NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 2 Geoscientific Preliminary Assessment, Observation of General Geological Features

TOWN OF CREIGHTON, SASKATCHEWAN

APM-REP-06145-0012

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Phase 2 Geoscientific Preliminary Assessment, Observation of General Geological Features, The Town of Creighton, Saskatchewan

Report Prepared for

Nuclear Waste Management Organization

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SRK Consulting (Canada) Inc.
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Phase 2 Geoscientific Preliminary Assessment, Observation of General Geological Features, The Town of Creighton, Saskatchewan

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Cover: Aerial view looking east of the towns of Creighton, Saskatchewan (foreground) and Flin Flon, Manitoba (background).

Executive Summary

This technical report documents the results of the Observation of General Geological Features (OGGF) activity conducted as part of the Phase 2 Geoscientific Preliminary Assessment, to further assess the suitability of the Creighton area to safely host a deep geological repository (Golder, 2015). This study followed the successful completion of a Phase 1 Geoscientific Desktop Preliminary Assessment (NWMO, 2013; Golder, 2013).

The Phase 2 OGGF activity was undertaken to confirm and ground truth the presence and nature of key geological features. The general potentially suitable area was investigated over a period of approximately nine mapping days by one team of two geologists with the aid of one local guide for logistical support. A digital data collection protocol was applied to the documentation and compilation of the observations into a GIS-compatible database. These include bedrock character (lithology, primary fabric, magnetic susceptibility, geomechanical nature), fracture character, bedrock exposure and surface constraints. Representative rock samples were also collected.

Much of the potentially suitable area of the Annabel Lake pluton can be accessed by boat along the south side of Annabel Lake or by short foot traverse from Highway 106. While parts of the lakeshore are well-exposed, some inland areas are covered by smaller lakes and may also exhibit a high percentage of muskeg that can hamper access. Away from such features, there is generally moderate bedrock exposure with low moss-covered outcrops. One exception is a large area in the east with almost continuous bedrock exposure. The southern margin of the area is difficult to reach and requires long foot traverses or fixed-wing aircraft for access.

Observations were made at a total of 41 locations in the general potentially suitable area of the Annabel Lake pluton identified in the Phase 1 Preliminary Assessment. The field observations identified six domains on the basis of their lithological and structural character. Five of the domains represent distinct subdivisions of the Annabel Lake pluton. These include an L-tectonite biotite granodiorite domain, a foliated biotite to hornblende granodiorite domain, a fractured biotite granodiorite domain, a heterolithic biotite granodiorite domain, and a hornblende granodiorite to diorite domain. The sixth domain represents the surrounding supracrustal rocks of the Amisk and Missi groups.

In the L-tectonite biotite granodiorite of Domain 1, the rock strength is characteristically very strong and magnetic susceptibility is uniformly low. The dominant structural feature is a penetrative L_2 mineral lineation defined by elongate quartz grains and aligned biotite grains. A weak, generally flat-lying S_2 foliation is locally observed. Brittle-ductile to ductile shear zones are locally present. Domain 1 is generally massive to sparsely fractured with localized domains of moderate to abundant fracture density next to lineaments. The jointing pattern suggested that the bedrock was blocky to massive.

In Domain 2, the foliated biotite to hornblende granodiorite has rock strength that is characteristically strong to very strong, and magnetic susceptibility is much higher than in Domain 1 and exhibits a wider range in values. The dominant structural features are a well-developed S_2 foliation and L_2 mineral lineation. Brittle-ductile to ductile shear zones are locally present. Domain 2 transitions from moderately fractured near Domain 1 to abundantly fractured towards the shear zones that bound the pluton. Similarly, the jointing pattern indicated bedrock conditions that transition from blocky to very blocky towards the outer margins of the domain.

The fractured biotite granodiorite of Domain 3 is uniformly very strong, and magnetic susceptibility is greater than in Domain 1 but does not show the same broad range as in Domain 2.The domain is moderately to abundantly fractured, whereas foliation and lineation are only weakly developed. Brittle-ductile to ductile shear zones are locally present. The jointing pattern suggested that the bedrock was very blocky to blocky/disturbed.

The heterolithic biotite granodiorite of Domain 4 is abundantly fractured. Rock strength is characteristically very strong. Magnetic susceptibility in Domain 4 is similar to Domain 2 and relatively high. The foliation is generally well developed. The jointing pattern indicates a very blocky to blocky/disturbed bedrock condition.

In Domain 5, the hornblende granodiorite to diorite is moderately to abundantly fractured increasing in closer proximity to the West Arm shear zone. Rock strength is characteristically very strong with moderate to low magnetic susceptibility. The domain is only weakly foliated except near its southern margin proximal to the West Arm shear zone. The jointing pattern indicates a blocky to blocky/disturbed bedrock condition.

The supracrustal rocks of Domain 6 exhibit a particularly well-developed foliation, especially in proximity to the steeply-dipping Annabel Lake and West Arm shear zones. Rock strength is characteristically weak. Low magnetic susceptibility values were measured within the supracrustal rocks in both of the shear zones. The dominant fractures tend to be parallel to the shear zones. The jointing pattern in Domain 6 indicates a very blocky to blocky/disturbed bedrock condition.

Table of Contents

List of Tables

List of Figures

List of Appendices

IMPORTANT NOTICE

1 Introduction

This technical report documents the results of the Observation of General Geological Features (OGGF) activity conducted as part of the Phase 2 Geoscientific Preliminary Assessment, to further assess the suitability of the Creighton area to safely host a deep geological repository (Golder, 2015). This study followed the successful completion of a Phase 1 Geoscientific Desktop Preliminary Assessment (NWMO, 2013; Golder, 2013). The purpose of the Phase 2 OGGF activity was to confirm and ground truth the presence and nature of key geological features of the bedrock unit within the potentially suitable area in the Annabel Lake pluton identified in Phase 1 desktop assessment.

The Phase 2 OGGF activity was completed by SRK Consulting (Canada) Inc. (SRK) and Golder Associates Ltd. (Golder) for the Creighton area in Saskatchewan. The observations were conducted at select readily-accessible locations using waterways and the existing road network. The Phase 2 OGGF activity was undertaken to confirm and ground truth the presence and nature of key geological features. These include: bedrock character (lithology, primary fabric, magnetic susceptibility, geomechanical nature); fracture character; and bedrock exposure and surface constraints.

1.1 Scope of Work and Work Program

The scope of work for the Phase 2 OGGF comprises three stages, including:

- Stage 1: Pre-observation planning;
- Stage 2: Observation of General Geological Features; and
- Stage 3: Synthesis and reporting.

During the pre-observation stage, a plan for the observation of general geological features was developed for the general potentially suitable area, covering the central part of the Annabel Lake pluton, identified in the Phase 1 Preliminary Assessment (Golder, 2013). Another general area in the south-central portion of the Reynard Lake pluton was identified as potentially suitable in the Phase 1 assessment, but was removed from further consideration as it was located on land classified as Crown Reserve (Canadian Forces Station Flin Flon).

During the OGGF stage geological information was collected in accordance with the work plan defined during Stage 1 (see Section 4 Methodology) and during Stage 3 the information was analysed, compiled and is documented in this report.

The general potentially suitable area in the Creighton area was investigated over a period of approximately nine mapping days by one team of two geologists with the aid of one local guide for logistical support. Several GIS datasets were used as base maps for the Phase 2 OGGF activity; including georeferenced historical geological outcrop mapping, high-resolution satellite imagery, and high-resolution geophysical data.

1.2 Qualifications of Team

The SRK Group comprises of more than 1,500 professionals, offering expertise in a wide range of resource engineering disciplines. The independence of the SRK Group is ensured by the fact that it holds no equity in any project it investigates and that its ownership rests solely with its staff. These facts permit SRK to provide its clients with conflict-free and objective recommendations. SRK has a proven track record in undertaking independent assessments of mineral resources and mineral reserves, project evaluations and audits, technical reports and independent feasibility evaluations to bankable standards on behalf of exploration and mining companies, and financial institutions worldwide. Through its work with a large number of major international mining companies, the SRK Group has established a reputation for providing valuable consultancy services to the global mining industry.

Employee-owned since its formation in Toronto in 1960, Golder Associates has grown to more than 8,000 employees in offices located throughout Africa, Asia, Australasia, Europe, North America, and South America. Golder has a depth of experience and expertise supporting the nuclear industry including approvals and licensing, radioactive waste management, and investigations and engineering for Deep Geological Repositories in Canada, the United States, Sweden, Finland, France, Hungary, and the United Kingdom.

The investigations and compilation of the data presented in this report were completed by Mr. Blair Hrabi (SRK) and Dr. Alex Man (Golder). A brief description of their roles and qualifications is provided below.

Mr. Blair Hrabi, MSc, PGeo (APGO #1723) is a Principal Consultant (Structural Geology) with SRK, based in the Toronto office. He is a structural geologist with 18 years of experience gained in the exploration industry, government geological surveys, and academic settings. He has extensive experience in field mapping and structural analysis of Archean and Proterozoic terranes from regional to detailed scales. Mr. Hrabi was the lead geologist on the OGGF, responsible for the lithological and structural characterization and is responsible for writing sections 1, 3, 5.1, 5.2, 5.3, 5.7 and 6.

Dr. Alex Man, PEng is an Associate and senior geological engineer at Golder with a focus on nuclear repository site selection and characterization. He was the task leader for the Phase 1 Geoscientific Assessments for the Creighton, Pinehouse and ERFN communities that have participated in the APM site selection process. Dr. Man led the collection of rock strength, fracture, and magnetic susceptibility data, and is responsible for writing sections 2, 5.4, 5.5 and 5.6.

Dr. James P. Siddorn, PGeo (Practice Leader; APGO #1314) served as a technical advisor and reviewed a draft of this report prior to its delivery to Golder and the NWMO as per SRK internal quality management procedures.

Mr. George Schneider, MSc, PGeo (APGO #1239) is a Principal and senior geoscientist at Golder with a focus on nuclear repository site selection and characterization. He is the Project Manager to NWMO on this project, was responsible for assembling Section 4, and has provided senior review of this report, as per Golder's quality management procedures.

1.3 Report Organization

This report was prepared by SRK with support from Golder. A general description of the Creighton area, including location, physiography, and access is provided in Chapter 2. Chapter 3 summarizes the regional and local geological setting for the Creighton area. The methodology employed to undertake the OGGF activity is provided in Chapter 4. Results are summarized in Chapter 5. A brief summary of the results is included in Chapter 6, followed by references cited in Chapter 7 and a set of figures. In addition, Appendix A at the end of the report includes summary tables of all collected field information.

2 Description of the Creighton Area

2.1 Location

The Town of Creighton is located on the east-central edge of Saskatchewan adjacent to the Manitoba border, a few kilometres (km) west of Flin Flon, Manitoba. The general potentially suitable area on the Annabel Lake pluton identified during the Phase 1 Geoscientific Desktop Preliminary Assessment (Golder, 2013) comprised the focus of the field visit on September 8-15, 2014. This area is approximately 127 square kilometres (km^2) in size and is located immediately to the west of the Town of Creighton and south and west of Highway 106 (Figure 1).

2.2 Physiography

The Creighton area is located in the Kazan Upland Physiographic Region of the western Precambrian Shield (Bostock, 1970). The Kazan Upland topography is typical of the Canadian Shield, with large areas of bedrock that form broad, smooth uplands and lowlands.

Local relief is generally low with variations in elevation of less than 100 metres (m). Much of this relief is the result of bedrock structure, and some is the result of differential erosion of the different rock types by glacial ice. Ice movement smoothed and polished resistant bedrock hills and scoured out low-lying areas. Valleys and depressions between bedrock ridges and knolls are typically filled with lakes and bogs. Lakes and ridges in the Canadian Shield region are often aligned in a northeast-southwest direction, reflecting the direction of glacial ice advance (Schreiner, 1984) as well as the structure of the underlying basement rocks.

Distinctive topographic features in the Creighton area are the elevated, plateau-like surfaces of the Annabel Lake and Reynard Lake plutons. These plutons are characterized by areas of relatively low relief with relatively high relief margins (JDMA, 2013), which is presumably due to differences in lithology between the plutons and the adjacent greenstone rocks. The elevated aspect of these plateau-like intrusive bodies is generally provided by the low-lying nature of the adjacent shear zones and belts of metasedimentary and metavolcanic rocks around their margins. Of these plutons, a greater proportion of the Annabel Lake pluton is considered high ground (i.e., >10 m higher than average within a 20 km radius). The Annabel Lake pluton is continuously mapped as high ground except along the margin associated with the Annabel Lake shear zone and the Arner Lake trough within the pluton (JDMA, 2013). The Arner Lake trough is an east-west oriented, linear depression (approximately 10 m deep compared to surrounding ground) with a topographic expression similar to that of the shear zones forming the margins of the pluton.

Quaternary sediments in the Creighton area are composed of glaciolacustrine deposits, till, and organic plains. However, thicker overburden tends to occur only in low-lying areas. The elevated surfaces of the plutons consist of approximately 60% exposed bedrock or a thin veneer of overburden (Figure 2). Where glacial sediments cover the bedrock, they are generally thin (less than 1 m thick) (Schreiner, 1984; Henderson and Campbell, 1992; Henderson, 2002).

2.3 Accessibility

The main transportation routes through the Creighton area include Highway 167, which passes northeast from Denare Beach to the Town of Creighton, and Highway 106 which extends to the northwest from the Town of Creighton providing direct access by foot traverse to the eastern portion of the Annabel Lake pluton (Figure 2). Much of this eastern portion of the pluton experienced a forest fire that has left very well exposed bedrock, almost no moss cover, and relatively easy ground travel due to minimal tree coverage.

A combination of boat and foot traverse is required to access the northwest portion of the Annabel Lake pluton. Boat access to this portion of the pluton is via Annabel Lake which spans more than 50% of the length of the pluton along its north edge (Figure 2). The boat launch is at the easternmost end of the lake at Highway 106. As such, boat commutes on the order of 45 minutes are required to reach the west end of the pluton. Foot traverses that extend south from the lake are generally slow, with a ground pace of approximately 2 - 3 kilometres per hour (km/hr). This is due to greater forest cover at the west end of the pluton.

All southern areas are best accessed by fixed-wing aircraft (i.e. floatplane) to the line of lakes (e.g., Meridian, Raft, Wilson and Alder lakes; Figure 2) that define the southern boundary of the pluton.

3 Summary of Geology

Details of the geology of the Creighton area were described in the Phase 1 Geoscientific Desktop Preliminary Assessment (Golder, 2013). The following sections provide a brief summary of the regional geological setting and local-scale bedrock geology, structural history, mapped structures, metamorphism, and Quaternary geology. The description focuses on the area identified during Phase 1 as being potentially suitable (central portion of the Annabel Lake pluton), its surrounding bedrock units and important structural features.

3.1 Regional Geological Setting

The Creighton area is located within the Flin Flon-Glennie complex, directly north of the Western Canada Sedimentary Basin. The Flin Flon-Glennie complex is located within the Reindeer zone in northern Saskatchewan, and represents a portion of the Paleoproterozoic Trans-Hudson Orogen (Corrigan et al., 2007). Proterozoic intrusions including the Annabel Lake and the Reynard Lake plutons were emplaced into the older supracrustal rocks of the Flin Flon greenstone belt (Amisk Group) and the overlying succession of sedimentary rocks, the Missi Group. These Precambrian bedrock units have been subjected to varying amounts of metamorphism. The Western Canada Sedimentary Basin to the south of the Creighton area represents the Phanerozoic cover dominating the southern portion of the province of Saskatchewan. All bedrock units in the Creighton area are crosscut by brittle faults.

3.2 Local Geological Setting

3.2.1 Bedrock Geology

The main geological units in the Creighton area include granitoid intrusions (Annabel Lake and Reynard Lake plutons), the supracrustal rocks of the Flin Flon greenstone belt, and metasedimentary rocks of the Missi Group (Figure 2). The bedrock in the Creighton area is crosscut by several orientations of brittle faults and the individual rock units have been subjected to varying amounts of metamorphism. The Phase 1 Geoscientific Desktop Preliminary Assessment identified a general potentially suitable area within the Annabel Lake pluton (Golder, 2013), which is described in more detail below. The following subsections also include a brief description of the Reynard Lake pluton, the Flin Flon greenstone belt, and the Missi Group, which surround the Annabel Lake pluton.

Intrusive Rocks - Annabel Lake Pluton

The Annabel Lake pluton is an 1.86 billion years old (Ansdell and Kyser, 1990), dome-shaped, west-east elongated intrusion that widens from approximately 2.5 km in its western portion to approximately 5 km along the eastern portion (Figure 2). Hajnal et al. (1983) suggested that this pluton may extend to depths of up to 5.5 km based on gravity modelling.

The Annabel Lake pluton comprises medium- to coarse-grained, foliated granodiorite varying eastward to biotite granodiorite (Byers, 1954; Byers et al., 1965). The pluton contains a magmatic foliation which approximately parallels the foliation within the adjacent metavolcanic rocks. Given its proximity and similar geological history to the Reynard Lake pluton (Golder, 2013), the Annabel Lake pluton may be expected to have similar compositional zoning (see description of Reynard Lake pluton below and in Golder, 2013). Previous geophysical analyses yield a potassium-dominant radiometric response throughout the pluton, which is very similar to the northern two-thirds of the Reynard Lake pluton (PGW, 2013). Jointing is common at ground surface and occurs as defined sets common to both plutonic and surrounding metavolcanic rocks (Byers and Dahlstrom, 1954; Byers et al., 1965).

Intrusive Rocks - Reynard Lake Pluton

The Reynard Lake pluton is inferred to be a stitching pluton that intruded the Flin Flon greenstone belt during the Trans-Hudson Orogeny, and has been dated at approximately 1.853 billion years old (Ansdell and Kyser, 1990; 1992). The pluton comprises a central core of coarse-grained porphyritic granodiorite, surrounded by a shell of discontinuous equigranular biotite granodiorite. Deep drilling indicates that the composition of the intrusion transitions to quartz diorite at depths of around 500 m (Gendzwill, 1968; Davis and Tammemagi, 1982). With the exception of the central portion of the pluton, foliations are prominent and generally parallel to the foliations present in adjacent metavolcanic rocks. Jointing is common at the surface and occurs as defined sets common to both plutonic and surrounding metavolcanic rocks (Byers and Dahlstrom, 1954; Byers et al., 1965).

Greenstone Belts

Throughout the Creighton area, two linear elongate sequences of volcanic rocks of the approximately 1.9 billion year old Flin Flon greenstone belt trend west-northwest – east-southeast and bound the north and south contact of the Annabel Lake pluton. The distribution of these volcanic rocks coincides with the surface trace of the Annabel Lake and West Arm shear zones (Figure 2).

Rocks of the Flin Flon greenstone belt are heterogeneous and variable in type, and are arranged in layers of variable thickness and lithological compositions (Byers and Dahlstrom, 1954). Due to the complex structure (folding and faulting) within the Flin Flon greenstone belt, thickness of individual lithologies and stratigraphic interpretation within the assemblage can be difficult to estimate (NATMAP, 1998; Simard et al., 2010). It has been estimated that these rocks are approximately 4 to 6 km thick in the Creighton-Amisk Lake area (Byers and Dahlstrom, 1954; Byers et al., 1965). More recent estimates suggest they are in the order of 10 to 20 km thick (Lucas et al., 1994; Hajnal et al., 1996; White et al., 2005).

Metasedimentary Rocks of the Missi Group

The Missi Group is present in the north of the Creighton area, trending west-northwest – east-southeast along the northern contact of the Annabel Lake pluton and the southern contact of the Annabel Lake shear zone (Figure 2).

The Missi Group consists of synorogenic fluvial molasse deposits represented by a sequence of interlayered metamorphosed conglomerates, wackes and arkoses unconformably overlying the Flin Flon greenstone belt (Byers et al., 1965; Davis and Tammemagi, 1982; Ansdell and Kyser, 1990; Simard et al., 2010), deposited approximately 1.847 to 1.842 billion years ago (Fedorowich et al., 1993; Simard et al., 2010). The thickness of the Missi Group is estimated to be approximately 1 to 2.75 km (Byers and Dahlstrom, 1954; Byers et al., 1965).

3.2.2 Structural History and Mapped Structures

The chronology of tectonic events that occurred during the Trans-Hudson Orogeny provides a framework for understanding the structural history of the Creighton area. A summary of the important tectonic phases of the Trans-Hudson Orogeny provided below is based primarily on the geological and structural history detailed in Fedorowich et al. (1995).

The structural history of the Creighton area includes five main episodes of deformation (D_1 to D_5). A later D_6 event is included herein to represent the protracted continuation of late brittle deformation until as recently as the Mesozoic Era.

D_1 deformation overprints rocks of the Amisk Group and is constrained to have occurred between ca. 1.886 and 1.860 billion years, attributed to north-south collision. This was followed by a D_2 event, constrained to have occurred between ca. 1.860 and 1.834 billion years, characterized by continued movement along thrust faults and consequent fold development, associated to a peak period of crustal thickening and syntectonic plutonism (Fedorowich et al., 1995). The regional Annabel Lake and West Arm shear zones formed during this period. These regional shear zones dip subvertically and mark zones of intense shearing and mylonitization (Byers et al., 1965).

A subsequent D_3 event produced folds and associated axial planar foliations, as well as a number of steeply dipping, north-trending oblique-slip sinistral-reverse shear zones, which likely coincided with peak metamorphic conditions, as a consequence of east-southeast to west-northwest–oriented transpression between ca. 1.83 and 1.79 billion years. The Annabel Lake and West Arm shear zones were likely reactivated during this period of deformation Fedorowich et al. (1995).

A D_4 event, constrained between ca. 1.79 and 1.76 billion years, is characterized by the reactivation of strike-slip shear zones and the reactivation of some pre-existing faults under retrograde metamorphic conditions. During this period north-trending shear zones were also reoriented, under brittle-ductile conditions, into easterly trends, producing the Embury Lake flexure, the dominant map-scale fold structure in the Creighton area (Ansdell and Kyser, 1990; Fedorowich et al., 1993).

D_5 is characterized by late stage brittle oblique- and strike-slip movement under conditions of northwest to southeast compression between ca. 1.725 and 1.691 billion years. Resulting structures include near vertical to steeply east-dipping, north-northeast and north-northwest trending brittle faults characterized by sinistral strike-slip movement (Galley et al., 1991). Similar structures extend beyond the Creighton area to the north as a complex system of interconnecting, branching and en-echelon faults displaying reverse dip-slip and strike-slip movement. These faults are also located to the east of the Annabel Lake pluton, near the Manitoba-Saskatchewan border. Toward the west, approaching the Creighton area and the Annabel Lake pluton, several splays deflect towards the northwest. This is best observed north of Hamell Lake (adjacent to the east end of the Annabel Lake pluton) where a splay of the Ross Lake fault system bends into the Annabel Lake shear zone (Figure 2).

A second series of D_5 to D_6 faults in the Creighton area have northeast strikes and steep dips, and are characterized by dextral strike-slip movement (Galley et al., 1991). These faults have been documented surrounding the Creighton area, but not within the Creighton area (Byers, 1962). Protracted, post-1.691 billion years brittle reactivation of faults throughout the Creighton area is collectively attributed to a D_6 deformation event.

The Ross Lake fault system strikes north to north-northwest to the east of the Creighton area, spanning a total length of over 100 km (Byers, 1962; Fedorowich et al., 1993; Figure 2). This fault system crosscuts the Embury Lake flexure and the Annabel Lake shear zone (Ansdell and Kyser, 1990; Fedorowich et al., 1993; NATMAP, 1998; Saskatchewan Industry and Resources, 2010) indicating a post-D_4 timing of development. The Ross Lake fault system consists of several sets of inter-related faults that occur between Schist Lake to the south of the Creighton area (located within Manitoba), and Precipice Lake, approximately to the north of the Creighton area (Byers, 1962). Directly northeast of the Creighton area, approximately 1.25 km of sinistral-reverse oblique-slip has occurred along the Ross Lake fault system (Byers et al., 1965).

It is possible that the faults directly northeast of the Creighton area interpreted to be a part of the Ross Lake fault system are in fact related to the much larger Tabbernor fault system (Byers, 1962). The Tabbernor fault is a deep rooted, splayed fault system that extends from the Northwest Territories to the states of North and South Dakota (Giroux, 1995). In Saskatchewan, the fault has a northerly strike and displays sinistral strike-slip movement. This fault initially formed during the Trans-Hudson Orogeny approximately 1.815 billion years (Davies, 1998), but likely experienced more recent periods of reactivation (Elliot, 1996).

3.2.3 Metamorphism

Two stages of metamorphism are recorded in the Creighton area (Fedorowich et al., 1993). A first period of metamorphism initiated during D_2 and likely continued throughout D_3 (Bailes and Syme, 1989), with low metamorphic grade contact metamorphism, up to 1 km wide, developed with the intrusion of the major felsic plutons in the area (Byers et al., 1965; Fedorowich et al., 1993), although a higher amphibolite grade halo has been noted around the Reynard Lake pluton (Ansdell and Kyser, 1990).

A second metamorphic event is related to the collisional stage of the Trans-Hudson Orogen, and has been constrained between approximately 1.815 and 1.796 billion years (Corrigan et al., 2007). The resulting metamorphism varied from greenschist to amphibolite facies within the Creighton area (Parslow and Gaskarth, 1981; Ferguson et al., 1999), preserving primary textures and structures (Simard and MacLachlan, 2009) and overprinting earlier contact aureoles. Hydrothermal alteration within faults and shear zones in the Creighton area are also interpreted to have occurred during this period (Byers et al., 1965).

3.2.4 Quaternary Geology

The Quaternary sediments that overlie the bedrock in the Creighton area are glacial and post-glacial materials interpreted to have formed during the Wisconsinan glaciations. The glacial deposits in the Creighton area form a thin (veneer like), less than 1 m thick, discontinuous drift cover that reflects the bedrock topography (Davis and Tammemagi, 1982; Hajnal et al., 1983; Schreiner, 1984; Henderson and Campbell, 1992; Henderson, 2002). Thicker overburden deposits tend to occur in low lying areas. Till in the Creighton area is subdivided into two till units (Henderson and Campbell, 1992). A subglacial lower till unit composed of sandy and silty material, underlies glaciolacustrine deposits. The upper till unit overlies glaciolacustrine sediments as a thin veneer in places throughout the Creighton area. Glaciofluvial and glaciolacustrine deposits constitute the most prominent surficial sediments in the Creighton area. They are primarily ice proximal and near-shore sediments of well sorted, horizontally bedded sand and gravel, as well as deep water deposits of massive to bedded fine sand, silt and clay (Henderson and Campbell, 1992). Approximately 32% of the Annabel Lake pluton has been mapped as exposed bedrock, and another 28% has been mapped as having a thin (<1 m) till or glaciolacustrine veneer, for a total of 60% of the pluton being relatively well exposed. Exposed bedrock dominates the eastern half of the Annabel Lake pluton (JDMA, 2013).

