# Initial Assessment of Acid Rock Drainage and Metal Leaching Potential

# Aappaluttoq Ruby Property, Greenland

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*Confidentiality*

*This report on the Aappaluttoq Ruby Project in Greenland has been prepared exclusively for True North Gems by Mr. Brian Soregaroli, Independent Consultant, and Dr. Rick Lawrence of Lawrence Consulting Ltd. ('the Consultants'). The information, interpretation and conclusions contained herein represent our professional opinions and are based on: i) information available at the time of preparation, ii) data supplied by True North Gems and other companies involved in the Project, and iii) the assumptions, conditions and qualifications set forth in this report. The report is intended only for use by True North Gems. Any other use of, or reliance on, this report by any third party is at that party's sole risk.*

## Executive Summary

The Consultants have carried out an initial assessment of the acid rock drainage and metal leaching potential of the Aappaluttoq Ruby Project in Greenland based on discussions and review of drill logs, test data and geological information provided by True North Gems, and analysis of select core samples from the property by Maxxam Analytics (formerly Cantest Ltd.) in Burnaby, BC, Canada.

This report provides a background discussion of the theoretical and practical aspects of ARD and metal leaching in the context of the geological characteristics of the project site. This is followed by a review and discussion of the project, in which the project setting, site observations and a review and analysis of the ARD test programs and data are presented, using Canadian ARD guidelines as a primary point of reference. The report is concluded with a discussion of issues pertaining to ARD and metal leaching with respect to the planned mine development at the property.

A total of 109 core samples, representing sulphide-bearing and non-sulphide intervals of each major lithology at the property, were selected and put through an analytical program that included:

- Acid-Base Accounting (ABA) using the Modified ABA NP method (MEND Acid Rock Drainage Prediction Manual, MEND Project 1.16.1b (pages 6.2-11 to 17), March 1991)
- Total sulphur and sulphate-sulphur speciation analysis to determine sulphide-sulphur content, by the difference between the two
- Elemental (trace metals) analysis by aqua regia digestion followed by ICP-MS scan
- Whole Rock analysis by lithium metaborate fusion followed by x-ray fluorescence (XRF) spectroscopy
- Mineralogical assessment of 6 samples, conducted by Vancouver Petrographics, and
- Short-term leaching tests on 20 select samples, using shake-flash extraction in distilled water followed by ICP-MS scan.

**The principal conclusions** resulting from this assessment are as follows:

- Lithological units that are not generally of concern with respect to potential acid generation, include pegmatite (PEG) and phlogopite (PHLOG), which represent the ore and tailings, sapphirine/gedrite (SAPGED), overburden (OVB) and non-sulphide ultramafics (UM). Sulphides do not appear to be generally associated with these rock types.

- A few lithological units, such as mafic gabbro (GABM), gneiss (GNS) and sulphide-bearing ultramafics (UMS), may be of concern with respect to potential acid generation. These concerns are directly related to sulphide concentrations in the relative absence of adequate neutralizing potential.
- Subaqueous deposition of most waste rock and tailings material in the lake will minimize sulphide weathering and reduce potential acid generation to negligible rates in PAG and low-PAG materials by limiting exposure to free oxygen.
- Short-term leaching tests indicated that these elements are not likely to be mobilized to any significant extent under the neutral pH drainage conditions that prevail at the project site.

| Classification | Lithologies | ARD & Metal Leaching Potential |
|---|---|---|
| Non-Acid Generating (NAG) | Pegmatite (PEG)<br><br>Phlogopite (PHLOG) (Main Ore, Tailings)<br><br>Sapphirine/Gedrite (SAPGED)<br><br>Overburden<br><br>Non-sulphide Ultramafics (UM) | These lithologies generally do not pose a concern with regard to acid generation, as sulphide minerals are typically not associated with them.<br><br>Metal leaching from these materials is expected to be minimal.<br><br>From the perspective of ARD and metal leaching, these lithologies are generally appropriate for infrastructure use.<br><br>Although likely to be a relatively uncommon occurrence for these rock types, field screening should be undertaken to ensure that any sub-units containing greater than 0.3% sulphides are managed by sub-aqueous disposal. |

| Classification | Lithologies | ARD & Metal Leaching Potential |
|---|---|---|
| Low Potential for Acid Generation (Low-PAG) | Gabbro (GAB) (Secondary Ore)<br><br>Leucocratic Gabbro (GABL) (Secondary Ore) | These lithologies generally pose a low concern with regard to acid generation, as sulphide concentrations are typically low. Acid generation is a potential issue when sulphides are present in higher concentrations, but this appears to be the exception for these rock types.<br><br>Metal leaching from these materials is expected to be minimal.<br><br>From the perspective of ARD and metal leaching, these rock types may be appropriate for use in construction, provided that field screening is undertaken to ensure that any sub-units containing greater than 0.3% sulphides are managed by sub-aqueous disposal. |
| Potentially Acid Generating (PAG) | Mafic Gabbro (GABM)<br><br>Gneiss (GNS)<br><br>Sulphide-bearing Ultramafics (UMS) | The acid generating potential of these lithologies is related directly to the presence of sulphides, which these rock types appear to possess in variable but generally higher amounts. Acid generation is a potential issue when sulphides are present in higher concentrations.<br><br>Metal leaching from these materials is expected to be minimal.<br><br>From the perspective of ARD and metal leaching, these rock types are not generally recommended for use in construction, but if necessary they may be used provided that field screening is undertaken to ensure that any sub-units containing greater than 0.3% sulphides (0.1% in the case of gneiss) are managed by sub-aqueous disposal. |

**Other conclusions of note:**

- **Chemical-weathering reactions will be hindered** by the low summer temperatures and frozen winter conditions at the property.
- **A field screening protocol** should be developed and implemented to ensure that any materials that contain greater than 0.3% sulphide are managed by sub-aqueous disposal.
- **NAG materials** may be used for infrastructure construction if needed for this purpose, provided that a field screening protocol is undertaken to ensure that any sub-units that contain greater than 0.3% sulphide are managed by sub-aqueous disposal.
- **Low-PAG materials** of most rock types (i.e., other than gneiss, which should generally be submerged due to the pervasive presence of pyrite) may be used for infrastructure construction if needed for this purpose provided that a field screening protocol is undertaken to ensure that any sub-units that contain greater than 0.3% sulphide (and 0.1% sulphide in the case of gneiss) are managed by sub-aqueous disposal.
- **PAG materials** should be identified and managed such that these materials are submerged and not used for infrastructure construction. However, these rock types may be used for infrastructure construction if needed for this purpose provided that a field screening protocol is undertaken to ensure that any sub-units that contain greater than 0.3% sulphide (or 0.1% sulphide in the case of gneiss) are managed by sub-aqueous disposal.
- **Kinetic test work** and modeling of potential acid generation and pit water quality are not warranted at this stage in the mine development process given the generally low potential for acid generation and metal leaching.
- **Open pit water quality** should be monitored during mine operation to determine what, if any, mitigating measures might be required.
- **The open pit will be flooded**, post-closure, and the subaqueous environment will limit ongoing oxidation of sulphides exposed in the pit walls to negligible rates. The extent of fresh rock exposed after flooding of the pit is expected to be negligible, at most only a few metres wide along the west and southwest edge of the open pit, with a small area (less than 100 $m^2$) at the north end of the pit. As such, this exposed rock does not represent a significant concern for acid generation or metal leaching.

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# 1 Introduction

This section provides background information relating to the Aappaluttoq project and outlines the scope of work for this ARD and metal leaching assessment project.

## 1.1 Background

True North Gems is in the advanced stages of exploring, and is planning to develop its Aappaluttoq Ruby Property, located on the southwest coast of Greenland, 160 km south of the capital, Nuuk. The ruby mineralization occurs within the Fiskanaessett layered igneous complex; this is an Archean aged mafic/ultramafic intrusive body that has been subjected to two regional metamorphic events since its formation. The rubies are concentrated between a layer of altered ultramafic (SAPGED) and the leucogratic gabbro (GABL). This reaction zone is tens of meters in width and is generally filled with a phlogopite-rich metasomatic rock (PHLOG); this phlogopite zone and the GABL are the main ore rocks at Aappaluttoq. True North Gems is developing plans to create an open pit mine and construct a mill operation on the property.

Since some of the rock at the property contains sulphide minerals, such as pyrrhotite and, to a lesser extent, pyrite, there is a requirement to evaluate the potential for acid rock drainage (ARD) to be able to assess potential impacts on the local environment from planned future mining activities. Such activities may include excavation of an open pit, milling of ore material, construction of roads and ancillary facilities for the mining operation, and deposition of waste rock and tailings materials.

True North Gems has retained the services of the Consultants to provide a review and assessment of the ARD and metal leaching potential at Aappaluttoq. The Consultants have reviewed the available information with regard to the property, including drill core logs and past geologic reports, and designed a static analytical testing program. The studies were focused on the material to be mined during the initial 3-years of a proposed open pit mining operation. The core sampling and testing program was designed based on core log records available at the commencement of the program, with a focus on (but not exclusive to) the top 40 meters of core within the initial 3-year open pit design plan. The proportions of each major rock type and the proportion of sulphide-bearing and non-sulphide core intervals within each rock type represented within the top 40 meters of core compared closely to those within the top 75 metres (the depth parameter for a potential 10-year mine plan). As such, the findings of this assessment are expected to be representative of the general geology of the property. This report provides the results of the review and assessment.

### 1.2 Scope of Work

The Consultants carried out the following tasks:

- Review and assess existing information relating to ARD potential, such as drill logs, geologic reports, maps and cross-sections within the context of the preliminary mine plan established in 2009.
- Design and execute a static analytical testing program to assess the ARD and metal leaching potential at the Aappaluttoq property.
- Assess whether or not a kinetic test program is warranted, based on the information available and the mine development plans at the time this initial static program was carried out.
- Prepare this report of the review and assessment of ARD and metal leaching at the Aappaluttoq property using Canadian ARD guidelines as a primary point of reference.

## 2 ARD and Metal Leaching

This section outlines theoretical and practical considerations with regard to acid rock drainage and metal leaching, and provides guidance regarding the test work and assessment.

The low summer temperatures and frozen winter conditions at the property will hinder chemical-weathering reactions. The current plan for subaqueous deposition of most waste rock and tailings material, including all potentially acid generating (PAG) material, will minimize sulphide weathering and potential acid generation by limiting exposure to free oxygen.

### 2.1 Theoretical and Practical Considerations

Acid rock drainage (ARD) is an important environmental concern in the mining industry and other industries in which large volumes of rock are disturbed, exposed, excavated, used for construction and/or stored in a manner in which they are exposed to air and water. The term ARD refers to water drainage or seepage that becomes contaminated with acidity and/or metals due to oxidation reactions involving sulphide minerals contained in the rock mass as the water flows over, passes through, or drains from the exposed rock, whether it remains in place or has been excavated and placed in a structure such as a dam or rock pile. The name implies that solutions are acidic although in practice, drainage and seeps with elevated metals and sulphate concentrations at circum-neutral pH are often referred to as ARD.

The sulphide mineral that is most commonly associated with the generation of ARD is pyrite, $FeS_2$, due to its widespread occurrence and abundance in most sulphide mineral deposits. In many cases in mining, pyrite concentrations exceed, often very significantly, the concentrations of the valuable sulphide minerals of copper, zinc, nickel, and other important metals. Pyrite, therefore, is the mineral almost always used as the example to explain of the mechanisms of ARD generation. Theoretical calculations of the quantity of acidity that could potentially be generated if all the sulphur contained in waste rock, tailings or other mine component were oxidized, usually assume that the sulphur is present as pyrite.

Some rock types (primarily gneiss) at the Aappaluttoq project site contain pyrite ($FeS_2$), although another iron sulphide mineral, pyrrhotite, usually represented as $Fe_{1-x}S$, is more abundant and more prevalent across the various rock types (particularly ultramafics) at the property. The waste rock will contain these iron sulphide minerals in varying concentrations and their oxidation can give rise to the production of acidity. Trace amounts of other metals might also be mobile under the acidic conditions, resulting in heavy metal contamination in drainage or seepage from waste rock and the open pit.

The oxidation and related reactions pyrite are shown in Equations 1 to 4.

The oxidation of pyrite initially releases dissolved ferrous iron and acidity into the water (equation 1).

$$FeS_2 + {}^{7}/_{2}\,O_2 + H_2O \rightarrow Fe^{2+} + 2\,SO_4^{2-} + H^+ \qquad (1)$$

The ferrous iron produced is oxidized to ferric iron, (equation 2) which can then hydrolyze to form insoluble ferric hydroxide and release more acidity (equation 3).

$$Fe^{2+} + {}^{1}/_{4}\,O_2 + H^+ \rightarrow Fe^{3+} + {}^{1}/_{2}\,H_2O \qquad (2)$$

$$Fe^{3+} + 3\,H_2O \rightarrow Fe(OH)_3 + 3\,H^+ \qquad (3)$$

The overall reaction can be written as follows:

$$FeS_2 + {}^{15}/_{4}\,O_2 + {}^{7}/_{2}\,H_2O \rightarrow Fe(OH)_3 + 2\,SO_4^{2-} + 4\,H^+ \qquad (4)$$

From reaction (4) it can be seen that complete reaction of 1 mole $FeS_2$ produces 2 moles of $H_2SO_4$, or 4 equivalents of acidity. Therefore, 1 mole of S produces 2 equivalents of acidity.

It is the normal convention that the quantity of acid that can be generated from a material is called the Acid Potential (AP) and is expressed in units of calcium carbonate, usually kg $CaCO_3$/tonne. Therefore, the 2 equivalents of acidity produced per mole of S are equal to 2 equivalents of $CaCO_3$. It follows that a material containing 1% S (10 kg S/tonne) as pyrite has an acid potential given by:

*Acid Potential (AP):*

= 10 kg S/tonne * (2 * equiv. weight of $CaCO_3$ / mol. weight of S)
= 10*(2 * 50/32)
= 31.25 kg $CaCO_3$/tonne

The multiplying factor of 31.25 for each 1% of S contained in a material is the basis for calculating AP in units of $CaCO_3$ equivalent in standard test procedures (see section 2.2).

A number of possible oxidation reactions for pyrrhotite can be written, although there is sometimes significant debate about which reactions might actually take place under a specific set of environmental conditions. Possible reactions are as follows (adapted from Nicholson and Sharer, 1994, Nicholson, 1994, and Rossi, 1990):

$$Fe_{1-x}S + (2 + {}^{x}/_{2})\, O_2 + x\, H_2O \rightarrow (1-x)\, Fe^{2+} + SO_4^{2-} + 2x\, H^+ \qquad (5)$$

$$Fe_{1-x}S + {}^{(1-x)}/_{2}\, O_2 + 2(1-x)\, H^+ \rightarrow (1-x)\, Fe^{2+} + S_o + (1-x)\, H_2O \qquad (6)$$

$$Fe_{1-x}S + ({}^{1}/_{2} - x)\, O_2 + (2-4x)\, H^+ \rightarrow FeS_2 + (1-2x)\, Fe^{2+}\ (1-2x)\, H_2O \qquad (7)$$

In the example shown in equation (5), pyrrhotite can oxidize to completion to provide up to one-quarter equivalent of acidity as in the case where x = 0.125 in the most iron-deficient form of the mineral. When x =0, as for stoichiometric FeS, no acidity is produced. However, in either case, further oxidation of the ferrous iron and subsequent hydrolysis of the ferric iron produced as previously represented by equations (2) and (3), or as the net reaction represented by equation (8), results in net acidity production in both cases.

$$Fe^{2+} + {}^{1}/_{4}\, O_2 + {}^{5}/_{2}\, H_2O \rightarrow Fe(OH)_3 + 2\, H^+ \qquad (8)$$

Equation (6) shows oxidation of pyrrhotite that does not proceed to completion as sulphide oxidation stops at elemental sulphur. In this case, acid is consumed. If conditions are well aerated, the reaction might simply represent an intermediate stage, with elemental sulphur oxidized to sulphate, with the net result the same as the reaction shown by equation (5). However, under poorly aerated conditions, elemental sulphur formation might represent the terminal stage and, reaction (8) might not proceed either, resulting in no acid generation.

Equation (7) represents another possible intermediate reaction, which, in this case, is followed by oxidation of the $FeS_2$ formed in the first stage. Again, equation (7) is acid consuming and the question of whether further oxidation of the $FeS_2$ and $Fe^{2+}$ takes place will depend on the prevalent conditions.

Pyrrhotite can also be oxidized by ferric iron under low pH conditions (approximately <3) in which ferric iron is soluble, as represented by equation (9), which is acid producing, or equation (10) in which elemental sulphur forms and the reaction is non-acid generating.

$$Fe_{1-x}S + (8-2x)\,Fe^{3+} + 4\,H_2O \rightarrow (9-3x)\,Fe^{2+} + SO_4^{2-} + 8\,H^+ \qquad (9)$$

$$Fe_{1-x}S + (2-2x)\,Fe^{3+} + 4\,H_2O \rightarrow (3-3x)\,Fe^{2+} + S_o \qquad (10)$$

The above discussion of the reactions of pyrrhotite is not intended to be complete but does indicate that the amount of acidity that might be produced by its oxidation is not readily predictable. Given that pyrrhotite is the predominant sulphide at the Aappaluttoq property, it is important to note that equations (4) and (8), above, indicate that the amount of acid that can be produced by pyrrhotite is at most (in the case of FeS, (i.e., $Fe_{1-x}S$ where x=0)) half of what could be produced by pyrite in a similar mineralogical habit under the same conditions.

It should also be noted that the generation of acidity is not necessarily a prerequisite for the mobilization of metals from mining wastes into the environment. Weathering reactions leading to metal mobilization can take place under apparently neutral pH drainage conditions. Although water draining from a rock structure might have a circum-neutral pH, in the very close proximity to a sulphide mineral surface, which we can term the microenvironment, solution pH might be low due to oxidation reactions taking place at the mineral surface.

The subsequent fate of any acidity generated and/or metals dissolved in such microenvironments will depend on the characteristics of the flow path down which the products of reaction travel. For example, if the volumes of water are very small and/or there are abundant acid neutralizing minerals along the flow path, then metals might precipitate if metal concentrations exceed saturation levels as determined by the solubility of the particular mineral species and the conditions of temperature, pH and redox. Some metals, such as zinc and manganese, remain soluble in significant concentration even if the pH is neutral.

## 2.2 Notes on ARD and Metal Leaching Test Work and Assessment

Mine waste management facilities must be designed to ensure that waste materials can be stored in a manner that will prevent or mitigate the generation of ARD and the migration of heavy metal-contaminated runoff and seepage into downstream watercourses both during operation and long after mine closure. Uncontrolled ARD emissions can result in significant ecological disruption in sensitive and productive receiving waters. To provide confident waste management plans that will allow permitting to proceed and acceptance of closure measures requires that proponents and operators characterize the wastes resulting from current or proposed mining activities in order to predict future performance of the materials when disposed of under environmental conditions.

Mining projects are assessed for ARD and metal leaching potential by carrying out a series of analyses and tests on rock samples. Every attempt should be made to select the type and number samples for analysis and testing that represent the variations in lithology, volume, and spatial distribution that is found in the ore deposit and associated waste rock. An initial suite of analyses and tests, termed Static Tests, are used to determine characteristics of the various rock types that will be exposed to the air and precipitation during mine operation and after mine closure. Characteristics of interest include:

- Elemental and Whole Rock analysis – to provide an analysis of the elements contained in a sample to indicate the metals of environmental concern and their concentration.
- Mineralogical analysis – to provide mineralogical speciation to identify major sulphide and oxide minerals and their abundance. Such data is essential to be able to qualify rates and extent of acid producing and neutralizing reactions indicated in a gross sense by other static test data.
- Sulphur species – analyses usually include total sulphur, sulphate-sulphur and sulphide-sulphur by difference to be able to calculate acid potential (AP).
- Neutralization potential (NP) – determination of NP together with the analysis of sulphur species makes up the Acid Base Accounting (ABA) Procedure. NP is determined by measuring the amount of acidity consumed by a sample. The NP and AP values are compared and the sample classified as potentially acid producing, uncertain potential for acid generation, or non-acid producing.
- Short-term leaching tests – leaching tests are usually carried out for 24 hours under mildly acidic or neutral conditions. Data indicate which metals of concern are potentially mobile in the short term and can be used to calculate acidity and metal flux rates that might be experienced for freshly deposited rock during the first few precipitation events. Standard protocols can be modified to make the test more relevant for specific conditions.

Following static testing, Kinetic Tests designed to provide information on the weathering characteristics of samples as a function of time:

- Laboratory kinetic tests – involve a periodic and repetitive leaching procedure, most commonly carried out in a device known as a humidity cell, and may take 6 months to 1 year or more to complete. The number of samples or sample composites tested is usually limited but should be selected using the same criteria as those for the static test program. Data from kinetic tests are used to (1) confirm predictions made on the basis of static test data and (2) calculate metal flux rates, which are used in empirical models based on site hydrology and other site-specific conditions and factors to predict water quality downstream of waste management facilities. Usually carried out according to standard protocols but can be modified to respond to specific meteorological conditions at site.

- Site kinetic tests – have similar objectives as laboratory kinetic tests but are carried out under actual site conditions of temperature and rainfall. A number of different test apparatus and protocols can be designed to meet specific test objectives and site conditions
- Other kinetic tests – can be designed to meet specific requirements such as non-oxidative leaching tests to simulate subaqueous deposition over a longer time frame than the short-term leaching test.

There are a number of static and kinetic analyses and test procedures in use. All of them have some shortcomings, which is not surprising given that they attempt to mimic or model what are usually long term and complex reactions in the natural environment using what are mostly simple and relatively short term procedures in the laboratory. However, we consider that some tests are considered better than others or provide information that might be useful in some circumstances but not in others. Specific recommendations can be provided for individual cases.

For information specific to the static test work conducted on Aappaluttoq samples refer to section 3.2.2 of this report. Kinetic tests have not been conducted on samples from the Aappaluttoq project. Such test work was deemed unnecessary at this time due to plans for subaqueous deposition of all potentially acid generating (PAG) materials and relatively low leaching rates of potential elements of concern in the short-term leaching tests that were conducted (refer to section 4.3.2).

# 3 The Aappaluttoq Ruby Project

This section provides a general description of the Aappaluttoq project setting, geology and project components, and an overview of the acid rock drainage (ARD) program design, including sample selection protocols and the analytical program.

## 3.1 General Project Description

Comments in this section are limited to information relevant to this assessment of the ARD and metal leaching potential at the project site.

### 3.1.1 Project Setting

The Aappaluttoq Ruby Project is located along the southwest coast of Greenland, 160 km south of the capital, Nuuk, and about 20 km to the east of the main coastline. The landscape has been shaped and sculpted by period of glacial activity, and the ice sheet is currently more than 30 km to the east.

The property is located within a low arctic maritime climate where sub-zero degree average temperatures are maintained throughout the winter months (November through April). There is a short, cool summer season from July and August, where the average temperature does not exceed 10°C. Precipitation averages around 900 mm per year, mixed rain and snow, with most falling between July and September. Ukkaata Qaava, formerly called Lake Katrina, has a near-neutral pH, ranging from 5.77 near the salt-water fjord, to as high as 7.94 closer to the project site.

### 3.1.2 General Geological Information

The geology of the project site is part of the Fiskenæsset anorthosite complex, which is an Archean aged (2970Ma) layered-cumulate igneous intrusion. The intrusive suite comprises gabbros (GAB), ultramafic rocks (UM/UMS), leucogabbro (GABL) and calcic anorthosite (GABM), listed in decreasing order of abundance. The cumulate layered intrusive complex is generally zoned upwards from mafic to calcic units.

The complex was intruded into oceanic crust and subsequently obducted onto the west side of Greenland during the early formation of the continent. Subsequent arc-collision and the associated upper amphibolite to granulite facies metamorphism created an environment that was ideal for the formation of corundum. Fluid induced metasomatism of the ultramafic units and the de-silicification of the Al-rich gabbros allowed corundum to form and provided all of the essential elements to turn it into coloured gemstones (Cr, V etc).

The earliest mineralization date for the corundum is 1,825-1,821 Ma, the subsequent phases of metamorphism appear to have had only a minor effect on the crystals. However, it is possible the amphibolite facies metamorphism around 1,800-1,775Ma could also have contributed to the mineralization. Current scientific studies cannot be more precise at present.

The ruby mineralization occurs along a regional geologic contact between an altered ultramafic body (SAPGED) and a leucogabbro (GABL), in a zone of high geochemical gradient. Along this zone, a metasomatic phlogopite (PHLOG) unit was formed. This is the main ruby-bearing ore at Aappaluttoq.

The country rock surrounding the igneous complex is mostly comprised of various varieties of Archean gneiss (GN), and metamorphosed amphibolitic greenstone belts. There are various packages of younger rocks, mostly comprising supracrustal marbles and pelite sequences formed after the tectonic addition of the Fiskenæsset complex onto West Greenland. These regional units form a very minor part of the succession near to Aappaluttoq.

### 3.1.3 Project Components

Various geologic materials with different characteristics with respect to ARD and metal leaching potential will be exposed, excavated, deposited subaqueously or in stockpiles, and/or used for construction. These materials can be referred to in this context as mine project components.

Water in the form of precipitation, surface runoff, melt water and lake water will interact with these components. Future chemistry of the water which flows or drains from these structures will depend on (1) the form and depositional conditions for each component, (2) the type of exposure, (3) volume of component and/or surface area of exposure, (4) the rate of exchange between component and water, and (5) the overall physical and geochemical characteristics and inventories of the components. A key part of ARD and metal leaching assessment programs is to determine the inventory of potentially acid generating and neutralizing materials, and those materials from which metals of potential environmental concern might be leached.

The following table (Table 1) summarizes the principal components of the Aappaluttoq Ruby Project relating to rock materials, together with some preliminary comments on ARD and metal leaching:

**Table 1: Summary of Project Components**

| Project Component | Preliminary Comments on ARD and Metal Leaching |
|---|---|
| Waste Rock & Tailings | Waste rock and tailings material will be deposited in the lake beside the open pit in a subaqueous environment where the very low rate of oxygen diffusion in water will limit oxidation of sulphides present to negligible rates. Short-term leaching tests were conducted to assess the mobilization of metals of environmental concern into the lake during deposition. |
| Construction Materials | Waste rock and quarry materials to be used for construction material, such as foundations and road works, will be exposed in a sub-aerial environment. Non-acid-generating (NAG) and select low potential for acid generation (low-PAG) materials may be selected for use in construction to minimize environmental impacts due to the potential for acid generation and metal leaching. |

| Project Component | Preliminary Comments on ARD and Metal Leaching |
|---|---|
| Open Pit | Potentially acid-generating (PAG) rock faces exposed in the open pit may start to generate acid conditions during mining. These are expected to represent a minor proportion of the exposed rock face, and (as noted in section 2.1, above) the arctic climate temperatures are expected to hinder reaction rates; however, it may be necessary to take mitigating measures to minimize the environmental impact should this occur.<br><br>Based on the factors above, modeling of potential acid generation and pit water quality was not deemed to be pragmatic at this stage in the mine development process. Monitoring of pit water quality during mining is advisable to determine what, if any mitigating action might be required.<br><br>Post-closure, the pit will be flooded, and the subaqueous environment will limit ongoing oxidation of sulphides to negligible rates. |

Preliminary estimates of the quantities of each rock type to be excavated from the upper portion of the open pit in the first 3 years, which formed part of the basis for the design of the ARD/ML program, are as follows (Table 2):

**Table 2: Open Pit Schedule for First 3 Years (by Lithology)**

| Lithology | Code | S.G. | % Waste Rock in Pit | Tonnes |
|---|---|---|---|---|
| Gabbro & Leucogabbro | GAB, GABL | 2.87 | 30% | 141,684 |
| Mafic Gabbro | GABM | 2.94 | 15% | 72,570 |
| Gneiss | GNS | 2.82 | 10% | 46,405 |
| Sapphirine/Gedrite | SAPGED | 3.25 | 30% | 160,443 |
| Ultramafic | UM | 3.43 | 10% | 56,443 |
| Ultramafic w/ Sulphides | UMS | 4 | 5% | 28,797 |
| Pegmatite | PEG | | 0% | - |
| Phlogopite (Ore) | PHLOG | 2.99 | (5%) | 31,000 |
| Other | | | 0% | - |
| Waste Total | | | 100% | 506,342 |
| Ore | | | 5% | 31,000 |
| **Total** | | | | **537,342** |

## 3.2 ARD Program Design

### 3.2.1 Sample Selection

Core samples for the ARD test program were selected based on information in the core log summary provided by True North Gems in 2009. The logs identified the major lithologies (rock types) at the Aappaluttoq project site and provided information regarding mineral content, including the presence of sulphides when they were encountered.

Sulphides were identified in the logs either simply as 'sulphides,' or more specifically the type of sulphide, which included pyrite, pyrrhotite and chalcopyrite. No other sulphides were mentioned in the logs. Of the 2,238 intervals recorded in the log summary, for all 69 drill holes, sulphides were noted in less than one quarter of the intervals, as follows (Table 3):

**Table 3: Summary of Sulphide Types Identified in Core Logs**

| Sulphide Type Noted | # Intervals | % of Total |
|---|---|---|
| Sulphide | 217 | 9.7% |
| Pyrite | 127 | 5.7% |
| Pyrrhotite | 89 | 4.0% |
| Chalcopyrite | 79 | 3.5% |
| **Total** | **512** | **22.9%** |

It should be noted that different field staff compiled the logs over the course of each field season and that the notes regarding sulphide abundance and speciation are qualitative and based on the judgment of each individual who logged the core. As such, the logs are largely considered anecdotal for the purposes of this assessment and no direct reliance was placed on them with regard to sulphide abundance and speciation. The log notes were used to assess the relative presence of sulphides within each lithology to determine the approximate proportion of sulphide-bearing and non-sulphide samples to select for each rock type.

All lithologies were noted to contain at least some sulphides, though they were most common in the ultramafic (UM, UMS) and to a lesser extent in the gabbro (GAB, GABL, GABM) rock types. Sulphides were least noted in overburden (OVB), phlogopite (PHLOG), pegmatite (PEG) and sapphirine/gedrite (SAPGED) rock types. All but seven drill holes encountered at least some sulphides, the exceptions being holes GL-07-01, 28, 40, 48 & 49, and GL-08-61 & 62. Sulphides were most abundantly noted in drill hole GL-08-67, and to a lesser extent in GL-08-60.

The number of samples selected for each lithology for the ARD program was determined by comparing the aggregate length of core of each rock type to the total length within the top 40 metres of the core for all sixty-seven drill holes (per the original 3-year pit design parameters provided at the commencement of this program in 2009). The proportion of sulphide-bearing to non-sulphide samples for each rock type was also determined by the relative aggregate length of core for which sulphides were present or absent in the logs.

The Consultants prepared guidelines for True North Gems regarding the number of sulphide-bearing and non-sulphide core samples to collect for each lithology, with a list of preferred drill hole intervals to sample, based on the type of sulphide present. The guidelines prescribed that approximately 100 core samples be selected, which in aggregate represents 10% of the core intervals within the top 40 metres, in order to adequately represent each lithology. Of those samples, at least 40 were to be sulphide-bearing, to reflect at a minimum the proportion of sulphide-bearing intervals noted in the logs.

The sample collection guidelines, along with sampling protocols provided by the Consultant (refer to Appendix I), were used by True North's consulting geologists in the field as a guide to collect core samples at the property. Due to unavailability of some drill core intervals in the field, some minor variance from the guidelines was necessary.

A total of 106 core samples were collected, representing 11% of the total number of intervals within the top 40 metres. This sample size is considered to be statistically sufficient to accurately characterize the lithological units within the upper portion of the open pit. Those samples included 58 sulphide-bearing intervals, which represents 35% of the 166 sulphide-bearing intervals identified in the logs within the top 40 metres of core. This over-representation of sulphide-bearing samples (which are present in less than 23% of all intervals (Table 3) was designed to ensure that sulphide variability within units of potential concern for ARD and metal leaching would be adequately characterized.

### 3.2.2 Analytical Program

A total of 106 drill core samples were submitted to Maxxam Analytics (formerly Cantest Ltd.) in Burnaby, BC, the project laboratory for the ARD assessment program. The samples were submitted to Maxxam in 4 batches between July 2009 and January 2011. Samples were inspected and documented by True North's project staff and/or the Consultant at the company's head office in Vancouver prior to sending the samples to Maxxam.

The first batch of samples included two phlogopite tailings samples, one from the tailings pond (sample # 11) and a second from the tailings jig (sample # 12). The second batch included 19 core samples from the 2007 drilling program that were available at True North's head office in Vancouver. The third batch was submitted to the project laboratory in November 2010 and included 72 core samples from both 2007 and 2008 drilling programs that were collected by True North's consulting geologists on site in Greenland and shipped to the project laboratory. The final batch included 13 phlogopite (PHLOG) ore samples from the 2008 drilling program that were transported by True North's project geologist from SGS's process testing laboratory in Lakefield, Ontario, to the project laboratory.

As outlined in section 2.2, the analytical program included the following analyses:

- Acid-Base Accounting (ABA) using the Modified ABA NP method (MEND Acid Rock Drainage Prediction Manual, MEND Project 1.16.1b (pages 6.2-11 to 17), March 1991)
- Total sulphur and sulphate-sulphur speciation analysis to determine sulphide-sulphur content, by the difference between the two
- Elemental (trace metals) analysis by aqua regia digestion followed by ICP-MS scan
- Whole Rock analysis by lithium metaborate fusion followed by x-ray fluorescence (XRF) spectroscopy
- Mineralogical assessment of 6 samples, conducted by Vancouver Petrographics, and
- Short-term leaching tests on 20 select samples, using shake-flash extraction in distilled water followed by ICP-MS scan.

