.1	0.5	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002	5	20	2	5	3
1634561	Rock	1.12	9	0.2	<0.5	46.92	15.81	7.47	5.67	3.92	1.41	8.96	0.57	2.75	0.44	0.002	35921	<20	2814	166	132
1634562	Rock	1.36	6	0.6	1.4	43.01	14.90	15.91	2.00	3.98	3.48	6.11	0.39	1.27	0.45	0.013	29614	<20	2511	858	1013
1634563	Rock	0.30	6	0.7	1.5	40.21	13.29	13.18	10.84	3.57	1.13	8.34	1.07	2.58	0.93	0.004	23457	<20	2155	769	181
1634564	Rock	0.56	2	0.3	<0.5	52.52	15.76	8.19	2.55	3.25	2.95	8.03	0.32	0.45	0.33	0.006	21395	<20	2016	563	442
1634565	Rock	2.27	14	0.2	<0.5	47.24	15.06	7.94	5.73	1.71	2.01	8.17	0.45	0.95	0.49	0.012	26891	<20	2224	1755	1155
1634566	Rock	1.48	3	0.2	<0.5	48.17	17.11	6.02	4.51	3.51	2.09	8.60	0.43	2.45	0.38	0.003	38600	<20	2849	885	243
1634567	Rock	0.49	2	0.2	<0.5	51.70	22.85	4.39	0.78	2.00	8.32	6.99	0.37	0.25	0.15	<0.002	3322	<20	861	202	23
1634568	Rock	2.70	46	1.4	3.7	10.57	3.14	66.73	1.08	7.68	1.10	0.53	5.11	3.71	1.11	0.002	84	26	1364	557	72
1634569	Rock	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.
1634570	Rock	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.
1634571	Rock	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.
1634572	Rock	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.
1634573	Rock	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.
1634574	Rock	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.
1634575	Rock	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.
1634576	Rock	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.
1634577	Rock	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.
1634578	Rock	1.76	4	1.7	2.8	41.70	14.06	11.71	4.57	12.49	5.57	4.10	0.63	1.21	0.52	0.017	1266	53	2348	338	57
1634579	Rock	1.40	2	0.1	<0.5	54.88	23.74	1.00	0.04	0.50	5.63	11.67	0.02	0.03	0.02	<0.002	2047	<20	741	91	5
1634580	Rock	0.08	3	0.6	1.3	51.69	19.09	9.13	0.70	3.76	7.64	6.47	0.19	0.06	0.25	0.003	1150	<20	889	395	8
1634581	Rock	1.13	1	0.2	<0.5	45.20	18.53	9.71	2.68	8.60	9.77	3.54	0.12	<0.01	0.50	<0.002	73	<20	572	857	13
1634582	Rock	1.83	9	1.0	2.5	27.57	11.95	39.98	1.65	4.77	5.74	2.57	4.99	<0.01	1.05	0.004	251	23	379	778	9
1634583	Rock	1.03	1	0.2	<0.5	52.66	17.27	7.97	1.41	5.00	5.50	7.87	0.26	<0.01	0.33	<0.002	2381	<20	638	580	9
1634584	Rock	2.64	9	1.4	3.0	39.06	13.99	24.29	2.14	6.81	6.52	3.63	2.31	<0.01	0.75	0.002	647	<20	498	781	12
1634585	Rock	0.91	10	1.0	2.9	2.11	0.97	86.00	0.34	0.26	0.09	0.12	11.06	<0.01	1.75	0.005	111	42	60	212	<3

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Project: Lackner
Report Date: September 22, 2015

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CERTIFICATE OF ANALYSIS YVO14000011.1

	Method	LF300	LF300	LF300	LF300	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
	Analyte	Nb	Sc	LOI	Sum	Ba	Be	Co	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W	Zr
	Unit	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	5	1	-5.1	0.01	1	1	0.2	0.1	0.5	0.1	0.1	0.1	1	0.5	0.1	0.2	0.1	8	0.5	0.1
1634561	Rock	410	<1	1.0	99.40	36662	5	18.4	9.2	18.9	1.6	408.0	335.2	2	2926.2	14.2	334.9	11.3	87	<0.5	161.5
1634562	Rock	871	6	1.2	96.66	28979	5	10.3	2.6	25.1	7.1	839.6	201.9	10	2451.5	33.9	3957.9	32.3	377	<0.5	676.2
1634563	Rock	767	1	0.9	99.15	23182	4	36.5	18.9	21.8	7.9	751.9	475.9	3	2213.8	33.3	497.9	24.7	152	<0.5	794.4
1634564	Rock	349	3	1.3	98.42	20992	2	9.7	29.4	20.8	5.3	339.9	255.3	3	2054.9	19.8	2164.8	32.4	55	<0.5	448.7
1634565	Rock	446	9	2.6	96.10	26299	4	15.3	6.2	27.2	14.7	430.1	318.8	2	2272.1	21.0	5005.1	29.7	82	6.6	1501.7
1634566	Rock	547	1	1.1	99.19	37150	1	14.5	8.1	19.3	8.1	538.6	299.6	2	2889.5	24.6	808.5	19.0	67	<0.5	854.0
1634567	Rock	233	2	1.6	99.95	3556	1	3.1	1.1	10.3	3.5	227.5	178.0	<1	925.6	8.3	28.2	2.6	<8	0.8	201.6
1634568	Rock	1429	2	-1.6	99.61	93	4	30.6	0.3	15.1	3.7	1286.2	22.0	32	1358.2	27.5	133.3	2.5	394	0.5	520.0
1634569	Rock	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.
1634570	Rock	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.
1634571	Rock	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.
1634572	Rock	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.
1634573	Rock	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.
1634574	Rock	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.
1634575	Rock	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.
1634576	Rock	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.
1634577	Rock	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.
1634578	Rock	606	13	2.6	99.76	1413	22	23.6	2.8	14.6	4.5	616.1	78.8	6	2511.5	31.2	80.4	36.1	143	0.9	358.3
1634579	Rock	64	<1	2.1	100.00	2205	11	0.4	22.7	14.4	1.1	62.2	528.0	<1	824.4	3.7	15.6	3.5	<8	1.2	93.2
1634580	Rock	113	<1	0.7	99.98	1219	1	5.2	0.8	18.9	5.7	112.5	181.9	3	929.7	7.7	5.3	2.3	22	1.4	395.0
1634581	Rock	98	1	1.1	99.93	82	17	8.5	0.7	18.4	9.6	96.8	119.4	5	628.1	3.9	10.4	2.0	34	<0.5	865.8
1634582	Rock	1201	2	-0.8	99.76	250	7	25.1	1.0	17.3	7.2	1105.5	78.8	17	389.1	22.5	51.3	4.4	277	<0.5	731.2
1634583	Rock	583	<1	1.2	99.94	2362	6	6.8	1.0	19.1	6.7	559.9	283.4	4	666.4	24.8	67.1	28.0	27	4.3	548.2
1634584	Rock	807	<1	0.0	99.84	667	13	17.8	0.8	19.1	8.5	780.7	127.5	11	536.4	26.8	86.6	20.0	148	<0.5	770.9
1634585	Rock	1399	<1	-3.3	99.61	130	1	49.7	<0.1	20.4	1.7	1236.6	5.0	34	61.9	20.4	2.1	0.2	577	<0.5	207.1

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Project: Lackner
Report Date: September 22, 2015

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CERTIFICATE OF ANALYSIS YVO14000011.1