4 Methodology

The following sections provide an overview of the approach taken for the OGGF activity in the central portion of the Annabel Lake pluton that was previously identified as having a potential to meet NWMO’s geoscientific site evaluation factors (Golder, 2013). The methods described below include tasks associated with planning, implementation, and reporting of the OGGF activity.

4.1 Pre-Observation Planning

Planning of the Phase 2 OGGF was completed prior to going to the field. The planning stage involved a review of all available information for the Creighton area and the general potentially suitable area, including access. This stage also included the development of a comprehensive list of source data, equipment, and task requirements for the observation of key geological attributes to be made during the activity (Table 1). SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. The outcome of this stage of the activity was a work plan for the OGGF in the central portion of the Annabel Lake pluton.

This work plan identified the proposed daily traverses along which the key geological attributes listed in Table 1 would be observed. Identification of key structural and lithological features provided the rationale for locating the planned traverses, although the final location of stations was ultimately determined while in the field (Figure 3).

The key geological attributes are stated in Table 1, along with the methods identified to observe and capture the relevant information. This includes the use of a digital data capturing method, which for this activity was an ArcGIS compatible data-logging instrument (Trimble® or equivalent) along with the GanFeld system software. The GanFeld system is an open source and fully customizable, map-based, field data capture system originally provided in an open file format by the Geological Survey of Canada (Shimamura et al., 2008). Entry of geological information into the GanFeld database follows a simple data collection protocol (Table 1) which directs the observer to the appropriate digital form within the database system to capture the appropriate information for this activity, based on NWMO’s objectives.

4.2 OGGF Implementation

Traverses were designed based on the pre-observation planning and modified to accommodate the specific logistical considerations determined during the field visit. The choice of stations along each traverse were also modified from the pre-observation plan, as needed, to choose locations with maximum exposure or based on logistical considerations.

At each station, lithological and structural features were observed and were collected in accordance with Table 1. In this report, planar structural measurements are recorded as strike and dip following the Canadian right-hand rule and linear structural measurements are recorded as trend and plunge.

Hand-sized rock samples, generally 1 kilogram (kg) in weight or larger, were collected to provide a representative example of the different rock types observed in the field. Field and sample magnetic susceptibility measurements were obtained from fresh surfaces of outcrop or from the rock samples using a KT-10 magnetic susceptibility meter provided and calibrated by Terraplus Inc. of Richmond Hill, Ontario. The KT-10 is operated with a pin adaptor to improve reliability when used on rough surfaces. The instrument operates an oscillator with an inductive coil to measure the frequency difference between a sample and free air measurements. Field measurements were entered as the average of five individual measurements over a representative portion of outcrop, while sample measurements were entered as the average of five individual measurements taken on a fresh surface of a grab sample. Sample-based magnetic susceptibility measurements are used for this report.

Preliminary geomechanical characterization of the bedrock was undertaken by means of a simple field-based hammer test for intact rock strength (IRS) and visual estimation of fracture spacing, primarily of joints, for block size determination. Table 2 and Table 3 describe the means by which these geomechanical characteristics are defined.

Table 1: Key Geological Attributes Characterized during the OGGF

Geological Attribute		Method(s)	Data Capture Protocol[1]
Location information		Trimble GPS point Handheld GPS tracklog and waypoints as redundant / backup data	**Station Form** • “Add with GPS” function • Tab 1 • Each observation location has a unique station identification number made up of the two digit year (14), the senior mapper’s initials (e.g., BH), and a unique sequential number indicating the order in which the mapping team visited each station during the field visit.
Host rock characterization	Lithology	Visually inspect the rock surface for identification of lithological units and their constituent minerals (e.g., granitic rocks have varying proportions of quartz, K-feldspar and plagioclase plus other minerals including micas, hornblende, etc.) Name the lithological unit(s) in terms of relative abundance at the outcrop scale Collect a small number of representative samples[b] of the dominant lithological unit(s) across the area of interest (will require use of hammer and chisel only) Take digital photographs of representative lithological units across the area of interest	**Lithology Form(s)** • If Intrusive (INT) = Tabs 1, 2a, 5 • If Volcanic Flow or Pyroclastic (VF, VP) = Tab 1 • If Metamorphic (M) = Tab 1, 3 **Sample Form** • Tab 1, Type = ‘representative’ • Notes **Photo Form** • Tab 1, Notes
Host rock characterization	Structure	Visually inspect the rock surface for identification of rock fabric (bedding, foliations, lineations) and fracture populations Take digital photographs of representative structures[c] Measure and document (by hand with compass and subsequent digital and manual entry) Strike and dip[d] of planar structures[e] Trend and plunge of linear structures	**Structure Form** • Tabs 1, 2 **Photo Form** • Tab 1, Notes
Host rock characterization	Geophysics	Record digitally, five magnetic susceptibility measurements for each identified lithological unit (the mean is entered into the GanFeld database)	**Sample Form[f]** • Tab 1, Type = “chip” • Notes
Host rock characterization	Geomechanics	Undertake field rock strength test[g] Undertake block size/fracture density assessment based on outcrop fracture geometry and spacing[h]	**For density** • FracDense Form • Tab 1 **For strength** • FracDense Form • Tab 2
Fracture characterization		Visually inspect the rock surface for identification of systematic fracture (joint, fault, vein) sets Take digital photographs of representative fracture features Measure and document (by hand with compass and subsequent digital and manual entry) Type (fault, vein, joint) Strike and dip of planar structures Fault, vein or joint spacing Trend and plunge of linear structures Alteration/mineral infill (if any) associated with identified fracture set(s) Relative age relationships	**Structure Form** • Tabs 1, 2 **For spacing** • Structure Form • Tab 2 **For relative age relationships** • Structure Form • Notes **For alteration** • Structure Form • Tab 2 **Photo Form** • Tab 1, Notes
Bedrock exposure and other surface constraints characterization		Visually inspect the area covered during the daily traverse and compare observations at each station against existing overburden coverage map	**Station Form** • Notes

Notes:

1 All observations were recorded in digital format (ArcPAD + GanFeld database) with manual (pen and paper) backup for most pertinent field observations only, unless required due to digital device failure. The data collection protocol refers to NWMO’s minimum requirements for digital data capture within the GanFeld database structure. The observer may include addition observations based on perceived importance of that feature in conveying the heterogeneity or homogeneity of a specific outcrop area or larger region. In addition, the ‘Notes’ tab in all forms can be utilized at the observers discretion in order to capture additional relevant information.

a Lithology Tab 2: Form and Rock Fabric, with Colour Index and Colour (typed in) most useful if it helps to characterize different phases of a multi-phase pluton.

b Samples were stored in bags numbered in accordance with the sample number generated in the GanFeld database.

c The caption entry location in the Notes section of the Photo form was used to link the digital camera number for each photo to the GanFeld generated photo number.

d Strike and dip measurements follow Canadian right-hand rule notation.

e Effort were made to characterize fractures of all dip magnitudes (including horizontal to shallow dipping features).

f Magnetic susceptibility (MS) measurements were recorded on the Sample Form. Type was entered as “chip” and five measurements were captured in the Reason section on the Notes page of the Sample Form.

g Refer to Table 2: Field Estimates of Intact Rock Strength.

h Refer to Table 3.

Table 2: Field Estimates of Intact Rock Strength

Grade	Description	Field Identification
R6	Extremely strong	Specimen can only be chipped with a geological hammer
R5	Very strong	Specimen requires many blows of a geological hammer to fracture it
R4	Strong	Specimen requires more than one blow of a geological hammer to fracture it
R3	Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single blow from a geological hammer
R2	Weak	Can be peeled with a pocket knife with difficulty, shallow indentation made by firm blow with point of a geological hammer
R1	Very weak	Crumbles under firm blows with a geological hammer, can be peeled by a pocket knife
R0	Extremely weak	Indented by thumbnail

Note: From Barton (1978).

Table 3: Rock Characterization Based on Observed Joint Spacing

Joint Spacing (cm)	Block Size	Description
>100	Massive	Very well interlocked, undisturbed rock mass blocks formed by three or less discontinuity sets with very wide joint spacing
30 – 100	Blocky	Very well interlocked, undisturbed rock mass consisting of cubical blocks formed by three orthogonal discontinuity sets
10 – 30	Very blocky	Interlocked, partially disturbed rock mass with multifaceted angular blocks formed by four or more discontinuity sets
3 – 10	Blocky/ disturbed	Folded and/ or faulted with angular blocks formed by many intersecting discontinuity sets
1 – 3	Disturbed	Poorly interlocked, heavily broken rock mass with a mixture of angular and rounded rock pieces
<1	Foliated/ laminated/ sheared	Thinly laminated or foliated, tectonically sheared rock, closely spaced schistosity prevails over any other discontinuity set, resulting in complete lack of blockiness

Note: Modified from Hoek (2007).

Capturing observations related to assessing bedrock exposure and other surface constraints was done by manual indication in the field notes and with spatial reference to specific proximal stations.

A summary of the equipment requirements for the OGGF activities, along with information regarding calibration requirements, is provided in Table 4.

Table 4: Equipment Requirements

Equipment	Calibration Required
Compass (Brunton Pocket Transit or similar)	Y – Check magnetic declination setting daily
Digital Camera	N
Trimble (or equivalent) field data collector w/GPS	Y – Check against hand held GPS
ArcPAD + GanFeld software	N
Magnetic Susceptibility Meter (KT-10 or equivalent)	Y – Calibrated by supplier before rental and upon return from rental period / daily check of reading at a reference rock outcrop. Certificate of Calibration provided by supplier.
Notebook and Pen	N
Handheld GPS	N
Geological Hammer	N
Sample Bags	N
Personal Protective Equipment	N

A number of daily tasks were identified which align with the objectives of the OGGF activity. These are outlined below in Table 5 along with allocation of responsibility for completing these tasks between the lead and assistant field geologist. This allocation of tasks was followed as a general guideline, noting that the lead field geologist had authority to make decisions in the field on how best to undertake the proposed work to meet the objectives within the schedule and accounting for field access constraints. Daily tasks during the OGGF activity in the Creighton area were undertaken by one team, each consisting of a lead and an assistant field geologist.

Table 5: Task Allocation

Task	Responsibility
Daily safety de-briefing	Assistant
Daily equipment calibration	Assistant
Host rock lithology characterization	Lead
Host rock structural characterization	Lead
Digital photographs	Lead
Fracture characterization	Lead
Data input into ArcPad	Lead
Manual (pencil and paper) note transcription	Assistant
Magnetic susceptibility measurements	Assistant
Rock strength assessment - Hammer test	Assistant
Bedrock overburden assessment	Assistant
Sample collection (if necessary)	Assistant
Surface constraint assessment	Both
Identification of potential detailed mapping areas	Lead
Daily log write-up and transmittal	Assistant
Daily data back-up and back-up for the back-up	Lead
Planning the next day traverse	Both

4.3 Synthesis and Reporting

Observations captured during the field work were compiled and synthesized from both members of the mapping team. Data collected included ArcPad/GanFeld data, field notes and sketches, digital photographs, rock samples, and magnetic susceptibility data. Data from the ArcPad/GanFeld system was checked for consistency with field notes. Stations and measurements that could not be entered in the field on the handheld device due to technical reasons were entered manually using ArcPad software on a laptop computer. Field notes from both team members were scanned and compiled together with all digital photographs.

The initial step of the data analysis required all measurements and observations to be classified according to their domain location. Domains were determined based on the lithological and structural observations made within the Annabel Lake pluton and adjacent supracrustal rocks. Field descriptions and photographs were reviewed to extract the key characteristics of the lithology, bedrock structure, fracture characteristics, and bedrock exposure. Foliation planes, lineations, and joints were plotted as equal area stereonets and rose diagrams to assess principal orientations and orientation variability.

The deliverables of the OGGF activity, together with this report, are shapefiles with the types of information entered into the GanFeld database. Shapefiles contain station, lithology, structure, fracture density, photo, and sample information. The average magnetic susceptibility measurement is also recorded within the sample shapefile. Magnetic susceptibility measurements are provided in spreadsheet format with clear linkage to the associated station and lithological unit where the measurement was taken. All digital photographs and scanned field notebooks are delivered to NWMO in a zipped folder with accompanying metadata. Metadata accompanying each shapefile and zipped folder are prepared according to metadata guidelines provided by the NWMO. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this report.

5 Geological Observation Findings

5.1 Introduction

This section summarizes the field observations in the Creighton area based on the work undertaken by Mr. Blair Hrabi (SRK) and Dr. Alex Man (Golder) from September 8 to 15, 2014. The initial field observations were conducted at select readily-accessible locations using existing roads, lakes, and some fixed-wing air transport.

A total of 41 locations were observed by one team of two mappers within or adjacent to the previously identified general potentially suitable area on the Annabel Lake pluton (Figure 3). The results are preliminary in nature and as such are presented in a factual manner below.

Each observation location has a unique station identification number made up of the two digit year (14), the lead geological mapper's initials (BH), and a unique sequential number indicating the order in which the mapping team visited each station during the field visit.

The Phase 2 OGGF activity was conducted to confirm and ground truth the presence and nature of key geological features in the identified areas. This included:

- Bedrock character (lithology, rock strength, magnetic susceptibility, structure);
- Fracture character and spacing; and
- Bedrock exposure and surface constraints.

The following sections describe these geological features based on the results of the field observations which identified six domains on the basis of variations in their lithological and structural character. Determination of domain boundaries was aided by observation of a newly-acquired high resolution magnetic dataset (SGL, 2015).

Domain 1, the L-tectonite biotite granodiorite domain, was defined based on observations collected at 10 locations. Domain 2, the foliated biotite granodiorite domain, was defined based on observations collected at 12 locations. Domain 3, the fractured biotite granodiorite phase of the Revell batholith, was observed at 7 stations. Domain 4, the heterolithic biotite granodiorite domain, was observed at 1 location. Domain 5, the hornblende granodiorite to diorite domain, was observed at 2 stations. Domain 6, the supracrustal rock domain, was observed at 41 stations. Five of the domains represent subdivisions of the Annabel Lake pluton, and the sixth domain represents the surrounding supracrustal rocks of the Amisk and Missi groups. The boundaries of the six domains are shown on Figure 3. A summary of the observations is included in Section 6.

The collected data is provided in a series of tables in Appendix A at the end of the report, including:

- Table A. 1: Stations Visited
- Table A. 2: Lithology Type – Intrusive
- Table A. 3: Lithology Type – Volcanic Flow
- Table A. 4: Lithology Type – Sedimentary
- Table A. 5: Lithology Type – Metamorphic
- Table A. 6: Magnetic Susceptibility Measurements
- Table A. 7: Summary of Magnetic Susceptibility Measurements by Domain

- Table A. 8: Structures
- Table A. 9: Geomechanical Characteristics
- Table A. 10: Samples
- Table A. 11: Photographs

Nomenclature within the following sections, and which was used while collecting the data presented in Appendix A, was adopted from the GanFeld field mapping database.

Where applicable, comments are made below with regard to the relation between these direct field observations and existing information based on the results from the Phase 1 Geoscientific Desktop Preliminary Assessment (Golder, 2013).

5.2 Bedrock Lithology and Intact Rock Strength

The descriptions below provide an overview of the bedrock lithology of the six identified domains combined with the field estimations of intact rock strength (IRS). IRS is directly related to lithology and therefore the results of both are provided together so that any variations between domains can be evaluated. Domain boundaries and associated visited stations are indicated on Figure 3. The complete dataset of bedrock lithological observations are included in Table A. 2 to Table A. 5.

Field estimations of intact rock strength (IRS) were undertaken in the six domains in order to provide some baseline understanding of rock strength variations for the Creighton area. No direct rock strength information was previously available for rocks in the Creighton area. The reference material for the nomenclature used in the descriptions rock strength is included in Table 2 above. The complete dataset of observations associated with the geomechanical characterization described below is included in Table A. 9.

The granodioritic bedrock of Domains 1, 2, 3, and 4 is generally lithologically similar and only varies in style of dominant structural overprint and lesser so with respect to minor compositional and mineralogical variation. These observations are consistent with the historic mapping that defines a relatively uniform lithology for the Annabel Lake pluton. Domains 5 and 6 are lithologically distinct from the pluton. This observation is also consistent with historic mapping.

5.2.1 Domain 1 - L-tectonite Biotite Granodiorite

Domain 1, in the core of the western part of the Annabel Lake pluton, consists of a light grey to pink weathering, light grey, medium-grained, metamorphically recrystallized, weakly foliated biotite ±hornblende granodiorite characterized by a strongly developed mineral lineation parallel to the long axis of the pluton (Figure 5A). The main lithology is commonly cut by pink granitic or aplitic dykes that locally are boudinaged but generally have unfractured contacts.

Rock strength was uniformly very strong (R5) throughout the domain.

5.2.2 Domain 2 - Foliated Biotite Granodiorite

Domain 2 consists of a light grey to pink weathering, light grey, strongly foliated, strongly lineated, recrystallized, medium-grained biotite ±hornblende granodiorite (Figure 5B). This rock type has a very similar composition as the L-tectonite biotite granodiorite of Domain 1. The bedrock is commonly cut by pink granitic or aplitic dykes that locally are boudinaged but generally have unfractured contacts. Metamorphic grade appears to increase to the north with the appearance of hornblende and garnet on the north margin of the domain.

Rock strength ranged from strong (R4) at some outcrops along the margin of Domain 2, to very strong (R5) within the domain.

5.2.3 Domain 3 - Fractured Biotite Granodiorite

Domain 3 is located to the east of the foliated biotite granodiorite (Domain 2) and consists of a light weathering, light to medium grey, strongly fractured, weakly foliated to massive medium-grained biotite granodiorite similar in composition to the previous two domains (Figure 5C). The main lithology is commonly cut by pink granitic or aplitic dykes that generally have unfractured contacts. The western contact of the domain is not clearly defined due to poor exposure in that part of the domain.

Rock strength was uniformly very strong (R5) throughout the domain.

5.2.4 Domain 4 - Heterolithic Biotite Granodiorite

Domain 4 consists of a light brown to tan weathering, medium-grained, grey biotite granodiorite with a high percentage of intermediate to mafic xenoliths (Figure 5D). The host granodiorite is similar in composition to that in Domains 1 to 3. It is generally well foliated but the foliation is strongly domainal with narrow panels of strong foliation separated by weakly foliated rock. The intermediate to mafic xenoliths are generally strongly deformed into flattened or tightly folded shapes.

Rock strength was uniformly very strong (R5) throughout the domain.

5.2.5 Domain 5 - Hornblende Granodiorite to Diorite

Domain 5 consists of a brown weathering, dark pink grey, medium-grained, melanocratic hornblende granodiorite to diorite (Figure 5E). It is compositionally distinct from the previous domains. Occasional mafic xenoliths were observed but these only form a small percentage of the unit. The domain is only weakly foliated except near its southern margin where it is in contact with the adjacent Amisk Group metavolcanic rocks.

Rock strength was uniformly very strong (R5) throughout the domain.

5.2.6 Domain 6 - Supracrustal Rocks

In Domain 6, mafic to intermediate metavolcanic rocks of the Amisk Group and metasedimentary rocks of both the Amisk and Missi groups are exposed on the flanks of the Annabel Lake pluton within the Creighton area. These are compositionally variable but in all cases have been strongly deformed and metamorphosed (Figure 5F).

Rock strength was uniformly weak (R2) in Domain 6. This includes the Missi Group metasedimentary rocks and the Amisk Group metavolcanic rocks associated with both the Annabel Lake and West Arm shear zones.

5.3 Bedrock Magnetic Susceptibility Measurements

Magnetic susceptibility readings were collected at each outcrop, and in addition, on the collected hand samples. The complete dataset of magnetic susceptibility measurements is included in Table A. 6 and Table A. 7. The latter summarizes the magnetic susceptibility measurements by domain.

Ground based, magnetic susceptibility measurements were not previously available for the Creighton area. The absence of visible indications of alteration suggests that the magnetic minerals are primary in origin, with magnetite being the largest contributor to the measured susceptibility based on visual observations. The mapped shear zones are associated with low magnetic susceptibility values. The Annabel Lake pluton shows some variation in magnetic susceptibility. An overview of the magnetic susceptibility results subdivided by domain is outlined below.

5.3.1 Domain 1 - L-tectonite Biotite Granodiorite

Domain 1 exhibited low magnetic susceptibility values overall, averaging 0.47 x 10^{-3} SI. The maximum magnetic susceptibility value measured in Domain 1 was 2.18 x 10^{-3} SI, which is significantly lower than the maximum values measured in other domains, which is inferred to represent low magnetite content in this domain of the pluton.

5.3.2 Domain 2 - Foliated Biotite Granodiorite

Domain 2 is characterized by a much larger range in magnetic susceptibility values relative to Domain 1, with an average of 2.33 x 10^{-3} SI. The highest magnetic susceptibility value measured in the Annabel Lake pluton (28.7 x 10^{-3} SI at Station 14BH014) was obtained in Domain 2. The location of this measurement corresponds to the margin of the Annabel Lake pluton south of Domain 1. The absence of visible indications of alteration suggests that the magnetic minerals are primary in origin, with magnetite being the largest contributor to the measured susceptibility based on visual observations.

5.3.3 Domain 3 - Fractured Biotite Granodiorite

Domain 3 displays relatively high magnetic susceptibility values, averaging 2.58 x 10^{-3} SI, which are similar to those recorded for Domain 2. However Domain 3 exhibits a less marked range in values relative to Domain 2. The maximum magnetic susceptibility value measured in Domain 3 was 8.12 x 10^{-3} SI (at Station 14BH027). The absence of visible indications of alteration suggests that the magnetic minerals are primary in origin with magnetite being the largest contributor to the measured susceptibility based on visual observations.

5.3.4 Domain 4 - Heterolithic Biotite Granodiorite

Domain 4 displays an average magnetic susceptibility of 3.95 x 10^{-3} SI, which is similar to that measured in Domains 2 and 3. Although the response was similar to Domain 2, the maximum value was lower, likely due to the limited number of measurements conducted in this domain (only one station in this domain). The maximum magnetic susceptibility value measured in Domain 4 was 9.19 x 10^{-3} SI (at Station 14BH006). The absence of visible indications of alteration suggests that the magnetic minerals are primary in origin, with magnetite being the largest contributor to the measured susceptibility based on visual observations.

5.3.5 Domain 5 - Hornblende Granodiorite to Diorite

Domain 5 displays an average magnetic susceptibility value of 0.70×10^{-3} SI, which is lower than in Domains 2 and 4. This difference is likely due to the limited number of measurements conducted in this domain (only two stations in this domain). The maximum magnetic susceptibility value measured in Domain 5 was 2.2×10^{-3} SI (Station 14BH033).

5.3.6 Domain 6 – Supracrustal Rocks

In Domain 6, low magnetic susceptibility values were measured within the supracrustal rocks in both of the shear zones (West Arm and Annabel Lake), with an average value of 0.49×10^{-3} SI for the combined data. The magnetic susceptibility measured in the Annabel Lake shear zone (average value of 0.62×10^{-3} SI) was only marginally higher than the measurements made in the West Arm shear zone (average value of 0.31×10^{-3} SI).

5.4 Bedrock Structure

This section provides a description of the observations made regarding the structural fabric of the bedrock. The primary focus is on the foliations and lineations observed within the six domains. Figure 4 displays a composite plot of data for the Creighton area, while displays data for four of the six domains where sufficient data is present. The complete dataset of structural observations are included in Table A. 8.

Previous documented mapping of bedrock structure within the Creighton area highlighted the elongate east-west nature of the Annabel Lake pluton, as well as its doubly-plunging nature. The results described below provide additional detail on the spatial structural variation, as well as the understanding that discrete shear zones are found within the pluton in addition to the major mapped shear zones bounding the pluton (Figure 4).

5.4.1 Domain 1 - L-tectonite Biotite Granodiorite

The dominant structural feature in Domain 1 is a penetrative mineral lineation, tentatively correlated to the regional D_2 event and described herein as L_2. L_2 is defined by elongate quartz grains and aligned biotite grains. A weak S_2 foliation is locally observed in the domain and predominantly was observed to be sub-horizontal (Figure 6A). The dominant foliation trend is to the northwest (Figure 6A’). The dominant lineation orientation very shallowly plunges to the east-southeast on the east end of the domain and shallowly plunges west-northwest on the western end (Figure 6A”), defining an elongate dome in the western end of the Annabel Lake pluton. Overall, the domain forms a doubly plunging lens-shaped dome with shallowly to moderately outward dipping north and south flanks and shallowly plunging east and west ends.

Steep-dipping and west-northwest trending ductile to brittle-ductile shear zones were locally developed within Domain 1. At Station 14BH019, one of these zones cuts obliquely across the dominant lineation. Structural features in proximity to this shear zone include a locally developed steeply south-dipping S_3 (shear zone) foliation, and boudinaged pegmatite dykes (Figure 7A). This structure is spatially associated with a linear magnetic low striking slightly oblique to the dominant magnetic grain.

5.4.2 Domain 2 - Foliated Biotite Granodiorite

Domain 2 provides a margin between the relatively intact core of the pluton (Domain 1) and the bounding shear zones to the north and south. The dominant S_2 foliation, which is largely defined by foliation-parallel surficial lineaments, trends west-northwesterly (Figure 6B’) and has been folded about a shallowly east-plunging F_3 fold axis (Figure 6B). This pattern is reflected in the great circle distribution of poles to foliation (Figure 6B) and shallowly east-southeast plunging L_2 mineral lineations (Figure 6B”). The east end of Domain 2 coincides with the nose of a prominent, tight, eastward-closing antiform which is largely defined by S_2 foliation that wraps around Arner Lake (Figure 2 and Figure 6B). The same general pattern of folding is evident in the composite foliation plots (Figure 4A). The fold nose is elongated and has been refolded by an open, upright, north-trending younger generation of folds.

Similar to Domain 1, brittle-ductile to ductile shear zones obliquely transect the dominant foliation in Domain 2, with proto-mylonite developed in them. This is evident at station 14BH021, where a steeply north-dipping ductile shear zone cuts the shallowly north-dipping dominant S_2 foliation (Figure 7B).

5.4.3 Domain 3 - Fractured Biotite Granodiorite

Domain 3 has a more weakly developed foliation and lineation than either of Domains 1 or 2. Where present, the foliation is spread about a poorly defined great circle with a concentration of steeply northeast-dipping foliation planes (Figure 6C). The dominant foliation trend is to the north-northwest (Figure 6C’) and similar to most other domains, the lineation is shallowly east-southeast plunging (Figure 6C”). The most prominent structural characteristic of the domain is the high fracture density.