The mineralogical assessment was conducted on a suite of 6 rock samples representing several rock types that were available at True North's head office during the initial planning stages of this ARD assessment. This assessment was used to guide the development of the program. All 106 of the samples sent to the project laboratory were subjected to ABA and elemental analyses, with whole rock analyses conducted on all but the two phlogopite tailings samples. Based on these results, a sub-set of 20 core samples, representing each major rock type and with varying ABA and elemental characteristics was selected for the short-term leaching tests.

# 4 Discussion of Results

This section presents a discussion of the analytical results, including acid-base accounting (ABA), elemental and whole rock analysis, mineralogical assessment and short-term metal leaching tests.

## 4.1 Mineralogical Assessment

The mineralogical report provided details regarding the composition of the key lithologies at the Aappaluttoq property. The report indicated that carbonates occur only in minor quantities, and the abundance of aluminosilicates suggests that these are the likely source of neutralizing potential measured in the ABA testing. A gneiss (GN) rock sample contained minor pyrite and trace, pyrrhotite and chalcopyrite, corroborating the drill core log observations that identified these as the predominant sulphide minerals at the property.

True North geologists provided the Consultants with sulphide speciation data from a detailed assessment of 643 sulphide-bearing intervals, two-thirds of which were from within the top 40 metres of core. Only intervals containing sulphides visible in the core were included in the assessment. The data, summarized in Table 4, indicates that:

- Pyrrhotite was the primary sulphide in 96% (618 of 643) of the samples
- Only 3% (21 of 643 samples) contained pyrite, and
- Over 97% of the chalcopyrite (403 of 414 samples) is in the ultramafic (UM/UMS) lithology.

**Table 4: Number of Sulphide-Bearing Intervals (by Lithology)**

| Lithology | Pyrrhotite | Pyrite | Chalcopyrite |
|---|---|---|---|
| Mafic Gabbro (GABM) | 11 | 2 | 3 |
| Gosan (GOS) | 4 | | 4 |
| Overburden (OVB) | | | |
| Sapphirine/Gedrite (SAPGED) | 8 | 1 | 4 |
| Ultramafic (UM) | 7 | | 3 |
| Ultramafic (UMS) | 588 | 18 | 400 |
| **Total (643 Intervals)** | **618** | **21** | **414** |

Based on inspection of core samples submitted to the laboratory and the sulphide speciation data provided by True North, gneiss is the only rock type in which pyrite is the primary sulphide. Pyrrhotite is the primary sulphide in all of the other lithologies, with secondary chalcopyrite in the UM/UMS lithology, and generally very little pyrite present.

## 4.2 Acid-Base Accounting

Acid-base accounting (ABA) analyses included paste pH, total sulphur, sulphate sulphur, fizz rating and neutralization potential (NP). Calculated values from this analytical test work included sulphide-sulphur ($S_{Sulphide} = S_{Total} - S_{Sulphate}$), acid potential ($AP = S_{Sulphide} \times 31.25$), net neutralization potential ($NNP = NP - AP$), and net potential ratio ($NPR = NP/AP$), which is sometimes alternately referred to as the NP/AP ratio.

The key indicators used to identify potentially acid generating (PAG) materials are $S_{Sulphide}$ and NPR. The guidelines used for these parameters are as follows:

- Materials with sulphide-sulphur concentrations less than 0.1%, and more generally less than 0.3%, do not contain sufficient sulphide to sustain acid generating chemical reactions in the field, and

- Materials with an NPR (i.e., an NP/AP ratio) greater than 3:1 contain sufficient neutralizing potential to prevent a net positive production of acid.

As such, using these two criteria, materials can be classified as follows:

- **NAG:** Non-acid generating materials have an NPR greater than 3:1 and/or contain less than 0.1% sulphide-sulphur
- **Low-PAG:** Materials with a low probability of being potentially acid generating have an NPR less than 3:1 and a sulphide-sulphur concentration between 0.1% and 0.3%.
- **PAG:** Potentially acid generating materials have an NPR less than 3:1 and a sulphide-sulphur concentration greater than 0.3%.

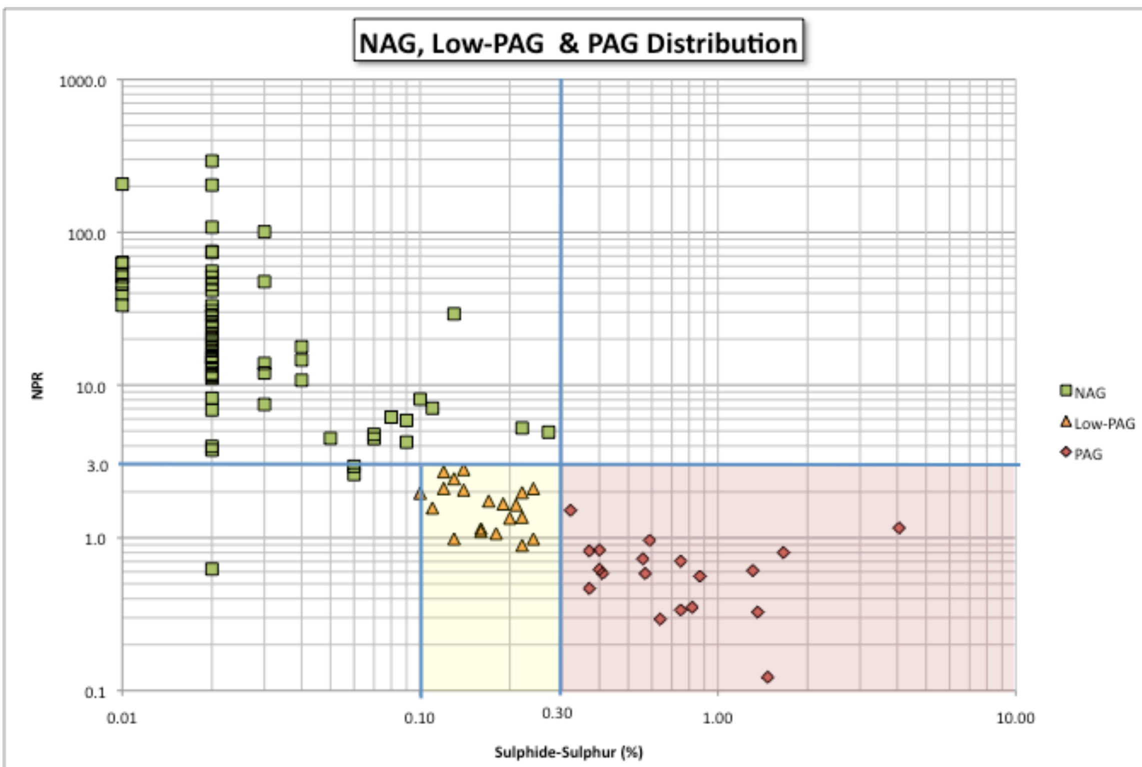


**Figure 1: NPR-S Chart showing NAG, Low-PAG & PAG distribution of Aapaluttoq samples**

The results for these two parameters (NPR and sulphide-sulphur) for the 106 Aappaluttoq samples have been presented in a log-log chart in Figure 1 to illustrate the distribution of samples that are NAG, low-PAG and PAG. The chart in Figure 1 shows that of the 106 Aappaluttoq core samples, 19 are considered to be PAG material, 20 are considered to be low-PAG, and the balance (67 samples) are considered to be NAG material.

These sample classifications are summarized by lithology in Table 5, as follows:

**Table 5: Summary of Acid Generating Potential by Lithology**

| Lithology | Predominant Sulphide | NAG Samples | Low-PAG Samples | PAG Samples | Total Samples |
|---|---|---|---|---|---|
| GAB | Minor pyrrhotite | 5 | 2 | 2 | 9 |
| GABL | Minor pyrrhotite | 4 | 3 | 1 | 8 |
| GABM | Pyrrhotite | 2 | 4 | 4 | 10 |
| GNS | Pyrite | 1 | 6 | 1 | 8 |
| GNSAUG | Pyrite | 1 | | 1 | 2 |
| Overburden | (None) | 3 | | | 3 |
| PEG | (Trace pyrrhotite) | 9 | 3 | 1 | 13 |
| PHLOG | Minor pyrrhotite | 4 | | 1 | 5 |
| PHLOG-Ore | (Trace pyrrhotite) | 13 | | | 13 |
| PHLOG-Tails | (None) | 2 | | | 2 |
| SAPGED | Minor pyrrhotite | 14 | | | 14 |
| UM | Pyrrhotite | 6 | | 3 | 9 |
| UMS | Pyrrhotite | 3 | 2 | 5 | 10 |
| **Total Samples** | | **67** | **20** | **19** | **106** |

For all materials, except gneiss (GNS), the predominant sulphide is pyrrhotite, and as such for these other lithologies (per the discussion of ARD in section 2.1) low-PAG materials are not likely to be of concern with regard to generation of acid drainage.

The following subsections discuss ABA findings specific to each of the major rock types at the project site.

### 4.2.1 Phlogopite (PHLOG) Ore & Tailings

Phlogopite represents only a small percentage (5%) of rock from the proposed open pit (Table 2). However, as the principal ruby mineralization-hosting rock unit at the property, it represents ore material that will be processed and that will produce tailings from the mill. As shown in **Error! Reference source not found.**, all of the phlogopite ore and tailings samples and all but one of the phlogopite waste rock samples fall into the NAG category.

The sulphides noted in the drill core logs appear to be very low in concentrations in this rock type, with only 1 of 20 samples analyzed containing greater than 0.3% sulphide-sulphur (0.75%), and all but 3 containing less than 0.1%. Neutralization potential in this rock type also far outstrips the acid potential with only that same single sample having an NPR less than 4:1 (at 0.34). These results suggest that the phlogopite rock type, whether ore, tailings or waste rock, does not pose a concern with regard to acid generation.

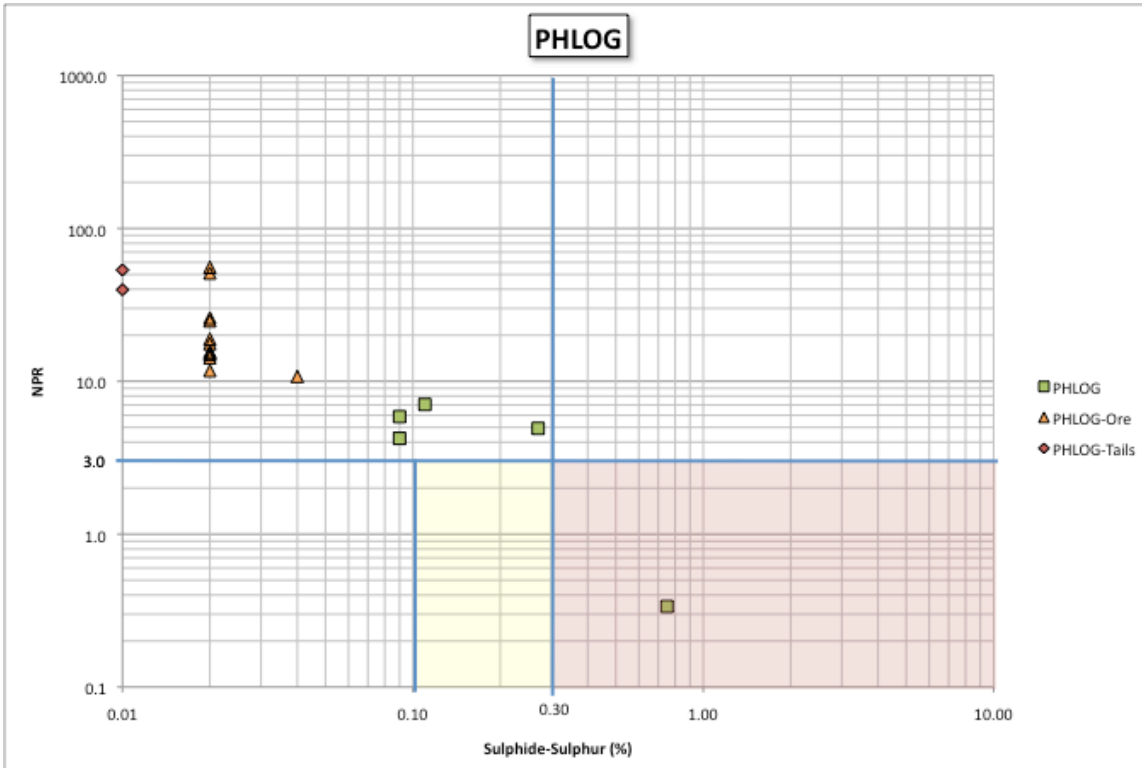


**Figure 2: NPR-S chart of Phlogopite lithology**

#### 4.2.2 Pegmatite (PEG)

As shown in Figure 2, all but three pegmatite samples are considered NAG, two are low-PAG and only one is PAG. The sulphides identified in the drill core logs correlate closely with the sulphide-sulphur analytical results and appear to be very low in concentrations in this rock type with only 1 of 13 samples containing greater than 0.3% sulphide-sulphur (0.38%), and all but 3 containing 0.1% or less. Neutralization potential in this rock type is relatively low compared to the acid potential, with over half of the samples having an NPR less than 3:1. These results suggest that the pegmatite rock type generally does not pose a concern with regard to acid generation, except where sulphides are present in higher concentrations.

Although pegmatites generally appear to contain very little sulphide, field screening should be undertaken to ensure that only sub-units containing less than 0.3% sulphides are utilized for infrastructure, with the higher sulphide concentration portions managed by sub-aqueous disposal.

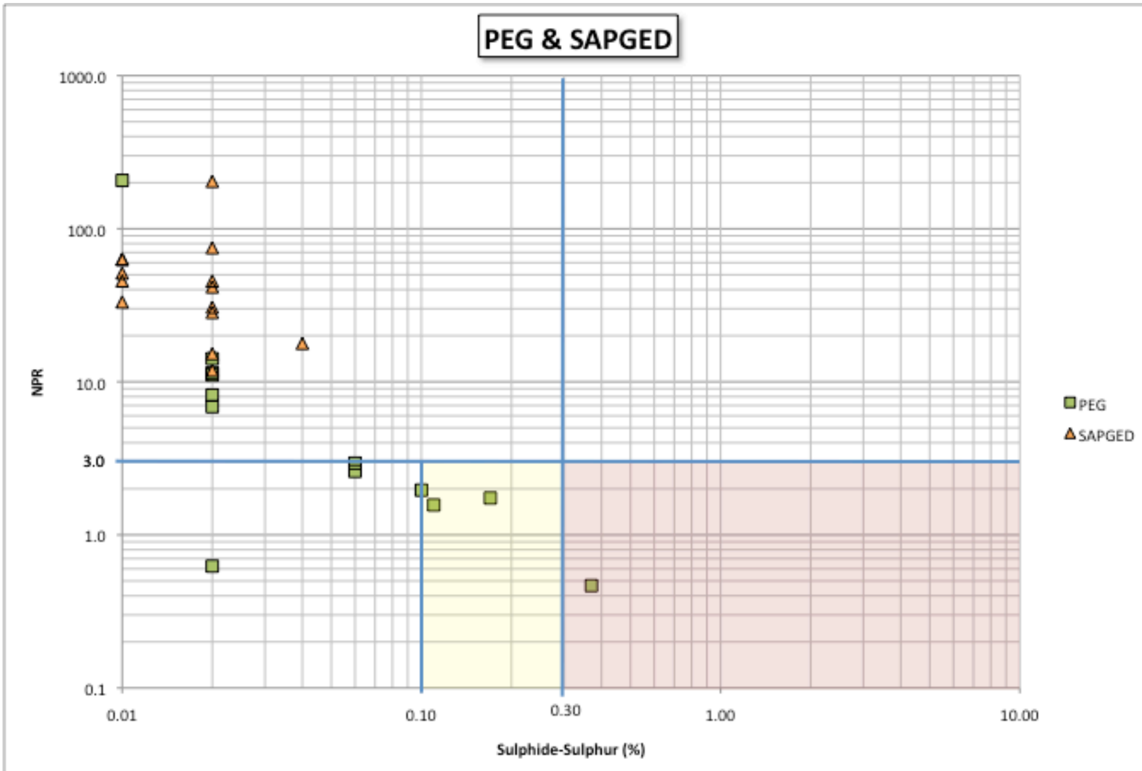


**Figure 3: NPR-S chart of Pegmatite & Sapphirine/Gedrite lithologies**

### 4.2.3 Sapphirine/Gedrite (SAPGED)

As also shown in Figure 3, all of the sapphirine/gedrite samples are considered NAG. Sulphides were identified in only 24 drill core intervals in this rock type, and the highest concentration of sulphide-sulphur in any sample was 0.04%, which is well below the 0.1% low-PAG threshold. Neutralizing potential was greater than 10 kg $CaCO_3$/tonne in all but 2 samples (7.1 and 9.1 kg $CaCO_3$/tonne), resulting in NPR values greater than 10:1 for all samples. These results suggest that the sapphirine/gedrite rock type does not pose a concern with regard to acid generation.

### 4.2.4 Gabbro (GAB, GABL & GABM)

The gabbro rock type is separated into 3 distinct sub-groups:

- Gabbro (GAB)
- Leucogabbro (GABL), and
- Mafic (calcic anorthosite) gabbro (GABM).

With NP values relatively consistent within this rock type (though generally lower for GABM), NPR is largely driven by sulphide-sulphur concentrations.

***GAB & GABL***
GAB and GABL are ruby mineralization-hosting rock units and represents secondary ore material that will be processed and that will produce tailings from the mill.

As shown in Figure 4, at least half of the GAB and GABL samples (5 of 9 and 4 of 8, respectively) are considered NAG, 5 of 17 are low-PAG, and only 3 are considered PAG material. The sulphides identified in the drill core logs appear to be generally relatively low in concentration in these two rock types with only 3 of 17 samples containing greater than 0.3% sulphide-sulphur (and none greater than 0.6%).

These results suggest that the acid generating potential of the GAB and GABL lithologies are related directly to the presence of sulphides. These rock types do not pose a concern with regard to acid generation when sulphide concentrations are low, though acid generation is a potential concern when sulphides are present in higher concentrations.

Field screening of GAB and GABL lithologies should be undertaken to ensure that only sub-units containing less than 0.3% sulphides are utilized for infrastructure, with the higher sulphide concentration portions managed by sub-aqueous disposal.

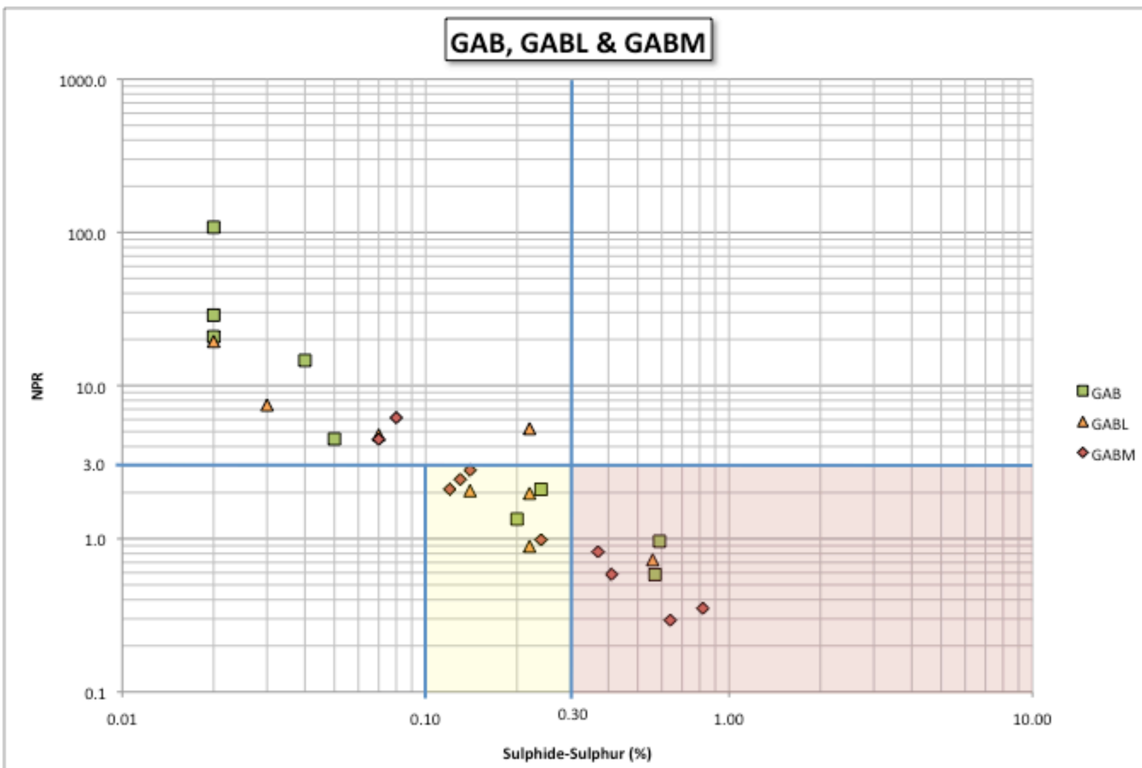


**Figure 4: NPR-S chart of Gabbro lithology**

***GABM***

As shown in Figure 4, only 2 of the 10 GABM samples are considered NAG, 4 are low-PAG, and 4 are considered PAG material. The sulphides identified in the drill core logs are generally higher in concentration in this GABM rock type than in GAB or GABL, with 4 of 10 samples containing greater than 0.3% sulphide-sulphur and 4 containing between 0.1% and 0.3%. Only 2 GABM samples contained less than 0.1% sulphide-sulphur. These results suggest that the acid generating potential of the GABM lithology is related directly to the presence of sulphides. With NP values generally lower than the other gabbro lithologies, acid generation is a potential concern when sulphides are present in higher concentrations.

Based on the high proportion of PAG and low-PAG within the GABM sample set, it might appear that most GABM is of potential concern with regard to acid generation. However, sulphides are listed in only 40% of the core log intervals for the GABM lithology, so it is possible that that sulphide-bearing GABM is disproportionately represented within the sample set submitted to the project laboratory.

Field screening of the GABM lithology should be undertaken to ensure that only sub-units containing less than 0.3% sulphides are utilized for infrastructure, with the higher sulphide concentration portions managed by sub-aqueous disposal.

### 4.2.5 Ultramafic (UM & UMS)

The ultramafic lithology is divided within the core logs into intervals classified as containing significant visible sulphides, visually estimated to be greater than 1% (UMS), and those not containing significant sulphides, visually estimated to be less than 1% (UM). Because of the broad distribution of sulphides within this lithology, sampled intervals of either UM or UMS rock types may or may not contain sulphides. The results of the ABA analyses are shown in Figure 5.

Most of the UM samples are considered NAG, and most of the UMS samples were considered PAG material, with 3 exceptions in both cases. Notes from the visual inspection of the samples submitted to the project laboratory indicated that the 3 PAG UM samples contained visible sulphides. Two of the 3 NAG UMS samples did not contain visible sulphides. Neutralizing potential in UM material ranged from 12.5 to 183 kg $CaCO_3$/tonne. Neutralizing potential in UMS material largely fell within the same range, with 3 samples with lower NP, between 4.0 and 9.4 kg $CaCO_3$/tonne.

Looking at the ABA data for this rock type, independent of the UM and UMS core log classifications, ultramafic material does not pose a concern with regard to acid generation when sulphide concentrations are low, though acid generation is a potential concern when sulphides are present in higher concentrations.

Field screening of the ultramafic (UM & UMS) lithology should be undertaken to ensure that only sub-units containing less than 0.3% sulphides are utilized for infrastructure, with the higher sulphide concentration portions managed by sub-aqueous disposal.

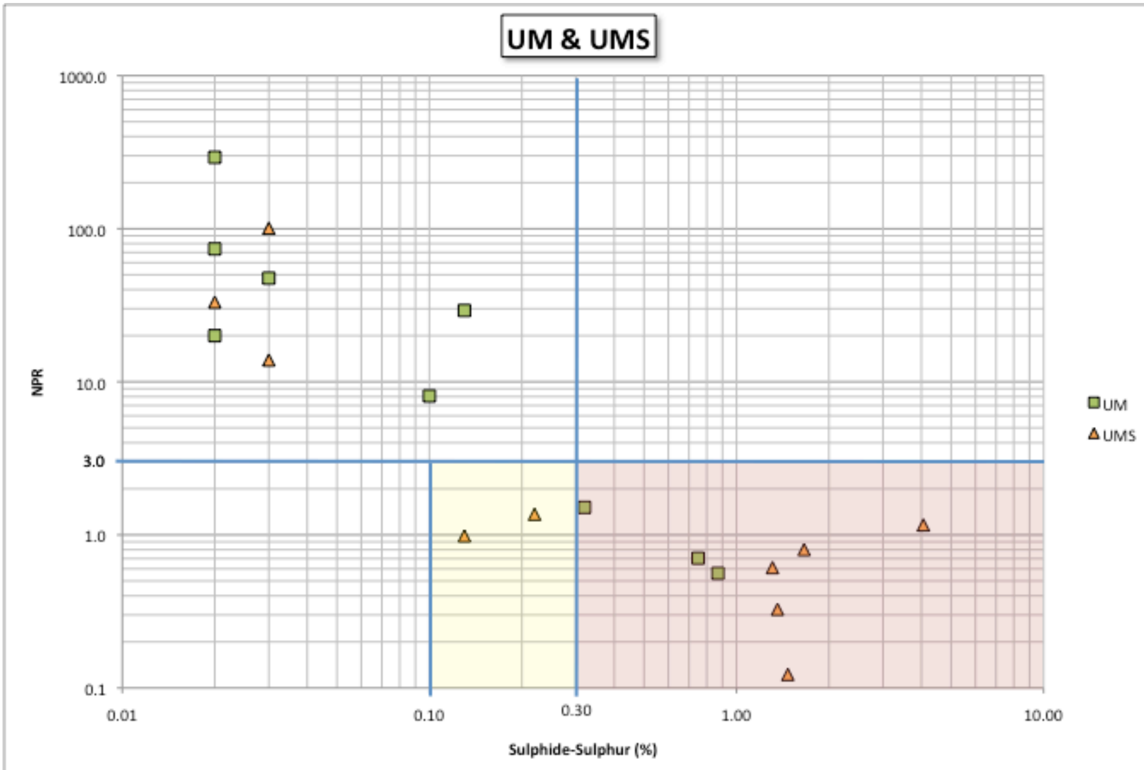


**Figure 5: NPR-S chart of Ultramafic lithology**

### 4.2.6 Gneiss (GNS)

The core logs for the gneiss samples indicated that 5 of the 10 intervals sampled contained sulphides (primarily pyrite). However, inspection of the samples submitted to the project laboratory confirmed that only 1 sample did not contain sulphides.

As shown in Figure 6, 2 of the 10 gneiss samples are considered NAG, 2 are PAG, and the remaining 6 are considered low-PAG material. As with the gabbro samples, NP values were low (less than 12 kg $CaCO_3$/tonne) and relatively constant within the gneiss lithology, and the NPR is driven by sulphide-sulphur concentrations. These results suggest that the acid generating potential of the gneiss lithology is related directly to the presence of pyrite. Acid generation is a potential issue when sulphides are present in higher concentrations.

Based on the high proportion of PAG and low-PAG within the sample set, it might appear that most gneiss is of potential concern with regard to acid generation. However, sulphides are listed in less than 30% of the core log intervals for the gneiss lithology, so it is possible that that sulphide-bearing gneiss is disproportionately represented within the sample set submitted to the project laboratory.

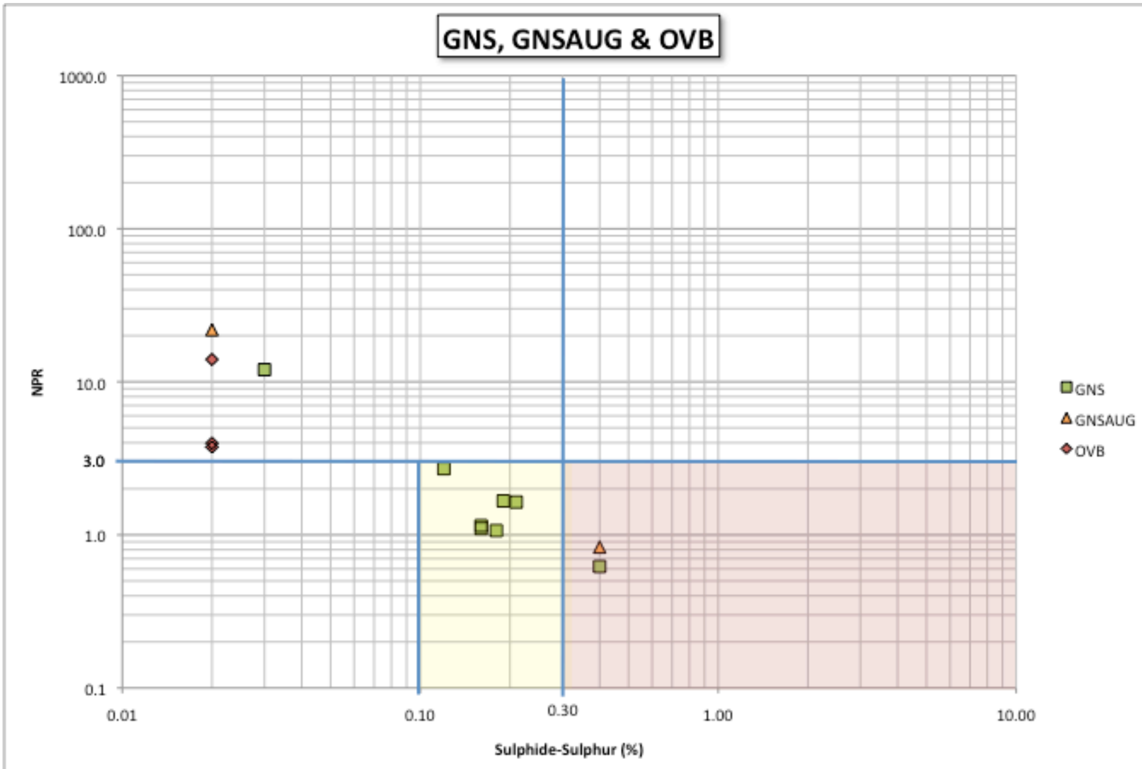


**Figure 6: NPR-S chart of Gneiss lithology and Overburden**

With such low neutralizing potential and the primary sulphide in the gneiss being pyrite (not pyrrhotite), this rock type should only be utilized for infrastructure if field screening indicates that sub-units contain less than 0.1% sulphides, with the higher sulphide concentration portions managed by sub-aqueous disposal.

### 4.2.7 Overburden (OVB)

Sulphides were not identified in the drill core logs or sample inspection for overburden. As shown in Figure 6, all three overburden samples are considered NAG due to the absence of sulphides. These results suggest that the overburden does not pose a concern with regard to acid generation.

## 4.3 Metal Leaching

Metal leaching test work included elemental and whole rock analysis of all 106 core samples, and short-term leaching tests on 20 select samples representing sulphide-bearing and non-sulphide samples of each major lithological unit.

### 4.3.1 Elemental & Whole Rock Analysis

Elemental analysis identified elements of potential concern for each lithology within the Aappaluttoq core samples, as summarized in Table 6, below. These select elements occurred in notably higher concentrations and with greater frequency than other elements. Elements in brackets are generally of lesser concern as they were identified in fewer samples from each lithology.

**Table 6: Summary of Elements of Potential Concern**

| Lithology | Elements of Potential Concern |
|---|---|
| Gabbro | As, Cu (Pb, V) |
| Gneiss | (As, Cu) |
| Overburden | – |
| Pegmatite | (As, Cu, Ni, Pb, V) |
| Phlogopite | Ni, V (As, Cr, Cu) |
| Sapphirine/Gedrite | (As, Ni) |
| Ultramafic | As, Cu (Ni, V) |

Elements of potential concern, such as arsenic (As), copper (Cu), nickel (Ni) and vanadium (V), were identified in most of the lithologies, with lead (Pb) more specifically associated with gabbros and pegmatites. Chromium (Cr) was most prevalent in the phlogopite (PHLOG), as would be expected given that this rock type hosts the corundum mineralization and chromium is the element that gives rubies and pink sapphires their distinctive colour. Concentrations of other metals and trace elements were generally low and do not represent a specific concern. Short-term leach tests were conducted on representative samples of each rock type to characterize the potential for metal leaching from these lithologies, as detailed in section 4.3.2, below.

Whole rock analyses confirmed the bulk composition of each lithology and suggested (consistent with the mineralogical assessment discussed in section 4.1) that aluminosilicates are likely the most prominent source of neutralization potential in all lithologies. Carbonates occur only in minor quantities or are not present in the major lithologies.

### 4.3.2 Short-Term Leaching Tests

The short-term leach tests were conducted on 20 samples, representing sulphide-bearing and non-sulphide intervals of each lithology, to identify elements of potential concern that might be mobilized by exposure to water. The results of the highly rigorous shake flask test extraction process (finely ground material (<¼-inch) in distilled water at a liquid-to-solid ratio of 3:1, shaken vigorously for 24 hours using a gyratory shaker) represent a far more extreme scenario in terms of potential metal and trace element loading than could be expected under the field conditions at the property. However, the test results provide an indication of which elements, if any, might be of potential concern with respect to leaching.

