BIG ROCK Exploration, LLC
Thorp Building
1620 Central Ave NE, Suite 104
Minneapolis, MN 55413
P: (612) 236-4562
W: www.bigrockexploration.com

Elizabeth Roepke
Geologist
651-890-7361
liz@bigrockexploration.com

Aubrey Lee
Project Manager - Geologist
619-871-5386
aubrey@bigrockexploration.com

AGAM Field Mapping Program Report August 2018

Prepared for AngloGold Ashanti Minnesota by Big Rock Exploration

List of Figures

List of Plates

Contents

1 Executive Summary

The purpose of this report is to document work performed by Big Rock Exploration ("Big Rock" or "BRE") on two of AngloGold Ashanti Minnesota's ("Anglo" or "AGAM") lease packages or areas of interest (AOI), Magni and Ran, northwest and southeast of Deer Lake near the town of Bigfork in northern Minnesota (*fig. 1*). Field work was conducted August 13-26, 2018. This document is appended with a geospatial dataset containing all digital components of the program including geologic maps, field notes and maps, photos, sampling data, structure data, and alteration data.

Outcrops were mapped at 1:8,000 scale in the field by drawing on 8.5" x 11" mylar sheets taped over laminated base maps. Field observations in the form of notes and sketches from field stations include UTM coordinates, lithology, mineralogy, alteration style and intensity, abundance and type of sulfide minerals, structural measurements, samples taken, and other notable features. Dry summer conditions allowed increased access to marshy and swampy terrains. In total, one hundred twenty-three (123) bedrock samples were collected. Twenty (20) samples were gathered from the Magni area and one hundred three (103) samples were gathered from Ran. Approximately 1-2 kg of rock was collected for each sample. Each sample was cut and divided. One half is stored in an AGAM sample archive library in Hibbing; these portions are large enough to create billets for thin sections if needed. The second half of each sample was shipped to ALS for geochemical analysis. Geological structures were measured to establish physical and temporal relationships between geologic units and events. Measurement types include stratigraphic indicators, shear fabric, orientations of dikes and veins, brittle deformation, and glacial striations. Regional shearing trends roughly N-S, with some local deviation that may be proximal to a potential mineralization zone.

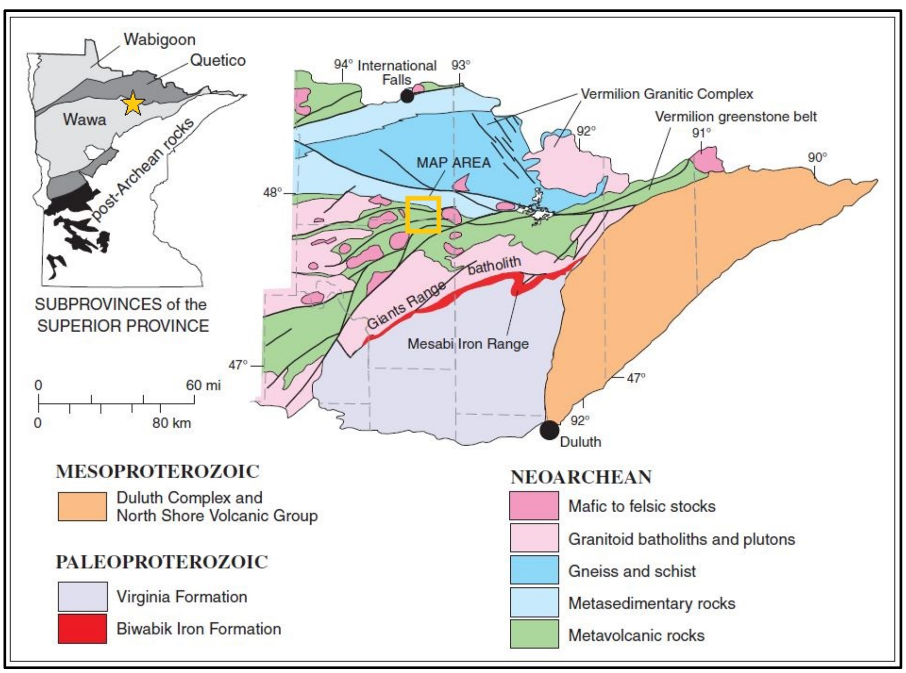


Figure 1: Geological overview of northern Minnesota showing the major suites of Precambrian rocks - Deer Lake area designated by yellow box. Inset map displays the Archean subprovinces of the Superior Province - Deer Lake area designated by yellow star.

Regional lithology is wholly comprised of Neoarchean to Paleoproterozoic intrusive and extrusive igneous rocks of the Wawa subprovince of the Superior province of the Canadian Shield (*fig. 1*). Major mapped rock units include Paleoproterozoic diabase dikes, and Archaean gabbro, andesite, and massive to pillowed basalt. Greenstone to amphibolite facies alteration is documented throughout the entire area. Secondary biotite, silicification, epidotization, chloritization, carbonatization, and saussuritization are common in varying degrees in all rock types in accordance with metamorphism and metasomatism of mafic volcanic and intrusive rocks. Sulfide minerals, primarily pyrite and chalcopyrite, occur throughout the region. The most encouraging findings for gold prospects include a pyrite-bearing shear zone in the southwest area of the Ran AOI, felsic intrusions in the Ran AOI, and a chlorite-altered quartz vein in the Magni AOI. Additionally, encouraging findings for VMS-style sulfide mineralization occur in southern Ran and include strongly epidotized and silicified pillowed basalt and many lithologies signifying the paleo-seafloor.

2 Introduction

Big Rock was contracted by AGAM in August 2018 to plan and execute a two-week reconnaissance mapping program on two of their lease areas, Magni and Ran, NW and SE of Deer Lake near the town of Bigfork in northern Minnesota. The primary goals were to collect detailed geologic data on various outcrop exposures, collect representative samples for geochemical analysis, generate bedrock maps for each AOI, compile the data into a final ArcGIS geodatabase for AGAM to integrate into their systems, and delineate potential zones of interest for continued evaluation. Big Rock supplied AGAM with four field geologists who were supervised by AGAM geologist Paul Fix.

Gold exploration has been active in the Bigfork, MN region throughout the last 50 years with prominence from 1969 through 1989 (*Chandler et.al., 1997*). US Steel drilled 13 holes southwest of Deer Lake in outcrops exposed west of AGAM's Ran AOI in the early 1970s. Bear Creek, Moore, and Hanna mining companies sporadically drilled holes throughout the Deer Lake region from 1969 to 1971. Meridan L&M company focused on drilling in a small area east of Deer Lake in the northern part of AGAM's Ran AOI in 1988. Finally, Normin Mining drilled seven holes in the southwest to south-central area of AGAM's Ran AOI from 1988 to 1989. Most historic drilling encountered metavolcanics, volcaniclastics, and mafic intrusions with local mineralization indicators but no deposit was developed.

The regional bedrock geology of the Deer Lake area consists of 2.7 Ga Neoarchean metavolcanic and volcaniclastic rocks intruded by 2.6 Ga metagabbroic stocks and sills, all cross-cut by 2.0 Ga Paleoproterozoic northwest trending diabasic to gabbroic dikes and sills (*Southwick et.al., 1998*). All

Figure 2: Liz Roepke uncovering an obscured outcrop by peeling back a thick blanket of moss and sweeping debris away.

bedrock is metamorphosed to greenschist facies and grade northward to amphibolite facies approaching the Wawa-Quetico subprovince boundary. The region is overlain by up to 290 feet of glacial till of the Rainy and Koochiching lobes (*Johnson et.al., 2016* and *Hobbs & Goebel, 1982*) making bedrock outcrop exposure sporadic and sparse.

Regional bedrock mapping in the Bigfork area was conducted by the Minnesota Geological Survey (MGS) from the late 1990's through the 2000's. MGS generated a bedrock geologic map of the Virginia Horn region which (*Jirsa et.al., 1998* and *Jirsa & Morey, 2003*), along with George Hudak's investigation of the Five Mile Lake volcanic sequence (*Hudak et.al., 2002*), produced many insights into regional Archean volcanic stratigraphy. In 2005, MGS produced a local-scale map of the Deer Lake Complex; a mafic intrusive suite northwest of Deer Lake (*Severson & Jirsa, 2005*). The study helped to clarify deformational events, give a structural framework for the region, and highlight the area's potential for Cu-Ni-PGE occurrences. Once the Deer Lake Complex was elucidated, MGS produced a regional-scale bedrock geologic map of the Bigfork quadrangle in 2007 (*Jirsa & Chandler, 2007*). These maps were essential tools for the Big Rock team's planning and execution of the field program.

In preparation for the field program, Big Rock used public depth to bedrock and outcrop data to generate maps of potential outcrop exposure - these areas became the focus of field data collection for this program. Digital elevation models (DEMs) were occasionally used to identify potential outcrop exposure in till-covered areas. Almost 100% of MGS-mapped outcrops in Magni and Ran were observed and mapped by the Big Rock field team during this program. A few additional exposures were identified only by Big Rock.

This document is paired with a geospatial dataset containing all digital components of the program, including geologic maps, field notes and maps, photos, sampling data, structure data, and alteration data. Scans of field notes and maps are appended to this report. Original copies will be stored at the Big Rock office in Minneapolis until requested. All data has been shared via Dropbox.

3 Goals and Objectives

Field work was completed by Big Rock August 13-26, 2018 on two of AGAM's lease packages – Magni and Ran (collectively, "Deer Lake"). Data compilation and reporting was completed in March 2019. The following objectives were identified and completed for both properties:

- Detailed geological mapping of exposed outcrops on lease holdings with a focus on lithology, mineralogy, contacts, structure, and alteration
- Collecting representative hand samples from lease holdings for geochemical analysis, archival purposes, and potential further analysis
- Compiling mapping program data into geologic maps of each lease package

4 Methodology and Approach

To complete the goals and objectives listed above, the Big Rock team formulated their approach based on the terrain, scope of the project, and data organization. Big Rock's methodology is detailed below.

4.1 Health, Safety, and Environment

Driving to and from the AGAM leases was a top priority hazard for the Big Rock team. For field work, Big Rock rented two pickup trucks and a UTV. These vehicles were inspected daily before use for the following: adequate fuel and fluid levels, body or tire damage, and safety and first-aid equipment. A two-seat UTV was employed on trails where truck use was unsafe, impractical, or prohibited. All passengers in the UTV were required to wear seat belts, helmets, and eye protection during operation.

Additionally, terrain and environment were concerns for the team as many areas of AGAM's leases were inhospitable to walking. Safety considerations for the Big Rock team included slips-trips-falls, dangerous plants and insects, and weather. Each geologist carried personal first aid kits, insect repellant, sunscreen, rain gear, and food and water. In addition, each truck and the UTV contained a first aid kit, fire extinguisher, and extra food and water.

Finally, communication while in the field was a crucial part of Big Rock's approach to health and safety. Crew locations were communicated to AGAM supervisors via WhatsApp before leaving Hibbing to drive to the field site, after returning to Hibbing from the field site, and for other important location updates. For communications outside of cell service, short-range radios were carried by all field crew and satellite phones were kept in trucks. Satellite phones were tested in the field and confirmed as functional.

In accordance with MN DNR regulations, personnel and equipment were inspected for excess plant matter and cleaned when necessary to avoid spreading invasive species.

No major incidents occurred during the field program. One minor incident (a tick bite from a species that does not carry Lyme disease) prompted a trip to an urgent care clinic as a preventative measure. The incident is documented, and no loss of time occurred.

4.2 Site Access

Mapping sites were accessed via 4WD trucks, one UTV, and walking. Dry summer conditions allowed increased access to marshy and swampy terrains. Many existing trails were clear enough to drive the trucks or UTV into an area of interest. Where driving was not possible due to overgrown vegetation, swamps or muddy road conditions, the area was accessed on foot.

Georeferenced maps showing lease boundaries and GPS locations were used in the field to ensure personnel remained in permitted areas and on AGAM lease property.

4.3 Geospatial dataset

A comprehensive review of publicly-available geologic data (spatial and reporting) was conducted by Big Rock prior to the field program. Five main data sources were utilized for relevant geological or mineral potential data:

- United States Geological Survey (USGS) National Geological Map Database
- Minnesota Geological Survey (MGS)
- Minnesota Department of Natural Resources (MN DNR) Mineral Potential Reports
- MN DNR MINArchive (historical industry files, reports, and drill logs)
- Economic Geology Group at the University of Minnesota Natural Resources Research Institute (NRRI)

These sources supplied Big Rock with administrative datasets including lease holdings, land ownership, road and trail locations, mineral potential, depth to bedrock, outcrop locations, historical drilling reports and logs, lidar, topography, and satellite imagery. Outcrop potential maps were generated by BRE using depth to bedrock and outcrop exposure data from MGS (*plt. 1*). The Magni and Ran AOI lease areas are 13,359 and 16,976 acres, respectively. According to BRE calculations, high outcrop potential (depth to bedrock 0-15 feet) blankets an area of 54 acres in Magni and 138 acres in Ran. Additionally, BRE conducted

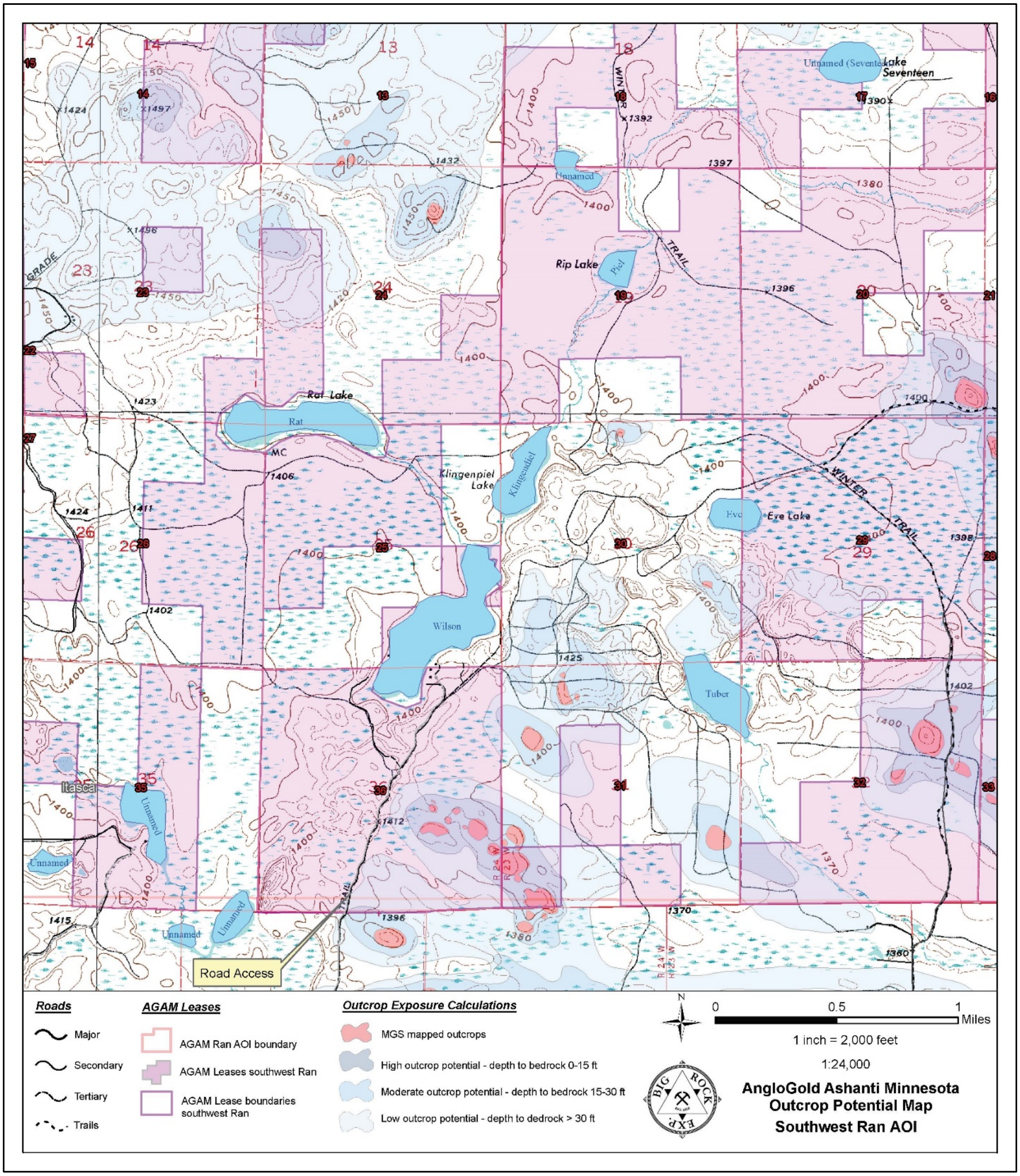


Plate 1: BRE-generated outcrop potential map generated with MGS outcrop shapefiles, MN DNR road shapefiles, MGS depth-to-bedrock data, and AGAM's lease package overlay. This map is one of many created for the region to help Big Rock geologists focus on areas where bedrock is near-surface.

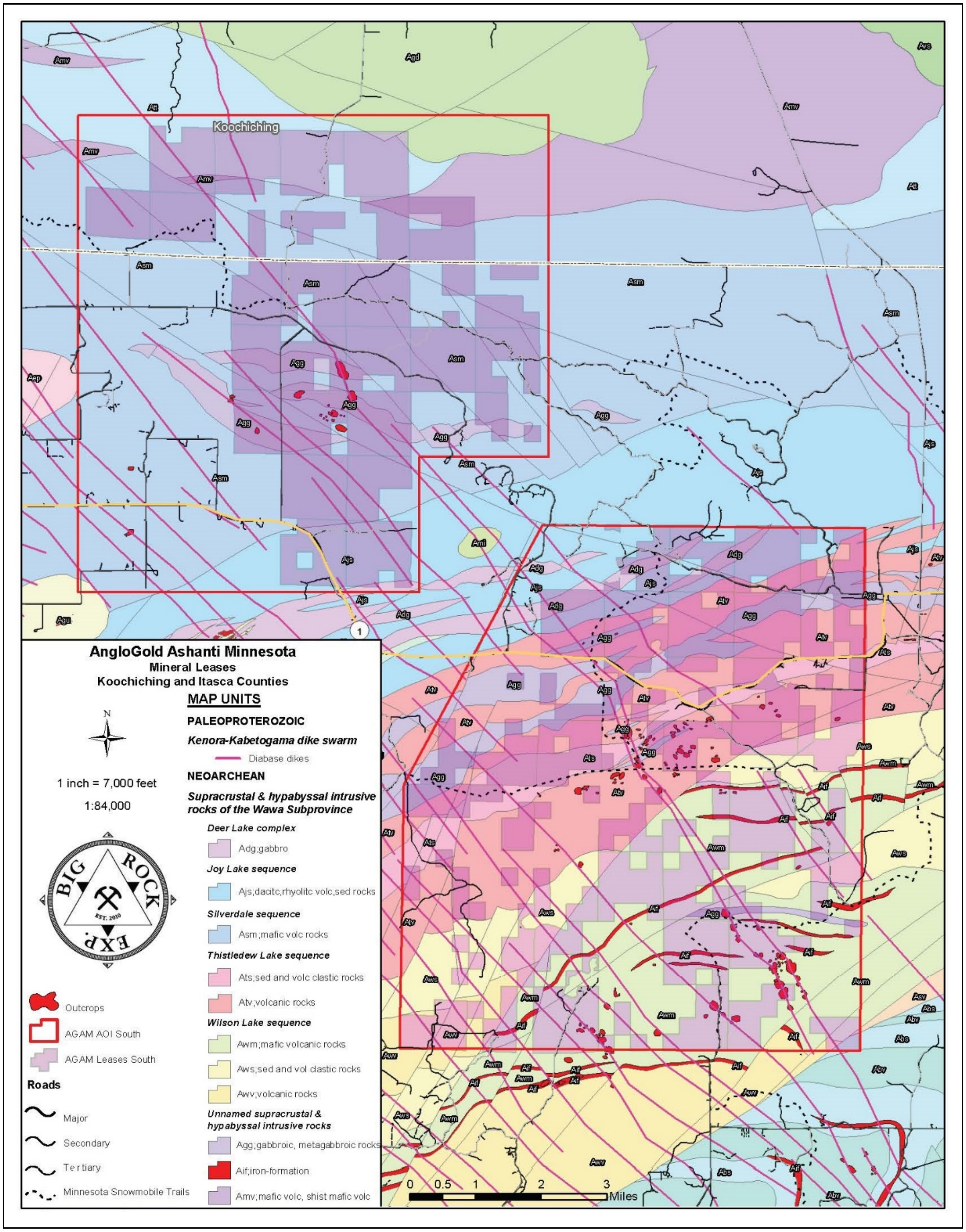


Plate 2: AGAM lease package overlain on lithology boundaries, outcrop footprints, and roads and trails. Data sourced by BRE from MGS, MN DNR, and AGAM.

terrain analysis to identify hill slopes angled greater than 33° (average angle of repose) where unmapped outcrops could potentially be exposed (*plt. 1*). An overlay of AGAM's lease package was used to identify areas where high outcrop potential overlaps AGAM mineral leases – these areas became the focus of field data collection (*plt. 2*). Field base maps were created using 1 m Lidar DEM Hill Shade, topographic maps, and aerial imagery overlain by AGAM's lease package (*fig. 3*). Outcrop footprints and map units from Minnesota Geological Survey map M-176 (*Jirsa & Chandler, 2007*) were used to locate known exposures whereas lidar was used to locate topographic highs where unmapped outcrops could exist. Datasets used in program planning were presented in the approved plan as displayed in the proposal (Appendix 7). These datasets can be found on Dropbox.

All products of field mapping including field station and outcrop locations, field notes, photos, structural measurements, and sample locations have been incorporated into the accompanying geodatabase file (.*gdb*).

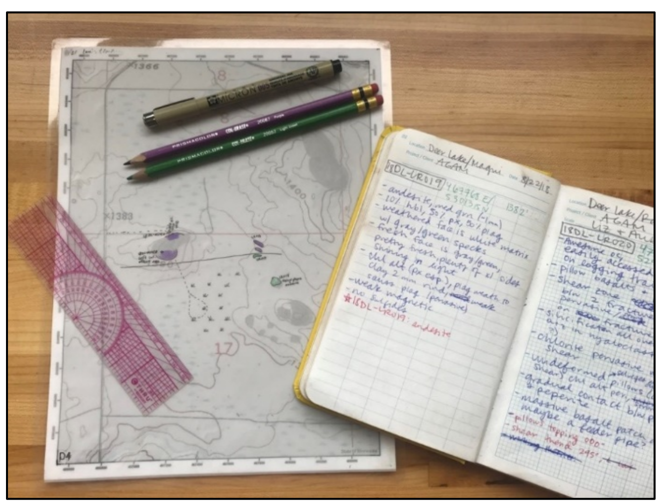
4.4 Data Collection

Big Rock's data collection techniques include noting field observations in a notebook, taking photos of outcrops and rock characteristics, gathering GIS location data, marking outcrops on field maps, and sampling (*fig. 3*, Appendix 6). Field notes are organized by station number – station numbers may correspond to individual outcrops or multiple small outcrops, and very large outcrops may be associated with multiple stations. Photos, locations, and samples are all noted in field notebooks corresponding to the station at which they were collected.

4.4.1 Notes

Members of the field team documented their observations in personal Rite in the Rain notebooks (*fig. 3*, Appendix 6). Observations include notes and sketches from field stations, including UTM coordinates, lithology, mineralogy, alteration style and intensity, abundance and type of sulfide minerals, structural measurements, samples taken, and any other pertinent information. Field stations are named with 2 digits for the year, 2 letters for the project ID (Deer Lake), a hyphen, then 2 letters to denote the first and last initial of the note taker, followed by 3 digits for that note taker's field station

Figure 3: Mapping tangibles including base map with lidar overlay, field notebook, compass for adding structure to the map, and various pens and pencils for drawing and color-coding.



number. For example, 18DL-AL001 indicates the first station collected in 2018 in the Deer Lake area by Aubrey Lee. Garmin GPS units (model 64S) were used to store waypoints corresponding to each field station. Data from each field station is stored in a master Excel spreadsheet, which also includes a sample tracking tab correlating an ALS Y-series ID to the field station from which the sample was taken (Appendix 3). Scanned copies of all notes can be found on Dropbox and originals are housed at BRE headquarters.

4.4.2 Maps

Base maps were created by overlaying 1m Lidar DEM Hill Shade (*fig. 4*) over georeferenced 1:24,000 topographic maps. A grid was created to divide the AOIs into one hundred thirty-two (132) 1:8,000-scale rectangles (Appendix 2). The twelve columns were assigned an alphanumeric code designating letters A-L, and the eleven rows were assigned numbers 1-11. Each grid section was used to create 132 unique base maps (A1, A2, etc.). These base maps were laminated then overlain by 8.5'' x 11'' mylar sheets. At 1:8,000-scale, the Big Rock team drew color-coded outcrop footprints, major structures, walking tracks, and station locations on the mylar-covered base maps (Appendix 6). Scanned copies of all field maps can be found on Dropbox and originals are housed at BRE headquarters.

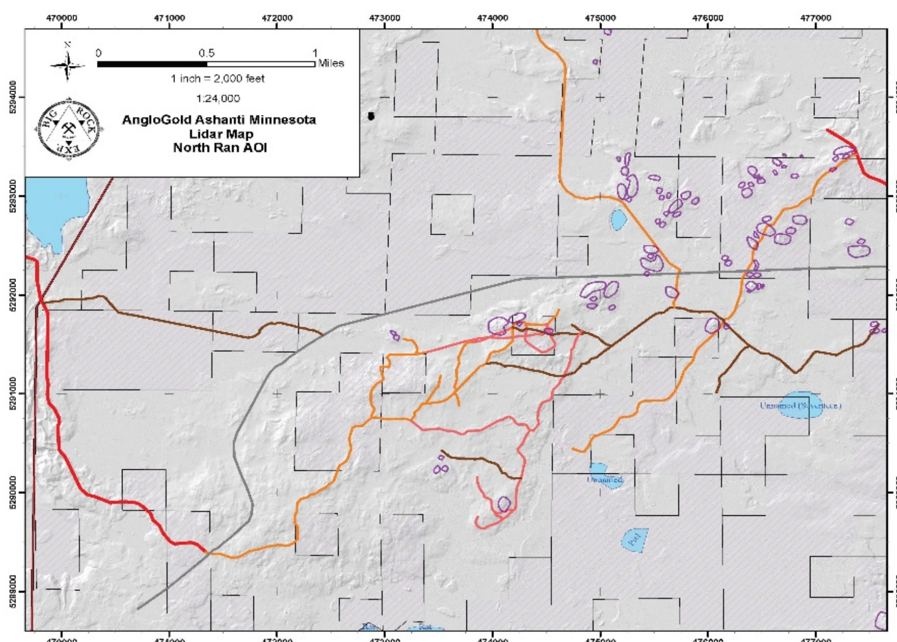


Figure 4: Roads, leases, and outcrop footprints (purple) overlain on lidar. These maps were covered in mylar and used as base maps in the field. BRE geologists were able to navigate to known outcrop exposures as well as discover new outcrop in areas of lidar-highs. Roads and lidar elevation data accessed through MN DNR.

4.4.3 Photos

Photos were taken at most field stations to document the appearance of outcrops and samples, using a notebook, rock hammer, pencil, compass, or person for scale. Photos of samples in a labelled bag were also taken at most field stations. Each photo has been renamed to indicate the field station it portrays. Photos can be found on Dropbox where they are organized by field station and hyperlinked to their corresponding field station data point in the ESRI Map Package (*.mpk*).

4.4.4 Samples

In total, 123 bedrock samples were collected – 20 samples were gathered from the Magni area, and 103 samples from Ran (Appendix 3). Approximately 1-2 kg of rock was collected in a plastic bag for each sample, except for a few samples where very little material was able to be collected. All sample locations were recorded in field notebooks and in an Excel spreadsheet, and are included in the geodatabase as data points. Samples were assigned a unique identifier from an ALS sample numbering booklet, ranging from Y554001 – Y554129. This range includes a QAQC sample assigned to every sample identifier ending in a multiple of 20. Two each of the standards G314-4 and G908-1, and the blank CDN-10 were included in the shipment. Samples were cut and divided with a representative portion kept in a sample archive library in Hibbing. These portions are large enough to create billets for thin sections if needed. The rest of each sample was double-bagged and prepared to be shipped to ALS for geochemical analysis.

5 Discussion of Field Observations

The regional bedrock geology of the Deer Lake area consists of 2.7 Ga Neoarchean metavolcanic and volcaniclastic rocks intruded by 2.6 Ga metagabbroic stocks and sills, all cross-cut by 2.0 Ga Paleoproterozoic northwest-trending diabasic to gabbroic dikes and sills (*Jirsa & Chandler, 2007* and *Southwick et.al., 1998*). All bedrock is metamorphosed to greenschist facies and grade northward to amphibolite facies approaching the Wawa-Quetico subprovince boundary. The region is overlain by up to 290 feet of glacial till of the Rainy and Koochiching lobes (*Johnson et.al., 2016* and *Hobbs & Goebel, 1982*) making bedrock outcrop exposure sporadic and sparse. Though rocks throughout the Deer Lake region are of similar age and have experienced similar structural deformation and mineral alteration, the two AOI's Magni and Ran are discussed below as separate terranes due to their lithology differences (*fig. 5*).

5.1 Regional Overview

Four main geologic sequences occur in the Deer Lake region (*fig. 5*). The Thistledew Lake and Wilson Lake sequences occur south of Deer Lake, the Joy Lake sequence runs through Deer Lake, and the Silverdale sequence occurs north of Deer Lake (*Southwick et.al., 1998*). The Ran lease package overlaps the Joy Lake, Thistledew Lake, and Wilson Lake sequences while the Magni lease package sits almost completely within the Silverdale Sequence. The Wilson Lake, Thistledew Lake and Silverdale sequences are comprised of ENE-trending Archean massive to pillowed to autobrecciated basalt flows (*Southwick*

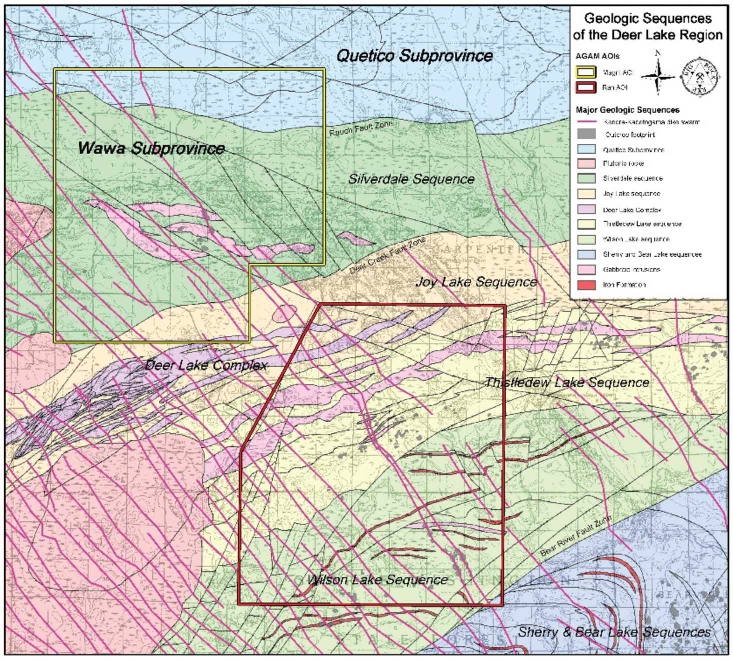


Figure 5: Regional overview map of AGAM AOIs overlain on simplified MGS bedrock geology showing extents of major rock sequences in the Deer Lake region. Modified from MGS digital geology data.

et.al., 1998). All three sequences are cross-cut by early Archean E-W trending hypabyssal gabbroic sills and dikes which are chemically comparable to the basalts. The Wilson Lake sequence lava flows are interbedded with lenses of iron-formation. The Thistledew Lake and Silverdale sequences are not in contact; they are separated by the Joy Lake sequence which trends NE through Deer Lake itself. Joy Lake sequence rocks are in faulted contact with the Silverdale sequence to the north and conformable contact with the Thistledew Lake sequence to the south. The Joy Lake sequence is comprised of Archean dacitic to rhyolitic volcanic and volcaniclastic rocks and is host to the Archean Deer Lake Complex – a package of mafic to ultramafic dikes and sills which are chemically identical to rocks of the Joy Lake Sequence (*Severson & Jirsa, 2005* and *Berkley et.al., 1978*).

These four volcanic sequences and their associated intrusions are all cross-cut by diabasic and gabbroic dikes of the Paleoproterozoic Kenora-Kabetogama dike swarm (*Jirsa & Chandler, 2007* and *Southwick et.al., 1998*). While there are no granitic plutons or batholiths within AGAM's AOIs, there are various nearby plutons which may be related to the felsic intrusive rocks encountered by Big Rock – namely, the Coon Lake syenite pluton SW of Deer Lake.

Of all the rocks in the region, mafic to ultramafic dikes and sills tolerate weathering and erosion best and comprise most outcropping rocks – especially in the Magni AOI. Very little exposure exists of the volcanic and volcaniclastic rocks of the Joy Lake and Silverdale sequences. Basalts of the Thistledew Lake sequence also prominently outcrop south of Deer Lake in the Ran AOI.

5.1.1 Lithology

Note that rock units described here correspond to field observations made by Big Rock during the August 2018 field program. Map unit labels on lithologic maps in the appendix correspond to those defined on Minnesota Geological Survey (MGS) map M-176 (*Jirsa & Chandler, 2007*).

The following is a list of rock types the Big Rock team encountered throughout the field area and a brief discussion of their significance for exploration. Please see Appendix 1 for full rock descriptions.

Mafic Volcanic and Volcaniclastic Rocks

- *Massive basalt*: basaltic lava flows with no discernible internal structures. Massive basalt flows tend to form proximal to long-lived eruptive volcanic vents and fissures. They generally transition to pillowed flows away from eruptive centers.
- *Pillowed basalt*: small to large (10-150 cm diameter) basalt pillows with glassy selvedges and inter-pillow hyaloclastite (*fig. 6*). Pillowed basalt locally displays autobrecciation (flow-top breccia), amygdaloidal rims and pipe amygdules, intra-pillow cavities, vesicles, glass selvedges, radial cooling joints, and inter-pillow hyaloclastite. Inter-pillow hyaloclastite and intra-pillow cavities are often replaced by quartz. Pillowed basalt is easily recognizable due to the pillows' characteristic pinching oval shape. Generally, basalt pillows develop thinner glass selvedges and become smaller in diameter with distance from the eruptive center (*Hudak et.al., 2002*). This is caused by increasing crystallinity of the lava away from the vent which inhibits the formation of glass and enhances the viscosity of the flow.

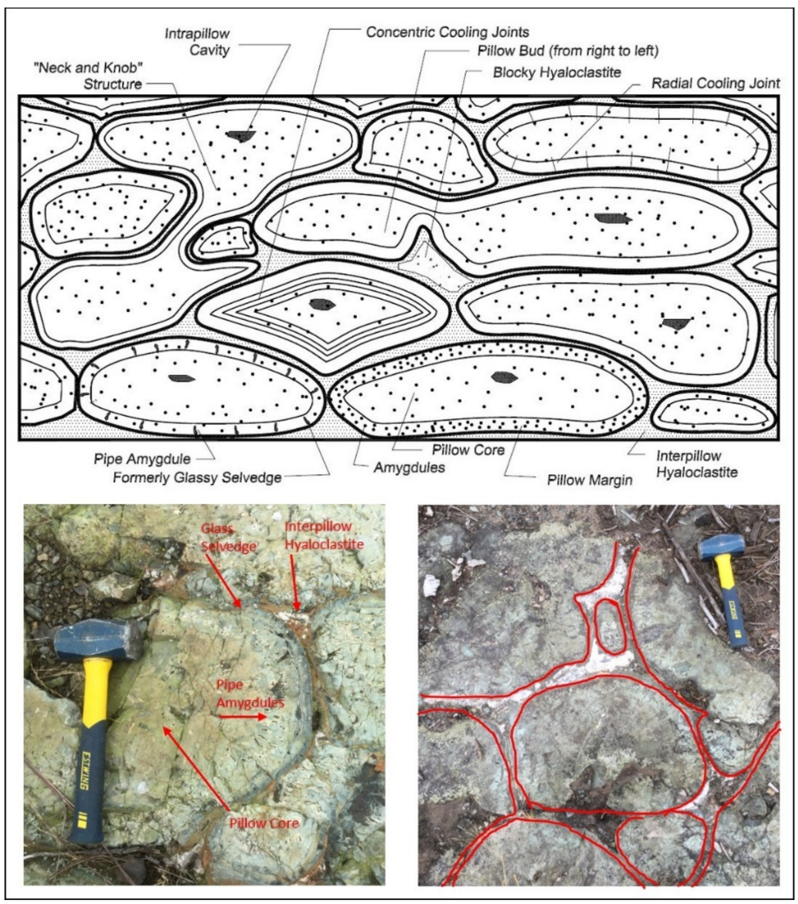


Figure 6: Top - pillowed basalt flow internal features diagram from Hudak et.al., 2002. The pinching bottom and rounded top of each pillow indicates stratigraphic topping. Pillowed basalt is common throughout the Deer Lake Region. Bottom – pillowed basalt at station 18DL-LR020 with strong epidotization and silicification. The left image is annotated to show internal pillow features. The right image is annotated to highlight pillow shapes and forms. Notice the quartz-replacement of inter-pillow hyaloclastite.

Peperite: a breccia-like formation that occurs stratigraphically above pillowed basalt flows as a chaotic jumble of small (2-20 cm), rounded basalt lobes in a sandy matrix with local iron formation clasts and quartz replacement between lobes (*fig. 7*). It is developed when basaltic lava is emplaced into wet, unconsolidated sediment causing in-situ fragmentation of the fast-cooling lava. In their assessment of the western Vermilion district, Hudak et.al. point out that "Peperites are important in terms of massive sulfide exploration because: a) they develop where rising magma comes in contact with wet sediment, and therefore define vent-proximal environments that are generally considered favorable hosts for massive sulfide mineralization; and b) they distinguish synvolcanic intrusions that may be associated with ore genesis from post-volcanic intrusions that are genetically unrelated to ore forming processes."

Figure 7: Chaotic peperite outcrop in north Ran at station 18DL-LR020. Notice the small sub-rounded lobes of basalt in a sandy matrix.

- *Lapilli tuff*: layers of lapilli (1-5 mm ash spheres), basalt clasts, and scoria (frothy-textured basalt) in an ashy tuff matrix – occurring stratigraphically above massive and pillowed basalt flows. Basalt lava bombs up to 20 cm occur locally. Like peperite, the presence of lapilli tuff indicates the location of the seafloor and proximity to an active volcanic vent (*Hudak et.al., 2002*). It is an ashy layer that forms atop a previously-formed lava flow, collecting fragments and bombs of material falling through the water column. Though not outcropping in the field area, exhalite layers of volcanogenic massive sulfide deposits form at the contact between pillowed flows and overlying lapilli tuffs. Exhalite layers tend to develop locally and are evidence of contemporaneous volcanic and hydrothermal venting.

Chemical Sedimentary Rocks

- *Iron formation*: irregular layers of cherty magnetite- and hematite-rich iron formation. This unit occurs in outcrop mapped by MGS (*Jirsa & Chandler, 2007*) within the Deer Lake AOIs, but not on AGAM leases. During the field program, iron formation was observed as clasts in basalt, breccia, and tuff units and as an interbedded lens between pillowed flows.

Mafic Intrusive Rocks

- *Archaean gabbro*: gabbroic hypabyssal sills and dikes of variable texture and mineralogy ranging from ophitic pyroxene gabbro to hornblende gabbro to gabbroic anorthosite. These bodies occur as multiple lenses within and striking parallel to volcanic packages. They withstand weathering well (*fig. 8*) and comprise a large portion of outcrops in the Deer Lake region.

- *Gabbro/diabase dikes*: dikes of the Paleoproterozoic Kenora-Kabetogama dike swarm. These dikes are composed of medium to coarse-grained gabbro with finer-grained (diabasic) chilled margins. They range from 3 m to 50 m wide, are variably magnetic, and trend NW – cross-cutting regional stratigraphy. Local narrow (5 to 50 cm wide) plagioclase-phyric diabase dikes were also observed. These dikes resist weathering and leave prominent outcrops, but their extent and density throughout northern Minnesota is best demonstrated on geomagnetic anomaly maps (*Chandler et.al., 1997*).

Figure 8: Massive polished outcrop of Archean gabbro obscured by moss in the Magni AOI at station 18DL-AL028. This "whaleback" outcrop is glacially polished into a large hump shape. Gabbroic rocks resist weathering better than adjacent volcanic rocks in the Deer Lake region.

Felsic Intrusive Rocks

- *Syenite*: occurs in SW Ran (station 18DL-AL019) as the matrix in an igneous breccia with rounded to sub-rounded clasts of basalt, iron formation, and gabbro/diabase. It is intruded alongside a diabase dike – its width is approximately 3 m, but its extent is unknown as the dike was not traceable through other outcrops. This syenite is most likely related to the Neoarchean Coon Lake Pluton to the SW of Deer Lake (*Jirsa & Chandler, 2007*).

- *Diorite*: occurs in SE Ran as narrow intrusion with igneous breccia at edge, and as a narrow dike (1-3 cm) in an outcrop of Archaean gabbro in East Magni (station 18DL-MH019). This diorite dike may also be genetically related to the Coon Lake Pluton or other Neoarchean plutons in the region.

5.1.2 Structure

Jirsa and Chandler (*2007*) and Southwick et.al. (*1998*) describe three main regional deformational events denoted as D_1, D_2 and D_3. The oldest event, D_1, caused the tectonic stacking, tilting, and folding of supracrustal rocks such that the major sequence and terrane boundaries are D_1 structures. The Deer Creek Fault Zone separating the northern Silverdale sequence from the southern Joy Lake Sequence, and the Rauch Fault Zone separating the northern Quetico metasedimentary subprovince from the southern Wawa metavolcanics subprovince are both examples of D_1 structures. The D_2 structures were generated by NW-SE transpression imparting foliation, lineation, and local folding and faulting – weakly exhibited in more competent rocks of the Wawa subprovince. The D_2 event was accompanied by regional metasomatism of all bedrock to greenschist-amphibolite facies – increasing with proximity to large plutons and northward toward the province boundary. The final regional event, D_3, generated widespread folding taken up mainly in the Quetico subprovince leaving only partitioned deformation in metavolcanics of the Wawa subprovince. Due to the rheologic contrast between Quetico metasediments and Wawa metavolcanics, the rocks in the Deer Lake region took up very little strain during D_2 and D_3. Local crenulations, folds, minor faults, and shearing are present, but major faults and folds are obscured by glacial scouring of weak rock and can only be inferred by topographic lows and geomagnetic data (*Jirsa & Chandler, 2007*).

Geological structures were measured to establish physical and temporal relationships between geologic units and events. The strike and stratigraphic topping of pillowed flows was determined by pinched bases and rounded tops. Bedding was measured where stratigraphic layers were clear. Strike and dip (or only trend, where no dip was discernible) of shear zones were recorded, with shear sense, C and S fabrics designated when possible. Numerous faults and fractures were measured throughout the area, most of which had cm-scale offset. Strike and dip (or only trend, where no dip was discernible) of dikes and veins were recorded. Igneous layering (parallel layers of compositional variation in gabbro) was observed at one outcrop of Archean gabbro (station 18DL-LR014) in the Magni AOI.

5.1.3 Alteration

Greenschist to amphibolite facies alteration was documented throughout the entire area. Secondary biotite and saussurite (aggregate of very fine chlorite, sericite, and epidote) were commonly observed to varying degrees in all rock types, consistent with greenschist-amphibolite facies metamorphism and metasomatism of mafic volcanic and intrusive rocks. Local secondary carbonate, hornfels (baked) texture, and bleaching (reducing fluids) were also observed. Hydrothermal alteration associated with active hydrothermal venting was observed locally as epidotization and/or silicification. Alteration was described in terms of minerals present and intensity (weak – moderate – strong – intense). Recorded veins included sulfide veins, quartz veins and carbonate veins. Where possible, veins were described based on their mineralogy, thickness, and general orientation.