Very localized east-dipping brittle ductile shear zones were observed cutting the dominant foliation in two outcrops in Domain 3. Both have associated down-dip lineations and rotated porphyroclasts or stepped fault surfaces indicating a reverse dip-slip sense of motion. For example, the portion of the shear zone observed at station 14BH027 is shallowly dipping and characterized by mylonite fabric development, rotated porphyroclasts, and boudinaged veins (Figure 7C).

5.4.4 Domain 4 - Heterolithic Biotite Granodiorite

Domain 4 has a strong foliation and lineation which are developed discontinuously rather than penetratively throughout the bedrock. The main foliation is steeply dipping to the northeast and is associated with a dominant mineral lineation that plunges shallowly to the east-southeast, similar to Domains 1, 2, and 3. Too few measurements were made to justify plotting of a foliation dataset for Domain 4. Strain can be very high with mafic xenoliths strongly flattened or tightly folded in the foliation plane, including in discrete ductile shear zones with observed steeply northeast dipping fabric.

5.4.5 Domain 5 - Hornblende Granodiorite to Diorite

Most of Domain 5 varies from massive to very weakly foliated hornblende granodiorite to diorite. Too few measurements were made to justify plotting of a foliation dataset for Domain 5. The intrusive phase is in contact with the adjacent supracrustal rocks at its south margin. At this contact increased foliation development and a discrete contact-parallel east northeast-striking shear zone were observed.

5.4.6 Domain 6 - Supracrustal Rocks

The supracrustal rocks of Domain 6 exhibit visual evidence of having undergone a high degree of strain. A strong foliation and lineation are found within all of the outcrops. The foliation is particularly intense in proximity to the Annabel Lake and West Arm shear zones. The foliation trends west-northwest parallel the West Arm and Annabel Lake shear zones and dip steeply away from the Annabel Lake pluton (Figure 6D and D'). An associated lineation plunges shallowly to either the northwest or southeast (Figure 6D"). Adjacent to the shear zones, additional evidence of high strain such as tightly folded and boudinaged hook-shaped veins, intense flattening and strong subsequent upright to steeply inclined folding of the well-developed main foliation were observed (Figure 5F). A brittle overprint in the form of conjugate faulting was also observed (Figure 7D). South of Annabel Lake on the north margin of the pluton an open concave bend in the contact coincides with a domain of open, shallowly north-plunging folds within the metavolcanic rocks.

5.5 Bedrock Fracture Characterization and Spacing

The brittle structure of the six domains is described below based on the field observations of fractures. Most measured fractures are joints with no indication of movement on them, with less common observation of small scale faults with either slickenlines on the fault faces or offset markers indicating movement on the structure. Field observations of joint spacing were undertaken in the six domains in order to provide some baseline fracture spacing data. The reference material for the nomenclature used in the descriptions of fracture spacing is included in Table 3 above.

Figure 8 summarizes the data described below in a set of equal area lower hemisphere stereonets and rose diagrams. In addition, Figure 9 provides a qualitative assessment of the relative degree of fracturing in the bedrock domains based on the observations. The complete dataset of observations associated with the fracture structural characterization and joint spacing are included in Table A. 8 and Table A. 9, respectively.

Although there is a marked variability in fracture density between domains, the dominant fracture orientations are generally reproduced throughout the Creighton area. The most prominent, west-northwest oriented joints correspond to the orientation of the pluton-bounding Annabel Lake and West Arm shear zones (300 to 310 degree [°] trend) as well as a set of long (>5 km) west-northwest trending lineaments (Figure 4F and G). A tighter joint spacing is observed in proximity to these northwest- to north-trending surface lineaments. This structural orientation also coincides with that of the dominant lineation that defines the elongated domal nature of the west end of the pluton. In addition, both the Triangle Lake fault (310° trend) and Ross Lake fault (326° trend) are located to the east of this area and are also oriented to the northwest. North to northeast oriented jointing corresponds to a set of surficial lineaments observed in the area. The east-northeast oriented joint set is also representative of a set of similarly oriented surface lineaments.

5.5.1 Domain 1 - L-tectonite Biotite Granodiorite

Fractures observed in Domain 1 include two steeply-dipping, and one shallowly-dipping, sets of joints (Figure 8A). Fracture orientations of the two steeply dipping joint sets were to the north to northeast and west-northwest, with the west-northwest set being dominant. The shallow dipping joint set was also oriented to the west-northwest (Figure 8A').

The bedrock was observed to be generally massive to sparsely fractured throughout the majority of Domain 1. Joint spacing was generally greater than 50 cm indicating blocky to massive bedrock. The lowest fracture density in the Annabel Lake pluton was observed in Domain 1 (Figure 9). Localized domains of moderate to abundant fracture density were observed next to surface lineaments and, in one case, brittle-ductile features. Prominent linear surface features generally coincided with a zone of higher fracture density relative to rock located distal to the features, but the zone of rock damage was generally localized to the fault zone and immediately adjacent rock mass. For example, at Station 14BH017, located in the north-central portion of the domain, there is only a 3 m distance between moderately fractured rock associated with the edge of a lineament and the sparsely fractured rock that is more representative of the domain.

5.5.2 Domain 2 - Foliated Biotite Granodiorite

Fractures observed in Domain 2 include two steeply dipping joints sets oriented to the north-northwest to northeast and west-northwest, and one moderate to shallow dipping joint set oriented west-northwest. An additional minor joint set is oriented to the east to east-southeast with shallow to moderate dips to the south (Figure 8B). The joint sets observed in Domain 2 show similar orientations as the observed linear surface features that define the prominent east-trending fold of the Annabel Lake pluton, with the addition of more north to north-northeast oriented structures (Figure 8B').

In general, Domain 2 is moderately fractured (Figure 9), but also transitions to abundantly fractured with increasing distance away from the relatively intact Domain 1 and towards the shear zones that bound the Annabel Lake pluton. Joint spacing varied from 10 – 40 centimetres (cm) (very blocky) to 30 – 60 cm (blocky), depending on proximity to the outer margins of the domain. The south branch of Domain 2 appears to be a 750 m wide zone of moderately fractured rock around the core represented by Domain 1. This relationship is less pronounced along the north branch of the domain, where fracture density was relatively lower than the south branch. Fracture density also increases towards the east as the nose of the fold is approached.

5.5.3 Domain 3 - Fractured Biotite Granodiorite

Two prominent orientations of joint sets plus two less common sets characterized the observed fractures in Domain 3. These include: more common steeply dipping northwest to north northwest-striking joints, and shallow to moderately northeast-dipping, northwest-striking joints as well as minor north- and east-trending joint sets (Figure 8C). Within the generally broad range of joint orientations, the dominant joint trend is to the northwest (Figure 8C'). This observation is generally consistent with that of Domain 1 and Domain 2.

Overall, domain 3 is moderately to abundantly fractured (Figure 9). Joint spacing generally varied from 3 – 10 cm (blocky/disturbed) to 10 – 40 cm (very blocky). Abundant fractures were specifically noted towards the west end of Domain 3, between Arner Lake and Limit Lake. Here, a notably tighter joint spacing is observed in proximity to a high density of northwest to north oriented linear surface features. This area is also an extension of the fold nose noted at the east end of Domain 2 in the east-central portion of the pluton.

5.5.4 Domain 4 - Heterolithic Biotite Granodiorite

Three prominent orientations of joint sets characterized the observed fractures in Domain 4. These include: a steeply dipping north-northeast to north-northwest oriented set, a steeply dipping west oriented set, and shallow dipping south-southeast oriented set (Figure 8D). These joint sets orientations appear consistent with those observed at the east end of Domain 3 with the exception that the trends are slightly rotated (Figure 8D').

Domain 4 is abundantly fractured (Figure 9). Joint spacing varied from 3 – 10 cm (blocky/disturbed) to 10 – 40 cm (very blocky). This may be a reflection of its close proximity to the greenstone rocks to the east of the pluton and the faults that are mapped therein (Figure 2).

5.5.5 Domain 5 - Hornblende Granodiorite to Diorite

Fractures observed in Domain 5 include a dominant northwest- to north-striking joint set with a steep dip and a secondary east-northeast trending joint set (Figure 8E and E’). Domain 5 is abundantly fractured adjacent to the West Arm shear zone, becoming moderate at a distance of approximately 750 m (north of the West Arm shear zone) into the pluton (Figure 9). Joint spacing varied from 3 – 10 cm (blocky/disturbed) to 30 – 100 cm (blocky).

5.5.6 Domain 6 – Supracrustal Rocks

Small-scale conjugate faults were observed in outcrop (Figure 7D), and larger faults are inferred by increased fracture density adjacent to north- northwest and north-northeast-trending lineaments in Domain 6. Fractures in three distinct orientations (Figure 8F’) are observed in Domain 6, including a dominant, generally west-northwest trending (shear-zone parallel) and steeply dipping joint set, a steeply dipping joint set oriented north-northwest to north-northeast, and a shallow dipping joint set oriented west-northwest (Figure 8F). Domain 6 is characterized by abundant fracturing (Figure 9), with joint spacing ranging between 3 – 10 cm (blocky/disturbed) and 10 – 40 cm (very blocky).

5.6 Bedrock Exposure and Surface Constraints

The following descriptions provide observational information regarding the extent of bedrock exposure, and any natural surface constraints encountered while accessing the general potentially suitable area in the Creighton area.

In general, the distribution of exposed bedrock is consistent with the understanding based on the Phase 1 Preliminary Assessment (Golder, 2013). Glacial deposits in the Creighton area form a thin (veneer like), less than 1 m thick, discontinuous drift cover that reflects the bedrock topography. Thicker overburden deposits tend to occur in low lying areas and exposed bedrock dominates the eastern half of the Annabel Lake pluton. Valleys defined by surficial lineaments tend to contain overburden with an estimated thickness that is greater than 2 m.

Access to the northern portions of the Annabel Lake pluton is generally straight-forward with either water or road, followed by a short distance of hiking. There are numerous shoreline exposures and islands within Annabel Lake, some of which provide access to the west-central area of the pluton (via Bellamy Bay). Foot traverses that extend south from the lake are generally slow, with a ground pace of approximately 2 - 3 kilometres per hour (km/hr). This is due to greater forest cover in the western portion of the pluton. In order to reach the more southerly parts of the pluton, fixed-wing aircraft is recommended. An outline of the bedrock exposure and natural surface constraints by domain is provided below.

5.6.1 Domain 1 - L-tectonite Biotite Granodiorite

Domain 1 is located in the core of the western part of the Annabel Lake pluton (Figure 3). It is only readily accessible using a boat from Annabel Lake. The bedrock is generally well exposed on the lakeshore and lesser so away from the lake where low moss-covered outcrops dominate (Figure 10A). Locally there is a high percentage of muskeg that hampers access, particularly in the eastern part of the domain.

5.6.2 Domain 2 - Foliated Biotite Granodiorite

Domain 2 surrounds the lens-shaped Domain 1 and extends east from it (Figure 3). The bedrock in Domain 2 is very easily observed in the eastern part of the domain with large open and clean exposures (Figure 10B), and good exposures along the northern part of the Annabel Lake pluton. In contrast, there is a high percent of lakes and muskeg covering portions of the western half of the domain with only moderate bedrock exposure and low moss-covered outcrops away from the lake, similar to Domain 1. Domain 2 has moderate to difficult access with the north margin accessible by boat along Annabel Lake and the core of the domain accessible by a moderately long foot traverse (~ 2.5 km) from Annabel Lake or Highway 106. The south margin requires long foot traverse or fixed-wing aircraft to access it.

5.6.3 Domain 3 - Fractured Biotite Granodiorite

Domain 3 lies directly east of Domain 2 (Figure 3). A major forest fire over much of Domain 3 resulted in very well exposed, large and clean, white outcrops (Figure 10C) distinctly visible on satellite imagery. Easy access to the domain is available by a short foot traverse (< 2 km with minimal forest cover) from Highway 106.

5.6.4 Domain 4 - Heterolithic Biotite Granodiorite

Domain 4 is located in the northeast corner of the Annabel Lake pluton (Figure 3). The same forest fire that affected Domain 3 also resulted in very well exposed bedrock in Domain 4 with large, clean outcrops (Figure 10D). The domain is very easy to access directly from Highway 106. Only one location was visited in Domain 4 during the OGGF activity.

5.6.5 Domain 5 - Hornblende Granodiorite to Diorite

Domain 5 consists of a small intrusive phase in the southeast corner of the Annabel Lake pluton (Figure 3). The bedrock is covered by 30-40 % muskeg but has large, clear outcrops where exposed (Figure 10E). The domain is difficult to access and reaching the area requires either a fixed-wing charter to Raft Lake or a long ATV and bush traverse from Highway 167.

5.6.6 Domain 6 – Supracrustal Rocks

Supracrustal rocks of Domain 6 bound the Annabel Lake pluton on both its north and south margins (Figure 3). The north margin of Domain 6 is well exposed and is easy to access along Annabel Lake and Highway 106. In contrast, the south margin has variable bedrock exposure although it is locally well exposed on Annabel and Amy lakes (Figure 10F) and is difficult to access, requiring either a long traverse (~ 4.5 km through low-lying wet areas and relatively thick forest at the south end) or fixed-wing aircraft. The West Arm shear zone found along the south edge of the mapping area projects eastward to Highway 167 where it is exposed in a series of small, low outcrops along the highway.

6 Summary of Results

This report presents the results of the Phase 2 Observation of General Geological Features (OGGF) activity conducted in the Creighton area. Observations were made at select locations within and proximal to the area covering the central part of the Annabel Lake pluton. The Phase 2 OGGF activity was conducted using a consistent approach to confirm and ground truth the presence and nature of key geological features of this pluton, including bedrock lithology, structural character, fracture character and spacing, and bedrock exposure and surface constraints. The work included planning, implementation, synthesis, and reporting stages for undertaking the geological observations.

Six domains were identified for the Creighton area on the basis of their lithological and structural character and aided by a newly-acquired high resolution magnetic dataset. Five of the domains represent distinct subdivisions of the Annabel Lake pluton. These include an L-tectonite biotite granodiorite domain, a foliated biotite to hornblende granodiorite domain, a fractured biotite granodiorite domain, a heterolithic biotite granodiorite domain, and a hornblende granodiorite to diorite domain. The sixth domain represents the surrounding supracrustal rocks of the Amisk and Missi groups. A summary of the observations is included below (Table 6).

In terms of bedrock exposure and surface constraints, much of the potentially suitable area of the Annabel Lake pluton can be accessed by boat along the south side of Annabel Lake or by short foot traverse from Highway 106. While parts of the lakeshore are well-exposed, some inland areas are covered by smaller lakes and may also exhibit a high percentage of muskeg that can hamper access. Away from such features, there is generally moderate bedrock exposure with low moss-covered outcrops. One exception is a large area in the east with almost continuous bedrock exposure. The southern margin of the area is difficult to reach and requires long foot traverses or fixed-wing aircraft for access.

In the L-tectonite biotite granodiorite of Domain 1 the dominant structural feature is a penetrative L_2 mineral lineation defined by elongate quartz grains and aligned biotite grains. A weak S_2 foliation is locally observed in the domain and predominantly was observed to be flat lying. Brittle-ductile to ductile shear zones are locally present. The rock strength is characteristically very strong. Magnetic susceptibility in Domain 1 is uniformly low. Domain 1 is generally massive to sparsely fractured with localized domains of moderate to abundant fracture density next to lineaments. The jointing pattern suggested that the bedrock was blocky to massive.

In Domain 2, the dominant structural features are a well-developed S_2 foliation and L_2 mineral lineation. Brittle-ductile to ductile shear zones are locally present. Rock strength was characteristically strong to very strong. Magnetic susceptibility in Domain 2 is much higher than in Domain 1 and exhibits a wider range in values. The foliated biotite to hornblende granodiorite of Domain 2 transitions from moderately fractured near Domain 1 to abundantly fractured towards the shear zones that bound the pluton. Similarly, the jointing pattern indicated bedrock conditions that transition from blocky to very blocky towards the outer margins of the domain (nearer to the bounding shear zones).

The fractured biotite granodiorite of Domain 3 is moderately to abundantly fractured. The rock is uniformly very strong. Magnetic susceptibility in Domain 3 is greater than in Domain 1 but does not show the same broad range as in Domain 2. Foliation and lineation are only weakly developed in this domain. Brittle-ductile to ductile shear zones are locally present. The jointing pattern suggested that the bedrock was very blocky to blocky/disturbed.

The heterolithic biotite granodiorite of Domain 4 is abundantly fractured. Rock strength is characteristically very strong. Magnetic susceptibility in Domain 4 is similar to Domain 2 and relatively high. The foliation is generally well developed. The jointing pattern indicates a very blocky to blocky/disturbed bedrock condition.

The hornblende granodiorite to diorite of Domain 5 is moderately to abundantly fractured with the latter occurring in closer proximity to the West Arm shear zone. Rock strength is characteristically very strong. Domain 5 exhibits a moderate to low magnetic susceptibility. The domain is only weakly foliated except near its southern margin where it is in contact with the adjacent Amisk Group metavolcanic rocks in and proximal to the West Arm shear zone. The jointing pattern indicates a blocky to blocky/disturbed bedrock condition.

The supracrustal rocks of Domain 6 exhibit a particularly well-developed foliation, especially in proximity to the steeply-dipping Annabel Lake and West Arm shear zones. Rock strength is characteristically weak. Low magnetic susceptibility values were measured within the supracrustal rocks in both of the shear zones. The dominant fractures tend to be parallel to the shear zones. The jointing pattern in Domain 6 indicates a very blocky to blocky/disturbed bedrock condition.

Table 6: Summary of Domain Characteristics for the Creighton Area

Domain	Host Rock Character	Fracture Characterization	Bedrock Exposure and Surface Constraints
Domain 1 - L-tectonite Biotite Granodiorite Western part of Annabel Lake pluton	• Weakly foliated, recrystallized, medium-grained biotite granodiorite • Very strongly developed mineral lineation parallel to the long axis of the pluton characterizes the domain • Doubly plunging dome with shallowly to moderately dipping north and south flanks and shallowly plunging east and west ends • Uniformly very strong (R5)	• Brittle-ductile to ductile shear zones locally developed within domain • Predominantly massive to sparsely fractured rock • Localized domains of moderate to abundant fracture density next to lineaments • Three dominant fracture sets - North to northeast oriented set, steeply dipping to vertical - West-northwest oriented set, steeply dipping to the south, to vertical - West-northwest oriented set, shallow dipping to the north	• Only accessible using boat on Annabel Lake • Well exposed on lake edge • Moderate bedrock exposure with low moss-covered outcrops away from lake • Locally high percentage of muskeg
Domain 2 - Foliated Biotite Granodiorite Outer margin of L-tectonite domain in western and central parts of Annabel Lake pluton	• Strongly foliated, strongly lineated, recrystallized, medium-grained biotite ± hornblende granodiorite • Elongate, east-plunging fold has been refolded by an open, upright, north-trending fold set • Strong (R4) in some outcrops on margin to very strong (R5)	• Brittle-ductile to ductile shear zones locally developed within domain • Fracture density, which is generally moderate, increases towards the Annabel Lake and West Arm shear zones • Three fracture sets generally consistent with those in Domain1, plus random sets oriented east to east-south-east with shallow to moderate dips to the south	• Moderate to difficult access • North margin exposed along Annabel Lake • Core is moderate foot traverse from Annabel Lake or Highway 106 • South margin requires long traverse or fixed-wing aircraft charter • Moderate bedrock exposure with low moss-covered outcrops away from lake • Large, open and clean exposures in the eastern part of this domain
Domain 3 - Fractured Biotite Granodiorite East part of Annabel Lake pluton	• Strongly fractured, weakly foliated to massive, medium-grained biotite granodiorite similar in composition to the previous two domains • Very strong (R5)	• Brittle-ductile shear zones locally developed within domain • Fracture density ranges from moderate to abundant in this domain Increased fracturing was noted in the nose of the fold • Three dominant fracture sets, with a broader range of orientations than the above domains - North-northeast to north-northwest oriented sets, steeply dipping to vertical - West-southwest to west-northwest oriented sets, steeply dipping - East-northeast to southeast oriented sets, shallow to moderately dipping to the south	• Easy access from Highway 106 • Major forest fire resulted in a very well exposed domain with large, clean, white outcrops distinctly visible on satellite imagery
Domain 4 - Heterolithic Biotite Granodiorite Northeast part of Annabel Lake pluton	• Heterolithic, medium-grained biotite granodiorite with a significant proportion of mafic volcanic xenoliths • Variable and domainal foliation development • Very Strong (R5)	• Abundant fracture density • Three dominant fracture sets - North-northeast to north-northwest oriented set, steeply dipping - West oriented set, steeply dipping - South-southeast oriented set, shallow dipping to the west	• Easy access directly from Highway 106 • Major forest fire resulted in a very well exposed domain with large, clean outcrops visible on satellite imagery
Domain 5 - Hornblende Granodiorite Small domain in southeast part of Annabel Lake pluton	• Weakly foliated, medium-grained hornblende granodiorite to diorite • Very strong (R5)	• Moderate fracture density, becoming abundant close to the West Arm shear zone • Dominant set is oriented northwest to north-northwest, steeply dipping • Secondary set is steeply-dipping and trends east-northeast	• Difficult to access • Requires fixed-wing aircraft charter to Raft Lake or long ATV and bush traverse from Highway 167 • 30-40% muskeg but has large, well-exposed outcrops where present
Domain 6 - Supracrustal Rocks North and south margins of Annabel Lake pluton including Annabel Lake and West Arm shear zones	• Aphanitic to fine-grained metavolcanic and metasedimentary rocks of the Amisk and Missi groups • Strongly to intensely developed foliation where observed dipping away from pluton • Foliation parallels mapped shear zones and dips steeply away from centre of pluton • Locally refolded about shallowly north- and northwest-plunging fold axes • Weak (R2) in both metasedimentary and metavolcanic rocks	• Abundant fracture density associated with the supracrustal rocks near the Annabel Lake and West Arm shear zones • Dominant fracture sets tend to be parallel with the west-northwest trending shear zones at a given location • Other fracture sets have consistent orientations with the above domains, including steeply-dipping north-northwest to north-northeast and shallowly north-dipping west-northwest fractures	• North margin well exposed and easy to access along Annabel Lake and Highway 106 • South margin difficult to access, requires long traverse or fixed-wing aircraft charter • South margin has variable bedrock exposure; well exposed on Annabel and Amy lakes • West Arm Shear Zone projects eastward to Highway 167, where it is exposed in small outcrops