	Method	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
	Analyte	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	Unit	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	0.1	0.1	0.1	0.02	0.3	0.05	0.02	0.05	0.01	0.05	0.02	0.03	0.01	0.05	0.01
1634561	Rock	146.2	1433.5	1545.3	323.75	1095.2	150.00	38.43	90.30	9.23	40.90	5.52	11.85	1.42	6.73	0.68
1634562	Rock	1037.7	12026.8	12428.0	2963.32	>10000	1357.60	345.27	778.62	80.37	353.79	47.74	106.38	12.63	59.72	5.77
1634563	Rock	193.8	1723.7	1835.9	404.34	1383.1	193.61	50.91	117.34	12.39	55.71	7.66	17.33	2.07	10.07	1.00
1634564	Rock	453.9	5611.6	5768.9	1242.60	4145.5	569.27	143.24	333.83	34.89	156.56	20.82	46.16	5.63	26.81	2.70
1634565	Rock	1172.5	13583.6	14139.7	3089.86	>10000	1363.95	346.46	786.39	85.11	384.98	52.96	116.37	14.45	67.09	6.74
1634566	Rock	259.6	2274.2	2336.9	551.37	1877.7	263.97	69.13	157.29	17.00	77.31	10.61	23.39	2.82	13.56	1.35
1634567	Rock	24.9	155.4	258.3	32.72	108.6	15.57	4.89	9.31	1.16	5.77	0.94	2.35	0.33	2.13	0.31
1634568	Rock	72.1	301.5	712.5	88.21	336.0	55.28	14.88	39.87	4.35	20.00	2.80	6.28	0.83	4.67	0.61
1634569	Rock	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.
1634570	Rock	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.
1634571	Rock	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.
1634572	Rock	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.
1634573	Rock	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.
1634574	Rock	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.
1634575	Rock	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.
1634576	Rock	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.
1634577	Rock	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.
1634578	Rock	61.8	308.9	643.0	68.66	239.0	35.24	9.76	24.60	2.87	14.41	2.38	5.75	0.85	5.01	0.73
1634579	Rock	5.2	43.9	64.3	6.02	18.8	2.48	0.81	1.74	0.20	1.10	0.16	0.43	0.06	0.38	0.04
1634580	Rock	7.6	32.6	67.7	8.80	32.6	4.61	1.36	3.13	0.36	1.83	0.29	0.91	0.19	1.68	0.34
1634581	Rock	14.4	25.7	62.2	8.45	32.7	6.44	1.91	4.24	0.58	2.96	0.54	2.00	0.50	5.18	1.06
1634582	Rock	9.0	16.5	43.1	5.75	22.0	4.17	1.22	2.76	0.36	2.04	0.38	1.24	0.28	2.77	0.57
1634583	Rock	9.6	18.9	51.4	6.12	24.1	4.44	1.31	2.94	0.37	1.98	0.35	1.22	0.30	2.88	0.59
1634584	Rock	12.7	20.2	58.0	7.80	30.5	5.83	1.80	3.94	0.54	2.93	0.53	1.73	0.41	4.28	0.87
1634585	Rock	1.1	5.2	9.2	0.98	3.1	0.51	0.15	0.37	0.05	0.26	0.04	0.14	0.03	0.21	0.04

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Project: Lackner
Report Date: September 22, 2015

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QUALITY CONTROL REPORT YVO14000011.1

	Method	WGHT	FA130	FA130	FA130	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300
	Analyte	Wgt	Au	Pt	Pd	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y
	Unit	kg	ppb	ppb	ppb	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
	MDL	0.01	1	0.1	0.5	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002	5	20	2	5	3
1634545	Rock	1.21	1	0.2	<0.5	54.43	20.02	4.78	0.82	2.25	5.98	9.21	0.15	0.05	0.19	<0.002	2712	<20	1183	322	15
1634584	Rock	2.64	9	1.4	3.0	39.06	13.99	24.29	2.14	6.81	6.52	3.63	2.31	<0.01	0.75	0.002	647	<20	498	781	12
Pulp Duplicates																					
1634511	Rock	1.62	14	0.8	1.7	12.33	1.51	65.05	9.71	1.89	0.04	0.73	2.24	<0.01	1.77	0.087	4050	143	353	459	24
REP 1634511	QC		14	1.7	1.7																
1634520	Rock	0.44	2	0.2	0.5	46.02	16.27	10.46	3.55	10.18	8.57	3.09	0.18	<0.01	0.55	<0.002	94	<20	598	1137	15
REP 1634520	QC																				
1634525	Rock	2.02	2	0.2	0.5	50.18	16.66	8.87	2.15	7.69	7.33	5.23	0.12	0.17	0.46	<0.002	1181	<20	1004	842	18
REP 1634525	QC					49.82	16.83	8.94	2.16	7.77	7.31	5.29	0.12	0.16	0.46	<0.002	1192	<20	998	848	18
1634548	Rock	2.21	2	1.2	1.2	47.48	18.17	9.27	3.28	6.19	6.66	5.94	0.65	0.54	0.29	0.018	1975	45	2049	293	28
REP 1634548	QC		2	1.2	1.2																
REP 1634559	QC																				
1634564	Rock	0.56	2	0.3	<0.5	52.52	15.76	8.19	2.55	3.25	2.95	8.03	0.32	0.45	0.33	0.006	21395	<20	2016	563	442
REP 1634564	QC					52.79	15.63	8.18	2.54	3.21	2.92	7.98	0.31	0.45	0.33	0.006	21436	<20	2020	551	439
1634585	Rock	0.91	10	1.0	2.9	2.11	0.97	86.00	0.34	0.26	0.09	0.12	11.06	<0.01	1.75	0.005	111	42	60	212	<3
REP 1634585	QC		9	1.2	2.9	1.62	0.97	86.55	0.34	0.26	0.09	0.12	10.95	<0.01	1.76	0.005	109	41	60	213	<3
Core Reject Duplicates																					
1634521	Rock	1.49	14	1.7	3.4	13.57	4.70	66.04	1.10	2.69	1.97	0.93	8.74	<0.01	1.53	0.006	157	25	249	666	8
DUP 1634521	QC		12	1.7	3.1	13.41	4.70	66.34	1.09	2.68	1.99	0.93	8.62	<0.01	1.53	0.006	154	29	243	674	8
1634559	Rock	0.78	2	1.0	1.2	41.27	16.08	13.13	3.79	10.10	7.65	3.46	0.97	1.16	0.40	0.004	2268	28	2076	217	45
DUP 1634559	QC		2	1.0	1.2	41.35	16.14	13.14	3.77	9.96	7.63	3.48	0.97	1.16	0.40	0.004	2329	26	2105	217	45
Reference Materials																					
STD CDN-PGMS-23	Standard		529	511.4	>1000																
STD PD1	Standard		543	469.9	565.2																
STD PD1	Standard		550	469.9	553.8																
STD PD1	Standard		540	480.8	550.5																
STD SO-18	Standard																				
STD SO-18	Standard																				
STD SO-18	Standard																				

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35 Kristi Court
Sudbury ON P3E 5R4 CANADA

Project: Lackner
Report Date: September 22, 2015

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QUALITY CONTROL REPORT YVO14000011.1