Shake flask test results are summarized in Figure 7, which shows the concentration range for each element, with markers indicating the Greenland water quality compliance point guideline value for each parameter listed within the BMP Guidelines document (Johansen, et al, 2011). These guideline values are provided for reference only, as the concentrations of metals and trace elements from the shake flask tests do not represent actual expected concentrations in the field, and the Guideline specifies that effluent criteria be developed based on the dilution factor between the point of discharge and the compliance point.

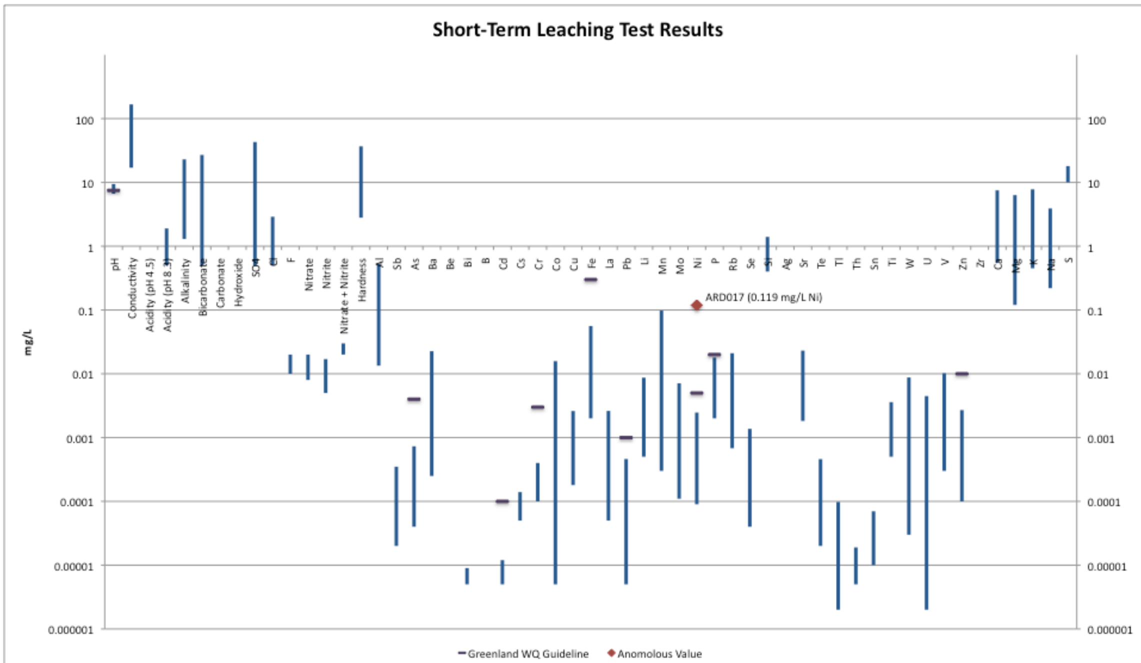


**Figure 7: Summary chart of short-term leaching test results**

Physical parameters such as pH, conductivity, acidity, alkalinity and the various dissolved anions, indicated very little dissolution activity from the samples. Concentrations of metals and trace elements were also generally very low, with few exceptions. None of the parameters exceeded the Greenland Guideline values except for a single, anomalously high nickel value from one sample.

The anomalous 0.119 mg/L nickel concentration was generated from sample number ARD017, a mafic gabbro (GABM) sample from within drill hole GL-08-52, taken from an interval depth of 8.68–9.10 metres. This rock sample contained a slightly elevated nickel concentration (95.1 ug/g) compared to the two other GABM samples (the next closest being 66.4 ug/g), and a slightly higher sulphide-sulphur concentration (0.82% versus 0.64%). However, this nickel concentration was mid-range compared to the other lithologies, which ranged from 5.2 ug/g (in an overburden sample) to 2,643 ug/g (in an ultramafic sample), with several between 115 and 330 ug/g. None of the shake flask test nickel results from the other samples, even those with much higher nickel concentrations in the rock, were within even one-and-a-half orders of magnitude of this value, the next closest being 0.00247 mg/L from a phlogopite sample.

This anomalous nickel result does not present a significant concern regarding metal leaching from GABM material. Very little nickel leached from the other two GABM samples (0.00035 mg/L and 0.00071 mg/L), and the dissolution of metals under site conditions is unlikely to come close to matching that of the rigorous shake flask extraction process used for this test.

To put this into perspective, if all 72,570 tonnes of the GABM waste material (refer to Table 2 on page 10) were to leach at this rate (i.e., ignoring the other two short-term leach test results for this lithology), and assume that the average size of the waste rock boulders will be 1,000 times greater than the pulverized sample used in the shake flask test, and that somehow these boulders were stirred vigorously in the lake for a day before they were allowed it to settle to the bottom, it would require approximately 5,200 $m^3$ of lake water to dilute the nickel to the 0.005 mg/L Greenland water quality guideline value*. That volume can be represented by a cube of water a little more than 17 metres on each side, or a column of water 10 metres by 10 metres across and 52 metres deep. Given these extreme assumptions and the relatively small volume of water needed to provide adequate dilution, this anomalous nickel concentration does not present a significant metal leaching concern.

This short-term leaching test work suggests that only very minor metal leaching should be expected from these materials at the property. Monitoring of runoff and lake water quality where subaqueous deposition occurs is recommended, but mitigation measures are not expected to be necessary.

# 5 Conclusions

The test work conducted for this acid rock drainage (ARD) and metal leaching assessment of True North Gems' Aappaluttoq Ruby property has shown that overall there are a few lithological units, such as mafic gabbro (GABM), gneiss (GNS) and sulphide-bearing ultramafics (UMS), that may be of concern with respect to potential acid generation. These concerns are directly related to sulphide concentrations in the relative absence of adequate neutralizing potential.

Lithological units that are not generally of concern with respect to potential acid generation, include as pegmatite (PEG), phlogopite (PHLOG), which represents the ore and tailings, sapphirine/gedrite (SAPGED), overburden (OVB) and non-sulphide

* This is example is based on the following calculations:
(0.119 mg Ni/L x 0.75 L) / (0.25 kg x 0.001 t/kg)= 357 mg Ni/t GABM
(72,570 t GABM x 357 mg Ni/t GABM) / (0.005 mg Ni/L x 1000 L/$m^3$ x 1000 $m^2$/$m^2$) ≈ 5,200 $m^3$

ultramafics (UM). Sulphides do not appear to be generally associated with some rock types.

Based on the elemental and whole rock analyses, elements of potential concern included: arsenic (As), copper (Cu), nickel (Ni) and vanadium (V), and to a lesser extent lead (Pb). The short-term leaching tests indicated that these elements are not likely to be mobilized to any significant extent under the neutral pH drainage conditions that prevail at the project site.

The low summer temperatures and frozen winter conditions at the property will hinder chemical-weathering reactions. The current plan for subaqueous deposition of most waste rock and tailings material in the lake will minimize sulphide weathering and reduce potential acid generation to negligible rates in PAG and low-PAG materials by limiting exposure to free oxygen.

Table 7, summarizes the ARD and metal leaching potential of each of the main lithologies at the Aappaluttoq property:

**Table 7: Summary of ARD & Metal Leaching Potential (by Lithology)**

| Classification | Lithologies | ARD & Metal Leaching Potential |
|---|---|---|
| Non-Acid Generating (NAG) | Pegmatite (PEG)<br><br>Phlogopite (PHLOG) (Main Ore, Tailings)<br><br>Sapphirine/Gedrite (SAPGED)<br><br>Overburden<br><br>Non-sulphide Ultramafics (UM) | These lithologies generally do not pose a concern with regard to acid generation, as sulphide minerals are typically not associated with them.<br><br>Metal leaching from these materials is expected to be minimal.<br><br>From the perspective of ARD and metal leaching, these lithologies are generally appropriate for infrastructure use.<br><br>Although likely to be a relatively uncommon occurrence for these rock types, field screening should be undertaken to ensure that any sub-units containing greater than 0.3% sulphides are managed by sub-aqueous disposal. |

| Classification | Lithologies | ARD & Metal Leaching Potential |
|---|---|---|
| Low Potential for Acid Generation (Low-PAG) | Gabbro (GAB) (Secondary Ore)<br><br>Leucocratic Gabbro (GABL) (Secondary Ore) | These lithologies generally pose a low concern with regard to acid generation, as sulphide concentrations are typically low. Acid generation is a potential issue when sulphides are present in higher concentrations, but this appears to be the exception for these rock types.<br><br>Metal leaching from these materials is expected to be minimal.<br><br>From the perspective of ARD and metal leaching, these rock types may be appropriate for use in construction, provided that field screening is undertaken to ensure that any sub-units containing greater than 0.3% sulphides are managed by sub-aqueous disposal. |
| Potentially Acid Generating (PAG) | Mafic Gabbro (GABM)<br><br>Gneiss (GNS)<br><br>Sulphide-bearing Ultramafics (UMS) | The acid generating potential of these lithologies is related directly to the presence of sulphides, which these rock types appear to possess in variable but generally higher amounts. Acid generation is a potential issue when sulphides are present in higher concentrations.<br><br>Metal leaching from these materials is expected to be minimal.<br><br>From the perspective of ARD and metal leaching, these rock types are not generally recommended for use in construction, but if necessary they may be used provided that field screening is undertaken to ensure that any sub-units containing greater than 0.3% sulphides (0.1% in the case of gneiss) are managed by sub-aqueous disposal. |

**In summary:**

- **A field screening protocol** should be developed and implemented to ensure that any materials that contain greater than 0.3% sulphide are managed by sub-aqueous disposal.
- **NAG materials** may be used for infrastructure construction if needed for this purpose, provided that a field screening protocol is undertaken to ensure that any sub-units that contain greater than 0.3% sulphide are managed by sub-aqueous disposal.
- **Low-PAG materials** of most rock types (i.e., other than gneiss, which should generally be submerged due to the pervasive presence of pyrite) may be used for infrastructure construction if needed for this purpose provided that a field screening protocol is undertaken to ensure that any sub-units that contain greater than 0.3% sulphide (or 0.1% sulphide in the case of gneiss) are managed by sub-aqueous disposal.
- **PAG materials** should be identified and managed such that these materials are submerged and not used for infrastructure construction. However, these rock types may be used for infrastructure construction if needed for this purpose provided that a field screening protocol is undertaken to ensure that any sub-units that contain greater than 0.3% sulphide (or 0.1% sulphide in the case of gneiss) are managed by sub-aqueous disposal.
- **Kinetic test work** and modeling of potential acid generation and pit water quality are not warranted at this stage in the mine development process given the generally low potential for acid generation and metal leaching. Open pit water quality should be monitored during mine operation to determine what, if any, mitigating measures might be required.
- **The open pit will be flooded**, post-closure, and the subaqueous environment will limit ongoing oxidation of sulphides exposed in the pit walls to negligible rates. The extent of fresh rock exposed after flooding of the pit is expected to be negligible, at most only a few metres wide along the west and southwest edge of the open pit, with a small area (less than 100 $m^2$) at the north end of the pit. As such, this exposed rock does not represent a significant concern for acid generation or metal leaching.

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# Appendices

*to the Initial Assessment of*
*Acid Rock Drainage and Metal Leaching Potential*
*Aappaluttoq Ruby Property, Greenland*

*May 2011*


*Appendix I:* *Sample Selection Guidelines*

*Appendix II:* *Acid-Base Accounting (ABA) Data*

*Appendix III:* *Elemental Analysis Data*

*Appendix IV:* *Whole Rock Analysis Data*

*Appendix V:* *Short-Term Leaching Test Data*

*Appendix VI:* *Mineralogical Report*

# Appendix I

# Sample Selection Guidelines

*Provided to True North Gems by the Consultants, August 2009*

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The table below has been excerpted from the detailed table at the end of this appendix. It indicates the number of samples of each rock type, including the number of sulphide samples that should be part of that total. That is, a total of 100 samples should be collected for this initial program for the 3-year starter pit, of which 40 should be from intervals within which the logs indicate the presence of sulphides (sul, py, po &/or cpy). To clarify, that is only 100 samples in total, not 140.

**ABA Sampling Program Summary**

| Lithology | # Samples | # Sulphide |
|---|---|---|
| GAB-GABL | 15 | 8 |
| GABM | 6 | 3 |
| GN (All) | 10 | 3 |
| OTHER (All) | 6 | 1 |
| PEG | 10 | 3 |
| PHLOG | 10 | 3 |
| SAPGED | 20 | 4 |
| UM | 8 | 0 |
| UMS | 15 | 15 |
| **Grand Total** | **100** | **40** |

Each ABA sample should be between approximately **500g and 1kg** in weight, as permitted by the availability of the core. If samples are collected from across multiple intervals to create a sample of this size, the complete interval should be noted in order to correlate these samples accurately to the Lithology Log database.

Use the Lithology Log database to identify both **sulphide-bearing** and **non-sulphide** drill core intervals within approximately the top 40 m of core (which is the final depth of the proposed initial 3-year starter pit). Use these filtered database lists to select representative samples of each rock type, per the summary table.

With regard to rock types where multiple designations exist (e.g., 'GAB-GABL' may include GAB, GAB1, GAB2 & GABL, and 'GN (All)' may include GN, GNAUG, GNS & GNSAUG, etc.), select samples such that each designation is represented within the suite that represents that aggregate rock type. For example, of the 8 sulphide-bearing GAB-GABL samples requested, most should be GAB and GABL samples (say, 3 of each), and a couple should be GAB1 and GAB2 (1 each) if sufficient core is available. If not, the next step would be to create a composite sample from the available GAB1 and GAB2 samples, if possible.

With regard to sulphides, the Lithology Log database can be filtered based on the type(s) of sulphides noted in the logs, such as S for sulphide, Py for pyrite, Po for pyrrhotite, Cpy for chalcopyrite and various combinations of these abbreviations (e.g., SPy where both sulphide and pyrite are noted in the log, and PyPoCpy where all 3 sulphides have been noted). Again, as per the note above regarding rock type sub-designations, the suite of samples that represents each rock type should include a range of these sulphide designations. For example, the 7 sulphide-bearing 'UMS' samples should include intervals with a variety of sulphide designations such as S, PO, SPyPoCpy, PyPoCpy, etc., such that the most common designations are represented within the suite of samples that is submitted to the laboratory.

The 'Other' category includes what appear to be very minor rock types, such as GOS and OVB. At depths greater than 40 m, PARG (?) and PYX would also be included in this category. The DOL rock type is shown only in the legend for the maps I was given, but does not show up anywhere on the maps or in the logs, so I assume that there is no dolerite in the immediate vicinity of the deposit. Please advise if this is not correct.

These instructions should provide you with sufficient information to select 100 representative samples from the drill core samples. Based on the fact that each rock type is sufficiently represented within the core, collection of additional surface samples should not be necessary. For example, the gneiss that borders the deposit on each side can be represented by samples from within the core. (If, however, there is any reason to believe that this is not the case please let me know and arrange to collect samples of this distinct rock type.)

The samples collected for each lithology (both suphide and non-sulphide) need to represent both ore and waste rock. From the logs, I can only tell which intervals contain corundum, but not whether or not they represent ore or waste rock. Within the intervals I have recommended for sampling, 108 contain the code for corundum ('cor') in the log, and only 6 of these contain sulphide. This property needs to be noted in the sample logs such that materials that will become tailings and waste rock can be adequately assessed.

# 3-Year ABA Sampling Program Summary

(Pit 40 m deep, 20 m across bottom, 40-degree pit walls)

**By Intervals Logged**

| LITH_1 | # Sulphide | # Non-Sulphide | % Sulphide | % Total | # Samples | # Sulphide |
|---|---|---|---|---|---|---|
| GAB-GABL | 49 | 97 | 34% | 15% | 15 | 8 |
| GABM | 7 | 17 | 29% | 3% | 8 | 4 |
| GNS | 10 | 37 | 21% | 5% | 8 | 4 |
| OTHER | 2 | 50 | 4% | 5% | 6 | 1 |
| PEG | 9 | 113 | 7% | 13% | 15 | 5 |
| PHLOG | 12 | 136 | 8% | 15% | 15 | 5 |
| SAPGED | 9 | 296 | 3% | 32% | 15 | 4 |
| UM | 20 | 32 | 38% | 5% | 8 | 4 |
| UMS | 48 | 16 | 75% | 7% | 10 | 7 |
| **Grand Total** | **166** | **794** | **17%** | | **100** | **42** |
| **Total** | | **960** | | | **10%** | **25%** |

**By Metres Logged**

| | | | | | Planned | | Actual | | Variance | |
|---|---|---|---|---|---|---|---|---|---|---|
| LITH_1 | # Sulphide | # Non-Sulphide | % Sulphide | % Total | # Samples | # Sulphide | Samples | Sulphides | Samples | Sulphides |
| GAB-GABL | 117 | 332 | 26% | 15% | 15 | 8 | 17 | 14 | 2 | 6 |
| GABM | 14 | 48 | 23% | 2% | 6 | 3 | 10 | 8 | 4 | 5 |
| GNS | 37 | 217 | 15% | 8% | 10 | 3 | 10 | 9 | 0 | 6 |
| OTHER | 6 | 67 | 8% | 2% | 6 | 1 | 3 | 0 | -3 | -1 |
| PEG | 17 | 168 | 9% | 6% | 10 | 3 | 13 | 5 | 3 | 2 |
| PHLOG | 14 | 172 | 8% | 6% | 10 | 3 | 18 | 5 | 8 | 2 |
| SAPGED | 24 | 1121 | 2% | 37% | 20 | 4 | 14 | 3 | -6 | -1 |
| UM | | 156 | 0% | 5% | 8 | 0 | 9 | 6 | 1 | 6 |
| UMS | 553 | | 100% | 18% | 15 | 15 | 10 | 8 | -5 | -7 |
| **Grand Total** | **782** | **2281** | **26%** | **100%** | **100** | **40** | 104 | 58 | 4 | 18 |
| **Total** | | **3063** | | | **10%** | **24%** | **11%** | **35%** | | |

# Appendix II

# Acid-Base Accounting (ABA) Data

**True North Gems**
**Aappaluttoq Ruby Property, Greenland**
**ARD Data**

| S. No. | Sample ID | Lithology | Sulphides | S-Type | Paste pH | S-Total | S-SO4 | S-Sulphide | Acid Potential | Neutralization Potential | NNP | Fizz Rating | NPR | S-Sulphide (# | PAG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ABA | | | | | | | | | | |
| | | | | | | (Wt.%) | (Wt.%) | (Wt.%) | (Kg CaCO3/Tonne) | (Kg CaCO3/Tonne) | (Kg CaCO3/Tonne) | | | | |
| 11 | 13169 | PHLOG-Tails | no | | 8.3 | 0.01 | <0.01 | 0.01 | 0.3 | 16.7 | 16.4 | None | 53.44 | 0.01 | N |
| 12 | 13170 | PHLOG-Tails | no | | 9.8 | 0.01 | <0.01 | 0.01 | 0.3 | 12.4 | 12.1 | None | 39.68 | 0.01 | N |
| 2009-01 | M390901 | UMS | yes | SPyCpy | 9.4 | 0.13 | <0.01 | 0.13 | 4.1 | 4.0 | -0.1 | None | 0.98 | 0.13 | M |
| 2009-02 | M390902 | GNS | no | | 9.7 | 0.03 | <0.01 | 0.03 | 0.9 | 11.3 | 10.3 | None | 12.00 | 0.03 | N |
| 2009-03 | M390903 | PEG | no | | 10.4 | <0.01 | <0.01 | <0.01 | <0.3 | 62.0 | 62.0 | Slight | 206.67 | 0.01 | N |
| 2009-04 | M390904 | GAB | yes | | 10.1 | 0.02 | <0.01 | 0.02 | 0.6 | 18.0 | 17.4 | None | 28.80 | 0.02 | N |
| 2009-05 | M390905 | SAPGED | no | | 10.3 | 0.01 | <0.01 | 0.01 | 0.3 | 14.3 | 13.9 | None | 45.60 | 0.01 | N |
| 2009-06 | M390906 | UM | yes | | 9.7 | 0.75 | <0.01 | 0.75 | 23.4 | 16.5 | -6.9 | Slight | 0.70 | 0.75 | Y |
| 2009-07 | M390907 | GABL | yes | | 9.4 | 0.22 | <0.01 | 0.22 | 6.9 | 36.0 | 29.1 | None | 5.24 | 0.22 | N |
| 2009-08 | M390908 | SAPGED | no | | 9.9 | <0.01 | <0.01 | <0.01 | <0.3 | 19.0 | 19.0 | None | 63.33 | 0.01 | N |
| 2009-09 | M390909 | GAB | yes | | 9.6 | 0.59 | <0.01 | 0.59 | 18.4 | 17.8 | -0.7 | None | 0.96 | 0.59 | Y |
| 2009-10 | M390910 | GAB | yes | | 9.4 | 0.24 | <0.01 | 0.24 | 7.5 | 15.8 | 8.3 | Slight | 2.10 | 0.24 | M |
| 2009-11 | M390911 | GNS | yes | | 9.6 | 0.18 | <0.01 | 0.18 | 5.6 | 6.0 | 0.4 | None | 1.07 | 0.18 | M |
| 2009-12 | M390912 | GABL | yes | S | 7.8 | 0.57 | 0.01 | 0.56 | 17.5 | 12.8 | -4.8 | None | 0.73 | 0.56 | Y |
| 2009-13 | M390913 | SAPGED | no | | 10.2 | 0.01 | <0.01 | 0.01 | 0.3 | 19.6 | 19.3 | None | 62.80 | 0.01 | N |
| 2009-14 | M390914 | GNS | yes | S | 9.8 | 0.21 | <0.01 | 0.21 | 6.6 | 10.8 | 4.2 | None | 1.64 | 0.21 | M |
| 2009-15 | M390915 | GAB | yes | | 9.8 | 0.05 | <0.01 | 0.05 | 1.6 | 7.0 | 5.4 | None | 4.48 | 0.05 | N |
| 2009-16 | M390916 | SAPGED | no | | 9.8 | 0.01 | <0.01 | 0.01 | 0.3 | 16.0 | 15.7 | None | 51.20 | 0.01 | N |
| 2009-17 | M390917 | GABL | yes | | 9.8 | 0.14 | <0.01 | 0.14 | 4.4 | 9.0 | 4.6 | None | 2.06 | 0.14 | M |
| 2009-18 | M390918 | SAPGED | no | | 10.2 | 0.01 | <0.01 | 0.01 | 0.3 | 10.4 | 10.1 | None | 33.20 | 0.01 | N |
| 2009-19 | M390919 | GNS | yes | S | 9.9 | 0.16 | <0.01 | 0.16 | 5.0 | 5.8 | 0.8 | None | 1.15 | 0.16 | M |
| 2010-01 | ARD002 | PEG | no | | 9.3 | <0.02 | <0.01 | <0.02 | <0.6 | 8.5 | 8.5 | Slight | 14.17 | 0.02 | N |
| 2010-02 | ARD003 | UMS | yes | SPyPoCpy | 9.6 | 4.07 | 0.01 | 4.06 | 126.9 | 147.3 | 20.4 | None | 1.16 | 4.06 | Y |
| 2010-03 | ARD004 | SAPGED | yes | | 10.1 | 0.04 | <0.01 | 0.04 | 1.3 | 22.3 | 21.0 | None | 17.80 | 0.04 | N |
| 2010-04 | ARD005 | UMS | no | SPyCpy | 10.0 | <0.02 | <0.01 | <0.02 | <0.6 | 19.9 | 19.9 | None | 33.13 | 0.02 | N |
| 2010-05 | ARD007 | PEG | no | | 10.4 | <0.02 | <0.01 | <0.02 | <0.6 | 0.4 | 0.4 | None | 0.62 | 0.02 | N |
| 2010-06 | ARD008 | SAPGED | no | | 9.9 | <0.02 | <0.01 | <0.02 | <0.6 | 18.4 | 18.4 | None | 30.63 | 0.02 | N |
| 2010-07 | ARD010 | PEG | no | | 10.3 | <0.02 | <0.01 | <0.02 | <0.6 | 4.1 | 4.1 | None | 6.87 | 0.02 | N |
| 2010-08 | ARD012 | SAPGED | no | Cpy | 10.7 | <0.02 | <0.01 | <0.02 | <0.6 | 7.1 | 7.1 | None | 11.88 | 0.02 | N |
| 2010-09 | ARD013 | UM | yes | Py | 10.0 | 0.32 | <0.01 | 0.32 | 10.0 | 15.1 | 5.1 | None | 1.51 | 0.32 | Y |
| 2010-10 | ARD014 | SAPGED | no | | 10.5 | <0.02 | <0.01 | <0.02 | <0.6 | 17.0 | 17.0 | None | 28.33 | 0.02 | N |
| 2010-11 | ARD015 | GAB | no | | 10.5 | <0.02 | <0.01 | <0.02 | <0.6 | 12.5 | 12.5 | None | 20.83 | 0.02 | N |
| 2010-12 | ARD016 | OVB | no | | 10.3 | <0.02 | <0.01 | <0.02 | <0.6 | 2.3 | 2.3 | None | 3.75 | 0.02 | N |
| 2010-13 | ARD017 | GABM | yes | | 8.7 | 0.83 | 0.01 | 0.82 | 25.6 | 9.0 | -16.6 | None | 0.35 | 0.82 | Y |
| 2010-14 | ARD018 | UMS | yes | Po | 9.9 | 1.37 | 0.01 | 1.36 | 42.5 | 13.9 | -28.6 | None | 0.33 | 1.36 | Y |
| 2010-15 | ARD019 | UMS | yes | PyPoCpy | 9.8 | 1.47 | <0.01 | 1.47 | 45.9 | 5.6 | -40.3 | None | 0.12 | 1.47 | Y |
| 2010-16 | ARD020 | UM | yes | S | 10.2 | 0.13 | <0.01 | 0.13 | 4.1 | 118.8 | 114.7 | Moderate | 29.23 | 0.13 | N |
| 2010-17 | ARD021 | GABM | no | SPo | 9.5 | 0.65 | 0.01 | 0.64 | 20.0 | 5.9 | -14.1 | None | 0.29 | 0.64 | Y |
| 2010-18 | ARD022 | UMS | no | Po | 9.9 | 0.03 | <0.01 | 0.03 | 0.9 | 94.4 | 93.4 | Slight | 100.67 | 0.03 | N |
| 2010-19 | ARD023 | PHLOG | yes | SPo | 9.7 | 0.11 | <0.01 | 0.11 | 3.4 | 24.3 | 20.8 | Slight | 7.05 | 0.11 | N |
| 2010-20 | ARD024 | UM | yes | | 10.2 | <0.02 | <0.01 | <0.02 | <0.6 | 44.3 | 44.3 | None | 73.75 | 0.02 | N |
| 2010-21 | ARD025 | PHLOG | no | Po | 9.9 | 0.27 | <0.01 | 0.27 | 8.4 | 41.5 | 33.1 | Slight | 4.92 | 0.27 | N |
| 2010-22 | ARD026 | UMS | yes | PoCpy | 10.1 | 0.03 | <0.01 | 0.03 | 0.9 | 13.0 | 12.1 | None | 13.87 | 0.03 | N |
| 2010-23 | ARD027 | UM | yes | Cpy | 9.7 | 0.87 | <0.01 | 0.87 | 27.2 | 15.3 | -11.9 | None | 0.56 | 0.87 | Y |
| 2010-24 | ARD028 | GAB | yes | | 10.1 | 0.02 | <0.01 | 0.02 | 0.6 | 67.5 | 66.9 | None | 108.00 | 0.02 | N |
| 2010-25 | ARD029 | GABM | yes | PyPoCpy | 8.5 | 0.42 | 0.01 | 0.41 | 12.8 | 7.5 | -5.3 | None | 0.59 | 0.41 | Y |
| 2010-26 | ARD030 | GABM | yes | PyPoCpy | 9.6 | 0.37 | <0.01 | 0.37 | 11.6 | 9.5 | -2.1 | None | 0.82 | 0.37 | Y |
| 2010-27 | ARD031 | UM | no | | 9.9 | 0.02 | <0.01 | 0.02 | 0.6 | 12.5 | 11.9 | None | 20.00 | 0.02 | N |
| 2010-28 | ARD032 | UMS | yes | Po | 9.8 | 0.22 | <0.01 | 0.22 | 6.9 | 9.4 | 2.5 | None | 1.36 | 0.22 | M |
| 2010-29 | ARD033 | PEG | yes | | 9.9 | 0.17 | <0.01 | 0.17 | 5.3 | 9.3 | 3.9 | None | 1.74 | 0.17 | M |
| 2010-30 | ARD034 | SAPGED | no | | 10.1 | <0.02 | <0.01 | <0.02 | <0.6 | 122.3 | 122.3 | None | 203.75 | 0.02 | N |
| 2010-31 | ARD035 | SAPGED | no | | 10.0 | <0.02 | <0.01 | <0.02 | <0.6 | 45.0 | 45.0 | None | 75.00 | 0.02 | N |
| 2010-32 | ARD036 | UM | yes | S | 9.5 | 0.10 | <0.01 | 0.10 | 3.1 | 25.3 | 22.1 | None | 8.08 | 0.10 | N |
| 2010-33 | ARD037 | GNS | yes | | 9.8 | 0.16 | <0.01 | 0.16 | 5.0 | 5.5 | 0.5 | None | 1.10 | 0.16 | M |
| 2010-34 | ARD038 | PEG | no | S | 9.9 | 0.02 | <0.01 | 0.02 | 0.6 | 5.1 | 4.5 | None | 8.20 | 0.02 | N |
| 2010-35 | ARD039 | GABL | no | | 9.7 | 0.03 | <0.01 | 0.03 | 0.9 | 7.0 | 6.1 | None | 7.47 | 0.03 | N |
| 2010-36 | ARD040 | GABM | yes | S | 9.6 | 0.14 | <0.01 | 0.14 | 4.4 | 12.3 | 7.9 | Slight | 2.80 | 0.14 | M |
| 2010-37 | ARD041 | GABM | yes | | 9.7 | 0.07 | <0.01 | 0.07 | 2.2 | 9.8 | 7.6 | Slight | 4.46 | 0.07 | N |
| 2010-38 | ARD042 | PEG | yes | | 10.0 | 0.10 | <0.01 | 0.10 | 3.1 | 6.1 | 3.0 | None | 1.96 | 0.10 | M |
| 2010-39 | ARD043 | PEG | no | | 9.9 | <0.02 | <0.01 | <0.02 | <0.6 | 6.9 | 6.9 | None | 11.46 | 0.02 | N |
| 2010-40 | ARD044 | GABM | yes | PyPo | 9.3 | 0.25 | 0.01 | 0.24 | 7.5 | 7.4 | -0.1 | None | 0.98 | 0.24 | M |
| 2010-41 | ARD045 | UMS | yes | SPyPo | 9.1 | 1.67 | 0.01 | 1.66 | 51.9 | 41.5 | -10.3 | Slight | 0.80 | 1.66 | Y |
| 2010-42 | ARD046 | UM | no | | 9.5 | 0.03 | <0.01 | 0.03 | 0.9 | 44.5 | 43.6 | Moderate | 47.52 | 0.03 | N |
| 2010-43 | ARD047 | GABM | yes | | 10.1 | 0.08 | <0.01 | 0.08 | 2.5 | 15.4 | 12.9 | None | 6.17 | 0.08 | N |
| 2010-44 | ARD049 | OVB | no | | 9.9 | <0.02 | <0.01 | <0.02 | <0.6 | 2.4 | 2.4 | None | 3.97 | 0.02 | N |
| 2010-45 | ARD050 | UMS | yes | SPo | 9.1 | 1.32 | 0.01 | 1.31 | 40.9 | 25.0 | -15.9 | Slight | 0.61 | 1.31 | Y |
| 2010-46 | ARD054 | PEG | no | | 10.3 | <0.02 | <0.01 | <0.02 | <0.6 | 6.6 | 6.6 | None | 11.07 | 0.02 | N |
| 2010-47 | ARD056 | PHLOG | yes | SPy | 10.3 | 0.09 | <0.01 | 0.09 | 2.8 | 11.9 | 9.1 | None | 4.23 | 0.09 | N |
| 2010-48 | ARD057 | PEG | yes | SPy | 9.8 | 0.38 | 0.01 | 0.37 | 11.6 | 5.4 | -6.2 | None | 0.47 | 0.37 | Y |
| 2010-49 | ARD058 | GNS | yes | Py | 9.7 | 0.19 | <0.01 | 0.19 | 5.9 | 9.9 | 4.0 | None | 1.67 | 0.19 | M |
| 2010-50 | ARD059 | GNS | yes | SPyPo | 9.8 | 0.40 | <0.01 | 0.40 | 12.5 | 7.8 | -4.7 | None | 0.62 | 0.40 | Y |
| 2010-51 | ARD060 | GABL | yes | SPyPo | 10.0 | 0.07 | <0.01 | 0.07 | 2.2 | 10.4 | 8.2 | None | 4.75 | 0.07 | N |
| 2010-52 | ARD061 | GAB | yes | SPy | 9.8 | 0.20 | <0.01 | 0.20 | 6.3 | 8.4 | 2.1 | None | 1.34 | 0.20 | M |
| 2010-53 | ARD062 | PEG | yes | S | 9.7 | 0.11 | <0.01 | 0.11 | 3.4 | 5.4 | 2.0 | None | 1.57 | 0.11 | M |
| 2010-54 | ARD063 | UM | no | | 9.2 | 0.24 | 0.22 | 0.02 | 0.6 | 182.9 | 182.3 | Strong | 292.66 | 0.02 | N |
| 2010-55 | ARD065 | SAPGED | yes | | 10.0 | <0.02 | 0.01 | <0.02 | <0.6 | 24.9 | 24.9 | None | 41.56 | 0.02 | N |
| 2010-56 | ARD066 | SAPGED | no | | 9.7 | <0.02 | <0.01 | <0.02 | <0.6 | 27.3 | 27.3 | None | 45.48 | 0.02 | N |
| 2010-57 | ARD067 | SAPGED | yes | S | 10.3 | <0.02 | <0.01 | <0.02 | <0.6 | 9.1 | 9.1 | None | 15.25 | 0.02 | N |
| 2010-58 | ARD069 | PHLOG | yes | | 10.2 | 0.09 | <0.01 | 0.09 | 2.8 | 16.5 | 13.7 | None | 5.87 | 0.09 | N |
| 2010-59 | ARD070 | GNS | yes | | 9.7 | 0.13 | 0.01 | 0.12 | 3.8 | 10.2 | 6.4 | None | 2.71 | 0.12 | M |
| 2010-60 | ARD071 | PEG | no | | 10.0 | 0.06 | <0.01 | 0.06 | 1.9 | 5.5 | 3.6 | None | 2.94 | 0.06 | N |
| 2010-61 | ARD072 | GABL | yes | S | 10.0 | 0.23 | 0.01 | 0.22 | 6.9 | 13.6 | 6.7 | Slight | 1.98 | 0.22 | M |
| 2010-62 | ARD073 | OVB | no | | 9.8 | <0.02 | <0.01 | <0.02 | <0.6 | 8.4 | 8.4 | None | 13.99 | 0.02 | N |
| 2010-63 | ARD074 | PEG | yes | Po | 10.2 | 0.06 | <0.01 | 0.06 | 1.9 | 4.9 | 3.0 | None | 2.60 | 0.06 | N |
| 2010-64 | ARD075 | GAB | yes | Py | 9.8 | 0.04 | <0.01 | 0.04 | 1.3 | 18.2 | 17.0 | Slight | 14.59 | 0.04 | N |
| 2010-65 | ARD076 | GABM | no | | 9.9 | 0.13 | <0.01 | 0.13 | 4.1 | 9.9 | 5.8 | None | 2.44 | 0.13 | M |
| 2010-66 | ARD077 | GABL | no | S | 10.4 | <0.02 | <0.01 | <0.02 | <0.6 | 11.7 | 11.7 | None | 19.42 | 0.02 | N |
| 2010-67 | ARD078 | GABM | yes | S | 9.8 | 0.13 | 0.01 | 0.12 | 3.8 | 7.9 | 4.1 | None | 2.11 | 0.12 | M |
| 2010-68 | ARD079 | GNSAUG | yes | | 9.8 | 0.41 | 0.01 | 0.40 | 12.5 | 10.4 | -2.1 | None | 0.83 | 0.40 | Y |
| 2010-69 | ARD080 | PHLOG | yes | S | 9.7 | 0.76 | 0.01 | 0.75 | 23.4 | 7.9 | -15.5 | None | 0.34 | 0.75 | Y |
| 2010-70 | ARD081 | GABL | yes | Py | 9.5 | 0.23 | 0.01 | 0.22 | 6.9 | 6.1 | -0.7 | None | 0.89 | 0.22 | M |
| 2010-71 | ARD082 | GAB | yes | S | 9.5 | 0.58 | 0.01 | 0.57 | 17.8 | 10.4 | -7.4 | Slight | 0.58 | 0.57 | Y |
| 2010-72 | ARD083 | GNSAUG | yes | S | 10.0 | 0.02 | <0.01 | 0.02 | 0.6 | 13.7 | 13.0 | Slight | 21.85 | 0.02 | N |
| 2011-01 | ARD211 | PHLOG-Ore | no | | 10.1 | <0.02 | <0.01 | <0.02 | <0.6 | 15.6 | 15.6 | None | 25.96 | 0.02 | N |
| 2011-02 | ARD210 | PHLOG-Ore | no | | 10.1 | 0.04 | <0.01 | 0.04 | 1.3 | 13.4 | 12.2 | None | 10.75 | 0.04 | N |
| 2011-03 | ARD201 | PHLOG-Ore | no | | 10.1 | <0.02 | <0.01 | <0.02 | <0.6 | 14.9 | 14.9 | None | 24.81 | 0.02 | N |
| 2011-04 | ARD200 | PHLOG-Ore | no | | 10.4 | <0.02 | <0.01 | <0.02 | <0.6 | 9.0 | 9.0 | None | 15.08 | 0.02 | N |
| 2011-05 | ARD202 | PHLOG-Ore | no | | 10.2 | <0.02 | <0.01 | <0.02 | <0.6 | 8.5 | 8.5 | None | 14.24 | 0.02 | N |
| 2011-06 | ARD212 | PHLOG-Ore | no | | 10.2 | <0.02 | <0.01 | <0.02 | <0.6 | 7.0 | 7.0 | None | 11.73 | 0.02 | N |
| 2011-07 | ARD203 | PHLOG-Ore | no | | 10.2 | <0.02 | <0.01 | <0.02 | <0.6 | 33.4 | 33.4 | Slight | 55.59 | 0.02 | N |
| 2011-08 | ARD206 | PHLOG-Ore | no | | 10.3 | <0.02 | <0.01 | <0.02 | <0.6 | 9.0 | 9.0 | None | 15.08 | 0.02 | N |
| 2011-09 | ARD204 | PHLOG-Ore | yes | PyPo | 10.6 | <0.02 | <0.01 | <0.02 | <0.6 | 10.6 | 10.6 | None | 17.59 | 0.02 | N |
| 2011-10 | ARD207 | PHLOG-Ore | no | | 10.5 | <0.02 | <0.01 | <0.02 | <0.6 | 9.3 | 9.3 | None | 15.49 | 0.02 | N |
| 2011-11 | ARD209 | PHLOG-Ore | no | | 10.0 | <0.02 | <0.01 | <0.02 | <0.6 | 30.5 | 30.5 | Slight | 50.88 | 0.02 | N |
| 2011-12 | ARD208 | PHLOG-Ore | no | | 10.4 | <0.02 | <0.01 | <0.02 | <0.6 | 9.3 | 9.3 | None | 15.49 | 0.02 | N |
| 2011-13 | ARD205 | PHLOG-Ore | no | | 10.1 | <0.02 | <0.01 | <0.02 | <0.6 | 11.3 | 11.3 | None | 18.84 | 0.02 | N |