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FIGURES

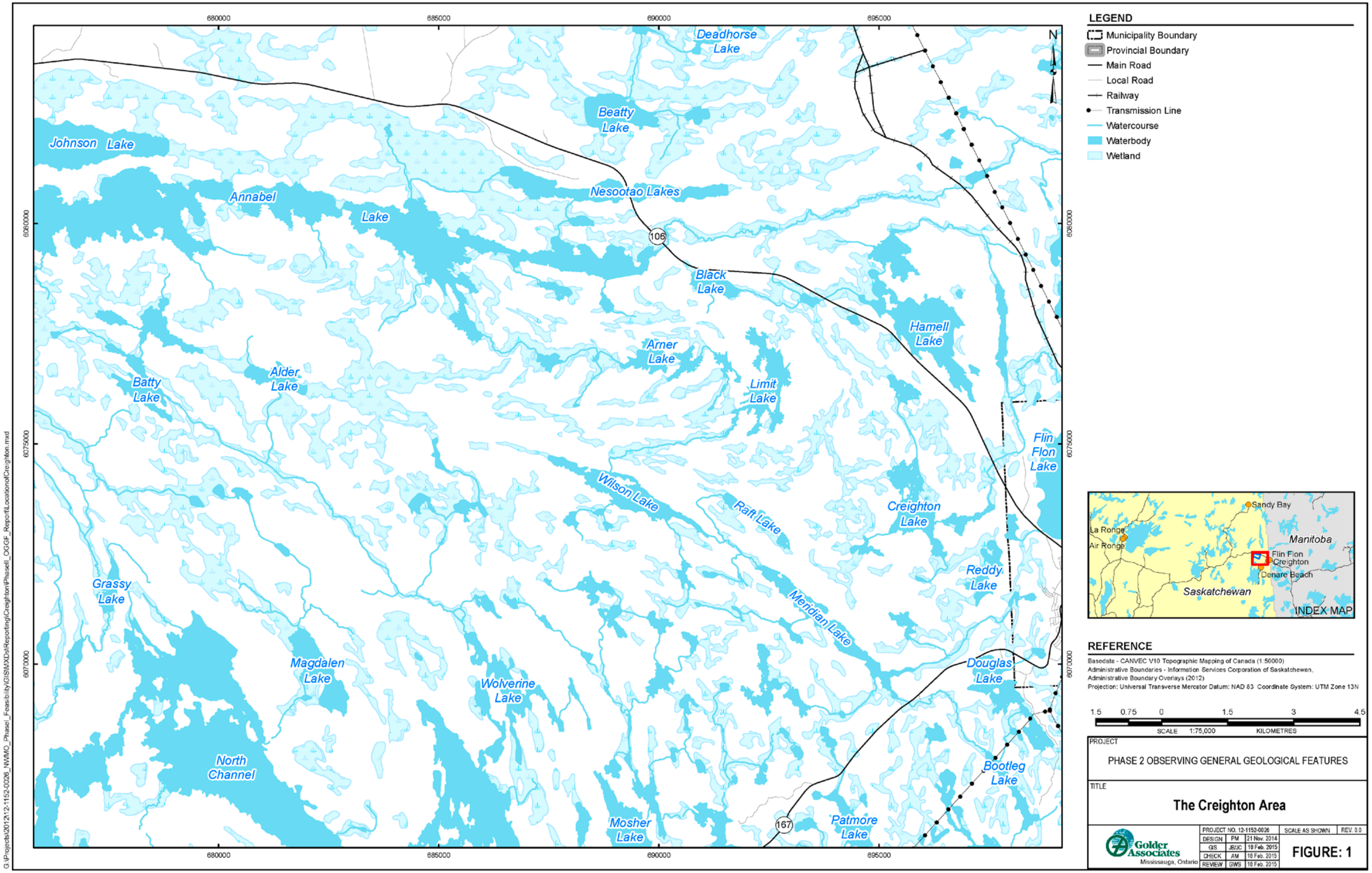

Figure 1: The Creighton Area

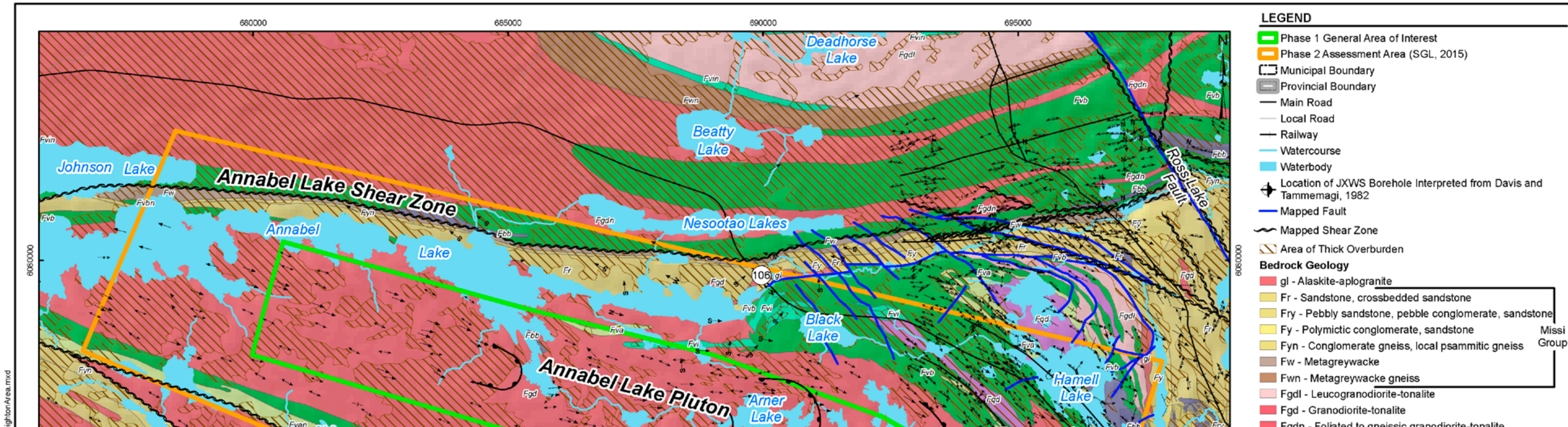

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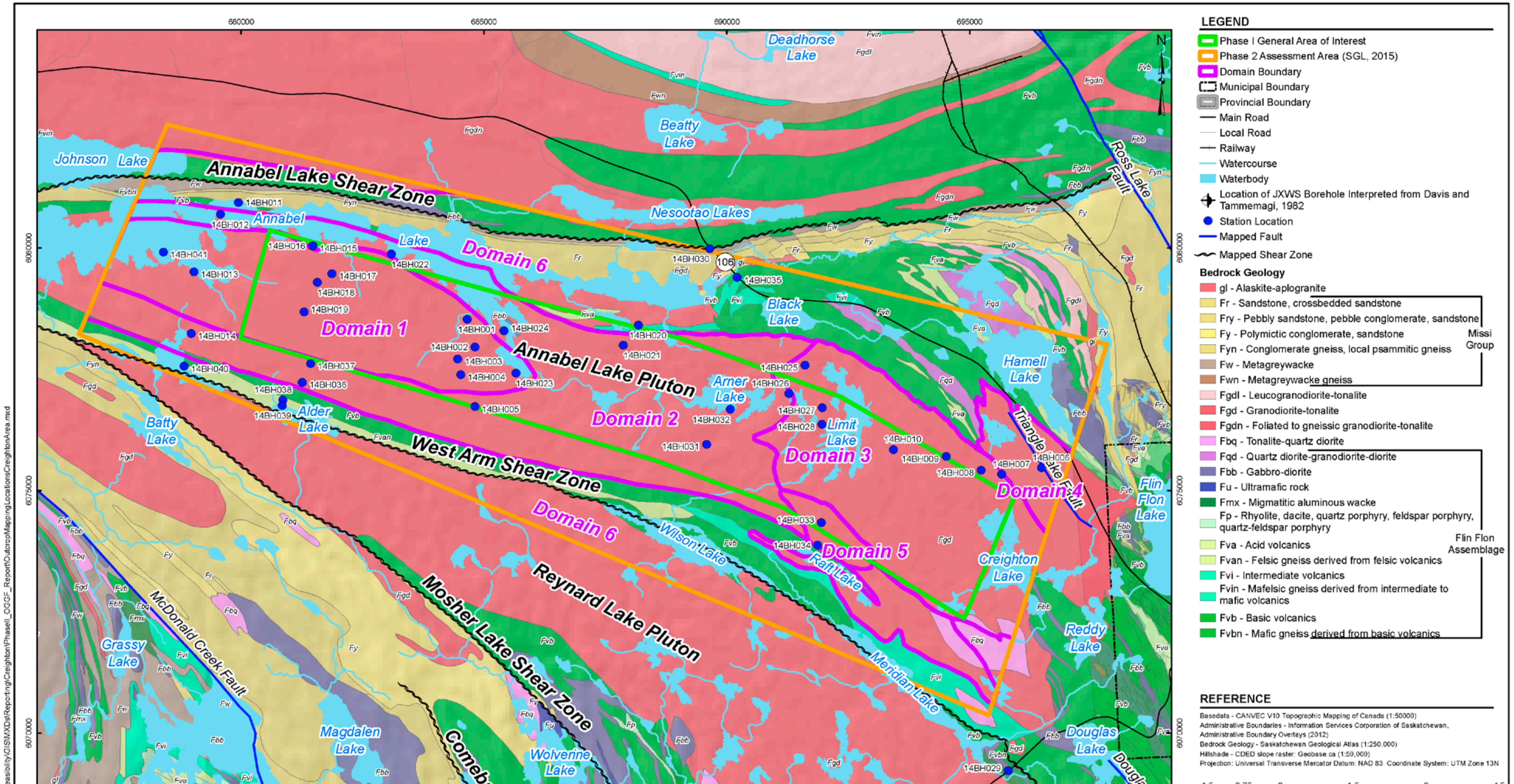
Figure 2: Bedrock Geology and Overburden Coverage of the Creighton Area



[redacted]

Figure 3: Outcrop Mapping Locations in the Creighton Area

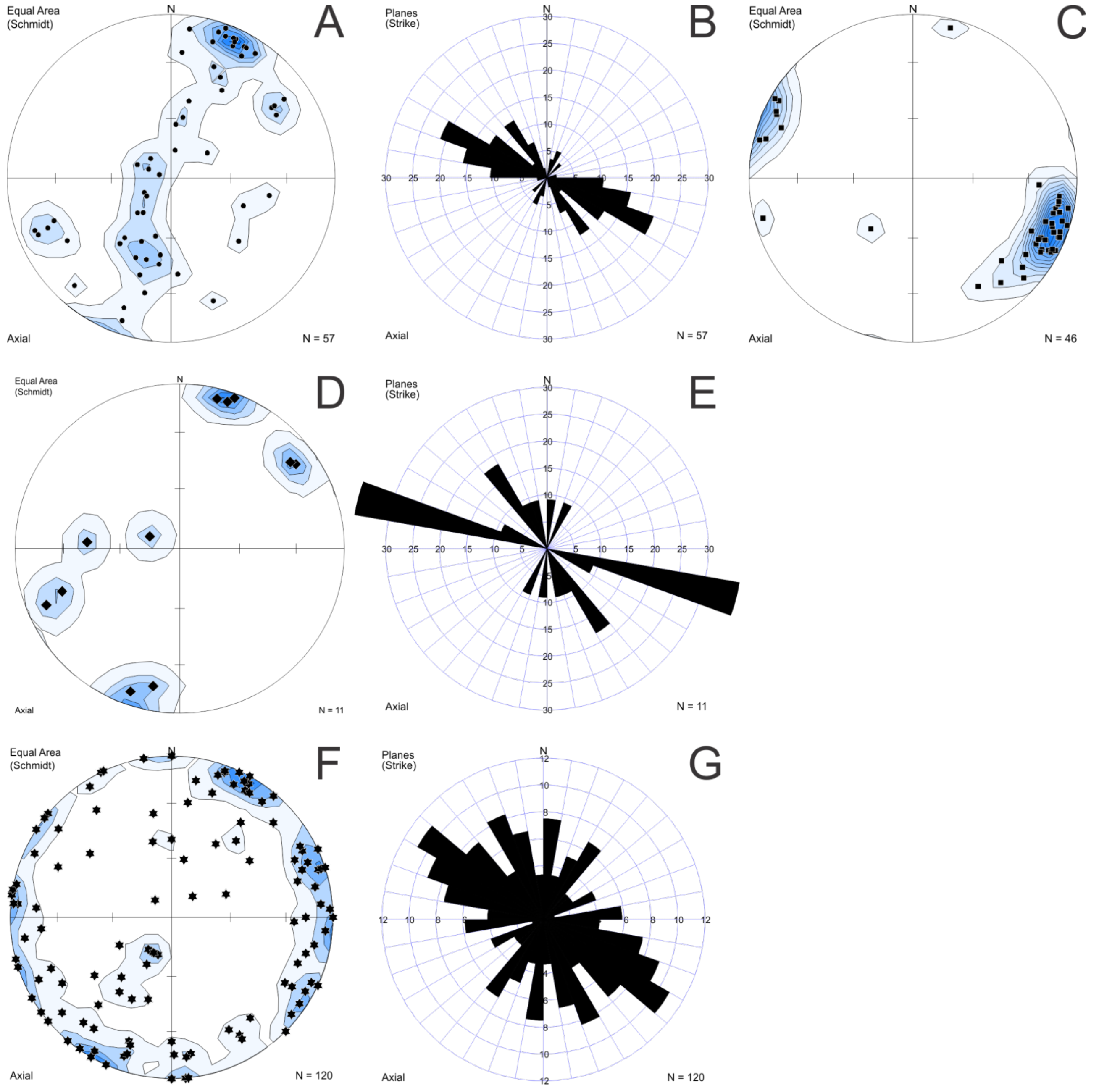


Figure 4: Composite Plots of Structural Orientation Data for the Creighton Area

A. Equal Area Lower Hemisphere Stereonet Plot of Poles to Foliation.
B. Rose Diagram of Trends of Foliation Planes.
C. Equal Area Lower Hemisphere Stereonet Plot of Lineation.
D. Equal Area Lower Hemisphere Stereonet Plot of Shear Zones.
E. Rose Diagram of Trends of Shear Zones.
F. Equal Area Lower Hemisphere Stereonet Plot of Poles to Fractures.
G. Rose Diagram of Trends of Fracture Planes.

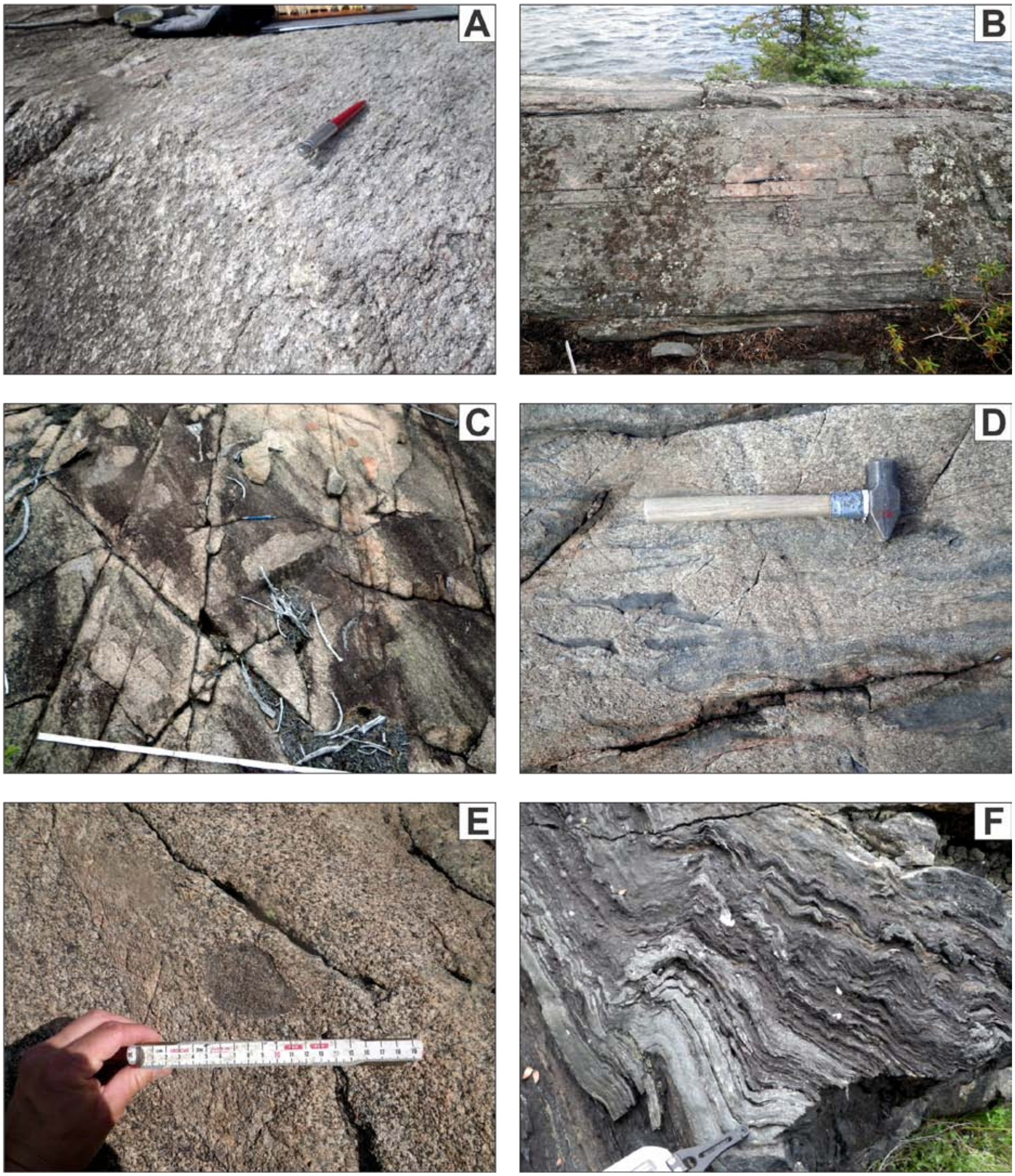


Figure 5: Representative Lithology and Structural Character of Rock Units in the Six Domains

A. Domain 1 L-tectonite biotite granodiorite showing well-developed mineral lineation (Station 14BH013).
B. Domain 2 Foliated biotite to hornblende granodiorite (Station 14BH012).
C. Domain 3 Fractured biotite granodiorite showing example of abundant fracture density west of Limit Lake (Station 14BH028).
D. Domain 4 Heterolithic biotite granodiorite with irregular mafic xenoliths (Station 14BH006).
E. Domain 5 Hornblende granodiorite to diorite with rounded mafic xenoliths (Station 14BH033).
F. Domain 6 Amisk Group supracrustal rocks showing refolding of the main foliation in proximity to the Annabel Lake shear zone (Station 14BH030).

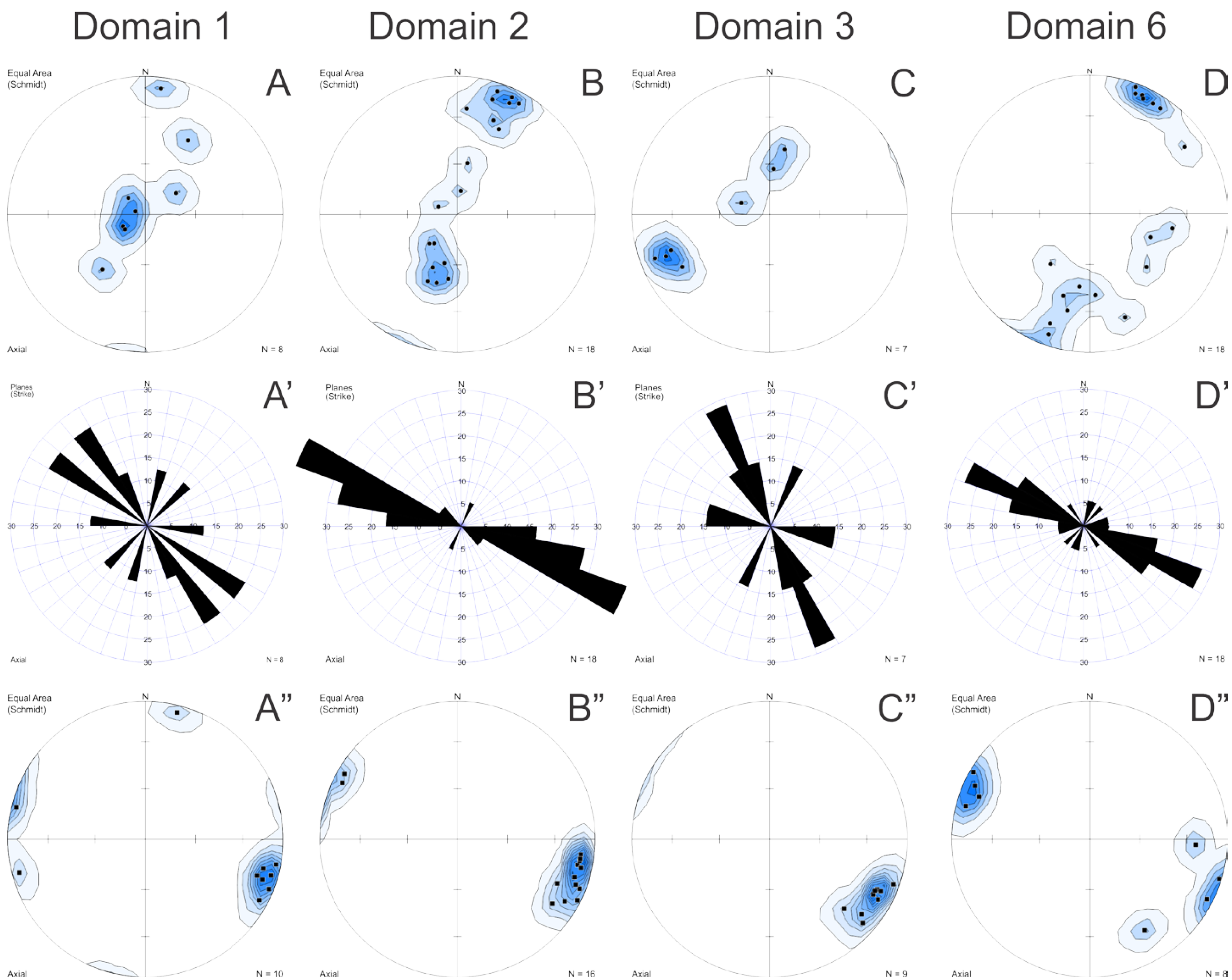


Figure 6: Foliation and Lineation Orientation Data Plotted for Domains 1, 2, 3, and 6

Data displayed as equal area lower hemisphere stereonet plots of poles to foliation (A,B,C,D), rose diagrams of trends of foliation planes (A',B',C',D'), and equal area lower hemisphere stereonet plots of lineation (A",B",C",D"). There are insufficient data in domains 4 and 5 to plot.

A. Domain 1 – Annabel Lake pluton L–tectonite biotite granodiorite.
B. Domain 2 – Annabel Lake pluton foliated biotite granodiorite.
C. Domain 3 – Annabel Lake pluton fractured biotite granodiorite.
D. Domain 6 – Supracrustal Rocks.

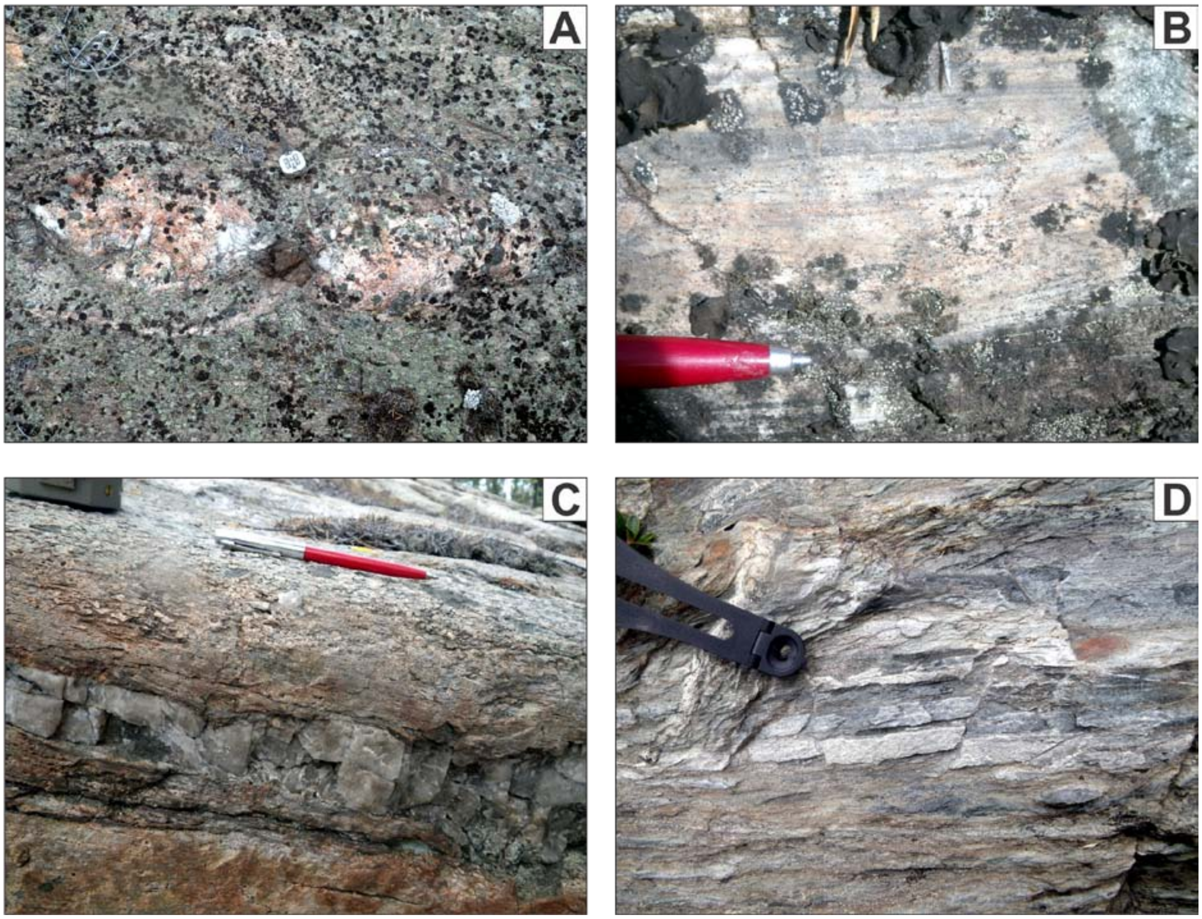


Figure 7: Additional Structural Features in the Rock Units of the Six Domains

A. Boudinaged pegmatite dykes in brittle – ductile high strain zone of Domain 1 (Station 14BH019).

B. Protomylonitic foliation marking a steeply dipping brittle-ductile shear zone that overprints the shallowly dipping dominant foliation at the margin of the pluton in Domain 2 (Station 14BH021).

C. Shallowly east-dipping brittle ductile shear zone with rotated porphyryclasts and boudinaged quartz vein in Domain 3 (Station 14BH027).

D. Conjugate faulting in strongly deformed metavolcanic rocks adjacent to the West Arm shear zone in Domain 6 (Station 14BH029).

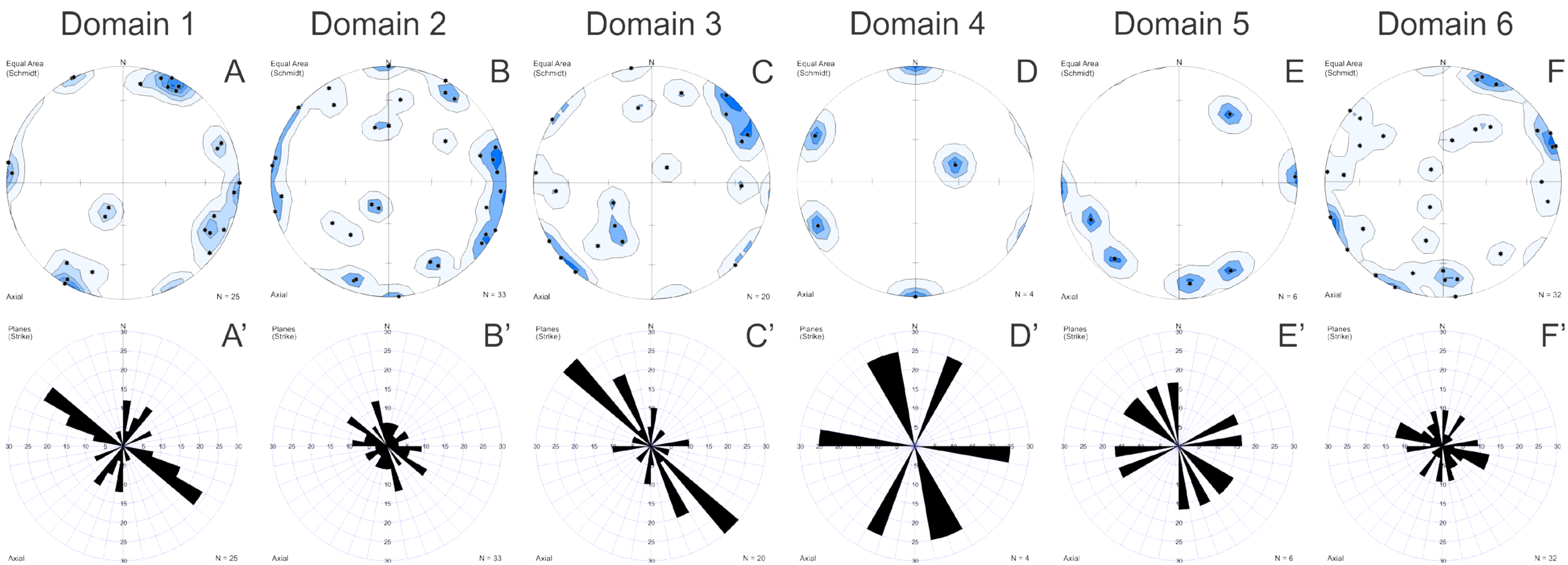


Figure 8: Fracture Orientation Data Plotted By Domain

Data displayed as equal area lower hemisphere stereonet plots of poles to fractures (A,B,C,D,E,F) and rose diagrams of trends of fracture planes (A',B',C',D',E',F').

A. Domain 1 – Annabel Lake pluton L- tectonite biotite granodiorite.
B. Domain 2 – Annabel Lake pluton foliated biotite granodiorite.
C. Domain 3 – Annabel Lake pluton fractured biotite granodiorite.
D. Domain 4 – Annabel Lake pluton heterolithic biotite granodiorite.
E. Domain 5 – Annabel Lake pluton hornblende granodiorite.
F. Domain 6 – Supracrustal rocks.