	Method	LF300	LF300	LF300	LF300	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
	Analyte	Nb	Sc	LOI	Sum	Ba	Be	Co	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W	Zr
	Unit	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	MDL	5	1	-5.1	0.01	1	1	0.2	0.1	0.5	0.1	0.1	0.1	1	0.5	0.1	0.2	0.1	8	0.5	0.1
1634545	Rock	227	<1	1.6	99.95	2765	9	3.9	2.8	15.9	3.7	230.3	344.0	2	1303.8	11.3	23.2	12.0	16	1.4	330.8
1634584	Rock	807	<1	0.0	99.84	667	13	17.8	0.8	19.1	8.5	780.7	127.5	11	536.4	26.8	86.6	20.0	148	<0.5	770.9
Pulp Duplicates																					
1634511	Rock	1029	80	3.2	99.29	4222	6	54.1	0.3	7.8	6.6	954.4	15.4	92	365.0	4.1	1359.3	8.5	313	1.0	386.1
REP 1634511	QC																				
1634520	Rock	1899	4	0.5	99.87	102	11	10.7	0.6	15.2	10.0	1868.4	103.2	6	643.4	64.8	232.9	55.7	46	<0.5	1123.9
REP 1634520	QC					100	12	11.4	0.5	14.9	9.7	1830.5	101.8	6	628.2	64.6	228.6	54.6	45	<0.5	1124.5
1634525	Rock	468	<1	0.6	99.92	1241	9	8.3	0.6	16.4	10.5	466.7	167.8	4	1059.9	30.9	53.6	29.5	14	<0.5	854.3
REP 1634525	QC	479	<1	0.6	99.93																
1634548	Rock	287	7	0.8	99.86	2050	6	17.2	1.4	13.7	4.2	286.7	145.7	2	2165.5	12.1	25.1	10.3	63	<0.5	302.1
REP 1634548	QC																				
REP 1634559	QC					2333	11	29.9	1.2	13.1	3.4	369.6	78.5	3	2121.6	18.9	49.2	10.9	90	<0.5	213.0
1634564	Rock	349	3	1.3	98.42	20992	2	9.7	29.4	20.8	5.3	339.9	255.3	3	2054.9	19.8	2164.8	32.4	55	<0.5	448.7
REP 1634564	QC	353	4	1.3	98.43																
1634585	Rock	1399	<1	-3.3	99.61	130	1	49.7	<0.1	20.4	1.7	1236.6	5.0	34	61.9	20.4	2.1	0.2	577	<0.5	207.1
REP 1634585	QC	1398	<1	-3.3	99.58	124	1	49.5	<0.1	19.8	1.7	1272.8	4.8	34	59.7	21.2	2.4	0.2	564	<0.5	206.5
Core Reject Duplicates																					
1634521	Rock	1987	2	-2.1	99.64	170	4	41.1	0.4	16.0	5.1	1704.2	33.8	28	250.4	42.1	109.7	23.3	465	<0.5	651.6
DUP 1634521	QC	2032	2	-2.1	99.64	160	3	38.5	0.4	16.2	5.2	1704.0	33.4	28	246.0	41.9	107.8	22.8	435	<0.5	635.3
1634559	Rock	384	5	1.2	99.82	2446	8	29.8	1.7	13.3	3.6	377.6	81.6	2	2192.3	19.5	49.8	11.4	85	<0.5	225.2
DUP 1634559	QC	371	5	1.2	99.84	2461	3	29.6	1.1	13.6	3.7	362.2	80.2	2	2145.3	19.1	47.6	10.9	85	<0.5	225.7
Reference Materials																					
STD CDN-PGMS-23	Standard																				
STD PD1	Standard																				
STD PD1	Standard																				
STD PD1	Standard																				
STD SO-18	Standard					503	<1	25.0	6.6	15.2	8.8	19.4	26.8	14	400.8	6.6	9.8	16.1	191	14.1	287.5
STD SO-18	Standard					522	<1	25.7	7.2	15.8	9.4	19.9	28.1	15	408.9	6.7	9.7	16.1	198	14.3	299.8
STD SO-18	Standard					502	<1	24.9	7.0	17.0	9.4	21.6	28.3	14	425.6	6.9	9.4	15.7	203	14.3	304.8

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35 Kristi Court
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Project: Lackner
Report Date: September 22, 2015

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QUALITY CONTROL REPORT YVO14000011.1

		WGHT	FA130	FA130	FA130	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300	LF300
		Wgt	Au	Pt	Pd	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y
		kg	ppb	ppb	ppb	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
		0.01	1	0.1	0.5	0.01	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002	5	20	2	5	3
STD SO-18	Standard																				
STD SO-18	Standard																				
STD SO-18	Standard																				
STD SO-18	Standard					58.19	14.08	7.59	3.37	6.31	3.73	2.15	0.70	0.79	0.40	0.532	492	44	384	309	30
STD SO-18	Standard					58.39	14.04	7.55	3.38	6.32	3.67	2.12	0.68	0.77	0.39	0.532	481	45	386	300	29
STD SO-18	Standard					58.20	14.16	7.61	3.40	6.26	3.66	2.12	0.68	0.80	0.40	0.538	492	43	382	300	30
STD SO-18	Standard					58.27	14.11	7.58	3.39	6.29	3.63	2.13	0.69	0.80	0.40	0.546	491	48	385	302	29
STD SO-18	Standard					58.28	14.14	7.58	3.39	6.30	3.63	2.13	0.69	0.77	0.40	0.535	486	50	382	304	29
STD SO-18	Standard					58.38	14.02	7.60	3.37	6.31	3.67	2.10	0.69	0.78	0.39	0.529	482	47	379	304	30
STD SO-18	Standard					58.21	14.01	7.55	3.36	6.38	3.60	2.35	0.70	0.78	0.39	0.532	482	51	384	295	29
STD SO-18	Standard					58.45	13.95	7.47	3.34	6.32	3.58	2.36	0.69	0.77	0.39	0.535	475	57	379	294	29
STD CDN-PGMS-23			496	456	2032																
STD PD1 Expected			542	456	563																
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	515	44	402	290	29
BLK	Blank		2	0.4	0.7																
BLK	Blank		2	0.4	0.6																
BLK	Blank		2	0.2	0.5																
BLK	Blank		2	0.4	0.7																
BLK	Blank		2	0.4	0.7																
BLK	Blank																				
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	<5	<20	<2	<5	<3
BLK	Blank					<0.01	<0.01	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<5	<20	<2	<5	<3
BLK	Blank					<0.01	<0.01	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<5	<20	<2	<5	<3
Prep Wash																					
G1	Prep Blank		1	0.2	<0.5	67.07	16.03	3.48	1.08	3.51	3.61	3.64	0.40	0.17	0.10	<0.002	1080	<20	734	171	17
G1	Prep Blank		1	0.3	0.6	67.93	15.76	3.22	0.99	3.35	3.59	3.59	0.38	0.16	0.10	<0.002	900	<20	717	149	16

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Client: **Gold Crossing Exploration**
35 Kristi Court
Sudbury ON P3E 5R4 CANADA

Project: Lackner
Report Date: September 22, 2015

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QUALITY CONTROL REPORT YVO14000011.1

		LF300	LF300	LF300	LF300	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
		Nb	**Sc**	**LOI**	**Sum**	**Ba**	**Be**	**Co**	**Cs**	**Ga**	**Hf**	**Nb**	**Rb**	**Sn**	**Sr**	**Ta**	**Th**	**U**	**V**	**W**	**Zr**
		ppm	**ppm**	**%**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
		5	**1**	**-5.1**	**0.01**	**1**	**1**	**0.2**	**0.1**	**0.5**	**0.1**	**0.1**	**0.1**	**1**	**0.5**	**0.1**	**0.2**	**0.1**	**8**	**0.5**	**0.1**
STD SO-18	Standard					508	<1	24.9	6.7	15.9	9.3	18.8	27.9	14	409.8	8.1	9.8	15.0	210	15.4	297.8
STD SO-18	Standard					500	<1	25.0	6.8	16.2	9.6	22.8	28.3	15	402.2	6.8	10.1	16.3	205	14.6	300.5
STD SO-18	Standard					493	<1	24.0	6.6	17.5	9.6	17.8	28.2	15	408.0	6.8	10.0	17.0	209	13.8	301.9
STD SO-18	Standard	18	24	1.9	99.89																
STD SO-18	Standard	27	24	1.9	99.90																
STD SO-18	Standard	44	24	1.9	99.89																
STD SO-18	Standard	31	24	1.9	99.90																
STD SO-18	Standard	25	24	1.9	99.89																
STD SO-18	Standard	28	24	1.9	99.90																
STD SO-18	Standard	12	23	1.9	99.91																
STD SO-18	Standard	29	23	1.9	99.90																
STD CDN-PGMS-23																					
STD PD1 Expected																					
STD SO-18 Expected		21	25			514	1	26.2	7.1	17.6	9.8	19.3	28.7	15	407.4	7.4	9.9	16.4	200	14.8	290
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank																				
BLK	Blank					<1	<1	<0.2	<0.1	<0.5	<0.1	0.1	0.1	<1	<0.5	<0.1	<0.2	<0.1	<8	<0.5	<0.1
BLK	Blank					<1	<1	<0.2	<0.1	0.6	<0.1	<0.1	0.3	<1	0.7	<0.1	<0.2	<0.1	<8	<0.5	0.2
BLK	Blank					2	1	<0.2	0.2	<0.5	<0.1	<0.1	1.1	<1	<0.5	0.4	<0.2	<0.1	<8	<0.5	0.1
BLK	Blank	<5	<1	0.0	<0.01																
BLK	Blank	<5	<1	0.0	<0.01																
BLK	Blank	6	<1	0.0	<0.01																
Prep Wash																					
G1	Prep Blank	27	6	0.6	99.97	1139	<1	4.6	5.3	19.9	3.9	25.0	132.9	2	791.1	1.2	9.8	3.6	59	<0.5	151.0
G1	Prep Blank	24	5	0.7	99.98	972	2	3.9	5.3	19.7	4.1	24.0	132.8	2	739.1	1.4	9.9	3.7	45	1.3	159.8