5.1.4 Mineralization

Observed mineralization consisted of iron sulfide minerals – primarily pyrite and chalcopyrite. In some cases, the presence of sulfide minerals was noted but the crystals were too small (<2 mm) or altered to be identified further. Pyrrhotite was also identified at 2 field stations. The texture of sulfide mineral occurrence was noted as either disseminated, patchy, stringers, clumps, clots, localized, as weathering stains, or near a structural feature (vein, shear zone, fracture). Presence of sulfide minerals was described qualitatively on a scale from trace – weak – moderate, and semi-quantitatively by estimating what percentage of the rock consisted of sulfide minerals.

5.1.5 Glacial Geomorphology

Thin sets of parallel scrapes called glacial striations, and wider deep gouges called glacial grooves are made by movement of glaciers over rocks, scraping their surface with debris. These features were recorded by the Big Rock team and vary in orientation between 210° and 230° from north with local outliers around 110° from north. These features were likely generated by the Quaternary Rainy and Koochiching glacial lobes (*Hobbs & Goebel, 1982* and *Johnson, 2016*).

5.2 Magni Lease Package

Outcrop exposure in the Magni AOI is poor relative to the Ran AOI (*plt. 3*). The vast majority of the AOI is made up of massive basalt flows with local lenses of Archaean metagabbro, but the intrusive rocks form outcrops while the volcanic rocks do not. Almost all outcrops mapped in Magni are related to Archean gabbroic intrusions. A previously-undifferentiated (on MGS maps) hornblende andesite was also observed. Big Rock discovered previously unmapped outcrop in swampland by using lidar elevation maps.

5.2.1 Lithology

Rock types found in the Magni AOI include Archaean gabbro, massive basalt and andesite of the Silverdale sequence, and gabbro and diabase dikes of the Paleoproterozoic Kenora-Kabetogama dike swarm (*plt. 3*). Two smaller dikes were also observed, both trending roughly NNW-SSE: a 30 cm-wide plagioclase-phyric diabase dike at station 18DL-LR010 and an 8 cm-wide felsic dike at station 18DL-MH019 (*fig. 9a*). Archean gabbroic rocks range in composition from gabbroic anorthosite to gabbro and vary in texture and grain size (*fig. 9c*). Local igneous layering was found in a cluster of outcrops in East Magni suggesting these intrusive bodies underwent textural and chemical differentiation (*fig. 9e*).

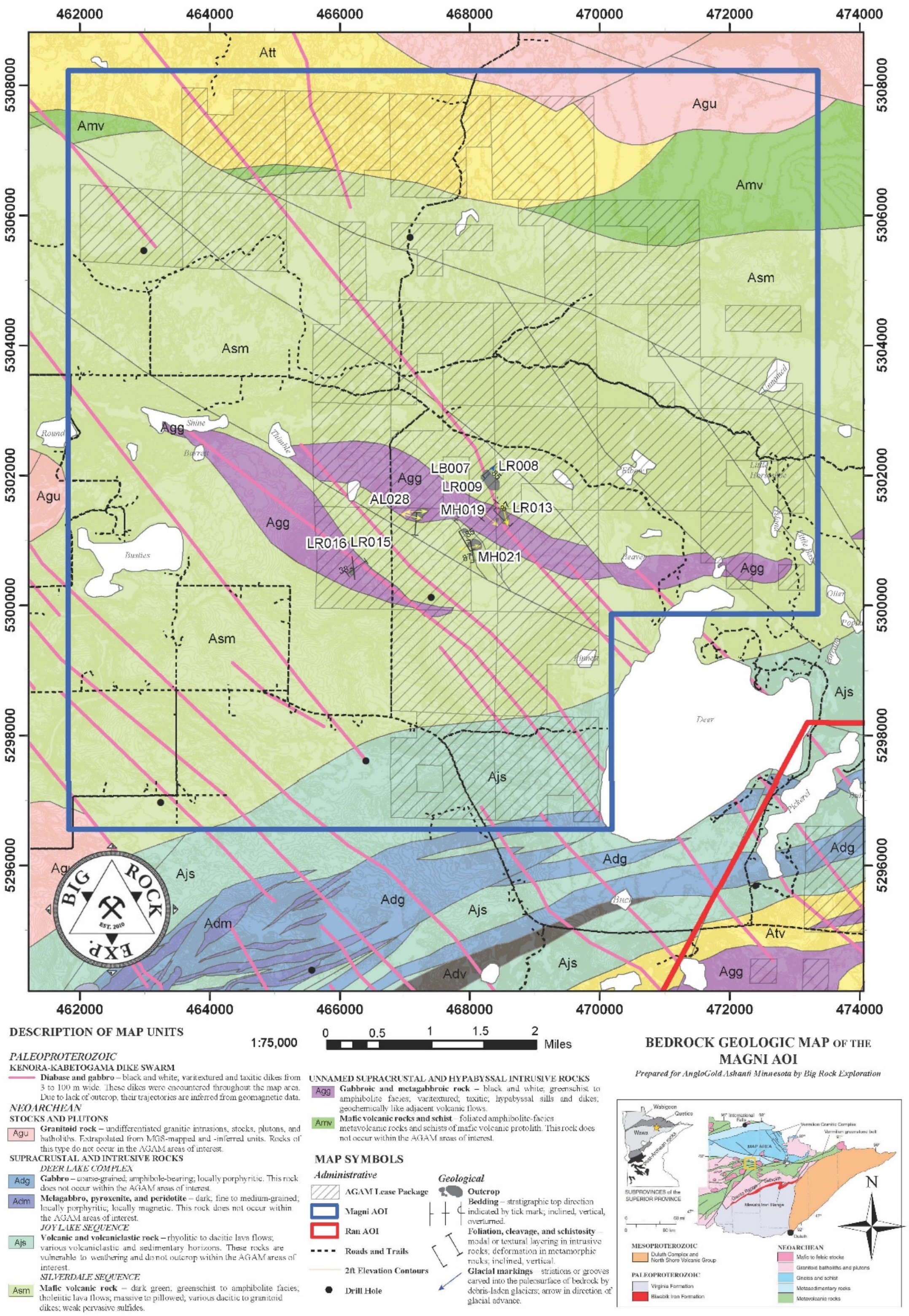


Plate 3: Bedrock geologic map of the Magni AOI. Prepared for AGAM by BRE using 2018 field data, MGS geology data, MN DNR road and topography data, and AGAM lease and AOI footprints.

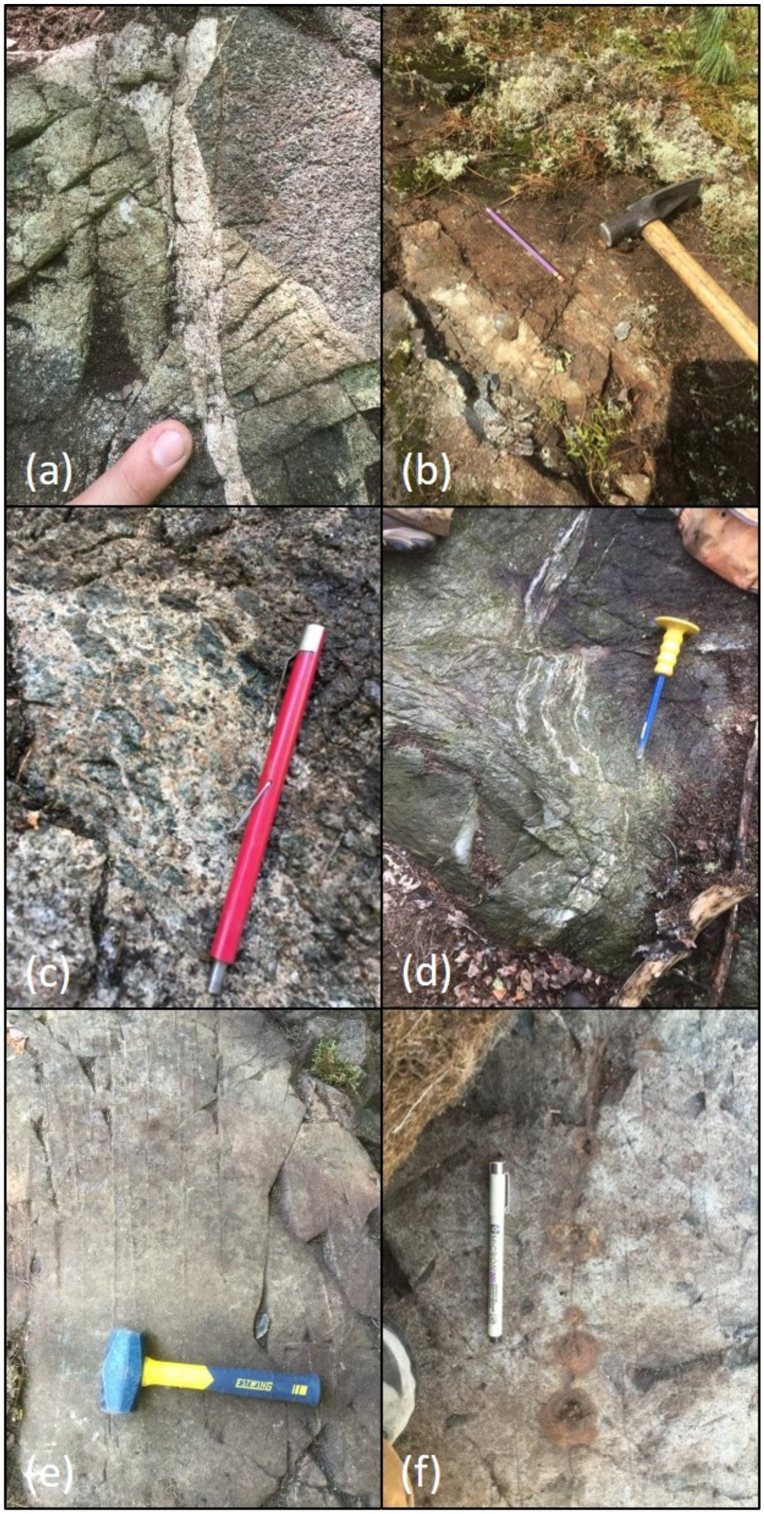


Figure 9: Rocks observed in Magni. (a) diorite dike at station 18DL-MH019. (b) shear zone at station 18DL-LR008. (c) varitextured gabbro observed at station 18DL-LR012. (d) greenschist-facies metagabbro with minor folding, faulting, and shearing at station 18DL-AL028. (e) igneous layering observed at station 18DL-LR014. (f) string of pyrite nodules in gabbro at station 18DL-LB-26.

5.2.2 Structure

Shearing was observed in both basalt and Archaean gabbro, trending generally NNW-SSE. Fractures were measured trending SW-NE through outcrops of Archaean gabbro at stations 18DL-LR008 and 18DL-LR015 (*fig. 9b*).

5.2.3 Alteration & Veining

Weak to moderate chloritization was observed at the western-most outcrops in Magni. Epidotization was strongest in the central area of outcrop exposure, and weak-moderate in the eastern area. Silicification is present throughout Magni. Strongest in the southeastern area of outcrop exposure, silicification weakens to the north and west.

There are 2 main sets of vein orientations: approximately W-E and approximately parallel to gabbro dike (NNW-SSE). A 10-45 cm wide, 5 m long quartz vein was observed cutting through a gabbro outcrop at station 18DL-LR013, oriented 345°/45°E. Although the vein was sugary and milky white in the interior, some parts of the vein selvedge were chloritized, and a chlorite alteration halo extended ~5 cm into the host gabbro. Evidence of sulfide mineral weathering was also found at the contact between the vein and gabbro, as red-brown stains along fracture planes in the vein and gabbro. Pink potassium feldspar crystals also lined the vein selvedge, about 1 cm wide. This vein pinched and swelled and ended at a contact with a different gabbro unit; either truncated by the second gabbro unit or fading away at that location.

5.2.4 Mineralization

The average sulfide mineral percentage in Magni rocks ranged from 0 to 1%. Very fine-grained pyrite and local chalcopyrite is disseminated in the Archean gabbroic rocks. Sulfide nodules of pyrite and minor chalcopyrite locally occur in fractures in Archean gabbro (*fig. 9f*).

5.2.5 Glacial Geomorphology

Glacial grooves trending 215° at station 18DL-LR008 were measured in the direction of ice movement. This measurement suggests that the Rainy lobe of the Laurentide ice sheet coming from the NE, impacted this area during the Wisconsinan glaciation (*Hobbs & Goebel, 1982* and *Johnson, 2016)*.

5.3 Ran Lease Package

Though outcrop exposure is still less than 1% of the land surface, outcrops are much more abundant in the Ran AOI than in the Magni AOI with more exposed structure and lithologic variation. The Ran AOI overlies bedrock of the Joy Lake, Thistledew Lake, and Wilson Lake sequences (*plt. 4*). Joy Lake sequence rocks are not exposed within the AOI, but many outcrops of the Thistledew Lake and Wilson Lake sequences occur. Bedrock lithologies comprise Archean mafic volcanic units intruded by Archean gabbroic units (Thistledew Lake and Wilson Lake sequences) with local lenses of iron formation (Wilson Lake sequence only). Sedimentary, volcaniclastic, and felsic lava flow units of both sequences are strongly weathered and do not outcrop in the region. Ran also contains NW-SE trending 3-100 m wide gabbro and diabase dikes of the paleoproterozoic Kenora-Kabetogama dike swarm – these rocks withstand weathering and cause less competent adjacent volcanic and volcaniclastic rocks to resist erosion as well. Most volcanic and volcaniclastic rock outcrops mapped in Ran occur very close or adjacent to gabbroic rocks. The bedrock is generally undeformed but low-grade greenstone to amphibolite facies alteration is pervasive throughout Ran. Local shearing imparts a fissile texture to some rocks – a chlorite-actinolite altered shear zone was mapped south of Wilson Lake.

Local VMS-style hydrothermal alteration (*i.e.* pervasive epidotization and silicification) occurs in the southern part of Ran in pillowed basalt flows of the Wilson Lake sequence. Pillowed basalt outcrops in this region display strong pervasive pistachio-green epidote alteration and moderate to strong silicification. This type of alteration is generated by active hydrothermal venting (*Gibson et.al., 2007* and *Shanks III, 2012*).

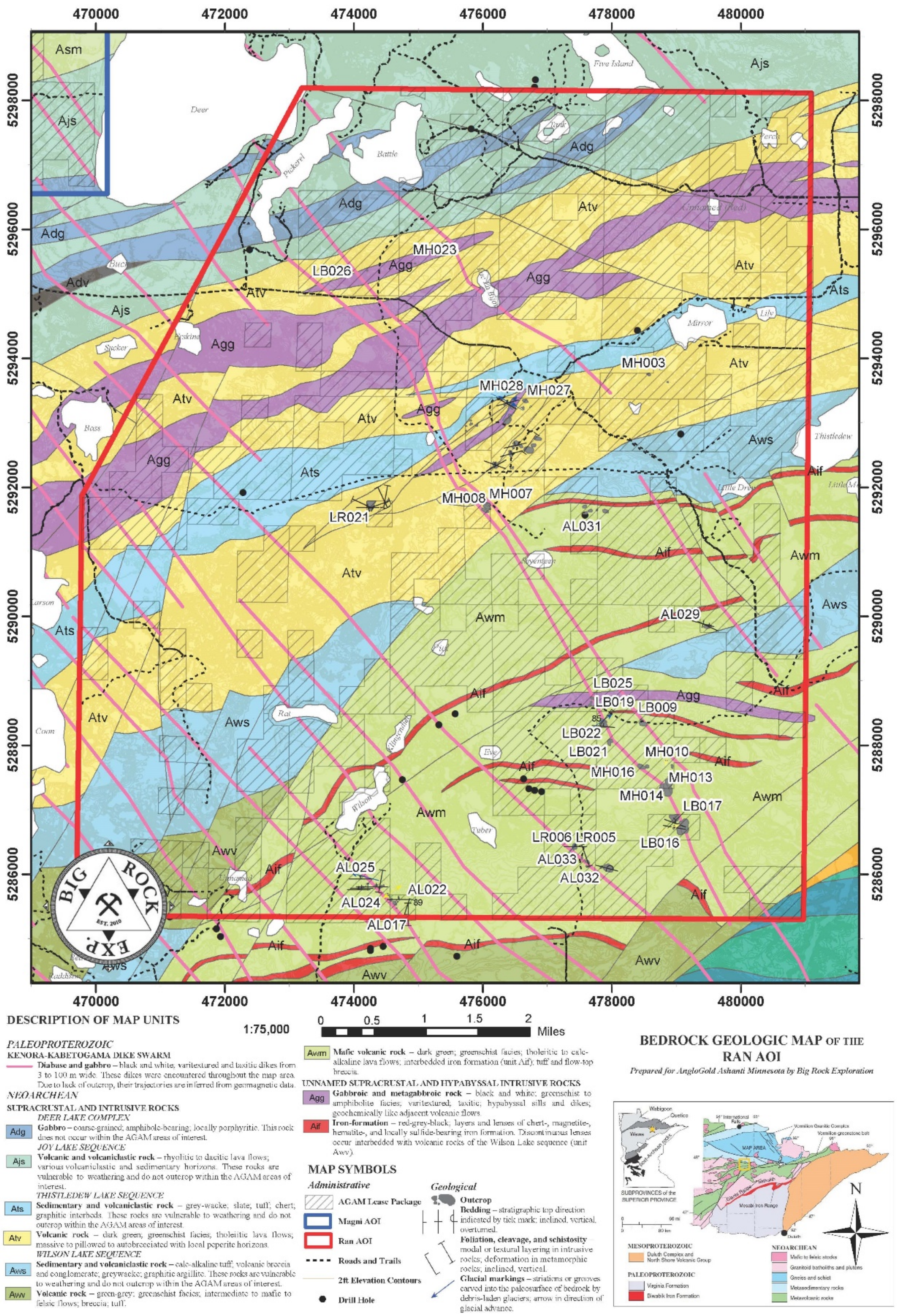


Plate 4: Bedrock geologic map of the Ran AOI. Prepared for AGAM by BRE using 2018 field data, MGS geology data, MN DNR road and topography data, and AGAM lease and AOI footprints.

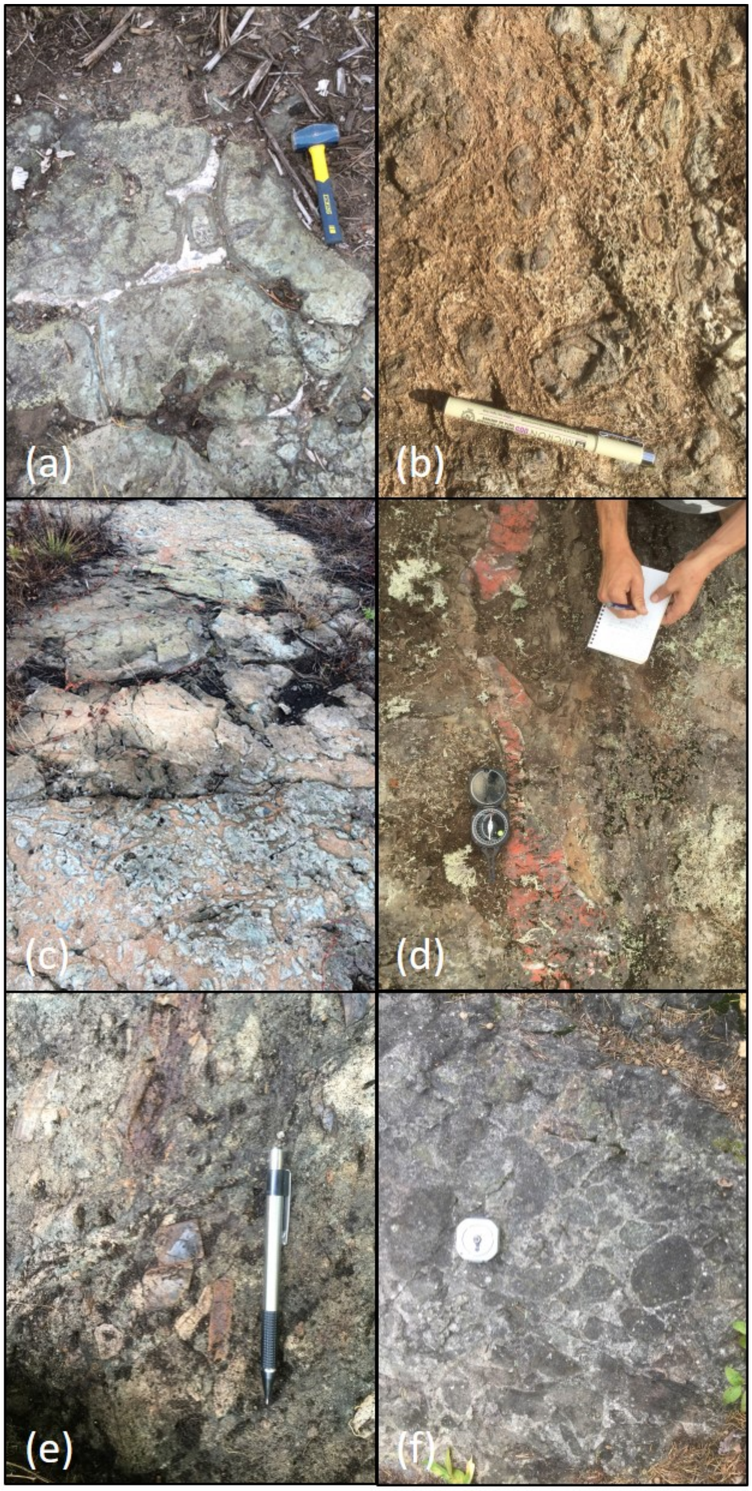


Figure 10: Rocks observed in Ran. (a) pillowed basalt flows at station 18DL-LR020. (b) lapilli tuff flow-top breccia at station 18DL-LB029. (c) peperite (top and bottom) and pillowed basalt dike (center) at station 18DL-LR020. (d) iron-formation lens within pillowed basalt at station 18DL-MH009. (e) diorite breccia with basalt, gabbro, and iron-formation clasts at station 18DL-LR022. (f) syenite breccia with basalt, gabbro, and iron-formation clasts at station 18DL-AL019.

Iron formation lenses and lapilli tuff flow-tops of the Wilson Lake sequence signify the paleo-seafloor at the time of their formation while basalt flows are indicative of active volcanic venting (*Hudak et.al., 2002*). Active proximal volcanic and hydrothermal venting on the seafloor supports the potential for VMS-style mineralization within the Wilson Lake sequence rocks (*Gibson et.al., 2007*).

Basalt flows of the Thistledew Lake sequence occur stratigraphically above those of the Wilson Lake sequence. They do not contain any iron formation, and lapilli tuff horizons are less common. Aside from pillowed flows, the most dominant lava formation in the Thistledew Lake sequence is peperite – formed when basalt is extruded into wet, unconsolidated seafloor sediments (*Hudak et.al., 2002*). Like iron formation and lapilli tuffs, peperites also signify the paleo-seafloor. However, VMS-style hydrothermal alteration was not identified in rocks of the Thistledew Lake sequence.

Local felsic dikes were mapped throughout the Ran AOI (stations 18DL-AL019, 18DL-LB009, and 18DL-LR024). They may be related to the large Coon Lake pluton SW of Deer

Lake and could be promising for gold remobilization near specific outcrops. Nonetheless, quartz-carbonate veining is not prominent in this region.

5.3.1 Lithology

Rock types found in the Ran AOI include massive to pillowed to autobrecciated mafic flows, mafic peperite, lapilli tuff horizons, gabbroic intrusions, felsic dikes, iron formation lenses, and gabbro and diabase dikes of the paleoproterozoic Kenora-Kabetogama dike swarm. Lava flows are dark green, steep- to vertically-dipping, north-topping, aphyric to plagioclase-phyric, basalt to andesite composition with massive, pillowed and autobrecciated structures. Pillowed flows throughout the region contain diverse internal structures such as amygdules and pipe amygdules, vesicles, and scoria which all indicate eruption into shallow water (*fig. 10a, Hudak et.al., 2002*). Iron formation lenses were found interbedded with lava flows of the Wilson Lake sequence (*fig. 10d*) and were also observed as angular clasts within flows of the Thistledew Lake and Wilson Lake sequences. Felsic lava flows, sedimentary units and volcaniclastic units of the Joy Lake, Thistledew Lake and Wilson Lake sequences are not exposed in the Ran AOI.

The central area of Ran is host to a swath of peperite deposits within the Thistledew Lake mafic volcanic flows. Though timber logging has exposed quite a lot of bedrock, there is not much AGAM lease coverage in this area so the extent of this peperite unit could not be well-documented. Nonetheless, peperites were mapped at stations 18DL-LR020 and 18DL-LR021. Peperite units were documented as monomict breccias of basalt clasts in a light brown, medium- to fine-grained sandy, silty matrix (*fig. 9c*). The green-grey basalt fragments are ameboid in shape, range in size from 1 to 50 cm in diameter and contain up to 5% round to oval quartz amygdules up to 20 mm in diameter. Peperite in this area was interpreted as interbedded units within massive and pillowed basalt flows, but we now question whether they are peperite dikes intruded along syn-volcanic structures. This is an important distinction to confirm as peperites are important tools for massive sulfide exploration (*Hudak et.al., 2002*). They indicate a volcanic vent-proximal environment where rising magma encounters wet, unconsolidated sediments on the sea floor and they usually signify synvolcanic intrusions along synvolcanic structures.

A previously unmapped ~100 m wide potentially NE-striking grey-black diorite intrusion was observed in central Ran within basalt and iron formation of the Wilson Lake sequence at stations 18DL-LR022 – 18DL-LR024. An igneous breccia developed at its eastern margin with 5-10 cm angular clasts of iron formation and 10-20 cm rounded clasts of basalt and gabbro (*fig. 10e*). A similar igneous breccia was mapped in the southwest area of Ran cross-cutting a gabbroic dike (station 18DL-AL019). The intrusion strikes NE and is a breccia of 5-10 cm angular iron formation clasts and 10-20 cm rounded basalt and gabbro clasts suspended in a weakly magnetic medium-grained pinkish syenite matrix (*fig. 10f*) – the syenite is likely related to the Coon Lake pluton SW of Deer Lake (*Jirsa & Chandler, 2007*). Though these two felsic dikes share the same strike, texture, and clast varieties and may be the same unit, the composition of their matrixes distinguishes them. Quartz-carbonate veining was not observed in the region, but these felsic dikes might warrant more investigation.

5.3.2 Structure

Stratigraphic topping of basalts of the Thistledew Lake and Wilson Lake sequences is consistently between 355° and 5° north; exhibited by the orientation of volcanic flow top features. Some pillowed basalt outcrops in the southeast area of Ran were found to be overturned and topping to the S (station 18DL-AL032) – likely due to their proximity to the Bear River Fault Zone to the south (*plt. 4*).

Local faults and fractures in the Ran AOI were measured in basalt and gabbro, trending NE with small (<10 cm) offsets. Narrow shear zones up to 3 m wide anastomose through the bedrock. Local shearing has a right-lateral sense and trends roughly N-S in southern Ran and varies from NW-SE to NE-SW in north-central Ran. This region could be important for identifying potential intersecting shear structures or dilatant zones, but further structural mapping on surface and at depth is needed.

Due to poor outcrop coverage, structural aspects of the region are difficult to examine via field mapping. On MGS map *M-176: Bedrock geology of the Bigfork quadrangle*, published by MGS (2007), Jirsa and Chandler note that geomagnetic anomaly data was crucial in constructing the structural history of the region. They inferred faults from linear magnetic lows coincident with offset geologic units. The generational history and geometry of major structures was also constructed in this way. The structural aspects of map *M-176* were relied on heavily by the Big Rock mapping team.

5.3.3 Alteration & Veining

Greenschist-facies alteration was observed in most of the Ran AOI imparting a dark green to green-grey hue on the rocks – amphibolite facies was not observed. In gabbroic rocks, pervasive moderate chlorite + actinolite are the main alteration products of mafic minerals. Plagioclase feldspar is commonly moderately saussuritized (fine-grained chlorite + sericite + epidote). Pillowed basalt throughout the region is moderately chlorite + actinolite altered with moderate saussurite alteration of local plagioclase phenocrysts in plagioclase-phyric basalts. Chlorite alteration increases in intensity where these rocks have been deformed or experienced shearing.

VMS-style hydrothermal alteration (i.e. pervasive epidotization and silicification) occurs in the southern part of Ran in pillowed basalt flows of the Wilson Lake sequence (station 18DL-AL025). Local pillowed basalt outcrops in this region display strong pervasive pistachio-green epidote alteration and moderate to strong silicification – the intensity of this alteration is variable across the outcrop with the strongest preferentially confined to more porous pillows (*fig. 11*). Intra-pillow hyaloclastite and inter-pillow vesicles

Figure 11: Strongly epidotized and silicified pillowed basalt at station 18DL-LR020 in southwest Ran. In a VMS environment, sulfide deposits typically form stratigraphically above epidote and silica alteration zones.

are strongly silicified with almost complete quartz replacement. This type of alteration is generated by active hydrothermal venting through fluid-flow, boiling, and element remobilization (*Shanks III, 2012*). In a VMS environment, sulfide deposits typically form stratigraphically above epidote and silica alteration zones. Moreover, 1-2 mm euhedral garnets were observed in lapilli tuff directly W of the highly epidotized pillows at station 18DL-AL013. This may be evidence for a higher-grade VMS-style alteration zone (*Gibson et.al., 2007*).

Small-scale quartz and calcite veins were observed throughout the Ran AOI. Veining may: a) exhibit a stockwork pattern of thin veins lacking consistent orientation, or b) occur as one vein up to 3 cm wide with a consistent trend. Thin (≤3 cm) quartz veins and thinner (≤2 cm) carbonate veins were found near outcrops that were carbonate-altered. In northern Ran, carbonate-filled vugs were found with ≤2 mm pyrite cubes (station 18DL-LB020).

Narrow shear zones (≤3 m wide) exist in Ran with strong chlorite alteration and weak to moderate rusty carbonate alteration (stations 18DL-AL014 and 18DL-AL015). These shear zones horsetail and anastomose throughout the region, but generally trend N-S.

5.3.4 Mineralization

Modal abundance of sulfide minerals (pyrite and chalcopyrite) in the Ran AOI was highest in the Archaean gabbro outcrops in the northwestern area (4% at station 18DL-LB026, 2% at station 18DL-LB027), and in basalt outcrops in the southwestern area (stations 18DL-AL013, 18DL-AL014, 18DL-AL018, and 18DL-AL024). Sulfide minerals were located predominantly along fractures in gabbro and near shearing and quartz veins in basalt.

5.3.5 Glacial Geomorphology

Glacial striations and grooves indicate ice flow from the NE (Rainy lobe) throughout the AOI and from the NW (Koochiching lobe) in the northern and southeastern areas of the AOI.

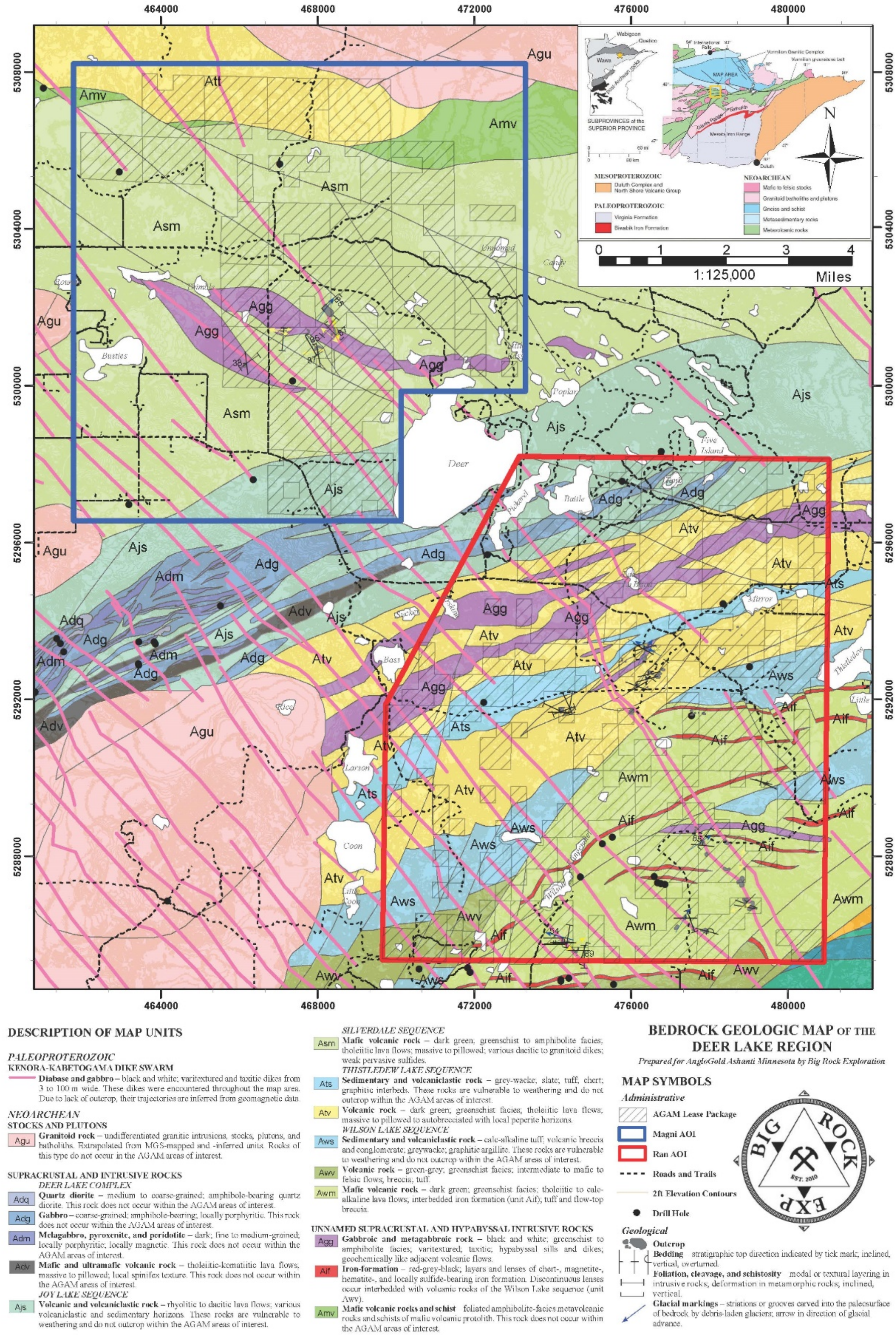


Plate 5: Bedrock geologic map of the Deer Lake region showing AGAM's Magni AOI footprint in blue and Ran AOI footprint in red. Prepared for AGAM by BRE using 2018 field data, MGS geology data, MN DNR road and topography data, and AGAM lease and AOI footprints.

6 Recommendations

6.1 Geochemistry

Geochemical analysis using IoGas, Leapfrog, and ArcMap would improve evaluation of lithologic units, alteration styles, and mineralization indicators and pathfinders. Integrating Big Rock field observations with historic mapping, drilling, sampling, and interpretation would provide a deeper understanding of the area and more confident future targeting. Relevant drill logs, core, and geochemical analyses available from the DNR and maps from MGS provide a wealth of historic data. The *USGS Exploration-Resource Assessment Guide* for VMS deposits (*Slack, 2012*) is a good resource for various geochemical plots – Big Rock recommends using this guide as a baseline for initial geochemical analysis.

6.2 Petrography

Petrographic analysis of certain lithologies encountered during this field program can help construct paragenesis, mineralization timing, and deformational events. Big Rock recommends focusing on samples within or near alteration and structure zones. Thin sections should be made for all altered or structurally deformed rocks as well as seafloor horizons like peperites and lapilli tuff flow-top units. Big Rock is capable of transmitted and reflected light petrography at our headquarters. Big Rock recommends petrography as the first step in selecting samples for more advanced analytical techniques.

6.3 Diamond Drilling

If AGAM is considering a diamond drilling and core recovery program on their leases in the Deer Lake region, Big Rock recommends targeting the south-central area of the Ran AOI. This area contains the most promising visible features for VMS deposit potential including VMS-style alteration, shearing, and lapilli tuff horizons. Using these criteria along with geomagnetic anomaly data could help direct drilling toward seafloor horizons adjacent to hydrothermal venting and active volcanism. Drill holes can likely be short (a few hundred feet) and oriented across stratigraphy toward the south.

6.4 Magni

6.2.1 Rainy lobe moraine

Much of the Magni AOI lacks bedrock exposure at the surface and is covered by glacial deposits from the Late-Wisconsinan Rainy lobe of the Laurentide ice sheet (*Hobbs & Goebel, 1982* and *Johnson et.al., 2016*). A Rainy lobe end moraine (unit ***rve*** on MGS map *S-1*) occurs in the northern and eastern parts of the Magni leases and may be a useful reference for future sonic drilling in the area.

6.5 Ran

6.3.1 Sulfidic shear zone

The southwestern area of Ran hosts a shear zone trending roughly N-S through pillowed basalt flows and gabbroic dikes (*fig. 12*). The shear zone coincides with a zone of carbonate alteration, a felsic intrusion, and evidence of local metamorphism up to garnet grade. This combination of features is consistent with sulfur-bearing fluid transport through the shear zone (*Hudak et.al., 2002*). The presence of a felsic dike is encouraging because felsic dikes through mafic volcanic units in the nearby Virginia Horn area are strongly correlated to gold mineralization (*Jirsa & Morey, 2003*).

Further field mapping could help constrain the path of this shear zone and allow for more sample collection along its strike. Geomagnetic anomaly data may be useful in detecting dilatant zones within or near this shear zone – especially in the sub-surface – which can be useful vectors toward mineralization.

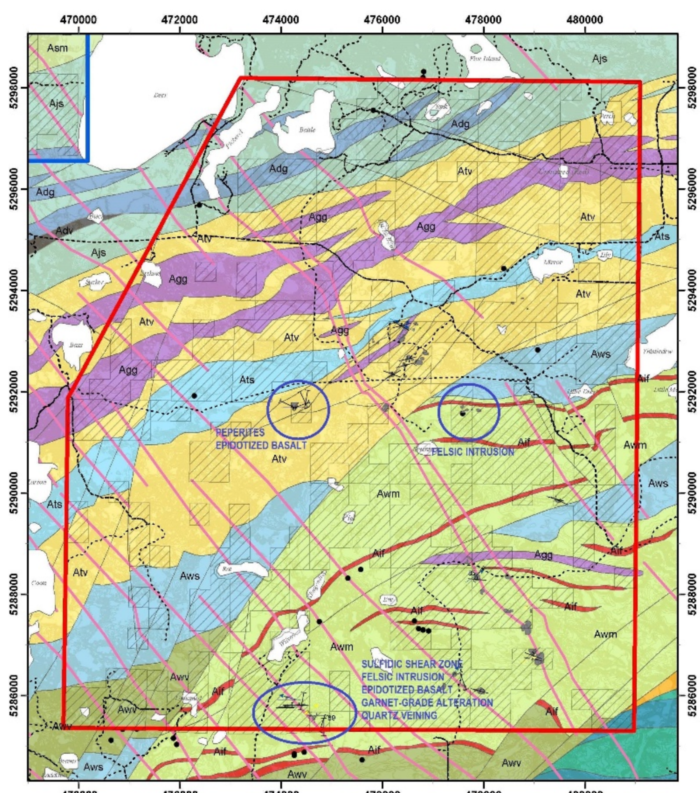


Figure 12: Bedrock geology of Ran AOI highlighting sites where follow-up work is recommended. Epidotized basalt and peperite was observed in west-central Ran, a felsic intrusion in east-central Ran, and many promising features were observed in southwest Ran.

6.3.2 Peperite

Mafic peperite deposits interbedded with pillowed flows in the central area of Ran indicate magma interaction with sediment on the seafloor (*fig. 12*). Peperite was only found within the Thistledew Lake sequence and likely continue along strike near the northern boundary of the sequence. The Big Rock team interpreted this area as interbedded peperites within massive and pillowed basalt flows, but they may instead be peperite dikes intruded along syn-volcanic structures. Further exploration of this area could elucidate where these syn-volcanic structures are located and determine their proximity to active volcanism and hydrothermal activity – the three pillars of VMS deposit genesis. The area of field stations 18DL-LR020 and 18DL-LR021 has been timber logged and

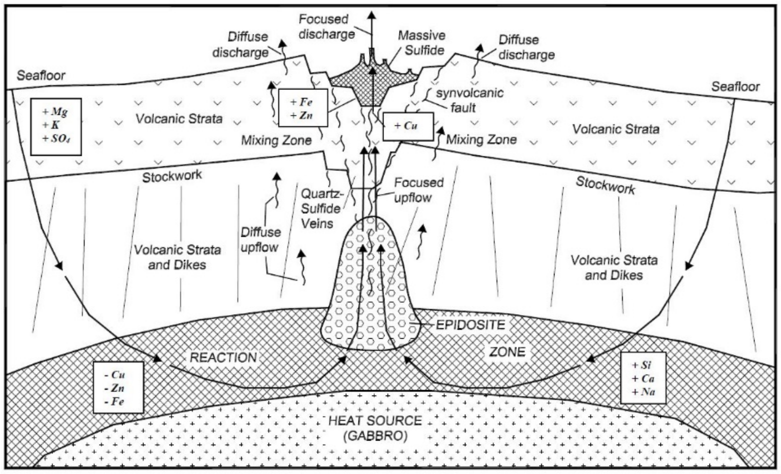


Figure 13: Schematic of a hydrothermal cell in a mafic-dominated, subaqueous volcanic setting (from Hudak et al., 2002). "Seawater percolates downward into the seafloor and is heated by a synvolcanic intrusion, e.g., gabbro as shown above, generally located at 2-4 kilometers depth. Complex metasomatic reaction involving calcium and base metals occur in the reaction zone, transforming seawater into an evolved, metalliferous hydrothermal fluid. This fluid buoyantly rises toward the seafloor in synvolcanic fault zones and is expelled in subaqueous hot springs (black smoker and white smoker vents). Massive sulfides are deposited on or immediately below the seafloor due to rapid cooling of the evolved hydrothermal fluid."

outcrops are very well-exposed, but AGAM only has one ¼ section leased in this area which is surrounded by un-leased property.

6.3.3 Felsic intrusions

Two newly identified intermediate to felsic intrusions and associated igneous breccia were mapped in central-east and south-central Ran within rocks of the Wilson Lake sequence (*fig. 12*). The diorite dike in central-east Ran is located near a major fault and a sedimentary unit with conglomeratic lenses. According to Jirsa and Morey (*2003*), this combination of features is favorable for gold mineralization because there is a conduit (fault), remobilization cause (felsic intrusion), and mineralization host (metasedimentary unit, iron formation, or mafic volcanic units on either side of the fault). Drill hole C-K-2 (DNR# 11971) was drilled at this location in 1969 and has a core log accessible via the DNR (*Himmelberg, 1973*). Similarly, the syenite intrusion in the southwest area of Ran was brecciated at its contact with the same clast-types and shapes as the diorite dike to the northeast. Big Rock recommends further field mapping to confirm the strike and strike length of these dikes, collect more geochemistry samples, and determine their potential to host or remobilize gold.

6.3.4 Epidotized basalt

A few outcrops of strongly epidotized and silicified pillowed basalt flows were mapped in south-central Ran – a zone of VMS-style hydrothermal alteration (*fig. 12*; *fig. 13*). In this area there is also a shear zone, a lapilli-tuff flow-top horizon, and garnet-grade alteration. This area needs further work to delineate the extent of the alteration, use internal pillow structures to vector toward a volcanic vent, use alteration patterns to vector toward a hydrothermal vent, and potentially find a massive sulfide horizon stratigraphically above it. Felsic volcanic rocks of the Wilson Lake sequence are poorly exposed as they are prone to weathering – but geomagnetic anomaly data may help elucidate where felsic volcanic horizons may exist under glacial till cover. Historic drilling in the area was aimed at intersecting these more felsic units (*Himmelberg, 1973*).