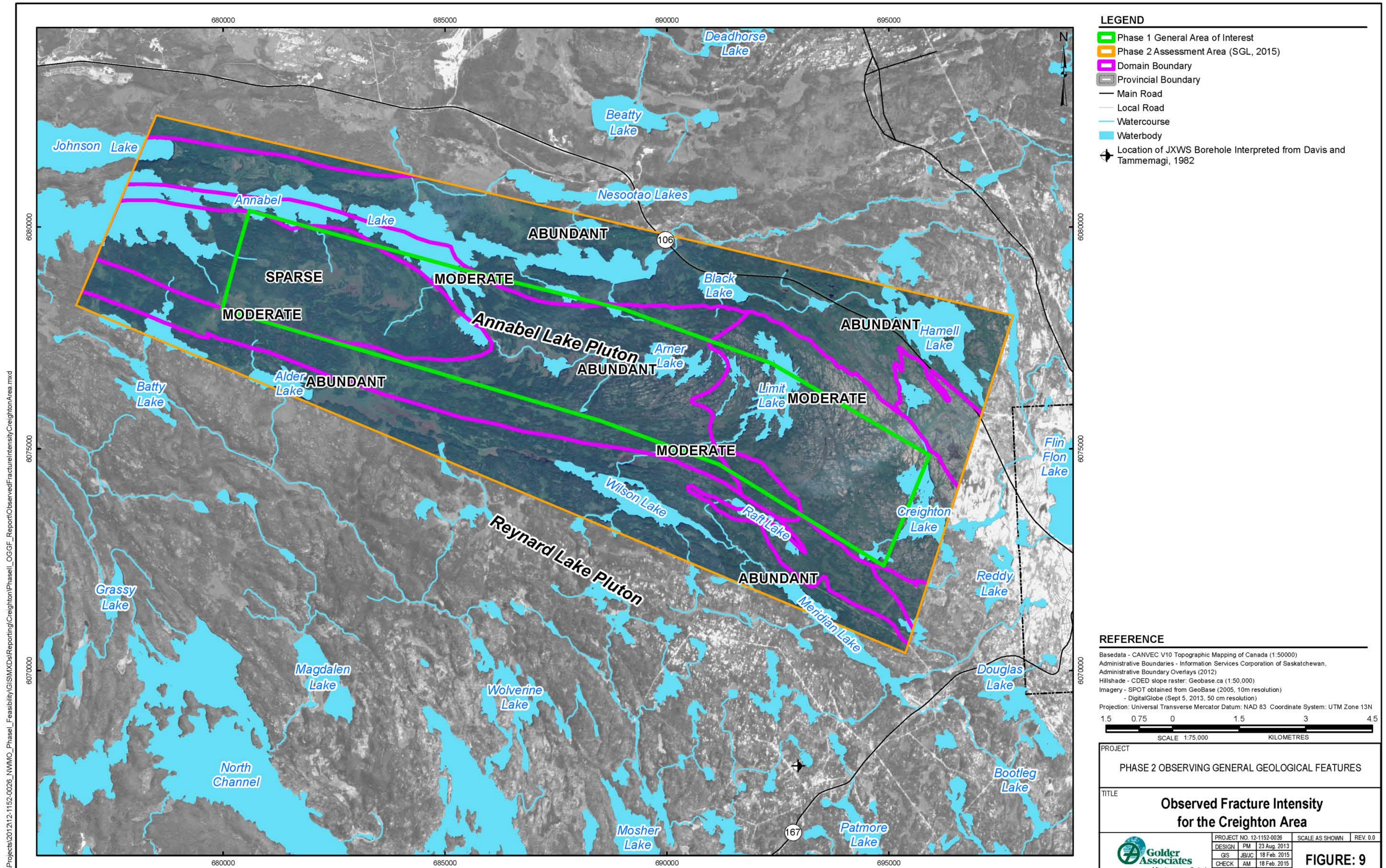


Figure 9: Fracture Density Variation across the Annabel Lake Area

Figure 10: Representative Examples of Bedrock Exposure in the Six Domains

A. L-tectonite biotite granodiorite outcrop observed in Domain 1 (Station 14BH018).

B. Foliated biotite to hornblende granodiorite on the south shore of Arner Lake in Domain 2 (Station 14BH032).

C. Fractured biotite granodiorite in well-exposed outcrops at the east end of Domain 3 (Station 14BH007).

D. Heterolithic biotite granodiorite in well-exposed outcrops of Domain 4 (Station 14BH006).

E. Hornblende granodiorite to diorite in the centre of Domain 5 (Station 14BH033).

F. Amisk Group supracrustal rocks exposed along a shoreline in Domain 6 (Station 14BH040).

APPENDIX A

GIS Data Tables

Table A. 1: Stations Visited

Station ID	Visit Date	Latitude	Longitude	Easting NAD83Z13N	Northing NAD83Z13N	Elevation	PDOP	Obs Type	Trav No	Stat Note
14BH001	9/7/2014	54.81982828	-102.12575075	684658	6078530	318.04	1.51	outcrop	1	• wp1102; planned outcrop AL24; isolated outcrops exposed between low-lying, open, spruce stands
14BH002	9/7/2014	54.81466678	-102.12363742	684818	6077960	330.04	1.88	outcrop	1	• wp1103; AL22; large, low relief outcrop surrounded by open spruce bush, potential detailed mapping area (large outcrop, relatively low fracture density)
14BH003	9/7/2014	54.81256745	-102.12928358	684465	6077710	325.54	4.19	outcrop	1	• wp1104; AL21; large low (5m high) outcrops surrounded by open, flat spruce forest, potential detailed mapping area (large outcrop, relatively low fracture density)
14BH004	9/7/2014	54.80964428	-102.12852892	684526	6077390	327.34	2.47	outcrop	1	• wp1105; AL20; small very low outcrop in flat, open spruce forest, no barriers to access
14BH005	9/7/2014	54.80361695	-102.12448675	684814	6076730	325.04	2.04	outcrop	1	• wp1106; AL19; larger outcrop in flat open area
14BH006	9/8/2014	54.78788560	-101.94402031	696485	6075470	315.94	1.50	outcrop	2	• wp1107; AL40; low lying outcrop on edge of swamp beside a strong lineament, walking here from road was high oc % with narrow covered intervals, quite dry this year as well
14BH007	9/8/2014	54.78698076	-101.95686314	695664	6075330	317.24	1.97	outcrop	2	• wp1108; AL41; high outcrop exposure %, crossed a narrow poplar swamp and came out onto this leucocratic, very fgr mafic granodiorite with strong fracturing
14BH008	9/8/2014	54.78789510	-101.96345614	695236	6075420	329.14	1.94	outcrop	2	• wp1109; AL42; 95% outcrop between here and last, same lith, bt getting mgr, wp1110 is at fault zone 50m to west
14BH009	9/8/2014	54.79074010	-101.97447213	694514	6075700	320.24	3.09	outcrop	2	• wp1111; AL43; travelled over large expanses of well exposed outcrop, fractured but not strongly foliated bt grdr, between were wet bog / muskeg
14BH010	9/8/2014	54.79243160	-101.99119913	693431	6075850	328.44	2.18	outcrop	2	• wp1112; AL45; long walk to get here, mix of open outcrop, and watery bogs
14BH011	9/9/2014	54.84315778	-102.19745305	679949	6080940	314.94	1.42	outcrop	3	• wp1113; AL1; isolated outcrop on shore, surrounded by swamp or lake
14BH012	9/9/2014	54.84109528	-102.20339722	679577	6080690	312.94	1.37	outcrop	3	• wp1114; AL3; steep sided narrow outcrop on shoreline, lichen covered, parallel to the east trending shore, low lying ground to south
14BH013	9/9/2014	54.83064529	-102.21263105	679030	6079510	319.94	1.84	outcrop	3	• wp1115; AL5; point of outcrop on lake, exposed adjacent to a very strong lineament in mag and satellite
14BH014	9/9/2014	54.81927495	-102.21432672	678972	6078240	331.64	1.51	outcrop	3	• wp1118; AL7; good trail in from Annabel Lake to Amy Lake makes access easy, 90% low-lying open forest with 10% low outcrop exposed, most oc are thickly moss/lichen covered which makes fracture density calculations difficult
14BH015	9/10/2014	54.83457145	-102.17428040	681475	6080040	314.44	1.72	outcrop	4	• wp1120; AL9; no data associated with this station, was duplicated by station 14BH016
14BH016	9/10/2014	54.83459128	-102.17428106	681475	6080040	315.64	1.71	outcrop	4	• wp1120; AL9; , duplicated stn, data was all consolidated under 14BH016; main outcrop, wp1119 NE-striking joint set, large oc with foliation following the dip slope to NNE into water, sharp lineament strikes ESE behind oc and NNE breaks on W side of oc
14BH017	9/10/2014	54.82929511	-102.16842890	681875	6079470	333.14	1.74	outcrop	4	• wp1121; AL10; low lying 2m high, moderately large, moderately moss covered outcrop, to get here crossed several WNW striking ridges parallel to strike of foln but dipping steeply to SSW
14BH018	9/10/2014	54.82782012	-102.17325440	681572	6079290	333.14	1.71	outcrop	4	• wp1122; AL11; wide, flat, low lying (1m) outcrop set in open flat spruce forest, potential detailed mapping area but would probably need stripping and doesn't expose the vertical much (large outcrop, relatively low fracture density)
14BH019	9/10/2014	54.82242528	-102.17794873	681294	6078680	335.24	2.24	outcrop	4	• wp1123; AL12; two long linear, inverted canoe shaped outcrops, was all good flat bush nearby, easy traversing, no access issues by, except fir open muskeg and sparse trees in low spot to N
14BH020	9/11/2014	54.81748044	-102.07104160	688183	6078410	321.44	2.01	outcrop	5	• wp1124; AL30; linear set of oc that parallel foliation and are cut off to west by a NNW lineament, mostly spruce forest with narrow alder muskeg, no serious impediments to travel
14BH021	9/11/2014	54.81386594	-102.07610993	687874	6078000	336.04	2.63	outcrop	5	• wp1125; AL31; at margin of Annabel Lake pluton , strongly foliated and good lineation, complex lith as tectonic slivers parallel to foliation
14BH022	9/11/2014	54.83248245	-102.14920157	683095	6079880	311.74	2.46	outcrop	5	• wp1128; no planned oc; shoreline outcrop, fairly steep slope, in well foliated grdr with good lineation, intruded by peg, which is locally boudinaged and and is locus for folds of main foln
14BH023	9/11/2014	54.80949978	-102.11091159	685659	6077420	315.44	1.71	outcrop	5	• wp1129; no planned oc; shoreline, at nose of fold gently plunging to E, bush inland is good, west shore of bay is dotted with outcrop, east shore is low muskeg and forest, potential detailed mapping area (large outcrop, relatively low fracture density)
14BH024	9/11/2014	54.81747711	-102.11415609	685414	6078300	313.84	1.52	outcrop	5	• wp1131; no planned outcrop; back close to the community visit spot on the first day, well foliated and lineated, cut by straight pink peg, but see a good folded peg in a large loose block
14BH025	9/12/2014	54.80875093	-102.01829745	691612	6077590	323.04	2.36	outcrop	6	• wp1134; AL340; traversed in from Black Lake after canoeing across from outfitter's, great high ground with high outcrop percentage and Jack pine forest and narrow bog filled lineaments, station is at intersection of strong NW & min lin parallel lineament
14BH026	9/12/2014	54.80363177	-102.02378712	691284	6077000	318.84	1.29	outcrop	6	• wp1136; no planned outcrop; area is well exposed bedrock around lake with narrow creeks running into lake, supposed to be in the tip of the tightly folded phase, is the same lith, still an L tectonite , locally has mafic xenos, with foliation
14BH027	9/12/2014	54.80070960	-102.01336362	691967	6076700	326.54	1.97	outcrop	6	• wp1138; AL35; big open outcrops in open Jack pine forest; lith here is both more ductily deformed as well as more fractured, at the intersection of two lineaments
14BH028	9/12/2014	54.79766343	-102.01368312	691961	6076370	323.74	1.58	outcrop	6	• wp1139; AL36; at intersection of NW lineament and NE lineament which corresponds t0 a strong shallowly dipping fracture set, still large outcrops with open Jack pine forest between, no obvious impediments to access
14BH029	9/13/2014	54.73210493	-101.95900132	695792	6069220	296.94	2.29	outcrop	7	• wp1143; no planned outcrop; small series of roadside outcrops near West Arm SZ, not a complete section but definitely a strain gradient from wp1142 in mafic to intermediate volcanic rocks, the Renard pluton is just to S across small stream, easy access
14BH030	9/13/2014	54.83102960	-102.04723277	689649	6079990	322.14	1.77	outcrop	7	• wp1146; AL27; small oc on N side of road, low mag so just S of the strong mag high linear, extreme foln, strongly refolded, about upright NW trending, shallowly NE plunging S folds
14BH031	9/14/2014	54.79488644	-102.05089378	689583	6075960	323.54	2.19	outcrop	8	• wp1149; main oc, replacement for planned outcrop AL33; wp1147 along way to take rep foln, wp1148 just to S as close to E-W lineament; good large exposed outcrops, with open Jack pine forest and narrow muskeg between
14BH032	9/14/2014	54.80115544	-102.04284478	690071	6076670	319.04	1.54	outcrop	8	• wp1150; replacement for planned outcrop AL32; back at lake, good wide outcrop, many like it around Arner Lake, 50% outcrop in area, in distinct ENE trending ridges

Station ID	Visit Date	Latitude	Longitude	Easting NAD83Z13N	Northing NAD83Z13N	Elevation	PDOP	Obs Type	Trav No	Stat Note
14BH033	9/14/2014	54.77947760	-102.01517063	691952	6074340	319.14	1.84	outcrop	8	• wp1153; near AL38 along same N-trending lineament; started in mafic volc, quickly got into a dark orange weathering hbe granite, definitely more kspar but plag is higher, quartz is down, bush is a lot thicker to S in mafic, but open oc in pluton
14BH034	9/14/2014	54.77532760	-102.01667379	691875	6073870	315.84	2.15	outcrop	8	• wp1155; AL39; large outcrop still in hbe gran-grdr, open Jack pine forest on outcrop tops, thick spruce and alder muskeg between
14BH035	9/14/2014	54.82548844	-102.03883911	690214	6079390	330.14	1.43	outcrop	8	• wp1157; near AL28 and 29; moderate roadside outcrop in mafic volcanic rocks near boat launch for Annabel Lake, no access problems, part of type 2/mushroom refold
14BH036	9/15/2014	54.80943228	-102.17935090	681262	6077230	334.94	2.01	outcrop	9	• wp1163; AL15; in pluton at NW lineament, Missi seds at shore, Amisk volc at wp1159,1160,1161, first grdr at wp1162, most low moss covered oc with Jack pine, more alder/ poplar bush, mixed with spruce in lows, far from roads but terrain isn't a barrier
14BH037	9/15/2014	54.81282512	-102.17643007	681435	6077620	335.94	2.01	outcrop	9	• wp1165; AL14; again low lying outcrop covered in moss, good flat open spruce forest between here and last outcrop , in lighter weathering lineated bt grdr
14BH038	9/15/2014	54.80630029	-102.18586690	680858	6076870	328.74	1.65	outcrop	9	• wp1166; no planned outcrop; back to the Amisk volcanic we crossed at wp1159, moderate sized outcrop, low lying wet alder, poplar and spruce forest around it
14BH039	9/15/2014	54.80527795	-102.18608190	680849	6076750	321.84	2.18	outcrop	9	• wp1167; replacement for planned outcrop AL16; at shore in Missi sedimentary rocks, small oc, only a couple metres long, only doing overview data
14BH040	9/15/2014	54.81326179	-102.21698039	678828	6077560	322.34	2.09	outcrop	9	• wp1168; AL8; shoreline outcrop, numerous outcrops around Amy Lake, dropped by plane, not sure about bush conditions, in Amisk rocks
14BH041	9/15/2014	54.83451895	-102.22219572	678399	6079910	312.64	1.35	outcrop	9	• wp1169 no planned outcrop; on small island in Annabel Lake , in core at west end of pluton, island is 80% rock, 60% is bt +-hbe grdr, 40% pink gran peg, potential detailed mapping area on nearby larger islands (good exposure, rel. low fracture density)

Table A. 2: Lithology Type – Intrusive

Colour I	Colour	Rock Fab	Con Group	Contact	Form	Xtal Size	Xtal Form	Notes
Leucocratic	lgt grey pink	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Lineated and foliated bt grdr
Mesocratic	lgt grey pink	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Wkly foliated , strongly lineated bt grdr cut by weakly deformed granitic pematite
Leucocratic	red	Massive	Discordant	Unchilled	Dike-unzoned	Medium grained 1-5mm		• Sharp, straight, to itreg contacts approximately perpendicular to lineation
Mesocratic	lgt grey pink	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Well lineated, weakly foliated bt grdr cuy by high % of gran peg, and upright, second tightly spaced clvg, decreases un edges of outcrop
Leucocratic	red	Massive	Discordant	Chilled	Dike-unzoned			
Mesocratic	grey pink	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• More strongly foliated bt grdr, dipping to the south, lin shallow to esst
Mesocratic	mottld lgt pink	Foliated			Undetermined	Medium grained 1-5mm		• This is the high mag unit, mt-bt as mafic clots, strong foliation to incipient gneissocity, weaker lin shallow to E
Melanocratic	dark grey	Foliated	Concordant	Gradational	Undetermined	Medium grained 1-5mm		• Dark grey to brown silicified, qtz-fsp phenocrysts, weakly foliated with gradational structural contacts, unit parallel to foliation
Melanocratic	pink	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Strongly foliated to prototomyl parallel to fault, high xeno percent , this is magnetic, the volc isn't
Leucocratic	lgt pink weathered, lgt gray fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Very hard leucocratic, definitely changed, strongly fractured
Leucocratic	lgt pink	Massive	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Similar comp to last but weaker foliation and coarser grained biotite
Mesocratic	mottled light pink	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Similar lith composition, more and bigger clots of mafics
Mesocratic	lgt pink gray	Foliated	Discordant	Unchilled	Pluton	Medium grained 1-5mm		• The granite gets strongly foliated contact with the bt volcanic
Mesocratic	off white weathering, dk grey fresh	Foliated			Stock	Medium grained 1-5mm		• The outcrop is close to lineament but seems to be affected by it
Melanocratic	off-white weathered, dark gr		Not observed	Not observed	Pluton	Fine grained 0.5-1mm	Equigranular	• Similar comp to the oc on other side of high but big jump in flattening/foliation compared to rock in situ
Mesocratic	off white pink weathered, pink grey fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Foliated and lineated, L=S, mgr bt grdr
Mesocratic	off white weathered, mottled gray pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Foliated and lineated L=S, mgr bt grdr, bt 5%, similar to community stop 1
Leucocratic	pink weathered, dark pink fresh	Massive	Discordant	Unchilled	Dike-unzoned	Medium grained 1-5mm	Inequigranular	• Pink, varitextured leucocratic ms bt (<2%total) granite pegnatite, fsp megacrysts up 3-10cm
Mesocratic	light gray pink weathered, mottled black pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Mgr bt grdr cut by peg
Leucocratic	pink weathered , red fresh	Massive	Discordant	Unchilled	Dike-unzoned	Coarse grained 5-10mm	Vari-texture	• Similar bt granite pegmatite, sharp contact with grdr
Mesocratic	light pink weathered , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Representative bt grdr , weak foliation , strong lineation
Leucocratic	pink weathered , dark pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Similar leucocratic gran peg, little evidence for bt
Mesocratic	light gray pink weathering, mottled black pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Similar lineated and weakly foliated bt grdr
Mesocratic	tan weathering, grey pink fresh	Massive	Discordant	Unchilled	Dike-unzoned	Very fine grained 0.1-0.5mm	Equigranular	• Vfgr to aplitic bt ms gran dyke cuts mgr bt grd and is cut by gran peg dykes
Leucocratic	pink weathering , red weathering	Massive			Dike-unzoned	Unsubdivided	Vari-texture	• Typical leucocratic bt ms gran pegmatite dyke cuts aplite but here is boudinaged and cut by a late shear or foln domain, consistent with a post main foliation event
Melanocratic	mottled grey weathered , darker grey fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Into the intrusive rocks here after crossing increasingly foliated and recrystallized mafic units and interlayered mafic and intrusuve rocks
Leucocratic	pink	Foliated			Dike-unzoned	Very fine grained 0.1-0.5mm		• Narrow 10-20cm zones of what look like aphanitic felsic dykes, strong flattening fabric, significant grain size reduction, may be mylonitic, cuts the shallowly dipping foliation in bt-hb grdr
Melanocratic	grey weathered , darker grey fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Strongly recrystallized bt hbe grdr with good foln and lin
Leucocratic	pink weathering , pink fresh	Massive	Discordant	Unchilled	Dike-unzoned	Medium grained 1-5mm		• Grt and v minor hbe, leucocratic rock, deformed by boudinage
Mesocratic	pale pink weathering , mottled black pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Good lineated biotite granodiorite at nose of fold
Mesocratic	light gray weathering , mottled black light pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Progression from L>>S at south end of bay in core of pluton to L>S to L=S here
Leucocratic	pink weathering , red fresh		Discordant	Unchilled	Dike-unzoned	Medium grained 1-5mm		• Low % of outcrop , most straight, one out of place block had a great folded peg with the main foln ap to fold
Leucocratic	light pink weathering , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• L tectonite bt granodiorite, couldn't reliably determine foliation ori, 1:1:8-10, cut by numerous qtz veins minor leucocratc cgr granite to pegmatite dykes
Mesocratic	pale pink weathering , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Very similar composition and strain state to last, magnetic grain is on edge to a stronger fabric, but rock looks same here
Mesocratic	light pink gray weathering , mottled black and flesh fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Much more deformed by both stronger foliation domains with strong lineation narrow mylonitic zone with reverse movement indicators and boud qtz-ms veins
Mesocratic	pale pink weathering , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• The same biotite granodiorite , L>S, only a weak foln visible from flattened and aligned biotite
Leucocratic	red to pink weathering , red fresh	Massive	Discordant	Unchilled	Dike-zoned	Fine grained 0.5-1mm		• Leucocratic granite dykes, fgr, low mafics, straight, 2-5cm wide, <5% of oc
Mesocratic	grey weathering , dark grey fresh	Massive	Discordant	Unchilled	Dike-unzoned	Very fine grained 0.1-0.5mm		• Vfgr intermediate dyke, sharp but irreg contacts , very hard indurated rock
Mesocratic	light pink weathering , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• At wp1148 the mafics are slightly smaller, less clot like, incr mt assic with bt gives the higher mag, at wp1149 main oc, typical mgr bt granodiorite with some intergranular mt
Mesocratic	light pink weathering , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Fairly typical mgr bt granodiorite with some mt, locally weakly foliated, all well

Colour I	Colour	Rock Fab	Con Group	Contact	Form	Xtal Size	Xtal Form	Notes
								lineated
Mesocratic	pink weathering , medium grey fresh	Foliated	concordant	Sharp	Undetermined	Fine grained 0.5-1mm	Equigranular	• Fgr uniform, hard, siliceous fracture, dissem fgr mt, grdr composition, little to no bt
Melanocratic	dark orange weathering , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Coarser than bt grdr, more melanocratic, not as strong a lin, also mt bearing, weakly foliated and lineated, <5% more mafic irreg xenos
Melanocratic	dark orange weathering , mottle black red fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm		• Mgr hbe granite like last
Mesocratic	light pink weathering, light pink grey fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Well foliated, well lineated biotite granodiorite in high mag linear
Leucocratic	pink weathering , pink fresh					Fine grained 0.5-1mm	Equigranular	• Narrow strongly foliated intrusions transposed parallel to foliation
Mesocratic	light pink weathering , mottled black and pink fresh	Foliated	Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Foliated and lineated bt grdr , L=S, not strongly magnetic
Mesocratic	off white weathering, mottled black and light pink		Not observed	Not observed	Pluton	Medium grained 1-5mm	Equigranular	• Lineated bt grdr , may have small hbe coring bt, also apatite, garnet - ts to check
Leucocratic	pink weathering , red fresh	Massive	Discordant	Unchilled	Dike-zoned	Zoned		• 40% of outcrop is peg, have enclave of bt rich rock and qtz veins, lots of volatiles?
Melanocratic	dark pink, fresh and weathered	Foliated	Not observed	Not observed	Undetermined	Medium grained 1-5mm	Equigranular	• At wp 1148, melanocratic, med grained equigranular panel represents the mag, high linear; mt-nbt is fine grained and more uniformly distributed, not clotty
Leucocratic	pink weathering, grey fresh	Massive			Dike-unzoned	Very fine grained 0.1-0.5mm		• Pink, very fine grained leucocratic dyke
Leucocratic	grey pink weathering, grey fresh	Massive	Discordant	Unchilled	Dike-unzoned	Very fine grained 0.1-0.5mm		• Thin dykes of grey vfgr siliceous granitoid/aplite

Table A. 3: Lithology Type – Volcanic Flow

Station ID	Litho ID	Class	Sub Class	Rock Type	Mineral	Occurrence	Colour	Rock Fab	Con Group	Contact	Xtal Size	Xtal Form	Flow Thick	Notes
14BH006	14BH006B	Volcanic Flow	mafic	lava flow	mica	screen	dirty brown black	Foliated			Very fine grained 0.1-0.5mm		Undetermined	• Strongly transposed rafts and hooks of dark, plag phyric, bt, non-mag intermediate volc
14BH010	14BH010B	Volcanic Flow	mafic	lava flow	biotite	minor lithology	black	Foliated	Discordant	Unchilled			Undetermined	• Strongly foliated bt schist in contact with granite
14BH020	14BH020A	Volcanic Flow	mafic	lava flow	feldspar; amphibole; chlorite	main lithology	dark green weathering, dark green fresh	Foliated	Discordant	Unchilled	Very fine grained 0.1-0.5mm		Undetermined	• 2-20cm banded/layered mafic volcanic, well foliated, penetrative foln, layers are folded, composition very similar to massive mafic volcanic
14BH030	14BH030A	Volcanic Flow	mafic	lava flow	hornblende; feldspar; olivine	main lithology	dark green black weathering , dark green fresh	Foliated	Concordant	Sharp	Fine grained 0.5-1mm	Vari-texture	Undetermined	• Mafic to intermediate volcanic rock, extremely flattened , L<<S, transposed foln, strongly refolded about upright , shallowly NW plunging folds, main foln reactivated by late sinistral reverse faults
14BH034	14BH034B	Volcanic Flow	mafic	lava flow		minor lithology	dark green black weathering , dark green fresh	Foliated	Concordant	Sharp	Fine grained 0.5-1mm	Vari-texture	Undetermined	• Mafic to intermediate volcanic rock, extremely flattened , L<<S, transposed foln, transposed mafic at contact with the hornblende granodiorite to diorite, complex contact, strong calcite and silica altn
14BH035	14BH035A	Volcanic Flow	mafic	lava flow	hornblende; plagioclase; garnet	main lithology	dark green weathering, dark green fresh	Foliated			Very fine grained 0.1-0.5mm	Vari-texture	Undetermined	• Mafic to intermediate volcanic rock, extremely flattened , L<<S, transposed foln, foln folded by tight F2folds and strongly refolded about upright , shallowly NW plunging F3 folds
14BH038	14BH038A	Volcanic Flow	mafic	lava flow	amphibole; chlorite; feldspar	main lithology	medium green weathering , dark green fresh	Foliated			Very fine grained 0.1-0.5mm	Equigranular	Undetermined	• Mafic to intermediate volcanic rock, strongly flattened , L<S, transposed foln on margin of the pluton, only minor refolding