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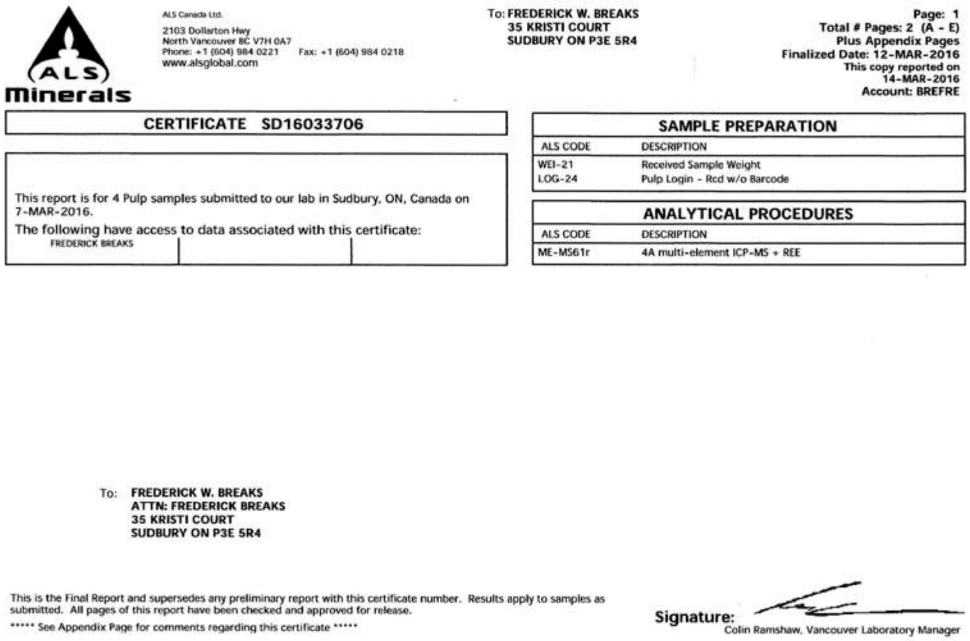
		LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100	LF100
		Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
		0.1	0.1	0.1	0.02	0.3	0.05	0.02	0.05	0.01	0.05	0.02	0.03	0.01	0.05	0.01
STD SO-18	Standard	29.8	12.2	26.3	3.19	13.6	2.77	0.82	2.90	0.45	2.87	0.56	1.71	0.26	1.67	0.25
STD SO-18	Standard	30.5	13.3	28.3	3.40	13.3	2.94	0.86	3.01	0.47	2.83	0.58	1.76	0.27	1.66	0.25
STD SO-18	Standard	31.2	13.3	28.3	3.34	13.6	2.96	0.86	3.00	0.47	2.98	0.64	1.80	0.28	1.75	0.26
STD SO-18	Standard															
STD SO-18	Standard															
STD SO-18	Standard															
STD SO-18	Standard															
STD SO-18	Standard															
STD SO-18	Standard															
STD SO-18	Standard															
STD SO-18	Standard															
STD CDN-PGMS-23																
STD PD1 Expected																
STD SO-18 Expected		29	12.3	27.1	3.45	14	3	0.89	2.93	0.53	3	0.62	1.84	0.27	1.79	0.27
BLK	Blank															
BLK	Blank															
BLK	Blank															
BLK	Blank															
BLK	Blank															
BLK	Blank	<0.1	<0.1	<0.1	<0.02	<0.3	<0.05	<0.02	<0.05	<0.01	<0.05	<0.02	<0.03	<0.01	<0.05	<0.01
BLK	Blank	<0.1	<0.1	<0.1	<0.02	<0.3	<0.05	<0.02	<0.05	<0.01	<0.05	<0.02	<0.03	<0.01	<0.05	<0.01
BLK	Blank	<0.1	<0.1	<0.1	<0.02	<0.3	<0.05	<0.02	<0.05	<0.01	<0.05	<0.02	<0.03	<0.01	<0.05	<0.01
BLK	Blank															
BLK	Blank															
BLK	Blank															
Prep Wash																
G1	Prep Blank	16.9	33.6	62.8	7.03	25.3	4.50	1.12	3.47	0.48	3.08	0.54	1.76	0.26	1.69	0.28
G1	Prep Blank	15.0	34.5	63.5	6.85	24.6	4.04	1.03	3.33	0.45	2.63	0.53	1.55	0.23	1.72	0.29

Appendix 3. Mineral chemistry of apatite concentrates from the Lackner Lake alkalic complex. Analyses by ALS Global Labs.



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To: **FREDERICK W. BREAKS**
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SUDBURY ON P3E 5R4

Page: 1
Total # Pages: 2 (A - E)
Plus Appendix Pages
Finalized Date: 12-MAR-2016
This copy reported on
14-MAR-2016
Account: BREFRE

CERTIFICATE SD16033706

This report is for 4 Pulp samples submitted to our lab in Sudbury, ON, Canada on 7-MAR-2016.

The following have access to data associated with this certificate:

FREDERICK BREAKS		

SAMPLE PREPARATION	
ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-24	Pulp Login - Rcd w/o Barcode

ANALYTICAL PROCEDURES	
ALS CODE	DESCRIPTION
ME-MS61r	4A multi-element ICP-MS + REE

To: **FREDERICK W. BREAKS**
ATTN: FREDERICK BREAKS
35 KRISTI COURT
SUDBURY ON P3E 5R4

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Minerals

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To: FREDERICK W. BREAKS
35 KRISTI COURT
SUDBURY ON P3E 5R4

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Plus Appendix Pages
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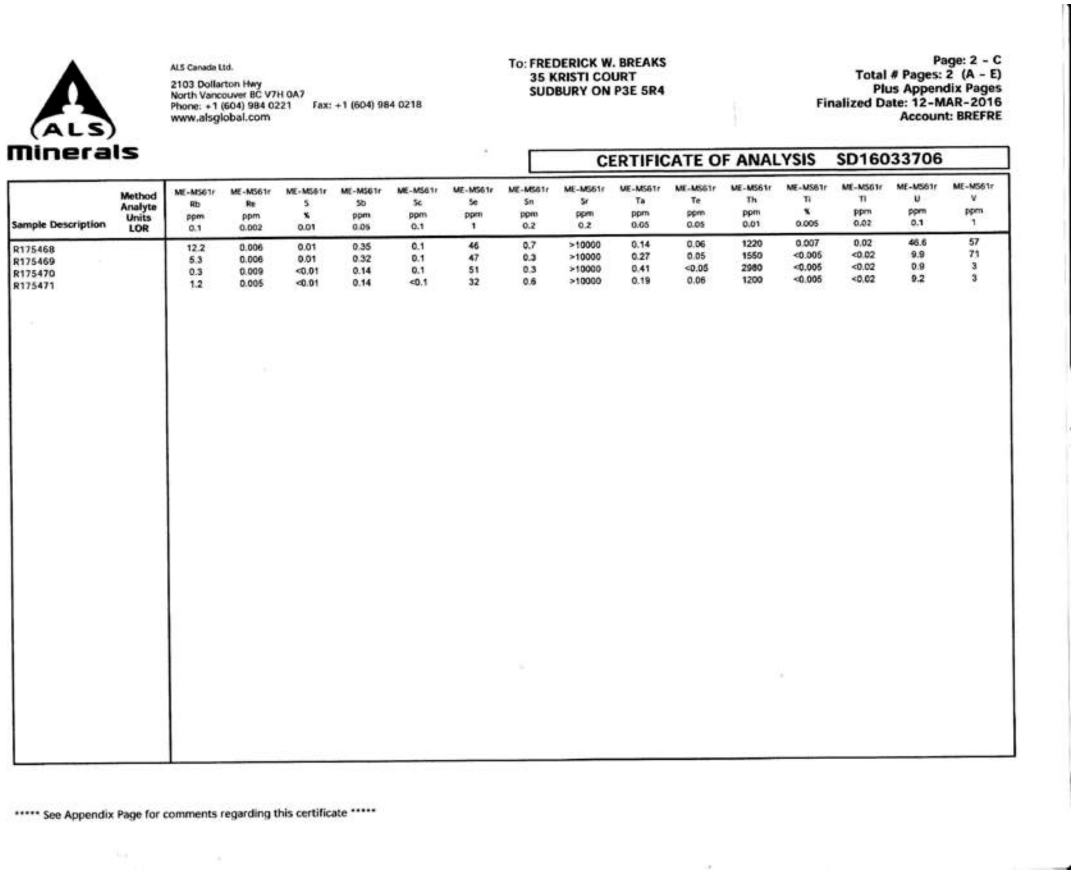
Account: BREFRE