6.3.5 Lease acquisition

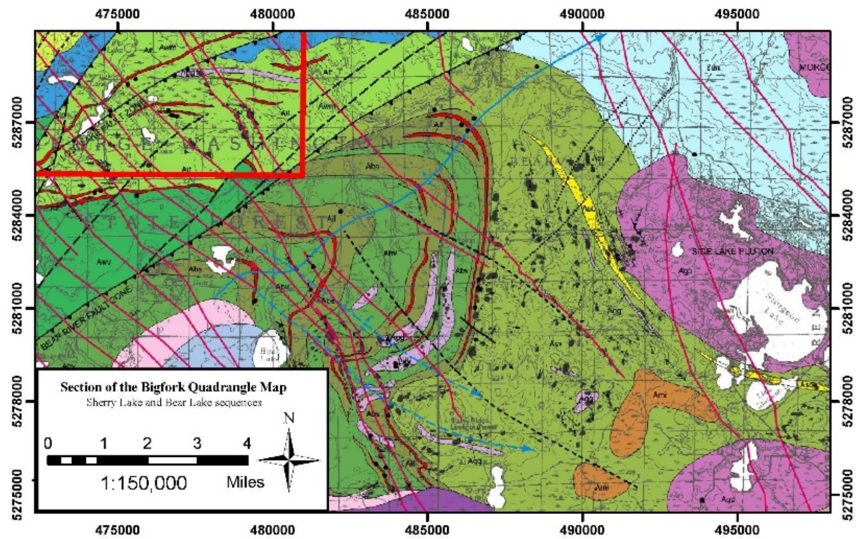


Figure 14: Section of the Bigfork Quadrangle Map showing area of recommended lease acquisition. Southeast of the Ran AOI and west of the Side Lake Pluton is a region of prominently-outcropping volcanic units, interbedded iron formation, and intrusive rocks of the Sherry Lake and Bear Lake sequences.

AGAM might consider leasing an area adjacent to the south and east of their current holdings including the majority of T60N-R21W and T60N-R22W, in Itasca and St. Louis counties (*fig. 14*). This area is currently unleased according to the MN DNR except for T60-R22-S5-6, on which Vermillion Gold has a request for negotiated leases. This area has abundant outcrop exposure (shown on MGS maps *M-68*, *M-75*, and *M-176*) with multiple promising structural features for a Hemlo-type gold deposit (*Davis & Lin, 2003*). Felsic dikes with sulfide minerals intrude mafic volcanic units to the south and west of the Side Lake pluton (*M-68*). Faults and sheared/brecciated zones are also mapped in the area (*M-68* and *M-75*), providing a fluid transportation zone. Moreover, the Sherry Lake and Bear Lake sequence geology is very similar to the geology of the Thistledew Lake and Wilson Lake sequences. This region of abundant outcrop could provide better surficial evidence for VMS-style mineralization.

7 References

Berkley, J.L., G.R. Himmelberg, and E.M. Ripley (1978). **RI-20:** Geology of the Deer Lake Complex, Itasca County, Minnesota. *Minnesota Geological Survey Report of Investigations 20, A and B.*

Chandler, V.W., M.A. Jirsa, and G.B. Morey (1997). **OFR-97-5:** Mineral potential assessment of northern St. Louis County, southeastern Koochiching County and northeastern Itasca County, Minnesota. *Minnesota Geological Survey Open File Report OFR-97-5.*

Davis, D.W. and S. Lin (2003) Unraveling the geologic history of the Hemlo Archean gold deposit, Superior province, Canada: A U-Pb Geochronological Study. *Economic Geology* (vol. 98; pg. 51-67).

Gibson, H.L., R.L. Allen, G. Riverin, and T.E. Lane (2007). The VMS Model: Advances and Application to Exploration Targeting. *Proceedings of Exploration 07: Fifth Decennial International Conference on Mineral Exploration* (pg. 713-730).

Himmelberg, G.R. (1973). Geologic descriptions of drill core from greenstone belt in northeastern Itasca County, Minnesota. *Unedited open-file report. Minnesota Geological Survey.*

Hobbs, H.C. and J.E. Goebel (1982). **Map S-1:** Geologic map of Minnesota, Quaternary geology. *Minnesota Geological Survey State Map Series S-1, scale 1:500,000.*

Hudak, G.J., J. Heine, T. Newkirk, J. Odette, and S. Hauck (2002). Comparative geology, stratigraphy, and lithogeochemistry of the Five Mile Lake, Quartz Hill, and Skeleton Lake VMS occurrences, western Vermilion district, NE Minnesota. *A report to the Minerals Coordinating Committee, DNR Minerals Division, State of Minnesota.*

Jirsa, M.A., T.J. Boerboom, and G.B. Morey (1998). **Map M-85:** Bedrock geologic map of the Virginia Horn, Mesabi Iron Range, St. Louis County, Minnesota. *Minnesota Geological Survey Miscellaneous Map M-85, scale 1:48,000.*

Jirsa, M.A. and V.W. Chandler (2007). **Map M-176:** Bedrock geology of the Bigfork 30’ X 60’ quadrangle, northern Minnesota. *Minnesota Geological Survey Miscellaneous Map M-176, scale 1:100,000.*

Jirsa, M.A. and G.B. Morey (2003). **RI-53:** Contributions to the geology of the Virginia Horn area, St. Louis County, Minnesota: *Minnesota Geological Survey Report of Investigations 53*.

Johnson, M.D., R.S. Adams, A.S. Gowan, K.L. Harris, H.C. Hobbs, C.E. Jennings, A.R. Knaeble, B.A. Lusardi, and G.N. Meyer (2016). **RI-68:** Quaternary lithostratigraphic units of Minnesota: *Minnesota Geological Survey Report of Investigations 68.*

Severson, M.J. and M.A. Jirsa (2005). **Map M-165:** Bedrock geology of the Deer Lake Complex and vicinity, Itasca County, Minnesota. *Minnesota Geological Survey Miscellaneous Map M-165, scale 1:24,000.*

Shanks III, W.C. Pat (2012). Hydrothermal alteration in volcanogenic massive sulfide occurrence model: *U. S. Geological Survey Scientific Investigations Report* (ch. 11).

Slack, J.F. (2012). Exploration-resource assessment guides in volcanogenic massive sulfide occurrence model: *U.S. Geological Survey Scientific Investigations Report* (ch. 19).

Southwick, D.L., T.J. Boerboom, and M.A. Jirsa (1998). **RI-51:** Geologic setting and descriptive geochemistry of Archean supracrustal and hypabyssal rocks, Soudan-Bigfork area, northern Minnesota: Implications for metallic mineral exploration. *Minnesota Geological Survey Report of Investigations 51.*

8 Appendices

The following appendices are meant to supplement the information in this report.

8.1 Appendix 1 – Lithologic descriptions

8.1.1 Mafic volcanic flows

Fine- to medium-fine-grained and dark gray to black in color; Non-magnetic to strongly magnetic, varying by outcrop; Alteration to epidote and chlorite imparts a light to dark green color. Silicified outcrops were lighter gray and harder, making them more difficult to break apart. Iron formation clasts/xenoliths ranging from ~5-50 cm occur in basalt units throughout Ran, but not in Magni. Some outcrops also contained cherty quartz clasts, which may have been clasts or amygdules in some instances. Often seen near pillowed flows and Archaean gabbro, mafic flows were found in the Ran and Magni AOIs. In the Magni AOI, three outcrops were mapped as hornblende andesite. These outcrops are located next to similar, more basaltic-looking flows, and so are included in this rock type. In the Ran AOI, some flow-top indicator features such as lapilli tuff and flow-top breccias were found at outcrops of massive flows.

In field notes, massive flow units are referred to as “basalts” for simplicity, but geochemical data will determine their exact classification.

Interpretation

Subaqueous massive lava flows are simple sheet flows that occur close to volcanic venting. In the Ran AOI, massive basalt flows occur near pillowed flows and sometimes peperites, suggesting periodic changes to the style and vigor of active venting. In the Magni AOI, only massive flows were found, suggesting volcanism occurred primarily or exclusively as near-vent eruptions. Sheared massive flows in the southwestern area of Ran also display carbonate alteration and sulfide mineralization, good indicators for further exploration.

8.1.2 Mafic volcanic flows, pillowed

Aphanitic to very fine grained, light to dark gray, commonly tinged green or bluish with a lighter weathered face and darker fresh face; Glassy, dark selvedges define the edge of each pillow, with a hyaloclastite matrix between the pillows. In some exposures, milky quartz replaces or partially replaces the area between the pillows as well as amygdules near the pillow selvedges, suggesting secondary silicification. Pillows were found throughout the Ran AOI but not in the Magni AOI. In field notes, pillowed units are referred to as “pillow basalts” for simplicity, but geochemical data will determine their exact classification. Pillows were commonly silicified and epidotized. At one outcrop in the southwest Ran area (18DL-AL025), some pillows were strongly epidotized but sat right next to pillows with far less alteration. A piece of scoria was found in the northern Ran area (18DL-LR021), in a ~50 m sequence of alternating pillows and peperite.

Interpretation

Pillowed basalt flows are generated by lavas extruded at undersea volcanic vents. The size of pillows, the thickness of their glass selvedges, and their internal crystallinity are characteristics of pillowed flows that change with proximity to such vents. Approaching a volcanic vent, pillow size tends to increase, and the flow may even become massive. Also, glass selvedges of pillows become wider and lava crystallinity increases near-vent. As undersea vent-proximal sites are favorable for massive sulfide formation, characteristics of pillowed flows can be useful guides for massive sulfide mineralization.

8.1.3 Mafic volcanic flows, peperite

Aphanitic to very fine-grained, round to subangular pillow-like lobes with glassy selvedges in contact with sandy, hyaloclastite matrix; Lobes are bluish to greenish gray on fresh face and have a light to medium gray weathered surface; Lobes range in size from 1 to 50 cm and are variably magnetic; Lobes vary in shape from round to elongate ovals, sometimes with sub-lobes budding out from the main lobe. Peperites are speckled with quartz nodules and amygdules. The lobes are suspended in a silicified reddish-brown sandy matrix. The overall appearance is breccia-like, with lobes scattered through matrix in a sometimes puzzle-like orientation. Some lobes appear fractured, with thin (<1 mm) veins between lobe pieces. Peperite was observed in the North Ran area at 6 outcrops. Usually observed near or within outcrops of pillowed basalt flows. Commonly silicified, chloritized, and epidotized. Pyrite and chalcopyrite mineralization observed at most outcrops from trace (0.1%) to weak (0.5%) modal abundance.

Interpretation

Peperite forms during the mixing of molten lava with wet sediment, generally at the bottom of a lake or ocean. “Peperites are important in terms of massive sulfide exploration because: a) they develop where rising magma comes in contact with wet sediment, and therefore define vent-proximal environments that are generally considered favorable hosts for massive sulfide mineralization; and b) they distinguish synvolcanic intrusions that may be associated with ore genesis from post-volcanic intrusions that are genetically unrelated to ore forming processes” (*Hudak et.al., 2002*).

8.1.4 Flow-top breccia and lapilli tuff

Matrix-supported, light brown ash matrix with ½-1 cm rounded glass lapilli, and dark-green-grey sub-rounded basalt fragments, blocks, and bombs up to 10 cm diameter. Bombs tend to be teardrop-shaped with the pointed end pointing towards stratigraphic topping and dense quartz amygdules occurring near the bulbous end. Wormy-shaped basalt fragments up to 10 cm make up most breccia clasts. Local scoria blocks are present. Contact between lapilli tuff layers and massive flow was observed at one outcrop (18DL-AL013) in the southwestern Ran area. For flow-top breccias, the weathered surface provided the easiest visual distinction between matrix and clasts. These units may experience pervasive epidote alteration – especially of the ashy matrix material. Green and pink crystalline epidote as well as euhedral garnets were observed at station 18DL-AL013. Clusters of 1-2 mm euhedral pyrite with trace chalcopyrite rims and ½ mm pyrite stringers with amorphous chalcopyrite were also observed at this outcrop.

Interpretation

Lapilli tuff was found to stratigraphically and conformably overlie basalt flows (either pillowed or massive). The sharp basal contact observed at station 18DL-AL013 illustrates how the material draped over the basalt-dominated paleotopography of the seafloor at the time of deposition. The ash, lapilli, blocks, bombs, and fragments most likely fell through the water column and gravitationally settled on the seafloor. They could also have been deposited in water-rich mass flows such as turbidites or density currents. Flow top units such as these are often found to be the hanging wall of massive sulfide deposits (Hudak et.al., 2002).

8.1.5 Iron formation

Red, black, and white; strongly to intensely magnetic; massive magnetite, hematite, and chert. Iron formation occurs as elongate lenses deposited between basalt flows of the Wilson Lake sequence, though very few were observed. Aside from a large lens-like xenolith broken up in various outcrops at stations 18DL-LB028 – 18DL-LB031, most iron formation occurs as 2-10 cm clasts in massive and pillowed flows and in inter-pillow spaces of pillowed flows, or xenoliths in intrusive igneous breccias. Clasts in volcanic units and breccias are cherty white to black to bright red, silicified, angular nodules.

Interpretation

The MGS has mapped outcrops of iron formation to the south of the field area, and aeromagnetic data suggest they are part of 50-200 m wide, 1-25 km long lenses curving through mafic volcanic units of the Wilson Lake sequence. The occurrence of iron formation clasts and xenoliths in other rock units indicates this is one of the oldest rock types encountered in the field area and is prone to re-mobilization.

8.1.6 Gabbro, Archean

Black and white speckled, medium-fine to coarse-grained, strongly varitextured and taxitic, trace to moderately magnetic gabbro. Gabbro occurs in outcrops throughout both AOIs and within all volcanic sequences in the Deer Lake region. Greenschist-facies alteration is dominant with weak-moderate saussuritization and chloritization with local epidote. Gabbroic rocks display local shearing and quartz-carbonate veining with only local sulfide blebs of pyrite with trace chalcopyrite. In the Magni AOI, a grouping of outcrops at stations 18DL-LR014 – 18DL-LR016 display the taxitic and varitextured nature of these sills. Anorthositic to gabbroic to diabasic rocks were encountered throughout these stations. Very coarse anorthosite and gabbro grade into med- to fine-grained gabbro and diabase with local varitextured clots. Igneous layering (textural and compositional) is also present on outcrop scale.

Interpretation

Long lens-shaped gabbroic sills are mapped by MGS within mafic volcanic units of the Silverdale, Thistledew Lake, and Wilson Lake sequences. MGS worked with geomagnetic anomaly data to elucidate the contacts of gabbroic sills because outcrops of the unit are very scarce. They generally trend E-W with variable thickness between 1 and 2 km and variable strike lengths between 5 and 40 km. MGS explains that gabbroic sills are compositionally equivalent to the volcanic unit they occur in and they are interpreted as synvolcanic intrusions – likely the hypabyssal sources of regional magmatism.

8.1.7 Gabbro and diabase, Paleoproterozoic

White-grey-black speckled fresh face, white-brown speckled weathered face, medium- to coarse-grained, 5-100 m wide diabase to gabbro dikes. Finer-grained chill margins near contacts with host rock, coarser-grained in center of wide dikes. Average composition estimated in the field is 40-60% plagioclase feldspar, 40-60% pyroxene, ≤10% magnetite, ± ≤1% sulfide minerals pyrite. Sulfide minerals occur as disseminated pyrite. Weakly to strongly magnetic. Dikes trend roughly NW-SE, with local bends and kinks.

Interpretation

These gabbro and diabase dikes are much more resistant to weathering than surrounding rock. They outcrop well and often allow adjacent rocks to outcrop near dike edges. Many of the smaller dikes observed display a similar orientation to these dikes, suggesting that magma exploited similar or related features during their intrusion. These dikes are much younger than all other rocks in the Deer Lake region and likely had no important effects on the regional rocks in the form of alteration or mineralization.

8.1.8 Diorite and diorite breccia

Medium to coarse-grained, weakly magnetic hornblende-phyric (4 mm) quartz diorite. Observed at three outcrops in the east-central area of Ran (18DL-LR022 – 18DL-LR024). One of the three outcrops was composed entirely of massive quartz diorite. At the other two outcrops, quartz diorite was observed as the matrix in an igneous breccia with clasts (xenoliths) of iron formation, basalt, gabbro, and granodiorite. Iron formation clasts are angular to sub-angular, layered, and slaty while Granodiorite clasts had the largest average size, with some clasts up to 15 cm diameter. Basalt and gabbro clasts were approximately 2-10 cm in diameter. Chlorite alteration is pervasive in the massive quartz diorite. Approximately 1% disseminated euhedral pyrite up to 2 mm in diameter occur at two of the three outcrops.

Interpretation

The outcrops mapped in this area were acknowledged by Jirsa & Chandler (2007), but no lithologic information was available for them in the Supplementary GIS information for that publication. Drill hole C-K-2 (Hanna Mining, 1969; drill log in References) is located next to these outcrops, and archived core may be of interest for future portable XRF analysis.

8.1.9 Syenite breccia

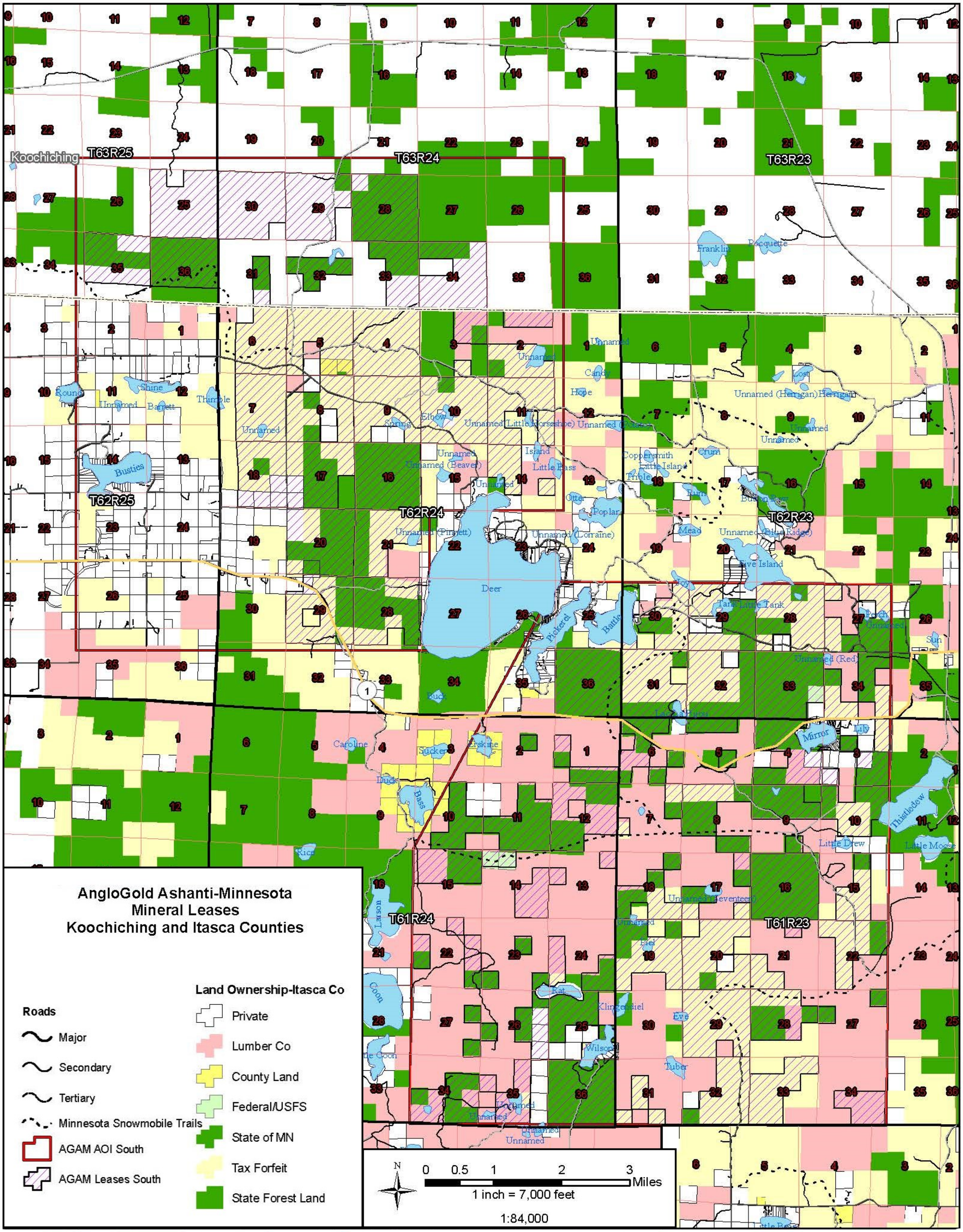
Igneous breccia with a matrix of pink-grey medium-grained syenite and sub-rounded, partially resorbed 1-30 cm clasts of iron formation, basalt, and gabbro/diabase. Syenite consists of 70% subhedral potassium feldspar, 15% euhedral hornblende, 10% anhedral plagioclase, and 5% anhedral quartz. The fresh face is gray to pink with black spots, and the weathered face is light pink with black spots. The syenite matrix is weakly magnetic. This unit was only seen in two small (2 x 2 m) outcrops at field station 18DL-AL019 in Southwest Ran, adjacent to a Kenora-Kabetogama gabbro dike. The strike of this unit was unclear in outcrop, but it appears to trend N-S along the Kenora-Kabetogama gabbro dike. It may also trend NE-SW and line up with the diorite breccia described above. No visible sulfide mineralization was observed.

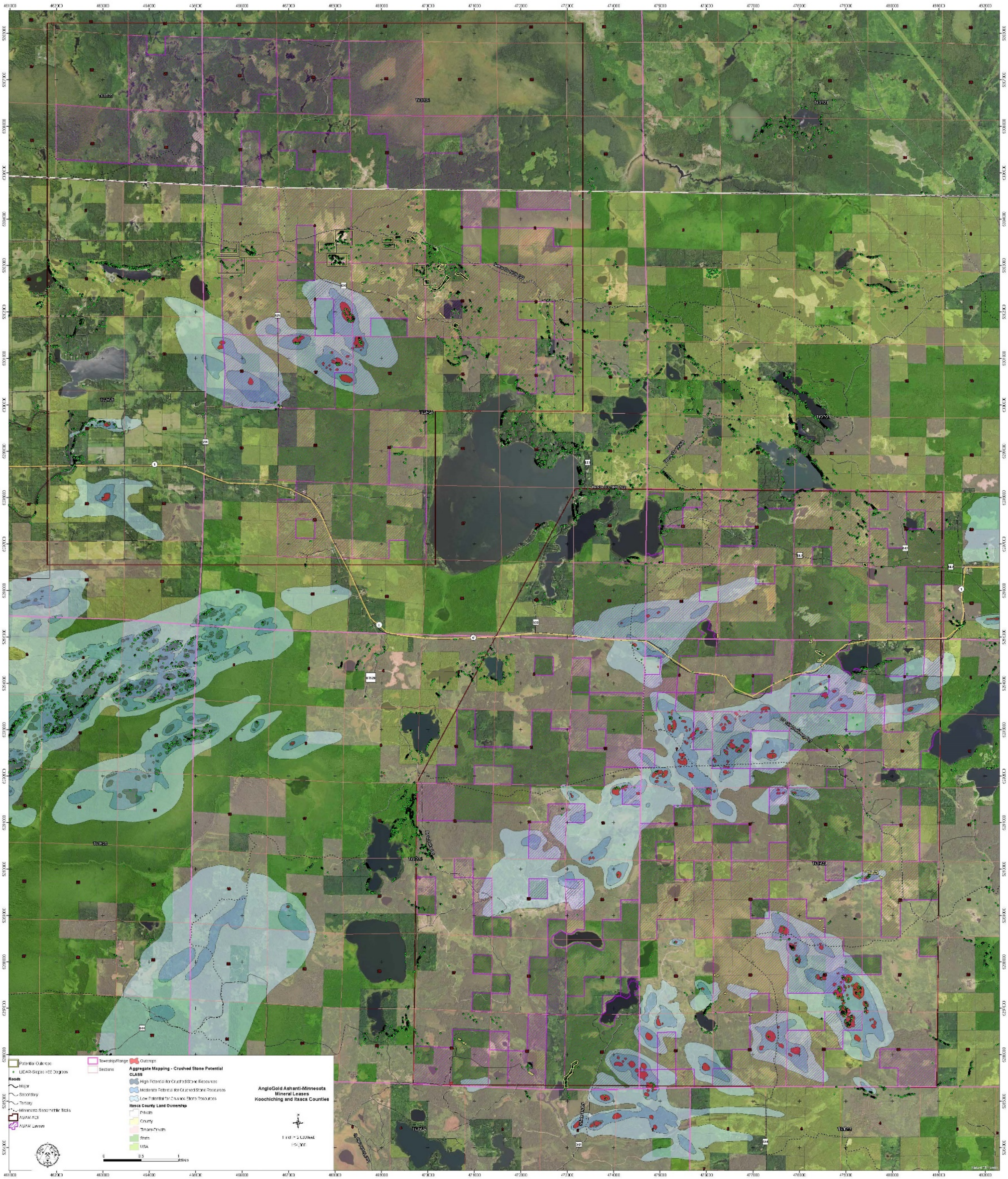
Interpretation

This unit is potentially related to nearby Archaean syenitic or felsic intrusions including the Coon Lake Pluton, Side Lake Pluton, Morcom Pluton, Linden Pluton, or other unnamed intrusions (Jirsa & Chandler, 2007). Geochemical and petrographic analysis could help clarify this unit’s source.

8.2 Appendix 2 – BRE-generated maps

The following pages comprise 8 maps generated by BRE from various data sources. These maps are pertinent to understanding terrain, land leases, outcrop potential and geology. Maps showing mineral leases and outcrop potential were used to focus geologic mapping in areas where known outcrop occurs on AGAM mineral leases. Leases were also overlain on Lidar to generate a grid of field base maps. After field work was complete BRE generated a geologic bedrock map for the Deer Lake region. Cropped maps of each AOI were also generated. Finally, because structure and alteration data are difficult to visualize on the bedrock map, cropped maps of each AOI highlighting structure and alteration are also included. All these maps and others can be found in the shared Dropbox folder.

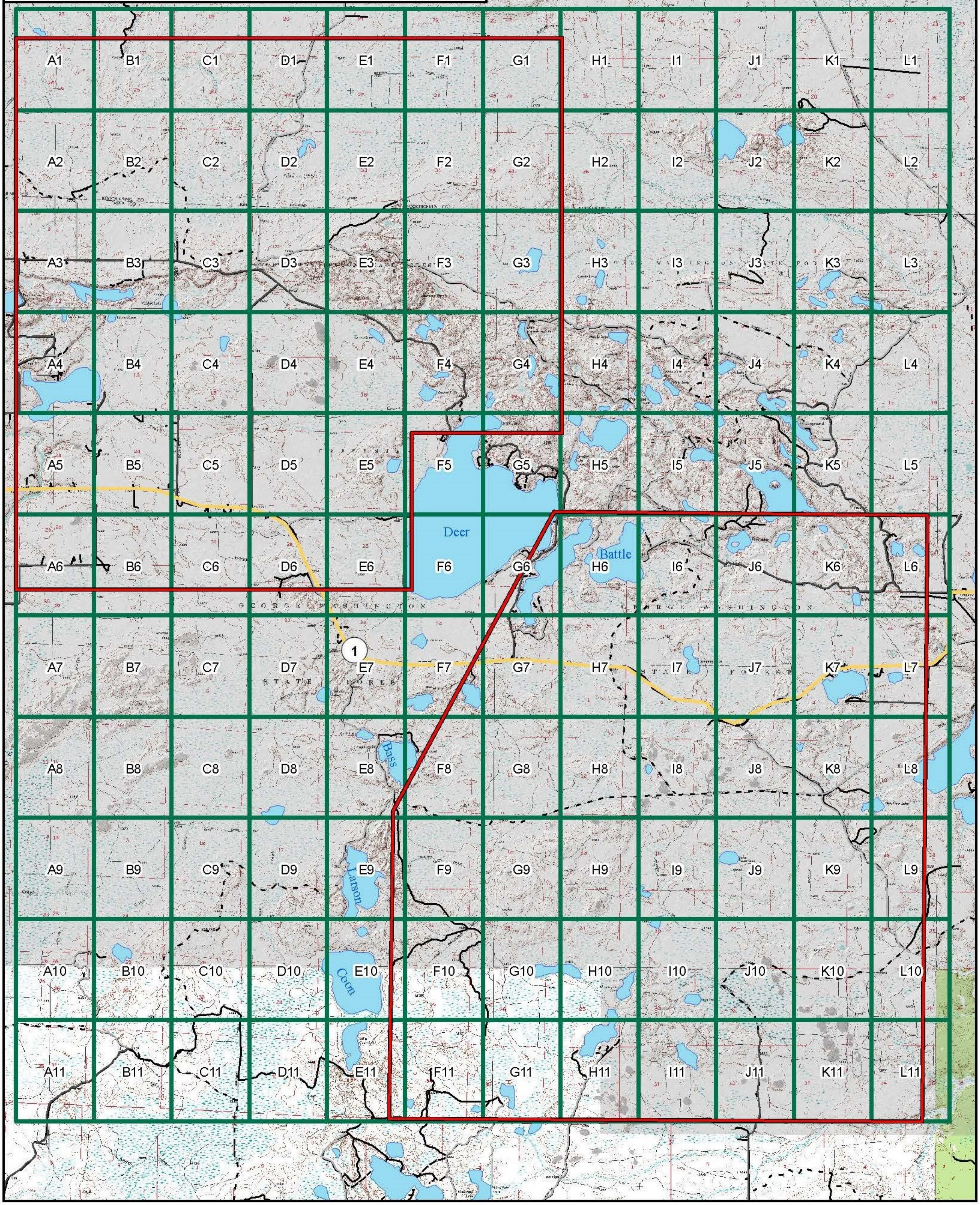

AngloGold Ashanti-Minnesota
Mineral Leases
Koochiching and Itasca Counties
Roads
Major
Secondary
Tertiary
Minnesota Snowmobile Trails
AGAM AOI South
AGAM Leases South
Land Ownership-Itasca Co
Private
Lumber Co
County Land
Federal/USFS
State of MN
Tax Forfeit
State Forest Land
N
0 0.5 1 2 3 Miles
1 inch = 7,000 feet
1:84,000
Koochiching
T63R25
T63R24
T63R23
T62R25
T62R24
T62R23
T61R24
T61R23
Deer
Busties
Pickerel
Battle
Thistledew
Mirror
Franklin
Bass
Coon
Larson
Sucker
Erskine
Caroline
Shine
Barrett
Thimble
Poplar
Mead
Five Island
Little Moose
Little Drew

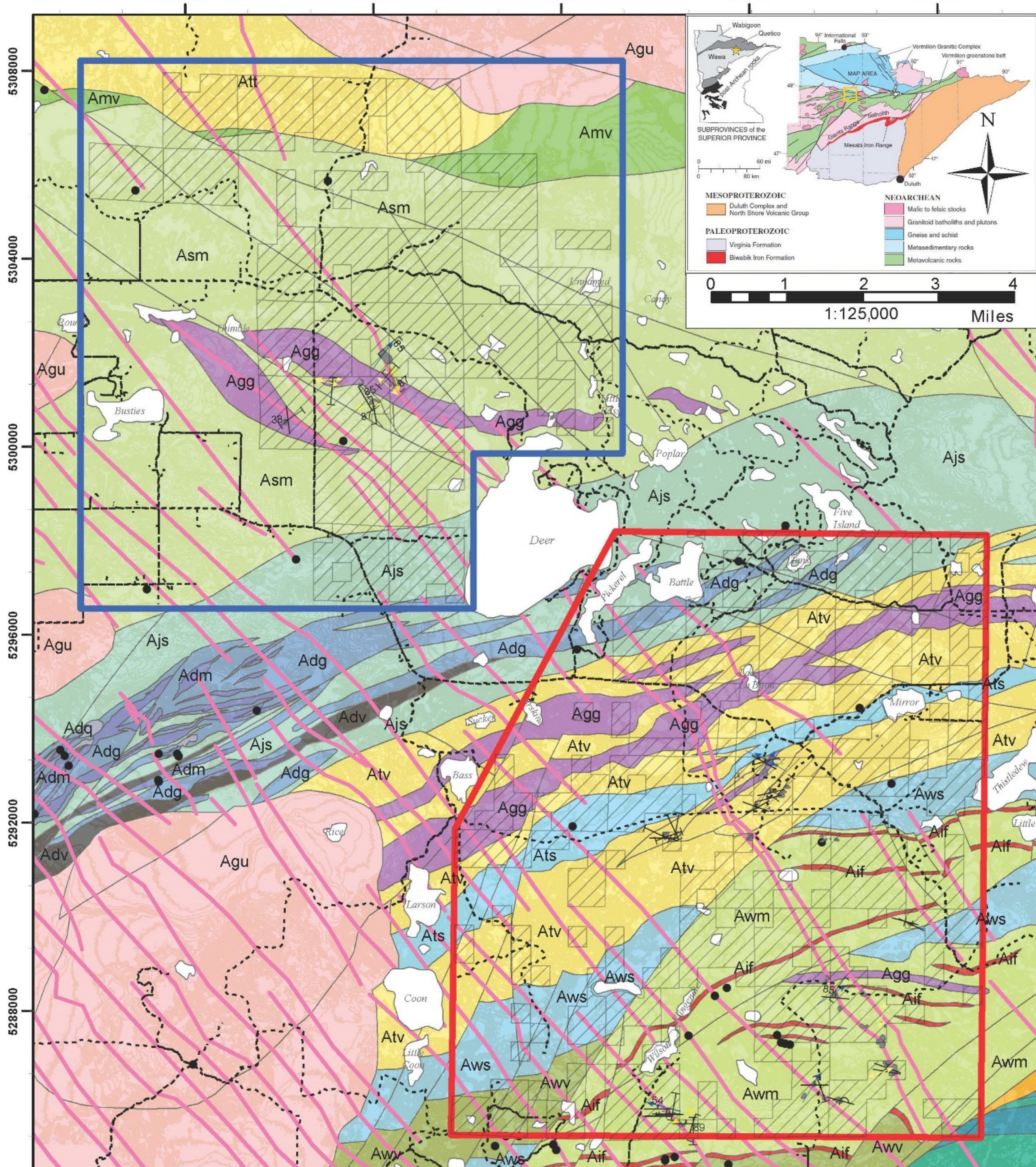

AngloGold Ashanti-Minnesota
Mineral Leases
Koochiching and Itasca Counties
Potential Outcrops
LIDAR-Slopes >35 Degrees
Roads
Major
Secondary
Tertiary
Minnesota Snowmobile Trails
AGAM AOI
AGAM Leases
Township/Range
Sections
Outcrops
Aggregate Mapping - Crushed Stone Potential
CLASS
High Potential for Crushed Stone Resources
Moderate Potential for Crushed Stone Resources
Low Potential for Crushed Stone Resources
Itasca County Land Ownership
Private
County
Timber-Private
State
USA
0
0.5
1
Miles
N
1 inch = 2,000 feet
1:24,000

Deer Lake Region

BRE-Generated Gridded Map Index

AGAM Leases and Topo overlain on Lidar





DESCRIPTION OF MAP UNITS

PALEOPROTEROZOIC

KENORA-KABETOGAMA DIKE SWARM

Diabase and gabbro – black and white; varitextured and taxitic dikes from 3 to 100 m wide. These dikes were encountered throughout the map area. Due to lack of outcrop, their trajectories are inferred from geomagnetic data.

NEOARCHEAN

STOCKS AND PLUTONS

Agu **Granitoid rock** – undifferentiated granitic intrusions, stocks, plutons, and batholiths. Extrapolated from MGS-mapped and -inferred units. Rocks of this type do not occur in the AGAM areas of interest.

SUPRACRUSTAL AND INTRUSIVE ROCKS

DEER LAKE COMPLEX

Adq **Quartz diorite** – medium to coarse-grained; amphibole-bearing quartz diorite. This rock does not occur within the AGAM areas of interest.

Adg **Gabbro** – coarse-grained; amphibole-bearing; locally porphyritic. This rock does not occur within the AGAM areas of interest.

Adm **Melagabbro, pyroxenite, and peridotite** – dark; fine to medium-grained; locally porphyritic; locally magnetic. This rock does not occur within the AGAM areas of interest.

Adv **Mafic and ultramafic volcanic rock** – tholeiitic-komatiitic lava flows; massive to pillowed; local spinifex texture. This rock does not occur within the AGAM areas of interest.

JOY LAKE SEQUENCE

Ajs **Volcanic and volcaniclastic rock** – rhyolitic to dacitic lava flows; various volcaniclastic and sedimentary horizons. These rocks are vulnerable to weathering and do not outcrop within the AGAM areas of interest.

SILVERDALE SEQUENCE

Asm **Mafic volcanic rock** – dark green; greenschist to amphibolite facies; tholeiitic lava flows; massive to pillowed; various dacitic to granitoid dikes; weak pervasive sulfides.

THISTLEDEW LAKE SEQUENCE

Ats **Sedimentary and volcaniclastic rock** – grey-wacke; slate; tuff; chert; graphitic interbeds. These rocks are vulnerable to weathering and do not outcrop within the AGAM areas of interest.

Atv **Volcanic rock** – dark green; greenschist facies; tholeiitic lava flows; massive to pillowed to autobrecciated with local peperite horizons.

WILSON LAKE SEQUENCE

Aws **Sedimentary and volcaniclastic rock** – calc-alkaline tuff; volcanic breccia and conglomerate; greywacke; graphitic argillite. These rocks are vulnerable to weathering and do not outcrop within the AGAM areas of interest.

Awv **Volcanic rock** – green-grey; greenschist facies; intermediate to mafic to felsic flows; breccia; tuff.

Awm **Mafic volcanic rock** – dark green; greenschist facies; tholeiitic to calc-alkaline lava flows; interbedded iron formation (unit Aif); tuff and flow-top breccia.

UNNAMED SUPRACRUSTAL AND HYPABYSSAL INTRUSIVE ROCKS

Agg **Gabbroic and metagabbroic rock** – black and white; greenschist to amphibolite facies; varitextured; taxitic; hypabyssal sills and dikes; geochemically like adjacent volcanic flows.

Aif **Iron-formation** – red-grey-black; layers and lenses of chert-, magnetite-, hematite-, and locally sulfide-bearing iron formation. Discontinuous lenses occur interbedded with volcanic rocks of the Wilson Lake sequence (unit Awv).

Amv **Mafic volcanic rocks and schist** – foliated amphibolite-facies metavolcanic rocks and schists of mafic volcanic protolith. This rock does not occur within the AGAM areas of interest.

BEDROCK GEOLOGIC MAP OF THE DEER LAKE REGION

Prepared for AngloGold Ashanti Minnesota by Big Rock Exploration

MAP SYMBOLS

Administrative

AGAM Lease Package

Magni AOI

Ran AOI

Roads and Trails

2ft Elevation Contours

Drill Hole

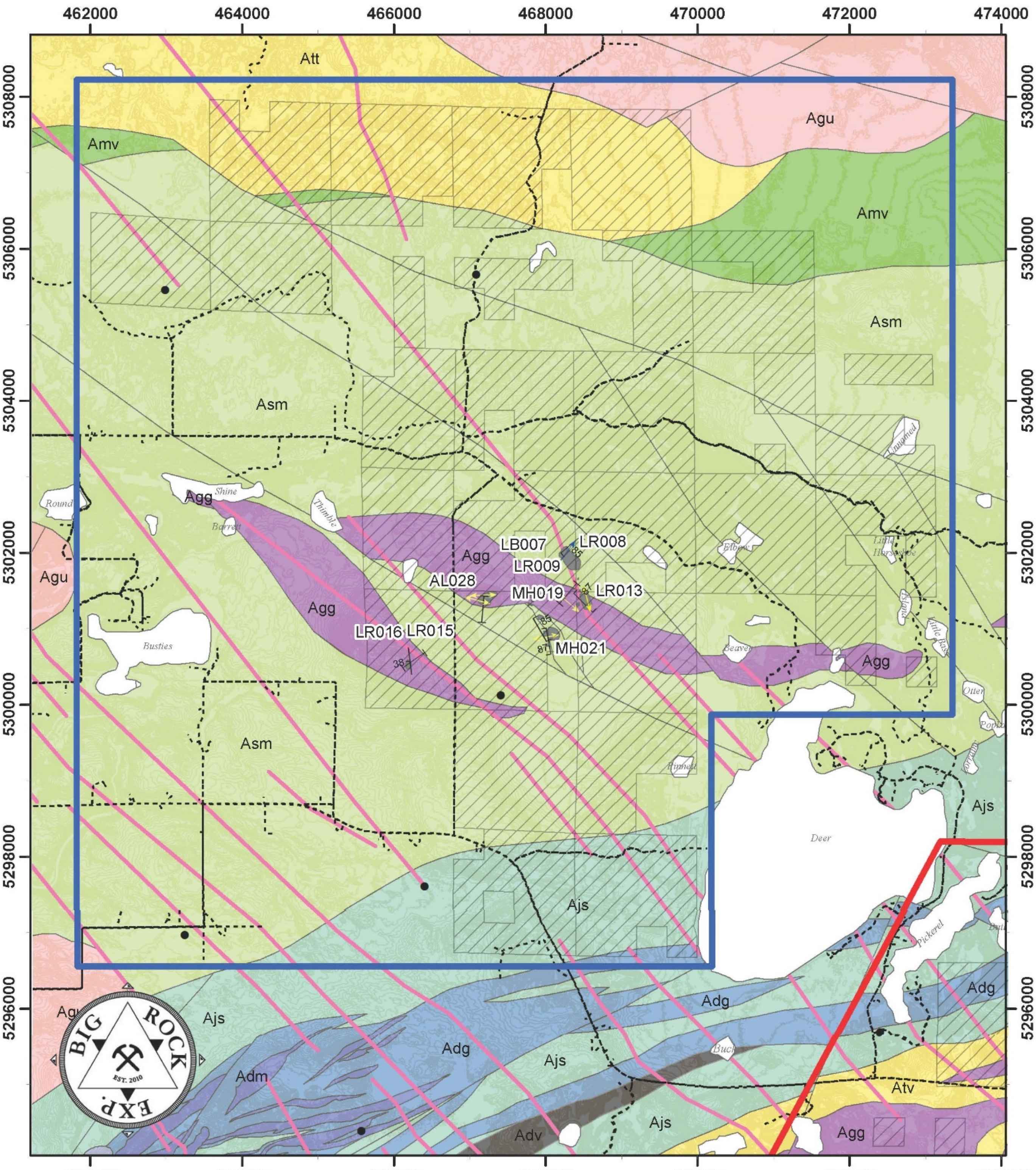
Geological

Outcrop

Bedding – stratigraphic top direction indicated by tick mark; inclined, vertical, overturned.

Foliation, cleavage, and schistosity – modal or textural layering in intrusive rocks; deformation in metamorphic rocks; inclined, vertical.

Glacial markings – striations or grooves carved into the paleosurface of bedrock by debris-laden glaciers; arrow in direction of glacial advance.



DESCRIPTION OF MAP UNITS

1:75,000

0 0.5 1 1.5 2 Miles

PALEOPROTEROZOIC

KENORA-KABETOGAMA DIKE SWARM

Diabase and gabbro – black and white; varitextured and taxitic dikes from 3 to 100 m wide. These dikes were encountered throughout the map area. Due to lack of outcrop, their trajectories are inferred from geomagnetic data.

NEOARCHEAN

STOCKS AND PLUTONS

Agu **Granitoid rock** – undifferentiated granitic intrusions, stocks, plutons, and batholiths. Extrapolated from MGS-mapped and -inferred units. Rocks of this type do not occur in the AGAM areas of interest.

SUPRACRUSTAL AND INTRUSIVE ROCKS

DEER LAKE COMPLEX

Adg **Gabbro** – coarse-grained; amphibole-bearing; locally porphyritic. This rock does not occur within the AGAM areas of interest.

Adm **Melagabbro, pyroxenite, and peridotite** – dark; fine to medium-grained; locally porphyritic; locally magnetic. This rock does not occur within the AGAM areas of interest.

JOY LAKE SEQUENCE

Ajs **Volcanic and volcaniclastic rock** – rhyolitic to dacitic lava flows; various volcaniclastic and sedimentary horizons. These rocks are vulnerable to weathering and do not outcrop within the AGAM areas of interest.

SILVERDALE SEQUENCE

Asm **Mafic volcanic rock** – dark green; greenschist to amphibolite facies; tholeiitic lava flows; massive to pillowed; various dacitic to granitoid dikes; weak pervasive sulfides.

UNNAMED SUPRACRUSTAL AND HYPABYSSAL INTRUSIVE ROCKS

Agg **Gabbroic and metagabbroic rock** – black and white; greenschist to amphibolite facies; varitextured; taxitic; hypabyssal sills and dikes; geochemically like adjacent volcanic flows.

Amv **Mafic volcanic rocks and schist** – foliated amphibolite-facies metavolcanic rocks and schists of mafic volcanic protolith. This rock does not occur within the AGAM areas of interest.

MAP SYMBOLS

Administrative

AGAM Lease Package

Magni AOI

Ran AOI

Roads and Trails

2ft Elevation Contours

Drill Hole

Geological

Outcrop

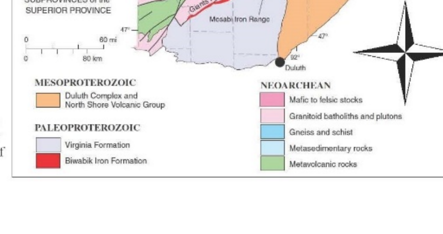
Bedding – stratigraphic top direction indicated by tick mark; inclined, vertical, overturned.