Table A. 4: Lithology Type – Sedimentary

Station ID	Litho ID	Class	Sub Class	Rock Type	Mineral	Occurrence	Colour	Rock Fab	Bedding	Notes
14BH039	14BH039A	Sediment	Terrigenous-clastic	muddy sandstone	quartz; feldspar; biotite	main lithology	Tan grey weathered, grey fresh	Foliated	Very thinly bedded 1-3cm	• Very fine grained, interlayered pelite-psammite, very siliceous, recrystalized, layering is very straight and transposed, a metamorphic rock but still recognizably a sedimentary protolith
14BH040	14BH040A	Sediment	Terrigenous-clastic	muddy sandstone	quartz; feldspar; biotite; garnet	main lithology	Tan to light green weathering, dark green fresh	Foliated	Very thinly bedded 1-3cm	• Garnet biotite schist derived from Amisk group sedimentary rocks, within 100 m of West Arm shear zone

Table A. 5: Lithology Type – Metamorphic

Class	Sub Class	Rock Type	Mineral	Occurrence	Outcrop	Rock Fab	Contact	Notes
Metamorphic	Schist	intermediate schist	biotite; muscovite; sericite; garnet	main lithology		Foliated	Not observed	• Bt-ms-grt schist, strongly foliated and asym S-folded near margin of Annabel Lake pluton, probable sedimentary protolith, prev mapped as part of Missi Group conglomerate, saw no clasts on this outcrop
Metamorphic	Schist	intermediate schist	biotite; quartz	main lithology	Melanocratic	Foliated	Not observed	• Differentiated bt qtz schist, layers with similar composition but different gr sizes, mgr 2-5mm leuco layers, fgr .5-1.0mm melano layers, openly warped , low A warp

Table A. 6: Magnetic Susceptibility Measurements (x 10^{-3} SI)

Station ID	Sample ID	Sample Type	Reason
14BH001	14BH001AG02	chip	• mag sus avg., 0.649
14BH002	14BH002AG03	chip	• mag sus avg., 0.091 (0.097)
14BH002	14BH002BG04	chip	• mag sus avg., 0.044 (0.028)
14BH003	14BH003AG02	chip	• mag sus avg., 0.266 (0.792)
14BH003	14BH003BG03	chip	• mag sus avg., (0.023)
14BH004	14BH004AG01	chip	• mag sus avg., 0.142 (0.220)
14BH005	14BH005AG03	chip	• mag sus avg., 3.870
14BH005	14BH005BG04	chip	• mag sus avg., 0.108
14BH006	14BH006AG03	chip	• mag sus avg., 7.592 (0.413)
14BH006	14BH006BG04	chip	• mag sus avg., 0.306 (0.311)
14BH007	14BH007AG02	chip	• mag sus avg., 1.159
14BH008	14BH008AG03	chip	• mag sus avg., 2.092 (1.62)
14BH009	14BH009AG01	chip	• mag sus avg., 2.265 (1.51)
14BH010	14BH010AG01	chip	• mag sus avg., 1.905 (1.33)
14BH010	14BH010BG02	chip	• mag sus avg., 0.125 (0.242)
14BH011	14BH011AG02	chip	• mag sus avg., 0.517 (1.21)
14BH012	14BH012AG03	chip	• mag sus avg., 0.116
14BH012	14BH012AG04	chip	• mag sus avg., 1.813
14BH013	14BH013AG02	chip	• mag sus avg., 1.190 (0.231)
14BH014	14BH014AG02	chip	• mag sus avg., 22.500 (1.100)
14BH016	14BH016AG03	chip	• mag sus avg., 0.401 (1.340)
14BH016	14BH016BG04	chip	• mag sus avg., 0.015 (0.025)
14BH017	14BH017AG03	chip	• mag sus avg., 0.715 (0.424)
14BH017	14BH017BG04	chip	• mag sus avg., 0.028 (0.050)
14BH018	14BH018AG02	chip	• mag sus avg., 1.835 (0.857)
14BH018	14BH018BG03	chip	• mag sus avg., no 18B handsample (0.057)
14BH019	14BH019AG04	chip	• mag sus avg., 0.207 (0.125)
14BH019	14BH019BG05	chip	• mag sus avg., 0.066 (0.267) aplite
14BH019	14BH019CG06	chip	• mag sus avg., 1.488 (0.098)
14BH020	14BH020AG03	chip	• mag sus avg., 0.530 (0.625)
14BH020	14BH020BG04	chip	• mag sus avg., 0.502 (0.718), quite similar to layered mafic volcanic
14BH021	14BH021AG03	chip	• mag sus avg., 0.315 (0.305)
14BH021	14BH021BG04	chip	• mag sus avg., 0.139
14BH022	14BH022AG03	chip	• mag sus avg., 0.401 (0.198)
14BH022	14BH022BG04	chip	• mag sus avg., 0.426
14BH023	14BH023AG02	chip	• mag sus avg., 0.141 (0.133)
14BH024	14BH024AG02	chip	• mag sus avg., 0.236 (0.156)
14BH025	14BH025AG02	chip	• mag sus avg., 3.686 (0.658)
14BH026	14BH026AG02	chip	• mag sus avg., 0.100 (got bimodal result; avg recorded in unit - 1.82; group 1 - 1.82; group 2 - 0.145)
14BH027	14BH027AG04	chip	• mag sus avg., 6.051 for background rock
14BH027	14BH027AG05	chip	• mag sus avg., 5.283, taken on AG02, the stronger deformed sample
14BH028	14BH028AG04	chip	• mag sus avg., 3.329
14BH028	14BH028BG05	chip	• mag sus avg., 1.160
14BH028	14BH028CG06	chip	• mag sus avg., 1.329, vfgr grey intermediate dyke
14BH029	14BH029AG02	chip	• mag sus avg, .0.239, only a small sample
14BH030	14BH030AG02	chip	• mag sus avg., 0.759
14BH031	14BH031AG04	chip	• mag sus avg., 0.164
14BH031	14BH031BG03	chip	• mag sus avg., 1.784
14BH032	14BH032AG03	chip	• mag sus avg., 0.229
14BH032	14BH032BG04	chip	• mag sus avg., 5.930
14BH033	14BH033AG03	chip	• mag sus avg., 1.805
14BH033	14BH033BG04	chip	• mag sus avg., 0.212
14BH034	14BH034AG03	chip	• mag sus avg., 0.440
14BH034	14BH034BG04	chip	• mag sus avg., 0.334

Station ID	Sample ID	Sample Type	Reason
14BH035	14BH035AG02	chip	• mag sus avg., 0.396
14BH036	14BH036AG03	chip	• mag sus avg., 2.405, low mag panel of bt-mt-grdr
14BH036	14BH036AG04	chip	• mag sus avg., 5.587, high mag panel of rock that failed on outcrop
14BH037	14BH037AG02	chip	• mag sus avg., 0.095
14BH038	14BH038AG02	chip	• mag sus avg., 0.340 (0.326 +/- 0.070, field measurement)
14BH039	14BH039AG02	chip	• mag sus avg., 0.310
14BH040	14BH040AG02	chip	• mag sus avg., 0.337
14BH041	14BH041AG03	chip	• mag sus avg., 0.108
14BH041	14BH041BG04	chip	• mag sus avg., 0.038

Table A. 7: Summary of Magnetic Susceptibility Measurements (x 10^{-3} SI) by Domain

	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6
n*	75	100	55	10	20	50
Mean	0.47	2.33	2.58	3.95	0.70	0.49
Std. Dev.	0.59	5.05	1.83	3.72	0.66	0.24
Range	2.16	28.69	8.02	8.94	2.07	1.12
Maximum	2.18	28.70	8.12	9.19	2.21	1.34
Minimum	0.02	0.01	0.10	0.25	0.14	0.22
Median	0.15	0.29	2.01	3.38	0.37	0.43
25%	0.07	0.13	1.10	0.30	0.25	0.33
75%	0.75	2.19	3.55	7.97	1.35	0.57

All data from re-measured hand samples

*n refers to all measurements not to the number of samples

Table A. 8: Structures

Station ID	Litho ID	Struc ID	Type	Sub Type	Symbol	Azimuth	Dip	Intensity	Fabric	Struc. Space.	Struc. Infil.	Notes
14BH001	14BH001A	14BH001AS01	Foliation	gen1f	FOL1I	332	15	LIN STRONG	L>S			• Between the two tour stops in terms of elongation vs flattening
14BH001	14BH001A	14BH001AS02	Lineation	mineral	LINM1	118	7	FOL MODERATE	L>S			
14BH001	14BH001A	14BH001AS03	Joint	joint	JNTI	185	85			300.00		• Spacing range, 100-500cm
14BH001	14BH001A	14BH001AS04	Joint	joint	JNTI	115	80			400.00	quartz;	• Spacing range, 200-700cm, only occasional qtz
14BH002	14BH002A	14BH002AS01	Foliation	gen1f	FOL1I	324	15	LIN STRONG	L>S			• Foliation is visible on 2 surfaces
14BH002	14BH002A	14BH002AS02	Lineation	mineral	LINM1	14	6	LIN STRONG	L>S			
14BH002	14BH002A	14BH002AS04	Joint	joint	JNTI	210	70			200.00		• Spacing range, 100-400cm
14BH002	14BH002A	14BH002AS05	Joint	joint	JNTI	110	85			40.00	quartz; hematite;	• Spacing range, 10-100cm
14BH002	14BH002B	14BH002BS03	Contacts	Dyke-A	IGCADI	185	81					• This is the igneous dyke contact, dykes are 50-70cm wide
14BH003	14BH003A	14BH003AS01	Lineation	mineral	LINM1	109	11	LIN STRONG	L>>S	0.00		• Lineated bt grdr cut by later steeply dipping tightly spaced foln/clvg
14BH003	14BH003A	14BH003AS02	Foliation	gen2f	FOL2I	113	76	FOL MODERATE				• Domainal tightly spaced steeply dipping foln develops adj to subparallel lineament
14BH003	14BH003A	14BH003AS04	Joint	joint	JNTI	205	85			300.00	quartz; feldspar;	• Spacing range, 100-700cm, peg dykes intrude parallel to this fracture set
14BH003	14BH003A	14BH003AS05	Joint	joint	JNTI	120	80			200.00		• Spacing range, 30-400cm
14BH003	14BH003B	14BH003BS03	Contacts	Dyke-A	IGCADI	36	84					• Contact of 2m wide dyke
14BH004	14BH004A	14BH004AS01	Foliation	gen1f	FOL1I	97	81	FOL MODERATE	L<S			• Well foliated, mod lineated bt grdr
14BH004	14BH004A	14BH004AS02	Lineation	mineral	LINM1	108	16	LIN MODERATE	L<S			
14BH004	14BH004A	14BH004AS03	Joint	joint	JNTI	5	85			500.00		• Spacing range, 180-700cm
14BH004	14BH004A	14BH004AS04	Joint	joint	JNTI	115	89			200.00		• Spacing range, 30->200cm
14BH005	14BH005A	14BH005AS01	Foliation	unknownf	FOLXI	108	83	FOL STRONG	L=S	0.00		• Strong foliation to protomylonitic fabric
14BH005	14BH005A	14BH005AS02	Lineation	mineral	LINMX	112	5	LIN STRONG	L=S	0.00		• Subhorizontal lineation on strong foliation/protomylonitic fabric
14BH006	14BH006A	14BH006AS01	Foliation	unknownf	FOLXI	337	77	FOL STRONG	L<S			• Strong, penetrative foln with lithons of earlier fabric CCW
14BH006	14BH006A	14BH006AS02	Foliation	unknownf	FOLXI	312	77	LIN MODERATE	L<S			• Only in mafic xenod, no good rotated clasts
14BH006	14BH006A	14BH006AS03	Lineation	mineral	LINM1	140	18	LIN MODERATE	L<S			• Quartz fattening and weak lin
14BH006	14BH006A	14BH006AS04	Joint	joint	JNTI	335	80			10.00	quartz;	• Spacing range, 3-200cm, parallel to xenos
14BH006	14BH006A	14BH006AS05	Joint	joint	JNTI	25	83			10.00	hematite;	• Spacing range, 3-20cm
14BH006	14BH006A	14BH006AS06	Joint	joint	JNTV	270	90			10.00	hematite;	• Spacing range, 1-40cm dominant
14BH006	14BH006A	14BH006AS07	Joint	joint	JNTI	157	30			150.00	hematite;	• Spacing range, 100-200cm, difficult to observe flat lying
14BH007	14BH007A	14BH007AS01	Joint	joint	JNTV	310	90			100.00	hematite;	• Spacing range, 5-170cm
14BH007	14BH007A	14BH007AS02	Joint	joint	JNTI	310	60			100.00	hematite;	• Only slight staining, spacing range, 25-100cm
14BH007	14BH007A	14BH007AS03	Joint	joint	JNTV	330	90			50.00	quartz;	• Spacing range, 10-100cm
14BH007	14BH007A	14BH007AS04	Joint	joint	JNTV	225	90			25.00	hematite;	• Spacing range, 1-100, just hematite staining
14BH007	14BH007A	14BH007AS05	Joint	joint	JNTI	135	15			50.00		• Spacing range, 25-100cm
14BH007	14BH007A	14BH007AS06	Foliation	unknownf	FOLXI	340	65	FOL MODERATE	L=S			• Defined by quartz flattening
14BH007	14BH007A	14BH007AS07	Lineation	mineral	LINMX	133	27	LIN MODERATE	L=S			• Quartz elongation, well developed
14BH008	14BH008A	14BH008AS01	Fault Brittle	UnknB-Sin	FTSXV	306	42			0.00		• 4m wide zone of tightly spaced fracturing with qtz vein
14BH008	14BH008A	14BH008AS02	Lineation	slickenside	LINSL2	121	15	FOL WEAK	L=S	0.00		• Good slicks and steps to give sinistral
14BH008	14BH008A	14BH008AS03	Foliation	gen1f	FOL1I	339	78	FOL WEAK	L=S			• Very weak foliation, almost massive
14BH008	14BH008A	14BH008AS04	Joint	joint	JNTI	5	88			30.00		• Spacing range, 2-70cm
14BH008	14BH008A	14BH008AS05	Joint	joint	JNTI	137	75			50.00		• Spacing range, 7-100cm
14BH008	14BH008A	14BH008AS06	Joint	joint	JNTI	296	47			25.00		• Spacing range, 20-30cm
14BH009	14BH009A	14BH009AS01	Foliation	gen1f	FOL1I	329	63	LIN MODERATE	L=S			• Good foln again
14BH009	14BH009A	14BH009AS02	Lineation	mineral	LINM1	132	10	LIN WEAK	L=S			
14BH009	14BH009A	14BH009AS03	Joint	joint	JNTI	355	70			25.00	quartz;	• Spacing range, 5-50cm
14BH009	14BH009A	14BH009AS04	Joint	joint	JNTV	320	90			50.00		• Spacing range, 1-200cm
14BH009	14BH009A	14BH009AS05	Joint	joint	JNTI	80	55			30.00		• Spacing range, 2-60cm
14BH009	14BH009A	14BH009AS06	Joint	joint	JNTV	80	90			30.00		• Spacing range, 2-60cm.
14BH010	14BH010A	14BH010AS01	Foliation	gen1f	FOL1I	338	70	FOL WEAK	L<<S			• Contact reps a sinistral-reverse fault, rapid change from low strain to contacts
14BH010	14BH010A	14BH010AS02	Fault-Brittle-Ductile	BD_gen1_Sin	BDS1I	6	53					• In bt grdr at contact
14BH010	14BH010A	14BH010AS05	Joint	joint	JNTI	182	65			20.00	quartz;	• Spacing range, 3-40cm
14BH010	14BH010A	14BH010AS06	Joint	joint	JNTI	153	80			20.00		• Spacing range, 5-40cm
14BH010	14BH010A	14BH010AS07	Joint	joint	JNTI	332	30			15.00		• Spacing range, 5-30cm
14BH010	14BH010A	14BH010AS08	Joint	joint	JNTI	108	70			70.00		• Spacing range, 60-100cm
14BH010	14BH010B	14BH010BS03	Fault-Brittle-Ductile	BD_gen1_Sin	BDS1I	4	47					• In bt grdr
14BH010	14BH010B	14BH010BS04	Lineation	slickenside	LINSL1	141	31	LIN MODERATE	L<S			• Good fibres and steps to give sinistral revers movement
14BH011	14BH011A	14BH011AS01	Foliation	gen1f	FOL1I	288	52	FOL STRONG	L<<S	0.00		• Well-developed anast to openly folded foliation , both tightly folded and open small

Station ID	Litho ID	Struc ID	Type	Sub Type	Symbol	Azimuth	Dip	Intensity	Fabric	Struc. Space.	Struc. Infil.	Notes
												warps/cren
14BH011	14BH011A	14BH011AS02	Foliation	gen2f	FOL2I	239	22					
14BH011	14BH011A	14BH011AS03	Lineation	mineral	LINM1	295	9			0.00		• Tight, 70 interlimb angle
14BH011	14BH011A	14BH011AS04	Lineation	fold-U	LINFUX	292	6			0.00		• Open small A, small wavelength warps
14BH011	14BH011A	14BH011AS05	Joint	joint	JNTI	262	74			5.00		• Spacing range, 0.5-10cm
14BH011	14BH011A	14BH011AS06	Joint	joint	JNTI	305	89			130.00		• Spacing range, 120-150cm
14BH011	14BH011A	14BH011AS07	Joint	joint	JNTV	342	90			300.00		• Spacing range, 100-600cm
14BH012	14BH012A	14BH012AS01	Foliation	gen1f	FOL1I	278	44	FOL STRONG	L<<S			• Very strong , regular foliation, gently warped
14BH012	14BH012A	14BH012AS02	Lineation	mineral	LINM1	107	2			0.00		
14BH012	14BH012A	14BH012AS03	Joint	joint	JNTI	5	88			50.00		• Spacing range, 7-100cm
14BH012	14BH012A	14BH012AS04	Joint	joint	JNTI	102	30			150.00		• Spacing range, 15-200cm
14BH012	14BH012A	14BH012AS05	Joint	joint	JNTI	286	44			40.00	quartz;	• Spacing range, 5-50cm
14BH013	14BH013A	14BH013AS01	Foliation	gen1f	FOL1I	120	52	FOL WEAK	L>>S			• Weak foln dipping other way, to NW, lineation is very subtle
14BH013	14BH013A	14BH013AS02	Lineation	mineral	LINM1	255	6	LIN STRONG	L>>S			• Great lineation defined by qtz elongate mineral
14BH013	14BH013A	14BH013AS03	Joint	joint	JNTI	219	85			250.00		• Spacing range, 155-300cm
14BH013	14BH013A	14BH013AS04	Joint	joint	JNTI	120	85			200.00	quartz;	• Spacing range, 2-300cm range
14BH013	14BH013A	14BH013AS05	Joint	joint	JNTI	300	20			80.00		• Spacing range, 70-100 cm range
14BH013	14BH013A	14BH013AS06	Joint	joint	JNTI	289	70					• General measurement, at edge of valley to west and parallels the valley edge
14BH014	14BH014A	14BH014AS01	Foliation	gen1f	FOL1I	116	58	LIN MODERATE	L=S			• Increase in foliation compared to core, lin still strong
14BH014	14BH014A	14BH014AS02	Lineation	mineral	LINM1	296	8	LIN STRONG	L=S			
14BH014	14BH014A	14BH014AS03	Joint	joint	JNTI	214	85			30.00	quartz;	• Spacing range, not recorded
14BH014	14BH014A	14BH014AS04	Joint	joint	JNTI	122	80			0.00		• Spacing range, not recorded
14BH016	14BH016A	14BH016AS01	Foliation	gen1f	FOL1I	295	35	FOL STRONG	L=S			• Good L=S tectonite on margin of pluton, in grdr only
14BH016	14BH016A	14BH016AS02	Lineation	mineral	LINM1	300	6	LIN MODERATE	L=S			• Well-developed qtz elongation mineral lineation
14BH016	14BH016A	14BH016AS04	Joint	joint	JNTV	8	90			300.00		• Spacing range, 40-+500cm spacing range
14BH016	14BH016A	14BH016AS05	Joint	joint	JNTI	55	70			200.00		• Spacing range, 50-350cm spacing range
14BH016	14BH016A	14BH016AS06	Joint	joint	JNTI	90	90			600.00		• Only 2 joints observed
14BH016	14BH016A	14BH016AS07	Joint	joint	JNTI	128	80			200.00	quartz;	• Spacing range, 100-300cm
14BH016	14BH016A	14BH016AS08	Joint	joint	JNTI	290	20			200.00		• Spacing range, 100-300cm
14BH016	14BH016B	14BH016BS03	Contacts	Dyke-A	IGCADI	323	50					• Sharp straight dyke contact of pluton granite peg
14BH017	14BH017A	14BH017AS01	Foliation	gen1f	FOL1I	308	42	FOL WEAK	L>S			• Weak foliation defined by qtz flattening and alignment of bt clots
14BH017	14BH017A	14BH017AS02	Lineation	mineral	LINM1	101	4	LIN MODERATE	L>S			• Good lineation defined best by elongate cluster of bt
14BH017	14BH017A	14BH017AS03	Joint	joint	JNTV	180	90			150.00		• Spacing range, 75-250cm
14BH017	14BH017A	14BH017AS04	Joint	joint	JNTI	160	75			40.00	quartz;	• 3-110 cm spacing range , full range over while oc, rep 10cm is close to lineament
14BH018	14BH018A	14BH018AS01	Foliation	gen1f	FOL1I	17	6	FOL WEAK	L>S			• Foliation is very weak, strikes perp to lineation , at the fold nose here
14BH018	14BH018A	14BH018AS02	Lineation	mineral	LINM1	106	6	LIN MODERATE	L>S	0.00		• Strong bt and qtz lin down dip, than stretching on weak foliation, more bt alignment
14BH018	14BH018A	14BH018AS03	Joint	joint	JNTI	210	75			200.00		• Spacing range, 50-300cm
14BH018	14BH018A	14BH018AS04	Joint	joint	JNTI	300	85			150.00	quartz;	• Spacing range, 100-200cm
14BH019	14BH019A	14BH019AS01	Foliation	gen1f	FOL1I	145	22	FOL WEAK	L>S			• Similar to previous, foliation has wrapped around in strike and dipping to SW, overprinted here as well
14BH019	14BH019A	14BH019AS02	Lineation	mineral	LINM1	112	4	LIN STRONG	L>>S			• Good v shallowly plunging lineation
14BH019	14BH019A	14BH019AS09	Joint	joint	JNTV	10	90			150.00		• Spacing range, 10-200cm
14BH019	14BH019A	14BH019AS10	Joint	joint	JNTI	300	90			50.00		• Spacing range, 2-200cm, pegmatite intrudes along this orientation
14BH019	14BH019A	14BH019AS10	Joint	joint	JNTI	298	27			40.00		• Spacing range, 2-75cm
14BH019	14BH019B	14BH019BS06	Contacts	Dyke-A	IGCADI	121	81			0		• 50-100cm wide dyke cuts parallel to strike but dips opposite to SW
14BH019	14BH019B	14BH019BS07	Contacts	Dyke-A	IGCADI	120	83			0		• Pegmatite dyke cutting bt gdr parallel to strike of foln
14BH019	14BH019C	14BH019CS03	Lineation	boudin_neck	LINB2	221	71					• Peg dykes are moderately boudinaged and bookshelf faulted
14BH019	14BH019C	14BH019CS04	Foliation	gen2f	FOL2I	81	79					• Tightly spaced fracture set, most pronounced in peg, not observed previously
14BH019	14BH019C	14BH019CS05	Fault-Brittle-Ductile	BD_gen2_Sin	BDS2I	144	76					• Small scale b-d shear working with boudin to extend section
14BH019	14BH019C	14BH019CS08	Contacts	Dyke-A	IGCADI	187	83			0		• Peg dyke cutting across aplite and bt grdr
14BH020	14BH020A	14BH020AS01	Foliation	gen1f	FOL1I	266	49	FOL MODERATE	L<S			• West end of oc, others measurements, 257/55 in centre, 280/43 at east end
14BH020	14BH020A	14BH020AS02	Axial fold plane	M-unknown	AXFMXI	359	81					• At west end, other measurements, 340/80 in centre, folds are open, 110 interlimb, upright, moderately N plunging
14BH020	14BH020A	14BH020AS03	Lineation	fold-M	LINFM2	9	54					• Western end, other measurements 345-53 in centre
14BH020	14BH020A	14BH020AS04	Foliation	gen1f	FOL1I	308	38	FOL MODERATE	L<S			• Foliation on a limb but was where lineation was observed ,
14BH020	14BH020A	14BH020AS05	Lineation	mineral	LINM1	93	24			0.00		• Vfgr plag, amphibole, show alignment but quite subtle
14BH020	14BH020A	14BH020AS08	Joint	joint	JNTI	180	72			10.00		• Spacing range, 2-20cm
14BH020	14BH020A	14BH020AS09	Joint	joint	JNTV	155	90			8.00		• Spacing range, 2-20cm