| **PAG Totals:** | | |
|---|---|---|
| | **Yes** | **19** |
| | **Maybe** | **20** |
| | **No** | **67** |

# Appendix III

# Elemental Analysis Data

**True North Gems**
**Aappaluttoq Ruby Property, Greenland**
**ARD Data**

| | | | | | Metals | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ppm | % | ppm | ppb | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | ppm | % | ppm | ppm | ppm | ppm | ppm | % |
| S. No. | Sample ID | Lithology | Sulphides | S-Type | Ag | Al | As | Au | B | Ba | Be | Bi | Ca | Cd | Ce | Co | Cr | Cs | Cu | Fe | Ga | Ge | Hf | Hg | In | K |
| 11 | 13169 | PHLOG-Tails | no | | <0.1 | 4.83 | <0.5 | <0.01 | | 180 | <1 | <0.1 | 1.37 | <0.1 | 5 | 18 | 920 | 5.9 | 25.8 | 1.54 | 6 | <0.1 | <0.1 | 0.06 | 0.01 | 1.68 |
| 12 | 13170 | PHLOG-Tails | no | | <0.1 | 3.08 | <0.5 | <0.01 | | 161 | <1 | <0.1 | 0.71 | <0.1 | 1 | 7.9 | 863 | 6.1 | 3.1 | 1.12 | 5 | <0.1 | <0.1 | <0.005 | 0.01 | 1.42 |
| 2009-01 | M390901 | UMS | yes | SPyCpy | 2.2 | 0.25 | 7.8 | 40 | | 3 | <1 | 5.4 | 0.04 | 0.2 | 1 | 5.5 | 73 | <0.1 | 1959.8 | 0.40 | <1 | <0.1 | <0.1 | 0.039 | 0.04 | <0.01 |
| 2009-02 | M390902 | GNS | no | | 0.1 | >5.00 | 2.5 | <10 | | 28 | <1 | 0.8 | 2.94 | <0.1 | 1 | 3.9 | 58 | <0.1 | 22.0 | 0.61 | 6 | <0.1 | <0.1 | 7.120 | <0.01 | 0.09 |
| 2009-03 | M390903 | PEG | no | | 0.1 | >5.00 | <0.5 | <10 | | 204 | <1 | 0.1 | 0.22 | <0.1 | 39 | 10.4 | 101 | 19.1 | 2.8 | 1.16 | 2 | 0.1 | <0.1 | 0.165 | 0.02 | 4.46 |
| 2009-04 | M390904 | GAB | yes | | 0.1 | >5.00 | <0.5 | <10 | | 299 | <1 | 0.1 | 2.19 | <0.1 | 2 | 13.3 | 99 | 18.5 | 5.2 | 2.49 | 9 | <0.1 | <0.1 | 0.090 | 0.01 | 3.54 |
| 2009-05 | M390905 | SAPGED | no | | <0.1 | 0.66 | <0.5 | <10 | | 5 | <1 | 0.1 | 0.03 | <0.1 | 8 | 1.2 | 84 | 1.2 | 2.0 | 0.21 | <1 | <0.1 | <0.1 | 0.030 | <0.01 | 0.26 |
| 2009-06 | M390906 | UM | yes | | 0.2 | 0.47 | <0.5 | <10 | | 2 | <1 | 0.2 | 0.32 | <0.1 | 3 | 41.6 | 114 | 0.2 | 94.3 | 4.16 | 1 | 0.1 | 0.1 | 0.039 | 0.01 | 0.04 |
| 2009-07 | M390907 | GABL | yes | | 0.1 | >5.00 | <0.5 | <10 | | 3 | <1 | 0.1 | 4.24 | <0.1 | 2 | 4.9 | 79 | 0.1 | 184.1 | 0.86 | 7 | <0.1 | <0.1 | 0.023 | <0.01 | 0.02 |
| 2009-08 | M390908 | SAPGED | no | | <0.1 | 0.43 | <0.5 | <10 | | 3 | <1 | 0.1 | 0.09 | <0.1 | 9 | 1.6 | 50 | 0.8 | 2.9 | 0.22 | <1 | <0.1 | <0.1 | 0.008 | <0.01 | 0.13 |
| 2009-09 | M390909 | GAB | yes | | 0.2 | 2.75 | <0.5 | <10 | | 351 | <1 | 0.4 | 0.98 | <0.1 | 259 | 25.3 | 70 | 3.5 | 213.0 | 2.92 | 7 | 0.2 | 0.2 | 0.012 | 0.02 | 1.59 |
| 2009-10 | M390910 | GAB | yes | | 0.2 | 1.50 | 0.5 | <10 | | 263 | <1 | 0.1 | 0.72 | 0.1 | 870 | 11.5 | 86 | 1.0 | 65.2 | 2.61 | 9 | 0.5 | 0.2 | 0.005 | 0.03 | 0.58 |
| 2009-11 | M390911 | GNS | yes | | 0.1 | 1.32 | <0.5 | <10 | | 421 | <1 | <0.1 | 0.23 | <0.1 | 82 | 7.8 | 84 | 1.4 | 58.1 | 1.67 | 4 | 0.1 | <0.1 | <0.005 | 0.01 | 0.95 |
| 2009-12 | M390912 | GABL | yes | S | 0.3 | 1.62 | <0.5 | <10 | | 119 | <1 | 0.4 | 0.97 | 0.1 | 168 | 15.1 | 54 | 3.0 | 151.3 | 2.09 | 4 | 0.2 | 0.2 | 0.008 | 0.02 | 0.60 |
| 2009-13 | M390913 | SAPGED | no | | <0.1 | 2.48 | <0.5 | <10 | | 42 | <1 | <0.1 | 0.04 | 0.1 | 6 | 2.7 | 73 | 5.5 | 2.5 | 0.62 | 1 | <0.1 | <0.1 | <0.005 | 0.01 | 1.52 |
| 2009-14 | M390914 | GNS | yes | S | 0.1 | 1.61 | <0.5 | <10 | | 527 | <1 | <0.1 | 0.38 | <0.1 | 213 | 11.1 | 82 | 1.8 | 53.5 | 1.94 | 5 | 0.2 | 0.1 | <0.005 | 0.01 | 1.15 |
| 2009-15 | M390915 | GAB | yes | | 0.1 | 1.71 | <0.5 | <10 | | 16 | <1 | 0.1 | 0.89 | <0.1 | 3 | 6.8 | 65 | 0.9 | 7.9 | 1.18 | 3 | <0.1 | 0.1 | <0.005 | 0.01 | 0.17 |
| 2009-16 | M390916 | SAPGED | no | | 0.1 | 0.27 | <0.5 | <10 | | 1 | <1 | 0.1 | 0.02 | <0.1 | 7 | 2.0 | 80 | 0.1 | 26.6 | 0.27 | <1 | <0.1 | <0.1 | <0.005 | <0.01 | 0.02 |
| 2009-17 | M390917 | GABL | yes | | 0.1 | 1.34 | <0.5 | <10 | | 213 | <1 | <0.1 | 0.23 | <0.1 | 44 | 5.6 | 77 | 1.8 | 33.3 | 1.51 | 4 | <0.1 | <0.1 | <0.005 | 0.01 | 0.99 |
| 2009-18 | M390918 | SAPGED | no | | <0.1 | 3.12 | <0.5 | <10 | | 158 | <1 | <0.1 | 0.02 | <0.1 | 6 | 7.8 | 148 | 7.7 | 3.0 | 0.66 | 1 | <0.1 | <0.1 | <0.005 | 0.01 | 1.92 |
| 2009-19 | M390919 | GNS | yes | S | 0.1 | 1.62 | <0.5 | <10 | | 364 | <1 | <0.1 | 0.21 | <0.1 | 68 | 8.6 | 75 | 4.4 | 32.8 | 2.03 | 5 | 0.1 | <0.1 | <0.005 | 0.01 | 1.18 |
| 2010-01 | ARD002 | PEG | no | | <0.1 | 0.32 | <0.5 | 1 | <20 | 26 | | <0.1 | 0.32 | 0.1 | | 1.5 | 85 | | 2.3 | 0.46 | 1 | | | <0.01 | | 0.22 |
| 2010-02 | ARD003 | UMS | yes | SPyPoCpy | 1.2 | 0.26 | <0.5 | 6.3 | <20 | <1 | | 1 | 4.54 | 0.1 | | 235.5 | 80 | | 1912.9 | 9.51 | <1 | | | <0.01 | | <0.01 |
| 2010-03 | ARD004 | SAPGED | yes | | <0.1 | 0.81 | <0.5 | 0.6 | <20 | 6 | | <0.1 | 0.12 | <0.1 | | 4.7 | 76 | | 16.3 | 0.56 | <1 | | | <0.01 | | 0.47 |
| 2010-04 | ARD005 | UMS | no | SPyCpy | <0.1 | 0.36 | <0.5 | <0.5 | <20 | <1 | | <0.1 | 0.2 | <0.1 | | 1.9 | 72 | | 3.5 | 0.38 | <1 | | | <0.01 | | 0.04 |
| 2010-05 | ARD007 | PEG | no | | <0.1 | 0.41 | <0.5 | 1.9 | <20 | 12 | | <0.1 | 0.05 | <0.1 | | 1.8 | 59 | | 1.9 | 0.62 | 3 | | | <0.01 | | 0.36 |
| 2010-06 | ARD008 | SAPGED | no | | <0.1 | 0.41 | <0.5 | 1 | <20 | 1 | | <0.1 | 0.02 | <0.1 | | 2.6 | 108 | | 9.4 | 0.35 | <1 | | | <0.01 | | <0.01 |
| 2010-07 | ARD010 | PEG | no | | <0.1 | 0.42 | <0.5 | 0.6 | <20 | 23 | | <0.1 | 0.11 | <0.1 | | 1.9 | 72 | | 2.4 | 0.59 | 2 | | | <0.01 | | 0.3 |
| 2010-08 | ARD012 | SAPGED | no | Cpy | 0.1 | 6.41 | 0.8 | 4.9 | <20 | 180 | | 0.2 | 0.03 | <0.1 | | 17.3 | 66 | | 124.3 | 2.14 | 2 | | | <0.01 | | 4.31 |
| 2010-09 | ARD013 | UM | yes | Py | <0.1 | 2.59 | 0.9 | 1 | <20 | 93 | | 0.2 | 1.12 | <0.1 | | 29.5 | 66 | | 124.1 | 2.53 | 7 | | | <0.01 | | 1.22 |
| 2010-10 | ARD014 | SAPGED | no | | <0.1 | 1.21 | 1.1 | <0.5 | <20 | 29 | | <0.1 | 0.06 | <0.1 | | 2.7 | 98 | | 3.7 | 0.38 | <1 | | | <0.01 | | 0.74 |
| 2010-11 | ARD015 | GAB | no | | <0.1 | >10.00 | 2.6 | <0.5 | <20 | 155 | | <0.1 | 3.89 | <0.1 | | 17.9 | 132 | | 3.7 | 2.96 | 15 | | | <0.01 | | 3.44 |
| 2010-12 | ARD016 | OVB | no | | <0.1 | 0.44 | 1.7 | <0.5 | <20 | 21 | | <0.1 | 0.07 | <0.1 | | 2 | 70 | | 5.8 | 0.8 | 2 | | | <0.01 | | 0.33 |
| 2010-13 | ARD017 | GABM | yes | | 0.1 | 2.99 | 1 | <0.5 | <20 | 309 | | <0.1 | 0.41 | <0.1 | | 54.1 | 105 | | 231.7 | 4.2 | 13 | | | <0.01 | | 1.97 |
| 2010-14 | ARD018 | UMS | yes | Po | 0.2 | 1.69 | 0.6 | 1 | <20 | 4 | | 0.3 | 0.73 | <0.1 | | 49.3 | 43 | | 106.8 | 3.37 | 4 | | | <0.01 | | 0.96 |
| 2010-15 | ARD019 | UMS | yes | PyPoCpy | 0.2 | 0.5 | <0.5 | <0.5 | <20 | <1 | | 0.2 | 0.64 | <0.1 | | 35.4 | 46 | | 82.9 | 2.88 | <1 | | | <0.01 | | 0.02 |
| 2010-16 | ARD020 | UM | yes | S | <0.1 | 0.29 | <0.5 | <0.5 | <20 | <1 | | <0.1 | 0.96 | <0.1 | | 18.9 | 56 | | 68.9 | 2.85 | <1 | | | <0.01 | | 0.02 |
| 2010-17 | ARD021 | GABM | no | SPo | <0.1 | 0.85 | <0.5 | <0.5 | <20 | 5 | | 0.1 | 0.72 | <0.1 | | 30.8 | 58 | | 162.2 | 1.79 | 2 | | | <0.01 | | 0.08 |
| 2010-18 | ARD022 | UMS | no | Po | <0.1 | 0.29 | <0.5 | <0.5 | <20 | <1 | | <0.1 | 0.75 | <0.1 | | 11.2 | 50 | | 2.1 | 2.64 | <1 | | | <0.01 | | 0.01 |
| 2010-19 | ARD023 | PHLOG | yes | SPo | <0.1 | 3.09 | 1.3 | <0.5 | <20 | 42 | | 0.5 | 1.77 | <0.1 | | 33.1 | 243 | | 86.3 | 2.25 | 5 | | | <0.01 | | 0.49 |
| 2010-20 | ARD024 | UM | yes | | <0.1 | 3.93 | 1.7 | <0.5 | <20 | 108 | | <0.1 | 0.1 | <0.1 | | 10.3 | 133 | | 1 | 1.49 | 6 | | | <0.01 | | 2.89 |
| 2010-21 | ARD025 | PHLOG | no | Po | <0.1 | 5.96 | 1.4 | <0.5 | <20 | 434 | | <0.1 | 0.4 | <0.1 | | 25.5 | 208 | | 207.1 | 3.41 | 11 | | | <0.01 | | 4.1 |
| 2010-22 | ARD026 | UMS | yes | PoCpy | <0.1 | 2.72 | 0.8 | 4.6 | <20 | 45 | | 0.3 | 0.66 | <0.1 | | 20.4 | 58 | | 11 | 2.9 | 5 | | | <0.01 | | 2.03 |
| 2010-23 | ARD027 | UM | yes | Cpy | 0.2 | 3.03 | 1.2 | 1.3 | <20 | 83 | | 0.2 | 1.98 | <0.1 | | 41.9 | 58 | | 263 | 2.75 | 6 | | | <0.01 | | 0.62 |
| 2010-24 | ARD028 | GAB | yes | | <0.1 | 0.68 | 0.9 | 2.5 | <20 | 9 | | 0.1 | 0.84 | <0.1 | | 100.7 | 60 | | 15.4 | 1.08 | 3 | | | <0.01 | | 0.29 |
| 2010-25 | ARD029 | GABM | yes | PyPoCpy | <0.1 | 1.29 | 1.1 | <0.5 | <20 | 21 | | <0.1 | 0.92 | <0.1 | | 32.5 | 59 | | 146.2 | 1.75 | 3 | | | <0.01 | | 0.22 |
| 2010-26 | ARD030 | GABM | yes | PyPoCpy | <0.1 | 0.96 | 1.4 | 0.5 | <20 | 7 | | <0.1 | 0.69 | <0.1 | | 26.5 | 52 | | 140.2 | 1.47 | 3 | | | <0.01 | | 0.21 |
| 2010-27 | ARD031 | UM | no | | <0.1 | 1.18 | 1.6 | 1.1 | <20 | 9 | | 0.2 | 1.05 | <0.1 | | 7.3 | 47 | | 9.5 | 1.38 | 3 | | | <0.01 | | 0.19 |
| 2010-28 | ARD032 | UMS | yes | Po | <0.1 | 0.83 | 1.4 | <0.5 | <20 | 2 | | 0.1 | 0.6 | <0.1 | | 19.1 | 56 | | 59.6 | 1.71 | 1 | | | <0.01 | | 0.2 |
| 2010-29 | ARD033 | PEG | yes | | <0.1 | 3.98 | 1.1 | <0.5 | <20 | 312 | | <0.1 | 0.74 | <0.1 | | 34.5 | 81 | | 115.6 | 4.21 | 13 | | | <0.01 | | 2.83 |
| 2010-30 | ARD034 | SAPGED | no | | <0.1 | 0.31 | <0.5 | <0.5 | <20 | 2 | | <0.1 | 0.38 | <0.1 | | 10.3 | 63 | | 1.7 | 1.81 | <1 | | | <0.01 | | 0.03 |
| 2010-31 | ARD035 | SAPGED | no | | <0.1 | 1.2 | 1.5 | <0.5 | <20 | 34 | | <0.1 | 0.03 | <0.1 | | 5.2 | 75 | | 1.5 | 0.73 | <1 | | | <0.01 | | 0.57 |
| 2010-32 | ARD036 | UM | yes | S | <0.1 | 7.86 | 3 | <0.5 | <20 | 7 | | <0.1 | 5.31 | <0.1 | | 4.7 | 45 | | 119.3 | 0.63 | 8 | | | <0.01 | | 0.05 |
| 2010-33 | ARD037 | GNS | yes | | <0.1 | 1.3 | 2.3 | <0.5 | <20 | 270 | | 0.2 | 0.23 | <0.1 | | 10.6 | 83 | | 83.4 | 2.12 | 6 | | | <0.01 | | 0.96 |
| 2010-34 | ARD038 | PEG | no | S | <0.1 | 0.47 | 1.7 | <0.5 | <20 | 51 | | <0.1 | 0.17 | <0.1 | | 2.3 | 74 | | 9.1 | 0.61 | 2 | | | <0.01 | | 0.25 |
| 2010-35 | ARD039 | GABL | no | | <0.1 | 1.62 | 1.7 | <0.5 | <20 | 207 | | <0.1 | 0.8 | <0.1 | | 20.4 | 115 | | 36.8 | 2.74 | 5 | | | <0.01 | | 0.9 |
| 2010-36 | ARD040 | GABM | yes | S | <0.1 | 2.3 | <0.5 | 0.6 | <20 | 16 | | <0.1 | 2.02 | <0.1 | | 15 | 60 | | 83.7 | 1.69 | 5 | | | <0.01 | | 0.08 |
| 2010-37 | ARD041 | GABM | yes | | <0.1 | 1.05 | <0.5 | 1.3 | <20 | 17 | | <0.1 | 1.24 | <0.1 | | 13.5 | 81 | | 40.8 | 1.78 | 3 | | | <0.01 | | 0.17 |
| 2010-38 | ARD042 | PEG | yes | | <0.1 | 0.95 | <0.5 | 1 | <20 | 114 | | <0.1 | 0.18 | <0.1 | | 7.3 | 99 | | 57.8 | 1.52 | 4 | | | <0.01 | | 0.66 |
| 2010-39 | ARD043 | PEG | no | | <0.1 | 1.66 | <0.5 | 0.7 | <20 | 323 | | <0.1 | 0.36 | <0.1 | | 14.5 | 113 | | 7.2 | 2.24 | 6 | | | <0.01 | | 1.25 |
| 2010-40 | ARD044 | GABM | yes | PyPo | <0.1 | 1.32 | <0.5 | 0.7 | <20 | 60 | | 0.2 | 1.02 | <0.1 | | 22.2 | 96 | | 59 | 2.99 | 5 | | | <0.01 | | 0.46 |
| 2010-41 | ARD045 | UMS | yes | SPyPo | 0.3 | 2.87 | <0.5 | 4.6 | <20 | 77 | | 0.5 | 0.92 | 0.2 | | 64.1 | 31 | | 271 | 5.11 | 6 | | | <0.01 | | 1.58 |
| 2010-42 | ARD046 | UM | no | | <0.1 | 0.42 | <0.5 | <0.5 | <20 | 4 | | <0.1 | 1.05 | 0.1 | | 6.4 | 63 | | 5.6 | 0.86 | <1 | | | <0.01 | | 0.03 |
| 2010-43 | ARD047 | GABM | yes | | <0.1 | 1.88 | <0.5 | 0.8 | <20 | 124 | | <0.1 | 0.75 | <0.1 | | 18.6 | 89 | | 32 | 2.47 | 6 | | | <0.01 | | 1.17 |
| 2010-44 | ARD049 | OVB | no | | <0.1 | 0.73 | <0.5 | <0.5 | <20 | 64 | | <0.1 | 0.11 | <0.1 | | 4.2 | 71 | | 1.6 | 1.33 | 3 | | | <0.01 | | 0.52 |
| 2010-45 | ARD050 | UMS | yes | SPo | 0.2 | 1.12 | <0.5 | 3.1 | <20 | 7 | | 0.6 | 0.97 | 0.2 | | 39.6 | 60 | | 202.6 | 3.19 | 2 | | | <0.01 | | 0.08 |
| 2010-46 | ARD054 | PEG | no | | <0.1 | 2.94 | <0.5 | <0.5 | <20 | 243 | | <0.1 | 0.13 | <0.1 | | 12.9 | 111 | | 3 | 2.2 | 12 | | | <0.01 | | 2.41 |
| 2010-47 | ARD056 | PHLOG | yes | SPy | <0.1 | 7.64 | <0.5 | 1.1 | <20 | 1087 | | <0.1 | 0.79 | <0.1 | | 42.2 | 147 | | 36.7 | 8.11 | 34 | | | <0.01 | | 5.61 |
| 2010-48 | ARD057 | PEG | yes | SPy | 0.2 | 1.43 | <0.5 | <0.5 | <20 | 122 | | 0.3 | 0.16 | <0.1 | | 16.9 | 66 | | 193.5 | 2.5 | 7 | | | <0.01 | | 1.01 |
| 2010-49 | ARD058 | GNS | yes | Py | <0.1 | 2.74 | 1 | 0.5 | <20 | 88 | | <0.1 | 1.41 | <0.1 | | 13.6 | 63 | | 91.9 | 1.37 | 5 | | | <0.01 | | 0.6 |
| 2010-50 | ARD059 | GNS | yes | SPyPo | 0.1 | 1.69 | 0.7 | 0.8 | <20 | 99 | | 0.1 | 0.81 | <0.1 | | 20.2 | 60 | | 129.2 | 1.82 | 4 | | | <0.01 | | 0.65 |
| 2010-51 | ARD060 | GABL | yes | SPyPo | <0.1 | 2.3 | <0.5 | <0.5 | <20 | 146 | | <0.1 | 0.98 | <0.1 | | 10.9 | 83 | | 24.8 | 1.79 | 6 | | | <0.01 | | 0.86 |
| 2010-52 | ARD061 | GAB | yes | SPy | <0.1 | 1.72 | <0.5 | 0.9 | <20 | 95 | | 0.1 | 0.23 | <0.1 | | 15.1 | 90 | | 80.1 | 2.47 | 8 | | | <0.01 | | 1.25 |
| 2010-53 | ARD062 | PEG | yes | S | <0.1 | 0.97 | <0.5 | <0.5 | <20 | 53 | | 0.2 | 0.1 | <0.1 | | 6.8 | 61 | | 41.4 | 1.47 | 6 | | | <0.01 | | 0.74 |
| 2010-54 | ARD063 | UM | no | | <0.1 | 1.2 | <0.5 | <0.5 | <20 | 33 | | 0.1 | 5.54 | <0.1 | | 5.5 | 43 | | 14.3 | 1.56 | 1 | | | <0.01 | | 0.22 |
| 2010-55 | ARD065 | SAPGED | yes | | <0.1 | 0.75 | 0.8 | <0.5 | <20 | 11 | | <0.1 | 0.07 | <0.1 | | 1.2 | 79 | | 1.3 | 0.29 | <1 | | | <0.01 | | 0.32 |
| 2010-56 | ARD066 | SAPGED | no | | <0.1 | 0.27 | <0.5 | <0.5 | <20 | <1 | | 0.2 | 1.53 | <0.1 | | 3 | 39 | | 4.1 | 0.4 | <1 | | | <0.01 | | 0.01 |
| 2010-57 | ARD067 | SAPGED | yes | S | <0.1 | 1.38 | 1.7 | <0.5 | <20 | 73 | | <0.1 | 0.04 | <0.1 | | 2.5 | 121 | | 1.8 | 0.42 | <1 | | | <0.01 | | 0.81 |
| 2010-58 | ARD069 | PHLOG | yes | | <0.1 | 7.26 | <0.5 | 0.9 | <20 | 1176 | | <0.1 | 1 | <0.1 | | 39.1 | 164 | | 39.5 | 8.57 | 28 | | | <0.01 | | 4.81 |
| 2010-59 | ARD070 | GNS | yes | | <0.1 | 1.88 | 0.6 | <0.5 | <20 | 228 | | <0.1 | 0.59 | <0.1 | | 12.3 | 84 | | 35.6 | 2.21 | 6 | | | <0.01 | | 1.08 |
| 2010-60 | ARD071 | PEG | no | | <0.1 | 1.95 | <0.5 | <0.5 | <20 | 229 | | <0.1 | 0.17 | <0.1 | | 11.6 | 97 | | 36.7 | 2.82 | 9 | | | <0.01 | | 1.41 |
| 2010-61 | ARD072 | GABL | yes | S | <0.1 | 1.73 | <0.5 | <0.5 | <20 | 203 | | <0.1 | 0.71 | <0.1 | | 15.8 | 94 | | 79.2 | 2.36 | 6 | | | <0.01 | | 0.99 |
| 2010-62 | ARD073 | OVB | no | | <0.1 | 1.11 | 0.7 | <0.5 | <20 | 132 | | <0.1 | 0.27 | <0.1 | | 7.1 | 85 | | 8.9 | 2 | 6 | | | <0.01 | | 0.91 |
| 2010-63 | ARD074 | PEG | yes | Po | <0.1 | 1.8 | <0.5 | <0.5 | <20 | 102 | | <0.1 | 0.07 | <0.1 | | 9.7 | 78 | | 31.1 | 2.91 | 11 | | | <0.01 | | 1.54 |
| 2010-64 | ARD075 | GAB | yes | Py | <0.1 | 5.18 | 2.4 | 1.5 | <20 | 29 | | 0.4 | 3.61 | <0.1 | | 10.1 | 61 | | 40.1 | 1.23 | 8 | | | <0.01 | | 0.17 |
| 2010-65 | ARD076 | GABM | no | | <0.1 | 1.24 | 1.3 | <0.5 | <20 | 32 | | 0.1 | 1.11 | <0.1 | | 15.8 | 80 | | 78 | 2.23 | 4 | | | <0.01 | | 0.28 |
| 2010-66 | ARD077 | GABL | no | S | <0.1 | 2.7 | 0.7 | 0.8 | <20 | 223 | | <0.1 | 0.26 | <0.1 | | 14.1 | 673 | | 3.5 | 2.95 | 10 | | | <0.01 | | 2.17 |
| 2010-67 | ARD078 | GABM | yes | S | <0.1 | 1.51 | 0.5 | <0.5 | <20 | 92 | | 0.2 | 0.86 | <0.1 | | 17.9 | 99 | | 61.4 | 2.65 | 5 | | | <0.01 | | 0.81 |
| 2010-68 | ARD079 | GNSAUG | yes | | 0.1 | 2.16 | 0.7 | 1.2 | <20 | 266 | | <0.1 | 0.5 | <0.1 | | 20.9 | 111 | | 159 | 3.2 | 8 | | | <0.01 | | 1.51 |
| 2010-69 | ARD080 | PHLOG | yes | S | 0.2 | 3.33 | <0.5 | 1.5 | <20 | 474 | | 0.2 | 0.11 | <0.1 | | 35.8 | 179 | | 282.5 | 5.67 | 16 | | | <0.01 | | 2.75 |
| 2010-70 | ARD081 | GABL | yes | Py | <0.1 | 1.84 | <0.5 | 0.6 | <20 | 179 | | <0.1 | 0.41 | <0.1 | | 15.8 | 96 | | 79.2 | 2.48 | 7 | | | <0.01 | | 1.17 |
| 2010-71 | ARD082 | GAB | yes | S | 0.2 | 2.23 | 0.6 | 3.3 | <20 | 231 | | 0.2 | 0.56 | <0.1 | | 21.3 | 129 | | 242.9 | 3.77 | 8 | | | <0.01 | | 1.6 |
| 2010-72 | ARD083 | GNSAUG | yes | S | <0.1 | 1.6 | 0.7 | 0.9 | <20 | 189 | | <0.1 | 0.67 | <0.1 | | 12 | 68 | | 7.1 | 1.89 | 5 | | | <0.01 | | 0.94 |
| 2011-01 | ARD211 | PHLOG-Ore | no | | <0.1 | 4.42 | <0.5 | <0.5 | <20 | 190 | | <0.1 | 0.06 | <0.1 | | 6.9 | 53 | | 0.6 | 1.19 | 5 | | | 0.01 | | 2.93 |
| 2011-02 | ARD210 | PHLOG-Ore | no | | <0.1 | 6.86 | <0.5 | <0.5 | <20 | 396 | | <0.1 | 1.56 | <0.1 | | 15.3 | 300 | | 13.4 | 3.95 | 14 | | | <0.01 | | 3.37 |
| 2011-03 | ARD201 | PHLOG-Ore | no | | <0.1 | 8.57 | <0.5 | <0.5 | <20 | 94 | | <0.1 | 3.79 | <0.1 | | 7.7 | 183 | | 1.1 | 0.89 | 9 | | | <0.01 | | 1.14 |
| 2011-04 | ARD200 | PHLOG-Ore | no | | <0.1 | 4.81 | <0.5 | 0.8 | <20 | 172 | | <0.1 | 0.1 | <0.1 | | 5.5 | 58 | | 0.6 | 1.24 | 4 | | | <0.01 | | 3.35 |
| 2011-05 | ARD202 | PHLOG-Ore | no | | 0.6 | 2.61 | <0.5 | 102.7 | <20 | 93 | | 5 | 0.04 | <0.1 | | 8.5 | 68 | | 324.5 | 0.86 | 2 | | | <0.01 | | 1.7 |
| 2011-06 | ARD212 | PHLOG-Ore | no | | <0.1 | 3.92 | <0.5 | 4.5 | <20 | 135 | | <0.1 | 0.07 | <0.1 | | 7.8 | 347 | | 1.9 | 1.07 | 5 | | | <0.01 | | 2.32 |
| 2011-07 | ARD203 | PHLOG-Ore | no | | <0.1 | 7.54 | <0.5 | 4.4 | <20 | 688 | | <0.1 | 1.46 | <0.1 | | 19.5 | 131 | | 1.3 | 2.3 | 13 | | | <0.01 | | 3.55 |
| 2011-08 | ARD206 | PHLOG-Ore | no | | <0.1 | 2.12 | <0.5 | <0.5 | <20 | 72 | | <0.1 | 0.07 | <0.1 | | 2.8 | 183 | | 1.2 | 0.48 | <1 | | | <0.01 | | 1.5 |
| 2011-09 | ARD204 | PHLOG-Ore | yes | PyPo | <0.1 | 6.67 | <0.5 | <0.5 | <20 | 553 | | <0.1 | 0.16 | <0.1 | | 13.7 | 817 | | 10.1 | 2.75 | 8 | | | <0.01 | | 4.27 |
| 2011-10 | ARD207 | PHLOG-Ore | no | | <0.1 | 5.79 | <0.5 | <0.5 | <20 | 305 | | <0.1 | 0.05 | <0.1 | | 10.2 | 99 | | 0.6 | 1.73 | 7 | | | <0.01 | | 3.61 |
| 2011-11 | ARD209 | PHLOG-Ore | no | | <0.1 | 4.98 | <0.5 | 4.1 | <20 | 69 | | <0.1 | 0.37 | <0.1 | | 12.4 | 372 | | 1.4 | 1.63 | 6 | | | <0.01 | | 3.67 |
| 2011-12 | ARD208 | PHLOG-Ore | no | | <0.1 | 3.28 | <0.5 | <0.5 | <20 | 110 | | <0.1 | 0.02 | <0.1 | | 8.7 | 153 | | 1.8 | 0.91 | 1 | | | <0.01 | | 2.1 |
| 2011-13 | ARD205 | PHLOG-Ore | no | | <0.1 | 4.92 | <0.5 | <0.5 | <20 | 166 | | <0.1 | 0.65 | <0.1 | | 11.3 | 151 | | 2.1 | 1.3 | 5 | | | <0.01 | | 2.38 |