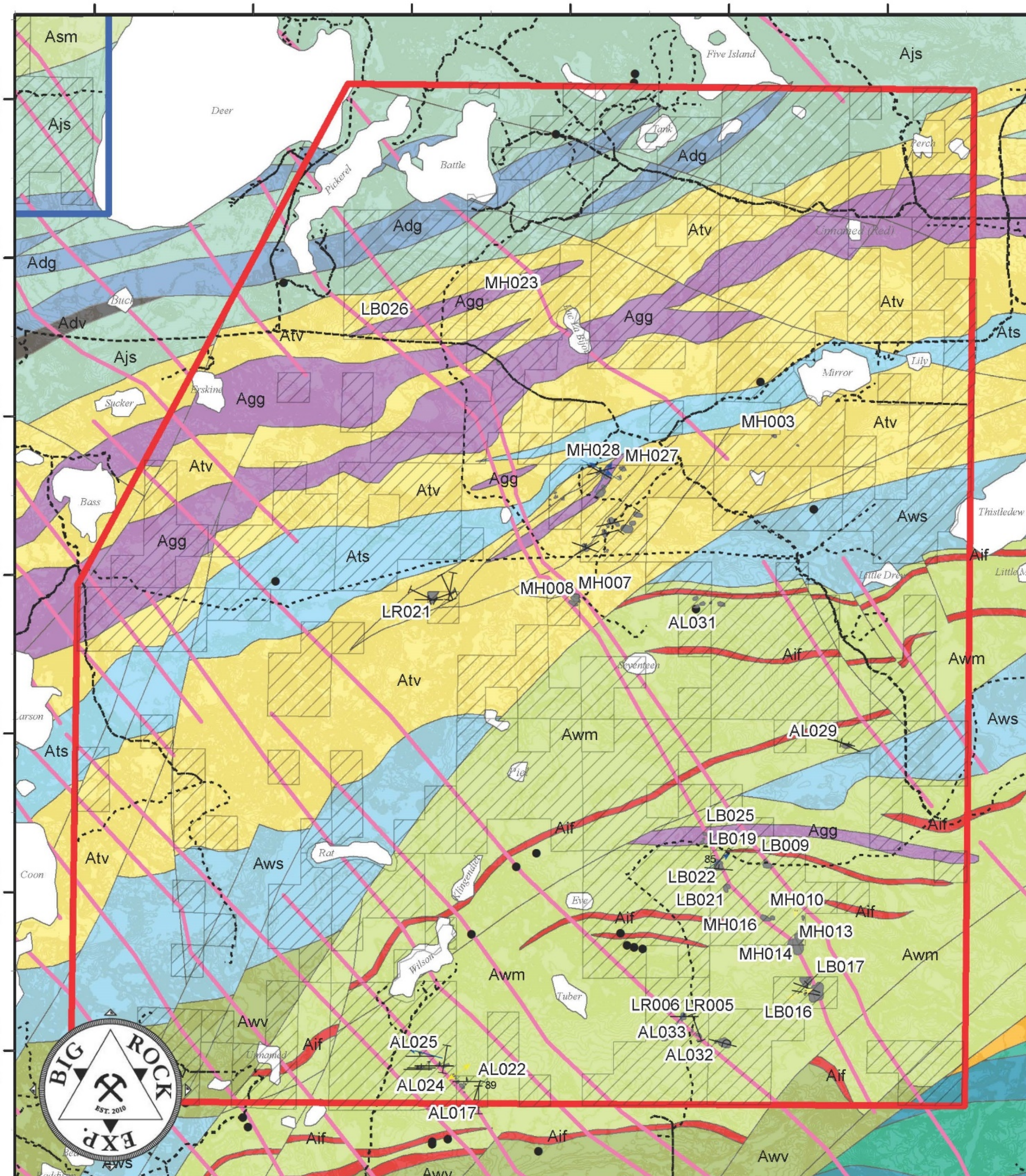
Foliation, cleavage, and schistosity – modal or textural layering in intrusive rocks; deformation in metamorphic rocks; inclined, vertical.

Glacial markings – striations or grooves carved into the paleosurface of bedrock by debris-laden glaciers; arrow in direction of glacial advance.

BEDROCK GEOLOGIC MAP OF THE MAGNI AOI

Prepared for AngloGold Ashanti Minnesota by Big Rock Exploration





DESCRIPTION OF MAP UNITS

1:75,000

0 0.5 1 1.5 2 Miles

PALEOPROTEROZOIC

KENORA-KABETOGAMA DIKE SWARM

Diabase and gabbro – black and white; varitextured and taxitic dikes from 3 to 100 m wide. These dikes were encountered throughout the map area. Due to lack of outcrop, their trajectories are inferred from geomagnetic data.

NEOARCHEAN

SUPRACRUSTAL AND INTRUSIVE ROCKS

DEER LAKE COMPLEX

Adg **Gabbro** – coarse-grained; amphibole-bearing; locally porphyritic. This rock does not occur within the AGAM areas of interest.

JOY LAKE SEQUENCE

Ajs **Volcanic and volcaniclastic rock** – rhyolitic to dacitic lava flows; various volcaniclastic and sedimentary horizons. These rocks are vulnerable to weathering and do not outcrop within the AGAM areas of interest.

THISTLEDEW LAKE SEQUENCE

Ats **Sedimentary and volcaniclastic rock** – grey-wacke; slate; tuff; chert; graphitic interbeds. These rocks are vulnerable to weathering and do not outcrop within the AGAM areas of interest.

Atv **Volcanic rock** – dark green; greenschist facies; tholeiitic lava flows; massive to pillowed to autobrecciated with local peperite horizons.

WILSON LAKE SEQUENCE

Aws **Sedimentary and volcaniclastic rock** – calc-alkaline tuff, volcanic breccia and conglomerate; greywacke; graphitic argillite. These rocks are vulnerable to weathering and do not outcrop within the AGAM areas of interest.

Awv **Volcanic rock** – green-grey; greenschist facies; intermediate to mafic to felsic flows; breccia; tuff.

Awm **Mafic volcanic rock** – dark green; greenschist facies; tholeiitic to calc-alkaline lava flows; interbedded iron formation (unit Aif); tuff and flow-top breccia.

UNNAMED SUPRACRUSTAL AND HYPABYSSAL INTRUSIVE ROCKS

Agg **Gabbroic and metagabbroic rock** – black and white; greenschist to amphibolite facies; varitextured; taxitic; hypabyssal sills and dikes; geochemically like adjacent volcanic flows.

Aif **Iron-formation** – red-grey-black; layers and lenses of chert-, magnetite-, hematite-, and locally sulfide-bearing iron formation. Discontinuous lenses occur interbedded with volcanic rocks of the Wilson Lake sequence (unit Awv).

MAP SYMBOLS

Administrative

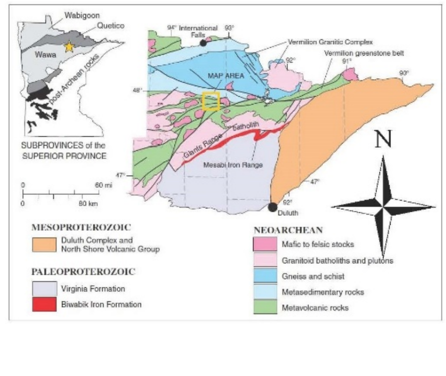
- AGAM Lease Package
- Magni AOI
- Ran AOI
- Roads and Trails
- 2ft Elevation Contours
- Drill Hole

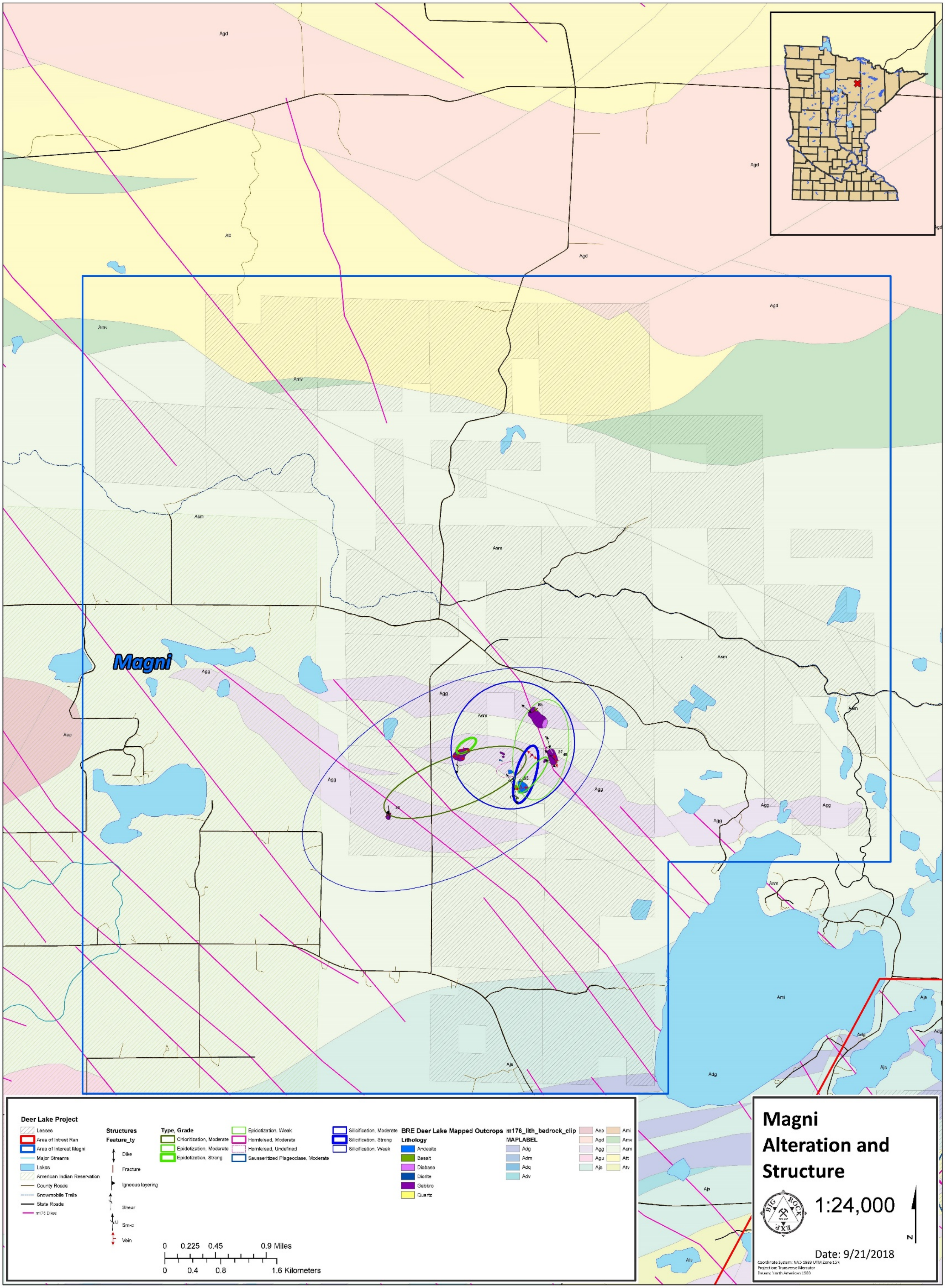
Geological

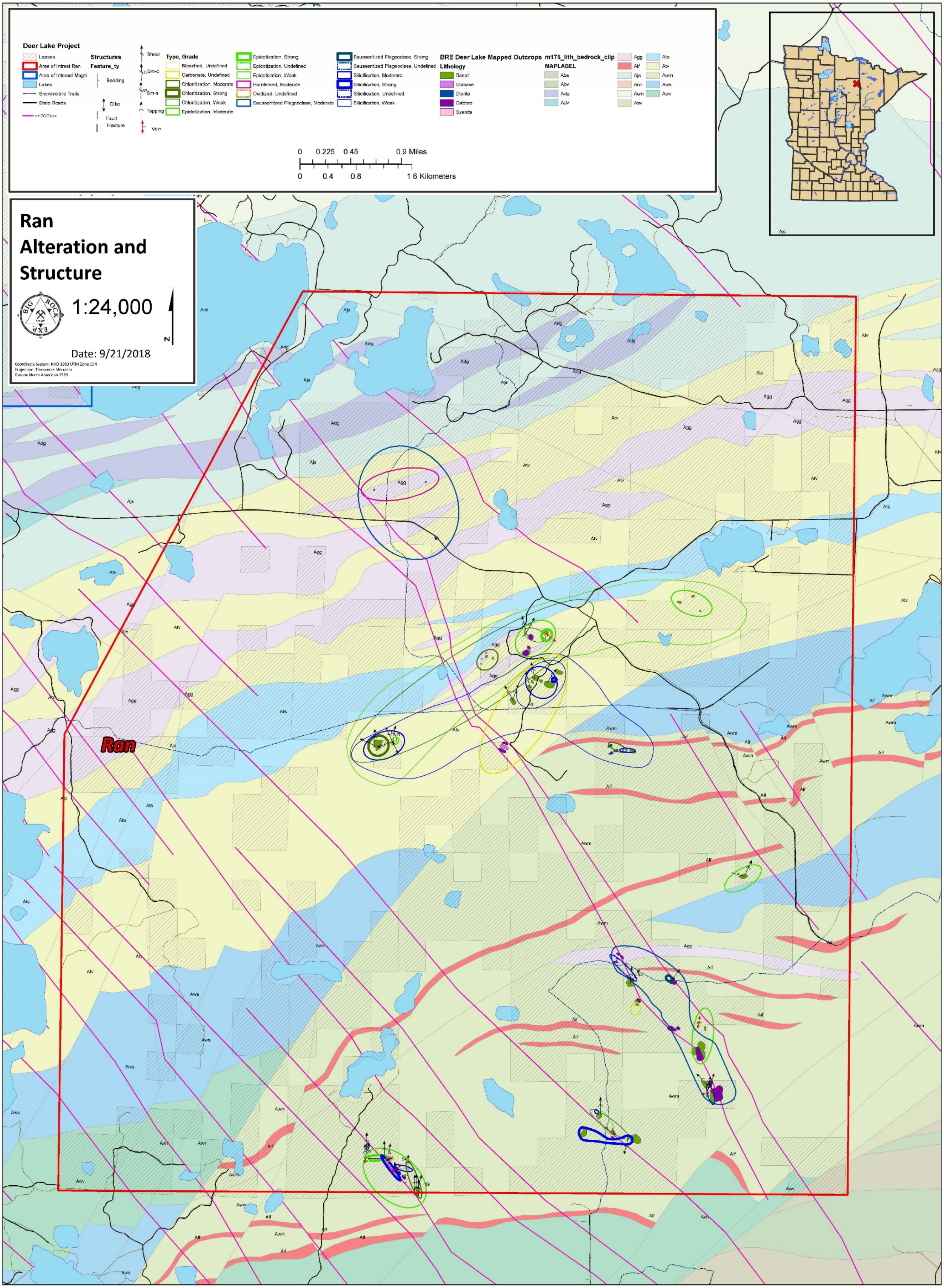
- **Outcrop**
- **Bedding** – stratigraphic top direction indicated by tick mark; inclined, vertical, overturned.
- **Foliation, cleavage, and schistosity** – modal or textural layering in intrusive rocks; deformation in metamorphic rocks; inclined, vertical.
- **Glacial markings** – striations or grooves carved into the paleosurface of bedrock by debris-laden glaciers; arrow in direction of glacial advance.

BEDROCK GEOLOGIC MAP OF THE RAN AOI

Prepared for AngloGold Ashanti Minnesota by Big Rock Exploration




Magni
Alteration and
Structure
1:24,000
N
Date: 9/21/2018
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983
Magni
Deer Lake Project
Lesses
Area of Intrest Ran
Area of Interest Magni
Major Streams
Lakes
American Indian Reservation
County Roads
Snowmobile Trails
State Roads
m176 Dikes
Structures
Feature_ty
Dike
Fracture
Igneous layering
Shear
Sm-c
Vein
Type, Grade
Chloritization, Moderate
Epidotization, Moderate
Epidotization, Strong
Epidotization, Weak
Hornfelsed, Moderate
Hornfelsed, Undefined
Saussenitized Plageoclase, Moderate
Silicification, Moderate
Silicification, Strong
Silicification, Weak
BRE Deer Lake Mapped Outcrops
Lithology
Andesite
Basalt
Diabase
Diorite
Gabbro
Quartz
m176_lith_bedrock_clip
MAPLABEL
Adg
Adm
Adq
Adv
Aep
Agd
Agg
Agu
Ajs
Ami
Amv
Asm
Att
Atv
0 0.225 0.45 0.9 Miles
0 0.4 0.8 1.6 Kilometers



Deer Lake Project
Leases
Area of Intrest Ran
Area of Interest Magni
Lakes
Snowmobile Trails
State Roads
Structures
Feature_ty
Bedding
Dike
Fault
Fracture
Shear
Sm-c
Sm-s
Topping
Vein
Type, Grade
Bleached, Undefined
Carbonate, Undefined
Chloritization, Moderate
Chloritization, Strong
Chloritization, Weak
Epidotization, Moderate
Epidotization, Strong
Epidotization, Undefined
Epidotization, Weak
Hornfelsed, Moderate
Oxidized, Undefined
Sausseritized Plageoclase, Moderate
Sausseritized Plageoclase, Strong
Sausseritized Plageoclase, Undefined
Silicification, Moderate
Silicification, Strong
Silicification, Undefined
Silicification, Weak
BRE Deer Lake Mapped Outcrops
Lithology
Basalt
Diabase
Diorite
Gabbro
Syenite
m176_lith_bedrock_clip
MAPLABEL
Abs
Abv
Adg
Adv
Agg
Aif
Ajs
Ami
Asm
Asv
Ats
Atv
Awm
Aws
Awv
0 0.225 0.45 0.9 Miles
0 0.4 0.8 1.6 Kilometers
Ran
Alteration and
Structure
1:24,000
N
Date: 9/21/2018
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983
Ran

8.3 Appendix 3 – Sample list

Map_ID	ALS_ID	Target	Easting	Northing	Lithology	Description
18DL-MH001	Y554001	Ran	478549	5293764	Basalt	Massive basalt; sample representative of outcrop
18DL-MH002	Y554002	Ran	478744	5293846	Basalt	Massive basalt with pyrrhotite blebs and carbonate veinlets ; sample representative of outcrop.
18DL-MH003	Y554003	Ran	478849	5293634	Basalt	Massive basalt with sulfides occuring along fracture planes and boxwork calcite veining with associated
18DL-MH004	Y554004	Ran	476173	5292366	Basalt	Pillow basalt with weak silification and carbonate alteration (includes boxwork carbonate veinlets). Sample is composite of entire outcrop.
18DL-MH005	Y554005	Ran	476173	5292366	Basalt	Massive basalt near a contact with pillow basalt; Moderate carbonate dissemination. Sample is representative of OC.
18DL-MH006	Y554006	Ran	476083	5291754	Gabbro	Varitextured Gabbro OC with minor disseminated carbonate. Sample is representative of OC.
18DL-MH007	Y554007	Ran	476056	5291710	Diabase	Diabase with crosscutting quartz veinlets; sample is representative of OC
18DL-MH008	Y554008	Ran	476056	5291640	Gabbro	Gabbro with minor saussuritization; sample representative of OC
18DL-MH009A	Y554009	Ran	478829	5287766	Basalt	Epidote altered basalt adjacent to boxwork quartz veins; sample is not represenative of OC
18DL-MH009B	Y554010	Ran	478829	5287766	Iron Formation	Iron formation (or some kind of quartz veining event with a bunch of iron formation rip ups) with brecciated texture; sample not representative of entire outcrop.
18DL-MH010	Y554011	Ran	478927	5287679	Basalt	Plag-phyric massive basalt with epidote blebs that contain fine grain needle-like sulfides. Sample represenative of OC.
18DL-MH011	Y554012	Ran	478775	5287336	Basalt	Epidote altered pillow basalt near contact with gabbro dike (contains needle-like sulfides that are potentially millerite). Sample not representative of outcrop.
18DL-MH013	Y554013	Ran	478858	5287389	Basalt	Pillow basalt OC with localized epidote alteration (coarse radial epidote crystals) and moderate quartz replacement of halioclastites. Sample representative of entire outcrop.
18DL-MH014	Y554014	Ran	478840	5287392	Gabbro	Eastern margin of gabbro dike (medium grained) near contact with pillow basalt. Sample is representative of outcrop.
18DL-MH015	Y554015	Ran	47853	5287676	Gabbro	Gabbro dike (same rock unit as MH014) with potential fault and strong adjacent epidote alteration. Sample not representative of entire outcrop.
18DL-AL001	Y554016	Ran	476486	5292671	Basalt	Pillowed basalt flow
18DL-AL002	Y554017	Ran	476661	5292612	Basalt	Silicified+sheared pillowed balsalt flow
18DL-AL003	Y554018	Ran	476751	5292660	Basalt	Silicified pillowed basalt with calcite microstringers
18DL-AL004	Y554019	Ran	476844	5292752	Basalt	Pillowed basalt flow
QAQC	Y554020				**STD**	**G314-4**
18DL-AL005	Y554021	Ran	476419	5292548	Basalt	Pillowed basalt flow
18DL-AL006	Y554022	Ran	476411	5292508	Basalt	Autobrecciated basalt flow
18DL-AL008	Y554023	Ran	474091	5285975	gabbro	Representative gabbro
18DL-AL009	Y554024	Ran	474082	5285968	basalt	Hornfelsed basalt
18DL-AL010	Y554025	Ran	474087	5285982	gabbro	Varitextured gabbro
18DL-AL011	Y554026	Ran	474088	5285956	Basalt	Pillowed basalt flow
18DL-AL012	Y554027	Ran	474064	5285791	Basalt	Autobrecciated basalt flow
18DL-AL013A	Y554028	Ran	474113	5285808	Basalt	Massive basalt flow
18DL-AL013B	Y554029	Ran	474113	5285808	Lapilli-tuff	Lapilli-tuff breccia
18DL-AL014A	Y554030	Ran	474385	5285803	gabbro	Representative gabbro
18DL-AL014B	Y554031	Ran	474385	5285803	Basalt	Sulfide-stained sheared basalt
18DL-AL015A	Y554032	Ran	474799	5285359	Basalt	Sulfide-stained sheared basalt
18DL-AL015B	Y554033	Ran	474799	5285359	Basalt	Sheared flow-top breccia w/qz vein material
18DL-AL016	Y554034	Ran	474776	5285355	Basalt	Pillowed basalt flow
18DL-AL018	Y554035	Ran	474681	5285639	Basalt	Massive basalt with sulfides
18DL-AL019	Y554036	Ran	474632	5285579	Syenite	Syenite breccia dike
18DL-AL021	Y554037	Ran	474559	5285601	Diorite	Diorite dike
18DL-AL022	Y554038	Ran	474525	5285566	Basalt	Massive basalt flow
18DL-AL024A	Y554039	Ran	474508	5285679	Basalt	Massive basalt with sulfide vein
QAQC	Y554040				**STD**	**G908-1**
18DL-AL024B	Y554041	Ran	474508	5285679	Basalt	Massive basalt with diss and stringer sulfides
18DL-AL025	Y554042	Ran	474338	5285836	Basalt	Strongly epidotized pillowed basalt
18DL-LR001A	Y554043	Ran	477608	5286210	basalt	chl + ep alt massive basalt
18DL-LR001B	Y554044	Ran	477608	5286210	basalt	chl + ep alt massive basalt
18DL-LR001C	Y554045	Ran	477608	5286210	qtz	qtz blob in basalt
18DL-LR002	Y554046	Ran	477523	5286248	basalt	magnetic basalt patch
18DL-LR003A	Y554047	Ran	477520	5286264	qtz	qtz blob
18DL-LR003B	Y554048	Ran	477520	5286264	felsic	felsic dike - for age dating?
18DL-LR003C	Y554049	Ran	477520	5286264	gabbro	big gabbro dike
18DL-LR004	Y554050	Ran	477413	5286440	basalt	massive basalt
18DL-LR006A	Y554051	Ran	477395	5286464	breccia	breccia of basalt clasts - thin section?
18DL-LR006B	Y554052	Ran	477395	5286464	breccia	sulfidic/rusty patch
18DL-LR007	Y554053	Ran	477386	5286400	diabase	diabase dike (?), tr sulfides
18DL-LB001	Y554054	Ran	476419	5293282	Gabbro	Representative
18DL-LB002	Y554055	Ran	476365	5293334	Basalt	Representative
18DL-LB003	Y554056	Ran	476384	5293292	Basalt	Representative
18DL-LB004	Y554057	Ran	476399	5293123	Gabbro	Representative
18DL-LB005a	Y554058	Ran	476415	5293092	Basalt	Representative, basalt w/ veins + alt halo
18DL-LB005b	Y554059	Ran	476415	5293092	Gabbro	Representative
QAQC	Y554060				**BLANK**	**CDN-10**
18DL-LB005c	Y554061	Ran	476415	5293092	Basalt	Basalt w/ milky quartz veins + alt halo
18DL-LB007a	Y554062	Ran	468205	5301989	Gabbro	Representative
18DL-LB007b	Y554063	Ran	468205	5301989	Diabase	Representative
18DL-LB008	Y554064	Ran	478455	5288397	Gabbro	Representative

18DL-LB009	Y554065	Ran	478451	5288367	Gabbro	Composite of Felsic Dike and Gabbro
18DL-LB010	Y554066	Ran	478990	5286890	Gabbro	Representative
18DL-LB012	Y554067	Ran	478964	5286862	Basalt	Representative (no milky quartz)
18DL-LB013	Y554068	Ran	478971	5286811	Basalt	Composite of Basalt and milky quartz
18DL-LB014	Y554069	Ran	478955	5286759	Basalt	Quartz veining and strongly silicified basalt prox. to veining
18DL-LB016	Y554070	Ran	479065	5286704	Gabbro	Representative
18DL-LB018	Y554071	Ran	477854	5288403	Gabbro	Representative
18DL-LB020	Y554072	Ran	477849	5288322	Basalt	Composite of shears, haloclast and silicified basalt
18DL-LB021a	Y554073	Ran	477952	5288013	Basalt	Carbonate and quartz+ proximal basalt
18DL-LB021b	Y554074	Ran	477952	5288013	Basalt	Fresh basalt
18DL-LB022	Y554075	Ran	477953	5288077	Gabbro	Gabbro Chill Margin
18DL-LB023	Y554076	Ran	477667	5288622	Gabbro	Representative
18DL-LB024	Y554077	Ran	477666	5288672	Gabbro	Representative
18DL-LR008	Y554078	Magni	468260	5302028	basalt	hornfelsed basalt off side of big gabbro oc
18DL-LR009	Y554079	Magni	468383	5301808	gabbro	med-grn, varitextured oc. Chiled margin?
QAQC	Y554080				**STD**	**G314-4**
18DL-LR010	Y554081	Magni	468475	5301477	diabase	dike in gabbro
18DL-LR012A	Y554082	Magni	468557	5301296	gabbro	vein host rock
18DL-LR012B	Y554083	Magni	468557	5301296	gabbro	area w/o vein in it
18DL-LR012C	Y554084	Magni	468557	5301296	gabbro	sheared area
18DL-LR012D	Y554085	Magni	468557	5301296	breccia	silicified breccia
18DL-LR013A	Y554086	Magni	468550	5301303	qtz vein	widest part of vein, dilation zone
18DL-LR013B	Y554087	Magni	468550	5301303	qtz vein	diff part of vein, 2 m SE of LR013A
18DL-LR013C	Y554088	Magni	468550	5301303	qtz vein selvege	chloritized, silicified, sulfidized selvege
18DL-LR014	Y554089	Magni	466158	5300565	gabbro	fine-grained, mod foliated
18DL-LR016	Y554090	Magni	466142	5300511	qtz diorite	
18DL-LR017	Y554091	Magni	467921	5301154	andesite	plag-phyrric hbl andesite
18DL-LR018	Y554092	Magni	467810	5301394	qtz vein	vein in gabbro, ep alt
18DL-LR019	Y554093	Magni	467768	5301315	andesite	hbl, chl-alt px
18DL-AL026A	Y554094	Magni	467180	5301449	gabbro	Quartz vein w/epidote alteration halo
18DL-AL026B	Y554095	Magni	467180	5301449	gabbro	Archean gabbro
18DL-AL028A	Y554096	Magni	467161	5301354	gabbro	Quartz vein w/epidote alteration halo
18DL-AL028B	Y554097	Magni	467161	5301354	gabbro	Archean gabbro
18DL-AL029	Y554098	Ran	479488	5289863	lapilli-tuff	Lapilli-tuff breccia
18DL-AL030	Y554099	Ran	477863	5291636	lapilli-tuff	Homogeneous gabbro
QAQC	Y554100				**STD**	**G908-1**
18DL-AL031	Y554101	Ran	477751	5291646	lapilli-tuff	Lapilli-tuff breccia
18DL-AL032	Y554102	Ran	477822	5286113	basalt	Silicified massive basalt flow
18DL-MH018A	Y554103	Magni	468214	5301392	Gabbro	Quartz vein and adjacent altered rock; sample is NOT representative of OC
18DL-MH018B	Y554104	Magni	468214	5301392	Gabbro	Gabbro (Archean); sample is representative of outcrop
18DL-MH019	Y554105	Magni	468397	5301320	Rhyolite	Anastamozing felsic dike (8 cm thick); sample is NOT representative of OC
18DL-MH020A	Y554106	Magni	468064	5300914	Quartz Vein	Quartz vein and surrounding silicified andesite; sample is NOT representative of OC
18DL-MH020B	Y554107	Magni	468064	5300914	Andesite	hornblende-plagioclase phyric andesite OC, sample is representative of OC
18DL-MH021	Y554108	Magni	467964	5300916	Basalt	silicified shear zone in hornblende-plagioclase-phyric massive basalt OC; sample is NOT representative of OC
18DL-MH022	Y554109	Magni	468003	5300775	Basalt	plag-phyric massive basalt with strong silification; sample is representative of OC.
18DL-LB026	Y554110	Ran	474197	5295365	Gabbro	Representative
18DL-LB027	Y554111	Ran	474931	5295469	Gabbro	Representative
18DL-LB028a	Y554112	Ran	475893	5292956	Basalt	Iron Formation
18DL-LB028b	Y554113	Ran	475893	5292956	Basalt	Basalt
18DL-LB029	Y554114	Ran	475796	5292990	Lapilli tuff	Representative
18DL-LB030	Y554115	Ran	475736	5292950	Lapilli tuff	Representative
18DL-LB031a	Y554116	Ran	475723	5292884	Basalt	Basalt
18DL-LB031b	Y554117	Ran	475723	5292884	Basalt	Iron Formation
18DL-LR020	Y554118	Ran	474205	5291711	basalt	peperite w/ basalt clasts, some sulfidic patches
18DL-LR021	Y554119	Ran	474457	5291766	basalt	variolitic massive basalt
QAQC	Y554120				**BLANK**	**CDN-10**
18DL-LR022	Y554121	Ran	477594	5291605	breccia	flow top or igneous breccia - clasts of basalt, granodiorite, and iron fmn
18DL-LR023	Y554122	Ran	477632	5291628	breccia	igneous breccia - clasts of basalt, iron fmn, and gabbro (?)
18DL-LR024	Y554123	Ran	477571	5291720	qtz diorite	intrusion that is likely responsible for ig breccia fmn at LR023 & LR024.
18DL-MH023	Y554124	Ran	475071	5295682	Gabbro	Gabbro OC with moderate saussuritization. Sample is REPRESENTATIVE of OC.
18DL-MH025	Y554125	Ran	476581	5293242	Basalt	Massive plag-phyric basalt with pyrite stringers. Sample is REPRESENTATIVE of OC.
18DL-MH026	Y554126	Ran	476606	5293233	Basalt	Massive basalt OC with stockwork quartz veining and associated epidote alteration. Sample is REPRESENTATIVE of OC.
18DL-MH027	Y554127	Ran	476717	5293259	Basalt	Massive basalt with minor silification and wispy quartz veining with strong associated epidote alteration. Sample is REPRESENTATIVE of OC.
18DL-MH028	Y554128	Ran	476646	5293328	Basalt	Massive plag-phyric basalt with bull quartz veins. Sample is REPRESENTATIVE of OC.
18DL-MH029	Y554129	Ran	477181	528614	Basalt	Massive plag-phyric basalt with strong silification and a sugary texture. Sample is REPRESENTATIVE of OC.

8.4 Appendix 4 – Geospatial data sources

A comprehensive review of publicly available geological data (spatial and reports) was conducted prior the BRE field mapping program. Five data sources were searched for relevant geological or mineral potential data:

- United States Geological Survey National Geological Map Database (NGMDB)
https://ngmdb.usgs.gov/mapview/

- Minnesota Geological Survey (MGS)
https://conservancy.umn.edu/handle/11299/708

- Minnesota Department of Natural Resources – Mineral Potential Reports (MN DNR)
https://www.dnr.state.mn.us/lands_minerals/mpes_projects/index.html

- Minnesota Department of Natural Resources – MINArchive (historical industry files, reports, and drill logs)
http://minarchive.dnr.state.mn.us/cgi-bin/query.pl

- University of Minnesota – Natural Resources Research Institute – Economic Geology Group (NRRI)
https://www.nrri.umn.edu/strategic-research/minerals-metallurgy-mining/economic-geology

Relevant data sources obtained from these sources are included in the digital data appendix.

The principal data sources found that assisted with planning the mapping program are:

- Bedrock Geology, Bigfork Quadrangle, 1:100,000, Map M-76
- MN DNR Aggregate Resource Potential Maps for Itasca County
- LIDAR Elevation Data (hosted on MN Geospatial Commons)

The Bigfork Quadrangle map provided a starting point for known outcrop locations and nomenclature of known rock types. The MN DNR Aggregate Resource Potential maps are completed analyses that incorporated bedrock type, depth to bedrock, and known outcrop exposure. These maps are colored coded based on a high, medium, and low potential for finding an aggregate source. BRE assumed that any high or medium potential areas should be prioritized for locating outcrops on AGAM's leased areas.

For potentially unmapped outcrops, a slope analysis using LIDAR (2 ft resolution) was reviewed. BRE assumed that bedrock exposure would likely have exposed sides of greater than angle of repose of sand (glacial till). We combined these locations with the MN DNR Aggregate Potential map to identify additional potential outcrop exposure areas.

8.5 Appendix 5 – File directory for shared folder

The following is a breakdown of all data captured, compiled, and organized by Big Rock Exploration for AngloGold Ashanti Minnesota (AGAM) on their Deer Lake regional mapping project in August 2018.

The primary compilation of geospatial data is assembled in one Esri Map Package (.mpk). This package, “DeerLake_GeospatialData.mpk” is stored in the GeospatialData → MXD_MPK folder. A basic outline of the folder structure is below, but we wanted to call special attention to the location of the primary ArcGIS (*ArcMap*) deliverable. All the data referenced in the MPK is coming from the DeerLake_Geospatial_Data.gdb. This geodatabase contains every Esri Feature Class created, used, clipped, or modified during this project. All vector data is within specific feature data sets that have the defined projection of UTM NAD83 Zone 15 N (Nad 83 conus Datum).

We would also like to draw special attention to the location of all the field work, notes, and maps. These documents have all been scanned and are in the FieldData folder. For your convenience, all the maps and notes have been compiled into a single PDF located at the top of each folder. Also note that a map of the AOI field mapping Grid Index is in the scanned field maps folder to give each map spatial context.

Please also note the presence of “ReadMe” text files. Many folders contain a “ReadMe” document that acts as a guide for users to locate information quickly. Please use these to help familiarize yourself with the contents of each major folder.

A basic overview of the folder structure: (most folders contain an Archive folder to keep a record and backup of older data versions).

Data **Folder**

Archive	Old versions of files or data
DNR Drill Logs	Scanned drill logs from the MN DNR in PDF format
FieldData	Notes, maps, and photos created in the field
GeospatialData	ArcGIS map packages and other GIS data
LabAnalysis	Sampling and assaying data
Literature	Library of compiled articles and papers
Maps	Maps compiled or generated by Big Rock

FieldData **Folder**

Field_Photos	Photos labeled by field station ID
FieldDataSpreadsheets	Tabular compilation of all field data
Scanned_FieldMaps	Scanned PDF copies of all field base maps
Scanned_FieldNotes	Scanned PDF copies of all field notes

***GeospatialData* Folder**

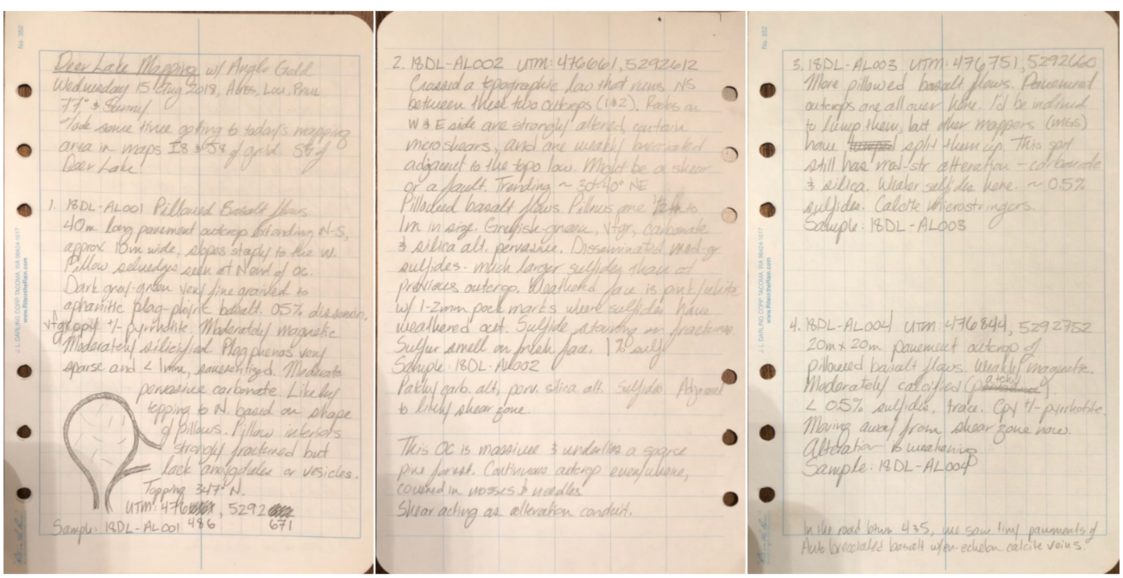
Archive	Old versions of files or data
DeerLake_Geospatial_data.gdb	Esri Geodatabase compilation of all field data
Geology	Compiled geology maps, docs, and data
GPS	GPS waypoints and tracks
Imagery	Aerial photos
KMZ	Google Earth data
MXD_MPK	Esri Map documents and packages
Tables	Additional tabular data
x LayerFiles	Esri Layer files (MGS bedrock color scheme)

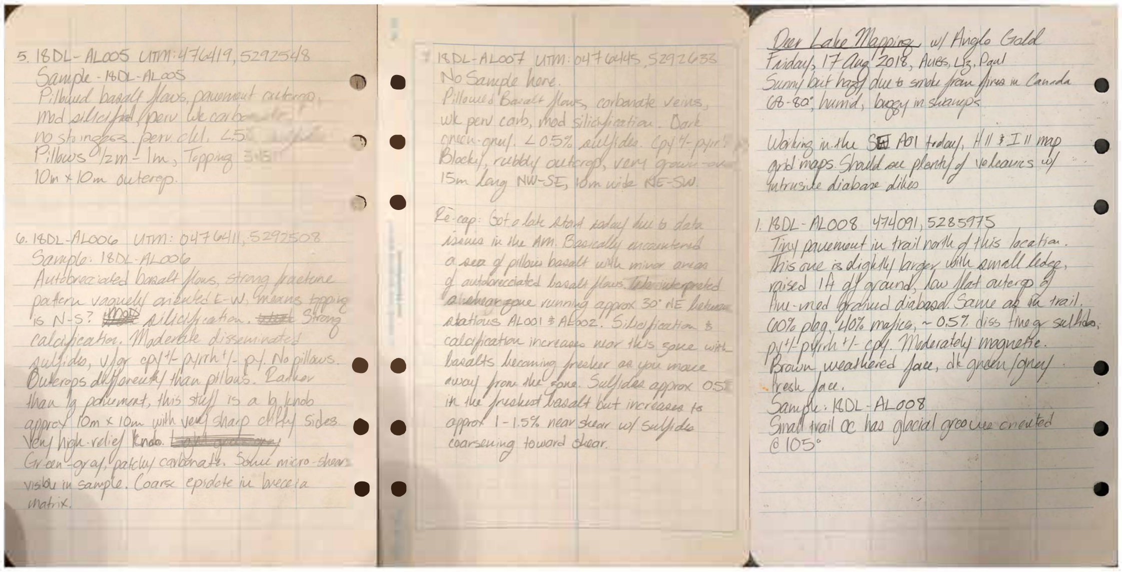
***Maps* Folder**

BRE Generated	Maps created by BRE prior to and after field work
Public	Maps compiled by BRE organized by size

8.6 Appendix 6 – Scanned Notes and Maps

The following images are scanned field notes and base maps. Field notes are first organized in alphabetical order of geologist, and sub-organized in order of field station. Big Rock geologists in alphabetical order are Aubrey Lee, Louis Baggetto, Liz Roepke, and Michael Harrigan. Field maps are first organized E-W, then N-S in the order they were gridded (Appendix 2). Only field maps that were used to collect data are shown here – blank maps with no outcrop are omitted.





5. 18DL-AL005 UTM: 476419, 5292548
Sample - 18DL-AL005
Pillowed basalt flows, pavement outcrop, mod silicified/perv wk carbonate?, no stringers. perv chl. <5% sulfide
Pillows ½m-1m, Topping 3-15°
10m x 10m outcrop.

6. 18DL-AL006 UTM: 0476411, 5292508
Sample: 18DL-AL006
Autobrecciated basalt flows, strong fracture pattern vaguely oriented E-W. Means topping is N-S? silicification. Strong calcification. Moderate disseminated sulfide, v/or cpy ½-pyrrh ½-py. No pillows. Outcrops different than pillows. Rather than lg pavement, this stuff is a lg knob approx 10m x 10m with very sharp clifty sides. Very high-relief knob. Green-gray, patchy carbonate. Some micro-shears visible in sample. Coarse epidote in breccia matrix.

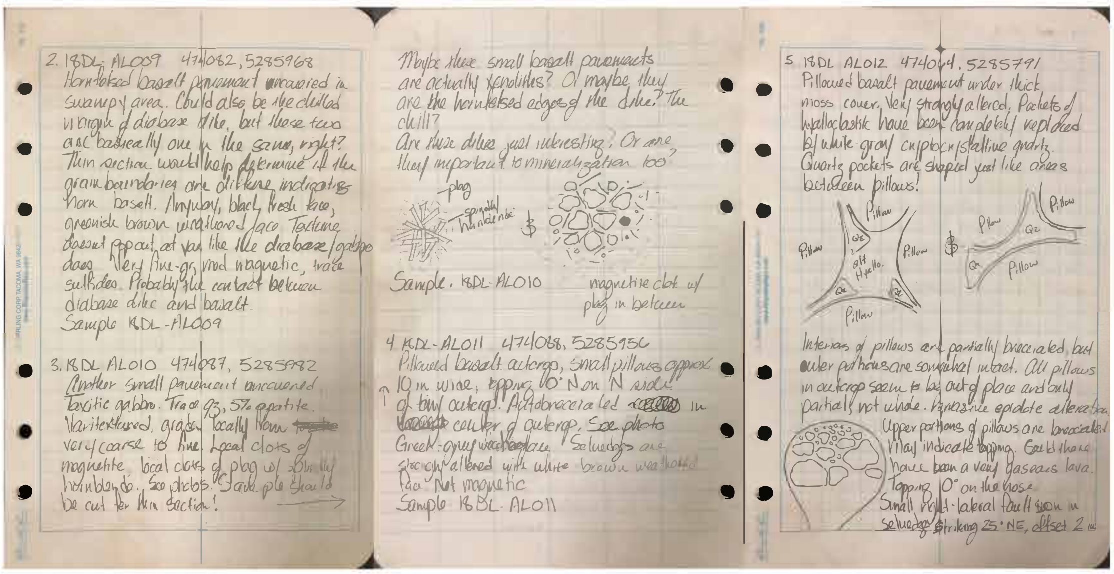
7. 18DL-AL007 UTM: 0476445, 5292655
No Sample here.
Pillowed Basalt flows, carbonate veins, wk perv carb, mod silicification. Dark green-gray. <0.5% sulfide. cpy ½-pyrr ½.
Blocky, rubbly outcrop, very green color
15m long NW-SE, 10m wide NE-SW.