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14BH020	14BH020A	14BH020AS10	Joint	joint	JNTV	294	90			10.00		• Spacing range, 2-20cm
14BH020	14BH020A	14BH020AS10	Joint	joint	JNTI	269	74			5.00	quartz;	• Spacing range, 1-10cm
14BH020	14BH020B	14BH020BS06	Shear	Ductile-SinU	SHSXIR	286	45					• Discrete shear fracture with slickenfibres on surface with steps to suggest sinistral reverse movement
14BH020	14BH020B	14BH020BS07	Lineation	slickenside	LINSLX	103	13					• Main foliation parallel discrete shear with qtz vein fibres developed with good steps to suggest sinistral-reverse movement
14BH021	14BH021A	14BH021AS01	Foliation	gen1f	FOL1I	285	30	FOL STRONG	L=S			• Flattening of qtz and align if hbe and bt define foln and alignment of same define lineation , also measured 294/44 and 287/43 on other side of fault
14BH021	14BH021A	14BH021AS02	Lineation	mineral	LINM1	102	12	LIN STRONG	L=S			• Also another 102-12
14BH021	14BH021A	14BH021AS04	Joint	joint	JNTI	305	47			30.00	quartz;	• Spacing range, 2-40cm
14BH021	14BH021A	14BH021AS05	Joint	joint	JNTI	12	88			250.00		• Spacing range, 20-300cm
14BH021	14BH021A	14BH021AS06	Foliation	gen1f	FOL1I	294	44	FOL STRONG	L=S	0.00		• 20m east of last measurement
14BH021	14BH021A	14BH021AS07	Lineation	mineral	LINM1	102	12	LIN STRONG	L=S	0.00		• 20m east of last
14BH021	14BH021A	14BH021AS08	Foliation	gen1f	FOL1I	287	43	FOL STRONG	L=S			• To south of steeply N-dipping shear
14BH021	14BH021B	14BH021BS03	Shear	Ductile-Unkn	SHUXI	281	74					• Also 289/74, grain size reduction and flattened qtz as thin laminae, mylonite?
14BH021	14BH021B	14BH021BS09	Shear	Ductile-Unkn	SHUXI	289	74	FOR INTENSE	L<S			• To west of other shear measurement
14BH022	14BH022A	14BH022AS01	Foliation	gen1f	FOL1I	278	39	FOL STRONG	L<S			• Very well foliated, regular penetrative foliation. Only disrupted mildly adjacent to peg dyke, also 295/37
14BH022	14BH022A	14BH022AS02	Lineation	mineral	LINM1	97	11	LIN MODERATE	L<S			• Defined by alignment of bt and qtz grain trains
14BH022	14BH022A	14BH022AS04	Joint	joint	JNTI	195	75			250.00		• Spacing range, 50-400cm
14BH022	14BH022A	14BH022AS05	Joint	joint	JNTI	90	40			125.00		• Spacing range, 100-150cm
14BH022	14BH022A	14BH022AS06	Joint	joint	JNTI	58	85			175.00		• Spacing range, 15-200cm
14BH022	14BH022B	14BH022BS03	Contacts	Dyke-A	IGCADI	139	70			0		• Cgr grt gran dyke, weakly boudinaged
14BH023	14BH023A	14BH023AS01	Foliation	gen1f	FOL1I	44	14	FOL WEAK	L>S			• Shallowly dipping foliation defined by weakly aligned bt clots
14BH023	14BH023A	14BH023AS02	Lineation	mineral	LINM1	104	13	LIN STRONG	L>>S			• Excellent elongate qtz, feldspar and bt almost down the dip of foliation , at the nose, have noted that there does not seem to be an axial planar foliation along an E trend
14BH023	14BH023A	14BH023AS03	Joint	joint	JNTV	64	90			200.00		• Spacing range, 65-300cm
14BH023	14BH023A	14BH023AS04	Joint	joint	JNTI	100	75			150.00		• Spacing range, 20-200cm
14BH023	14BH023A	14BH023AS05	Joint	joint	JNTI	158	80			200.00		• Spacing range, 3-400cm
14BH024	14BH024A	14BH024AS01	Foliation	gen1f	FOL1I	309	22	FOL MODERATE	L=S			• Here the main foln is stronger, lineation a bit weaker, L=S
14BH024	14BH024A	14BH024AS02	Lineation	mineral	LINM1	103	9	LIN STRONG	L=S			• bt plag and qtz aligned
14BH024	14BH024A	14BH024AS04	Joint	joint	JNTI	162	85			250.00	quartz;	• Spacing range, 5-400cm, higher density near shore
14BH024	14BH024A	14BH024AS05	Joint	joint	JNTV	265	90			200.00		• Spacing range, 100-500cme
14BH024	14BH024A	14BH024AS06	Foliation	gen1f	FOL1I	314	24	FOL MODERATE	L>S			• At wp1130, move it here, mod development
14BH024	14BH024A	14BH024AS07	Lineation	mineral	LINM1	99	11	LIN STRONG	L>S			• Move to wp1130, strong lineation development
14BH024	14BH024B	14BH024BS03	Contacts	Dyke-A	IGCADI	344	59					• Most peg have sharp straight contacts, one in a loose block was folded about the main foliation
14BH025	14BH025A	14BH025AS01	Lineation	mineral	LINM1	115	15	LIN STRONG	L>>S			• Very strong lineament, very weak to massive perpendicular to lin, also 119-11, 118-16
14BH025	14BH025A	14BH025AS02	Vein	extension-unknown	VNBXI	166	80					• Gash vein, also 158/75, 163/77
14BH025	14BH025A	14BH025AS03	Vein	extension-unknown	VNBXI	147	75					• Gash vein , also 152/83, 150/61
14BH025	14BH025A	14BH025AS04	Vein	extension-unknown	VNBXI	189	77					• Gash vein , also 183/75
14BH025	14BH025A	14BH025AS05	Vein	extension-unknown	VNBXI	63	18					• Flat gash vein linked to 150*61 gash vein
14BH025	14BH025A	14BH025AS06	Joint	joint	JNTI	33	90			100.00		• Spacing range, 1-200cm
14BH025	14BH025A	14BH025AS07	Joint	joint	JNTI	155	73			50.00	quartz;	• Spacing range, 3-170cm
14BH025	14BH025A	14BH025AS08	Joint	joint	JNTI	130	88			60.00		• Spacing range, 40-130cm
14BH025	14BH025A	14BH025AS09	Joint	joint	JNTI	310	40			50.00		• Spacing range, 20-110cm
14BH025	14BH025A	14BH025AS10	Lineation	mineral	LINM1	119	11	LIN STRONG	L>>S			• Multiple measurements on a big outcrop
14BH025	14BH025A	14BH025AS10	Lineation	mineral	LINM1	118	16	LIN STRONG	L>>S			• Multiple measurements on a single large outcrop
14BH026	14BH026A	14BH026AS01	Lineation	mineral	LINM1	111	9	LIN STRONG	L>>S			• Strong extension of qtz, fsp, aligned bt
14BH026	14BH026A	14BH026AS02	Foliation	gen1f	FOL1I	22	12	FOL WEAK	L>>S			• Very weak foln, subtle aligned bt, also 050/19 adjacent to foliated mafic xenos
14BH026	14BH026A	14BH026AS03	Vein	extension-unknown	VNBXI	175	15					• Shallowly dipping gash vein
14BH026	14BH026A	14BH026AS04	Joint	joint	JNTI	168	80			40.00	quartz;	• Spacing range, 3-140cm
14BH026	14BH026A	14BH026AS05	Joint	joint	JNTV	345	90			30.00		• Spacing range, 20-140cm
14BH026	14BH026A	14BH026AS06	Joint	joint	JNTV	40	90			25.00		• Spacing range, 7-60cm
14BH026	14BH026A	14BH026AS07	Joint	joint	JNTI	144	50			80.00		• Spacing range, 1-150cm
14BH026	14BH026A	14BH026AS08	Joint	joint	JNTI	76	40			80.00		• Spacing range, 50-100cm
14BH027	14BH027A	14BH027AS01	Foliation	gen1f	FOL1I	95	27	FOL STRONG	L>S			• Locally good foliation in poorly defined domains

Station ID	Litho ID	Struc ID	Type	Sub Type	Symbol	Azimuth	Dip	Intensity	Fabric	Struc. Space.	Struc. Infil.	Notes
14BH027	14BH027A	14BH027AS02	Lineation	mineral	LINM1	110	5	LIN STRONG	L>S			
14BH027	14BH027A	14BH027AS03	Foliation	gen1f	FOL1I	103	40	FOR INTENSE	L>S			• Very strong in < 1m domain
14BH027	14BH027A	14BH027AS04	Lineation	mineral	LINM1	115	12	LIN INTENSE	L>S			
14BH027	14BH027A	14BH027AS05	Shear	Ductile-Unkn	SHUXIR	22	16	FOR INTENSE	L=S			• Good mylonite zone, rotated porph suggest reverse movement, at waypoint 1138
14BH027	14BH027A	14BH027AS06	Lineation	mineral	LINMX	129	15	LIN INTENSE	L=S			
14BH027	14BH027A	14BH027AS07	Lineation	boudin_neck	LINBX	22	7	LIN MODERATE				• Boudinaged quartz vein in mylonite zone perpendicular to LM
14BH028	14BH028A	14BH028AS01	Foliation	gen1f	FOL1I	22	18	FOL MODERATE	L>>S			
14BH028	14BH028A	14BH028AS02	Lineation	mineral	LINM1	116	16	LIN MODERATE	L>>S			
14BH028	14BH028B	14BH028BS03	Contacts	Dyke-A	IGCADI	34	39			0		• Zoned 3 cm wide f-mgr granite dyke
14BH028	14BH028B	14BH028BS04	Contacts	Dyke-A	IGCADI	273	84			0		• Fgr bt + ms leucocratic grdr
14BH029	14BH029A	14BH029AS01	Shear	Ductile-SinU	SHSXI	142	74	FOL STRONG	L>S			• Main geometric point is that shear foliation is steep and dips away from pluton, will not impinge on pluton, kinematic indicators weakly suggests sinistral horizontal movement
14BH029	14BH029A	14BH029AS02	Lineation	mineral	LINMX	149	24	LIN STRONG	L=S			• Fine grained mineral lineation
14BH029	14BH029A	14BH029AS03	Fault Brittle	UnknB-Dex	FTDXI	263	75					• Veins have clear dextral separation
14BH029	14BH029A	14BH029AS04	Fault Brittle	UnknB-Sin	FTSXI	277	83					• Crosscuts shear foliation, sinistral separation offsets
14BH029	14BH029A	14BH029AS05	Foliation	gen1f	FOL1I	149	64	FOL STRONG	L<S			• At wp 1144 High strain with lower strain domains on outer margin of west arm shear zone, progressive increase towards wp 1143
14BH029	14BH029A	14BH029AS06	Foliation	gen1f	FOL1I	145	73	FOL STRONG				• At wp 1145, good penetrative foliation closer to shear zone with sinistral class rotation
14BH029	14BH029A	14BH029AS07	Joint	joint	JNTI	151	80			3.00		• Spacing range, 0.1-10 cm
14BH029	14BH029A	14BH029AS08	Joint	joint	JNTI	38	78			6.00	quartz;	• Spacing range, 0.5-15 cm
14BH029	14BH029A	14BH029AS09	Joint	joint	JNTI	270	66			20.00		• Spacing range, 4-80 cm
14BH029	14BH029A	14BH029AS10	Joint	joint	JNTV	264	90			1.00		• Spacing range, 0.5-6 cm
14BH030	14BH030A	14BH030AS01	Foliation	gen1f	FOL1I	289	81	FOR INTENSE	L<<S			• Long limb on first F2 fold
14BH030	14BH030A	14BH030AS02	Foliation	gen1f	FOL1I	201	39	FOR INTENSE	L<<S			• Short limb on first F2 fold
14BH030	14BH030A	14BH030AS03	Foliation	gen1f	FOL1I	290	73	FOR INTENSE	L<<S			• Long limb on second F2 fold.
14BH030	14BH030A	14BH030AS04	Foliation	gen1f	FOL1I	190	51	FOR INTENSE	L<<S			• Short limb on second F2 fold
14BH030	14BH030A	14BH030AS05	Foliation	gen1f	FOL1I	283	61	FOR INTENSE	L<<S			• On a long limb, with lineation observed.
14BH030	14BH030A	14BH030AS06	Lineation	mineral	LINM1	291	15	LIN WEAK	L<<S			• Weak mineral lineation.
14BH030	14BH030A	14BH030AS07	Lineation	fold-S	LINFS2	302	33					• Shallowly plunging close (70 degrees) S-fold
14BH030	14BH030A	14BH030AS08	Axial fold plane	S-unknown	AXFSXI	132	70					• Shallowly plunging close (70 degrees) S-fold
14BH030	14BH030A	14BH030AS09	Lineation	fold-S	LINFS2	300	32					• Second fold, shallowly plunging close (70 degrees) S-fold.
14BH030	14BH030A	14BH030AS10	Axial fold plane	S-unknown	AXFSXI	125	82					• Second fold, shallowly plunging close (70 degrees) S-fold, weak axial planar foliation associated with these folds.
14BH030	14BH030A	14BH030AS10	Fault Brittle	UnknB-horiz	FTUXI	285	64					• Discrete fault/fracture with slicken lines.
14BH030	14BH030A	14BH030AS10	Lineation	slickenside	LINSLX	94	21					• Well defined but no good steps, oblique slip with larger strike-slip component.
14BH030	14BH030A	14BH030AS10	Joint	joint	JNTI	288	72			0.50		• Spacing range, 0.1-3 cm
14BH030	14BH030A	14BH030AS10	Joint	joint	JNTI	232	68			60.00		• Spacing range, none recorded
14BH030	14BH030A	14BH030AS10	Joint	joint	JNTI	121	44			10.00		• Spacing range, 7-30 cm
14BH030	14BH030A	14BH030AS10	Joint	joint	JNTI	46	12			100.00		• Spacing range, 3-200 cm
14BH031	14BH031A	14BH031AS01	Foliation	gen1f	FOL1I	111	62	FOL MODERATE	L>S			• No ind of higher strain along E-W lineament beyond stronger foliation defined by bt and mt, also 107/76 @ wp1148, 095/66 @ wp1147
14BH031	14BH031A	14BH031AS02	Lineation	mineral	LINM1	124	18	LIN STRONG	L>S			• L still >S, between 1:2:5 and 1:3:5-7, still 1:2:10 @wp1149,also 100-11 @wp1147, 114-22 @wp1148
14BH031	14BH031A	14BH031AS03	Foliation	gen1f	FOL1I	95	66	FOL WEAK	L>S			• @ wp 1147, Weak but visible and measurable foliation
14BH031	14BH031A	14BH031AS04	Lineation	mineral	LINM1	100	11	LIN STRONG	L>S			• @ wp 1147
14BH031	14BH031A	14BH031AS07	Joint	joint	JNTI	98	61			30.00		• Spacing range, 4-60 cm
14BH031	14BH031A	14BH031AS08	Joint	joint	JNTV	205	90			70.00	quartz;	• Spacing range, 15-140 cm
14BH031	14BH031A	14BH031AS09	Joint	joint	JNTI	323	50			60.00	quartz;	• Spacing range, 20-90 cm
14BH031	14BH031B	14BH031BS05	Foliation	gen1f	FOL1I	107	76	FOL MODERATE	L=S			• @ wp 1148, in mt-rich
14BH031	14BH031B	14BH031BS06	Lineation	mineral	LINM1	114	22	LIN MODERATE	L=S			• @ wp 1148
14BH032	14BH032A	14BH032AS01	Foliation	gen1f	FOL1I	101	31	FOL WEAK	L>>S			• Good lineated bt grdr, weak foliation is shallowly dipping to S, also 098/14
14BH032	14BH032A	14BH032AS02	Lineation	mineral	LINM1	108	12	LIN STRONG	L>>S			• Well-developed min lin as usual, also 099-11
14BH032	14BH032A	14BH032AS03	Foliation	gen1f	FOL1I	98	14	FOL WEAK	L>>S			
14BH032	14BH032A	14BH032AS04	Lineation	mineral	LINM1	99	11	LIN STRONG	L>>S			
14BH032	14BH032A	14BH032AS05	Joint	joint	JNTI	319	79			10.00	quartz;	• Spacing range, 1-80 cm
14BH032	14BH032A	14BH032AS06	Joint	joint	JNTI	164	70			10.00	quartz;	• Spacing range, 1-80 cm
14BH032	14BH032A	14BH032AS07	Joint	joint	JNTI	240	73			30.00		• Spacing range, 3-40 cm

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14BH032	14BH032A	14BH032AS08	Joint	joint	JNTI	289	80			40.00		• Spacing range, 15-60 cm
14BH032	14BH032A	14BH032AS09	Joint	joint	JNTI	175	82			50.00		• Spacing range, 10-100 cm
14BH033	14BH033A	14BH033AS01	Foliation	gen1f	FOL1I	145	64	FOL WEAK	L=S			• In different phase, a hornblende granite? not an L-tectonite
14BH033	14BH033A	14BH033AS02	Lineation	mineral	LINM1	220	57	FOL WEAK	L>S			• Not an L-tectonite here.
14BH033	14BH033A	14BH033AS05	Joint	joint	JNTI	126	62			60.00	quartz;	• Spacing range, 2-80 cm, sub-parallel to foliation
14BH033	14BH033A	14BH033AS06	Joint	joint	JNTI	177	88			100.00		• Spacing range, 35-150 cm
14BH033	14BH033A	14BH033AS07	Joint	joint	JNTI	264	76			40.00		• Spacing range, 5-90 cm
14BH033	14BH033B	14BH033BS03	Vein	extension-unknown	VNBXI	333	64					• Extensional quartz vein set in outcrop.
14BH033	14BH033B	14BH033BS04	Contacts	Dyke-A	IGCADI	59	30					• parallel to lineation
14BH034	14BH034A	14BH034AS03	Foliation	gen1f	FOL1I	120	75	FOL MODERATE	L<S			• Foliation in granite 20 m from contact with mafics
14BH034	14BH034A	14BH034AS04	Shear	Ductile-SinU	SHSXI	298	86	FOL STRONG	L=S			• Discrete 5-20 cm wide shear zone internal to granite, sub-parallels S2 in adjacent volcanic, good C-S fabric.
14BH034	14BH034A	14BH034AS05	Lineation	mineral	LINMX	118	5	LIN MODERATE				• Lineation on shear fabric face.
14BH034	14BH034A	14BH034AS06	Vein	shear-unknown	VNAXI	297	80					• Quartz vein, deformed in the shear zone, unclear but probably predates shear zone.
14BH034	14BH034A	14BH034AS07	Vein	extension-unknown	VNBXI	315	78					• Extensional gash quartz veins, orientation not consistent with sinistral movement in shear zone, predates?
14BH034	14BH034A	14BH034AS08	Joint	joint	JNTI	310	74			101.00		• Spacing range 1-30cm
14BH034	14BH034A	14BH034AS09	Joint	joint	JNTI	240	76			30.00		• Spacing range 5-100cm
14BH034	14BH034A	14BH034AS10	Joint	joint	JNTI	337	70			30.00	quartz;	• Spacing range 4-50cm
14BH034	14BH034B	14BH034BS01	Foliation	gen1f	FOL1I	145	66	FOL STRONG	L<S			• Penetrative earlier foliation
14BH034	14BH034B	14BH034BS02	Foliation	gen2f	FOL2I	291	70	FOL MODERATE	L<S			• Spaced foliation cuts and rotates S1
14BH035	14BH035A	14BH035AS01	Foliation	gen1f	FOL1I	251	68	FOL STRONG	L<S			• On long limb of minor S fold
14BH035	14BH035A	14BH035AS02	Foliation	gen1f	FOL1I	223	47	FOL STRONG	L<S			• Measurement taken at boudinaged vein
14BH035	14BH035A	14BH035AS03	Lineation	fold-S	LINFS2	268	30					• S-shaped, 45 degree interlimb, F2 generation
14BH035	14BH035A	14BH035AS04	Axial fold plane	S-unknown	AXFSXI	264	72					• F2 generation, no strong axial planar foliation
14BH035	14BH035A	14BH035AS05	Lineation	fold-S	LINFS3	308	33					• S-shaped, 80 degree interlimb, upright, shallow to moderate plunging F3 fold
14BH035	14BH035A	14BH035AS06	Axial fold plane	S-unknown	AXFSXI	308	84					• F3 axial plane
14BH035	14BH035A	14BH035AS07	Lineation	fold-S	LINFS3	334	34					• S-shaped 80 degree interlimb F3 fold of S1 foliation
14BH035	14BH035A	14BH035AS08	Axial fold plane	S-unknown	AXFSXI	330	85					• S-shaped F3
14BH035	14BH035A	14BH035AS09	Lineation	fold-S	LINFS3	346	44					• S-shaped 80 degree interlimb F3 fold
14BH035	14BH035A	14BH035AS10	Axial fold plane	S-unknown	AXFSXI	339	72					• S-shaped F3
14BH035	14BH035A	14BH035AS10	Joint	joint	JNTV	38	90			10.00		• Spacing range 1-40cm
14BH035	14BH035A	14BH035AS10	Joint	joint	JNTI	38	54			5.00		• Spacing range - not recorded
14BH035	14BH035A	14BH035AS10	Joint	joint	JNTI	162	87			10.00		• Spacing range 3-20cm
14BH035	14BH035A	14BH035AS10	Joint	joint	JNTI	130	52			20.00		• Spacing range 5-40
14BH036	14BH036A	14BH036AS01	Foliation	gen1f	FOL1I	115	83	FOL MODERATE	L=S			• Good moderate foliation, L=S 1:4:7 strain ratio
14BH036	14BH036A	14BH036AS02	Lineation	mineral	LINM1	117	3	LIN MODERATE	L=S			• Good, well defined lineation.
14BH036	14BH036A	14BH036AS03	Lineation	fold-S	LINFS2	150	72					• S-fold close 60 degree interlimb, small scale 2 cm amplitude, 2 cm wavelength.
14BH036	14BH036A	14BH036AS04	Axial fold plane	S-unknown	AXFSXI	145	78					
14BH036	14BH036A	14BH036AS06	Joint	joint	JNTV	119	90			25.00	quartz;	• Spacing range, 10-50 cm
14BH036	14BH036A	14BH036AS07	Joint	joint	JNTI	209	84			20.00		• Spacing range, 20-45 cm
14BH036	14BH036A	14BH036AS08	Joint	joint	JNTI	243	67			35.00		• No spacing range recorded.
14BH036	14BH036B	14BH036BS05	Foliation	gen1f	FOL1I	119	81	FOL STRONG	L=S			• High strain in siliceous fine grained rock.
14BH037	14BH037A	14BH037AS01	Foliation	gen1f	FOL1I	115	78	FOL MODERATE	L=S			• Locally good foliation inside foliated domain but low mag.
14BH037	14BH037A	14BH037AS02	Lineation	mineral	LINM1	120	11	LIN MODERATE	L=S			• Quartz biotite alignment/elongation.
14BH037	14BH037A	14BH037AS03	Vein	extension-unknown	VNBXI	322	81					• Short extensional gash veins deflect foliation.
14BH037	14BH037A	14BH037AS04	Joint	joint	JNTI	352	81			20.00		• spacing range, 4-50 cm
14BH037	14BH037A	14BH037AS05	Joint	joint	JNTI	288	78			15.00		• spacing range, 10-20 cm
14BH037	14BH037A	14BH037AS06	Joint	joint	JNTI	306	20			30.00		• spacing range, 15-40 cm
14BH038	14BH038A	14BH038AS01	Foliation	gen1f	FOL1I	114	83	FOL STRONG	L<S			• Strong straight penetrative and pervasive foliation.
14BH038	14BH038A	14BH038AS02	Lineation	mineral	LINM1	117	5	LIN MODERATE	L<S			• Moderate to fine grained easy to see lineation.
14BH038	14BH038A	14BH038AS03	Foliation	gen1f	FOL1I	115	81	FOL STRONG	L<S			• Very strong foliation, openly warped.
14BH038	14BH038A	14BH038AS04	Foliation	gen1f	FOL1I	111	82	FOL STRONG	L<S			
14BH038	14BH038A	14BH038AS05	Lineation	fold-S	LINFS2	335	55					• Small scale fold, 0.5 cm amplitude, 1 cm wavelength, 90 degree interlimb
14BH038	14BH038A	14BH038AS06	Axial fold plane	S-unknown	AXFSXI	332	78					• S may indicate sinistral movement along high strain in volcanics.
14BH038	14BH038A	14BH038AS07	Joint	joint	JNTI	108	82			3.00	quartz;	• Spacing range, 1-10 cm
14BH038	14BH038A	14BH038AS08	Joint	joint	JNTI	191	79			30.00		• Spacing range, 10-40 cm
14BH038	14BH038A	14BH038AS09	Joint	joint	JNTV	324	90			20.00		• Spacing range, 10-unknown.