CERTIFICATE OF ANALYSIS SD16033706

Sample Description	Method Analyte Units LOR	WEI-21 Recvd Wt. kg 0.02	ME-MS61r Ag ppm 0.01	ME-MS61r Al % 0.01	ME-MS61r As ppm 0.2	ME-MS61r Ba ppm 10	ME-MS61r Be ppm 0.05	ME-MS61r Bi ppm 0.01	ME-MS61r Ca % 0.01	ME-MS61r Cd ppm 0.02	ME-MS61r Ce ppm 0.01	ME-MS61r Co ppm 0.1	ME-MS61r Cr ppm 1	ME-MS61r Cs ppm 0.05	ME-MS61r Cu ppm 0.2	ME-MS61r Fe % 0.01
R175468		<0.02	0.04	0.35	137.5	450	0.08	1.07	32.9	0.40	>500	0.2	4	0.96	1.8	0.02
R175469		<0.02	<0.01	0.21	158.0	130	0.32	1.36	34.8	0.51	>500	0.3	5	0.25	0.8	0.03
R175470		<0.02	<0.01	0.01	17.8	30	<0.05	3.54	35.1	0.29	>500	0.5	5	<0.05	1.8	0.10
R175471		<0.02	<0.01	0.07	8.4	20	<0.05	0.19	35.7	0.22	>500	0.2	5	4.29	3.3	0.05

***** See Appendix Page for comments regarding this certificate *****



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CERTIFICATE OF ANALYSIS SD16033706

Sample Description	Method Analyte Units LOR	ME-MS61r Rb ppm 0.1	ME-MS61r Re ppm 0.002	ME-MS61r S % 0.01	ME-MS61r Sb ppm 0.05	ME-MS61r Sc ppm 0.1	ME-MS61r Se ppm 1	ME-MS61r Sn ppm 0.2	ME-MS61r Sr ppm 0.2	ME-MS61r Ta ppm 0.05	ME-MS61r Te ppm 0.05	ME-MS61r Th ppm 0.01	ME-MS61r Ti % 0.005	ME-MS61r Tl ppm 0.02	ME-MS61r U ppm 0.1	ME-MS61r V ppm 1
R175468		12.2	0.006	0.01	0.35	0.1	46	0.7	>10000	0.14	0.06	1220	0.007	0.02	46.6	57
R175469		5.3	0.006	0.01	0.32	0.1	47	0.3	>10000	0.27	0.05	1550	<0.005	<0.02	9.9	71
R175470		0.3	0.009	<0.01	0.14	0.1	51	0.3	>10000	0.41	<0.05	2980	<0.005	<0.02	0.9	3
R175471		1.2	0.005	<0.01	0.14	<0.1	32	0.6	>10000	0.19	0.06	1200	<0.005	<0.02	9.2	3

***** See Appendix Page for comments regarding this certificate *****

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SUDBURY ON P3E 5R4

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CERTIFICATE OF ANALYSIS SD16033706

Sample Description	Method	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r
	Analyte	W	Y	Zn	Zr	Dy	Er	Eu	Gd	Ho	Lu	Nd	Pr	Sm	Tb	Tm
	Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	LOR	0.1	0.1	2	0.5	0.05	0.03	0.03	0.05	0.01	0.01	0.1	0.03	0.03	0.01	0.01
R175468		0.2	>500	<2	0.7	308	123.0	213	485	52.1	6.83	>1000	>1000	774	63.6	13.95
R175469		0.2	>500	<2	0.6	310	122.5	220	493	52.7	7.30	>1000	>1000	830	63.0	14.45
R175470		<0.1	>500	4	0.5	357	118.5	269	631	55.5	5.44	>1000	>1000	>1000	78.8	12.80
R175471		<0.1	>500	<2	7.0	227	75.8	175.5	410	36.0	3.90	>1000	>1000	672	50.7	8.04

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SUDBURY ON P3E 5R4

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CERTIFICATE OF ANALYSIS SD16033706

	Method	ME-MS61r
	Analyte	Yb
	Units	ppm
Sample Description	**LOR**	0.03
R175468		66.6
R175469		70.4
R175470		57.1
R175471		38.0

***** See Appendix Page for comments regarding this certificate *****

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SUDBURY ON P3E 5R4

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CERTIFICATE OF ANALYSIS SD16033706

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

	REE's may not be totally soluble in this method.
Applies to Method:	ME-MS61r

LABORATORY ADDRESSES

	Processed at ALS Sudbury located at 1351-B Kelly Lake Road, Unit #1, Sudbury, ON, Canada.
Applies to Method:	LOG-24 WEI-21
	Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.
Applies to Method:	ME-MS61r

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SUDBURY ON P3E 5R4**

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Finalized Date: 12-MAR-2016
This copy reported on
14-MAR-2016
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QC CERTIFICATE SD16033706

This report is for 4 Pulp samples submitted to our lab in Sudbury, ON, Canada on 7-MAR-2016.

The following have access to data associated with this certificate:

FREDERICK BREAKS

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-24	Pulp Login - Rcd w/o Barcode

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION
ME-MS61r	4A multi-element ICP-MS + REE

To: **FREDERICK W. BREAKS
ATTN: FREDERICK BREAKS
35 KRISTI COURT
SUDBURY ON P3E 5R4**

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

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Page: 2 - A
Total # Pages: 2 (A - D)
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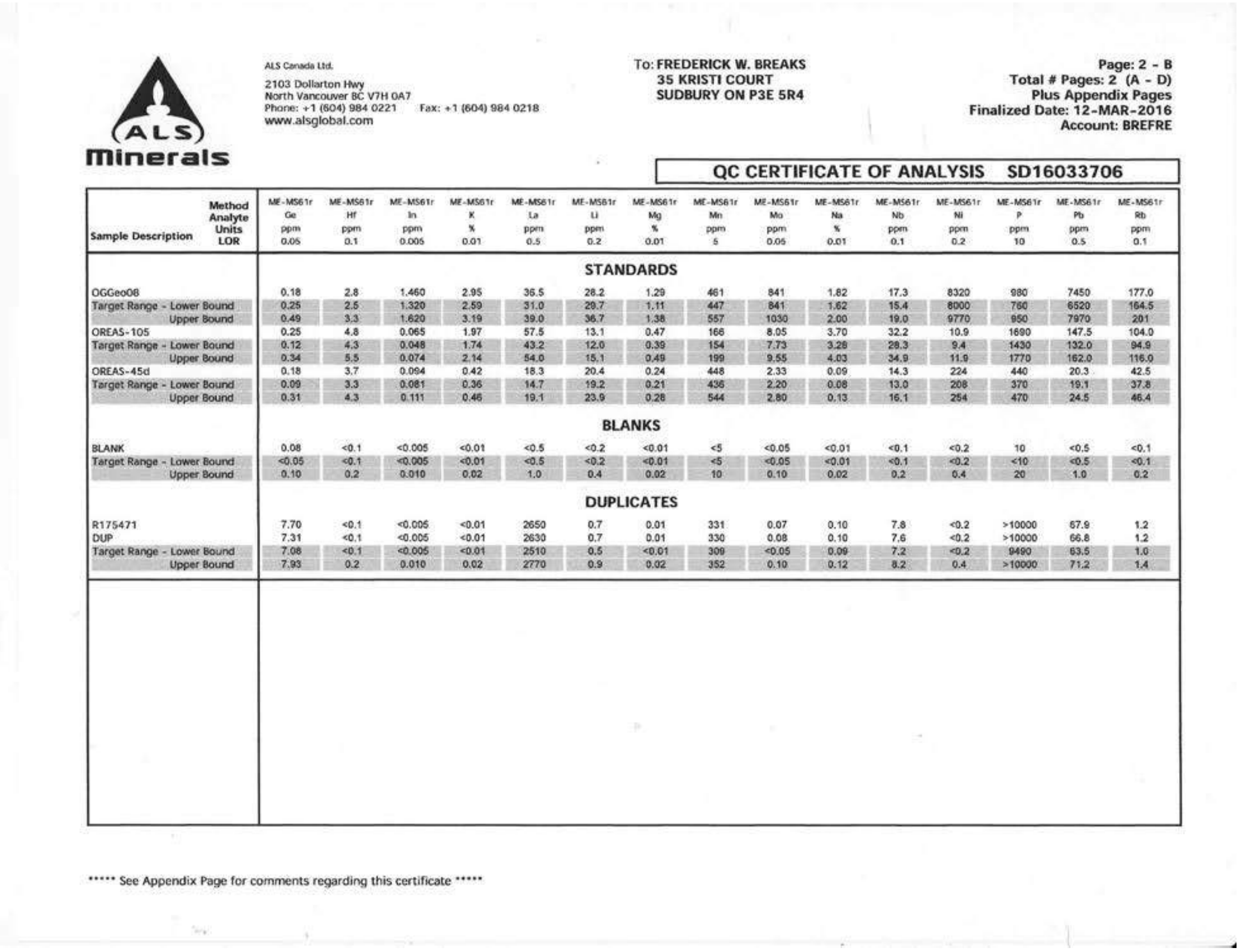
QC CERTIFICATE OF ANALYSIS SD16033706