**True North Gems**
**Aappaluttoq Ruby Property, Greenland**
**ARD Data**

| S. No. | Sample ID | Lithology | Sulphides | S-Type | La | Li | Mg | Mn | Mo | Na | Nb | Ni | P | Pb | Rb | Re | S | Sb | Sc | Se | Sn | Sr | Ta | Te | Th | Ti |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ppm | ppm | % | ppm | ppm | % | ppm | ppm | % | ppm | ppm | ppb | % | ppm | ppm | ppm | ppm | ppm | ppm | ppm | ppm | % |
| 11 | 13169 | PHLOG-Tails | no | | 2 | 20.2 | 5.03 | 162 | 5.5 | 0.24 | 0.2 | 128.4 | 0.008 | 0.4 | 106.3 | <5 | | <0.1 | 5.9 | <0.5 | 11.8 | 24 | <0.1 | <0.1 | 0.5 | 0.157 |
| 12 | 13170 | PHLOG-Tails | no | | <1 | 13 | 4.12 | 73 | 5.1 | 0.22 | 0.1 | 82.7 | <0.001 | <0.1 | 88.1 | <5 | | <0.1 | 4.4 | <0.5 | 0.4 | 15 | <0.1 | <0.1 | 0.1 | 0.139 |
| 2009-01 | M390901 | UMS | yes | SPyCpy | 1 | 3.5 | 0.44 | 34 | 4.5 | 0.04 | 0.1 | 53.3 | <0.001 | 6.3 | 0.2 | <5 | | 0.1 | 0.8 | <0.5 | 0.5 | 1 | <0.1 | 4 | <0.1 | 0.006 |
| 2009-02 | M390902 | GNS | no | | 1 | 8.1 | 0.24 | 136 | 5.8 | 1.01 | 0.1 | 12.7 | 0.007 | 7.6 | 0.8 | <5 | | <0.1 | 1.8 | <0.5 | 0.3 | 37 | <0.1 | 0.1 | 0.4 | 0.029 |
| 2009-03 | M390903 | PEG | no | | 17 | 75.3 | >10.00 | 66 | 0.9 | 0.55 | <0.1 | 143.8 | 0.004 | 5.4 | 188.5 | <5 | | <0.1 | 12.1 | <0.5 | 0.4 | 14 | <0.1 | <0.1 | 5.3 | 0.268 |
| 2009-04 | M390904 | GAB | yes | | 1 | 63.2 | 4.46 | 138 | 1.9 | 0.86 | 0.1 | 66.5 | 0.003 | 3.9 | 132.2 | <5 | | <0.1 | 7.1 | <0.5 | 0.5 | 36 | <0.1 | <0.1 | 0.1 | 0.171 |
| 2009-05 | M390905 | SAPGED | no | | 3 | 3.9 | 1.61 | 29 | 4.7 | 0.07 | <0.1 | 20.6 | 0.001 | 1.1 | 11.2 | <5 | | <0.1 | 1.1 | <0.5 | 0.1 | 1 | <0.1 | <0.1 | 0.1 | 0.021 |
| 2009-06 | M390906 | UM | yes | | 1 | 2.1 | 1.12 | 65 | 4.3 | 0.05 | 0.2 | 364.3 | 0.019 | 2.5 | 1.5 | <5 | | <0.1 | 3.5 | <0.5 | 0.2 | 2 | <0.1 | 0.4 | 0.1 | 0.096 |
| 2009-07 | M390907 | GABL | yes | | 1 | 2.8 | 0.41 | 79 | 4.5 | 0.26 | <0.1 | 51.3 | 0.004 | 1.4 | 0.4 | <5 | | <0.1 | 2.4 | <0.5 | 0.1 | 85 | <0.1 | 0.2 | <0.1 | 0.023 |
| 2009-08 | M390908 | SAPGED | no | | 4 | 1.4 | 1.34 | 29 | 3.4 | 0.02 | <0.1 | 27.5 | 0.013 | 0.7 | 7.6 | <5 | | <0.1 | 1.6 | <0.5 | 0.1 | 2 | <0.1 | <0.1 | 0.1 | 0.011 |
| 2009-09 | M390909 | GAB | yes | | 140 | 30.8 | 1.79 | 236 | 2.4 | 0.14 | 0.6 | 63.7 | 0.197 | 7.4 | 77.3 | 5 | | <0.1 | 4.9 | <0.5 | 0.6 | 17 | <0.1 | 0.3 | 44.3 | 0.232 |
| 2009-10 | M390910 | GAB | yes | | 468 | 18.1 | 1.02 | 195 | 3.9 | 0.11 | 0.2 | 28.7 | 0.054 | 15.9 | 29.9 | <5 | | <0.1 | 4.8 | <0.5 | 1.0 | 15 | <0.1 | 0.1 | 120.6 | 0.166 |
| 2009-11 | M390911 | GNS | yes | | 40 | 20.1 | 0.76 | 168 | 12.8 | 0.07 | 0.3 | 16.6 | 0.055 | 1.7 | 45.0 | <5 | | <0.1 | 2.7 | <0.5 | 0.6 | 16 | <0.1 | <0.1 | 9.2 | 0.160 |
| 2009-12 | M390912 | GABL | yes | S | 83 | 15.3 | 0.96 | 211 | 3.4 | 0.13 | 0.3 | 34.1 | 0.170 | 3.4 | 27.0 | <5 | | <0.1 | 4.6 | <0.5 | 0.8 | 18 | <0.1 | 0.2 | 21.0 | 0.147 |
| 2009-13 | M390913 | SAPGED | no | | 3 | 15.6 | 3.78 | 64 | 51.7 | 0.12 | <0.1 | 52.5 | 0.014 | 2.4 | 68.6 | 24 | | <0.1 | 5.2 | <0.5 | 0.2 | 5 | <0.1 | <0.1 | 0.5 | 0.091 |
| 2009-14 | M390914 | GNS | yes | S | 108 | 34.7 | 1.20 | 65 | 6.6 | 0.09 | 0.2 | 23.0 | 0.129 | 3.8 | 56.7 | <5 | | <0.1 | 1.0 | <0.5 | 0.4 | 23 | <0.1 | <0.1 | 28.1 | 0.219 |
| 2009-15 | M390915 | GAB | yes | | 1 | 10.0 | 0.67 | 168 | 3 | 0.23 | 0.4 | 23.5 | 0.009 | 1.0 | 10.4 | <5 | | <0.1 | 4.2 | <0.5 | 0.2 | 6 | <0.1 | <0.1 | 0.4 | 0.072 |
| 2009-16 | M390916 | SAPGED | no | | 4 | 0.7 | 0.86 | 38 | 5 | 0.01 | <0.1 | 19.1 | <0.001 | 0.4 | 1.2 | <5 | | <0.1 | 0.9 | <0.5 | 0.3 | <1 | <0.1 | <0.1 | 0.2 | 0.005 |
| 2009-17 | M390917 | GABL | yes | | 22 | 19.7 | 0.73 | 166 | 6.1 | 0.07 | 0.5 | 10.7 | 0.043 | 2.4 | 54.4 | <5 | | <0.1 | 6.0 | <0.5 | 0.7 | 11 | <0.1 | <0.1 | 6.6 | 0.122 |
| 2009-18 | M390918 | SAPGED | no | | 3 | 11.6 | 3.90 | 26 | 8 | 0.19 | <0.1 | 55.4 | 0.001 | 1.6 | 54.7 | <5 | | <0.1 | 3.4 | <0.5 | 0.5 | 6 | <0.1 | <0.1 | 0.1 | 0.122 |
| 2009-19 | M390919 | GNS | yes | S | 34 | 28.7 | 0.92 | 196 | 4.8 | 0.07 | 0.9 | 17.4 | 0.053 | 1.6 | 93.6 | <5 | | <0.1 | 3.8 | <0.5 | 0.9 | 12 | <0.1 | <0.1 | 7.6 | 0.196 |
| 2010-01 | ARD002 | PEG | no | | 3 | | 0.18 | 95 | 6.4 | 0.026 | | 4.5 | 0.002 | 3.9 | | | <0.05 | 0.1 | 0.9 | <0.5 | | 6 | | <0.2 | 53.5 | 0.034 |
| 2010-02 | ARD003 | UMS | yes | SPyPoCpy | 32 | | 9.05 | 385 | 7.1 | 0.014 | | 2643.4 | 1.748 | 1.9 | | | 3.15 | <0.1 | 9.2 | 15.9 | | 11 | | 2.9 | 4 | 0.027 |
| 2010-03 | ARD004 | SAPGED | yes | | 5 | | 2.47 | 63 | 3.6 | 0.024 | | 87.2 | 0.045 | 1 | | | <0.05 | <0.1 | 2.6 | <0.5 | | 2 | | <0.2 | 0.2 | 0.044 |
| 2010-04 | ARD005 | UMS | no | SPyCpy | 30 | | 1.57 | 55 | 3.7 | 0.002 | | 29.2 | 0.08 | 0.6 | | | <0.05 | <0.1 | 1.7 | <0.5 | | 1 | | <0.2 | 1.1 | 0.006 |
| 2010-05 | ARD007 | PEG | no | | 6 | | 0.24 | 120 | 4.2 | 0.02 | | 4.4 | 0.006 | 3.7 | | | <0.05 | <0.1 | 2 | <0.5 | | 2 | | <0.2 | 9.7 | 0.05 |
| 2010-06 | ARD008 | SAPGED | no | | 2 | | 1.33 | 51 | 6.3 | <0.001 | | 25.1 | 0.003 | 0.3 | | | <0.05 | <0.1 | 1.3 | <0.5 | | <1 | | <0.2 | 0.6 | 0.003 |
| 2010-07 | ARD010 | PEG | no | | 13 | | 0.25 | 108 | 5 | 0.036 | | 6.9 | 0.003 | 9.6 | | | <0.05 | <0.1 | 1.3 | <0.5 | | 3 | | <0.2 | 55 | 0.05 |
| 2010-08 | ARD012 | SAPGED | no | Cpy | 4 | | 8.65 | 105 | 2.9 | 0.371 | | 142.6 | 0.002 | 4.2 | | | <0.05 | <0.1 | 10.1 | <0.5 | | 7 | | <0.2 | 0.1 | 0.076 |
| 2010-09 | ARD013 | UM | yes | Py | 1 | | 2.34 | 248 | 2.2 | 0.193 | | 64.7 | 0.015 | 1.2 | | | 0.28 | <0.1 | 8.5 | <0.5 | | 9 | | 0.4 | 0.6 | 0.232 |
| 2010-10 | ARD014 | SAPGED | no | | <1 | | 2.58 | 55 | 3.9 | 0.106 | | 117.6 | 0.003 | 1.4 | | | <0.05 | <0.1 | 3.9 | <0.5 | | 3 | | <0.2 | 0.6 | 0.062 |
| 2010-11 | ARD015 | GAB | no | | <1 | | 5.42 | 288 | 1.7 | 0.761 | | 87.2 | 0.003 | 2.6 | | | <0.05 | <0.1 | 14.6 | <0.5 | | 59 | | <0.2 | <0.1 | 0.214 |
| 2010-12 | ARD016 | OVB | no | | 31 | | 0.2 | 134 | 4.9 | 0.042 | | 5.2 | 0.01 | 4.1 | | | <0.05 | <0.1 | 1.6 | <0.5 | | 4 | | <0.2 | 13 | 0.066 |
| 2010-13 | ARD017 | GABM | yes | | <1 | | 3.18 | 224 | 4.5 | 0.147 | | 95.1 | 0.001 | 0.9 | | | 0.8 | <0.1 | 9.2 | <0.5 | | 3 | | 0.3 | 0.2 | 0.362 |
| 2010-14 | ARD018 | UMS | yes | Po | <1 | | 2.34 | 280 | 2.2 | 0.121 | | 52.5 | 0.022 | 0.6 | | | 1.21 | <0.1 | 3.9 | 4.8 | | 2 | | 4.7 | 0.2 | 0.122 |
| 2010-15 | ARD019 | UMS | yes | PyPoCpy | <1 | | 0.87 | 212 | 3.2 | 0.042 | | 72.9 | 0.006 | 0.2 | | | 1.32 | <0.1 | 3.3 | 5.4 | | 3 | | 4.8 | <0.1 | 0.041 |
| 2010-16 | ARD020 | UM | yes | S | <1 | | 9.19 | 1261 | 4.1 | 0.028 | | 57 | 0.039 | 0.2 | | | 0.12 | <0.1 | 3.9 | <0.5 | | 6 | | 0.6 | 0.1 | 0.048 |
| 2010-17 | ARD021 | GABM | no | SPo | <1 | | 0.72 | 85 | 3.1 | 0.154 | | 66.4 | 0.015 | 0.4 | | | 0.58 | <0.1 | 7 | <0.5 | | 4 | | <0.2 | 0.1 | 0.059 |
| 2010-18 | ARD022 | UMS | no | Po | <1 | | 7.45 | 1321 | 3.3 | 0.029 | | 34.1 | 0.062 | 0.2 | | | <0.05 | <0.1 | 3.3 | <0.5 | | 3 | | <0.2 | 0.1 | 0.03 |
| 2010-19 | ARD023 | PHLOG | yes | SPo | 3 | | 2.02 | 410 | 14.3 | 0.191 | | 55.4 | 0.006 | 1.6 | | | 0.11 | <0.1 | 14.2 | <0.5 | | 46 | | 0.3 | 0.5 | 0.136 |
| 2010-20 | ARD024 | UM | yes | | <1 | | 10.78 | 234 | 1.9 | 0.24 | | 265.5 | 0.006 | 3 | | | <0.05 | <0.1 | 19.5 | <0.5 | | 4 | | <0.2 | 0.2 | 0.148 |
| 2010-21 | ARD025 | PHLOG | no | Po | <1 | | 9.75 | 281 | 2.5 | 0.324 | | 328.4 | 0.006 | 4.2 | | | 0.23 | <0.1 | 19.5 | <0.5 | | 5 | | 0.5 | 0.4 | 0.227 |
| 2010-22 | ARD026 | UMS | yes | PoCpy | 1 | | 3.57 | 494 | 1.8 | 0.132 | | 36 | 0.015 | 1.2 | | | <0.05 | <0.1 | 4.8 | <0.5 | | 4 | | 1.2 | 0.2 | 0.221 |
| 2010-23 | ARD027 | UM | yes | Cpy | <1 | | 1.54 | 399 | 3 | 0.252 | | 76.6 | 0.013 | 1.2 | | | 0.77 | <0.1 | 7.2 | 2.3 | | 29 | | 1.6 | 0.1 | 0.17 |
| 2010-24 | ARD028 | GAB | yes | | 5 | | 5.63 | 390 | 2.6 | 0.091 | | 215.3 | 0.164 | 0.6 | | | <0.05 | <0.1 | 8.9 | <0.5 | | 4 | | 2.3 | 0.7 | 0.059 |
| 2010-25 | ARD029 | GABM | yes | PyPoCpy | <1 | | 1.07 | 134 | 3.2 | 0.191 | | 62.9 | 0.014 | 0.5 | | | 0.41 | <0.1 | 7.7 | <0.5 | | 7 | | <0.2 | 0.1 | 0.098 |
| 2010-26 | ARD030 | GABM | yes | PyPoCpy | <1 | | 0.81 | 137 | 2.5 | 0.152 | | 51.6 | 0.018 | 0.4 | | | 0.37 | <0.1 | 6.5 | <0.5 | | 4 | | 0.4 | 0.2 | 0.075 |
| 2010-27 | ARD031 | UM | no | | <1 | | 1.46 | 368 | 2.2 | 0.153 | | 16.2 | 0.015 | 0.6 | | | <0.05 | <0.1 | 6.1 | <0.5 | | 5 | | 0.3 | 0.2 | 0.087 |
| 2010-28 | ARD032 | UMS | yes | Po | <1 | | 1.17 | 327 | 3.3 | 0.065 | | 39.1 | 0.016 | 0.5 | | | 0.24 | <0.1 | 4.5 | 1.9 | | 4 | | 1.1 | <0.1 | 0.062 |
| 2010-29 | ARD033 | PEG | yes | | 4 | | 3.73 | 624 | 1.9 | 0.14 | | 70.5 | 0.024 | 1.7 | | | 0.21 | <0.1 | 14.7 | <0.5 | | 9 | | <0.2 | 2.7 | 0.428 |
| 2010-30 | ARD034 | SAPGED | no | | <1 | | 10.75 | 1062 | 4.3 | 0.039 | | 91.1 | 0.015 | 0.3 | | | <0.05 | <0.1 | 4.7 | <0.5 | | 1 | | <0.2 | 0.1 | 0.035 |
| 2010-31 | ARD035 | SAPGED | no | | <1 | | 6.22 | 110 | 3.4 | 0.068 | | 171.6 | 0.004 | 1.1 | | | <0.05 | <0.1 | 4.6 | <0.5 | | 3 | | <0.2 | 0.1 | 0.049 |
| 2010-32 | ARD036 | UM | yes | S | <1 | | 0.54 | 55 | 2.5 | 0.351 | | 39.4 | 0.004 | 1.1 | | | 0.09 | <0.1 | 2.4 | <0.5 | | 99 | | 0.3 | <0.1 | 0.032 |
| 2010-33 | ARD037 | GNS | yes | | 31 | | 0.81 | 222 | 14 | 0.065 | | 22.8 | 0.045 | 2.9 | | | 0.25 | <0.1 | 3.5 | <0.5 | | 12 | | 0.3 | 9.8 | 0.195 |
| 2010-34 | ARD038 | PEG | no | S | 2 | | 0.22 | 70 | 5.1 | 0.077 | | 5.7 | 0.001 | 2.2 | | | <0.05 | <0.1 | 0.8 | <0.5 | | 8 | | <0.2 | 0.3 | 0.048 |
| 2010-35 | ARD039 | GABL | no | | 2 | | 1.4 | 345 | 3.5 | 0.145 | | 52.5 | 0.02 | 1 | | | 0.08 | <0.1 | 6.2 | <0.5 | | 5 | | <0.2 | 2 | 0.233 |
| 2010-36 | ARD040 | GABM | yes | S | 1 | | 0.57 | 215 | 1.8 | 0.295 | | 33.4 | 0.027 | 0.8 | | | 0.14 | <0.1 | 4.8 | <0.5 | | 42 | | <0.2 | 0.4 | 0.089 |
| 2010-37 | ARD041 | GABM | yes | | 3 | | 0.72 | 292 | 3.6 | 0.157 | | 25.7 | 0.023 | 0.9 | | | 0.08 | <0.1 | 6.3 | <0.5 | | 8 | | <0.2 | 1.7 | 0.12 |
| 2010-38 | ARD042 | PEG | yes | | 5 | | 0.59 | 171 | 10.4 | 0.076 | | 19.8 | 0.005 | 1.7 | | | 0.11 | <0.1 | 2.4 | <0.5 | | 7 | | 0.3 | 3.9 | 0.118 |
| 2010-39 | ARD043 | PEG | no | | 7 | | 1.24 | 238 | 5.4 | 0.108 | | 25.5 | 0.033 | 1.1 | | | <0.05 | <0.1 | 2.4 | <0.5 | | 10 | | <0.2 | 3.5 | 0.253 |
| 2010-40 | ARD044 | GABM | yes | PyPo | 3 | | 1.09 | 346 | 7.1 | 0.164 | | 38.1 | 0.03 | 1.3 | | | 0.29 | <0.1 | 7.6 | 0.9 | | 3 | | <0.2 | 3 | 0.169 |
| 2010-41 | ARD045 | UMS | yes | SPyPo | 3 | | 4.79 | 783 | 3.5 | 0.185 | | 89.4 | 0.009 | 2.3 | | | 1.73 | <0.1 | 7.8 | 3.3 | | 5 | | 3.3 | 1.5 | 0.21 |
| 2010-42 | ARD046 | UM | no | | <1 | | 2.14 | 222 | 4.4 | 0.044 | | 76.4 | 0.007 | 0.3 | | | <0.05 | <0.1 | 6.6 | <0.5 | | 36 | | <0.2 | 0.2 | 0.053 |
| 2010-43 | ARD047 | GABM | yes | | 2 | | 2.06 | 322 | 3.7 | 0.148 | | 52.6 | 0.035 | 0.9 | | | 0.07 | <0.1 | 5 | <0.5 | | 5 | | <0.2 | 0.9 | 0.241 |
| 2010-44 | ARD049 | OVB | no | | 25 | | 0.39 | 146 | 5.2 | 0.059 | | 5 | 0.028 | 1.4 | | | <0.05 | <0.1 | 1.5 | <0.5 | | 7 | | <0.2 | 8.2 | 0.129 |
| 2010-45 | ARD050 | UMS | yes | SPo | 1 | | 1.91 | 639 | 6.2 | 0.109 | | 59.9 | 0.013 | 0.8 | | | 1.38 | <0.1 | 6.1 | 2.2 | | 6 | | 2 | 0.2 | 0.067 |
| 2010-46 | ARD054 | PEG | no | | 1 | | 3.76 | 228 | 5.9 | 0.079 | | 180.2 | <0.001 | 1.2 | | | <0.05 | <0.1 | 8.1 | <0.5 | | 3 | | <0.2 | 0.7 | 0.246 |
| 2010-47 | ARD056 | PHLOG | yes | SPy | 1 | | 5.85 | 1082 | 0.7 | 0.188 | | 171 | 0.001 | 2.1 | | | 0.07 | <0.1 | 17 | <0.5 | | 21 | | <0.2 | 0.2 | 1.047 |
| 2010-48 | ARD057 | PEG | yes | SPy | 5 | | 0.79 | 287 | 3.6 | 0.085 | | 30.2 | 0.004 | 3.2 | | | 0.38 | <0.1 | 3.8 | <0.5 | | 8 | | <0.2 | 2.3 | 0.191 |
| 2010-49 | ARD058 | GNS | yes | Py | 6 | | 0.75 | 183 | 3.9 | 0.378 | | 48.2 | 0.016 | 2 | | | 0.2 | <0.1 | 2 | <0.5 | | 57 | | <0.2 | 1.4 | 0.091 |
| 2010-50 | ARD059 | GNS | yes | SPyPo | 8 | | 0.95 | 206 | 3.1 | 0.225 | | 57.3 | 0.028 | 1.6 | | | 0.39 | <0.1 | 2.6 | <0.5 | | 23 | | 0.3 | 2.8 | 0.108 |
| 2010-51 | ARD060 | GABL | yes | SPyPo | 3 | | 1.12 | 226 | 3.4 | 0.265 | | 39 | 0.012 | 1.3 | | | 0.07 | <0.1 | 3.5 | <0.5 | | 33 | | <0.2 | 1.5 | 0.131 |
| 2010-52 | ARD061 | GAB | yes | SPy | 23 | | 1.11 | 343 | 17.1 | 0.109 | | 42.6 | 0.007 | 9.7 | | | 0.25 | <0.1 | 5.3 | <0.5 | | 8 | | 0.3 | 36.2 | 0.184 |
| 2010-53 | ARD062 | PEG | yes | S | 18 | | 0.57 | 237 | 21.6 | 0.031 | | 24.6 | 0.003 | 9.9 | | | 0.14 | <0.1 | 2.9 | <0.5 | | 3 | | <0.2 | 31.9 | 0.107 |
| 2010-54 | ARD063 | UM | no | | 2 | | 3.08 | 704 | 3.1 | 0.077 | | 18.3 | 0.015 | 0.9 | | | 0.24 | <0.1 | 4.4 | <0.5 | | 41 | | <0.2 | 0.2 | 0.054 |
| 2010-55 | ARD065 | SAPGED | yes | | 4 | | 2.47 | 63 | 5.7 | 0.05 | | 21.4 | 0.005 | 0.8 | | | <0.05 | <0.1 | 1.3 | <0.5 | | 2 | | <0.2 | 0.2 | 0.031 |
| 2010-56 | ARD066 | SAPGED | no | | 17 | | 1.91 | 88 | 2.8 | 0.002 | | 61.5 | 0.727 | 0.9 | | | <0.05 | <0.1 | 1.1 | <0.5 | | 7 | | <0.2 | 1.6 | 0.006 |
| 2010-57 | ARD067 | SAPGED | yes | S | 2 | | 2.23 | 37 | 7.7 | 0.13 | | 28.8 | 0.007 | 1.3 | | | <0.05 | <0.1 | 1.5 | <0.5 | | 4 | | <0.2 | 0.2 | 0.084 |
| 2010-58 | ARD069 | PHLOG | yes | | 1 | | 5.35 | 656 | 1.2 | 0.232 | | 119.6 | 0.006 | 2.4 | | | 0.1 | <0.1 | 10.6 | 0.6 | | 29 | | <0.2 | 0.2 | 0.85 |
| 2010-59 | ARD070 | GNS | yes | | 49 | | 1 | 267 | 15.3 | 0.161 | | 27 | 0.062 | 6.9 | | | 0.14 | <0.1 | 3.2 | <0.5 | | 21 | | <0.2 | 24.2 | 0.196 |
| 2010-60 | ARD071 | PEG | no | | 8 | | 1.23 | 295 | 3.5 | 0.109 | | 35.9 | 0.007 | 2 | | | 0.06 | <0.1 | 4.7 | <0.5 | | 10 | | <0.2 | 7.2 | 0.252 |
| 2010-61 | ARD072 | GABL | yes | S | 29 | | 1.07 | 274 | 4.4 | 0.199 | | 32.9 | 0.05 | 4.5 | | | 0.24 | <0.1 | 3.7 | <0.5 | | 19 | | <0.2 | 15.5 | 0.209 |
| 2010-62 | ARD073 | OVB | no | | 40 | | 0.63 | 262 | 4.5 | 0.047 | | 16.9 | 0.064 | 3.9 | | | <0.05 | <0.1 | 3.6 | <0.5 | | 10 | | <0.2 | 14.4 | 0.218 |
| 2010-63 | ARD074 | PEG | yes | Po | 4 | | 1.12 | 415 | 4.2 | 0.038 | | 20.7 | 0.003 | 1.5 | | | 0.07 | <0.1 | 6.2 | <0.5 | | 4 | | <0.2 | 5.9 | 0.275 |
| 2010-64 | ARD075 | GAB | yes | Py | 2 | | 0.53 | 207 | 2.7 | 0.517 | | 23.3 | 0.011 | 2.5 | | | 0.08 | <0.1 | 4.4 | <0.5 | | 46 | | <0.2 | 1.1 | 0.099 |
| 2010-65 | ARD076 | GABM | no | | 2 | | 0.85 | 305 | 2.8 | 0.197 | | 26.6 | 0.023 | 0.9 | | | 0.12 | <0.1 | 6.6 | 0.6 | | 6 | | <0.2 | 1.3 | 0.122 |
| 2010-66 | ARD077 | GABL | no | S | 11 | | 2.4 | 435 | 4.5 | 0.073 | | 36 | 0.009 | 3.6 | | | <0.05 | <0.1 | 8.6 | <0.5 | | 6 | | <0.2 | 12.4 | 0.183 |
| 2010-67 | ARD078 | GABM | yes | S | 2 | | 1.17 | 335 | 3.4 | 0.144 | | 25.2 | 0.025 | 0.9 | | | 0.12 | <0.1 | 6.6 | <0.5 | | 4 | | <0.2 | 0.6 | 0.231 |
| 2010-68 | ARD079 | GNSAUG | yes | | 8 | | 1.5 | 365 | 3.8 | 0.155 | | 44.3 | 0.014 | 2.4 | | | 0.36 | <0.1 | 6.9 | 0.6 | | 12 | | <0.2 | 5.4 | 0.257 |
| 2010-69 | ARD080 | PHLOG | yes | S | 7 | | 2.54 | 574 | 6.9 | 0.062 | | 65.7 | 0.007 | 2.8 | | | 0.72 | <0.1 | 10.1 | 1 | | 5 | | 0.3 | 6.9 | 0.468 |
| 2010-70 | ARD081 | GABL | yes | Py | 19 | | 1.25 | 330 | 3.6 | 0.117 | | 35.6 | 0.019 | 5.4 | | | 0.21 | <0.1 | 4.5 | 0.7 | | 10 | | <0.2 | 15.2 | 0.182 |
| 2010-71 | ARD082 | GAB | yes | S | 6 | | 1.72 | 449 | 5.2 | 0.119 | | 45.5 | 0.025 | 1.7 | | | 0.56 | <0.1 | 8.2 | 0.6 | | 9 | | 0.5 | 1.5 | 0.286 |
| 2010-72 | ARD083 | GNSAUG | yes | S | 6 | | 1.11 | 313 | 3.6 | 0.13 | | 49.1 | 0.006 | 1.3 | | | <0.05 | <0.1 | 2.5 | <0.5 | | 9 | | <0.2 | 2.8 | 0.12 |
| 2011-01 | ARD211 | PHLOG-Ore | no | | 2 | | 6.78 | 110 | 1.6 | 0.34 | | 69.5 | 0.002 | 3.3 | | | <0.05 | <0.1 | 6.8 | <0.5 | | 7 | | <0.2 | 0.4 | 0.134 |
| 2011-02 | ARD210 | PHLOG-Ore | no | | 10 | | 4.12 | 585 | 2.8 | 0.136 | | 55 | 0.005 | 3.8 | | | <0.05 | <0.1 | 5.7 | <0.5 | | 61 | | <0.2 | 4.6 | 0.221 |
| 2011-03 | ARD201 | PHLOG-Ore | no | | 1 | | 2.43 | 67 | 2.7 | 0.565 | | 42.8 | 0.008 | 3.3 | | | <0.05 | <0.1 | 1.9 | <0.5 | | 85 | | <0.2 | <0.1 | 0.097 |
| 2011-04 | ARD200 | PHLOG-Ore | no | | 2 | | 6.36 | 193 | 1.4 | 0.24 | | 84.6 | 0.002 | 2 | | | <0.05 | <0.1 | 6.6 | <0.5 | | 6 | | <0.2 | <0.1 | 0.103 |
| 2011-05 | ARD202 | PHLOG-Ore | no | | <1 | | 3.83 | 47 | 2.9 | 0.17 | | 59.8 | <0.001 | 1.7 | | | <0.05 | <0.1 | 2.1 | <0.5 | | 6 | | 0.6 | 0.1 | 0.091 |
| 2011-06 | ARD212 | PHLOG-Ore | no | | <1 | | 4.96 | 78 | 4.4 | 0.239 | | 88.7 | <0.001 | 1.2 | | | <0.05 | <0.1 | 3.8 | <0.5 | | 7 | | <0.2 | <0.1 | 0.085 |
| 2011-07 | ARD203 | PHLOG-Ore | no | | 13 | | 7.44 | 114 | 2.1 | 0.39 | | 165.2 | 0.002 | 8.1 | | | <0.05 | <0.1 | 9.5 | <0.5 | | 88 | | <0.2 | 7.3 | 0.31 |
| 2011-08 | ARD206 | PHLOG-Ore | no | | 1 | | 3.51 | 37 | 5 | 0.198 | | 54.3 | 0.002 | 1.7 | | | <0.05 | <0.1 | 2.6 | <0.5 | | 6 | | <0.2 | 0.1 | 0.109 |
| 2011-09 | ARD204 | PHLOG-Ore | yes | PyPo | 9 | | 8.52 | 180 | 1.5 | 0.497 | | 120.9 | 0.003 | 5.4 | | | <0.05 | <0.1 | 10.8 | <0.5 | | 18 | | <0.2 | 0.9 | 0.369 |
| 2011-10 | ARD207 | PHLOG-Ore | no | | 2 | | 7.8 | 104 | 6.1 | 0.463 | | 94.1 | 0.002 | 5 | | | <0.05 | <0.1 | 7.6 | <0.5 | | 13 | | <0.2 | 0.5 | 0.187 |
| 2011-11 | ARD209 | PHLOG-Ore | no | | 1 | | 8.41 | 335 | 1.1 | 0.165 | | 200.5 | 0.005 | 2.8 | | | <0.05 | <0.1 | 16.7 | <0.5 | | 5 | | <0.2 | 0.5 | 0.171 |
| 2011-12 | ARD208 | PHLOG-Ore | no | | <1 | | 4.84 | 38 | 6.8 | 0.23 | | 68.7 | <0.001 | 1.8 | | | <0.05 | <0.1 | 3 | <0.5 | | 7 | | <0.2 | <0.1 | 0.115 |
| 2011-13 | ARD205 | PHLOG-Ore | no | | <1 | | 5.05 | 55 | 3.3 | 0.283 | | 89.4 | 0.002 | 1.9 | | | <0.05 | <0.1 | 3.2 | <0.5 | | 18 | | <0.2 | 0.1 | 0.128 |