Station ID	Litho ID	Struc ID	Type	Sub Type	Symbol	Azimuth	Dip	Intensity	Fabric	Struc. Space.	Struc. Infil.	Notes
14BH038	14BH038A	14BH038AS10	Joint	joint	JNTI	297	20			60.00		• Spacing range, 2-70 cm
14BH039	14BH039A	14BH039AS01	Bedding	unsubdivided1	BEDUIN	104	83					• Actually a transposed S0-S1 fabric.
14BH039	14BH039A	14BH039AS02	Lineation	fold-S	LINFS2	325	80					• S-fold of layering in defined layer within transposed layering.
14BH039	14BH039A	14BH039AS03	Axial fold plane	S-unknown	AXFSXI	314	85					• S-fold of transposed layering
14BH039	14BH039A	14BH039AS04	Joint	joint	JNTI	110	86			3.00		• Spacing range 1-10cm
14BH039	14BH039A	14BH039AS05	Joint	joint	JNTV	162	90			30.00		• Spacing range 15-100cm
14BH040	14BH040A	14BH040AS01	Foliation	gen1f	FOL1I	110	87	FOR INTENSE	L<<S			• Intense planar straight foliation
14BH040	14BH040A	14BH040AS02	Lineation	mineral	LINM1	285	8					• Good fine grained mineral lineation
14BH040	14BH040A	14BH040AS03	Foliation	gen1f	FOL1I	124	81	FOR INTENSE	L<<S			
14BH040	14BH040A	14BH040AS04	Lineation	mineral	LINM1	300	3	LIN MODERATE	L<<S			
14BH040	14BH040A	14BH040AS05	Foliation	gen1f	FOL1I	120	81	FOR INTENSE	L<<S			
14BH040	14BH040A	14BH040AS06	Lineation	fold-S	LINFS2	339	60					• Relatively late after most flattening, fold 1
14BH040	14BH040A	14BH040AS07	Axial fold plane	S-unknown	AXFSXI	331	83					• Fold 1
14BH040	14BH040A	14BH040AS08	Shear	Ductile-DexU	SHDXI	315	78					• Sinistral shear at fold 1
14BH040	14BH040A	14BH040AS09	Lineation	fold-S	LINFS2	313	64					• Fold 2
14BH040	14BH040A	14BH040AS10	Axial fold plane	S-unknown	AXFSXI	308	84					• Fold 2
14BH040	14BH040A	14BH040AS10	Shear	Ductile-SinU	SHSXI	276	88					• Sinistral shear at fold 2
14BH040	14BH040A	14BH040AS10	Foliation	gen2f	FOL2I	318	75	FOL MODERATE				• Folded layers are being boudinaged
14BH040	14BH040A	14BH040AS10	Lineation	fold-S	LINFS1	306	12					• Fold axis of S-fold parallels L1, is folding quartz vein cutting counterclockwise across foliation, enveloping surface at 292/75
14BH040	14BH040A	14BH040AS10	Axial fold plane	S-unknown	AXFSXI	308	58					• Axial plane is approximately parallel to S1
14BH040	14BH040A	14BH040AS10	Joint	joint	JNTI	118	85			3.00		• Spacing range, 0.1-10 cm, many of these joints are healed, foliation parallel
14BH040	14BH040A	14BH040AS10	Joint	joint	JNTI	4	73			50.00		• Spacing range, 6-60 cm
14BH040	14BH040A	14BH040AS10	Joint	joint	JNTI	329	68			200.00		• Spacing range, 20->200 cm
14BH040	14BH040A	14BH040AS10	Joint	joint	JNTI	24	66			6.00		• Spacing range, 0.5-10 cm
14BH041	14BH041A	14BH041AS01	Lineation	mineral	LINM1	284	4	LIN STRONG	L>>S			
14BH041	14BH041A	14BH041AS04	Joint	joint	JNTI	305	73			75.00	quartz;	• Spacing range, 1-100 cm
14BH041	14BH041A	14BH041AS05	Joint	joint	JNTV	65	90			150.00		• Spacing range, 10-200 cm
14BH041	14BH041A	14BH041AS06	Joint	joint	JNTI	200	72			100.00		• Spacing range, 30-140 cm
14BH041	14BH041B	14BH041BS02	Contacts	Dyke-A	IGCADI	325	74			0.00		• A peg dyke
14BH041	14BH041B	14BH041BS03	Contacts	Dyke-A	IGCADI	307	60			0.00		• Dyke

Table A. 9: Geomechanical Characteristics

Station ID	Litho ID	Struc ID	Type	Density	FD Def	Hardness	RH Details	RH Def	Notes
14BH001	14BH001A	14BH001AD01	Brittle	None	Massive; joint spacing > 100cm	Very Strong	R5	Fractured if many blows	• GSI 75-85
14BH002	14BH002A	14BH002AD01	Brittle	Sparse	Blocky; joint spacing 30-100cm	Very Strong	R5	Fractured if many blows	• GSI 65-70
14BH003	14BH003A	14BH003AD01	Brittle	None	Massive; joint spacing > 100cm	Very Strong	R5	Fractured if many blows	• GSI 75-85
14BH004	14BH004A	14BH004AD01	Brittle	None	Massive; joint spacing > 100cm	Very Strong	R5	Fractured if many blows	• GSI 75-85
14BH006	14BH006A	14BH006AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Very Strong	R5	Fractured if many blows	• GSI 35-40
14BH007	14BH007A	14BH007AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55
14BH008	14BH008A	14BH008AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55
14BH009	14BH009A	14BH009AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55
14BH010	14BH010A	14BH010AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 40-50
14BH011	14BH011A	14BH011AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 30-40
14BH012	14BH012A	14BH012AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Strong	R4	Fractured if >1 hammer blow	• GSI 50-60
14BH013	14BH013A	14BH013AD01	Brittle	Sparse	Blocky; joint spacing 30-100cm	Very Strong	R5	Fractured if many blows	• GSI 60-70
14BH014	14BH014A	14BH014AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Strong	R4	Fractured if >1 hammer blow	• GSI 45-55, called this moderate but visibility of surface hampers assessment
14BH016	14BH016A	14BH016AD01	Brittle	None	Massive; joint spacing > 100cm	Very Strong	R5	Fractured if many blows	• GSI 65-75, R5 for bith,
14BH017	14BH017A	14BH017AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55 near lineament, GSI 60-70 at top of outcrop, rock mass quality is moderate within 3m of outcrop edge along lineament, remainder of outcrop is sparse
14BH018	14BH018A	14BH018AD01	Brittle	None	Massive; joint spacing > 100cm	Very Strong	R5	Fractured if many blows	• GSI 70-80
14BH019	14BH019A	14BH019AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Very Strong	R5	Fractured if many blows	• GSI 40-50, all lith types are R5
14BH020	14BH020A	14BH020AD01	Brittle	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 35-45
14BH021	14BH021A	14BH021AD01	Ductile;Brittle-Ductile	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 50-60
14BH022	14BH022A	14BH022AD01	Brittle	Sparse	Blocky; joint spacing 30-100cm	Very Strong	R5	Fractured if many blows	• GSI 60-70
14BH023	14BH023A	14BH023AD01	Brittle	None	Blocky; joint spacing 30-100cm	Very Strong	R5	Fractured if many blows	• GSI 70-80

14BH024	14BH024A	14BH024AD01	Brittle	Sparse	Blocky; joint spacing 30-100cm	Very Strong	R5	Fractured if many blows	• GSI 60-70 at water; density = None and GSI 70-80 on top of outcrop
14BH025	14BH025A	14BH025AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55, lenses/domains of very abundant fractures
14BH026	14BH026A	14BH026AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 44-55
14BH005	14BH005A	14BH005AD01	Brittle	None	Massive; joint spacing > 100cm	Very Strong	R5	Fractured if many blows	• GSI 70-80
14BH029	14BH029A	14BH029AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 35-45
14BH030	14BH030A	14BH030AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 35-45
14BH031	14BH031A	14BH031AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 50-60
14BH032	14BH032A	14BH032AD01	Brittle	Abundant	Blocky-disturbed; joint spacing 3-10cm	Very Strong	R5	Fractured if many blows	• GSI 40-50
14BH033	14BH033A	14BH033AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55
14BH034	14BH034A	14BH034AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Very Strong	R5	Fractured if many blows	• GSI 40-50, R5 in hbe granitoid, R2 in foliated mafic rock to south
14BH035	14BH035A	14BH035AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 40-50
14BH036	14BH036A	14BH036AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55
14BH037	14BH037A	14BH037AD01	Brittle	Moderate	Very blocky; joint spacing 10-40cm	Very Strong	R5	Fractured if many blows	• GSI 45-55
14BH038	14BH038A	14BH038AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 40-50
14BH040	14BH040A	14BH040AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 40-50
14BH041	14BH041A	14BH041AD01	Brittle	Sparse	Blocky; joint spacing 30-100cm	Very Strong	R5	Fractured if many blows	• GSI 55-65, grdr and pegmatite are both very strong
14BH039	14BH039A	14BH039AD01	Ductile;Brittle-Ductile	Abundant	Blocky-disturbed; joint spacing 3-10cm	Weak	R2	Shallow Indent - firm point blow	• GSI 40-50
14BH027	14BH027A	14BH027AD01	Brittle	Abundant	Blocky-disturbed; joint spacing 3-10cm	Strong	R4	Fractured if >1 hammer blow	• GSI 35-45
14BH028	14BH028A	14BH028AD01	Brittle	Abundant	Blocky-disturbed; joint spacing 3-10cm	Very Strong	R5	Fractured if many blows	• GSI 40-50

Table A. 10: Samples

Station ID	Sample ID	Sample Type	Reason
14BH001	14BH001AG01	representative	• Lineated, foliated bt granodiorite, thin section for composition
14BH002	14BH002AG01	representative	• Rep foliated ,lineated bt grdr
14BH002	14BH002BG02	representative	• fgr red garnet or corundum?
14BH003	14BH003AG01	representative	• Rep bt grdr with steeply dipping foliation
14BH004	14BH004AG02	representative	• Well foliated bt grdr with moderate lineation
14BH006	14BH006AG01	representative	• fol to protomyl bt-mt grdr
14BH006	14BH006BG02	representative	• Representative xeno. rock
14BH007	14BH007AG01	representative	• Leucocratic bt grdr -has to be a different phase
14BH008	14BH008AG01	representative	• Weakly foliated, almost massive
14BH008	14BH008AG02	representative	• Strong fracture set and slicks
14BH009	14BH009AG02	representative	• Rep bt grdr, fol, incr in mafic
14BH010	14BH010AG03	representative	• Representative biotite granodiorite
14BH010	14BH010AG05	representative	• Highly foliated version of the granodiorite near the shear faulted contact
14BH010	14BH010BG04	representative	• Representative biotite rich metasedimentary?, metavolcanic? rock
14BH011	14BH011AG01	representative	• bt ms grt schist, sed protolith
14BH012	14BH012AG01	representative	• Representative fgr, melano, qtz-bt schist
14BH012	14BH012AG02	representative	• Representative mgr melano schist
14BH013	14BH013AG01	representative	• Representative weakly foliated L-tectonite bt grdr
14BH014	14BH014AG01	representative	• Rep foliated and lineated bt grdr
14BH016	14BH016AG01	representative	• Good bt grdr with fol and lin
14BH016	14BH016BG02	representative	• Pink varitextured, granite pegmatite
14BH017	14BH017AG01	representative	• Rep lineated > foliated biotite granodiorite
14BH017	14BH017BG02	representative	• Rep leucocratic bt poor granite pegmatite
14BH018	14BH018AG01	representative	• Rep lineated biotite granodiorite
14BH019	14BH019AG01	representative	• Typical bt grdr
14BH019	14BH019BG02	representative	• Aphlitic to vfgr bt gran dyke
14BH019	14BH019CG03	representative	• Typical leucocratic bt ms granite pegmatite
14BH020	14BH020AG01	representative	• Layered Amisk mafic volcanic
14BH020	14BH020BG02	representative	• Massive Amisk mafic volcanic
14BH021	14BH021AG01	representative	• Composition and foliation in marginal grdr
14BH021	14BH021BG02	representative	• fgr , grain size reduced felsic unit, upright shear zone?
14BH022	14BH022AG01	representative	• Representative, foliated melanocratic hornblende bt grdr
14BH023	14BH023AG01	representative	• Great L-tectonite bt grdr
14BH024	14BH024AG01	representative	• The bt grdr with good foliation and lineation , cut by narrow pink leucocratic dyke
14BH025	14BH025AG01	representative	• 2 orthogonal cuts; one perpendicular to lineation and one parallel to it
14BH026	14BH026AG01	representative	• L tectonite bt grdr again
14BH028	14BH028AG01	representative	• Representative bt grdr with a weak foln, still strong lineation
14BH028	14BH028BG02	representative	• Narrow 2cm leucocratic fgr granite dyke
14BH028	14BH028CG03	representative	• Rep vfgr intermediate dyke
14BH031	14BH031AG02	representative	• @wp1149, main oc, typical mgr equigranular bt grdr, some mt
14BH031	14BH031BG01	representative	• @wp1148, f-mgr mt-bt grdr with moderate foln
14BH032	14BH032AG01	representative	• Representative for composition
14BH032	14BH032BG02	representative	• Nature af grains, distribution of mt
14BH036	14BH036AG01	representative	• L=S bt grdr
14BH036	14BH036AG02	representative	• Rep foliated bt mt grdr along mag high, mag sus failed, sample to retest
14BH038	14BH038AG01	representative	• Strongly foliated mafic volcanic
14BH041	14BH041AG01	representative	• Identify if hbe, apatite and grt are present
14BH041	14BH041BG02	representative	• Rep sample of bt granite pegmatite

Table A. 11: Photographs

Station ID	Photo ID	Category	Scale	Direction	Caption
14BH001	14BH001AP01	outcrop	person	S	• 0839, representative outcrop
14BH002	14BH002AP02	outcrop	person	S	• 0847, representative outcrop photo
14BH002	14BH002BP01	minor lithology	pen/pencil	S	• 0846, granite peg cutting lineated grdr at high angle to lineation
14BH003	14BH003AP01	structure	hammer	E	• 0856, sample location showing sample with S2 foln parallel to hammer
14BH003	14BH003AP02	structure	hammer	W	• 0857, foliation cutting main lith and more discrete in dyke
14BH003	14BH003AP03	outcrop	person	SW	• 0858, outcrop shot
14BH004	14BH004AP01	outcrop	person	N	• 0860, representative outcrop photo
14BH005	14BH005AP01	outcrop	person	SE	• 0863, representative outcrop
14BH005	14BH005AP02	major lithology	pen/pencil	N	• 0864, representative high magnetic granodiorite with strong foliation
14BH005	14BH005AP04	structure	pen/pencil	N	• 0866, strong foliation, locally protomylonitic foliation in high mag lithology
14BH005	14BH005BP03	minor lithology	pen/pencil	N	• 0865, representative silicified quartz-feldspar porphyry
14BH006	14BH006AP01	structure	hammer	SW	• 0872, transposed xenos in strongly foliated bt-mt grdr
14BH006	14BH006AP02	outcrop	hammer	NW	• 0873, representative outcrop with sample location showing domain of NE dipping high strain
14BH007	14BH007AP01	outcrop	person	NW	• 0880, 0881, outcrop showing huge expanse of exposure
14BH008	14BH008AP01	structure	pen/pencil	N	• 0882, looking up plunge at strongly fractured section
14BH008	14BH008AP02	structure	pen/pencil	N	• 0883, looking at face of fracture/fault with pen along lin
14BH008	14BH008AP03	outcrop	person	N	• 0884, 0888, rep outcrop shot
14BH009	14BH009AP01	outcrop	person	N	• 0889, outcrop view from the lineament looking north
14BH010	14BH010AP01	outcrop	person	N	• 0896,0899, outcrop shot, schist on left, grdr on right
14BH010	14BH010AP02	structure	pen/pencil	NE	• 0897, 0898, highly foliated bt schist on left, fol grdr on right, strong strain gradient in
14BH011	14BH011AP01	outcrop	person	E	• 0913, outcrop photo
14BH011	14BH011AP02	structure	scale card	W	• 0910, tight Z fold of main foln
14BH012	14BH012AP01	structure	pen/pencil	N	• 0918, metamorphic segregation into different grain sizes of bt qtz schist
14BH012	14BH012AP02	structure	pen/pencil	N	• 0919, metamorphic segregation into different grain sizes of bt qtz schist, closer in
14BH012	14BH012AP03	outcrop	person	W	• 0929, outcrop nature long and skinny parallel to shore
14BH013	14BH013AP01	structure	pen/pencil	NW	• 0927, great lineation with rod like face perpendicular to lin, locally gets wkly foliated
14BH013	14BH013AP02	outcrop	person	W	• 0925, outcrop shot of strongly lineated, weakly fractured unit
14BH014	14BH014AP01	outcrop	scale card	E	• 0934, outcrop shot to show the heavy lichen and moss cover
14BH016	14BH016AP01	outcrop	hammer	S	• 0941, outcrop view at wp1119 at west end of oc
14BH016	14BH016AP04	major lithology	pen/pencil	N	• 0950, representative bt grdr
14BH016	14BH016AP06	outcrop	person	see Caption field	• 0952, looking south across WNW lineament to next oc; 0953, 0954, looking E along lineament
14BH016	14BH016BP02	outcrop	person	NW	• 0947, 0948, outcrop shot of vertical face showing gran peg cutting foliated and lineated biotite granodiorite
14BH016	14BH016BP03	dyke/vein	pen/pencil	N	• 0949, close-up of gran peg contact

Station ID	Photo ID	Category	Scale	Direction	Caption
14BH016	14BH016BP05	minor lithology	pen/pencil	N	• 0951, representative leucocratic granite pegmatite
14BH017	14BH017AP01	outcrop	hammer	W	• 0957, representative outcrop
14BH017	14BH017AP02	major lithology	pen/pencil	S	• 0958, rep weathered bt grdr
14BH017	14BH017AP03	major lithology	pen/pencil	W	• 0962, rep fresh lineated bt grdr
14BH017	14BH017AP04	see Caption field	person	SW	• 0965, representative open spruce forest with little underbrush and flat forest floor
14BH018	14BH018AP01	structure	pen/pencil	N	• 0967, pen on lineation, dip of face is down the lineation and reps the foliation plane
14BH018	14BH018AP02	structure	pen/pencil	N	• 0968, strike of foliation is perpendicular to the lineation and foliation dips shallowly to the ESE
14BH018	14BH018AP03	outcrop	person	S	• 0971, representative outcrop with significant moss cover
14BH019	14BH019AP01	outcrop	person	W	• 0973, outcrop shot
14BH019	14BH019AP02	outcrop	person	E	• 0977, lineament between the two parallel outcrops
14BH019	14BH019AP03	outcrop	see Caption field	NE	• 0978, across outcrop to see lineament
14BH019	14BH019BP06	structure	compass	N	• 0981, 2nd foln or tight fracture cuts the pegmatite
14BH019	14BH019BP08	minor lithology	pen/pencil	N	• 0984, pegmatite dyke cuts aplite parallel to strike
14BH019	14BH019BP09	minor lithology	compass	N	• 0983, rep shot of vfgr aplite
14BH019	14BH019CP04	structure	compass	N	• 0979, boudinaged pegmatite dyke
14BH019	14BH019CP05	structure	compass	N	• 0980, boudinaged and bookshelf faulted peg dyke
14BH019	14BH019CP07	structure	compass	N	• 0982, pegmatite dyke cuts aplite and bt grdr perpendicular to aplite dyke along N striking fracture
14BH020	14BH020AP01	outcrop	person	E	• 0993, from lineament to outcrop
14BH020	14BH020AP02	outcrop	scale card	E	• 0994, outcrop shot
14BH020	14BH020AP03	structure	compass	S	• 0995, 0996, shallowly E plunging slickenfibres on discrete shear, pen in photo 996 parallel to lineation
14BH020	14BH020AP04	structure	compass	N	• 0997, 0998, and 1018 @wp1127, upright, moderately N plunging, open folds deforming the main foliation
14BH020	14BH020AP05	structure	compass	N	• 0999, similar folds with fold axial plane close to but not the same as main fracture or lineation parallel fracture
14BH021	14BH021AP01	major lithology	pen/pencil	S	• 1014, typical foliated, lineated hbe-bt grdr
14BH021	14BH021AP03	outcrop	hammer	W	• 1013, outcrop shot
14BH021	14BH021BP02	structure	compass	S	• 1015, 1016, high strain pink felsite cutting foliated and lineated hornblende biotite granodiorite , closer in and real close-up
14BH022	14BH022AP01	outcrop	person	W	• 1023, nature of shoreline exposure
14BH022	14BH022AP02	major lithology	compass	S	• 1024, good foln and lin
14BH022	14BH022BP03	minor lithology	compass	N	• 1025, 1026, grt gran dyke, disrupts foln and close-up
14BH022	14BH022BP04	structure	compass	NE	• 1027, 1028, boudinaged gran dyke with non-systematic folds in neck
14BH023	14BH023AP01	outcrop	person	SW	• 1029, rep outcrop shot
14BH023	14BH023AP02	structure	compass	NW	• 1030, great lineation in bt grdr at nose of fold
14BH023	14BH023AP03	structure	pen/pencil	N	• 1031, elongation of qtz, plag and bt defining lineation
14BH024	14BH024AP01	outcrop	person	S	• 1052, 1053, rep outcrop shot

Station ID	Photo ID	Category	Scale	Direction	Caption
14BH024	14BH024AP02	dyke/vein	compass	N	• 1049, straight sharp contact of pegmatite cutting granodiorite
14BH024	14BH024AP04	major lithology	pen/pencil	see Caption field	• 1050, shot of rep hand sample showing foliation with pen on lineation
14BH024	14BH024BP03	dyke/vein	pen/pencil	see Caption field	• 1051, loose block with folded peg dyke
14BH025	14BH025AP01	structure	compass	E	• 1054, 1055, perpendicular to lineation looks massive
14BH025	14BH025AP02	structure	compass	S	• 1056, parallel to lineation shows strong L tectonite
14BH025	14BH025AP03	structure	compass	S	• 1064, 2 gash vein extensional vein
14BH025	14BH025AP04	structure	compass	S	• 1065, 1066, overview and close-up of flat qtz extensional vein linking to others
14BH025	14BH025AP05	outcrop	person	W	• 1067, outcrop overview shot
14BH026	14BH026AP01	structure	compass	S	• 1078, shallowly west dipping gash qv, common on oc
14BH026	14BH026AP02	structure	compass	S	• 1079, mafic xenos, boudinaged , better foliated in and adjacent to these
14BH026	14BH026AP03	outcrop	person	SE	• 1073, 1074, representative sloping outcrop with good exposure on side of small lake
14BH027	14BH027AP01	structure	compass	N	• 1099, 1100, 1101, mylonite zone with reverse movement according to rotated grains, boudinage perpendicular to mlin
14BH027	14BH027AP02	structure	compass	N	• 1102, high strain flattening and extension.
14BH027	14BH027AP03	structure	compass	SW	• 1103, high strain flattening and extension.
14BH027	14BH027AP04	outcrop	person	SW	• 1104, representative outcrop
14BH028	14BH028AP01	outcrop	person	NE	• 1112, 1114 representative outcrop
14BH028	14BH028BP02	dyke/vein	compass	NE	• 1113, Zoned felsic bt + ms dyke
14BH028	14BH028CP03	dyke/vein	compass	W	• 1115, representative grey intermediate dyke
14BH029	14BH029AP01	structure	compass	SW	• 1125, Hook folds in west arm shear zone
14BH029	14BH029AP02	structure	compass	SW	• 1126, Strong shear foliation and boudinaged vein
14BH029	14BH029AP03	structure	compass	SW	• 1127, Sinistral separation brittle fault offsets foliation
14BH029	14BH029AP04	structure	compass	SW	• 1128, Dextral offset of layers
14BH029	14BH029AP05	structure	compass	SW	• 1129, at wp 1144, domainal strain around lithon of vfgr, less foliated mafic volcanic
14BH029	14BH029AP06	structure	compass	SW	• 1130, at wp 1145, Sinistral sigma classed rotation
14BH029	14BH029AP07	outcrop	person	SW	• 1121, back at wp1143, representative small roadside outcrop
14BH030	14BH030AP01	structure	compass	NW	• 1136, 1137, 1138, Strongly foliated and refolded mafic volcanic in Annabel Lake shear zone
14BH030	14BH030AP02	structure	compass	W	• 1139, 1140, Strongly foliated and refolded mafic volcanic in Annabel Lake shear zone, different fold set
14BH030	14BH030AP03	structure	compass	W	• 1141, Boudinaged layering in shear zone
14BH030	14BH030AP04	structure	compass	S	• 1142, Moderate east plunging slicken line on west striking fault
14BH030	14BH030AP05	major lithology	pen/pencil	S	• 1143, Garnet porph. in garnet amphibolite mafic volcanic
14BH030	14BH030AP06	outcrop	hammer	W	• 1144, S-shaped fold train with shallow NW plunge, representative outcrop
14BH031	14BH031AP01	outcrop	person	W	• 1182, Representative outcrop exposure
14BH031	14BH031AP02	minor lithology	pen/pencil	S	• 1177, Magnetite from melanocratic magnetite-biotite-grdr
14BH032	14BH032AP01	outcrop	person	W	• 1190, 1191, Well exposed outcrop on Arner Lake
14BH032	14BH032BP02	minor lithology	compass	W	• 1192, Fine grained siliceous mt grdr.
14BH033	14BH033AP01	outcrop	person	N	• 1198, 1199, Representative large open outcrop in

Station ID	Photo ID	Category	Scale	Direction	Caption
					hornblende granite to grdr
14BH033	14BH033AP02	major lithology	scale card	N	• 1200, Mafic xenolith in hbe granite to grdr
14BH033	14BH033AP03	major lithology	pen/pencil	N	• 1201, Representative hbe gran. to grdr lithology
14BH034	14BH034AP01	outcrop	person	W	• 1207, Representative open outcrop near contact
14BH034	14BH034AP02	structure	compass	NW	• 1208, 1209, View parallel to strike of shear zone
14BH034	14BH034AP03	structure	compass	NE	• 1210, 1211, 1212, Rotated fabric in shear zone along discrete planes, at pen in 1212
14BH034	14BH034AP04	structure	compass	SE	• 1213, Deformed veins along shear zone and gash veins at angle to it
14BH035	14BH035AP01	structure	compass	NW	• 1229, upright, shallowly NW plunging S-shaped F3 fold
14BH035	14BH035AP02	structure	compass	W	• 1230, boudinaged and tightly folded vein in S1 foliation
14BH035	14BH035AP03	outcrop	see Caption field	W	• 1231, map case for scale, typical roadside outcrop at E end of outcrop sequences, the most deformed is closest to the boat launch
14BH035	14BH035AP04	structure	compass	NW	• 1233, 1234, F2 (tight) and F3 (more open) refolding of main S1 foliation
14BH036	14BH036AP01	outcrop	person	N	• 1246, 1247, Representative open but moss covered outcrops with low relief
14BH037	14BH037AP01	outcrop	person	W	• 1250, Representative open moss covered outcrop with 2 m relief
14BH037	14BH037AP02	structure	compass	N	• 1251, Nature of foliation in biotite grdr, representative rock, and extensional quartz vein
14BH038	14BH038AP01	outcrop	hammer	SW	• 1259, Representative moderate sized outcrop, low relief, mostly moss covered
14BH038	14BH038AP02	structure	compass	N	• 1260, Strong foliation in mafic metavolcanic, openly warped
14BH038	14BH038AP03	structure	compass	N	• 1261, Small scale NE plunging minor S-fold
14BH039	14BH039AP01	outcrop	person	SW	• 1263, Tiny outcrop on shoreline
14BH039	14BH039AP02	structure	pen/pencil	E	• 1264, Joint spacing in Amisk pelites
14BH039	14BH039AP03	structure	compass	N	• 1265, S-folds and rotation, sinistral component of movement on plan view
14BH040	14BH040AP01	outcrop	person	NW	• 1280, Low lakeshore outcrop, well-exposed
14BH040	14BH040AP02	structure	compass	NE	• 1281, 1282, S-fold at fold 1
14BH040	14BH040AP03	structure	compass	NE	• 1283, S-fold at fold 2
14BH040	14BH040AP04	structure	compass	N	• 1284, S-shaped, F1 generation tightly folded quartz vein, axial plane parallel to S1 foliation
14BH040	14BH040AP05	structure	compass	S	• 1285, S-shaped, F1 generation tightly folded quartz vein, axial plane parallel to S1 foliation
14BH041	14BH041AP01	outcrop	person	W	• 1300, Representative outcrop
14BH041	14BH041AP04	structure	compass	NW	• 1303, Pen on shallowly west plunging lineation
14BH041	14BH041BP02	dyke/vein	compass	W	• 1301, Pegmatite dyke intruding biotite granodiorite
14BH041	14BH041BP03	dyke/vein	compass	N	• 1302, Pegmatite dyke intruding biotite granodiorite