Sample Description	Method	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r
	Analyte	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga
	Units	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
	LOR	0.01	0.01	0.2	10	0.05	0.01	0.01	0.02	0.01	0.1	1	0.05	0.2	0.01	0.05
								STANDARDS								
OGGeo08		21.7	6.89	115.5	870	2.68	10.25	2.31	19.30	76.6	95.0	77	10.95	8000	5.33	16.90
Target Range - Lower Bound		18.15	6.07	107.0	700	2.59	9.44	1.98	16.70	64.8	87.2	78	9.85	7800	4.81	16.05
Upper Bound		22.2	7.44	131.0	980	3.27	11.55	2.44	20.5	79.2	107.0	98	12.15	8980	5.91	19.75
OREAS-105		0.08	7.17	3.3	700	3.93	0.46	1.14	0.13	133.5	4.3	40	2.06	102.5	1.94	24.8
Target Range - Lower Bound		0.06	3.73	1.8	580	3.47	0.41	0.94	0.09	103.5	3.9	36	1.78	94.7	1.75	23.7
Upper Bound		0.10	4.58	2.9	800	4.35	0.52	1.17	0.19	126.5	5.0	46	2.28	109.5	2.16	29.1
OREAS-45d		0.18	8.37	13.2	190	0.73	0.32	0.21	0.04	38.7	30.3	567	3.92	352	14.40	20.9
Target Range - Lower Bound		0.17	7.33	12.2	140	0.65	0.27	0.16	<0.02	33.5	26.5	493	3.47	345	13.05	19.05
Upper Bound		0.23	8.98	15.4	220	0.93	0.35	0.21	0.09	40.9	32.6	605	4.35	387	16.00	23.4
								BLANKS								
BLANK		<0.01	<0.01	<0.2	<10	<0.05	0.01	<0.01	<0.02	0.52	<0.1	<1	<0.05	0.3	<0.01	<0.05
Target Range - Lower Bound		<0.01	<0.01	<0.2	<10	<0.05	<0.01	<0.01	<0.02	<0.01	<0.1	<1	<0.05	<0.2	<0.01	<0.05
Upper Bound		0.02	0.02	0.4	20	0.10	0.02	0.02	0.04	0.02	0.2	2	0.10	0.4	0.02	0.10
								DUPLICATES								
R175471		<0.01	0.07	6.4	20	<0.05	0.19	35.7	0.22	>500	0.2	5	4.29	3.3	0.05	47.8
DUP		0.01	0.07	7.1	20	<0.05	0.19	35.8	0.23	>500	0.2	6	4.47	1.3	0.05	44.6
Target Range - Lower Bound		<0.01	0.06	6.2	<10	<0.05	0.17	34.0	0.19	475	<0.1	4	4.11	2.0	0.04	43.8
Upper Bound		0.02	0.08	7.3	30	0.10	0.21	37.5	0.26	>500	0.3	7	4.65	2.6	0.06	48.6

***** See Appendix Page for comments regarding this certificate *****



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To: FREDERICK W. BREAKS
35 KRISTI COURT
SUDBURY ON P3E 5R4

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Total # Pages: 2 (A - D)
Plus Appendix Pages
Finalized Date: 12-MAR-2016
Account: BREFRE

QC CERTIFICATE OF ANALYSIS SD16033706

Sample Description	Method	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r
	Analyte	Ge	Hf	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb
	Units	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
	LOR	0.05	0.1	0.005	0.01	0.5	0.2	0.01	5	0.05	0.01	0.1	0.2	10	0.5	0.1
STANDARDS																
OGGeo08		0.18	2.8	1.460	2.95	36.5	28.2	1.29	461	841	1.82	17.3	8320	980	7450	177.0
Target Range - Lower Bound		0.25	2.5	1.320	2.59	31.0	29.7	1.11	447	841	1.62	15.4	8000	760	6520	164.5
Upper Bound		0.49	3.3	1.620	3.19	39.0	36.7	1.38	557	1030	2.00	19.0	9770	950	7970	201
OREAS-105		0.25	4.8	0.065	1.97	57.5	13.1	0.47	166	8.05	3.70	32.2	10.9	1690	147.5	104.0
Target Range - Lower Bound		0.12	4.3	0.048	1.74	43.2	12.0	0.39	154	7.73	3.28	28.3	9.4	1430	132.0	94.9
Upper Bound		0.34	5.5	0.074	2.14	54.0	15.1	0.49	199	9.55	4.03	34.9	11.9	1770	162.0	116.0
OREAS-45d		0.18	3.7	0.094	0.42	18.3	20.4	0.24	448	2.33	0.09	14.3	224	440	20.3	42.5
Target Range - Lower Bound		0.09	3.3	0.081	0.36	14.7	19.2	0.21	436	2.20	0.08	13.0	208	370	19.1	37.8
Upper Bound		0.31	4.3	0.111	0.46	19.1	23.9	0.28	544	2.80	0.13	16.1	254	470	24.5	46.4
BLANKS																
BLANK		0.08	<0.1	<0.005	<0.01	<0.5	<0.2	<0.01	<5	<0.05	<0.01	<0.1	<0.2	10	<0.5	<0.1
Target Range - Lower Bound		<0.05	<0.1	<0.005	<0.01	<0.5	<0.2	<0.01	<5	<0.05	<0.01	<0.1	<0.2	<10	<0.5	<0.1
Upper Bound		0.10	0.2	0.010	0.02	1.0	0.4	0.02	10	0.10	0.02	0.2	0.4	20	1.0	0.2
DUPLICATES																
R175471		7.70	<0.1	<0.005	<0.01	2650	0.7	0.01	331	0.07	0.10	7.8	<0.2	>10000	67.9	1.2
DUP		7.31	<0.1	<0.005	<0.01	2630	0.7	0.01	330	0.08	0.10	7.6	<0.2	>10000	66.8	1.2
Target Range - Lower Bound		7.08	<0.1	<0.005	<0.01	2510	0.5	<0.01	309	<0.05	0.09	7.2	<0.2	9490	63.5	1.0
Upper Bound		7.93	0.2	0.010	0.02	2770	0.9	0.02	352	0.10	0.12	8.2	0.4	>10000	71.2	1.4

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QC CERTIFICATE OF ANALYSIS SD16033706