**True North Gems**
**Aappaluttoq Ruby Property, Greenland**
**ARD Data**

| S. No. | Sample ID | Lithology | Sulphides | S-Type | Tl | U | V | W | Y | Zn | Zr | Extraction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ppm | ppm | ppm | ppm | ppm | ppm | ppm | |
| 11 | 13169 | PHLOG-Tails | no | | 0.8 | 0.1 | 110 | 1.9 | 0.9 | 21 | 0.3 | |
| 12 | 13170 | PHLOG-Tails | no | | 0.7 | <0.1 | 96 | 0.1 | 0.5 | 12 | 0.3 | |
| 2009-01 | M390901 | UMS | yes | SPyCpy | <0.1 | 0.1 | 4 | 0.2 | 0.5 | 8 | 0.4 | |
| 2009-02 | M390902 | GNS | no | | <0.1 | 1.6 | 18 | 295 | 2.1 | 15 | 0.8 | y |
| 2009-03 | M390903 | PEG | no | | 1.5 | 0.3 | 257 | 5.4 | 3.1 | 10 | 0.2 | y |
| 2009-04 | M390904 | GAB | yes | | 1.7 | 0.1 | 96 | 3.2 | 0.5 | 41 | 0.2 | |
| 2009-05 | M390905 | SAPGED | no | | 0.1 | <0.1 | 25 | 1.1 | 0.8 | 4 | 0.3 | |
| 2009-06 | M390906 | UM | yes | | <0.1 | 0.1 | 209 | 1.3 | 1.2 | 4 | 1.7 | |
| 2009-07 | M390907 | GABL | yes | | <0.1 | 0.1 | 29 | 0.9 | 1.8 | 2 | 0.7 | |
| 2009-08 | M390908 | SAPGED | no | | 0.1 | 0.1 | 14 | 0.4 | 1.9 | 1 | 0.3 | |
| 2009-09 | M390909 | GAB | yes | | 0.6 | 2.2 | 78 | 0.6 | 5.9 | 46 | 3.1 | |
| 2009-10 | M390910 | GAB | yes | | 0.2 | 1.1 | 70 | 0.3 | 6.2 | 44 | 3.9 | |
| 2009-11 | M390911 | GNS | yes | | 0.4 | 0.4 | 40 | 0.3 | 2.4 | 42 | 1.2 | |
| 2009-12 | M390912 | GABL | yes | S | 0.2 | 2.0 | 45 | 0.5 | 5.6 | 34 | 4.3 | |
| 2009-13 | M390913 | SAPGED | no | | 0.7 | 0.1 | 64 | 0.2 | 2.4 | 4 | 0.3 | |
| 2009-14 | M390914 | GNS | yes | S | 0.5 | 0.4 | 58 | 0.2 | 1.7 | 47 | 1.7 | |
| 2009-15 | M390915 | GAB | yes | | 0.1 | 0.5 | 39 | 0.2 | 4.1 | 12 | 2 | |
| 2009-16 | M390916 | SAPGED | no | | <0.1 | 0.2 | 7 | 0.2 | 0.8 | 2 | 0.8 | |
| 2009-17 | M390917 | GABL | yes | | 0.5 | 0.7 | 31 | 0.3 | 2.9 | 38 | 0.7 | |
| 2009-18 | M390918 | SAPGED | no | | 0.4 | 0.1 | 46 | 0.2 | 0.6 | 10 | 0.3 | |
| 2009-19 | M390919 | GNS | yes | S | 0.7 | 0.3 | 43 | 0.2 | 2.2 | 53 | 0.6 | |
| 2010-01 | ARD002 | PEG | no | | 0.1 | 9.4 | 10 | 0.2 | | 14 | | |
| 2010-02 | ARD003 | UMS | yes | SPyPoCpy | <0.1 | 1 | 423 | 0.1 | | 3 | | y |
| 2010-03 | ARD004 | SAPGED | yes | | 0.2 | 1.1 | 38 | <0.1 | | 2 | | |
| 2010-04 | ARD005 | UMS | no | SPyCpy | <0.1 | 3 | 14 | <0.1 | | 2 | | |
| 2010-05 | ARD007 | PEG | no | | 0.4 | 3.6 | 7 | 0.2 | | 15 | | |
| 2010-06 | ARD008 | SAPGED | no | | <0.1 | 0.1 | 8 | <0.1 | | 2 | | |
| 2010-07 | ARD010 | PEG | no | | 0.2 | 9 | 8 | 0.1 | | 14 | | |
| 2010-08 | ARD012 | SAPGED | no | Cpy | 2.4 | 0.2 | 82 | <0.1 | | 2 | | y |
| 2010-09 | ARD013 | UM | yes | Py | 0.5 | 0.4 | 114 | <0.1 | | 51 | | |
| 2010-10 | ARD014 | SAPGED | no | | 0.4 | 0.1 | 41 | <0.1 | | 2 | | y |
| 2010-11 | ARD015 | GAB | no | | 1.4 | <0.1 | 148 | 0.2 | | 38 | | y |
| 2010-12 | ARD016 | OVB | no | | 0.2 | 0.3 | 8 | 0.2 | | 22 | | y |
| 2010-13 | ARD017 | GABM | yes | | 0.9 | 1.6 | 189 | 0.2 | | 77 | | y |
| 2010-14 | ARD018 | UMS | yes | Po | 0.4 | <0.1 | 60 | <0.1 | | 24 | | y |
| 2010-15 | ARD019 | UMS | yes | PyPoCpy | <0.1 | <0.1 | 28 | <0.1 | | 2 | | |
| 2010-16 | ARD020 | UM | yes | S | <0.1 | <0.1 | 27 | <0.1 | | 2 | | |
| 2010-17 | ARD021 | GABM | no | SPo | <0.1 | <0.1 | 51 | <0.1 | | 15 | | y |
| 2010-18 | ARD022 | UMS | no | Po | <0.1 | <0.1 | 29 | <0.1 | | 2 | | |
| 2010-19 | ARD023 | PHLOG | yes | SPo | 0.1 | 0.2 | 108 | 0.7 | | 12 | | |
| 2010-20 | ARD024 | UM | yes | | 1.3 | <0.1 | 99 | <0.1 | | 8 | | y |
| 2010-21 | ARD025 | PHLOG | no | Po | 2.2 | 0.5 | 145 | <0.1 | | 19 | | y |
| 2010-22 | ARD026 | UMS | yes | PoCpy | 1.2 | <0.1 | 77 | <0.1 | | 78 | | |
| 2010-23 | ARD027 | UM | yes | Cpy | 0.3 | <0.1 | 81 | <0.1 | | 37 | | |
| 2010-24 | ARD028 | GAB | yes | | <0.1 | 0.2 | 133 | 0.2 | | 4 | | |
| 2010-25 | ARD029 | GABM | yes | PyPoCpy | <0.1 | 0.1 | 66 | <0.1 | | 27 | | |
| 2010-26 | ARD030 | GABM | yes | PyPoCpy | <0.1 | <0.1 | 57 | <0.1 | | 18 | | |
| 2010-27 | ARD031 | UM | no | | <0.1 | <0.1 | 49 | <0.1 | | 23 | | y |
| 2010-28 | ARD032 | UMS | yes | Po | <0.1 | <0.1 | 47 | <0.1 | | 6 | | |
| 2010-29 | ARD033 | PEG | yes | | 1.4 | 1.2 | 175 | 0.2 | | 77 | | y |
| 2010-30 | ARD034 | SAPGED | no | | <0.1 | <0.1 | 60 | <0.1 | | 2 | | |
| 2010-31 | ARD035 | SAPGED | no | | 0.2 | <0.1 | 37 | <0.1 | | 1 | | |
| 2010-32 | ARD036 | UM | yes | S | <0.1 | <0.1 | 27 | <0.1 | | 2 | | |
| 2010-33 | ARD037 | GNS | yes | | 0.5 | 0.7 | 39 | 0.3 | | 41 | | y |
| 2010-34 | ARD038 | PEG | no | S | 0.1 | 0.4 | 8 | <0.1 | | 13 | | |
| 2010-35 | ARD039 | GABL | no | | 0.5 | 1 | 75 | <0.1 | | 45 | | |
| 2010-36 | ARD040 | GABM | yes | S | <0.1 | 0.2 | 53 | <0.1 | | 18 | | |
| 2010-37 | ARD041 | GABM | yes | | <0.1 | 0.8 | 53 | <0.1 | | 22 | | |
| 2010-38 | ARD042 | PEG | yes | | 0.4 | 0.3 | 26 | <0.1 | | 32 | | |
| 2010-39 | ARD043 | PEG | no | | 0.7 | 0.2 | 62 | <0.1 | | 44 | | |
| 2010-40 | ARD044 | GABM | yes | PyPo | 0.2 | 2.4 | 90 | <0.1 | | 48 | | |
| 2010-41 | ARD045 | UMS | yes | SPyPo | 0.9 | 2 | 123 | 0.2 | | 52 | | |
| 2010-42 | ARD046 | UM | no | | <0.1 | <0.1 | 34 | <0.1 | | 7 | | |
| 2010-43 | ARD047 | GABM | yes | | 0.8 | 0.5 | 89 | 0.1 | | 63 | | |
| 2010-44 | ARD049 | OVB | no | | 0.3 | 0.1 | 21 | <0.1 | | 33 | | |
| 2010-45 | ARD050 | UMS | yes | SPo | <0.1 | 0.9 | 49 | 0.3 | | 34 | | |
| 2010-46 | ARD054 | PEG | no | | 1.2 | 0.5 | 72 | 0.1 | | 59 | | |
| 2010-47 | ARD056 | PHLOG | yes | SPy | 3.4 | 0.1 | 205 | <0.1 | | 204 | | |
| 2010-48 | ARD057 | PEG | yes | SPy | 0.9 | 1.6 | 31 | 0.2 | | 50 | | |
| 2010-49 | ARD058 | GNS | yes | Py | 0.3 | 0.7 | 33 | 0.2 | | 24 | | |
| 2010-50 | ARD059 | GNS | yes | SPyPo | 0.3 | 0.8 | 41 | <0.1 | | 29 | | |
| 2010-51 | ARD060 | GABL | yes | SPyPo | 0.4 | 1.2 | 51 | 0.1 | | 39 | | |
| 2010-52 | ARD061 | GAB | yes | SPy | 0.9 | 2.2 | 44 | 0.4 | | 54 | | |
| 2010-53 | ARD062 | PEG | yes | S | 0.6 | 10.7 | 19 | 0.5 | | 33 | | |
| 2010-54 | ARD063 | UM | no | | 0.1 | 0.2 | 45 | 0.5 | | 2 | | |
| 2010-55 | ARD065 | SAPGED | yes | | 0.2 | <0.1 | 35 | <0.1 | | 1 | | |
| 2010-56 | ARD066 | SAPGED | no | | <0.1 | 0.9 | 18 | <0.1 | | 1 | | |
| 2010-57 | ARD067 | SAPGED | yes | S | 0.2 | <0.1 | 55 | <0.1 | | 2 | | |
| 2010-58 | ARD069 | PHLOG | yes | | 2.4 | 0.3 | 199 | 0.2 | | 205 | | |
| 2010-59 | ARD070 | GNS | yes | | 0.6 | 0.8 | 46 | <0.1 | | 48 | | |
| 2010-60 | ARD071 | PEG | no | | 0.9 | 0.6 | 55 | 0.1 | | 71 | | |
| 2010-61 | ARD072 | GABL | yes | S | 0.6 | 1.1 | 49 | <0.1 | | 49 | | |
| 2010-62 | ARD073 | OVB | no | | 0.5 | 0.3 | 29 | <0.1 | | 57 | | |
| 2010-63 | ARD074 | PEG | yes | Po | 1.3 | 1.4 | 39 | 0.2 | | 74 | | |
| 2010-64 | ARD075 | GAB | yes | Py | <0.1 | 0.8 | 48 | 0.4 | | 19 | | y |
| 2010-65 | ARD076 | GABM | no | | <0.1 | 1.5 | 68 | <0.1 | | 29 | | y |
| 2010-66 | ARD077 | GABL | no | S | 1.3 | 6.3 | 86 | 0.1 | | 126 | | |
| 2010-67 | ARD078 | GABM | yes | S | 0.4 | 1.2 | 86 | <0.1 | | 41 | | |
| 2010-68 | ARD079 | GNSAUG | yes | | 0.8 | 1.6 | 84 | <0.1 | | 72 | | y |
| 2010-69 | ARD080 | PHLOG | yes | S | 1.5 | 0.8 | 116 | 0.1 | | 141 | | y |
| 2010-70 | ARD081 | GABL | yes | Py | 0.7 | 2.3 | 61 | <0.1 | | 66 | | |
| 2010-71 | ARD082 | GAB | yes | S | 0.9 | 2.7 | 104 | 0.1 | | 86 | | y |
| 2010-72 | ARD083 | GNSAUG | yes | S | 0.4 | 1.5 | 35 | <0.1 | | 43 | | |
| 2011-01 | ARD211 | PHLOG-Ore | no | | 1.1 | 3.4 | 103 | <0.1 | | 8 | | |
| 2011-02 | ARD210 | PHLOG-Ore | no | | 2 | 1.3 | 86 | <0.1 | | 126 | | |
| 2011-03 | ARD201 | PHLOG-Ore | no | | 0.3 | 0.1 | 59 | <0.1 | | 24 | | |
| 2011-04 | ARD200 | PHLOG-Ore | no | | 1.4 | <0.1 | 136 | <0.1 | | 14 | | |
| 2011-05 | ARD202 | PHLOG-Ore | no | | 0.4 | <0.1 | 34 | <0.1 | | 16 | | |
| 2011-06 | ARD212 | PHLOG-Ore | no | | 0.6 | <0.1 | 74 | <0.1 | | 25 | | |
| 2011-07 | ARD203 | PHLOG-Ore | no | | 1.8 | 0.7 | 102 | <0.1 | | 6 | | |
| 2011-08 | ARD206 | PHLOG-Ore | no | | 0.5 | <0.1 | 102 | <0.1 | | 2 | | |
| 2011-09 | ARD204 | PHLOG-Ore | yes | PyPo | 2 | 0.4 | 214 | <0.1 | | 8 | | |
| 2011-10 | ARD207 | PHLOG-Ore | no | | 1.9 | 1.5 | 143 | <0.1 | | 8 | | |
| 2011-11 | ARD209 | PHLOG-Ore | no | | 1.9 | 0.5 | 134 | 1.1 | | 52 | | |
| 2011-12 | ARD208 | PHLOG-Ore | no | | 0.5 | <0.1 | 43 | 0.1 | | 18 | | |
| 2011-13 | ARD205 | PHLOG-Ore | no | | 0.5 | <0.1 | 76 | 0.3 | | 30 | | |

# Appendix IV

# Whole Rock Analysis Data

**True North Gems**
**Aappaluttoq Ruby Property, Greenland**
**ARD Data**

| | | | | | Whole Rock | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| S. No. | Sample ID | Lithology | Sulphides | S-Type | SiO2 | Al2O3 | Fe2O3 | CaO | MgO | Na2O | K2O | MnO | TiO2 | P2O5 | Cr2O3 | Ba | LOI | SUM |
| 11 | 13169 | PHLOG-Tails | no | | | | | | | | | | | | | | | |
| 12 | 13170 | PHLOG-Tails | no | | | | | | | | | | | | | | | |
| 2009-01 | M390901 | UMS | yes | SPyCpy | 44.4 | 17.35 | 10.82 | 0.45 | 23.05 | 1.61 | 0.03 | 0.11 | 0.39 | <0.01 | 0.047 | <0.01 | 1.34 | 99.49 |
| 2009-02 | M390902 | GNS | no | | 48.8 | 26.29 | 4.04 | 13.19 | 2.05 | 3.29 | 0.41 | 0.08 | 0.26 | 0.03 | 0.024 | <0.01 | 0.44 | 98.9 |
| 2009-03 | M390903 | PEG | no | | 38.3 | 17.86 | 2.8 | 0.45 | 24.46 | 1.15 | 5.62 | 0.01 | 0.82 | 0.02 | 0.027 | 0.03 | 7.58 | 99.09 |
| 2009-04 | M390904 | GAB | yes | | 43.9 | 24.59 | 6.24 | 6.41 | 9.95 | 2.19 | 3.68 | 0.07 | 0.57 | 0.01 | 0.023 | 0.03 | 1.64 | 99.26 |
| 2009-05 | M390905 | SAPGED | no | | 34.6 | 27.26 | 5.01 | 0.14 | 30.85 | 0.18 | 0.32 | 0.05 | 0.55 | <0.01 | 0.051 | <0.01 | 1.23 | 100.17 |
| 2009-06 | M390906 | UM | yes | | 36.2 | 15.34 | 20.45 | 2.76 | 22.24 | 0.38 | 0.12 | 0.1 | 1.26 | 0.06 | 0.054 | <0.01 | 1.13 | 100.08 |
| 2009-07 | M390907 | GABL | yes | | 42.5 | 24.3 | 9.31 | 10.2 | 9.54 | 1.1 | 0.1 | 0.1 | 0.78 | 0.02 | 0.036 | <0.01 | 0.53 | 98.49 |
| 2009-08 | M390908 | SAPGED | no | | 45.6 | 12.88 | 5.19 | 0.23 | 32.58 | 0.05 | 0.19 | 0.04 | 1.4 | 0.04 | 0.015 | <0.01 | 2.44 | 100.65 |
| 2009-09 | M390909 | GAB | yes | | 45.4 | 17.02 | 10.96 | 8.44 | 9.05 | 2.84 | 1.87 | 0.13 | 1.06 | 0.59 | 0.026 | 0.06 | 1.29 | 98.68 |
| 2009-10 | M390910 | GAB | yes | | 57.3 | 11.23 | 12.43 | 5.92 | 6.52 | 2.02 | 0.87 | 0.15 | 1.69 | 0.19 | 0.031 | 0.11 | 0.83 | 99.25 |
| 2009-11 | M390911 | GNS | yes | | 67.7 | 15.41 | 3.73 | 4.32 | 1.97 | 3.7 | 1.35 | 0.04 | 0.52 | 0.16 | 0.022 | 0.05 | 0.44 | 99.39 |
| 2009-12 | M390912 | GABL | yes | S | 48.2 | 19.7 | 8.85 | 9.75 | 5.53 | 3.8 | 0.98 | 0.12 | 1.1 | 0.48 | 0.018 | 0.03 | 1.18 | 99.66 |
| 2009-13 | M390913 | SAPGED | no | | 41.6 | 17.58 | 4.3 | 0.18 | 29.82 | 0.26 | 1.56 | 0.05 | 0.84 | 0.04 | 0.03 | <0.01 | 3.4 | 99.61 |
| 2009-14 | M390914 | GNS | yes | S | 63 | 16.13 | 4.94 | 4.92 | 3.12 | 3.76 | 1.48 | 0.02 | 1.05 | 0.36 | 0.02 | 0.09 | 0.45 | 99.35 |
| 2009-15 | M390915 | GAB | yes | | 48.1 | 20.49 | 9.45 | 9.98 | 6.07 | 3.16 | 0.45 | 0.16 | 0.71 | 0.04 | 0.026 | <0.01 | 0.43 | 99.08 |
| 2009-16 | M390916 | SAPGED | no | | 38.5 | 21.29 | 8.93 | 0.18 | 28.77 | 0.03 | 0.03 | 0.09 | 0.97 | <0.01 | 0.095 | <0.01 | 1.12 | 99.89 |
| 2009-17 | M390917 | GABL | yes | | 67.3 | 16.1 | 3 | 4.2 | 1.82 | 3.99 | 1.35 | 0.03 | 0.35 | 0.12 | 0.025 | 0.03 | 0.51 | 98.85 |
| 2009-18 | M390918 | SAPGED | no | | 33.8 | 32.59 | 4.2 | 0.2 | 23.31 | 1 | 2.22 | 0.03 | 0.44 | <0.01 | 0.044 | 0.01 | 2.02 | 99.77 |
| 2009-19 | M390919 | GNS | yes | S | 67.6 | 16.05 | 3.6 | 4.2 | 2 | 3.67 | 1.55 | 0.03 | 0.46 | 0.15 | 0.018 | 0.05 | 0.38 | 99.72 |
| 2010-01 | ARD002 | PEG | no | | 75.30 | 12.70 | 0.74 | 2.24 | 0.30 | 2.97 | 3.76 | 0.01 | 0.09 | <0.01 | 0.02 | 0.1 | 0.50 | 98.74 |
| 2010-02 | ARD003 | UMS | yes | SPyPoCpy | 24.60 | 11.53 | 20.94 | 7.35 | 26.56 | 0.08 | 0.02 | 0.09 | 0.70 | 5.04 | 0.06 | 0.0 | 2.06 | 99.02 |
| 2010-03 | ARD004 | SAPGED | yes | | 42.40 | 15.84 | 6.80 | 0.26 | 30.83 | 0.06 | 0.62 | 0.06 | 0.68 | 0.13 | 0.06 | <0.01 | 2.75 | 100.46 |
| 2010-04 | ARD005 | UMS | no | SPyCpy | 44.30 | 12.79 | 6.99 | 0.45 | 31.46 | <0.01 | 0.04 | 0.07 | 0.67 | 0.22 | 0.07 | <0.01 | 2.81 | 99.85 |
| 2010-05 | ARD007 | PEG | no | | 73.80 | 13.22 | 0.97 | 0.75 | 0.53 | 2.31 | 7.11 | 0.02 | 0.11 | 0.02 | 0.01 | 0.1 | 0.25 | 99.15 |
| 2010-06 | ARD008 | SAPGED | no | | 37.50 | 23.45 | 6.73 | 0.08 | 29.34 | 0.03 | 0.02 | 0.07 | 0.70 | <0.01 | 0.10 | <0.01 | 2.42 | 100.33 |
| 2010-07 | ARD010 | PEG | no | | 72.20 | 15.00 | 0.95 | 2.35 | 0.68 | 3.95 | 3.52 | 0.01 | 0.17 | 0.02 | 0.02 | 0.1 | 0.34 | 99.22 |
| 2010-08 | ARD012 | SAPGED | no | Cpy | 31.50 | 29.75 | 5.77 | 0.04 | 22.51 | 0.67 | 6.56 | 0.03 | 0.21 | <0.01 | 0.02 | 0.0 | 2.36 | 99.43 |
| 2010-09 | ARD013 | UM | yes | Py | 43.80 | 14.84 | 11.96 | 9.18 | 13.21 | 1.55 | 1.82 | 0.18 | 1.08 | 0.05 | 0.03 | 0.0 | 1.38 | 99.05 |
| 2010-10 | ARD014 | SAPGED | no | | 41.90 | 17.99 | 4.65 | 0.68 | 31.04 | 0.26 | 1.07 | 0.08 | 0.28 | 0.01 | 0.11 | <0.01 | 2.12 | 100.02 |
| 2010-11 | ARD015 | GAB | no | | 43.50 | 24.88 | 5.14 | 7.73 | 10.46 | 1.62 | 4.56 | 0.04 | 0.49 | <0.01 | 0.03 | 0.0 | 1.56 | 99.98 |
| 2010-12 | ARD016 | OVB | no | | 73.10 | 13.91 | 1.25 | 1.47 | 0.37 | 3.60 | 4.72 | 0.02 | 0.19 | 0.03 | 0.02 | 0.1 | 0.24 | 98.95 |
| 2010-13 | ARD017 | GABM | yes | | 47.70 | 13.62 | 12.54 | 5.92 | 11.68 | 1.41 | 2.72 | 0.14 | 0.96 | <0.01 | 0.03 | 0.0 | 1.93 | 98.66 |
| 2010-14 | ARD018 | UMS | yes | Po | 43.50 | 11.37 | 11.95 | 9.39 | 16.50 | 1.13 | 1.34 | 0.27 | 0.71 | 0.06 | 0.02 | <0.01 | 2.32 | 98.54 |
| 2010-15 | ARD019 | UMS | yes | PyPoCpy | 43.20 | 12.84 | 12.81 | 9.38 | 18.39 | 0.61 | 0.10 | 0.32 | 0.70 | 0.02 | 0.02 | <0.01 | 1.72 | 100.11 |
| 2010-16 | ARD020 | UM | yes | S | 34.50 | 16.83 | 9.61 | 6.78 | 28.57 | 0.64 | 0.18 | 0.33 | 1.05 | 0.11 | 0.03 | <0.01 | 1.62 | 100.25 |
| 2010-17 | ARD021 | GABM | no | SPo | 53.30 | 14.71 | 9.84 | 7.77 | 8.82 | 2.42 | 0.23 | 0.09 | 0.90 | 0.05 | 0.03 | <0.01 | 0.93 | 99.08 |
| 2010-18 | ARD022 | UMS | no | Po | 39.40 | 12.10 | 8.84 | 9.39 | 25.44 | 0.67 | 0.17 | 0.32 | 0.69 | 0.15 | 0.02 | <0.01 | 1.58 | 98.72 |
| 2010-19 | ARD023 | PHLOG | yes | SPo | 35.80 | 27.05 | 12.72 | 7.17 | 11.70 | 1.16 | 0.73 | 0.28 | 1.57 | 0.03 | 0.05 | <0.01 | 1.34 | 99.51 |
| 2010-20 | ARD024 | UM | yes | | 37.10 | 18.25 | 3.45 | 0.26 | 30.11 | 0.60 | 6.14 | 0.05 | 0.45 | 0.01 | 0.06 | <0.01 | 3.82 | 100.21 |
| 2010-21 | ARD025 | PHLOG | no | Po | 35.80 | 20.55 | 6.75 | 0.99 | 23.15 | 0.94 | 6.39 | 0.06 | 0.58 | 0.02 | 0.06 | 0.1 | 3.98 | 99.29 |
| 2010-22 | ARD026 | UMS | yes | PoCpy | 44.00 | 12.37 | 12.56 | 8.22 | 16.54 | 1.02 | 2.71 | 0.42 | 0.69 | 0.04 | 0.02 | <0.01 | 1.81 | 100.39 |
| 2010-23 | ARD027 | UM | yes | Cpy | 44.00 | 15.11 | 11.94 | 11.34 | 11.79 | 1.58 | 0.99 | 0.34 | 0.98 | 0.04 | 0.03 | <0.01 | 1.62 | 99.73 |
| 2010-24 | ARD028 | GAB | yes | | 43.70 | 11.25 | 5.04 | 8.97 | 25.90 | 1.24 | 0.55 | 0.17 | 1.30 | 0.42 | 0.04 | <0.01 | 1.71 | 100.27 |
| 2010-25 | ARD029 | GABM | yes | PyPoCpy | 51.70 | 14.04 | 9.80 | 8.59 | 10.41 | 1.96 | 0.43 | 0.12 | 0.93 | 0.05 | 0.02 | <0.01 | 1.21 | 99.23 |
| 2010-26 | ARD030 | GABM | yes | PyPoCpy | 52.10 | 15.01 | 9.50 | 7.72 | 9.17 | 2.46 | 0.40 | 0.17 | 0.90 | 0.06 | 0.02 | <0.01 | 0.98 | 98.43 |
| 2010-27 | ARD031 | UM | no | | 44.70 | 12.98 | 12.43 | 8.34 | 16.74 | 1.35 | 0.41 | 0.41 | 0.80 | 0.05 | 0.02 | <0.01 | 1.49 | 99.74 |
| 2010-28 | ARD032 | UMS | yes | Po | 43.70 | 13.16 | 14.27 | 6.22 | 19.51 | 0.59 | 0.31 | 0.40 | 0.78 | 0.05 | 0.02 | <0.01 | 0.90 | 99.89 |
| 2010-29 | ARD033 | PEG | yes | | 46.20 | 15.32 | 11.59 | 6.54 | 11.53 | 1.39 | 3.98 | 0.22 | 1.07 | 0.06 | 0.02 | 0.0 | 1.43 | 99.35 |
| 2010-30 | ARD034 | SAPGED | no | | 36.80 | 15.52 | 5.48 | 6.36 | 31.39 | 0.86 | 0.16 | 0.25 | 0.87 | 0.04 | 0.04 | <0.01 | 1.93 | 99.69 |
| 2010-31 | ARD035 | SAPGED | no | | 37.40 | 19.39 | 4.66 | 0.15 | 34.44 | 0.12 | 0.72 | 0.06 | 0.28 | <0.01 | 0.08 | <0.01 | 3.07 | 100.3 |
| 2010-32 | ARD036 | UM | yes | S | 44.00 | 23.54 | 8.00 | 10.75 | 10.36 | 1.34 | 0.15 | 0.07 | 0.71 | 0.02 | 0.02 | <0.01 | 0.81 | 99.74 |
| 2010-33 | ARD037 | GNS | yes | | 69.20 | 15.06 | 3.33 | 3.79 | 1.55 | 3.79 | 1.37 | 0.03 | 0.37 | 0.12 | 0.02 | 0.0 | 0.53 | 99.17 |
| 2010-34 | ARD038 | PEG | no | S | 73.90 | 14.63 | 0.98 | 3.86 | 0.44 | 4.16 | 0.67 | <0.01 | 0.15 | <0.01 | 0.02 | <0.01 | 0.32 | 99.09 |
| 2010-35 | ARD039 | GABL | no | | 56.20 | 14.34 | 9.76 | 6.84 | 5.68 | 2.65 | 1.40 | 0.14 | 0.78 | 0.06 | 0.03 | 0.0 | 0.66 | 98.52 |
| 2010-36 | ARD040 | GABM | yes | S | 50.20 | 14.51 | 12.89 | 11.19 | 6.58 | 1.99 | 0.41 | 0.16 | 1.16 | 0.08 | 0.03 | <0.01 | 0.64 | 99.82 |
| 2010-37 | ARD041 | GABM | yes | | 59.00 | 12.80 | 10.05 | 8.41 | 5.04 | 2.16 | 0.59 | 0.14 | 0.85 | 0.07 | 0.04 | <0.01 | 0.46 | 99.58 |
| 2010-38 | ARD042 | PEG | yes | | 73.10 | 13.98 | 2.42 | 3.39 | 1.12 | 3.70 | 1.25 | 0.02 | 0.25 | 0.02 | 0.02 | 0.0 | 0.40 | 99.69 |
| 2010-39 | ARD043 | PEG | no | | 68.50 | 14.10 | 4.06 | 4.21 | 2.62 | 2.94 | 1.68 | 0.04 | 0.50 | 0.08 | 0.03 | 0.0 | 0.42 | 99.14 |
| 2010-40 | ARD044 | GABM | yes | PyPo | 53.20 | 14.21 | 12.62 | 8.25 | 6.28 | 2.48 | 0.87 | 0.18 | 1.05 | 0.08 | 0.04 | <0.01 | 0.51 | 99.73 |
| 2010-41 | ARD045 | UMS | yes | SPyPo | 36.90 | 15.29 | 14.55 | 6.87 | 17.93 | 1.13 | 2.26 | 0.43 | 1.08 | 0.03 | 0.01 | <0.01 | 2.14 | 98.61 |
| 2010-42 | ARD046 | UM | no | | 38.60 | 17.59 | 9.21 | 3.70 | 27.06 | 0.42 | 0.08 | 0.17 | 1.03 | 0.03 | 0.03 | <0.01 | 2.02 | 99.87 |
| 2010-43 | ARD047 | GABM | yes | | 52.10 | 14.99 | 10.12 | 7.45 | 8.65 | 2.60 | 1.71 | 0.18 | 0.92 | 0.10 | 0.03 | 0.0 | 0.72 | 99.59 |
| 2010-44 | ARD049 | OVB | no | | 73.40 | 14.24 | 2.00 | 3.27 | 0.71 | 4.06 | 1.14 | 0.02 | 0.30 | 0.08 | 0.02 | 0.0 | 0.23 | 99.44 |
| 2010-45 | ARD050 | UMS | yes | SPo | 38.10 | 15.80 | 14.91 | 6.76 | 17.90 | 1.18 | 0.23 | 0.57 | 0.95 | 0.04 | 0.03 | <0.01 | 2.41 | 98.86 |
| 2010-46 | ARD054 | PEG | no | | 62.80 | 15.00 | 3.49 | 2.45 | 6.76 | 3.18 | 3.16 | 0.03 | 0.50 | <0.01 | 0.02 | 0.0 | 0.95 | 98.35 |
| 2010-47 | ARD056 | PHLOG | yes | SPy | 40.30 | 18.42 | 13.77 | 2.94 | 10.92 | 1.02 | 7.36 | 0.16 | 2.26 | <0.01 | 0.03 | 0.1 | 1.07 | 98.35 |
| 2010-48 | ARD057 | PEG | yes | SPy | 62.90 | 19.30 | 3.80 | 4.70 | 1.43 | 5.14 | 1.52 | 0.04 | 0.37 | 0.02 | 0.01 | 0.0 | 0.59 | 99.82 |
| 2010-49 | ARD058 | GNS | yes | Py | 52.80 | 24.35 | 3.67 | 9.75 | 2.40 | 4.42 | 0.92 | 0.05 | 0.29 | 0.04 | 0.02 | <0.01 | 0.65 | 99.33 |
| 2010-50 | ARD059 | GNS | yes | SPyPo | 51.60 | 22.05 | 5.61 | 9.12 | 3.74 | 4.38 | 1.06 | 0.08 | 0.34 | 0.08 | 0.02 | 0.0 | 0.79 | 98.88 |
| 2010-51 | ARD060 | GABL | yes | SPyPo | 58.00 | 19.24 | 4.88 | 7.46 | 3.55 | 3.58 | 1.32 | 0.06 | 0.33 | 0.03 | 0.02 | 0.0 | 0.65 | 99.12 |
| 2010-52 | ARD061 | GAB | yes | SPy | 64.20 | 17.22 | 4.50 | 4.27 | 2.41 | 4.10 | 2.04 | 0.06 | 0.32 | 0.02 | 0.02 | 0.0 | 0.67 | 99.78 |
| 2010-53 | ARD062 | PEG | yes | S | 69.30 | 15.10 | 2.25 | 1.50 | 1.05 | 2.86 | 6.28 | 0.03 | 0.23 | 0.02 | 0.01 | 0.1 | 0.54 | 99.27 |
| 2010-54 | ARD063 | UM | no | | 33.20 | 14.65 | 7.41 | 16.34 | 16.73 | 0.91 | 0.57 | 0.23 | 0.81 | 0.04 | 0.02 | <0.01 | 8.63 | 99.53 |
| 2010-55 | ARD065 | SAPGED | yes | | 34.80 | 26.17 | 3.57 | 0.17 | 31.34 | 0.07 | 0.40 | 0.05 | 0.52 | 0.02 | 0.04 | <0.01 | 3.31 | 100.42 |
| 2010-56 | ARD066 | SAPGED | no | | 41.00 | 13.48 | 7.79 | 2.44 | 30.02 | 0.01 | 0.02 | 0.07 | 0.41 | 1.75 | 0.03 | <0.01 | 3.40 | 100.38 |
| 2010-57 | ARD067 | SAPGED | yes | S | 33.10 | 33.06 | 4.58 | 0.37 | 25.52 | 0.86 | 1.08 | 0.05 | 0.44 | 0.02 | 0.12 | <0.01 | 1.34 | 100.47 |
| 2010-58 | ARD069 | PHLOG | yes | | 39.60 | 18.24 | 15.88 | 3.73 | 10.91 | 1.20 | 6.36 | 0.13 | 1.95 | 0.02 | 0.03 | 0.1 | 1.30 | 99.52 |
| 2010-59 | ARD070 | GNS | yes | | 62.40 | 18.30 | 3.68 | 5.71 | 1.91 | 3.96 | 1.53 | 0.04 | 0.35 | 0.16 | 0.02 | 0.0 | 0.57 | 98.66 |
| 2010-60 | ARD071 | PEG | no | | 59.30 | 19.79 | 4.55 | 4.75 | 2.77 | 4.57 | 1.95 | 0.04 | 0.48 | 0.02 | 0.02 | 0.0 | 0.58 | 98.8 |
| 2010-61 | ARD072 | GABL | yes | S | 60.30 | 18.18 | 5.03 | 6.30 | 2.72 | 3.97 | 1.39 | 0.06 | 0.42 | 0.13 | 0.02 | 0.0 | 0.70 | 99.26 |
| 2010-62 | ARD073 | OVB | no | | 68.50 | 15.53 | 3.03 | 2.91 | 1.16 | 4.36 | 2.58 | 0.03 | 0.42 | 0.16 | 0.02 | 0.1 | 0.47 | 99.15 |
| 2010-63 | ARD074 | PEG | yes | Po | 63.50 | 16.76 | 4.70 | 2.35 | 2.10 | 3.27 | 5.31 | 0.06 | 0.46 | <0.01 | 0.02 | 0.1 | 0.50 | 99.13 |
| 2010-64 | ARD075 | GAB | yes | Py | 48.70 | 20.51 | 8.21 | 12.70 | 4.73 | 2.10 | 0.59 | 0.12 | 0.71 | 0.03 | 0.03 | <0.01 | 0.69 | 99.15 |
| 2010-65 | ARD076 | GABM | no | | 52.50 | 16.55 | 10.52 | 9.03 | 5.33 | 3.07 | 0.70 | 0.15 | 0.90 | 0.07 | 0.03 | <0.01 | 0.56 | 99.41 |
| 2010-66 | ARD077 | GABL | no | S | 60.80 | 16.94 | 5.11 | 3.85 | 4.71 | 3.34 | 2.98 | 0.06 | 0.38 | 0.02 | 0.12 | 0.0 | 0.99 | 99.18 |
| 2010-67 | ARD078 | GABM | yes | S | 58.30 | 13.76 | 9.75 | 6.94 | 5.01 | 2.45 | 1.33 | 0.13 | 0.95 | 0.07 | 0.03 | <0.01 | 0.54 | 99.22 |
| 2010-68 | ARD079 | GNSAUG | yes | | 59.30 | 17.32 | 6.32 | 5.42 | 3.42 | 3.47 | 2.07 | 0.07 | 0.55 | 0.04 | 0.03 | 0.0 | 0.73 | 98.73 |
| 2010-69 | ARD080 | PHLOG | yes | S | 61.40 | 13.30 | 9.51 | 2.07 | 4.65 | 2.10 | 3.63 | 0.08 | 0.88 | 0.02 | 0.03 | 0.1 | 1.03 | 98.75 |
| 2010-70 | ARD081 | GABL | yes | Py | 61.60 | 17.52 | 5.10 | 5.49 | 2.97 | 3.65 | 1.65 | 0.07 | 0.37 | 0.06 | 0.02 | 0.0 | 0.74 | 99.23 |
| 2010-71 | ARD082 | GAB | yes | S | 61.30 | 14.82 | 7.24 | 4.93 | 3.93 | 2.80 | 2.11 | 0.09 | 0.69 | 0.06 | 0.03 | 0.0 | 0.95 | 98.91 |
| 2010-72 | ARD083 | GNSAUG | yes | S | 58.80 | 18.56 | 4.88 | 6.95 | 3.46 | 4.07 | 1.34 | 0.08 | 0.29 | 0.02 | 0.02 | 0.0 | 0.70 | 99.23 |
| 2011-01 | ARD211 | PHLOG-Ore | no | | 35.60 | 23.43 | 3.91 | 0.11 | 24.12 | 1.02 | 6.94 | 0.03 | 0.51 | <0.01 | 0.02 | 0.0 | 3.58 | 99.28 |
| 2011-02 | ARD210 | PHLOG-Ore | no | | 49.30 | 21.50 | 6.64 | 4.26 | 7.64 | 1.89 | 5.54 | 0.08 | 0.46 | 0.01 | 0.06 | 0.1 | 1.26 | 98.72 |
| 2011-03 | ARD201 | PHLOG-Ore | no | | 43.30 | 27.14 | 4.66 | 7.91 | 11.46 | 1.59 | 1.51 | 0.09 | 0.43 | 0.02 | 0.07 | <0.01 | 1.60 | 99.71 |
| 2011-04 | ARD200 | PHLOG-Ore | no | | 33.10 | 27.64 | 4.21 | 0.15 | 22.33 | 0.66 | 7.99 | 0.06 | 0.38 | <0.01 | 0.03 | 0.0 | 2.79 | 99.35 |
| 2011-05 | ARD202 | PHLOG-Ore | no | | 37.10 | 28.59 | 5.08 | 0.20 | 22.73 | 1.03 | 2.35 | 0.05 | 0.27 | <0.01 | 0.05 | <0.01 | 2.25 | 99.66 |
| 2011-06 | ARD212 | PHLOG-Ore | no | | 36.30 | 34.06 | 3.63 | 0.19 | 18.36 | 0.86 | 3.67 | 0.03 | 0.22 | <0.01 | 0.12 | 0.0 | 2.80 | 100.1 |
| 2011-07 | ARD203 | PHLOG-Ore | no | | 35.80 | 25.27 | 5.31 | 3.99 | 17.35 | 1.03 | 5.13 | 0.02 | 0.85 | <0.01 | 0.04 | 0.1 | 3.44 | 98.33 |
| 2011-08 | ARD206 | PHLOG-Ore | no | | 33.70 | 29.77 | 4.26 | 0.19 | 26.88 | 0.63 | 2.18 | 0.06 | 0.48 | 0.01 | 0.37 | <0.01 | 1.52 | 99.71 |
| 2011-09 | ARD204 | PHLOG-Ore | yes | PyPo | 36.40 | 23.55 | 6.37 | 1.13 | 19.78 | 1.43 | 6.70 | 0.04 | 0.99 | 0.02 | 0.50 | 0.1 | 2.58 | 99.04 |
| 2011-10 | ARD207 | PHLOG-Ore | no | | 37.60 | 21.68 | 5.30 | 0.25 | 22.84 | 1.25 | 6.18 | 0.06 | 0.48 | <0.01 | 0.03 | 0.0 | 3.15 | 98.82 |
| 2011-11 | ARD209 | PHLOG-Ore | no | | 38.30 | 18.66 | 4.61 | 1.37 | 23.97 | 0.82 | 6.88 | 0.08 | 0.79 | 0.01 | 0.10 | <0.01 | 3.95 | 99.49 |
| 2011-12 | ARD208 | PHLOG-Ore | no | | 34.50 | 30.68 | 4.70 | 0.18 | 22.63 | 1.11 | 2.71 | 0.04 | 0.29 | <0.01 | 0.05 | <0.01 | 2.29 | 99.1 |
| 2011-13 | ARD205 | PHLOG-Ore | no | | 37.00 | 30.15 | 4.96 | 1.64 | 19.02 | 0.88 | 3.45 | 0.04 | 0.38 | <0.01 | 0.07 | 0.0 | 2.48 | 100 |