Re-cap: Got a late start today due to data issues in the AM. Basically encountered a sea of pillow basalt with minor areas of autobrecciated basalt flows. a shear zone running approx 30° NE between stations AL001 & AL002. Silicification & calcification increases near this zone with basalts becoming fresher as you move away from the zone. Sulfides approx 0.5% in the freshest basalt but increases to approx 1-1.5% near shear w/ sulfide coarsening toward shear.

Dee Lake Mapping w/ Anglo Gold
Friday, 17 Aug 2018, Ames, Liz, Paul
Sunny but hazy due to smoke from fires in Canada
68-80°, humid, buggy in swamps

Working in the SE A01 today, H II & I II map grid maps. Should see plenty of volcanics w/ intrusive diabase dikes

1. 18DL-AL008 474091, 5285975
Tiny pavement in trail north of this location. This one is slightly larger with small ledge, raised 1ft off ground, low flat outcrop of fine-med grained diabase. Same as in trail. 60% plag, 40% mafics, ~0.5% diss fine-gr sulfides. py ½-pyrrh ½-cpy. Moderately magnetic. Brown weathered face, dk green/gray fresh face.
Sample: 18DL-AL008
Small trail oc has glacial grooves oriented @105°



2. 18DL-AL009 474082, 5285968
Hornfelsed basalt pavement uncovered in swampy area. Could also be the chilled margin of diabase dike, but these two are basically one in the same, right? Thin section would help determine if the grain boundaries are diffuse indicating horn basalt. Anyway, black fresh face, greenish brown weathered face. Texture doesn't pop out at you like the diabase/gabbro does. Very fine-gr, mod magnetic, trace sulfides. Probably the contact between diabase dike and basalt.
Sample 18DL-AL009

3. 18DL AL010 474087, 5285982
Another small pavement uncovered. Taxitic gabbro. Trace qz, 5% apatite. Varitextured, grades locally from very coarse to fine. Local clots of magnetite, local clots of plag w/ spindly hornblende. See photos. Sample should be cut for thin section! →

Maybe these small basalt pavements are actually xenoliths? Or maybe they are the hornfelsed edges of the dike? The chill?
Are these dikes just interesting? Or are they important to mineralization too?

plag
spindly hornblende
magnetite clot w/ plag in between

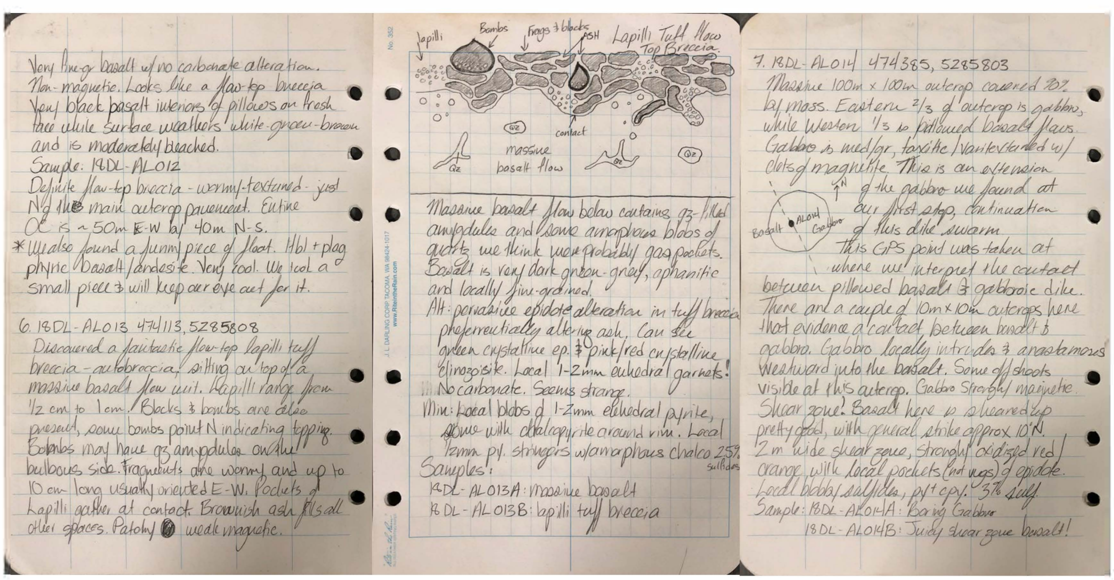
Sample: 18DL-AL010

4. 18DL-AL011 474088, 5285956
Pillowed basalt outcrop, small pillows approx 10 m wide, topping 0° N on N side of tiny outcrop. Autobrecciated in center of outcrop. See photo
Green-gray weathered face. Selvedges are strongly altered with white brown weathered face. Not magnetic
Sample 18DL-AL011

5. 18DL AL012 474064, 5285791
Pillowed basalt pavement under thick moss cover. Very strongly altered. Pockets of hyaloclastite have been completely replaced by white gray cryptocrystalline quartz. Quartz pockets are shaped just like areas between pillows!

Pillow
Qz
alt Hyallo.

Interiors of pillows are partially brecciated, but outer portions are somewhat intact. All pillows in outcrop seem to be out of place and only partial, not whole. Pervasive epidote alteration.
Upper portions of pillows are brecciated. May indicate topping. Could there have been a very gaseous lava.
Topping 0° on the nose
Small right-lateral fault seen in selvedge striking 25° NE, offset 2 m



Very fine-gr basalt w/ no carbonate alteration. Non-magnetic. Looks like a flow-top breccia
Very black basalt interiors of pillows on fresh face while surface weathers white-green-brown and is moderately bleached.
Sample: 18DL-AL012
Definite flow-top breccia - wormy-textured - just N of the main outcrop pavement. Entire OC is ~50m E-W by 40m N-S.
*We also found a funny piece of float. Hbl + plag phyric basalt/andesite. Very cool. We took a small piece & will keep our eye out for it.

6. 18DL-AL013 474113, 5285808
Discovered a fantastic flow-top lapilli tuff breccia - autobreccia, sitting on top of a massive basalt flow unit. Lapilli range from ½ cm to 1 cm. Blocks & bombs are also present, some bombs point N indicating topping. Bombs may have qz amygdules on the bulbous side. Fragments are wormy and up to 10 cm long usually oriented E-W. Pockets of Lapilli gather at contact. Brownish ash fills all other spaces. Patchy weak magnetic.

lapilli
Bombs
Frags & blocks
ASH
Lapilli Tuff Flow Top Breccia.
Qz
contact
massive basalt flow

Massive basalt flow below contains qz-filled amygdules and some amorphous blobs of quartz we think were probably gas pockets. Basalt is very dark green-grey, aphanitic and locally fine-grained.
Alt: pervasive epidote alteration in tuff breccia preferentially altering ash. Can see green crystalline ep. & pink/red crystalline clinozoisite. Local 1-2mm euhedral garnets! No carbonate. Seems strange.
Min: Local blobs of 1-2mm euhedral pyrite, some with chalcopyrite around rim. Local ½mm py. stringers w/amorphous chalco 2.5% sulfides
Samples:
18DL-AL013A: massive basalt
18DL-AL013B: lapilli tuff breccia

7. 18DL-AL014 474385, 5285803
Massive 100m x 100m outcrop covered 90% by moss. Eastern ⅔ of outcrop is gabbro, while Western ⅓ is pillowed basalt flows. Gabbro is med/gr, taxitic/varitextured w/ clots of magnetite. This is an extension of the gabbro we found at our first stop, continuation of this dike swarm.

N
Basalt
AL014
Gabbro

This GPS point was taken at where we interpret the contact between pillowed basalt & gabbroic dike. There are a couple of 10m x 10m outcrops here that evidence a contact between basalt & gabbro. Gabbro locally intrudes & anastamoses westward into the basalt. Some offshoots visible at this outcrop. Gabbro strongly magnetic. Shear zone! Basalt here is sheared up pretty good, with general strike approx 10°N. 2 m wide shear zone, strongly oxidized red/orange with local pockets (not vugs) of epidote. Local blobby sulfides, py + cpy. 3% sulf.
Sample: 18DL-AL014A: Boring Gabbro
18DL-AL014B: Juicy shear zone basalt!

Re-Cap: Encountered some very interesting basalt flows, flow-top breccias, shear zones and gabbroic dikes today. Didn't see nearly as many MGS-mapped outcrops as we expected, but what we did see was very good. Turns out the diabase dikes related to the dike swarm are about 100-200m wide. They are also more gabbroic than diabasic. Magnetic geophysical maps seem to verify the dikes' width.

- Basalt flows in the area vary from massive to pillowed with local flow-top breccias and lapilli-tuff breccias. Tuff breccias are strongly epidotized w/ ep +/- clinozoisite + gt. What could the presence of euhedral garnets imply about alteration facies? Sulfides are present in the altered lapilli-tuff breccia up to 25%: euhedral py w/ cpy rims, amorphous cpy, & py + cpy stringers.
- Found a minor shear zone at the end of the day with red/orange staining, lots of sulfides, cross-cutting bedding. Going to chase it down tomorrow.

Deer Lake Mapping w/ Anglo Gold
Saturday, 18 Aug 2018 Aubs & Liz
Overcast and humid, 70-80° buggy but getting a slight breeze on big knobby outcrops.
SE AOI, in SW corner of Wilson Lake
Came back to the same area as yesterday to follow the shear zone we found. At the head of the trail, we ran into a local man on a quad, white guy ~60 yrs old, two dogs named Buddy & Hunter. Didn't catch the man's name. Talked about what we are doing, he was very friendly and thought we might know Jim MacArthur & Edwin Boeglund, geos who used to work at UMD and have a cabin out here. His son/nephew (?) named Mike is the mayor. He told Liz & I that we should be doing something more glamorous!

1. 18DL-AL015 474799, 5285359
Large knobby outcrop just south of trail at the bottom of the group of outcrops trending NW. Difficult to peel due to trees growing all over, had to get all the roots which seem to grow where rock is weak & sheared. Massive and pillowed basalt with moderate shearing, local quartz veins and nodules. Shear fabric runs 0° N-S. Massive basalt flow is topped on N side by what looks like may have been a flow-top breccia with brown-weathered ash intermingled with basalt blocks. Basalt is weathered light green-grey while fresh face is dark green-grey. Flow-top, oriented 90° E-W, topping 0° N, seems to take up most of the outcrop, though massive unit is also moderately altered. Rock flakes when hammered. 2-3mm euhedral chlorite proximal to shear in massive basalt. Shearing plane measured at 078/89, dipping E. Very flaky. Weak sulfide staining, but <0.5% visible sulfides. Weakly silicified, strongly chloritized. carbonatized.
Sample 18DL-AL015A - make thin section
Sheared Basalt
18DL-AL015B - Sheared flow-top breccia w/ qz vein material.

*Reminder: declination!

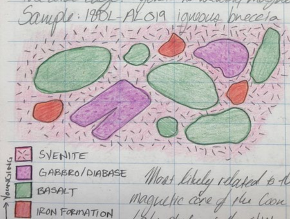
2. 18DL-AL016 474776, 5285355
Pillowed basalt flows in a few whaleback outcrops. Difficult to determine topping due to rubbliness of outcrop surface, but one large pillow seems to be pinching in a way that suggests topping to the N. Pillows vary in size from 20cm to 1m diam. Cores have a pock-marked surface where epidote & clinozoisite alteration is prominent. Weathered face is pink-yellow-green. Fresh face is dark green. No shearing here. Local 1mm cpy +/- py stringers and < 0.5% diss euhedral py cubes up to 2mm. Local iron formation nodules.
Sample: 18DL-AL016 pillowed basalt

3. 18DL-AL017 474829, 5285286
Weakly sheared basalt, intact pillow selvedges, moderate chlorite alteration, sulfide staining. Outcrop just south of prev. station. Prominent Mn oxide staining of some shear faces. We'll take another sample when we get close to the shear. Local iron formation nodules.
Shearing ~ 0° N.

4. 18DL-AL018 474681, 5285689
Massive basalt flow on N side of trail. Two outcrops, weathered face is white-pink while fresh is green-grey, aphanitic. Trace magnetic. Chloritized, silicified (mod), w/ up to 3% sulfides. Some are very fine-grained disseminated py + cpy and others are 1mm py cubes. Sulfide stringers (1mm) also present.
Pipe vesicles ~~orien~~ qz-filled oriented approx N-S, topping is to N. Qz amygdules up to 2cm diam. Sulfide staining on fracs.
Sample: 18DL-AL018 massive basalt w/ sulf.

5. 18DL-AL019 474682, 5285579
Crossed back to the S side of the trail & encountered multiple outcrops oriented E-W. All med-coarse-gr gabbro. However, the far E outcrop in this group is quite unusual (located at this waypoint). It is an igneous breccia of basalt, iron fm and diabase clasts in a med-grained matrix of syenite. →

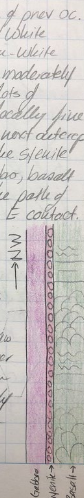
Syenite has 10% plag, 5% qz, 15% hbl & 70% kspar, weathers pink w/ black spots. Fresh face is grey-pink w/ black spots. Hbl is euhedral, kspar is subeuhedral, plag + qz are anhedral. Clasts are rounded to sub-rounded and range from 1 to 30cm diam. Edges seem sharp at first glance but are actually partially resorbed. Cannot get a true orientation of this, but generally seems to run NW-SE, along trend with the diabase dikes. These thing may be intruding along the dike edge. Syenite is weakly magnetic.
Sample: 18DL-AL019 igneous breccia



Most likely related to the magnetic core of the Coon Lake pluton to the NW.

6. 18DL-AL020 474624, 5285573
Large outcrops on the W side of prev oc. All gabbro. Med-coarse-gr, Black/White weathered face, Black/Green-White fresh face, 1% diss sulfides, moderately magnetic, taxitic with local clots of magnetite, locally coarse, locally fine. E contact weathered out, but next outcrop to the E is the previous one; the syenite igneous breccia w/ clasts of gabbro, basalt & iron fm. Probably followed the path of least resistance along the dikes E contact.

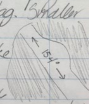
Re-cap: encountered a 2m wide shear in basalt at the southern extent of this outcrop chain. This shear doesn't line up with the shear we saw yesterday. Also saw a felsic dike on the E side of larger gabbroic dike with lots of clasts from regional rocks. It is most likely related to the nearby Coon Lake pluton of syenite.



Deer Lake Mapping w/ Anglo Gold
Sunday 19 Aug 2018, Liz & Aubs
Overcast and humid, 70-80°, may rain later. Bugs are pretty bad. Back to finish up same region we've been *CHANGED DECLINATION to 1°

1. 18DL-AL021 474559, 5285601
Very large gabbro pavements, 50m across 40m long N-S. This location has a 1ft m-gr diorite dike running through it. Diorite is 80% plag and 20% pyroxene w/ trace fine-gr diss sulfides (py +/- cpy) & trace qz. Strongly epidotized plag xtals. White weathered face, dark grey-blue fresh face. Non-mag. Gabbro is med-gr, mod mag, plag, px, ~~mt~~. Back to the diabase, it has bimodal plag w/ some lightly-altered 5m long euhedral plag in matrix of 1m sub-anhedral plag. Smaller plag matrix is more epidotized.
Sample: 18DL-AL021 Diorite dike

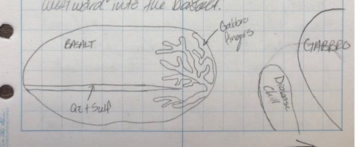
Dike trends 154°



2. 18DL-AL022 474525, 5285566
Very strongly silicified, vf gr, minor qz nodules throughout. No carbonate. Trace sulfides.
Contact to E w/ diabase is inferred.
Sample: 18DL-AL022

3. 18DL-AL023 474497, 5285700
Gabbro, med-coarse, taxitic, pyroxene clots up to 5cm. 1% diss sulfides.

4. 18DL-AL024 474508, 5285679
Large 10m x 5m SW trending whaleback outcrop of moderately silicified & strongly hornfelsed basalt. Very fine-gr basalt w/ 1-3mm qz vein stockwork, most veins are discontinuous. 2cm-wide red-brown vein carrying sulfides runs 055/54° SE. Basalt contains ~ 1.5% diss fine-gr sulfides, py +/- cpy. To E is gabbro & a small outcrop of that gabbro is a very fine-gr diabase chill margin. Actual contact is not exposed. However, on the E side of outcrop, many small fingers of coarse gabbro have intruded westward into the basalt.



Sample: 18DL-AL024A Basalt w/ sulfide veins

Basalt also has light green chlorite along qz vein contacts and local 1mm euhedral chlorite (dk-green) porphyroblasts.
SSW of previous sample about 50 ft is another SW-trending basalt outcrop with an area strongly stained with sulfide. More knobs & silicified basalt dark - full of pyrite. .1-1mm disseminated py & 0.5mm of stringers. Local rip-up clasts of iron formation no more than 1 ft diam. Partially fractured & brecciated.
Sample: 18DL-AL024B Basalt w/ diss sulf & sulf stringers.

5. 18DL-AL025 474338, 5285836
Round knob outcrop ~ 20m diam. of very strongly epidotized silicified pillow basalt. Pillow selvedges are not well defined and look broken, bent, and jumbled, but the pillows seem mostly intact but some look as though they were overtaken by other pillows. Topping is approximately N, evidenced by amygdules (qz) and pipe vesicles (ep+qz).

However, some indicate topping to W and NE, so maybe these are structurally deformed? Most notable is the very strong green epidotization of some pillows but not all pillows. Some of the pillows are dark green-grey & not epidotized while others are completely replaced by ep. from rim to core. ~~[illegible]~~ about 50/50. Most of the selvedges are also completely epidotized. Outcrop surface is a jumbled mess of pistachio green blobs intermingled with dark grey-blue-green blobs. Local sulfide staining throughout. Unaltered pillows weakly magnetic w/ diss. sulfides (py + cpy) while epidotized pillows are non-magnetic & contain no sulfides (visible). Qz nodules & qz-replaced hyaloclastite also present throughout outcrop.
Sample: 18DL-AL025 Epidotized pillow basalt

ALT? There were more epidotized pillow outcrops to the NW that looked exactly like this one.

Re-cap: Finished up mapping this SW area of the SE A01. The upper reaches of an epithermal zone occur here. Pillowed basalts are strongly epidotized in a region approx 1/4 square mile. A few small shears occur throughout zone and run perpendicular to bedding w/ prominent sulfide staining. All archean volcanic sequences cut by proterozoic gabbro dikes. Any mineralization is unlikely to be associated with these dikes.

Deer Lake Mapping w/ Anglo Gold
Tuesday, 21 Aug 2018, Louis & AUBS
Overcast & cool, Rainy AM, Sunny afternoon, Bugs aren't too bad. Working in "Magni" A01 NW of Deer Lake. Lg outcrop off 525 should be all archean gabbro.

1. 18DL-AL026 0467180, 5301449
Weathered, hornfelsed, altered archean gabbro. Looks very different than the proterozoic gabbro dikes. Strong pervasive hornfels, weak magnetism, Qz-vein stockwork throughout w/ epidote alteration halos around 90% of veins. Veining takes up 2% of outcrop/rock. Weak pervasive epidote alteration throughout, very strong ep. alt halos on qz veins. Most halos only a few mm, one is 10cm wide (total halo). Plag & px grain boundaries are diffuse and difficult to make out due to hornfels texture. ~~[illegible]~~ quartz - moderate silicification, not primary quartz. No sulfide
Sample: 18DL-AL026A Qz vein + ep alt halo
Sample: 18DL-AL026B Rep. Archean Gabbro

2. 18DL-AL027
Same as previous. Qz vein w/ 10cm. wide ep. halo strikes 268° W.
Rock surface is polished proximal to qz vein. Vein anastamoses all over the place but it's general trend is 268° W

3. 18DL-AL028 467161, 5301354
Archean gabbro. Salt & pepper weathered face w/ qz veining throughout. Major qz vein running 285° W, inconsistent width ranging from 20cm to 5cm wide with 3 main qz veins w/in zone. Ep alt halo ~ 1/2 m wide but not as strong as in ~~[illegible]~~ 1st 2 outcrops. Call it moderate. Vein is offset along a shear 2cm wide trending 185°; offset 5cm. Nearby qz vein offset 1cm. Small shears anastamose and horsetail all over this outcrop, as do a number of smaller qz veins. Veins make up 2% of this rock.
Gabbro is weakly hornfelsed, can see shapes of plag xtals much better here.
Chlorite alteration is moderate & pervasive.

18DL-AL028A
Sample: Qz vein material w/ ep alt.
Sample: 18DL-AL028B Composite Archean Gabbro

No visible sulfides. Weakly magnetic. Moderately pervasive silicified.

* Now we have to bush-whack about 0.4 mi to get to the next series of outcrops. We probably won't be able to spend much time there.
* Only made it halfway there - swamp was impassable

• Back down in SE A01 "RAN", headed to an outcrop in the far SE, OC is a 1/2 mile in the woods W of the Dahlberg Road.

4. 18DL-AL029 479488, 5289863
Lapilli Tuff breccia flow top with intermittent pillow basalts. Pillows are very large, on the order of 1m diam. Hyalloclastite pillow selvedges are very

wide - on the order of 5-10cm wide. Tuff unit indicates strike @ 285° E-W, while pillows indicate topping 25° NE. Pillows are weakly epidotized in cores. Entire rock is strongly chloritized but most strongly in glassy hyalloclastite. Moderate silicification throughout whole rock. Lapilli are prominent, occur in pockets w/in tuff breccia and oddly, at the base of pillows. Minor qz-filled amygdules at the top of pillows. 2-3cm qz vein runs through tuffaceous section. Trace pyrite throughout.

Sample: 18DL-AL029 Composite Lapilli Tuff Breccia.

Re-cap: Started off in Magni property on a very large well-exposed outcrop of altered, veined archean gabbro. Then we went to the Ran property & hiked 1/2 mile through swamp to outcrop of lappilli tuff breccia.

Deer Lake Mapping w/ Anglo Gold
Thursday 23 Aug 2018, MIKE & AUBS
Sunny, 75°, moderately humid, not too buggy

1. 18DL-AL030 0477863, 5291636
Fresh med-gr gabbro, mod magnetic, no structure, trace sulfides (py + cpy). Trace sauss of plag. Dark grey fresh face, white-brown weathered face. Mapped by MGS as a large outcrop, but the N 3/4 of it is covered in 5 ft of till, only southern 1/4 is exposed as a 1m high ledge. Homogenous.
Sample: 18DL-AL030 Homo Gabbro

2. 18DL-AL031 0477751, 5291646
Lappilli Tuff flow-top breccia, round-sub rounded clasts of grey cherty iron fm and a few red banded iron fm. Clasts 1cm - 2cm diam. Mod silicification - pervasive, wk perv. chl, trace patchy ep. Qz-filled amygdules. Pockets of lapilli. 60% of rock is ash. Wk sulf staining. No visible
Sample: 18DL-AL031 Lapilli tuff brx

N of Hwy 52, outcrop E. of 544 trail
3. 18DL-AL032 477822, 5286113
Lg mapped outcrop (MGS) is a series of knobs. Far W side, this location has an orange-brown weathered face, light grey fresh face. Aphanitic, phyric, w/ 1m xtals, sulfides, trace hornfels texture, trace silicified. Outcropping knob only 10m diam. Directly E is another knob of pillowed flows topping 195° S. Overturned. Pillows very small, only 10cm diam avg. & teardrop shaped with qz-filled amygdules around sides and bot top. Massive flows and lapilli tuff hyalloclastite breccias to the East.

SAMPLE: 18DL-AL032
Massive flow.

4. 18DL-ML033 477603, 5286122
Found Crop! Gabbro, med-gr. fresh, trace cpl + pl. Trc sul. Lines up well w/ gabbroic dike running NW in outcrop directly NW of here.

Recap: Terrible day. Incredibly swampy, hardly saw any rocks. Getting pretty fatigued.
First two outcrops were deep in a swamp. Mostly lapilli tuff/breccia w/ large clasts of gabbro, ind formation, and quartz nodules.
Second two outcrops were in southwest Ran property. Both were more silicic magma, trachyte? Small pillows w/ lapilli tuff breccia & dacite massive flows. Small pillows may be the result of more silicic/viscous lava flows!

Date 8/14

Two Properties "MAGNY" NW "RAND"

ON RAND
·18DL-LB001 — wp 047
GABBRO 0476419 5293282
·~~Malaysee~~ pavement outcrop 15×10m (Sampled)
~~Pyx 80-90%, 10-20 plag~~
~~Strong~~ magnetic, med grained.
· Plag 50-60%, Pyx 25-35%, magnetite 10%, Sulfide (Pent?) 2-3%
· Trace Saussuritization of plag
Glacial (striations) Gneiss @ 210

·18DL-LB002 476365/5293334
BASALT, Pillows, Small OC 3×5m
~~Vesicles obs.~~ Amygdules obs. - Qtz 0.25-1cm
Topping to 345°
Plag-Phyric, f.g; <1% Sulfides
V. weak mag.
Chl. Alt.
Striations @ 120 (Sampled)

18DL-LB003 476534/5293292
(Sampled)
BASALT, MASSIVE (less pronounced than other outcrops)
OC. 2-3 m, mod. mag., unaltered
Peridotite clots, v fg, magnetic, blobs 0.25-0.5cm, <1% sulfide

18DL-LB004 476399/5293123
Gabbro (Sampled)
·Medium grain Plag 60-70%, Pyx 30-40%
·Sulfide clots 1-2%
·Plag has striations. Small OC, Blocky 1-2m
·Strong Mag

18DL-LB005 476415/5293092
~~Bsf~~ Basalt, massive, plag-phyric
OC. Pavement 9×8m >1% sulfides
·To the North, there is Gabbro chill margin
·weak magnetic
·Basalt has randomly oriented Qtz veins, two obs. xcutting.
·The OC is blocky in some places, and vuggy in others
·Veins 0.1-4cm
·Epidote + Sericite Alt halos up to 2cm wide on either side of vein →

Location → To SE of other samples
(Basalt w/ milky vein + Alt halo Sampled 18DL-LB005 C)
~~Bsf~~ (Basalt w/ veins + Alt halo Sampled 18DL-LB005 A)
(Gabbro chill marg. Sampled 18DL-LB005 B)
↗ Gabbro chill margin
V. fg gabbro, weakly magnetic plag-phyric in contact w/ Basalt
Pavement on the NE, 2m wide
Quickly disappears into cover

18DL-LB006 476408/5293076
Basalt, massive, large 12×6m knob OC.
·Pervasive Epidote and ~~clyde~~ clynozoisite (pink) throughout OC ~~[illegible]~~
·Qtz vein obs. - Similar to last stop
·Epidote + sericite selvege prox to vein.
·Sulfide clots obs. ~1%
·weakly magnetic

18DL-LB007 468205/5301989
Gabbro OC, V large knob
-med Grain 65-75 plag, 25-35 pyx
-weak Saussurite. pyx clots, up to 2cm
-Non mag
-OCC. Basalt Xenolith, small 5cm
->1% Sulfide clots - silver color
~~Glacial Striation @ 130~~
(Sampled) 18DL-LB007A) ↑

DIABASE Dike, ~1-2m wide
V. fine grain, plag-phyric
V. minor sulfides, Disseminated
Weakly magnetic, stronger on edges of Dike
Dike trend @ 130
(Sampled Dike 18DL-LB007B)
Flow Banding of the plag // to Dike Strike
Samples taken ~10m ~~apt~~ apart.

Date 8/17/18
RAN Property
18DL-LB008 478455/5288397
-Gabbro OC, Pavement ~15×20m
· 65% Plag, 30% Pyx, 4% Bt. <1% pyrite
· mod Saussuritization, plag being alt. to epidote, chlorite
· Tr. magnetism
(Sampled)
· Py crystals up to 2×1mm
· Med grain size

18DL-LB009 478451/5288367
·Gabbro OC, lots of patches of pavement
· V. similar to last OC, Pyx coarser
· increased Alt, mod/strong Sauss.; plag "more" blue.
· 4cm wide aphanitic felsic dike, very // edges, v. little variation in width 215 trend. Qtz + v.fg minerals
· Dull white color, from Alt?
· Strong green mineral (epidote?) 2%, ~0.5×4mm strings of crystals
(Sampled - composite

18DL-LB010 478940/5286890
Gabbro, V. large OC that forms 10×20 knobs ~~that~~ stick up. Stack ontop of eachother with lows between. Pain in ass to cross!
·Plag 57%, Pyx 37, Biotite 2.5%, >1% sulfide, magnetite 3%
·Moderately Saussuritized plag blue and green (chl, epidote)
·Rare clots of magnetite, 1cm
·Whole rock mod magnetic
·Med coarse grain size
(Sampled)

18DL-LB011 0478979/5286877
Approx contact between Gabbro & Basalt; ~~contact~~ width in 4m.

18DL-LB012 478964/5286862
Basalt, Pillows Topping 315°
Blue hue, weak silicification,
Non magnetic. One block 3×2cm milky Qtz chunk obs.
Sampled

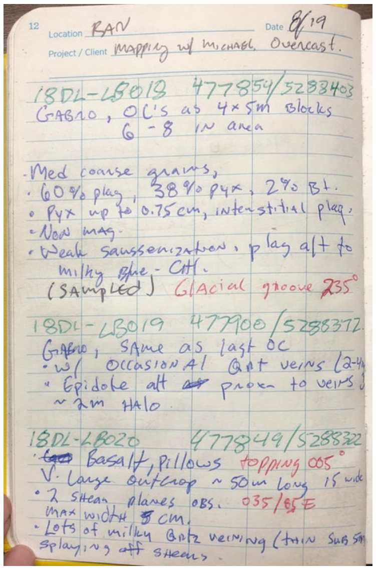
18DL-LB013 478971/5286811
·Pillow Basalt Topping 020°
Same as last OC, w/ the
·Milky Qtz replacing the Hyaloclast between the pillows.
(Sampled composite Qtz + Basalt)
~ Half of Haloclasts on OC have been replaced.

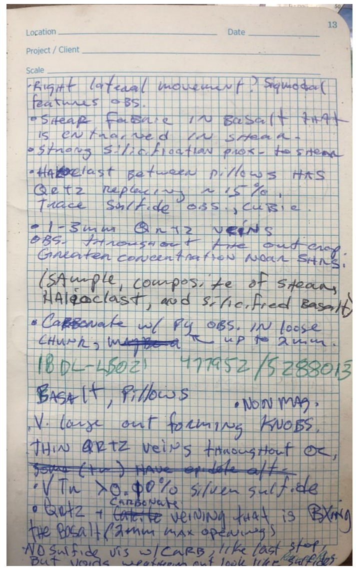
18DL-LB014 478955/5286759
·Pillow Basalt. Topping 010°
·Same as last OC, But less milky Qtz ~~cutting~~ replacing.
·Linear trend 250° of Qtz veining and strong silicification of Basalt, veins 0.5m-3m thick, splay off
(Sampled strong Qtz veining + silicified Basalt.

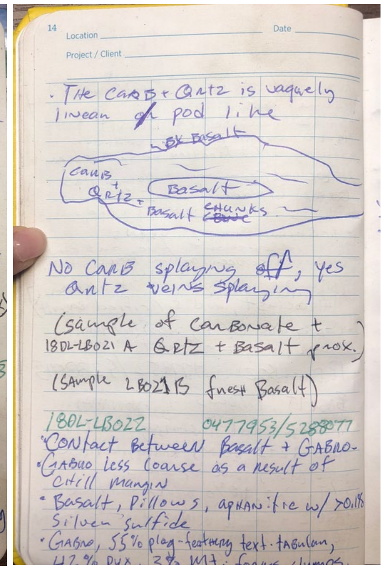
18DL-LB015 479051/5286698
Pillow Basalt OC. Much less milky Qtz replacing/veining

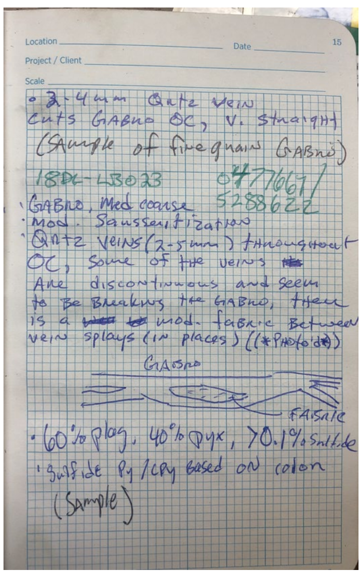
18DL-LB016 479065/5286704
Gabbro, Medium coarseness.
60% Plag, 36% pyx, 2% magnetite, 2% Biotite
·Weak saussuritization (chl + epidote)
·mod magnetism
·Mag. clots up to 1cm
(Sampled)

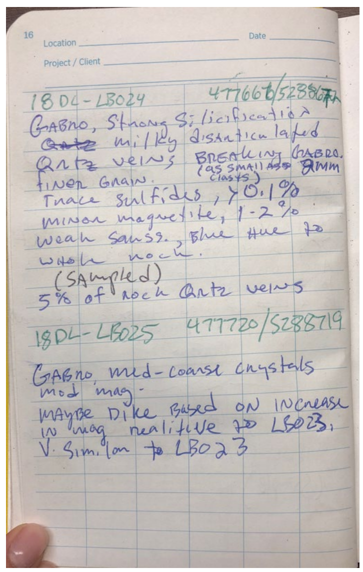
18DL-LB017 479036/5286797
Gabbro OC. Med Grain
Weak Sauss.
Med magnetism

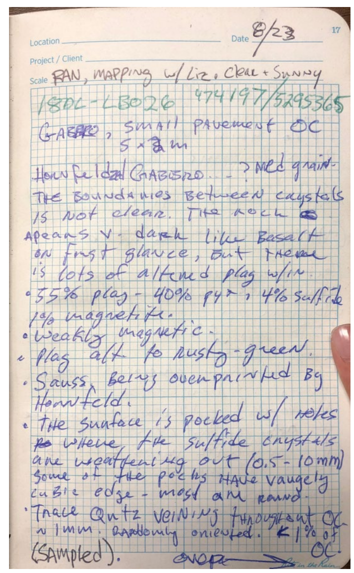

12
Location RAN
Date 8/19
Project / Client Mapping w/ Michael Overcast.
18DL-LB018 477854/5288403
GABRO, OC's as 4×5m Blocks
6-8 in area
Med coarse grains,
60% plag, 38% pyx, 2% Bt.
Pyx up to 0.75cm, interstitial plag.
Non mag
Weak saussenization, plag alt to milky Blue-Chl.
(Sampled) Glacial groove 235°
18DL-LB019 477900/5288372
Gabro, Same as last OC
w/ occasional Qrtz veins (2-4
Epidote alt prox. to veins
~2m halo
18DL-LB020 477849/5288322
Basalt, Pillows topping 005°
V. Large outcrop ~50m long 15 wide
2 Shear planes obs. 035/85E
max width 5cm.
Lots of milky Qrtz veining (thin sub
splaying off shears

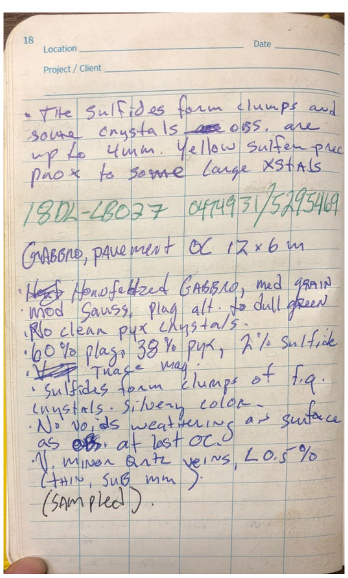

13
Location
Date
Project / Client
Scale
Right lateral movement? Sigmoidal features obs.
Shear fabric in Basalt that is entrained in shear.
Strong silicification prox. to shear
Hyaloclast between pillows has Qrtz replacing ~15%.
Trace sulfide obs., cubic
1-3mm Qrtz veins obs. throughout the outcrop
Greater concentration near shears.
(Sample, composite of shear, Hyaloclast, and silicified Basalt)
Carbonate w/ Py obs. in loose chunk, up to 2mm.
18DL-LB021 477952/5288013
Basalt, Pillows Non mag.
V. large out forming knobs.
Thin Qrtz veins throughout OC,
V Tr >0.00% silver sulfide
Qrtz + carbonate veining that is Bxing the Basalt (2mm max opening)
No sulfide vis w/carb, like last stop,
But voids weathering out look like sulfides

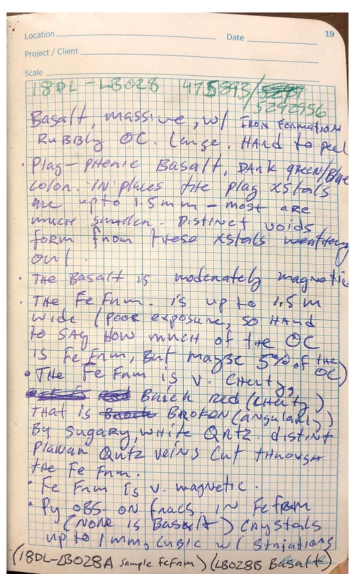

14
Location
Date
Project / Client
The carb + Qrtz is vaguely linear pod like
Bx Basalt
carb
Qrtz
Basalt
Basalt chunks
No carb splaying off, yes Qrtz veins splaying
(sample of carbonate + 18DL-LB021 A Qrtz + Basalt prox.)
(Sample LB021B fresh Basalt)
18DL-LB022 0477953/5288071
Contact between Basalt + Gabro-
Gabro less coarse as a result of chill margin
Basalt, Pillows, aphanitic w/ >0.1%
Silver sulfide
Gabro, 55% plag-featuring text-tabular,

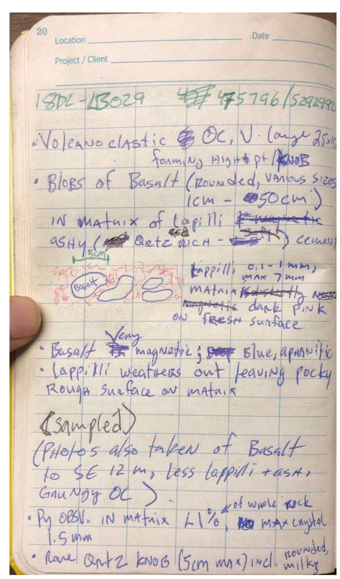

Location
Date
15
Project / Client
Scale
2-4mm Qrtz vein cuts Gabro OC, V. straight
(Sample of fine grain Gabro)
18DL-LB023 0477661/5288622
Gabro, Med coarse
Mod. Saussuritization
Qrtz veins (2-5mm) throughout OC, some of the veins are discontinuous and seem to be Breaking the Gabro, there is a mod. fabric Between vein splays (in places) ((*Photo'd*))
Gabro
Felsic
60% plag, 40% pyx, >0.1% sulfide
Sulfide Py/cpy based on color
(Sample)

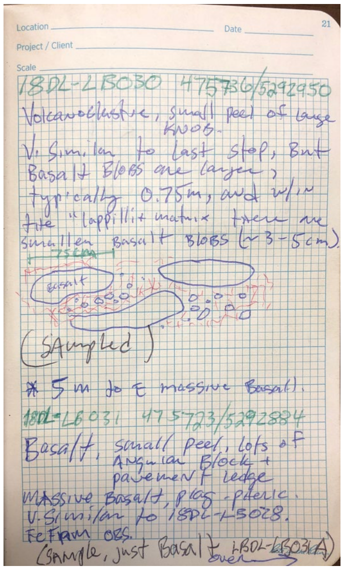

16
Location
Date
Project / Client
18DL-LB024 477660/5288674
Gabro, Strong silicification
milky disanticulated Qrtz veins Breaking Gabro. (as small clasts) 3mm
finer Grain
Trace sulfides, >0.1%
minor magnetite, 1-2%
weak sauss., blue hue to whole rock.
(Sampled)
5% of rock Qrtz veins
18DL-LB025 477720/5288719
Gabro mid-coarse crystals
mod mag.
maybe Dike based on increase in mag relative to LB023.
V. Similar to LB023


Location
Date 8/23
17
Project / Client RAN, Mapping w/ Liz, Clear + Sunny
18DL-LB026 474197/5295365
Gabro, small pavement OC 5×2m
Hornfelded Gabro... Med grain.
The boundaries between crystals is not clear. The rock appears v. dark like Basalt on first glance, but there is lots of altered plag w/in
55% plag - 40% pyx, 4% sulfide 1% magnetite.
Weakly magnetic.
Plag alt to rusty-green
Sauss, Being overprinted by Hornfeld.
The surface is pocked w/ holes where the sulfide crystals are weathering out (0.5-10mm)
Some of the pocks have vaguely cubic edge - most are round.
Trace Qrtz veining throughout OC ~1mm, Randomly oriented. <1% of OC.
(Sampled).


18
Location
Date
Project / Client
The sulfides form clumps and some crystals obs. are up to 4mm. Yellow sulfer-prox to some large xstals
18DL-LB027 0474931/5295469
Gabbro, pavement OC 12×6m
Hornfelded Gabbro, med grain
mod Sauss, plag alt. to dull green
No clean pyx crystals.
60% plag, 38% pyx, 2% sulfide
Trace mag
Sulfides form clumps of f.g. crystals. Silvery color.
No voids weathering as surface as obs. at last OC.
V. minor Qrtz veins, 0.5%
(thin, sub mm).
(Sampled).


Location
Date
19
Project / Client
Scale
18DL-LB028 475893/5295956
Basalt, massive, w/ iron formation
Rubbly OC. Large. Hard to peel
Plag-phyric Basalt, dark green/blue color. In places the plag xstals are up to 1.5mm - most are much smaller. Distinct voids form from these xstals weathering out
The Basalt is moderately magnetic
The Fe Fm. is up to 1.5m wide (poor exposure, so hard to say how much of the OC is Fe Fm, But maybe 5% of the OC)
The Fe Fm is v. cherty
Brick red (cherty) that is Broken (angular) By sugary, white Qrtz. distinct planar Qrtz veins cut through the Fe Fm.
Fe Fm is v. magnetic
Py obs. on fracs in Fe Fm
(None is Basalt) crystals up to 1mm, cubic w/ striations
(18DL-LB028A sample Fe Fm) (LB028B Basalt)


20
Location
Date
Project / Client
18DL-LB029 475796/5295
Volcanoclastic OC, V. large 25m forming High pt / knob
Blobs of Basalt (rounded, various sizes 1cm - 50cm)
in matrix of lapilli ash (Qrtz rich) cement
Basalt
lapilli 0.1-1mm, max 7mm
matrix dark pink on fresh surface
Basalt very magnetic; Blue, aphanitic
lappilli weathers out leaving pocky Rough surface on matrix
(Sampled)
(Photos also taken of Basalt to SE 12m, less lappili + ash, Gnuggy OC)
Py obs. in matrix <1% of whole rock, max crystal 1.5mm
Rare Qrtz knob (5cm max) incl. rounded, milky



21

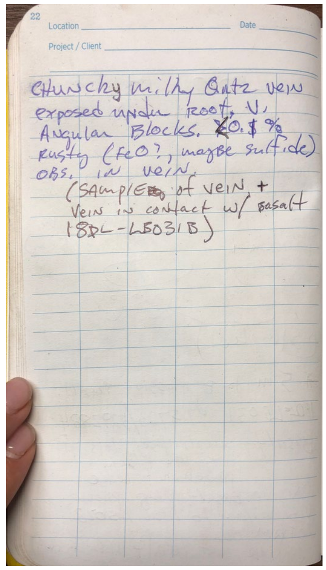
Location | Date
Project / Client
Scale

18DL-LB030 475736/5292950
Volcanoclastic, small peel of large knob.
V. similar to last stop, but Basalt Blobs are larger, typically 0.75m, and w/in the "lappilli+ matrix there are smaller Basalt Blobs (~3-5cm).

75cm
basalt
(SAmpled)

* 5m to E massive Basalt.