Method	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r
Analyte	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W
Units	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
Sample Description LOR	0.002	0.01	0.05	0.1	1	0.2	0.2	0.05	0.05	0.01	0.005	0.02	0.1	1	0.1
STANDARDS															
OGGeo08	1.380	2.84	25.7	9.4	10	13.3	241	1.29	0.15	20.3	0.368	1.73	5.2	83	4.3
Target Range - Lower Bound	1.285	2.51	22.8	9.2	8	12.5	224	1.19	0.09	16.90	0.353	1.43	4.5	77	3.9
Upper Bound	1.575	3.09	31.0	11.4	14	15.7	274	1.57	0.31	20.7	0.443	1.98	5.8	97	5.4
OREAS-105	<0.002	0.03	0.50	4.6	2	6.6	107.5	3.34	<0.05	365	0.211	0.40	524	26	2.3
Target Range - Lower Bound	<0.002	<0.01	0.28	4.4	<1	6.1	81.5	3.03	<0.05	324	0.196	0.33	462	24	2.0
Upper Bound	0.006	0.05	0.57	5.6	4	7.9	100.0	3.81	0.13	396	0.250	0.49	565	31	2.9
OREAS-45d	<0.002	0.05	0.93	50.9	3	2.6	33.5	1.06	0.10	16.10	0.705	0.25	2.7	220	1.6
Target Range - Lower Bound	<0.002	0.03	0.64	44.3	<1	2.2	28.0	0.87	<0.05	13.50	0.691	0.20	2.3	211	1.3
Upper Bound	0.007	0.07	1.00	54.3	5	3.2	34.6	1.17	0.23	16.50	0.855	0.34	3.0	260	2.0
BLANKS															
BLANK	<0.002	<0.01	0.10	<0.1	<1	<0.2	<0.2	<0.05	<0.05	0.09	<0.005	<0.02	<0.1	<1	<0.1
Target Range - Lower Bound	<0.002	<0.01	<0.05	<0.1	<1	<0.2	<0.2	<0.05	<0.05	<0.01	<0.005	<0.02	<0.1	<1	<0.1
Upper Bound	0.004	0.02	0.10	0.2	5	0.4	0.4	0.10	0.10	0.02	0.010	0.04	0.2	2	0.2
DUPLICATES															
R175471	0.005	<0.01	0.14	<0.1	32	0.6	>10000	0.19	0.06	1200	<0.005	<0.02	9.2	3	<0.1
DUP	0.004	<0.01	0.14	<0.1	30	0.2	>10000	0.24	<0.05	1190	<0.005	<0.02	9.0	3	0.1
Target Range - Lower Bound	<0.002	<0.01	0.08	<0.1	28	<0.2	9500	0.15	<0.05	1135	<0.005	<0.02	8.5	2	<0.1
Upper Bound	0.007	0.02	0.20	0.2	34	0.6	>10000	0.28	0.10	1255	0.010	0.04	9.7	4	0.2

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QC CERTIFICATE OF ANALYSIS SD16033706

Method	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r	ME-MS61r
Analyte	Y	Zn	Zr	Dy	Er	Eu	Gd	Ho	Lu	Nd	Pr	Sm	Tb	Tm	Yb
Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Sample Description LOR	0.1	2	0.5	0.05	0.03	0.03	0.05	0.01	0.01	0.1	0.03	0.03	0.01	0.01	0.03
STANDARDS															
OGGeo08	25.0	6710	90.3	4.65	2.42	1.35	5.23	0.92	0.32	34.5	8.72	6.67	0.80	0.34	2.19
Target Range - Lower Bound	21.1	6500	78.6	3.65	2.03	0.99	4.19	0.70	0.27	24.7	6.61	4.89	0.64	0.28	1.83
Upper Bound	26.0	7950	107.5	5.05	2.81	1.41	5.79	0.98	0.39	33.7	9.01	6.69	0.90	0.40	2.55
OREAS-105	55.2	48	164.0	11.30	6.36	1.79	12.40	2.25	0.81	75.5	17.40	16.15	1.95	0.92	5.79
Target Range - Lower Bound	47.6	43	145.0	9.06	5.17	1.27	10.10	1.75	0.72	56.9	13.50	13.00	1.54	0.81	5.08
Upper Bound	58.4	57	197.5	12.35	7.07	1.80	13.80	2.39	1.00	77.2	18.30	17.70	2.11	1.12	6.95
OREAS-45d	10.4	41	136.0	2.24	1.24	0.66	2.39	0.45	0.19	15.7	4.03	3.15	0.39	0.19	1.28
Target Range - Lower Bound	8.5	39	119.5												
Upper Bound	10.6	52	162.5												
BLANKS															
BLANK	0.1	<2	<0.5	<0.05	<0.03	<0.03	<0.05	<0.01	<0.01	0.1	0.03	0.04	<0.01	<0.01	<0.03
Target Range - Lower Bound	<0.1	<2	<0.5	<0.05	<0.03	<0.03	<0.05	<0.01	<0.01	<0.1	<0.03	<0.03	<0.01	<0.01	<0.03
Upper Bound	0.2	4	1.0	0.10	0.06	0.06	0.10	0.02	0.02	0.2	0.06	0.06	0.02	0.02	0.06
DUPLICATES															
R175471	>500	<2	7.0	227	75.8	175.5	410	36.0	3.90	>1000	>1000	672	50.7	8.04	38.0
DUP	>500	<2	11.1	218	73.3	171.0	396	34.1	3.77	>1000	984	658	48.4	7.78	36.8
Target Range - Lower Bound	475	<2	8.1	206	68.9	160.0	373	32.4	3.54	925	918	615	45.8	7.31	34.6
Upper Bound	>500	4	10.0	239	80.2	186.5	433	37.7	4.13	>1000	>1000	715	53.3	8.51	40.2

***** See Appendix Page for comments regarding this certificate *****

ALS Minerals

ALS Canada Ltd.
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Phone: +1 (604) 984 0221 Fax: +1 (604) 984 0218
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To: **FREDERICK W. BREAKS**
35 KRISTI COURT
SUDBURY ON P3E 5R4

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 12-MAR-2016
Account: BREFRE

QC CERTIFICATE OF ANALYSIS SD16033706

CERTIFICATE COMMENTS

ANALYTICAL COMMENTS

	REE's may not be totally soluble in this method.
Applies to Method:	ME-MS61r

LABORATORY ADDRESSES

	Processed at ALS Sudbury located at 1351-B Kelly Lake Road, Unit #1, Sudbury, ON, Canada.	
Applies to Method:	LOG-24	WEI-21
	Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.	
Applies to Method:	ME-MS61r	

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35 KRISTI COURT
SUDBURY ON P3E 5R4

Page: 1
Total # Pages: 2 (A)
Plus Appendix Pages
Finalized Date: 22-MAR-2016
Account: BREFRE

CERTIFICATE SD16038935

This report is for 4 Pulp samples submitted to our lab in Sudbury, ON, Canada on 14-MAR-2016.

The following have access to data associated with this certificate:

FREDERICK BREAKS

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
FND-02	Find Sample for Addn Analysis

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Ce-OGREE	Overlimit Ce by ICPAES	VARIABLE
ME-OGREE	Overlimit REE by ICPAES	ICP-AES
Pr-OGREE	Overlimit Pr by ICPAES	VARIABLE
Nd-OGREE	Overlimit Nd by ICPAES	VARIABLE
Sm-OGREE	Overlimit Sm by ICPAES	VARIABLE
ME-ICP61a	High Grade Four Acid ICP-AES	ICP-AES

To: **FREDERICK W. BREAKS**
ATTN: FREDERICK BREAKS
35 KRISTI COURT
SUDBURY ON P3E 5R4

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:
Colin Ramshaw, Vancouver Laboratory Manager

ALS Minerals

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Page: 2 - A
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CERTIFICATE OF ANALYSIS SD16038935

Sample Description	Method Analyte Units LOR	ME-ICP61a P ppm 50	ME-ICP61a Sr ppm 10	Ce-OGREE Ce % 0.01	Pr-OGREE Pr % 0.01	Nd-OGREE Nd % 0.01	Sm-OGREE Sm % 0.01	ME-ICP61a Y ppm 10
R175468		>100000	14750	1.25	0.13	0.49		1070
R175469		>100000	14150	1.33	0.14	0.52		1050
R175470		>100000	10600	1.19	0.14	0.56	0.09	930
R175471		>100000	12200	0.78	0.09	0.37		630