# Appendix V

# Short-Term Leaching Test Data

**Results of MEND-Shakeflask Extraction Conducted on 20 Aappaluttoq Samples - March 2011**

| S. No: | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sample ID | | | | | | | | | | | | | | | | | | | | | |
| Parameter | Units | Method | Reportable Detection Limit | ARD003 | ARD012 | ARD014 | ARD015 | ARD016 | ARD017 | ARD018 | ARD021 | ARD024 | ARD025 | ARD031 | ARD033 | ARD037 | ARD075 | ARD076 | ARD079 | ARD080 | ARD082 | M390902 | M390903 | M390903 Dup | Greenland WQ Guideline |
| Wt. of sample used | g | | 0.01 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | | |
| Vol. of DI water used | ml | Weighing Scale | 0.01 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | 750 | | |
| pH (24h) | pH Units | pH Meter | 0.5 | 9.1 | 9.2 | 9.3 | 9.3 | 7.3 | 6.6 | 8.1 | 7.8 | 9.2 | 9.3 | 9.2 | 9.0 | 8.8 | 9.4 | 9.3 | 9.2 | 7.7 | 9.0 | 9.3 | 9.4 | | 6.5 - 8.5 |
| Conductivity (24h) | µS/cm | Conductivity Meter | 0.5 | 50 | 36 | 37 | 35 | 17 | 167 | 81 | 69 | 59 | 90 | 45 | 49 | 54 | 45 | 68 | 70 | 84 | 89 | 41 | 53 | | |
| Acidity (pH 4.5) | mg/L | PC Titrator | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | |
| Acidity (pH 8.3) | mg/L | PC Titrator | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1.6 | 1.9 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1.3 | 1.1 | 1.4 | 1.4 | 1.2 | | |
| Total Alkalinity (as CaCO3) | mg CaCO3/L | PC Titrator | 0.5 | 10 | 12 | 12 | 11 | 3.8 | 1.3 | 10 | 6.4 | 23 | 21 | 13 | 12 | 9.7 | 14 | 14 | 14 | 8.4 | 12 | 13 | 21 | | |
| Bicarbonate (HCO3) | mg HCO3/L | PC Titrator | 0.5 | 12 | 15 | 14 | 14 | 4.7 | <0.5 | 12 | 7.8 | 27 | 26 | 16 | 15 | 12 | 17 | 17 | 18 | 10 | 15 | 16 | 26 | | |
| Carbonate (CO3) | mg CO3/L | PC Titrator | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | |
| Hydroxide (OH) | mg OH/L | PC Titrator | 0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | | |
| Dissolved Sulphate (SO4) | mg/L | UV-Vis. | 0.5 | 6 | <0.5 | 0.7 | <0.5 | <0.5 | 43 | 8.7 | 14 | 1 | 9.6 | 0.8 | 3.2 | 6.4 | 1.4 | 6.4 | 9.1 | 15 | 14 | 1.3 | <0.5 | | |
| Dissolved Chloride (Cl) | mg/L | IC | 0.5 | 2.1 | 0.6 | 0.9 | <0.5 | 1.0 | 1.2 | 2.2 | 1.2 | 0.7 | 1.9 | 1.3 | 1.4 | 0.8 | 1 | 2.9 | 0.8 | 2.3 | 2.4 | 0.8 | <0.5 | | |
| Fluoride (F) | mg/L | SIE | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 | | |
| Nitrate (N) | mg/L | Calculation | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.013 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.008 | | |
| Nitrite (N) | mg/L | Colorimetric | 0.005 | <0.005 | <0.005 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.017 | 0.007 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.012 | | |
| Nitrate plus Nitrite (N) | mgN/L | Colorimetric | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.03 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 | | |
| **Dissolved Metals by ICP-MS** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dissolved Hardness (CaCO3) | mg/L | Calculation from Mg & Ca | 0.5 | 20 | 4 | 5 | 6 | 3 | 37 | 16 | 22 | 16 | 22 | 13 | 11 | 14 | 13 | 16 | 16 | 19 | 23 | 11 | 8 | | |
| Dissolved Aluminum (Al) | mg/L | ICP-MS | 0.0002 | 0.0453 | 0.243 | 0.0917 | 0.379 | 0.12 | 0.0134 | 0.353 | 0.16 | 0.0264 | 0.0519 | 0.158 | 0.265 | 0.223 | 0.533 | 0.452 | 0.463 | 0.147 | 0.228 | 0.348 | 0.158 | 0.157 | |
| Dissolved Antimony (Sb) | mg/L | ICP-MS | 0.00002 | 0.00006 | 0.00003 | 0.00003 | <0.00002 | 0.00004 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.0003 | 0.00035 | 0.00035 | |
| Dissolved Arsenic (As) | mg/L | ICP-MS | 0.00002 | 0.00011 | 0.00009 | 0.00048 | 0.00021 | 0.00018 | 0.00004 | 0.00013 | 0.00011 | 0.00011 | 0.00019 | 0.00023 | 0.00011 | 0.00013 | 0.00018 | 0.00027 | 0.0002 | 0.00005 | 0.00014 | 0.00061 | 0.00073 | 0.00073 | 0.004 |
| Dissolved Barium (Ba) | mg/L | ICP-MS | 0.00002 | 0.00483 | 0.00094 | 0.00116 | 0.00096 | 0.00175 | 0.0226 | 0.00156 | 0.00073 | 0.00126 | 0.00645 | 0.00075 | 0.00206 | 0.00142 | 0.00075 | 0.00146 | 0.0037 | 0.00515 | 0.00236 | 0.00047 | 0.00026 | 0.00025 | |
| Dissolved Beryllium (Be) | mg/L | ICP-MS | 0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | |
| Dissolved Bismuth (Bi) | mg/L | ICP-MS | 0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | 0.000009 | 0.000005 | <0.000005 | |
| Dissolved Boron (B) | mg/L | ICP-MS | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | |
| Dissolved Cadmium (Cd) | mg/L | ICP-MS | 0.000005 | 0.000012 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | 0.000009 | <0.000005 | <0.000005 | <0.000005 | 0.000008 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | 0.0001 |
| Dissolved Cesium (Cs) | mg/L | ICP-MS | 0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | 0.00007 | 0.00014 | <0.00005 | <0.00005 | <0.00005 | 0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | |
| Dissolved Chromium (Cr) | mg/L | ICP-MS | 0.0001 | 0.0002 | 0.0002 | 0.0004 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0001 | 0.0002 | 0.0002 | 0.0003 | 0.0001 | 0.0002 | 0.0003 | 0.0003 | 0.0003 | 0.0002 | 0.0003 | 0.0001 | 0.0002 | 0.0002 | 0.003 |
| Dissolved Cobalt (Co) | mg/L | ICP-MS | 0.000005 | 0.000042 | 0.000009 | 0.000005 | 0.000008 | 0.000014 | 0.0158 | 0.000021 | 0.00007 | <0.000005 | 0.000021 | 0.000014 | 0.000016 | 0.000005 | 0.000013 | 0.000018 | 0.000028 | 0.000047 | 0.000015 | 0.000043 | 0.000023 | 0.000021 | |
| Dissolved Copper (Cu) | mg/L | ICP-MS | 0.00005 | 0.00049 | 0.00101 | 0.00021 | 0.00039 | 0.00207 | 0.00041 | 0.00023 | 0.00061 | 0.00018 | 0.0005 | 0.0004 | 0.00059 | 0.00075 | 0.00077 | 0.00093 | 0.00061 | 0.00031 | 0.00089 | 0.00261 | 0.00091 | 0.00096 | |
| Dissolved Iron (Fe) | mg/L | ICP-MS | 0.001 | 0.002 | 0.009 | 0.008 | 0.012 | 0.009 | 0.017 | 0.01 | 0.014 | 0.002 | 0.015 | 0.033 | 0.031 | 0.007 | 0.018 | 0.016 | 0.056 | 0.021 | 0.025 | 0.009 | 0.006 | 0.006 | 0.3 |
| Dissolved Lanthanum (La) | mg/L | ICP-MS | 0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | 0.00262 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | 0.00009 | 0.00005 | <0.00005 | 0.00011 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | |
| Dissolved Lead (Pb) | mg/L | ICP-MS | 0.000005 | 0.000011 | 0.000018 | 0.000009 | 0.000015 | 0.000079 | 0.000013 | 0.000006 | 0.00002 | <0.000005 | 0.000029 | 0.00002 | 0.000043 | 0.00003 | 0.000024 | 0.000027 | 0.000037 | 0.000014 | 0.000029 | 0.000462 | 0.000121 | 0.000125 | 0.001 |
| Dissolved Lithium (Li) | mg/L | ICP-MS | 0.0005 | <0.0005 | 0.0023 | 0.0022 | 0.0015 | <0.0005 | 0.0087 | 0.0049 | 0.0007 | 0.001 | 0.0011 | 0.0019 | 0.001 | 0.0012 | 0.0007 | 0.001 | 0.0024 | 0.002 | 0.0029 | <0.0005 | 0.0028 | 0.0027 | |
| Dissolved Manganese (Mn) | mg/L | ICP-MS | 0.00005 | 0.00066 | 0.00066 | 0.0003 | 0.00066 | 0.0144 | 0.0978 | 0.00558 | 0.00845 | 0.0015 | 0.00143 | 0.0057 | 0.0042 | 0.00589 | 0.00382 | 0.00226 | 0.0041 | 0.0144 | 0.00561 | 0.00431 | 0.00041 | 0.00043 | |
| Dissolved Molybdenum (Mo) | mg/L | ICP-MS | 0.00005 | 0.0071 | 0.00047 | 0.00025 | 0.00018 | 0.00016 | 0.00011 | 0.00045 | 0.00056 | 0.00068 | 0.00464 | 0.00043 | 0.0005 | 0.00043 | 0.00104 | 0.00054 | 0.00089 | 0.00029 | 0.00049 | 0.0006 | 0.00024 | 0.00025 | |
| Dissolved Nickel (Ni) | mg/L | ICP-MS | 0.00002 | 0.00236 | 0.00026 | 0.00043 | 0.00009 | 0.00025 | 0.119 | 0.00029 | 0.00071 | 0.00019 | 0.00097 | 0.00017 | 0.00018 | 0.00042 | 0.00039 | 0.00035 | 0.00058 | 0.00247 | 0.0009 | 0.00044 | 0.00018 | 0.00018 | 0.005 |
| Dissolved Phosphorus (P) | mg/L | ICP-MS | 0.002 | 0.018 | 0.007 | 0.005 | 0.007 | 0.006 | <0.002 | 0.003 | 0.006 | 0.008 | 0.008 | 0.006 | 0.004 | 0.005 | 0.005 | 0.012 | 0.011 | <0.002 | 0.004 | 0.013 | 0.011 | 0.012 | 0.02 |
| Dissolved Rubidium (Rb) | mg/L | ICP-MS | 0.00005 | 0.00068 | 0.00449 | 0.00809 | 0.00474 | 0.00263 | 0.021 | 0.0127 | 0.00641 | 0.0107 | 0.0146 | 0.0042 | 0.00693 | 0.00563 | 0.00407 | 0.0033 | 0.00716 | 0.0106 | 0.00686 | 0.001 | 0.00927 | 0.00963 | |
| Dissolved Selenium (Se) | mg/L | ICP-MS | 0.00004 | 0.00038 | 0.00032 | <0.00004 | <0.00004 | 0.00004 | 0.00137 | 0.00047 | 0.00014 | 0.00005 | 0.00029 | 0.00012 | 0.00039 | 0.00019 | 0.00034 | 0.00057 | 0.00054 | 0.00066 | 0.00114 | 0.00013 | 0.00004 | 0.00005 | |
| Dissolved Silicon (Si) | mg/L | ICP-MS | 0.1 | 0.7 | 0.7 | 1.4 | 1 | 0.6 | 0.7 | 0.4 | 0.8 | 1 | 1.1 | 1.2 | 0.8 | 0.8 | 1.2 | 1.3 | 1.3 | 0.6 | 1 | 0.8 | 1 | 1 | |
| Dissolved Silver (Ag) | mg/L | ICP-MS | 0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | |
| Dissolved Strontium (Sr) | mg/L | ICP-MS | 0.00005 | 0.00508 | 0.00182 | 0.00284 | 0.00469 | 0.00826 | 0.00686 | 0.00466 | 0.00279 | 0.00525 | 0.00914 | 0.00355 | 0.00544 | 0.0111 | 0.00935 | 0.00596 | 0.00768 | 0.00753 | 0.0231 | 0.0105 | 0.00654 | 0.00646 | |
| Dissolved Tellurium (Te) | mg/L | ICP-MS | 0.00002 | 0.00046 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00033 | <0.00002 | <0.00002 | 0.00005 | 0.00041 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | 0.00002 | <0.00002 | <0.00002 | 0.00002 | <0.00002 | <0.00002 | |
| Dissolved Thallium (Tl) | mg/L | ICP-MS | 0.000002 | 0.000018 | 0.000009 | 0.000017 | 0.000009 | 0.00001 | 0.000098 | 0.000025 | 0.000004 | 0.000012 | 0.000046 | 0.000007 | 0.000015 | 0.000008 | 0.000009 | 0.000006 | 0.000012 | 0.000014 | 0.000013 | <0.000002 | 0.00001 | 0.000009 | |
| Dissolved Thorium (Th) | mg/L | ICP-MS | 0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | 0.000011 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | 0.000007 | <0.000005 | <0.000005 | 0.000019 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | <0.000005 | |
| Dissolved Tin (Sn) | mg/L | ICP-MS | 0.00001 | <0.00001 | 0.00001 | 0.00003 | 0.00003 | 0.00003 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | 0.00002 | 0.00002 | 0.00001 | 0.00003 | 0.00005 | 0.00007 | 0.00003 | 0.00001 | 0.00004 | 0.00005 | 0.00006 | 0.00006 | |
| Dissolved Titanium (Ti) | mg/L | ICP-MS | 0.0005 | <0.0005 | <0.0005 | 0.0008 | 0.0008 | <0.0005 | 0.0009 | <0.0005 | 0.0006 | <0.0005 | 0.0006 | 0.0011 | 0.0023 | <0.0005 | 0.0015 | 0.0007 | 0.0036 | 0.0014 | 0.0016 | 0.0006 | 0.0007 | 0.0006 | |
| Dissolved Tungsten (W) | mg/L | ICP-MS | 0.00001 | 0.00055 | 0.00023 | 0.00037 | 0.00187 | 0.00396 | 0.00012 | 0.00012 | 0.00009 | 0.00119 | 0.00396 | 0.00035 | 0.00016 | 0.00017 | 0.00012 | 0.00025 | 0.00009 | 0.00003 | 0.00005 | 0.00876 | 0.00564 | 0.00572 | |
| Dissolved Uranium (U) | mg/L | ICP-MS | 0.000002 | <0.000002 | <0.000002 | <0.000002 | <0.000002 | 0.00009 | 0.000632 | 0.000053 | 0.000031 | <0.000002 | 0.000238 | 0.000101 | 0.00108 | 0.00106 | 0.00448 | 0.00172 | 0.00178 | 0.000154 | 0.00211 | 0.000831 | 0.000005 | 0.000004 | |
| Dissolved Vanadium (V) | mg/L | ICP-MS | 0.0002 | 0.0008 | 0.0009 | 0.0065 | 0.0014 | 0.0003 | 0.0003 | 0.0011 | 0.001 | 0.0004 | 0.0011 | 0.0102 | 0.0017 | 0.0008 | 0.002 | 0.0027 | 0.0015 | 0.0003 | 0.001 | 0.0011 | 0.0019 | 0.002 | |
| Dissolved Zinc (Zn) | mg/L | ICP-MS | 0.0001 | <0.0001 | 0.0008 | <0.0001 | 0.0002 | 0.0005 | 0.0027 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | 0.0003 | 0.0004 | 0.0002 | 0.0002 | 0.0002 | 0.0003 | 0.0001 | 0.0002 | 0.0003 | 0.0001 | 0.0002 | 0.01 |
| Dissolved Zirconium (Zr) | mg/L | ICP-MS | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| Dissolved Calcium (Ca) | mg/L | ICP-MS | 0.05 | 3.06 | 0.91 | 0.55 | 1.74 | 0.93 | 4.28 | 4.44 | 4.72 | 2.76 | 4.58 | 3.28 | 2.97 | 4.11 | 4.17 | 5.36 | 5.56 | 5.4 | 7.52 | 3.62 | 1.42 | | |
| Dissolved Magnesium (Mg) | mg/L | ICP-MS | 0.05 | 2.89 | 0.52 | 0.91 | 0.37 | 0.12 | 6.33 | 1.09 | 2.43 | 2.24 | 2.58 | 1.05 | 0.91 | 0.78 | 0.54 | 0.56 | 0.56 | 1.21 | 1.04 | 0.37 | 1.1 | | |
| Dissolved Potassium (K) | mg/L | ICP-MS | 0.05 | 0.45 | 4.9 | 3.82 | 3.83 | 1.1 | 7.8 | 5.11 | 1.54 | 5.05 | 5.42 | 1.75 | 3.7 | 2.43 | 1.96 | 2.6 | 5.41 | 6.56 | 4.49 | 0.96 | 5.34 | | |
| Dissolved Sodium (Na) | mg/L | ICP-MS | 0.05 | 0.22 | 1.68 | 2.09 | 1.25 | 1.65 | 2.08 | 2.23 | 2.04 | 1.43 | 2.93 | 1.68 | 1.63 | 1.84 | 1.83 | 3.91 | 1.76 | 1.51 | 2.62 | 1.11 | 2.79 | | |
| Dissolved Sulphur (S) | mg/L | ICP-MS | 10 | <10 | <10 | <10 | <10 | <10 | 18 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | | |
| Maxxam ID | | | | AB2329 | AB2330 | AB2331 | AB2332 | AB2333 | AB2334 | AB2335 | AB2336 | AB2337 | AB2338 | AB2339 | AB2340 | AB2341 | AB2342 | AB2343 | AB2344 | AB2345 | AB2346 | AB2347 | AB2348 | | |
| Sampling Date | | | | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | 03/01/11 | | |
| COC Number | | | | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | 8328893 | | |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ion Balance:** | | | | | | | | | | | | | | | | | | | | | | | |
| Anions | | | | 0.38 | 0.26 | 0.28 | 0.22 | 0.10 | 0.96 | 0.44 | 0.45 | 0.50 | 0.67 | 0.31 | 0.35 | 0.35 | 0.34 | 0.50 | 0.49 | 0.55 | 0.60 | 0.31 | 0.42 | |
| Cations | | | | 0.42 | 0.31 | 0.30 | 0.31 | 0.17 | 1.03 | 0.58 | 0.58 | 0.52 | 0.71 | 0.39 | 0.42 | 0.44 | 0.44 | 0.60 | 0.59 | 0.62 | 0.72 | 0.32 | 0.44 | |
| Balance % | | | | -4.1 | -10.0 | -3.7 | -17.3 | -24.1 | -3.8 | -13.3 | -12.5 | -1.6 | -2.9 | -10.6 | -9.6 | -11.1 | -13.5 | -9.7 | -9.3 | -6.5 | -8.9 | -2.2 | -2.0 | |

**Notes:**
Extraction Method Used: Using Gyratory Shaker for 24h.
Liquid:Solid ratio used: 3:1; 750 ml DI H2O:250g of cone-crushed (<1/4 inch) sample.

**Method References:**
pH: SM 4500-B (H+)
Conductivity (EC): SM 2510-B
Acidity: SM 2310-B
Alkalinity: SM 2320-B
Sulphate: SM 4500-E (SO4)
Fluoride: SM-4500-C (F-)
Chloride: SM 4500-Cl
Nitrate (NO3-N): SM 4500-D
Nitrite (NO2-N): SM 4500-B (NO3)
Hardness: SM 2340-B
ICP-MS (total or dissolved): EPA 200.8 & 6020A

# Appendix VI

# Mineralogical Report

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Report 090397 for:
**Rejane Amaral,**
**True North Gems Inc.,**
**500 – 602 West Hastings Street,**
**Vancouver, BC, V6B 1P2**
rejaneamaral@shaw.ca

**July 2009**

**copy to:**
**Brian Soregaroli,**
**Transformation Catalyst Corp.,**
**3091 West 20th Ave.,**
**Vancouver, BC, V6L 1H7**
b@transcatco.com

**Samples: 13159-13164**

**Summary:**

**Sample 13159 (10068A)** is a moderately foliated ultramafic rock dominated by an intergrowth of olivine and spinel with scattered grains of rutile. Interstitial patches are of tremolite, chlorite, and carbonate; some patches of these minerals also replace olivine. Trace minerals include fuchsite, apatite, and opaque.