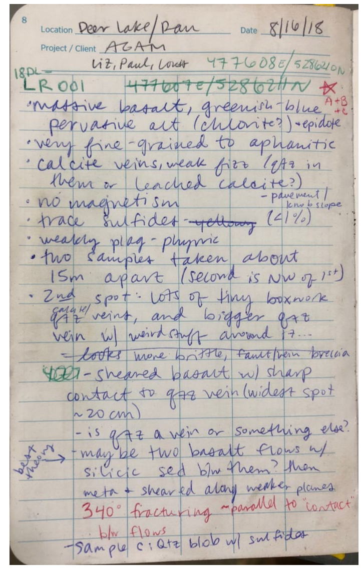
18DL-LB031 475723/5292884
Basalt, small peel, lots of Angular Block + pavement ledge
Massive Basalt, plag-phyric.
V. Similar to 18DL-LB028.
FeFram OBS.
(Sample, just Basalt 18DL-LB031A) over



22

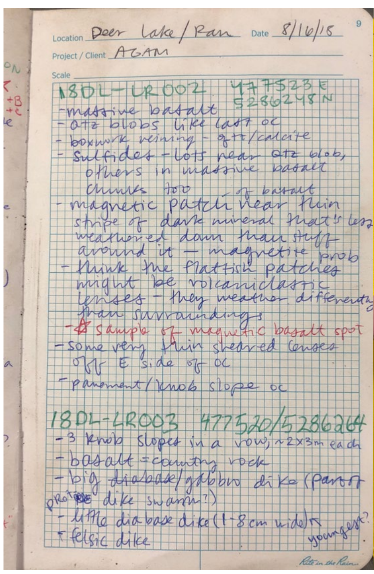
Location | Date
Project / Client

Chunky milky Qtz vein exposed under roof, V. Angular Blocks. ~~<~~0.1%
Rusty (FeO?, maybe sulfide) OBS. in vein.
(SAMPLE of vein, + vein in contact w/ basalt 18DL-LB031B)



8

Location Deer Lake/Ran Date 8/16/18
Project / Client AGAM
Liz, Paul, Louis 477608E/528621ON
18DL-LR001 ~~477607E/5286211N~~ ☆ A+B+C
• massive basalt, greenish-blue pervasive alt (chlorite?) + epidote
• very fine-grained to aphanitic
• calcite veins, weak fizz (qtz in them or leached calcite?)
• no magnetism - pavement/knob slope
• trace sulfides ~~yellowy~~ (<1%)
• weakly plag-phyric
• two samples taken about 15m apart (second is NW of 1st)
• 2nd spot: lots of tiny boxwork calcite/qtz veins, and bigger qtz vein w/ weird stuff around it...
- ~~looks more brittle, fault/vein breccia~~
~~4007~~ - sheared basalt w/ sharp contact to qtz vein (widest spot ~20 cm)
- is qtz a vein or something else?
best theory → - maybe two basalt flows w/ silicic sed b/w them? then meta + sheared along weaker planes
340° fracturing ~parallel to "contact" b/w flows
- sample C: Qtz blob w/ sulfides



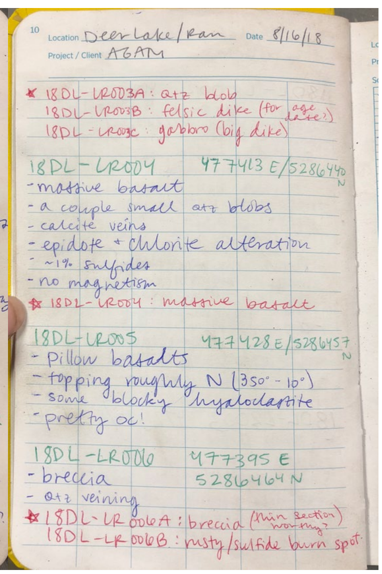
9

Location Deer Lake/Ran Date 8/16/18
Project / Client AGAM
Scale

18DL-LR002 477523E 5286248N
- massive basalt
- Qtz blobs like last oc
- boxwork veining - qtz/calcite
- sulfides - lots near Qtz blob, others in massive basalt chunks too
- magnetic patch near thin stripe of dark mineral that's less weathered down than stuff around it — magnetite prob
- think the flattish patches might be volcaniclastic lenses - they weather differently than surroundings
- ☆ sample of magnetic basalt spot
- some very thin sheared lenses off E side of oc
- pavement/knob slope oc

18DL-LR003 477520/5286264
- 3 knob slopes in a row, ~2x3m each
- basalt = country rock
- big ~~diabase~~/gabbro dike (part of prot ~~pe~~ dike swarm?)
- little diabase dike (1-8cm wide) ← youngest?
+ felsic dike

Rite in the Rain



10

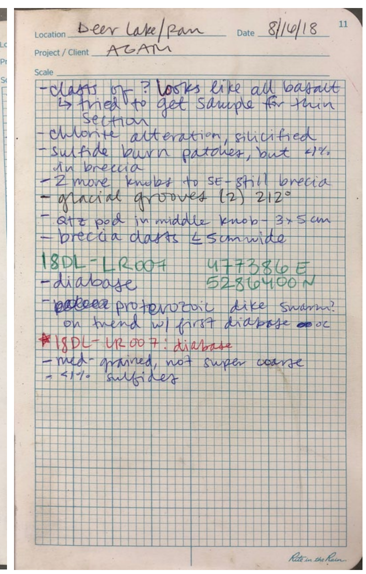
Location Deer Lake/Ran Date 8/16/18
Project / Client AGAM

☆ 18DL-LR003A: Qtz blob
18DL-LR003B: felsic dike (for age date?)
18DL-LR003C: gabbro (big dike)

18DL-LR004 477413 E/5286440 N
- massive basalt
- a couple small qtz blobs
- calcite veins
- epidote + chlorite alteration
- ~1% sulfides
- no magnetism
☆ 18DL-LR004: massive basalt

18DL-LR005 477428 E/5286457 N
- pillow basalts
- topping roughly N (350° - 10°)
- some blocky hyaloclastite
- pretty oc!

18DL-LR006 477395 E 5286464 N
- breccia
- Qtz veining
☆ 18DL-LR006A: breccia (thin section worthy?)
18DL-LR006B: rusty/sulfide burn spot



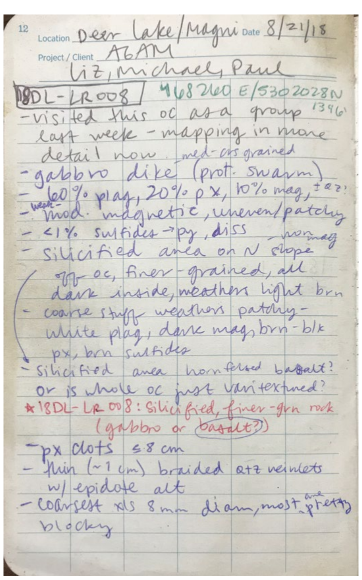
11

Location Deer Lake/Ran Date 8/16/18
Project / Client AGAM
Scale

- clasts of ? looks like all basalt
↳ tried to get sample for thin section
- chlorite alteration, silicified
- sulfide burn patches, but <1% in breccia
- 2 more knobs to SE - still breccia
- glacial grooves (2) 212°
- Qtz pod in middle knob - 3x5 cm
- breccia clasts ≤ 5cm wide

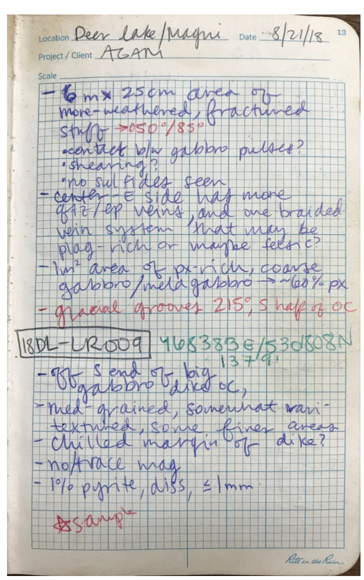
18DL-LR007 477386 E 5286400 N
- diabase
- ~~paleo~~ proterozoic dike swarm? on trend w/ first diabase ~~oc~~ oc
☆ 18DL-LR007: diabase
- med-grained, not super coarse
- <1% sulfides

Rite in the Rain



12

Location Deer Lake/Magni Date 8/21/18
Project / Client AGAM
Liz, Michael, Paul
18DL-LR008 468260 E/5302028N 1346'
- visited this oc as a group last week - mapping in more detail now
- gabbro dike (prot. swarm) med-crs grained
- 60% plag, 20% px, 10% mag, ± Qz?
- weak-mod. magnetic, uneven/patchy
- <1% sulfides → py, diss
- silicified area on N slope off oc, finer-grained, all dark inside, weathers light brn - non mag
- coarse stuff weathers patchy - white plag, dark mag, brn-blk px, brn sulfides
- silicified area hornfelsed basalt? or is whole oc just varitextured?
★ 18DL-LR008: silicified, finer-grn rock (gabbro or basalt?)
- px clots ≤ 8 cm
- thin (~1 cm) braided qtz veinlets w/ epidote alt
- coarsest xls 8 mm diam, most are pretty blocky



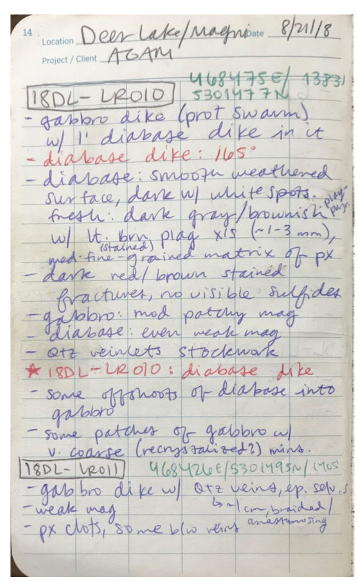
13

Location Deer lake/Magni Date 8/21/18
Project / Client AGAM
Scale

- 6m x 25cm area of more-weathered, fractured stuff → 050°/85°
• contact b/w gabbro pulses?
• shearing?
• no sulfides seen
- ~~center~~ E side has more qtz/ep veins, and one braided vein system that may be plag-rich or maybe felsic?
- 1m² area of px-rich, coarse gabbro/melagabbro → ~60% px
- glacial grooves 215°, S half of OC

18DL-LR009 468383E/5301808N 1379'
- off S end of big gabbro dike oc,
- med-grained, somewhat vari-textured, some finer areas
- chilled margin of dike?
- no/trace mag
- 1% pyrite, diss, ≤ 1mm
☆ sample

Rite in the Rain

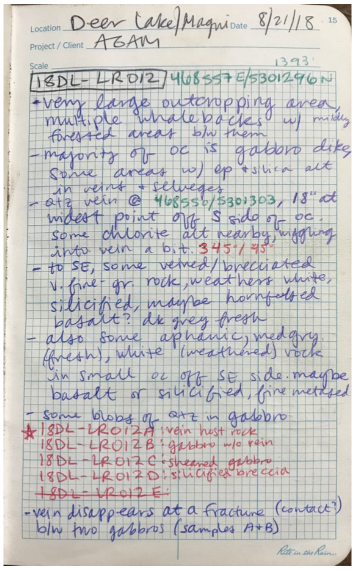


14

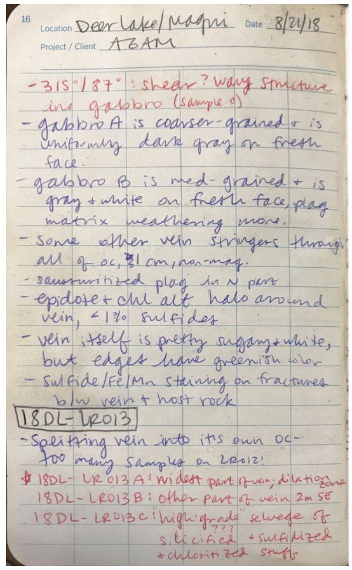
Location Deer Lake/Magni Date 8/21/18
Project / Client AGAM

18DL-LR010 468475E/ 5301477N 1383'
- gabbro dike (prot swarm) w/ 1' diabase dike in it
- diabase dike: 165°
- diabase: smooth weathered surface, dark w/ white spots. plag-phyr. fresh: dark gray/brownish w/ lt. brn (stained) plag xls (~1-3 mm), med-fine-grained matrix of px
- dark red/brown stained fractures, no visible sulfides
- gabbro: mod patchy mag
- diabase: even weak mag
- Qtz veinlets stockwork
★ 18DL-LR010: diabase dike
- some offshoots of diabase into gabbro
- some patches of gabbro w/ v. coarse (recrystallized?) mins.

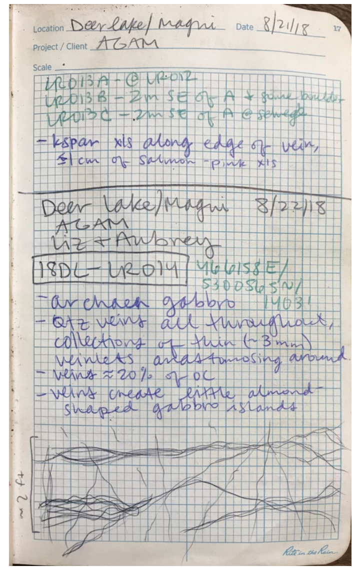
18DL-LR011 468426E/5301493N/ 1405'
- gabbro dike w/ Qtz veins, ep. selv.s ↳ ~1cm, braided/anastomosing
- weak mag
- px clots, some b/w veins



Location Deer Lake/Magni Date 8/21/18 15
Project / Client AGAM
1393'
18DL-LR012 468557E/5301296N
- very large outcropping area, multiple whalebacks w/ mildly forested areas b/w them
- majority of oc is gabbro dike, some areas w/ ep + silica alt in veins + selvages
- qtz vein @ 468556/5301303, 18" at widest point off S side of oc. some chlorite alt nearby, zigzag into vein a bit. 345°/75°
- to SE, some veined/brecciated v. fine gr. rock, weathers white, silicified, maybe hornfelsed basalt? dk grey fresh
- also some aphanitic, med gry (fresh), white (weathered) rock in small oc off SE side, maybe basalt or silicified, fine meta sed
- some blobs of qtz in gabbro
★ 18DL-LR012A: vein host rock
18DL-LR012B: gabbro w/o vein
18DL-LR012C: sheared gabbro
18DL-LR012D: silicified breccia
~~18DL-LR012E~~
- vein disappears at a fracture (contact?) b/w two gabbros (samples A+B)

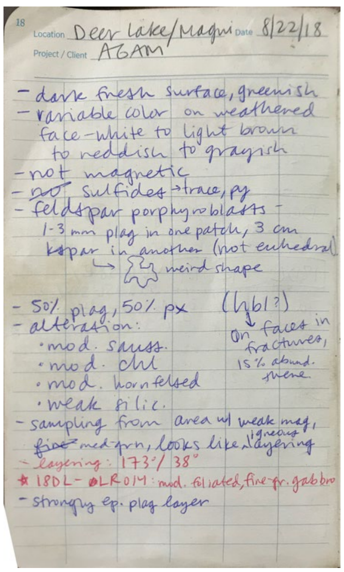


16 Location Deer Lake/Magni Date 8/21/18
Project / Client AGAM
- 315°/87°: shear? wavy structure in gabbro (sample C)
- gabbro A is coarser-grained + is uniformly dark gray on fresh face
- gabbro B is med-grained + is gray + white on fresh face, plag matrix weathering more.
- some other vein stringers through all of oc, ≤1 cm, non-mag.
- saussuritized plag in N part
- epidote + chl alt halo around vein, <1% sulfides
- vein itself is pretty sugary + white, but edges have greenish color
- sulfide/Fe/Mn staining on fractures b/w vein + host rock
18DL-LR013
- splitting vein into its own oc - too many samples in LR012!
★ 18DL-LR013A: widest part of vein, dilation zone
18DL-LR013B: other part of vein 2m SE
18DL-LR013C: high grade? selvege of silicified + sulfidized + chloritized stuff

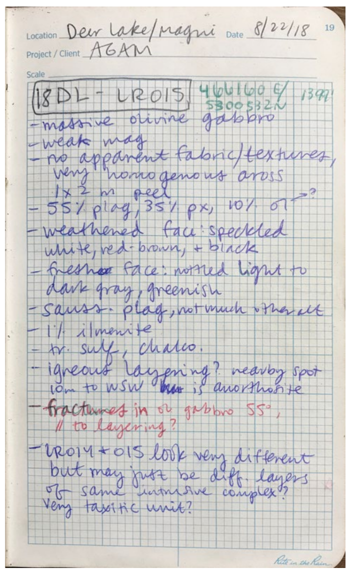


Location Deer Lake/Magni Date 8/21/18 17
Project / Client AGAM
LR013A - @ LR012
LR013B - 2m SE of A + giant boulder
LR013C - 2m SE of A @ selvage
- kspar xls along edge of vein, ≤1 cm of salmon-pink xls

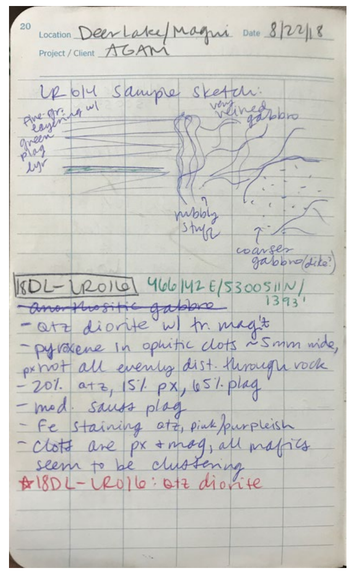
Deer Lake/Magni 8/22/18
AGAM
Liz + Aubrey
18DL-LR014 466158E/5300565N
- archean gabbro 1403'
- qtz veins all throughout, collections of thin (~3mm) veinlets anastomosing around
- veins ≈ 20% of oc
- veins create little almond-shaped gabbro islands
~2 ft



18 Location Deer Lake/Magni Date 8/22/18
Project / Client AGAM
- dark fresh surface, greenish
- variable color on weathered face - white to light brown to reddish to grayish
- not magnetic
- ~~no~~ sulfides → trace, py
- feldspar porphyroblasts - 1-3 mm plag in one patch, 3 cm kspar in another (not euhedral) → weird shape
- 50% plag, 50% px (hbl?) ↓ on faces in fractures, 15% abund. sphene.
- alteration:
  - mod. sauss.
  - mod. chl
  - mod. hornfelsed
  - weak silic.
- sampling from area w/ weak mag, ~~fine~~ med-grn, looks like igneous layering
- layering: 173°/38°
★ 18DL-LR014: mod. foliated, fine-gr. gabbro
- strongly ep. plag layer

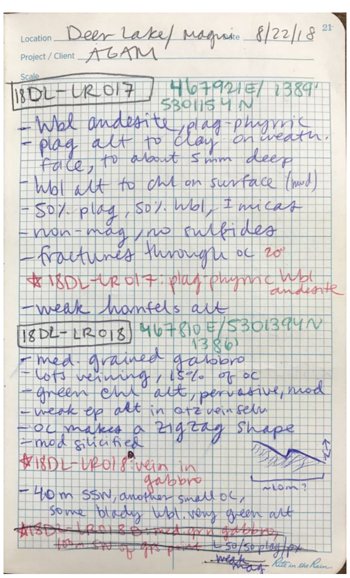


Location Deer Lake/Magni Date 8/22/18 19
Project / Client AGAM
Scale
18DL-LR015 466160E/5300532N 1399'
- massive olivine gabbro
- weak mag
- no apparent fabric/textures, very homogenous across 1x2 m peel
- 55% plag, 35% px, 10% ol → ?
- weathered face: speckled white, red-brown, + black
- fresh face: mottled light to dark gray, greenish
- sauss. plag, not much other alt
- 1% ilmenite
- tr. sulf, chalco.
- igneous layering? nearby spot 10m to WSW is anorthosite
- fractures in ol gabbro 55°, // to layering?
- LR014 + 015 look very different but may just be diff. layers of same intrusive complex? Very taxitic unit?

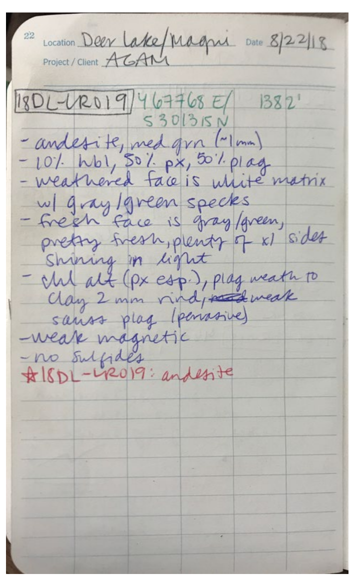


20 Location Deer Lake/Magni Date 8/22/18
Project / Client AGAM
LR014 sample sketch:

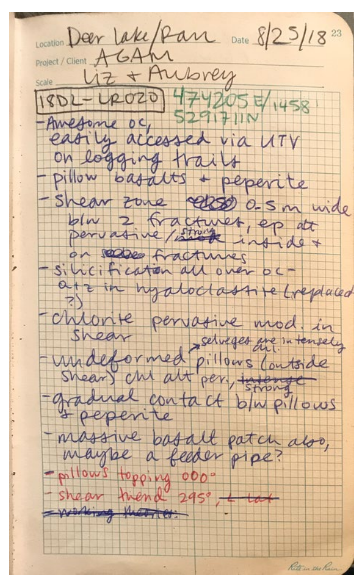
18DL-LR016 466142E/5300511N/ 1393'
~~anorthositic gabbro~~
- qtz diorite w/ tr. mag't
- pyroxene in ophitic clots ~5mm wide, px not all evenly dist. through rock
- 20% qtz, 15% px, 65% plag
- mod. sauss plag
- Fe staining qtz, pink/purpleish
- clots are px + mag, all mafics seem to be clustering
★ 18DL-LR016: qtz diorite



Location Deer Lake/Magni Date 8/22/18 21
Project / Client AGAM
Scale
18DL-LR017 467921E/5301154N 1389'
- hbl andesite, plag-phyric
- plag alt to clay on weath. face, to about 5mm deep
- hbl alt to chl on surface (mod)
- 50% plag, 50% hbl, I micas
- non-mag, no sulfides
- fractures through oc 20°
★ 18DL-LR017: plag-phyric hbl andesite
- weak hornfels alt
18DL-LR018 467810E/5301394N 1386'
- med. grained gabbro
- lots veining, 15% of oc
- green chl alt, pervasive, mod
- weak ep alt in qtz vein selv.
- oc makes a zigzag shape
- mod silicified
★ 18DL-LR018: vein in gabbro
~10m?
- 40m SSW, another small oc, some blady hbl. very green alt
~~★ 18DL-LR018B: med. grn gabbro, 10m SW of gps point, 50/50 plag/px weak mag~~



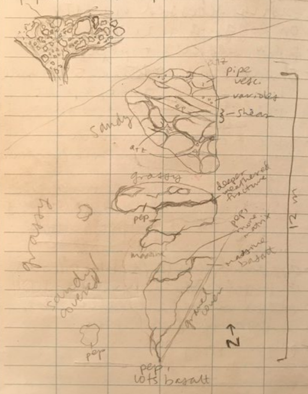
22 Location Deer Lake/Magni Date 8/22/18
Project / Client AGAM
18DL-LR019 467768E/5301315N 1382'
- andesite, med grn (~1mm)
- 10% hbl, 50% px, 50% plag
- weathered face is white matrix w/ gray/green specks
- fresh face is gray/green, pretty fresh, plenty of xl sides shining in light
- chl alt (px esp.), plag weath to clay 2 mm rind, ~~mod~~ weak sauss plag (pervasive)
- weak magnetic
- no sulfides
★ 18DL-LR019: andesite



Location Deer Lake/Ram Date 8/25/18 23
Project / Client AGAM
Scale Liz + Aubrey
18DL-LR020 474205E/5291711N 1458'
- Awesome oc, easily accessed via UTV on logging trails
- pillow basalts + peperite
- shear zone 0.5m wide b/w 2 fractures, ep alt pervasive/strong inside + on fractures
- silicification all over oc - qtz in hyaloclastite (replaced?)
- chlorite pervasive mod. in shear
- undeformed pillows (outside shear) chl alt per., ~~intense~~ strong → selveges are intensely chl.
- gradual contact b/w pillows + peperite
- massive basalt patch also, maybe a feeder pipe?
- pillows topping 000°
- shear trend 295°, ~~L lat~~
~~- working theories:~~

24 Location Deer Lake/Ran Date 8/25/18
Project / Client AGAM

18DL-LR020 sketch
peperite close-up:



Location Deer Lake/Ran Date 8/25/18 25
Project / Client AGAM
Scale

- 18DL-LR020 continued:
- piece of scoria in OC, 6x6x6" triangle
- some Qtz in hyalo. has Fe staining @ contact w/ basalt
  - ↳ red, Fe or sulfides?
- To NNE, alternating pillows + peperite
- Fe-fmn seen to W (in OC)
- Sample 18DL-~~Ø~~LR020: peperite, some sulfidic patches, w/ basalt clasts in it

18DL-LR021 474457E/5291766N 1461'
- pillow basalts, thin lenses of peperite
- red/orange stained (Fe? sulf?) pillow selveges, some near Qtz (in fill) + some not
- Qtz fill in hyalo./space b/w pillows
  - ↳ silicification
- patchy ep alt, weak-mod
- pipe vesicles seen @ pillow edges
- 7 cm-wide diabase dike ← 335° being offset by R-lat shear ← 250°

26 Location Deer lake/Ran Date 8/25/18
Project / Client AGAM

LR021 continued
- massive basalt oc to E, 10m, away (ESE) 10m wide
  Sample 18DL-LR021: variolitic massive basalt
- pillows to S (small oc)
- more massive basalt to SSE
  - shear zone: 335° (main) & 010° (C) S (cuts by main)
  - shear zone strongly ep alt, w/ clinozo. + Qtz too
  - edges of shear intense ep.
  - Qtz veins // to shear, 1 cm wide, ep. selv.
- no magnetism in LR020 + 021

18DL-LR022 477594E 5291605N 1365'
- Small pavement + ledge OC, 2 m²
- igneous breccia (flow top?)
- clasts of Fe-fmn (cherty + slaty pieces), granodiorite, basalt, maybe gabbro

Location Deer Lake/Ran Date 8/25/18 27
Project / Client AGAM
Scale

LR022 continued
- granodio seems to have largest clasts, up to 10 x 15 cm, mostly subrounded
- Some Fe-fmn clasts are very angular & rectangular, appear to have primary bedding/layering intact
- matrix appears to be basalt, so probably flow-top breccia?
- Sample 18DL-LR022: flow-top/igneous breccia
- Fe-fmn strong mag, none elsewh.
- lots of pockmarks on weath. surface - clasts weathered or glacially plucked out, many shapes, rounded to rectangular/angular, <1 cm to 5 cm wide

18DL-LR023 477632E/5291628N 1358'
- more ig. breccia, w/ gabbro ~~(not sure if clasts or matrix)~~
- matrix appears coarser than prev. stop, more like med-fine gabbro.

28 Location Deer Lake/Ran Date 8/25/18
Project / Client AGAM

LR023 continued
- still clasts of Fe-fmn (cherty + slaty), basalt, + gabbro (?)
- sample 18DL-LR023: ig. breccia
- trace sulfides, just a couple patches seen, 2m xls
- no magnetism

18DL-LR024 477571E/5291720N 1394'
- Qtz diorite, massive
- 50% plag, 25% px, 12% hbl, 12% Qtz, 1% sulfides
- med-crs grn, xls ~1-2mm; some hbl 4mm long, spindly
- chl alt, pervasive, mod
- weakly magnetic
- Sample 18DL-LR024: Qtz diorite
- looks like the matrix from prev breccia stops - were we on edge of this intrusion?
- ≤1% sulf, tiny, diss

8/14 3

~~LB~~ LB065C
18DL-
476419 5293084 1437 ft
Diabase (or microgabbro) ⇝ chilled margin
- plag (~70%); pyroxene (~30%)
- 1% sulfides (in chunks, but disseminated in groundmass)
- boxwork veining (~4 cm)
  - some right lateral offset
  - epidote alteration (~4 cm) on vein margins
- ~~weak~~ none

18DL-MH001
478549 5293764 1431
Massive basalt outcrop (~10 x 10 m)
- minor boxwork veining (~1 cm)
  - epidote alt (~4 cm) in vein margins
- moderate magnetism
- ~5% sulfides
  - disseminated in majority of rock but w/ some concentrated near "sulfide burns"

4 18DL-MH002
478744 5293846 1431 ft
Massive basalt OC (10 x 30 m)
- minimal alt (some surficial oxidation)
- moderate magnetism
- 1% sulfides (pyrrhotite?)
  - occur in blebs
- trace plag phenocrysts (v small)

host rock
sulfide blebs

- carbonate veinlets (~1 cm)
  - some has been replaced w/ oxides

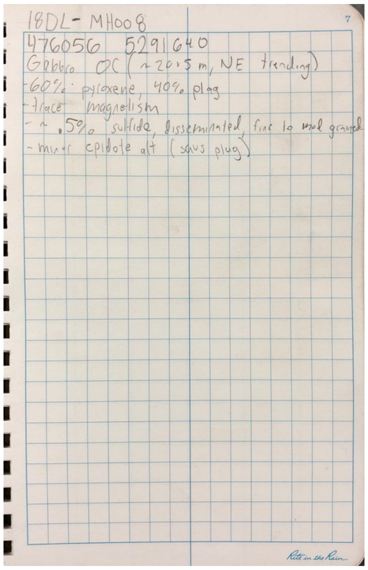
18DL-MH003
478849 5293634 1442 ft
Massive basalt OC (2 x 5 m)
- weak magnetism
- >1% sulfides (yellow) concentrated along fractures
- boxwork calcite veining (~2 cm)
  - some associated epidote alt (~6 cm) in vein margins
- mod manganese staining

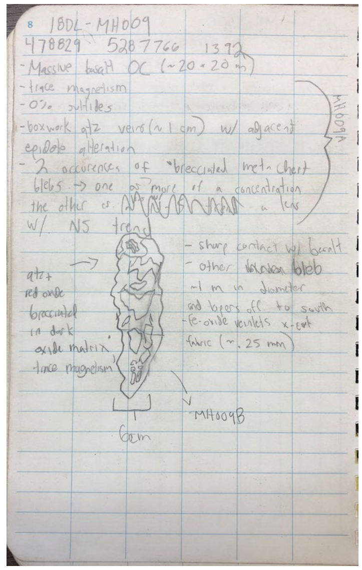
18DL-MH004 476454 5292313 5
pillowed basalt OC (5 x 5 m, roughly)
- topping direction: 20°
- trace magnetism
- disseminated sulfides (> .5%)
- weakly silicified
- carbonate veinlets, boxwork (~1 mm)
- carbonate disseminated throughout rock
- weak alteration

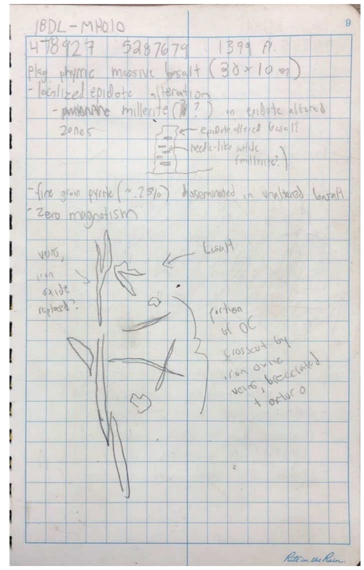
18DL-MH005
476173 5292366
massive basalt OC (NW-SE trending; 40 m long, 20 m wide)
- nearby pillowed basalt OC (contact)
  - topping direction (30° NE); inferred through pinching direction
- moderate amt of carbonate disseminated throughout rock
- <.5% dissem. sulfides
- weak magnetism

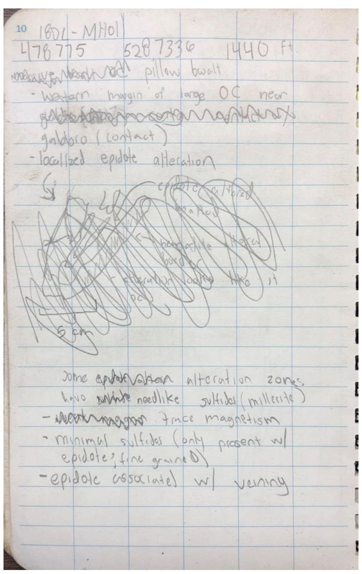
6 18DL-MH006
476083 5291754
Gabbro OC (10 x 10 m)
- 60% pyroxene, 40% plag - minor bt
- Var textured (medium to fine grained, sharp break)
- disseminated sulfides (~1%)
- minor carbonate disseminated
- weak magnetism

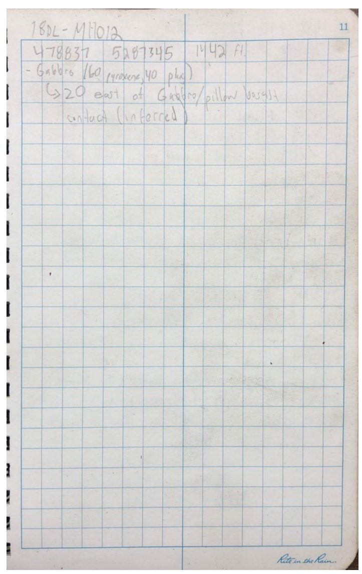
18DL-MH007
476056 5291710
Diabase OC (~40 x 40 m)
- 60% pyroxene, 40% plag
- fine texture (hard to see on fresh face but distinct in weathered surfaces)
- qtz veinlets (~1 mm) x-cuts fabric
- .5% sulfides
  - fine to med grained
- weak magnetism

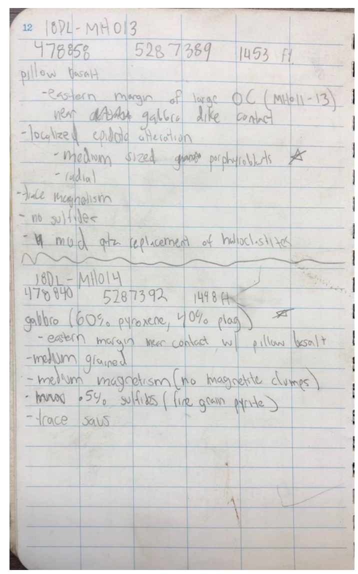

18DL-MH008
476056 5291640
Gabbro OC (~20×5 m, NE trending)
-60% pyroxene, 40% plag
-trace magnetism
-~.5% sulfide, disseminated, fine to med grained
-minor epidote alt (saus plag)

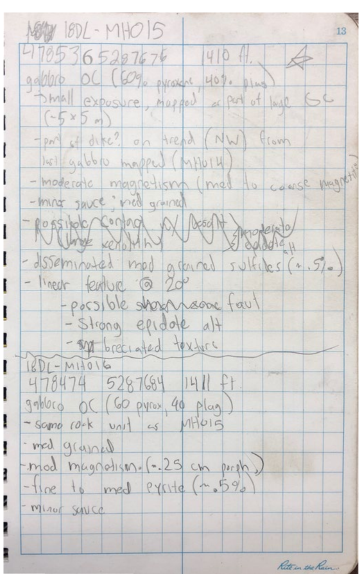

18DL-MH009
478829 5287766 1372
-Massive basalt OC (~20×20 m)
-trace magnetism
-0% sulfides
-boxwork qtz veins (~1 cm) w/ adjacent epidote alteration
-2 occurrences of "brecciated meta chert" blebs → one of more of a concentration the other as ... a lens w/ NS trend
MH009
qtz + Fe oxide brecciated in dark oxide matrix
-trace magnetism
-sharp contact w/ basalt
-other ... bleb ~1 m in diameter and tapers off to south
-Fe-oxide veinlets x-cut fabric (~.25 mm)
6cm
MH009B

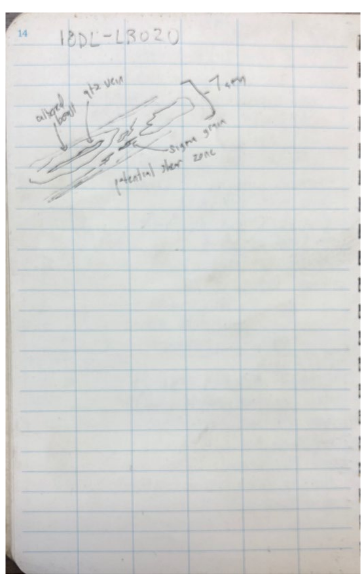

18DL-MH010
478927 5287679 1391 ft.
Plag phyric massive basalt (30×10 m)
-localized epidote alteration
-millerite (?) in epidote altered zones
epidote altered basalt
needle-like white (millerite?)
-fine grain pyrite (~.2%) disseminated in unaltered basalt
-zero magnetism
veins, iron oxide replaced?
basalt
portion of OC crosscut by iron oxide veins, brecciated & altered

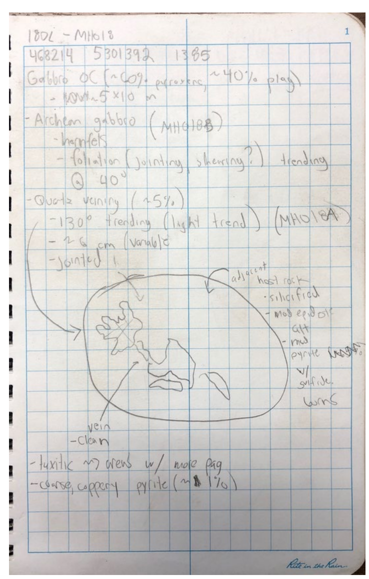

18DL-MH011
478775 5287336 1440 ft
pillow basalt
-western margin of large OC near gabbro (contact)
-localized epidote alteration
epidote altered
5 cm
some ... alteration zones have needlelike sulfides (millerite)
-trace magnetism
-minimal sulfides (only present w/ epidote; fine grained)
-epidote associated w/ veining

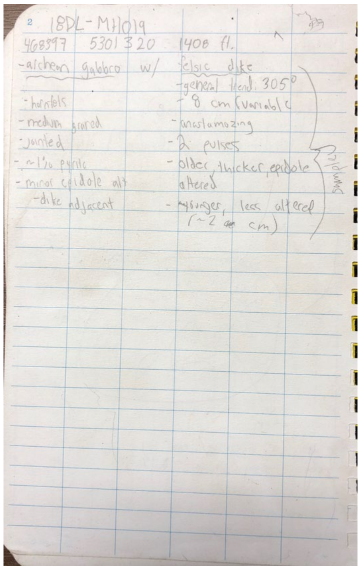

18DL-MH012
478837 5287345 1442 ft.
-Gabbro (60 pyroxene, 40 plag)
↳ 20 east of Gabbro/pillow basalt contact (inferred)

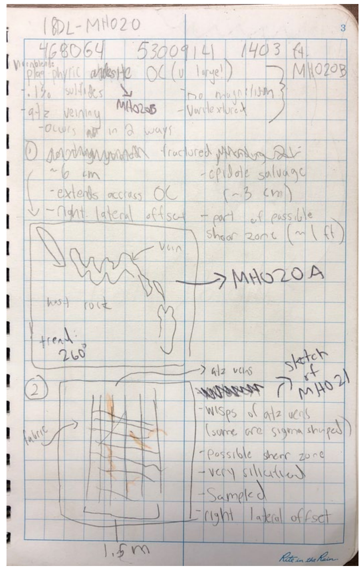

18DL-MH013
478858 5287389 1453 ft.
pillow basalt
-eastern margin of large OC (MH011-13) near gabbro dike contact
-localized epidote alteration
-medium sized porphyroblasts
-radial
-trace magnetism
-no sulfides
-mod qtz replacement of hyaloclastites
18DL-MH014
478840 5287392 1448 ft
gabbro (60% pyroxene, 40% plag)
-eastern margin near contact w/ pillow basalt
-medium grained
-medium magnetism (no magnetite clumps)
-.5% sulfides (fine grain pyrite)
-trace saus


18DL-MH015
478536 5287676 1410 ft.
gabbro OC (60% pyroxene, 40% plag)
-small exposure, mapped as part of large OC (~5×5 m)
-part of dike? on trend (NW) from last gabbro mapped (MH014)
-moderate magnetism (med to coarse magnetite)
-minor sauce; med grained
-disseminated mod grained sulfides (~.5%)
-linear feature @ 20°
-possible fault
-strong epidote alt
-brecciated texture
18DL-MH016
478474 5287684 1411 ft
gabbro OC (60 pyrox, 40 plag)
-same rock unit as MH015
-med grained
-mod magnetism (~.25 cm porph)
-fine to med pyrite (~.5%)
-minor sauce

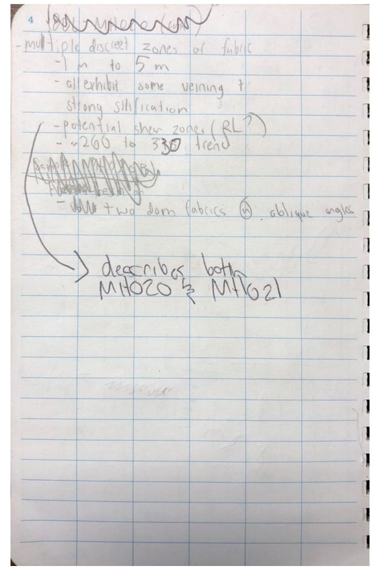

18DL-LB020
altered basalt
qtz vein
~7 cm
sigma grain
potential shear zone

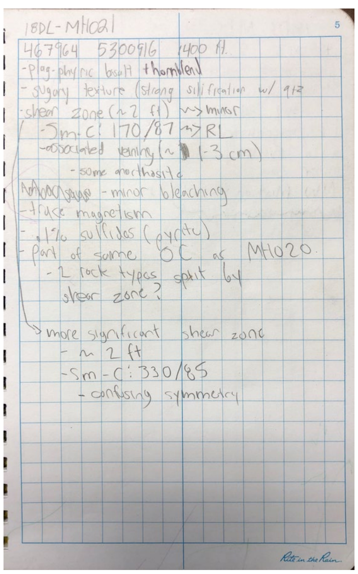

18DL-MH018
468214 5301392 1385
Gabbro OC (~60% pyroxene, ~40% plag)
- ~5×10 m
-Archean gabbro (MH018B)
-hornfels
-foliation (jointing, shearing?) trending @ 40°
-Quartz veining (~5%)
-130° trending (light trend) (MH018A)
- ~2 cm (variable)
-jointed
adjacent host rock
·silicified
-mod epidote alt
-mod pyrite w/ sulfide ...
vein
-clean
-taxitic ... w/ more plag
-coarse, coppery pyrite (~1%)

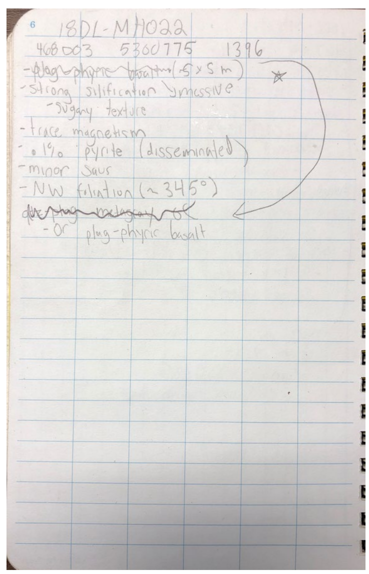

2
18DL-MH019
468397 5301320 1408 ft.
-archean gabbro w/ felsic dike
-general trend: 305°
-hornfels
-8 cm (variable)
-medium grained
-anastamozing
-jointed
-2 pulses
-~1% pyrite
-older, thicker, epidote altered
-minor epidote alt
-dike adjacent
-younger, less altered (~2 cm)
sampled

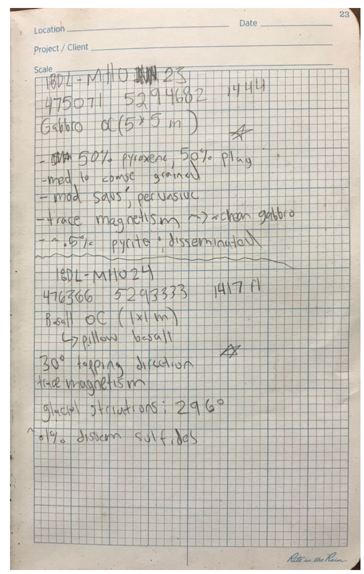

18DL-MH020
3
468064 5300914 1403 ft.
hornblende
plag phyric andesite OC (v large!)
MH020B
-.1% sulfides
no magnetism
MH020B
-qtz veining
-vorticexture
-occurs in 2 ways
1 fractured
~6 cm
-epidote salvage (~3 cm)
-extends accross OC
-right lateral offset
-part of possible shear zone (~1 ft)