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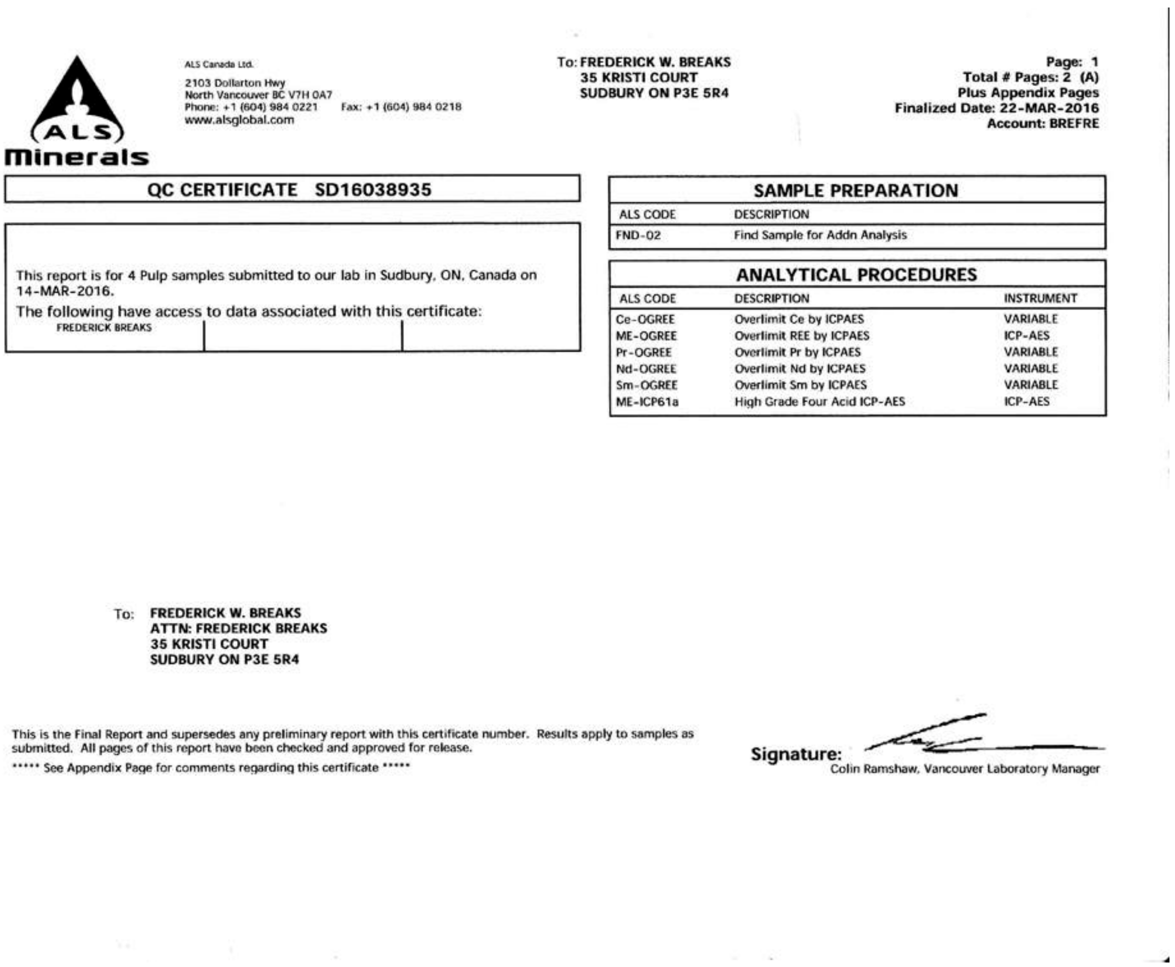
Account: BREFRE

CERTIFICATE OF ANALYSIS SD16038935

CERTIFICATE COMMENTS

	LABORATORY ADDRESSES			
	Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.			
Applies to Method:	Ce-OGREE	FND-02	ME-ICP61a	ME-OGREE
	Nd-OGREE	Pr-OGREE	Sm-OGREE	



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FREDERICK BREAKS

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
FND-02	Find Sample for Addn Analysis

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
Ce-OGREE	Overlimit Ce by ICPAES	VARIABLE
ME-OGREE	Overlimit REE by ICPAES	ICP-AES
Pr-OGREE	Overlimit Pr by ICPAES	VARIABLE
Nd-OGREE	Overlimit Nd by ICPAES	VARIABLE
Sm-OGREE	Overlimit Sm by ICPAES	VARIABLE
ME-ICP61a	High Grade Four Acid ICP-AES	ICP-AES

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ATTN: FREDERICK BREAKS
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Signature:
Colin Ramshaw, Vancouver Laboratory Manager

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SUDBURY ON P3E 5R4

QC CERTIFICATE OF ANALYSIS SD16038935

Method	ME-ICP61a	ME-ICP61a	Ce-OGREE	Pr-OGREE	Nd-OGREE	Sm-OGREE	ME-ICP61a
Analyte	P	Sr	Ce	Pr	Nd	Sm	Y
Units	ppm	ppm	%	%	%	%	ppm
Sample Description LOR	50	10	0.01	0.01	0.01	0.01	10
STANDARDS							
AMIS0185			4.04	0.32	0.90	0.05	
Target Range - Lower Bound			3.86	0.32	0.87	0.04	
Upper Bound			4.29	0.37	0.98	0.08	
GBM903-13	380	40					<10
Target Range - Lower Bound	250	20					<10
Upper Bound	470	60					20
OKA-2			12.30	1.47	5.84	0.90	
Target Range - Lower Bound			12.05	1.44	5.64	0.81	
Upper Bound			13.35	1.62	6.26	0.91	
OREAS 602	720	430					10
Target Range - Lower Bound	460	<10					<10
Upper Bound	680	20					30
BLANKS							
BLANK	50	<10					<10
Target Range - Lower Bound	<50	<10					<10
Upper Bound	100	20					20
BLANK			<0.01	<0.01	<0.01	<0.01	
Target Range - Lower Bound			<0.01	<0.01	<0.01	<0.01	
Upper Bound			0.02	0.02	0.02	0.02	
DUPLICATES							
R175471	>100000	12200	0.78	0.09	0.37		630
DUP			0.78	0.09	0.37	0.06	
Target Range - Lower Bound			0.75	0.08	0.35	0.05	
Upper Bound			0.81	0.10	0.39	0.07	

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QC CERTIFICATE OF ANALYSIS SD16038935

CERTIFICATE COMMENTS

LABORATORY ADDRESSES

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

Applies to Method:	Ce-OGREE	FND-02	ME-ICP61a	ME-OGREE
	Nd-OGREE	Pr-OGREE	Sm-OGREE	

Mineral Name	Chemical Formula	%Sc	MW
Pretulite	$ScPO_4$	32.13%	139.93
Thortveitite	$(Sc,Y)_2Si_2O_7$	24.08%	280.05
Kolbeckite	$ScPO_4 \bullet 2(H_2O)$	23.99%	176.18
Allendeite	$Sc_4Zr_3O_{12}$	20.87%	648.47
Heftetjernite	$ScTaO_4$	15.51%	289.9
Jervisite	$(Na,Ca,Fe^{++})(Sc,Mg,Fe^{++})Si_2O_6$	12.07%	223.42
Bazzite	$Be_3(Sc,Al)_2Si_6O_{18}$	11.95%	564.46
Juonniite	$CaMgSc(PO_4)_2(OH) \bullet 4(H_2O)$	11.58%	388.35
Cascandite	$Ca(Sc,Fe^{++})Si_3O_8(OH)$	10.64%	317.02
Davisite	$Ca(Sc,Ti^{+++},Mg,Ti^{++++})AlSiO_6$	9.54%	235.7
Scandiobabbingtonite	$Ca_2(Fe^{++},Mn)ScSi_5O_{14}(OH)$	8.00%	562.16
Kristiansenite	$Ca_2ScSn(Si_2O_7)(Si_2O_6OH)$	5.25%	291.23
Oftedalite	$(Sc,Ca)_2KBe_3Si_{12}O_3)O$	4.44%	973.03
Magbasite	$KBa(Al,Sc)(Mg,Fe^{++})_6Si_6O_2OF_2$	1.19%	943.31
Stavelotite-(La)	$La_3Mn^{++}{}_3Cu^{++}(Mn^{+++},Fe^{+++},Mn^{++++})\ {}_{26}(Si_2O_7)_6O_{30}$	0.99%	3,438.35
Lakargiite	$CaZrO_3$	0.25%	177.87
Samarskite-(Yb)	$(Yb,Y,REE,U,Th,Ca,Fe^{++})\ (Nb,Ta,Ti)O_4$	0.17%	312.29
Arrojadite-(SrFe)	$SrFe^{++}Na_2Ca(Fe^{++},Mn,Mg)_{13}\ Al(PO_4)_{11}(PO_3\ OH)(OH,F)_2$	0.09%	2,063.97
Dissakisite-(La)	$(Ca,Fe{+}{+},Th,\ La)(La,REE,Ca)(Al,Cr,Ti)_2\ (Mg,Fe,Al)Si_3\ O_{12}(OH,F)$ with La > Ce	0.02%	551.33