**Sample 13160 (GL-07-06)** is a moderately foliated metamorphosed ultramafic rock that is dominated by anthophyllite with much less abundant phlogopite, plagioclase, and tremolite, with one coarse grain of corundum and disseminated grains of rutile. Phlogopite is concentrated moderately in a few lenses parallel to foliation. Plagioclase is concentrated strongly in a band a few mm wide at one end of the section.

**Sample 13161 (GR10068B)** is a strongly altered ultramafic rock. It contains patches of glaucophane? intergrown intimately with corundum and minor disseminated rutile and opaque. These patches are intergrown with medium to coarse, interstitial grains of carbonate and lesser ones of plagioclase. Phlogopite is concentrated strongly in a band along one side of the section, in which it is intergrown coarsely in some patches with anthophyllite and in others with plagioclase.

**Sample 13162 (GR100069A)** is a metamorphosed ultramafic rock with a patchy texture consisting of coarse intergrowths of anthophyllite, plagioclase, and phlogopite, with scattered grains of corundum and patches of tremolite, glaucophane?, and carbonate (probably dolomite or magnesite).

**Sample 13163 (GL-07-G10A)** is a foliated gneiss containing bands dominated by equant plagioclase grains with much less abundant tremolite/actinolite, and less abundant bands dominated by tremolite/actinolite with lesser spinel and minor corundum. Phlogopite is concentrated strongly in a band on one side of the section.

**Sample 13164 (GL-07-G6B)** is a moderately foliated metamorphosed ultramafic rock that is dominated by prismatic anthophyllite with ragged patches of glaucophane?, some of which have cores of spinel and some of which contain ragged inclusions of corundum. Tremolite forms scattered prismatic grains. Trace minerals include phlogopite and rutile. A few irregular fractures are filled with angular mineral fragments.

**Mineralogical Notes:**

Several types of amphibole are present in the sections with some gradations between end members. They were identified and distinguished as follows:

anthophyllite: colourless, parallel extinction, locally up to 5° extinction angle
tremolite: colourless, inclined extinction (20-30°)
tremolite/actinolite: pale to light green, inclined extinction (20-30°)
glaucophane?: pale to light bluish green, extinction angle mainly <5°; mineral with similar pleochroism but larger extinction angle maybe a sodic variety of actinolite.

**Photographic Notes:**

The scanned section shows the gross textural features of the sections; these features are seen much better on the digital image than on the printed image. Photo numbers are shown in the lower left corner of the photographs. The letter in the lower right-hand corner indicates the lighting conditions: P = plane light, X = plane light in crossed nicols, ~X = plane light in nearly crossed nicols. Locations of photographs are shown on the scanned sections. Descriptions of the photographs are at the end of the report.

PROFESSIONAL PROVINCE OF J.G. PAYNE #21828 BRITISH COLUMBIA GEOSCIENTIST

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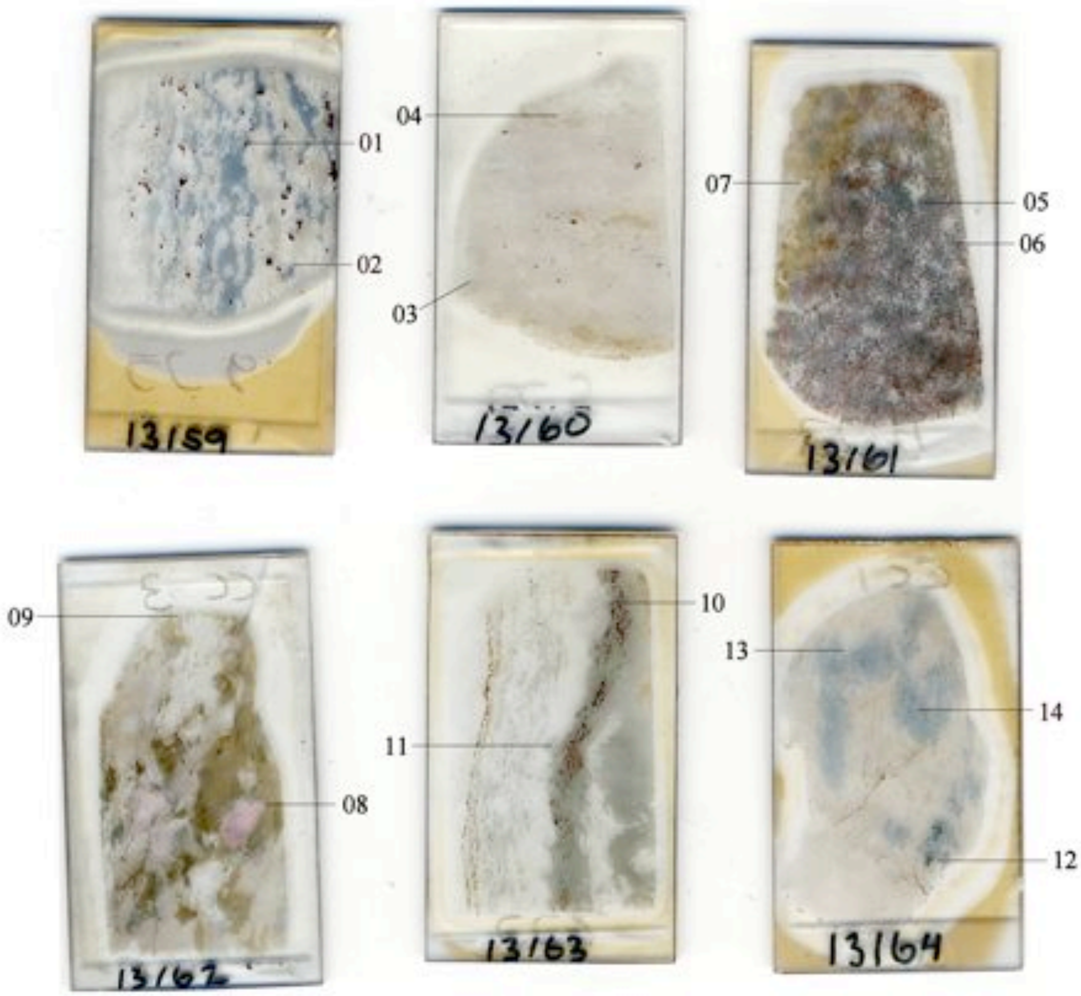
090397 true north gems sections



090397 true north gems blocks

13159 13160 13161

13162 13163 13164

**Sample 13159 (10068A)** **Ultramafic Rock**
**Olivine-Spinel-(Tremolite-Rutile-Chlorite-Carbonate)**

The sample is moderately foliated ultramafic rock that is dominated by an intergrowth of olivine and spinel with scattered grains of rutile. Interstitial patches are of tremolite, chlorite, and carbonate; some patches of these minerals also replace olivine. Trace minerals include fuchsite, apatite, and opaque.

| **mineral** | **percentage** | **main grain size range (mm)** | |
|---|---|---|---|
| olivine | 60-65% | 1-2 | |
| spinel | 20-25 | 0.7-1.5 | (a few up to 2.5 mm) |
| tremolite | 2- 3 | 0.5-1 | |
| rutile | 1- 2 | 0.2-1 | (a few grains up to 1.5 mm long) |
| chlorite | 1- 2 | 0.1-0.2 | |
| carbonate | 0.7 | 0.2-0.7 | |
| fuchsite | minor | 0.2-0.7 | |
| opaque | minor | 0.1-0.2 | |
| apatite | trace | 0.3-0.5 | |

Olivine forms subhedral prismatic to equant grains, many of which have rounded borders against spinel grains. Most prismatic grains are oriented parallel to foliation.

Spinel is light to medium blue in the scanned section and light, slightly bluish green in thin section. It forms subrounded grains and clusters of grains, the latter oriented parallel to foliation.

Tremolite forms scattered prismatic grains and clusters of a few to several anhedral grains that are intergrown coarsely with olivine.

Rutile forms anhedral equant grains and clusters of grains that are dark brown to semi-opaque. It is intergrown with and forms inclusions in both olivine and spinel.

Chlorite forms scattered flakes interstitial to spinel and olivine. It is colourless.

Carbonate forms anhedral grains interstitial to olivine, mainly near one end of the section.

Fuchsite forms scattered flakes, in part intergrown along cleavage with chlorite. Fuchsite is pleochroic from colourless to pale or light apple green.

Apatite forms a few equant anhedral grains associated with chlorite.

Opaque forms a few equant grains in similar sites to rutile; some of it may be rutile and some may be hematite (Note: no polished section was made).

**Sample 13160 (GL-07-06) Metamorphosed Ultramafic Rock**
**Anthophyllite-Phlogopite-Plagioclase-(Corundum-Tremolite)**

The sample is a moderately foliated metamorphosed ultramafic rock that is dominated by anthophyllite with much less abundant phlogopite, plagioclase, and tremolite, with one coarse grain of corundum and disseminated grains of rutile. Phlogopite is concentrated moderately in a few lenses parallel to foliation. Plagioclase is concentrated strongly in a band a few mm wide at one end of the section.

| **mineral** | **percentage** | **main grain size range (mm)** | |
|---|---|---|---|
| anthophyllite | 85-90% | 1- 2 | (a few up to 5 mm long) |
| phlogopite | 4- 5 | 0.5-1.5 | (a few grains up to 3 mm long) |
| plagioclase | 4- 5 | 0.5-1 | (a few grains up to 2 mm) |
| corundum | 1- 2 | 5.5 | |
| tremolite | 1- 2 | 0.5-1 | |
| rutile | 0.3 | 0.07-0.3 | (a few up to 0.5 mm long) |

Anthophyllite forms anhedral prismatic grains that show a moderately preferred orientation that defines the foliation.

Phlogopite forms disseminated, mainly slender flakes with pleochroism from colourless to light brown. It is concentrated moderately to strongly in a few phlogopite-rich lenses parallel to foliation.

Plagioclase forms anhedral grains interstitial to anthophyllite. It is concentrated strongly in a plagioclase-rich band near one end of the section. in which it is intergrown coarsely with less abundant anthophyllite.

Corundum forms one large anhedral grain that has an irregular rim up to 0.5 mm wide of interstitial plagioclase. It contains a few equant to prismatic inclusions of rutile.

Tremolite forms scattered grains that were distinguished from anthophyllite by the difference in extinction angle.

Rutile forms disseminated grains in anthophyllite and in corundum.

**Sample 13161 (GR10068B) Altered Ultramafic Rock**
**Glaucophane?-Carbonate-Plagioclase-Phlogopite-Corundum-Anthophyllite**

The sample is a strongly altered ultramafic rock. It contains patches of bluish green amphibole (glaucophane?) intergrown intimately with corundum and minor disseminated rutile and opaque. These patches are intergrown with medium to coarse, interstitial grains of carbonate and lesser ones of plagioclase. Phlogopite is concentrated strongly in a band along one side of the section, in which it is intergrown coarsely with patches of anthophyllite and others of plagioclase.

| **mineral** | **percentage** | **main grain size range (mm)** | |
|---|---|---|---|
| glaucophane? | 50-55% | 0.2-1 | (a few up to 1.5 mm long) |
| carbonate | 17-20 | 0.3-1.5 | |
| plagioclase | 8-10 | 0.5-1.2 | |
| phlogopite | 8-10 | 0.3-1.5 | |
| corundum | 5- 7 | 0.05-0.15 | (a few up to 0.4 mm across) |
| anthophyllite | 2- 3 | 0.2-0.5 | |
| rutile | 0.7 | 0.02-0.05 | |
| oxide | 0.5 | 0.02-0.05 | |

Much of the sample consists of ragged clusters of glaucophane? intergrown intimately in places with corundum? and disseminated oxide, probably hematite. Glaucophane? is variable pleochroic from pale to light/medium, slightly bluish green. Most grains have subparallel extinction, but several have inclined extinction up to 20°. Most grains are length-slow, but some are length-fast.

Corundum forms anhedral, equant grains, mainly intergrown intimately with glaucophane?. Corundum is pleochroic from colourless to light pink.

These patches are intergrown coarsely with interstitial grains of carbonate and of plagioclase. Interstitial patches commonly contain a few subhedral to euhedral prismatic grains of glaucophane? up to 1.5 mm long.

Phlogopite is concentrated strongly along one side of the section where it forms a band of grains intergrown in part with anthophyllite and in part with plagioclase. Pleochroism of phlogopite is from colourless to light brown.

Rutile forms disseminated equant grains that are concentrated moderately in some patches of glaucophane?-corundum.

**Sample 13162 (GR100069A) Metamorpohsed Ultramafic Rock**
**Anthophyllite-Plagioclase-Phlogopite-Corundum-(Tremolite-Glaucophane?)**

The sample has a patchy texture caused by a coarse intergrowth of anthophyllite, plagioclase, and phlogopite, with scattered grains of corundum and patches of tremolite, glaucophane?, and carbonate (probably dolomite or magnesite).

| mineral | percentage | main grain size range (mm) | |
|---|---|---|---|
| anthophyllite | 40-45% | 1- 2 | |
| plagioclase | 20-25 | 0.7-1.5 | |
| phlogopite | 17-20 | 0.5-3 | |
| corundum | 4- 5 | 0.5-1.5 | (one 3 mm across) |
| tremolite | 2- 3 | 0.7-2 | |
| glaucophane? | 2- 3 | 0.3-0.8 | |
| carbonate | 1 | 0.2-0.5 | |

Anthophyllite forms anhedral to subhedral prismatic grains, some of which are intergrown moderately with plagioclase in coarse sieve-like textures.

Plagioclase forms anhedral, mainly equant grains that were altered slightly in irregular patches to sericite. Included in some plagioclase grains are elongated patches of glaucophane?-corundum.

Phlogopite forms anhedral flakes that are concentrated moderately in phlogopite-rich patches. Pleochroism is from pale to light brown.

Corundum forms equant, subrounded grains included in plagioclase and in anthophyllite. A few ragged patches consist of intergrowths of corundum and phlogopite or corundum and glaucophane/actinolite; most of these are surrounded by plagioclase.

Tremolite forms scattered subhedral prismatic flakes intergrown coarsely with anthophyllite and phlogopite.

Glaucophane? forms prismatic grains included in plagioclase and in biotite; some are associated with corundum. It is light slightly bluish green in colour with an extinction angle ranging from 5-30°. Grains with a high extinction angle may be actinolite.

Carbonate forms interstitial grains up to 1.5 mm in size, several of which are associated with a large corundum grain.

**Sample 13163 (GL-07-G10A)  Gneiss: Plagioclase-Tremolite/Actinolite-Phlogopite-Spinel**

The sample is a foliated gneiss containing bands dominated by equant plagioclase grains with much less abundant tremolite/actinolite, and less abundant bands dominated by tremolite/actinolite with lesser spinel and minor corundum. Phlogopite is concentrated strongly in a band on one side of the section.

| mineral | percentage | main grain size range (mm) | |
|---|---|---|---|
| plagioclase | 65-70% | 0.7-1.5 | |
| tremolite/actinolite | 20-25 | 0.7-2 | |
| phlogopite | 2- 3 | 0.3-1 | |
| spinel | 3- 4 | 0.2-0.4 | |
| corundum | 1 | 1-2 | |
| glaucophane | 0.3 | 0.5-1 | |
| rutile | 0.1 | 0.05-0.15 | |
| hematite | minor | 0.05-0.15 | |
| pyrite | minor | 0.05-0.1 | (one grain 0.3 mm across) |
| pyrrhotite | trace | 0.03-0.05 | |
| chalcopyrite | trace | 0.02-0.04 | |

Plagioclase forms mainly equant grains with a composition of labradorite-andesine. Many grains are altered slightly to moderately to disseminated flakes or patches of sericite, whereas other grains are fresh.

Tremolite/actinolite forms anhedral equant to prismatic grains with a pale to light brownish green pleochroism.

Spinel forms trains of equant grains, almost entirely concentrated in some tremolite/actinolite-rich bands. Spinel is medium brown in colour and is isotropic. Some grains show a slight compositional growth zoning from darker cores to paler rims.

Phlogopite forms scattered flakes and clusters of a few flakes, mainly associated with tremolite/actinolite. It is concentrated strongly in a discontinuous phlogopite-rich band along one side of the section. Phlogopite is pleochroic from very pale to pale or light brown.

Corundum forms one cluster of pale blue grains between the major tremolite/actinolite-spinel band and the major plagioclase-(tremolite/actinolite) band. Between corundum and tremolite/actinolite is a thin reaction? zone of light bluish green glaucophane?.

Glaucophane also forms one equant grain on the border of plagioclase and tremolite/actinolite; the glaucophane grain was fractured coarsely and contains seams of corundum? along some of the fractures.

Rutile forms disseminated anhedral grains, in part associated with sulphides.

Sulphide patches are mainly less than 0.1 mm in size and are dominated by pyrite. One patch also contains lesser chalcopyrite and pyrrhotite. In several patches pyrite is rimmed by hematite.

**Sample 13164 (GL-07-G6B)** **Metamorphosed Ultramafic Rock**
**Anthophyllite-Glaucophane?-(Tremolite-Spinel)**

The sample is moderately foliated metamorphosed ultramafic rock that is dominated by prismatic anthophyllite with ragged patches of glaucophane?, some of which have cores of spinel and some of which contain irregular inclusions of corundum. Tremolite forms scattered prismatic grains. Trace minerals include phlogopite and rutile. A few irregular fractures are filled with angular mineral fragments.

| **mineral** | **percentage** | **main grain size range (mm)** | |
|---|---|---|---|
| anthophyllite | 75-80% | 1-3 | |
| glaucophane? | 15-17 | 0.5-1 | |
| tremolite | 1- 2 | 0.5-1 | |
| spinel | 1- 2 | 0.2-0.5 | |
| corundum | 1- 2 | 0.1-0.3 | (a few up to 0.4 mm) |
| phlogopite | trace | 0.1-0.15 | |
| rutile | trace | 0.02-0.03 | |
| fractures | 0.3 | 0.02-0.05 | (size of fragments) |

Anthophyllite forms colourless (in thin section) prismatic grains, many of which are in subparallel orientation defining a moderate lineation.

Glaucophane? forms ragged clusters up to 2 cm long of anhedral equant to prismatic grains. It is medium blue in colour in the stained offcut block and is pleochroic from pale to light slightly bluish green in thin section. It has low birefringence and moderate R.I. (= anthophyllite). It is length-slow and optically biaxial negative. Most grains have an extinction angle of less than 10°, but a few have extinction angles between 20-25° (possibly tremolite). Many grains contain 3-10% irregular to prismatic inclusions of anthophyllite (0.05-0.2 mm).

Tremolite? forms scattered anhedral to prismatic grains with moderately higher birefringence than anthophyllite and with a moderate extinction angle (15-25°).

Spinel forms ragged anhedral grains that are concentrated in the core of a few proximal patches of glaucophane. Spinel is light to medium greyish green in colour in thin section and is isotropic. A few spinel grains contain minor ragged inclusions of rutile.

Corundum forms ragged equant grains enclosed mainly in glaucophane?.

Phlogopite forms a few interstitial flakes with weak pleochroism from colourless to pale brown.

A few irregular fractures up to 0.1 mm wide are filled with angular fragments of host-rock minerals. Some are stained brown, probably by limonite.

## List of Photographs



| Photo | Section | Description |
|---|---|---|
| 01 | 13159 | intergrowth of rounded olivine and spinel with disseminated grains of rutile; interstitial grains and replacement patches of tremolite and carbonate (after olivine). |
| 02 | 13159 | to the left: intergrowth of olivine and spinel with minor interstitial chlorite and carbonate; to the right: interstitial patch of chlorite and tremolite with a slender flake of fuchsite in chlorite near the border of spinel. |
| 03 | 13160 | large corundum grain rimmed by plagioclase against aggregate of unoriented anthophyllite grains with a flake of phlogopite and a grain of rutile. |
| 04 | 13160 | foliated intergrowth of plagioclase, anthophyllite, and phlogopite with minor rutile. |
| 05 | 13161 | lower left: intergrowth of corundum? and glaucophane? with minor rutile and opaque; the rest of section: interstitial patch of carbonate with several prismatic grains of glaucophane?; one patch contains abundant disseminated rutile. |
| 06 | 13161 | intimate intergrowths of glaucophane? and corundum, with interstitial grains of plagioclase and carbonate and minor patches of rutile; glaucophane commonly is subhedral adjacent to plagioclase. |
| 07 | 13161 | coarse intergrowth of phlogopite, plagioclase, and anthophyllite, with a band of much finer grained glaucophane? and a few disseminated similar grains of glaucophane?. |
| 08 | 13162 | large grain of corundum (pink in scanned section) intergrown with phlogopite and anthophyllite with minor carbonate (bordering corundum) and a few grains of glaucophane/actinolite? in phlogopite. |
| 09 | 13162 | cluster of intimate intergrowth of phlogopite and corundum with a few subhedral prismatic grains of glaucophane? along its margin; enclosed in plagioclase that is intergrown coarsely with phlogopite. |
| 10 | 13163 | to the left: tremolite/actinolite with abundant brown spinel grains (in part growth-zoned); to the right: ragged corundum grain intergrown with anhedral plagioclase and minor tremolite/actinolite; between tremolite/actinolite and corundum is a reaction zone of light bluish green glaucophane?. |
| 11 | 13163 | coarsely fractured glaucophane grain with seams of corundum along fractures; along border between a plagioclase-rich band and a tremolite/actinolite-rich band; one flake of phlogopite borders glaucophane. |

## List of Photographs

(page 2 of 2)

| Photo | Section | Description |
|---|---|---|
| 12 | 13164 | ragged cores of spinel (with minor rutile) enclosed in aggregates of glaucophane, which is intergrown coarsely with anthophyllite. |
| 13 | 13164 | intergrowth of glaucophane? (with inclusions of anthophyllite) and anthophyllite. |
| 14 | 13164 | glaucophane? with several irregular inclusions of corundum and minor inclusions of spinel. |

**Thin Section Photographs**
(page 1 of 3)

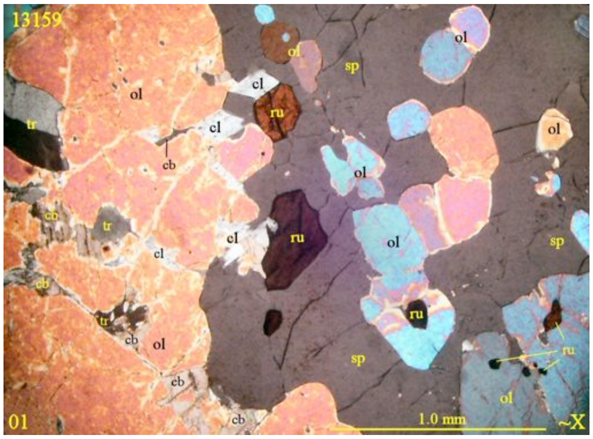


Photo 01

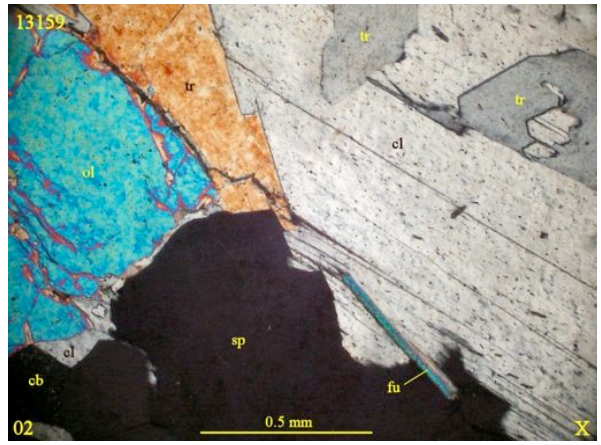
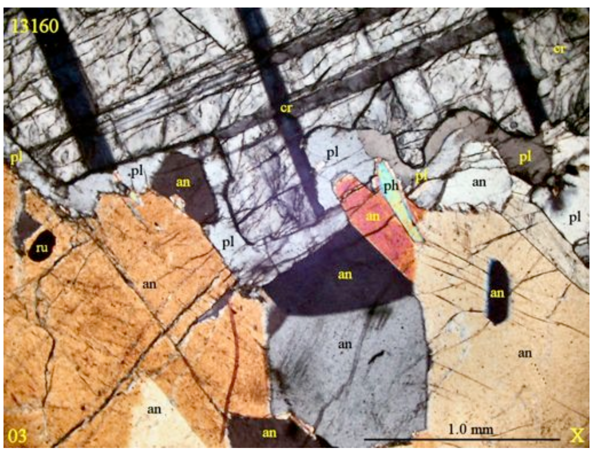


Photo 02



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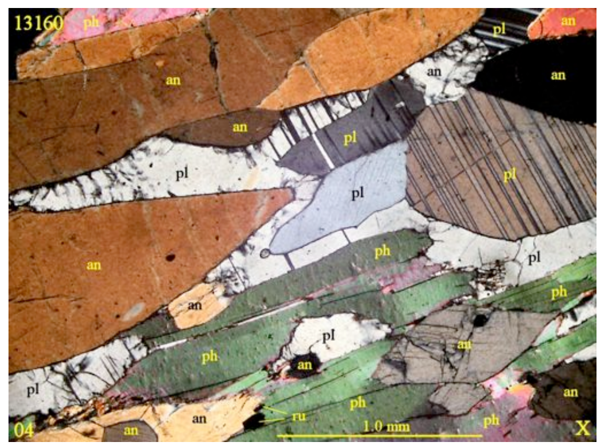

Photo 04

Photo 05

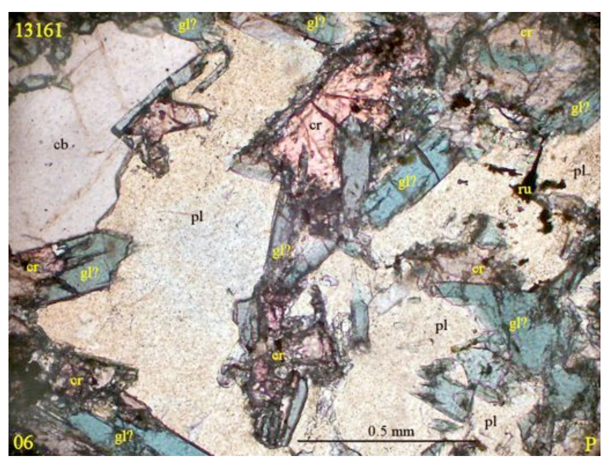

Photo 06

# Thin Section Photographs
(page 2 of 3)

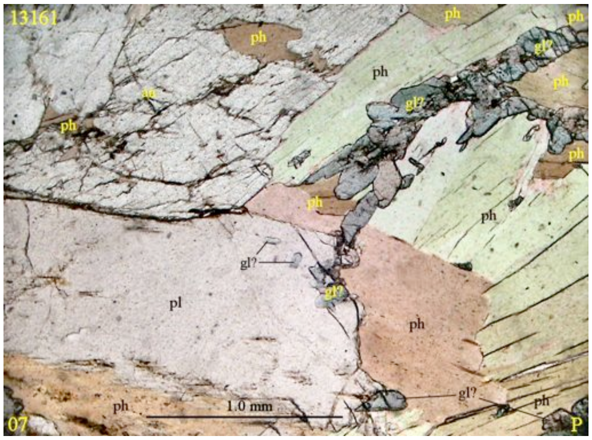

Photo 07

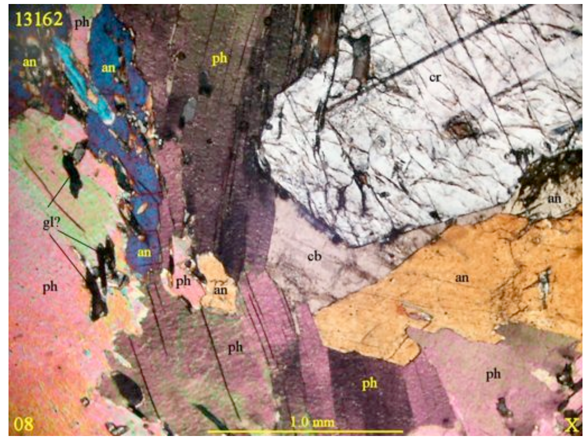

Photo 08

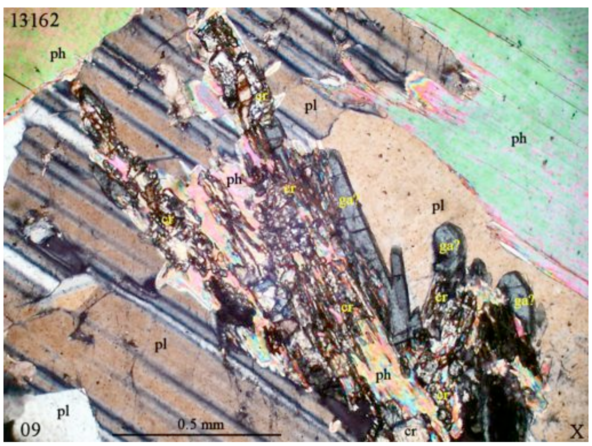

Photo 09

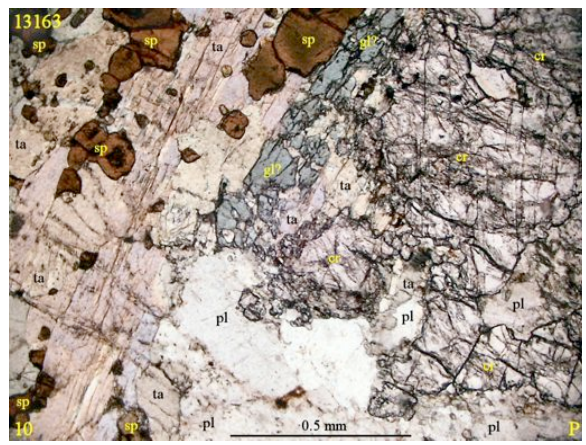

Photo 10

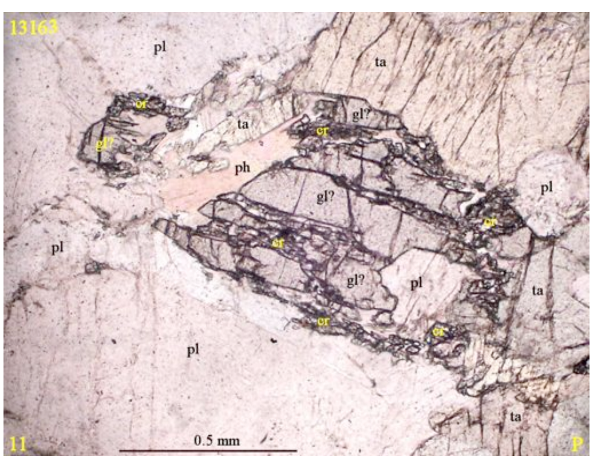

Photo 11

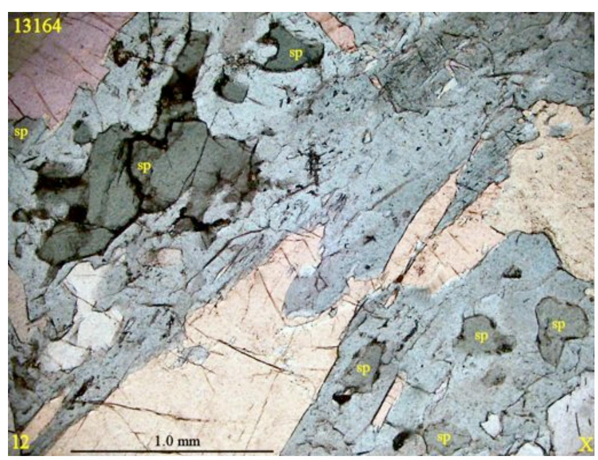

Photo 12

**Thin Section Photographs**


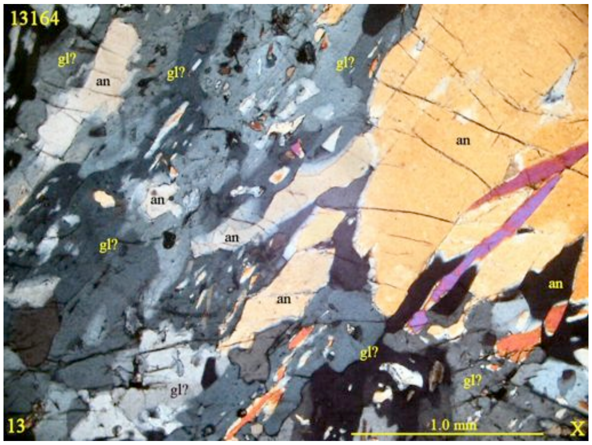

Photo 13

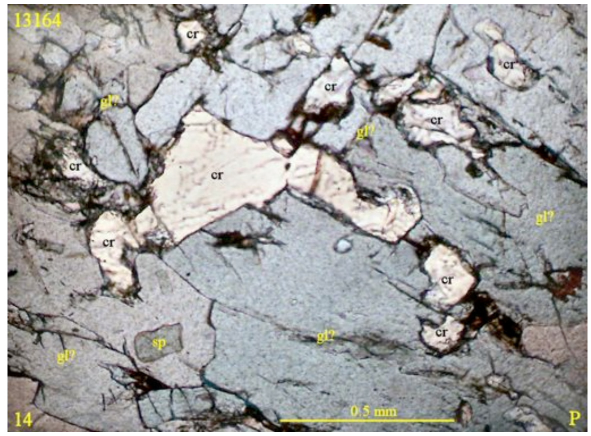

Photo 14