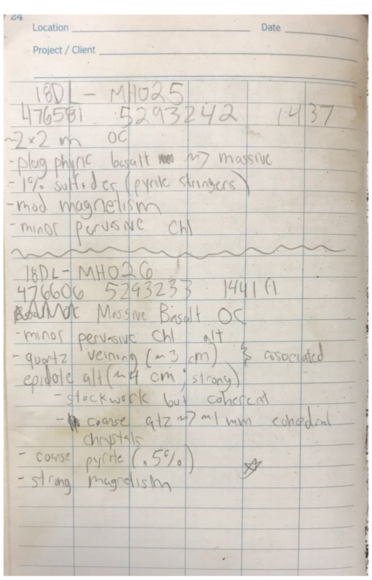
2
sketch of MH021
-wisps of qtz veins (some are sigma shaped)
-possible shear zone
-very silicified
-sampled
-right lateral offset
Rite in the Rain

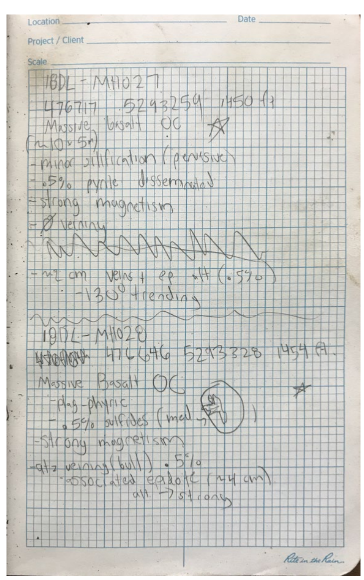

4
-multiple discreet zones of fabric
-1 m to 5 m
-all exhibit some veining + strong silification
-potential shear zones (RL?)
-~260 to 330 trend
-two dom fabrics @ oblique angles
describes both MH020 & MH021

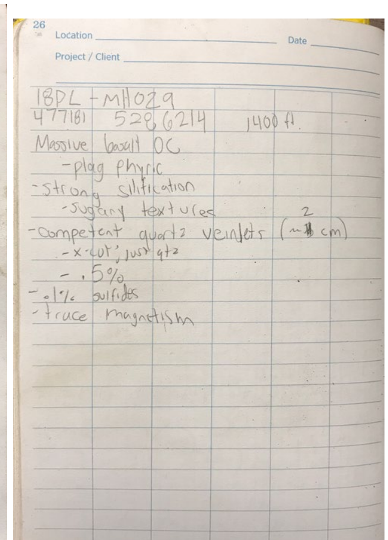

18DL-MH021
5
467964 5300916 1400 ft.
-plag-phyric basalt +hornblend
-sugary texture (strong silification w/ qtz
-shear zone (~2 ft) ~> minor
-Sm-C: 170/87 ~> RL
-associated veining (~ 1-3 cm)
-some anorthosite
-minor bleaching
-trace magnetism
-.1% sulfides (pyrite)
-part of same OC as MH020.
-2 rock types split by shear zone?
more significant shear zone
-~ 2 ft
-Sm-C: 330/85
-confusing symmetry
Rite in the Rain


6
18DL-MH022
468003 5300775 1396
-~~plag-phyric basalt~~ (5 x 5 m)
-strong silification ~> massive
-sugary texture
-trace magnetism
-.1% pyrite (disseminated)
-minor Saus
-NW foliation (~345°)
-Or plag-phyric basalt


23
Location
Date
Project / Client
Scale
18DL-MH023
475071 5294682 1444
Gabbro OC (5×5 m)
-50% pyroxene, 50% plag
-med to coarse grained
-mod saus, pervasive
-trace magnetism ~> archean gabbro
-~.5% pyrite, disseminated
18DL-MH024
476366 5293333 1417 ft
Basalt OC (1×1 m)
↳ pillow basalt
30° topping direction
trace magnetism
glacial striations: 296°
~.1% dissem sulfides
Rite in the Rain


24
Location
Date
Project / Client
18DL-MH025
476581 5293242 1437
~2×2 m OC
-plag phyric basalt ~> massive
-1% sulfides (pyrite stringers)
-mod magnetism
-minor pervasive Chl
18DL-MH026
476606 5293233 1441 ft
Massive Basalt OC
-minor pervasive Chl alt
-quartz veining (~3 cm) & associated epidote alt (~4 cm; strong)
-stockwork but coherent
-coarse qtz ~> ~1 mm euhedral crystals
-coarse pyrite (.5%)
-strong magnetism

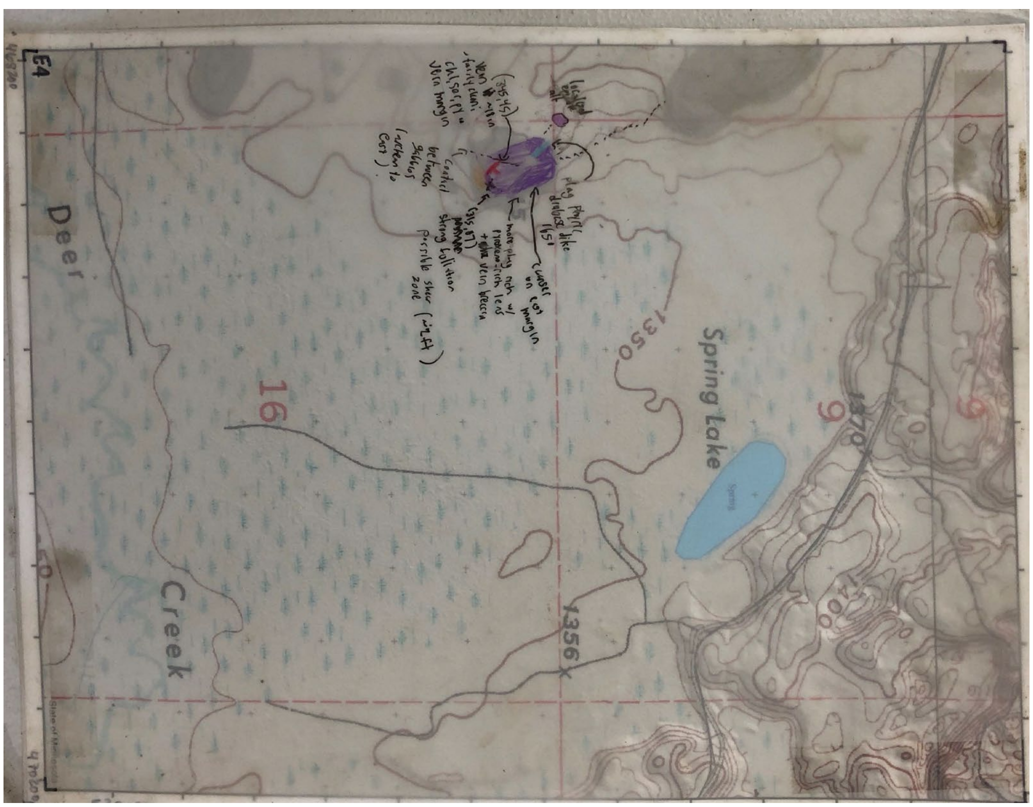

Location
Date
Project / Client
Scale
18DL-MH027
476717 5293259 1450 ft
Massive basalt OC
(~10×5 m)
-minor silification (pervasive)
-.5% pyrite disseminated
-strong magnetism
-Ø veining
-~2 cm veins + ep alt (.5%)
-130° trending
18DL-MH028
476646 5293328 1454 ft.
Massive Basalt OC
-plag-phyric
-.5% sulfides (med ~>)
-strong magnetism
-qtz veining (bull) .5%
-associated epidote (~4 cm) alt -> strong
Rite in the Rain


26
Location
Date
Project / Client
18DL-MH029
477181 5286214 1400 ft.
Massive basalt OC
-plag phyric
-strong silification
-sugary textures
-competent quartz veinlets (~2 cm)
-x-cut; just qtz
-.5%
-.1% sulfides
-trace magnetism

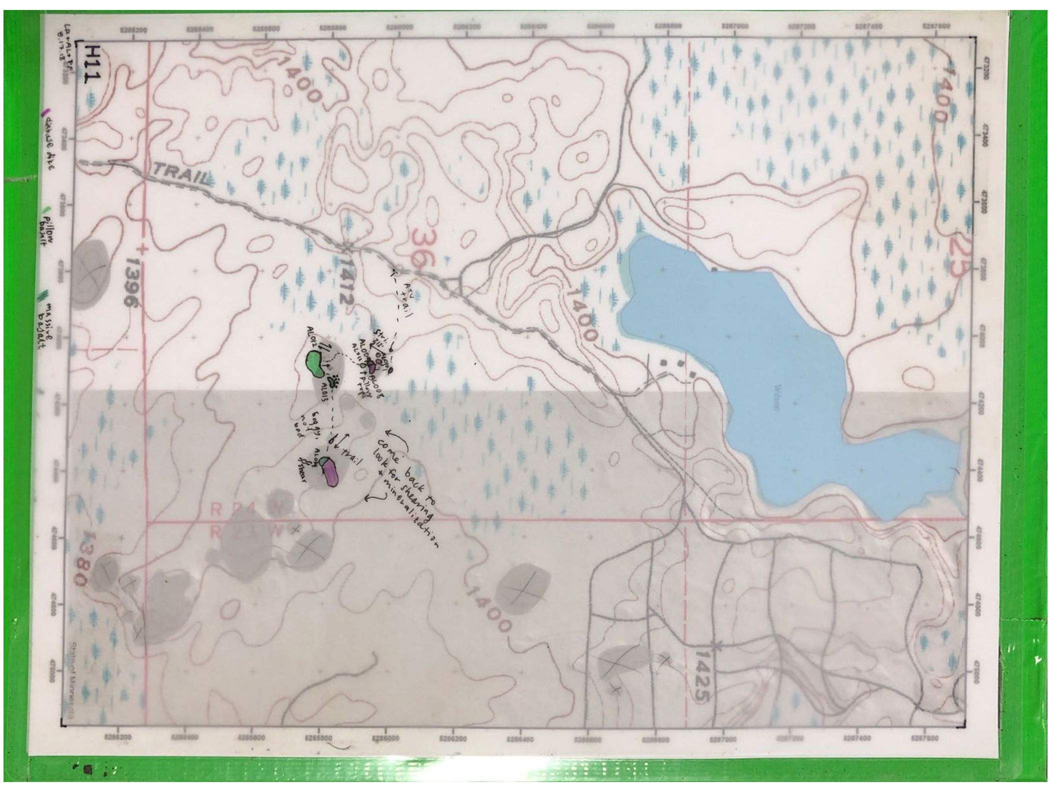

C4
1350
1353
1350
Thimble Lake
FANTASTIC TRAIL
1400
18
7
1390
GABBRO


D4
X1383
1366
1370
17
8
8
1400


D4
1383
1380
1370
17
8
1400


E4
Deer
Creek
16
9
1350
Spring Lake
1370
1400
1356


H7
1370
1380
36
1350
1382
1386
LB027

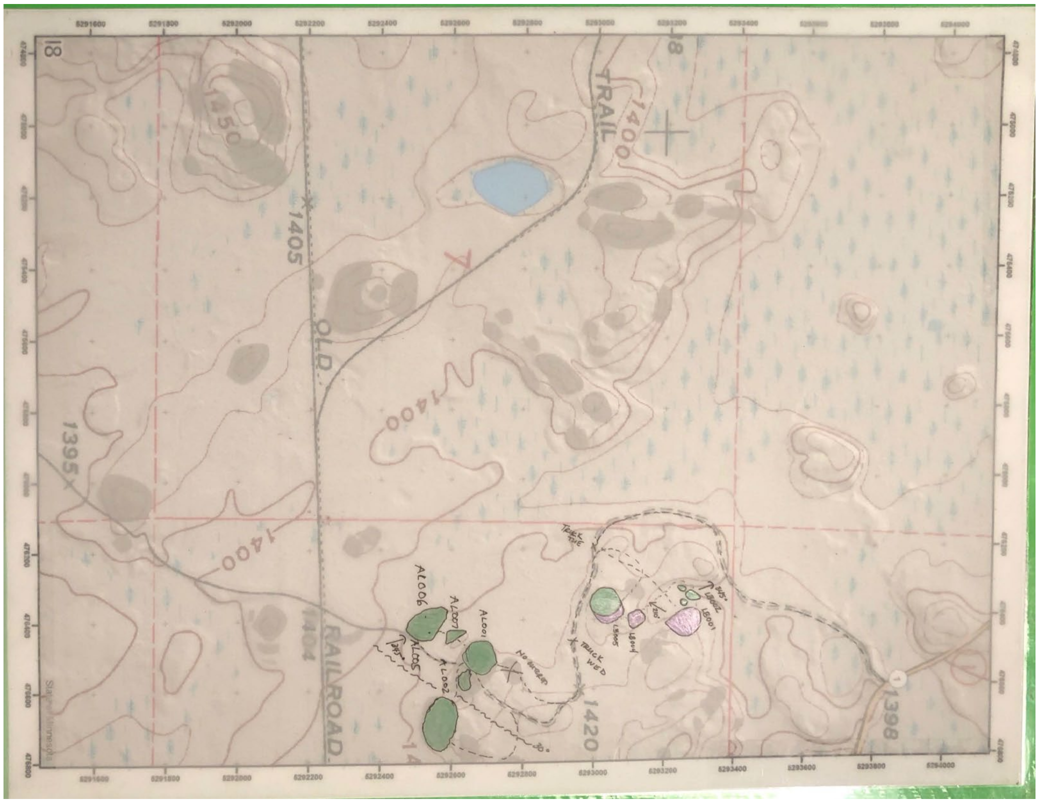

H11
TRAIL
1400
36
1412
1396
25
1380
1425

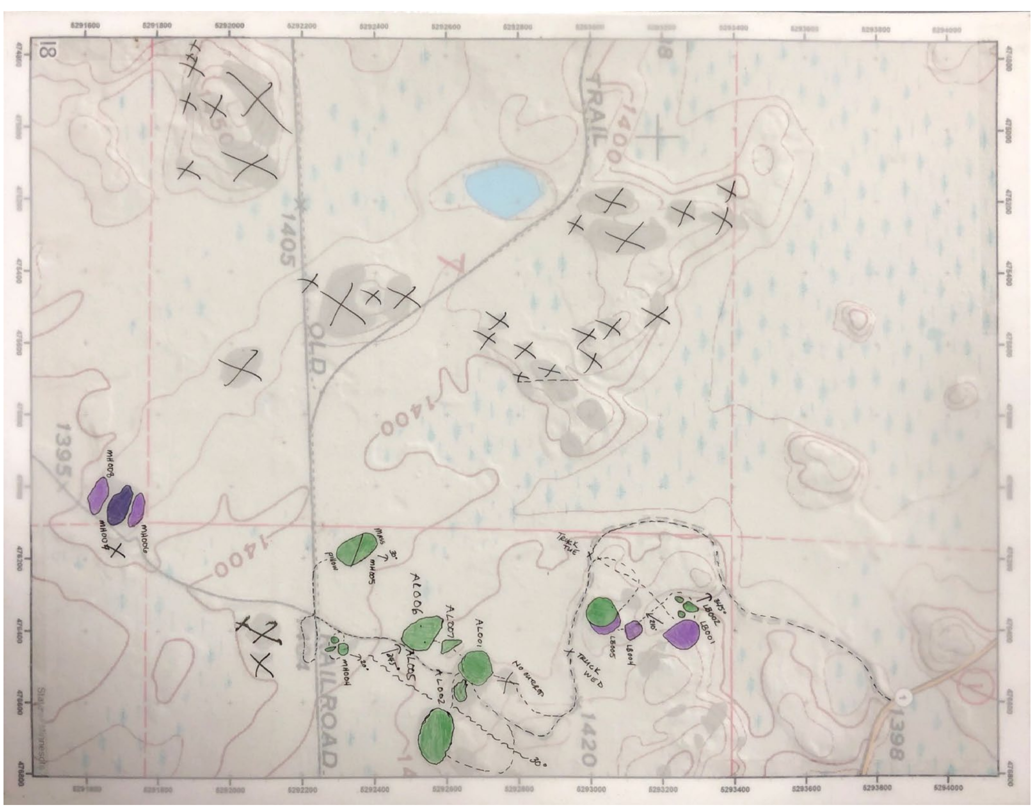

H9
Rip Lake


H11
TRAIL

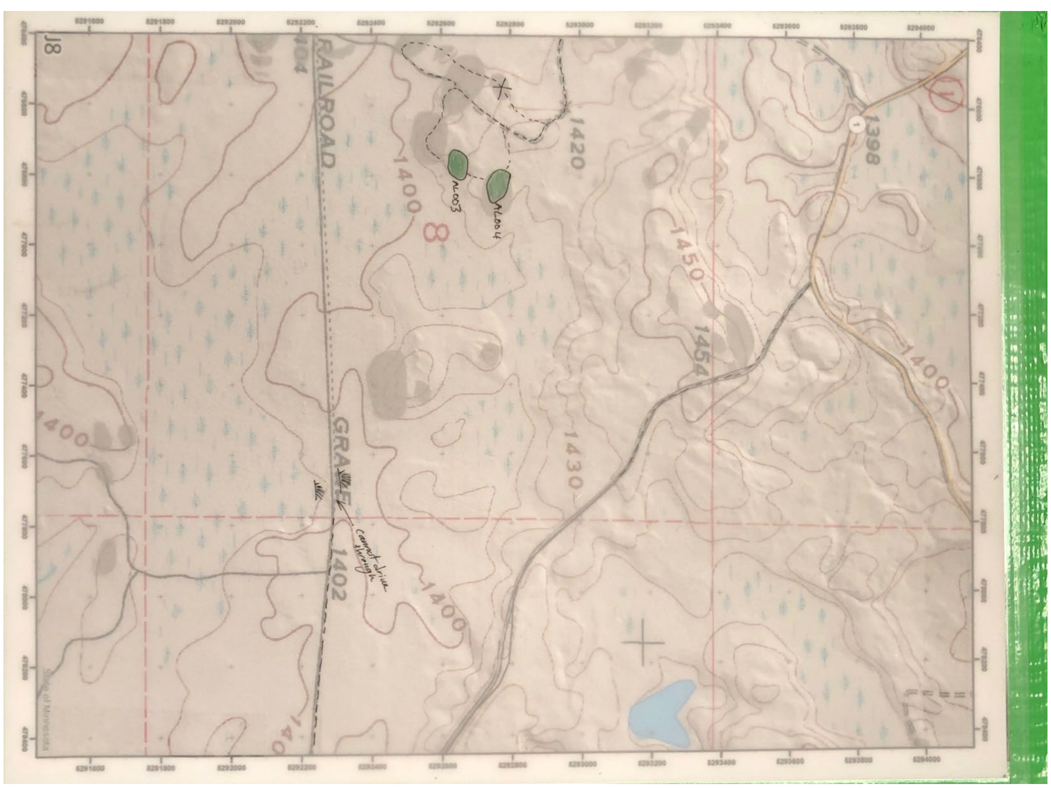

H11
TRAIL
1396
1412
1400
1380
1425
36
25
come back to look for shearing + mineralization
trail forks
felsic intrusive
diorite dike
gabbro/
pillow
trail


1400
1370
1391
31
6
1384
1398
Towline Lake


TRAIL
1400
1405
OLD
1395
RAILROAD
1420
1398


TRAIL
1400
1405
OLD
1395
RAILROAD
1420
1398


I8
TRAIL
OLD
RAILROAD
1400
1405
1395
1420
1398
basalt
not swamp in dry weather


I8
RAILROAD
GRADE
1402
1420
1400
1398
1450
1454
1430
8

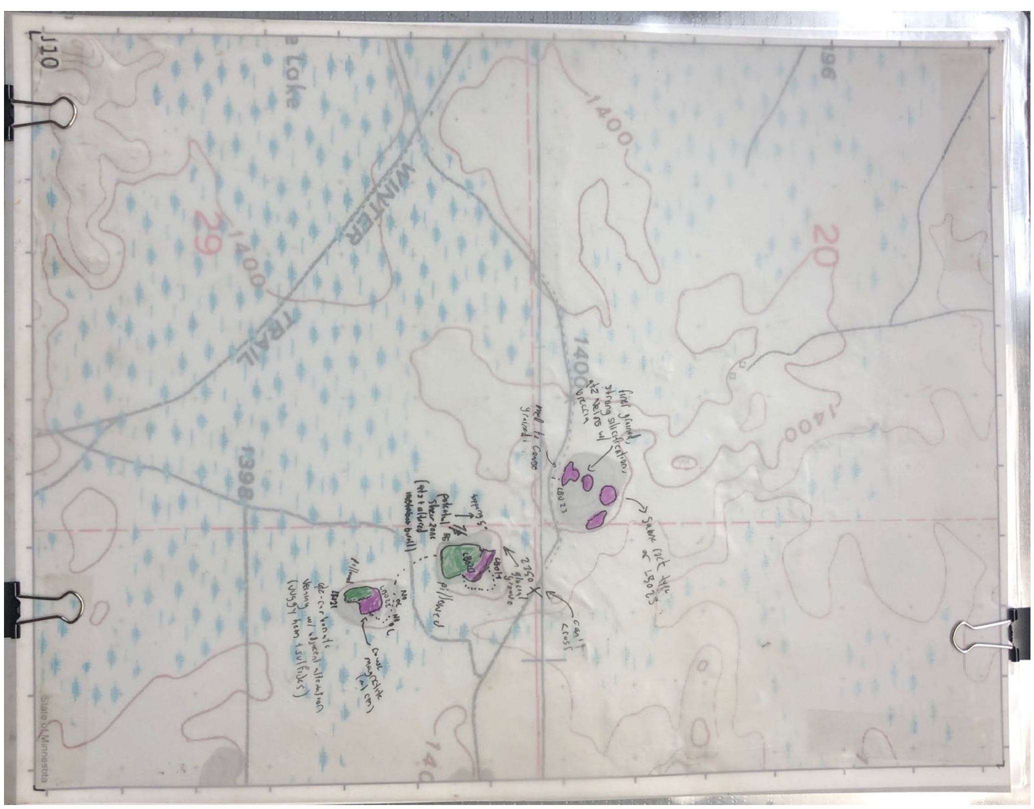

J8
RAILROAD
GRADE
1420
1398
1400
1450
1454
1430
1402
8
swamp
wet


J8
RAILROAD
GRADE
1420
1398
1400
1450
1454
1430
1402
8

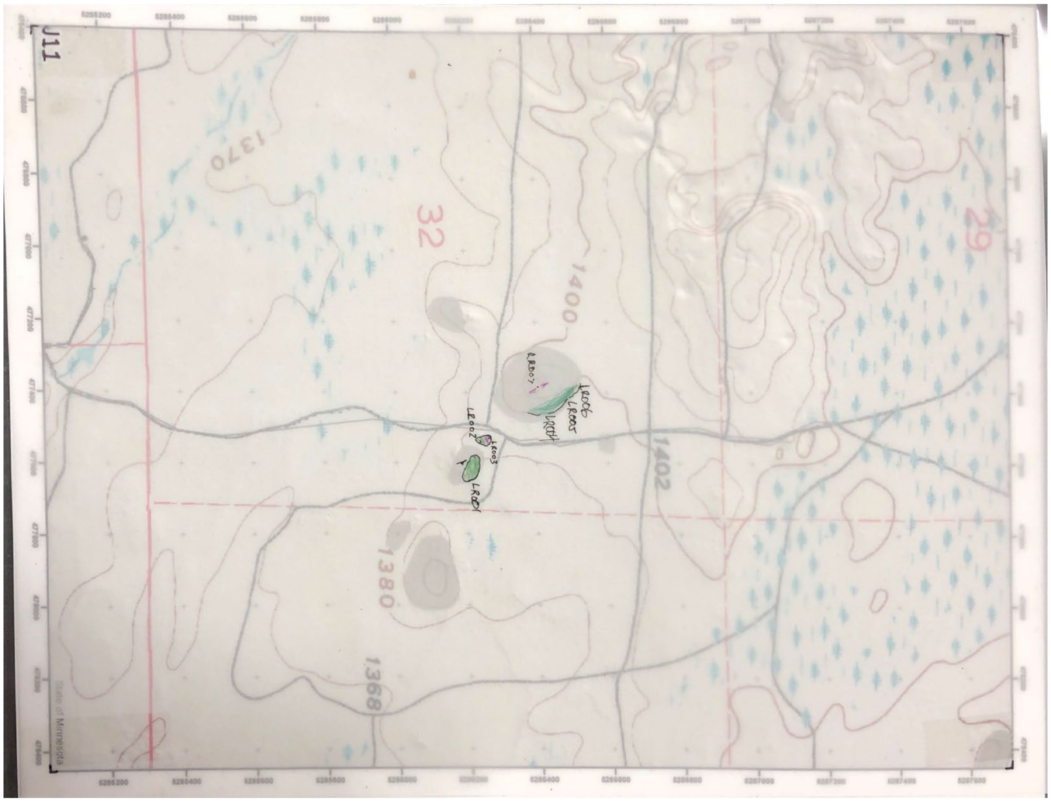

J8
RAILROAD
GRADE
1398
1400
1402
1420
1430
1450
1454
8
State of Minnesota
5291600
5292000
5292400
5293200
5293600
5294000

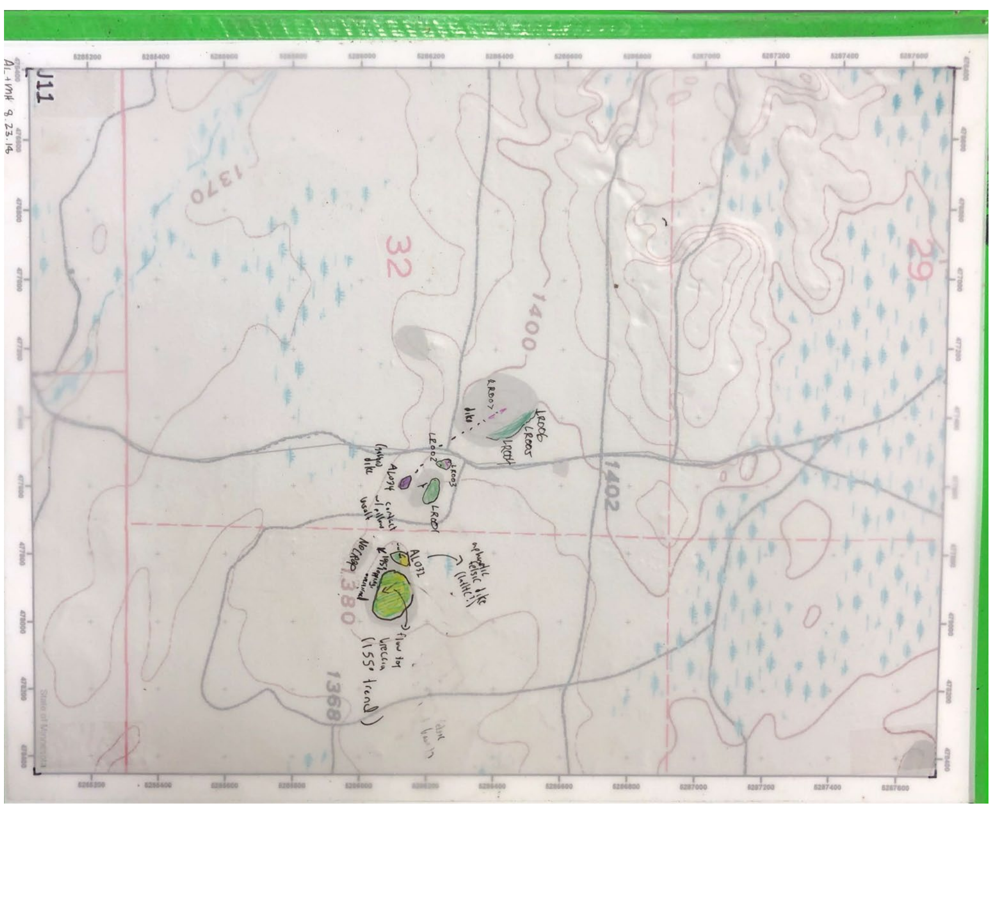

J8
RAILROAD
GRADE
1398
1400
1402
1420
1430
1450
1454
8

J8
RAILROAD
GRADE
1420
1400
1450
1454
1430
1402
1398
8
DIORITE
DIORITE BRECCIA
Swamp
wet
5291600
5292000
5293200
5293600
5294000



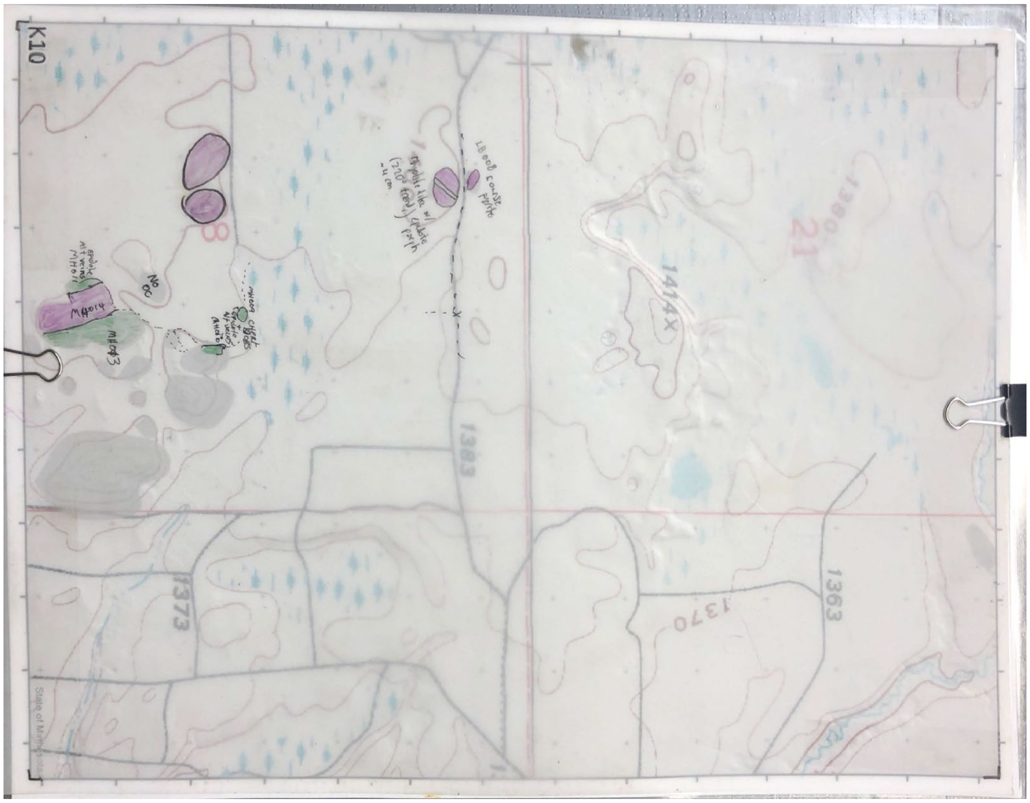
J10
WINTER
TRAIL
1400
1398
29
20
96


J11
1370
32
29
1400
1402
1380
1368


J11
1370
32
29
1400
1402
1368


K8
TRAIL
DAHLBERG
9
1400
1398
1401
1380
1427
trail ends


K10
28
21
1380
1414x
1383
1373
1370
1363


K10
1383
1373
1370
1363
21
1414X


K11
1368
33
1373
1350

8.7 Appendix 7 - Proposal

BIG ROCK
EXPLORATION

AngloGold Ashanti MN

Reconnaissance Mapping & Sampling Program

August 2018

Contents

BIG ROCK EXPLORATION

Anglogold Ashanti Minnesota: Mapping Strategy Overview

Itasca & Koochiching Counties

Overview

- AGA directed BRE to plan and execute a reconnaissance mapping program on two of their lease areas
- Primary goals of collecting detailed data and information on various outcrop exposures and compiling data into a final ArcGIS geodatabase for AGA to integrate into their systems.

Approach

- Two primary AOI areas to cover
  - Magni – North lease area
    - 3 primary regions for initial mapping reconnaissance
  - North Ran – South lease area
    - 4 primary regions for initial mapping reconnaissance
  - Additional follow up reconnaissance work may be warranted and will be recommended upon completion of this initial reconnaissance mapping

Major Goals

- Detailed geological mapping of exposed outcrops on lease holdings with a focus on:
  - Lithology, mineralogy, contacts, structure, alteration
- Collect representative hand samples for geochemical analysis (only on AGA properties)
  - Some samples will be duplicated to provide representative samples for a 'rock library' and potential petrographic/additional analysis
- Compile outcrop maps for each mapping region
- Begin to delineate potential zones of interest for continued assessment

BIG ROCK EXPLORATION

Anglogold Ashanti Minnesota: Mapping Strategy

Itasca & Koochiching Counties

Mapping Team
- AGA management and oversight by AGA geologist - Paul Fix
- 1 BRE project manager/project geologist – Aubrey Lee
- 2 mapping teams, 2 geos each
  - 1 project geologist/1 geologist each team

Schedule
- 2-week program; August 13th thru August 26th
- 1-week program extension possible pending status after initial 2 weeks
- Data compilation and field summary by mid/late-September

Deliverables
- All data, notes, photos, samples, etc. submitted to AGA
- Sample tracking spreadsheet
- An updated ArcGIS geodatabase (GDB)
- PDF maps for areas of interest
- Technical field summary report

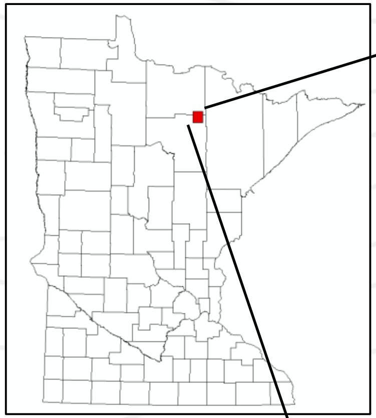
Logistics
- Man-day per diem for meals and lodging
  - Hampton Inn likely hotel (~$130/night)
- Two field trucks
- One side-by-side UTV (additional UTV/ATV if needed)
- Big Rock will supply sample tags and bags

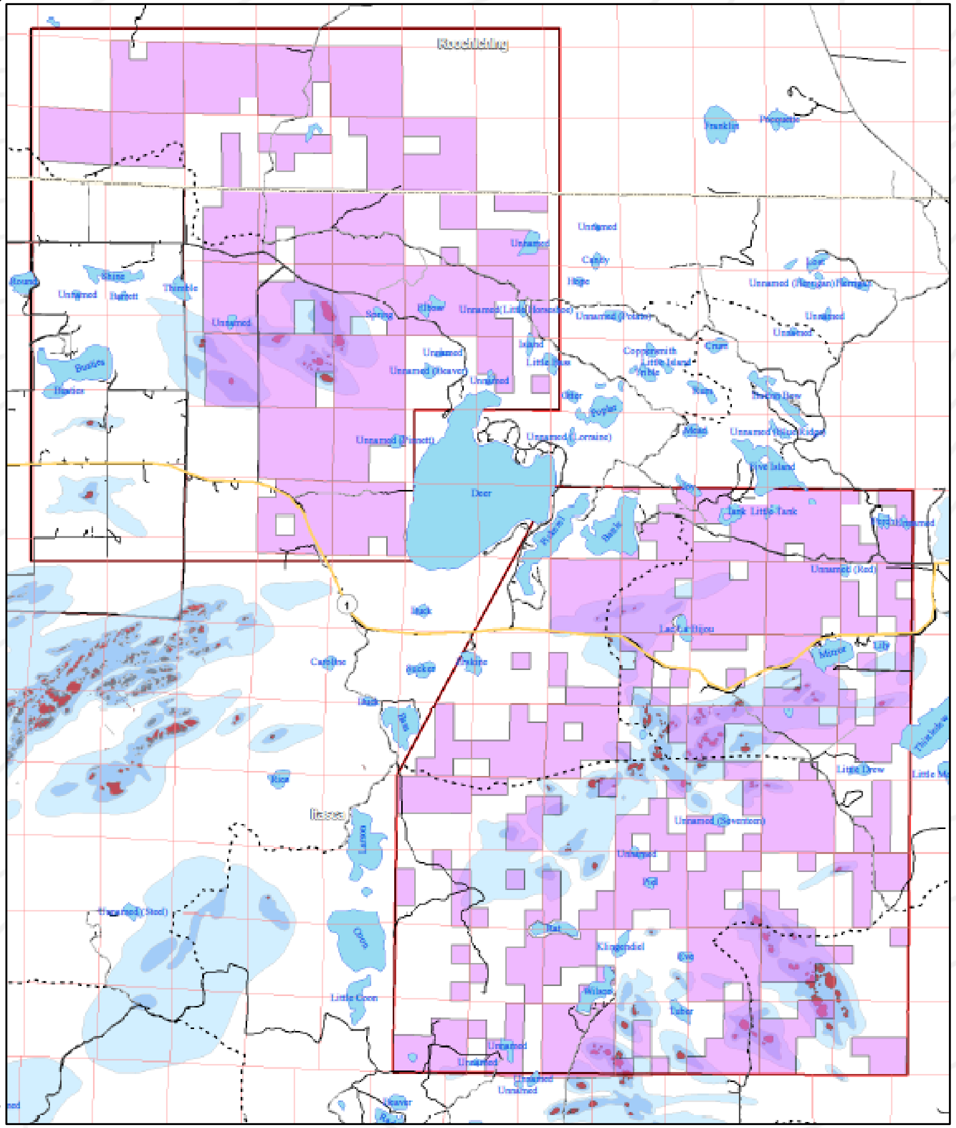
Safety
- Site specific safety induction will be provided by AGA
- 2 satellite phones rented for primary emergency comms (one per mapping group)
- 4 radios supplied (one for each person) for secondary comms
- 4 personal first aid kits for each person
- 3 vehicle first aid kits for each truck and the UTV
- Fire extinguishers will be purchased for each vehicle
- Each vehicle will have a prestart checklist

BIG ROCK EXPLORATION

AGA Lease Areas:

Magni and North Ran Projects





Anglo MN DNR Lease Summary - Magni

North	Acres	Square Miles
Total Lease Area	13359	20.87
Total Moderate Outcrop Potential Area	385	0.60
Total High Outcrop Potential Area	54	0.08

Anglo MN DNR Lease Summary – North Ran

South	Acres	Square Miles
Total Lease Area	16976	26.53
Total Moderate Outcrop Potential Area	867	1.35
Total High Outcrop Potential Area	138	0.22

"Moderate Outcrop Potential" - depth to bedrock is 15 to 30 feet

"High Outcrop Potential" - depth to bedrock is 0 to 15 feet

Data Sources: DNR Crush-Stoned Potential, CWI, bedrock mapping

Big Fork 30x60 Outcrops

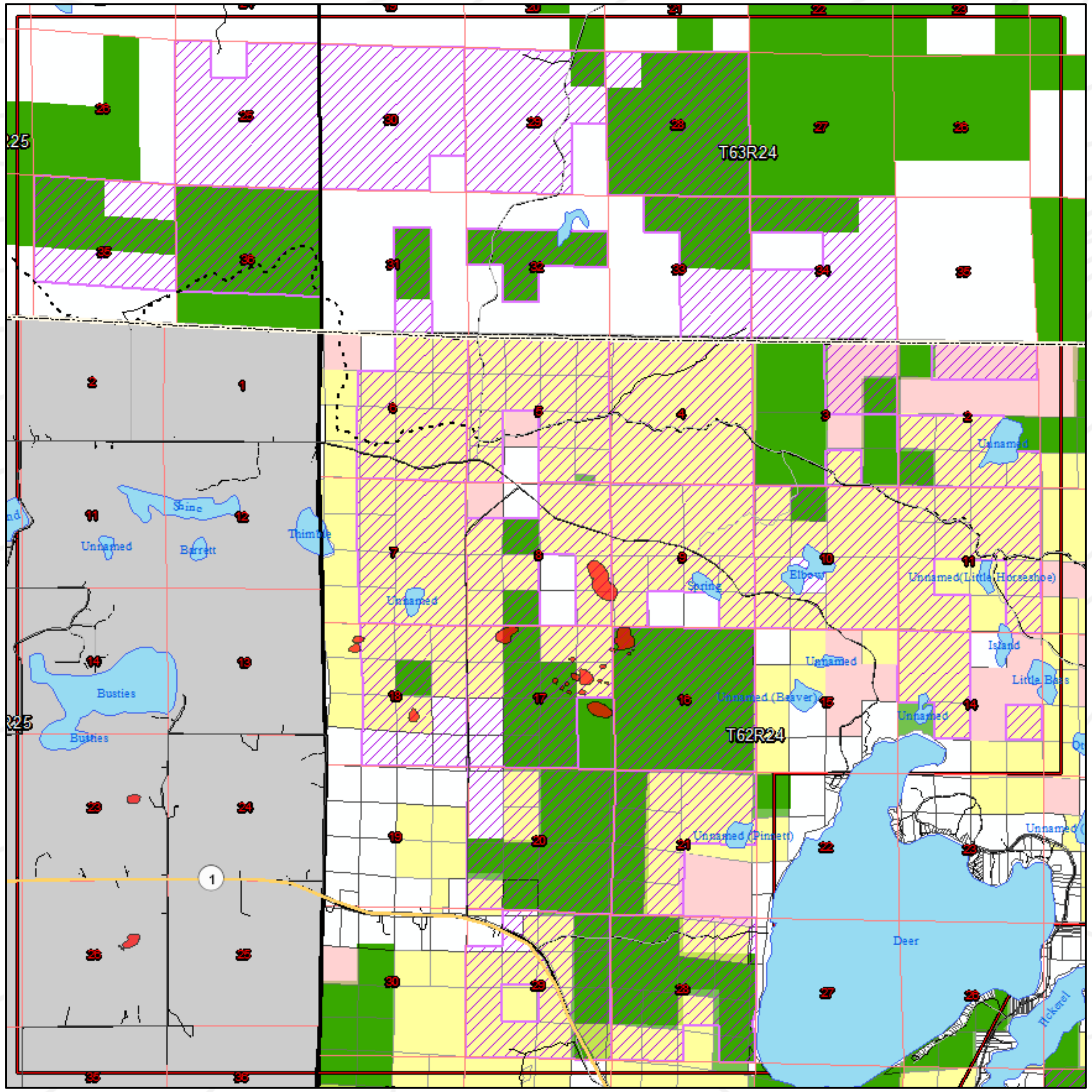
Aggregate Mapping - Crushed Stone Potential

- High Potential for Crushed Stone Resources
- Moderate Potential for Crushed Stone Resources
- Low Potential for Crushed Stone Resources

BIG ROCK EXPLORATION

Surface Ownership

Magni Lease Areas



- Outcrops
- AGAM AOI
- AGAM Leases

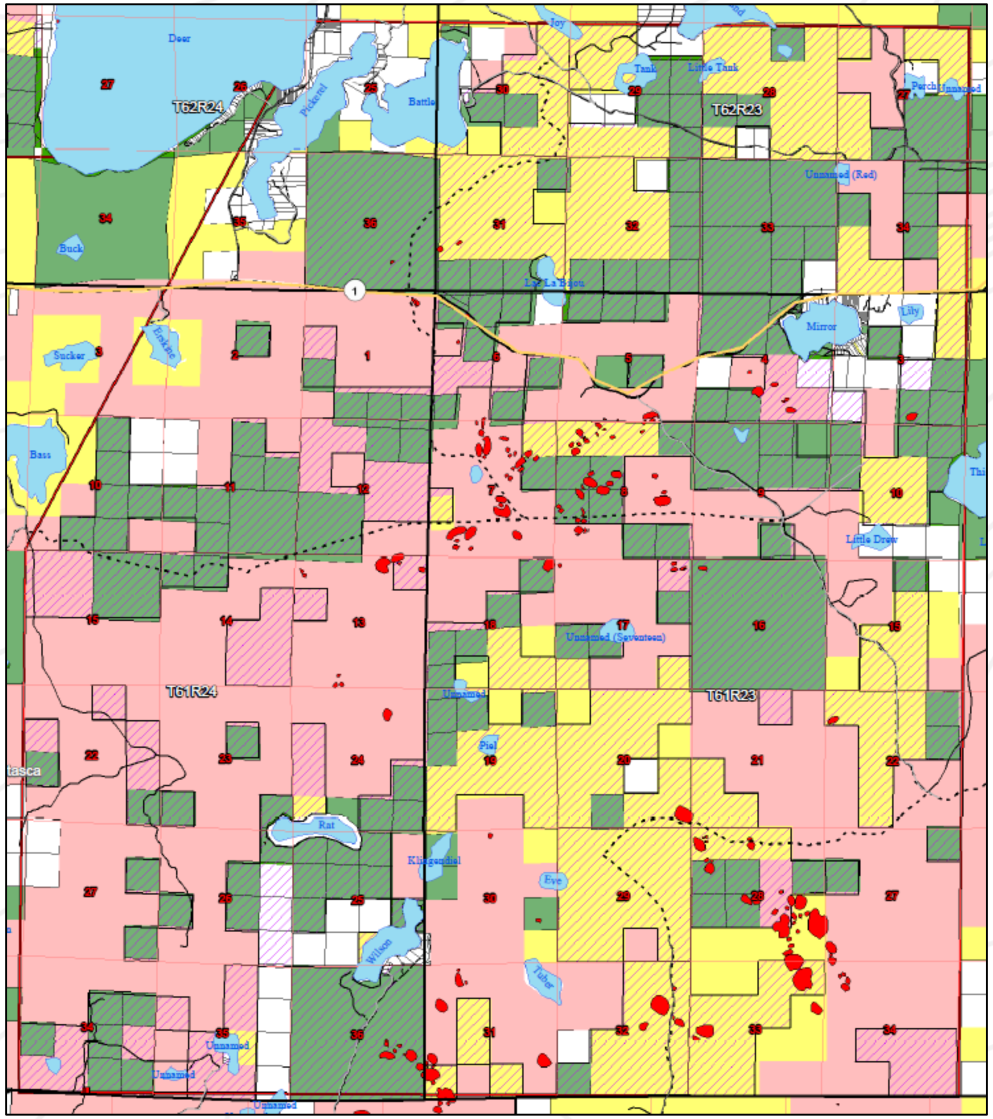
Surface Ownership (Itasca Co)

- Private
- Lumber Co
- County
- State/Federal
- State Forest Land

BIG ROCK EXPLORATION

Surface Ownership

North Ran Lease Areas



Outcrops
AGAM AOI
AGAM Leases

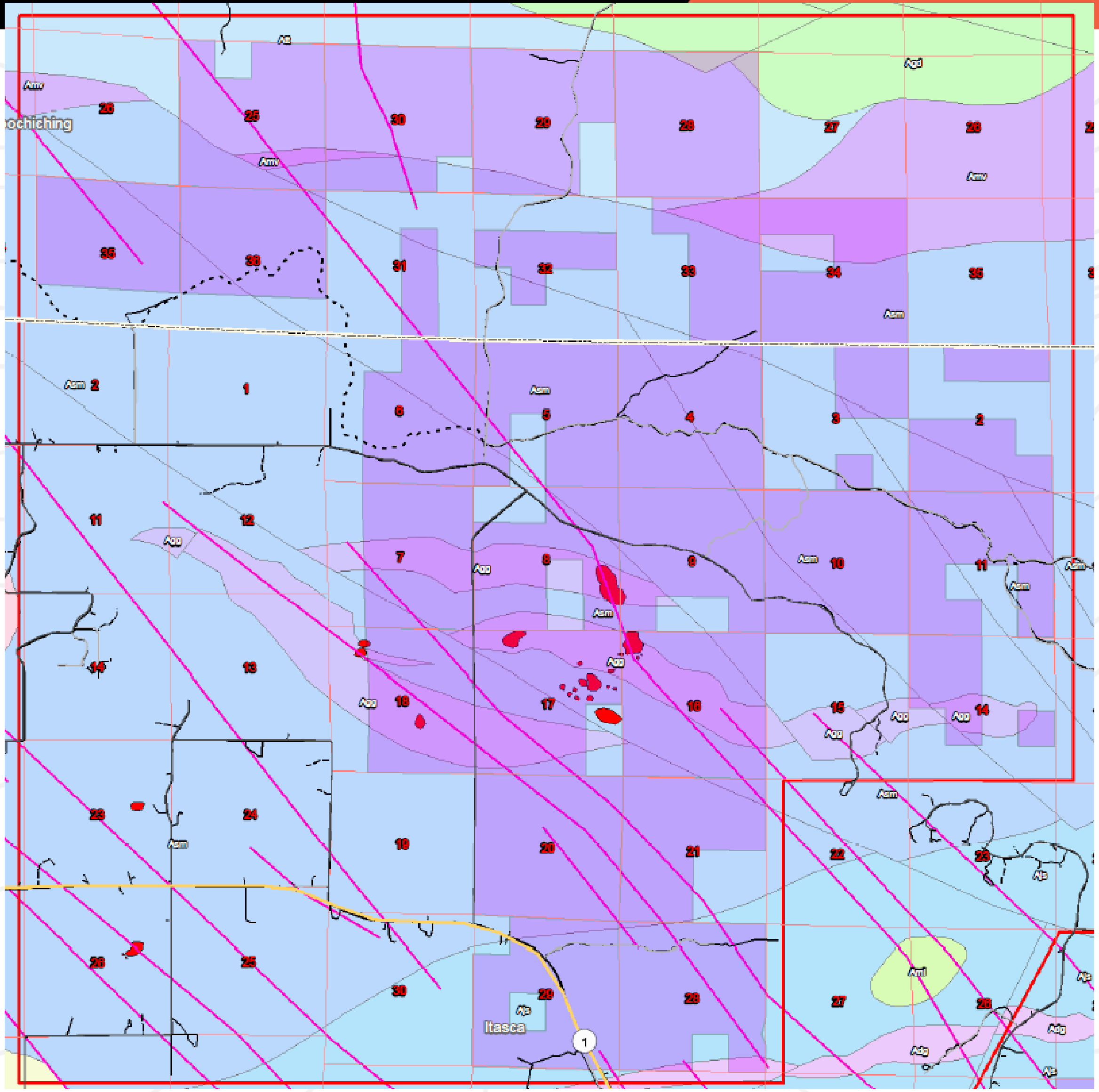
Surface Ownership (Itasca Co)

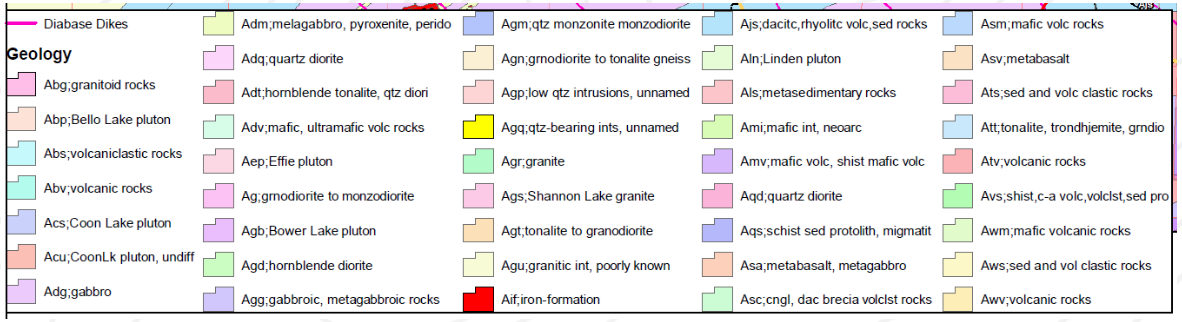
- Private
- Lumber Co
- County
- State/Federal
- State Forest Land

BIG ROCK EXPLORATION

Bedrock Geology

Magni Lease Areas

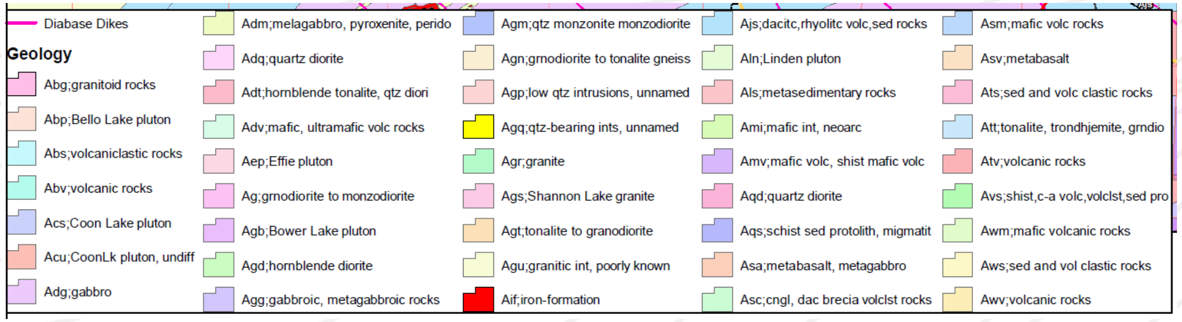


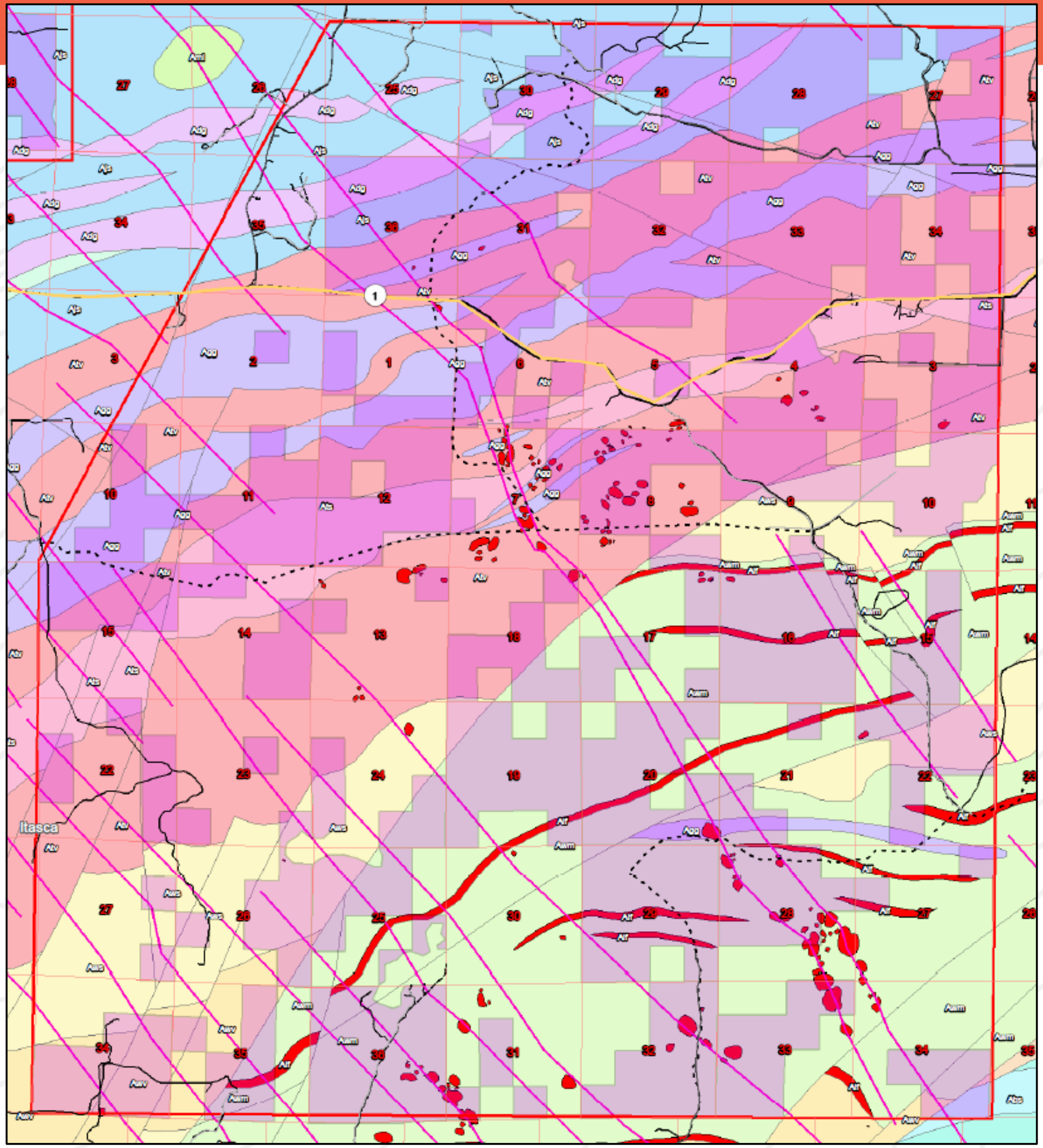


BIG ROCK EXPLORATION

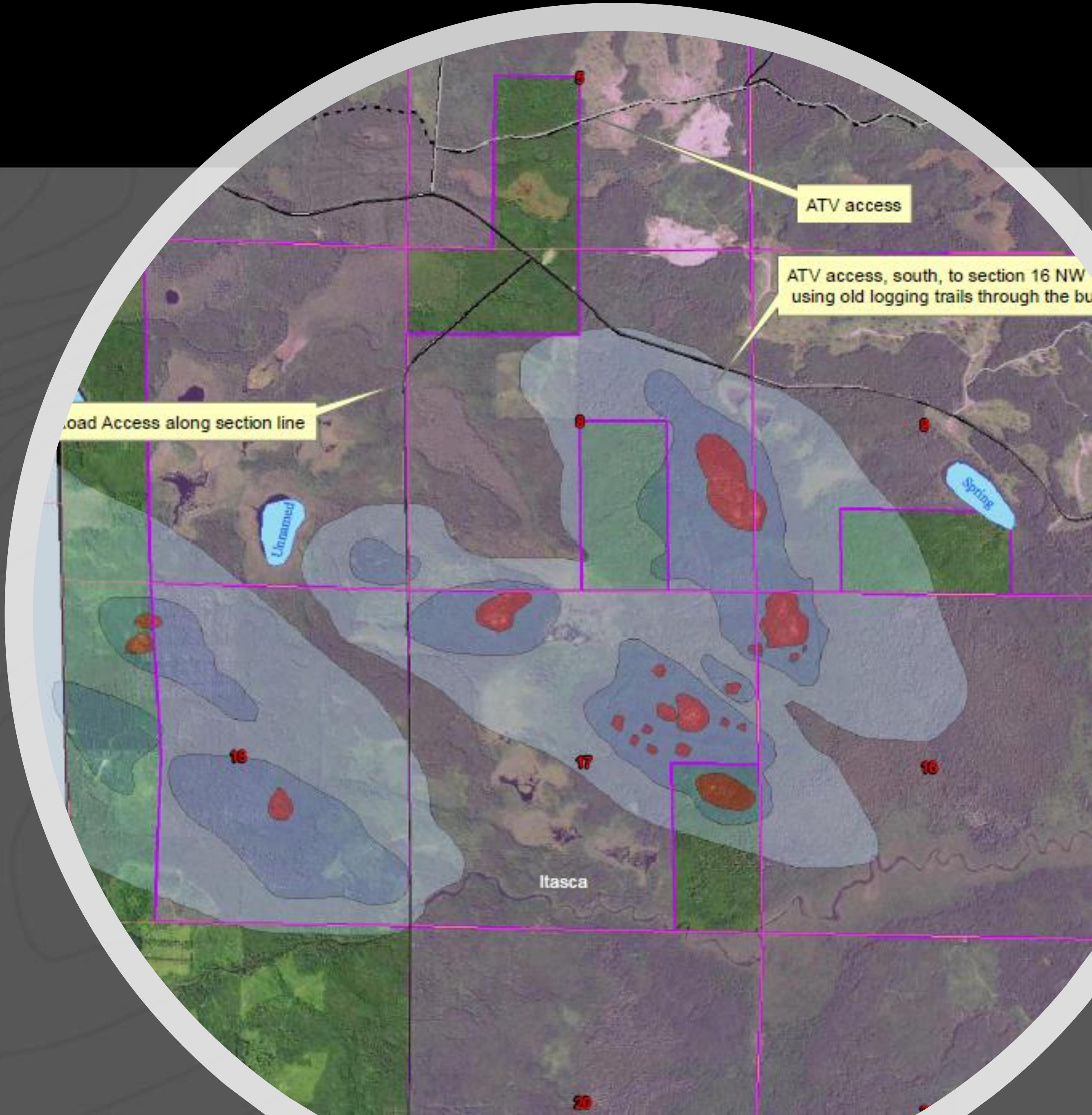
Bedrock Geology

North Ran Lease Areas

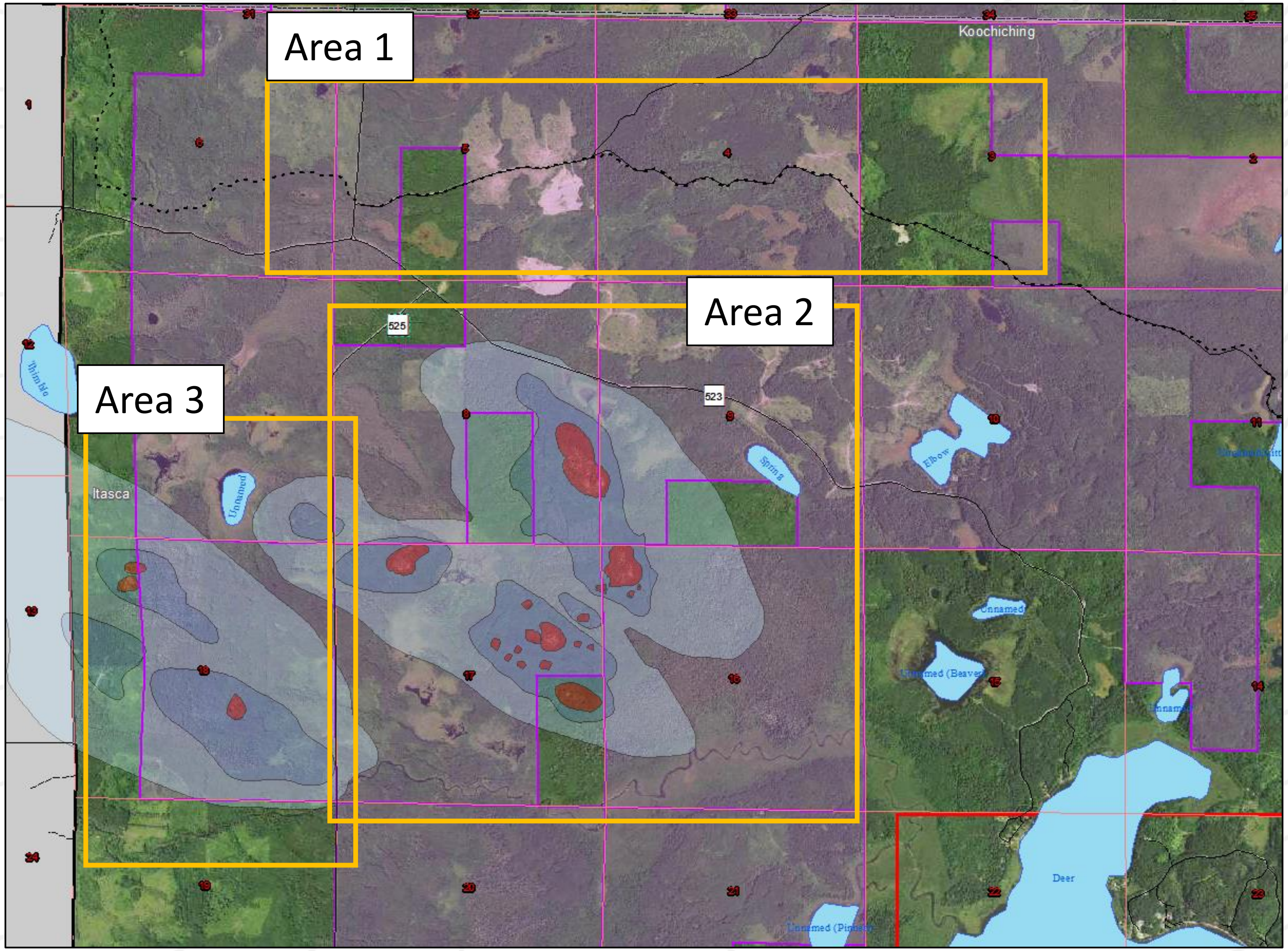




Outcrop Exposure: Magni Lease Area



Magni Lease Area: | Primary Mapping Areas & Access



Approach:

- Broken up into 3 primary mapping areas
- Limited known exposure in area 1 but decent access so it should be visited
- Areas 2 and 3 illustrate the greatest potential for exposure
- Surface ownership is variable
- Access is primarily walk-in with some ATV trails

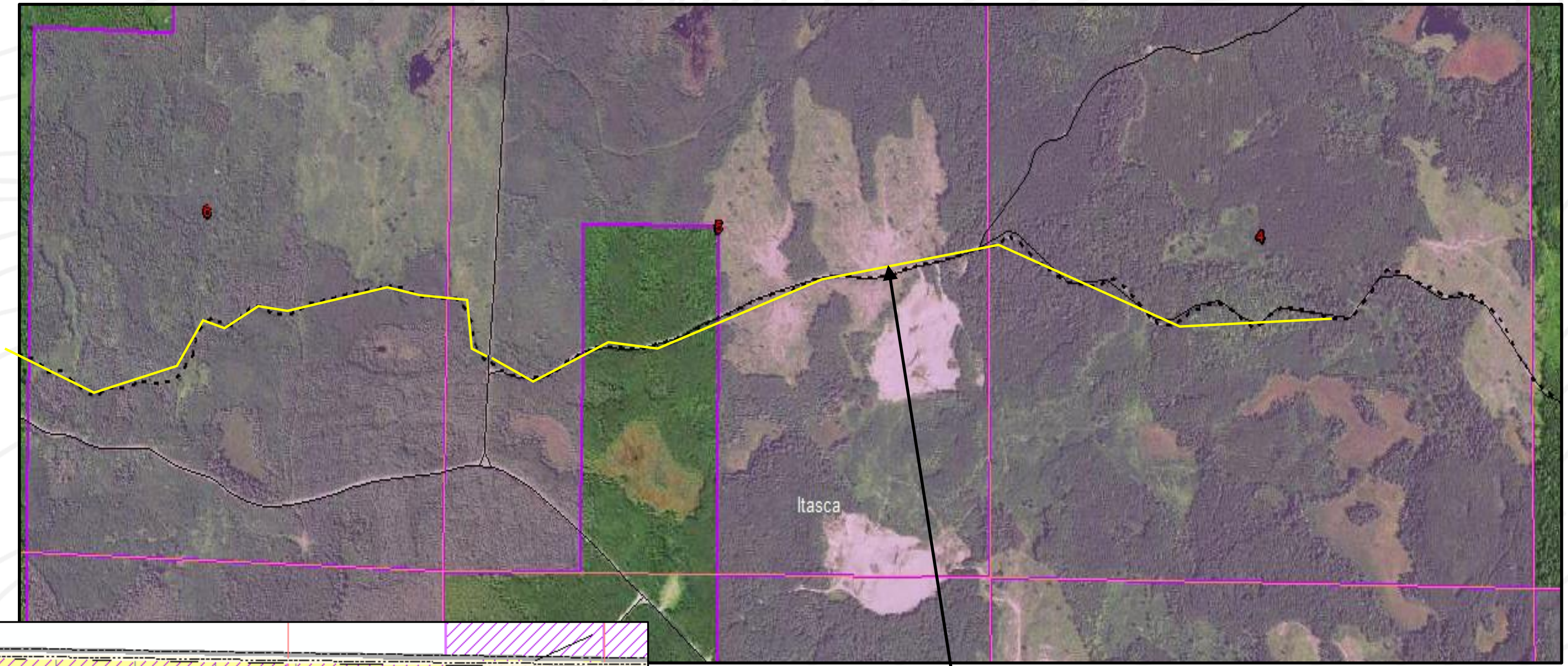
Magni Lease Area: Access Routes Area 1

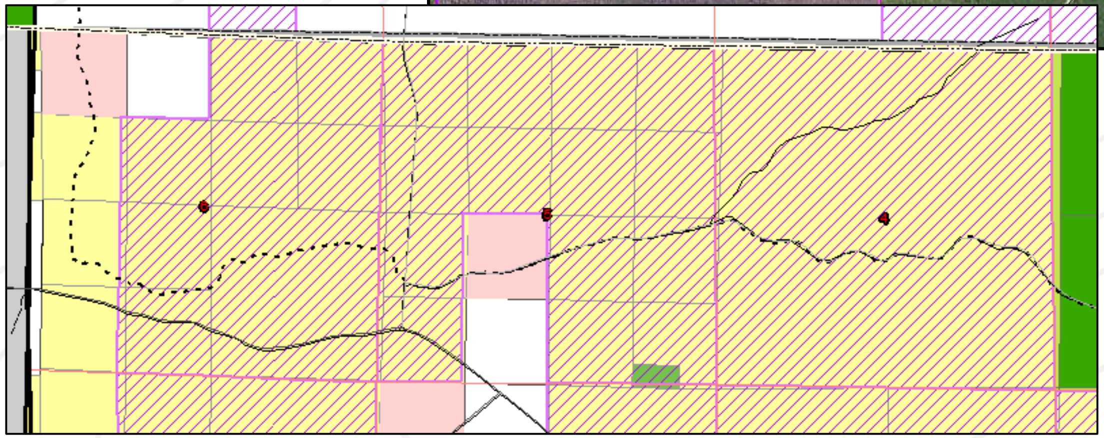
Access:

- Primarily walk-in access
- Potential ATV trail use with UTV
- Mainly scouting for potential exposure

Surface Ownership:

- County



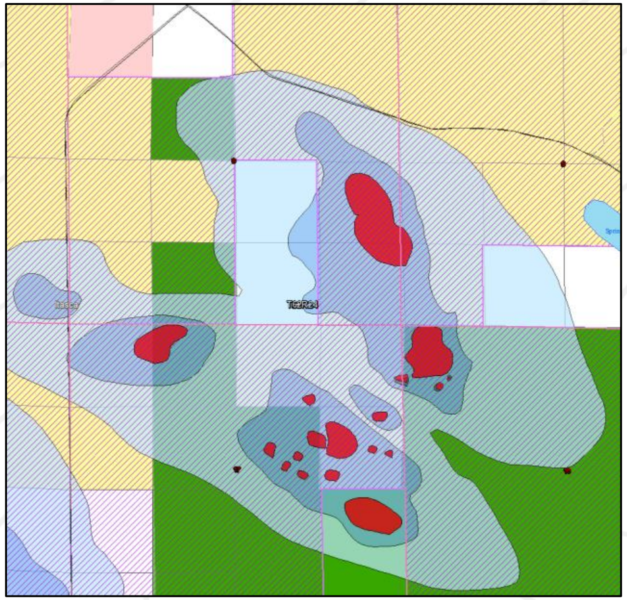


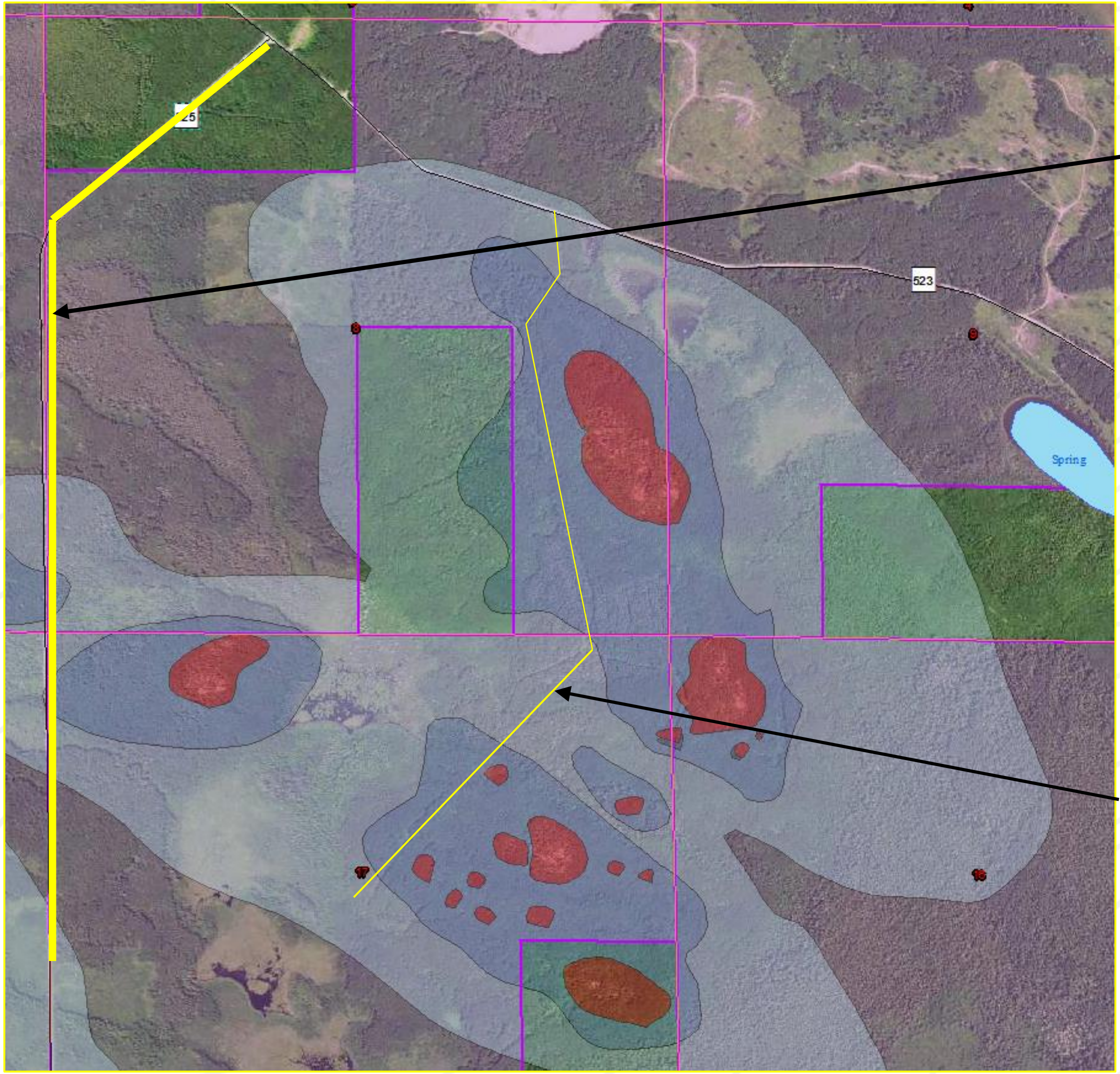
Can we use an ATV on this snowmobile trail for scouting areas?

Magni Lease Area: Access Routes Area 2

Access:
- Primarily walk-in access
- Potential ATV trail use with UTV

Surface Ownership:
- County
- State
- Private (minimal and could be avoided)

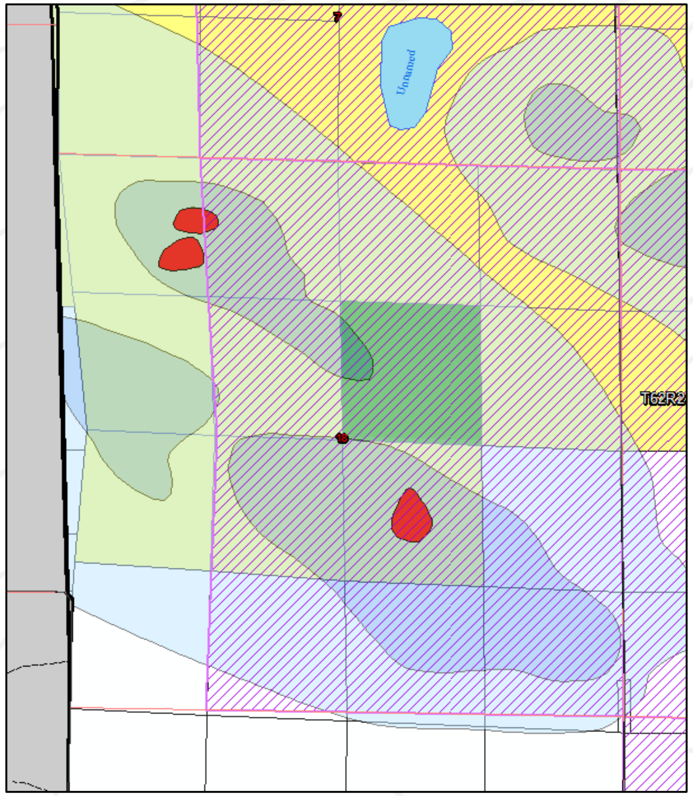


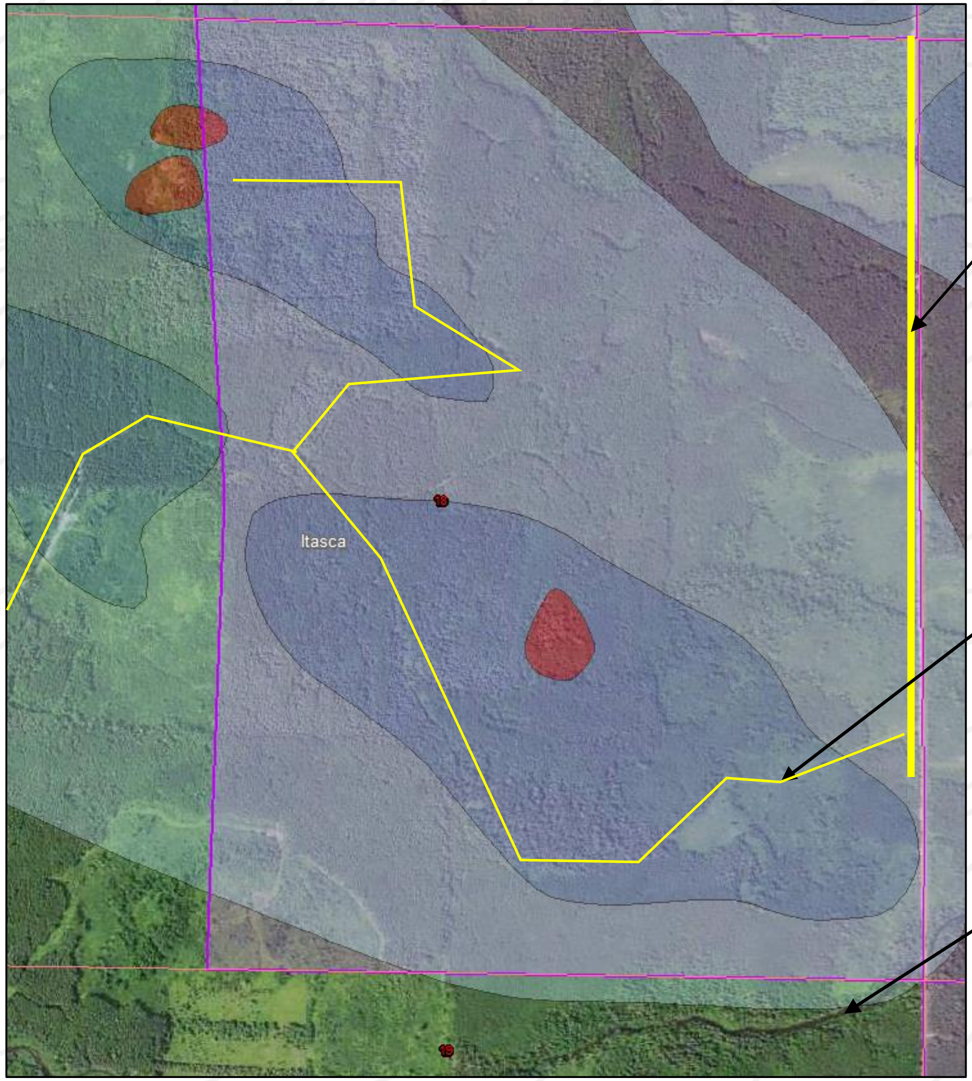


Magni Lease Area: Access Routes Area 3

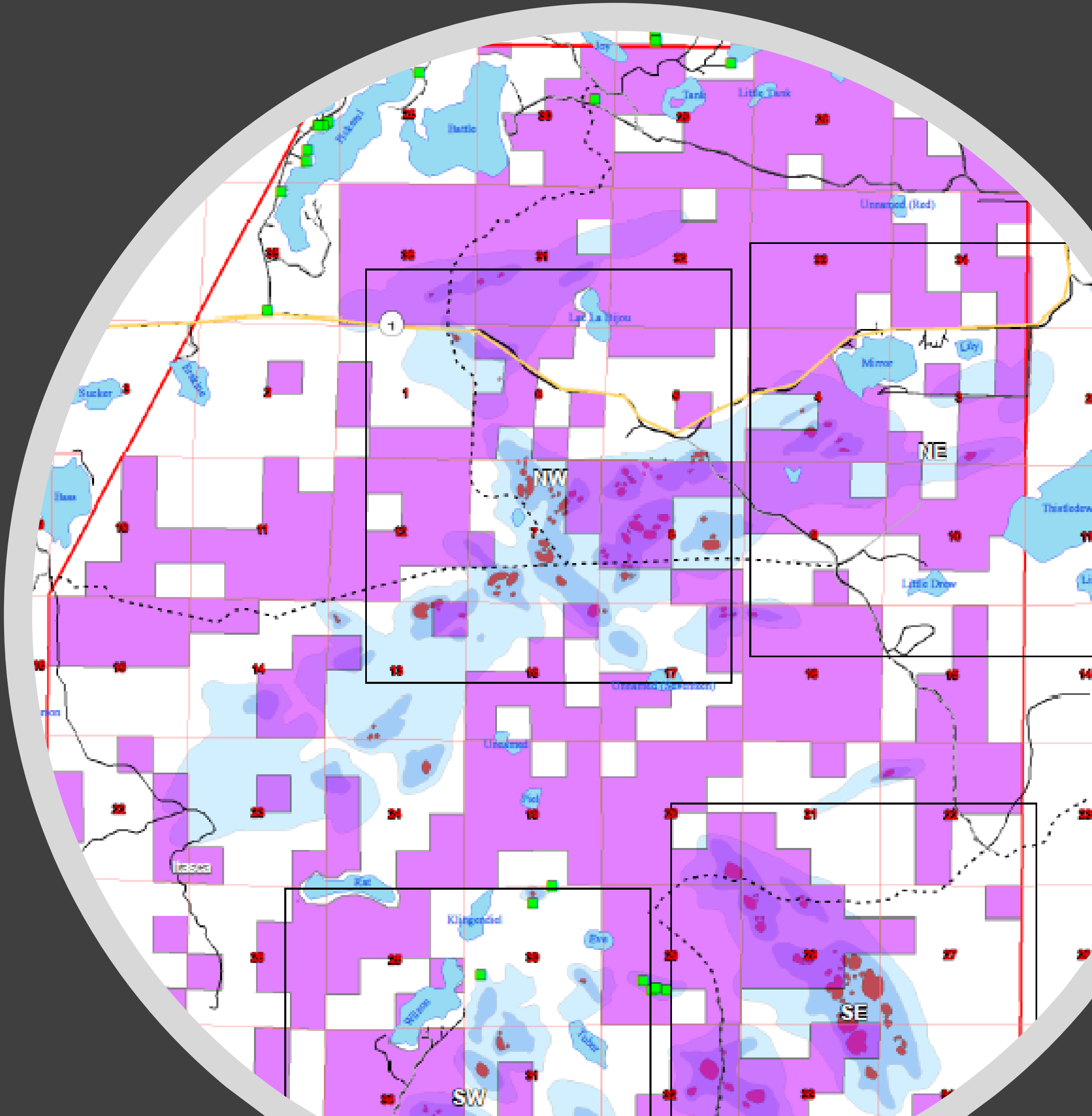
Access:
- Primarily walk-in access
- Potential ATV trail use with UTV

Surface Ownership:
- Federal primary
- State
- Timber
- Private
- County





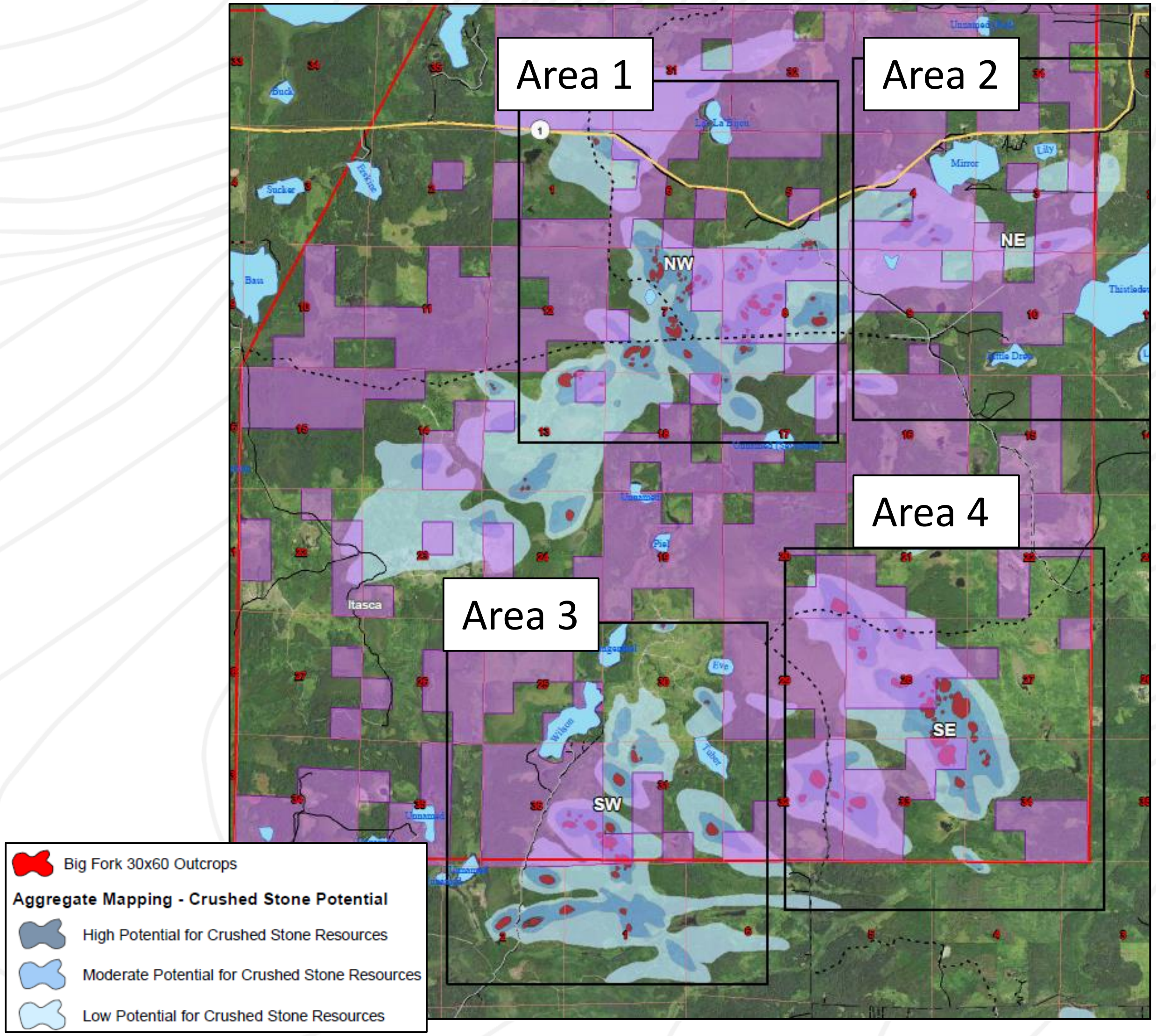
Outcrop Exposure: North Ran Lease Area



North Ran Lease Area: Primary Mapping Areas & Access

Approach:

- Broken up into 4 primary mapping areas
- Significantly more outcrop exposure potential than Magni lease area
- Surface ownership is variable
- Access is primarily walk-in with some ATV trails and county road access

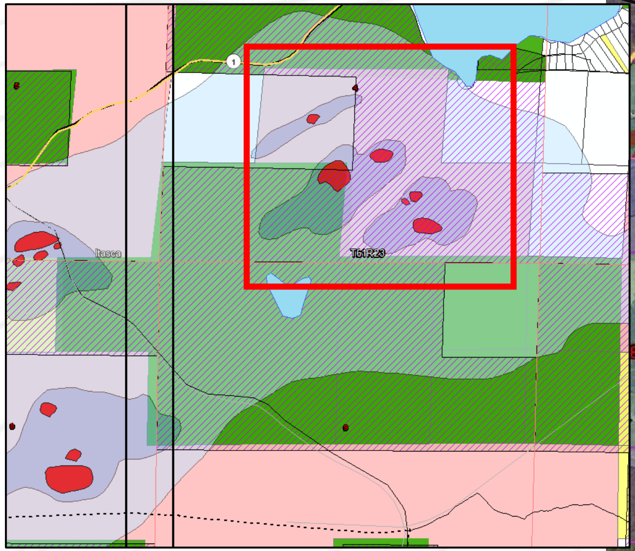


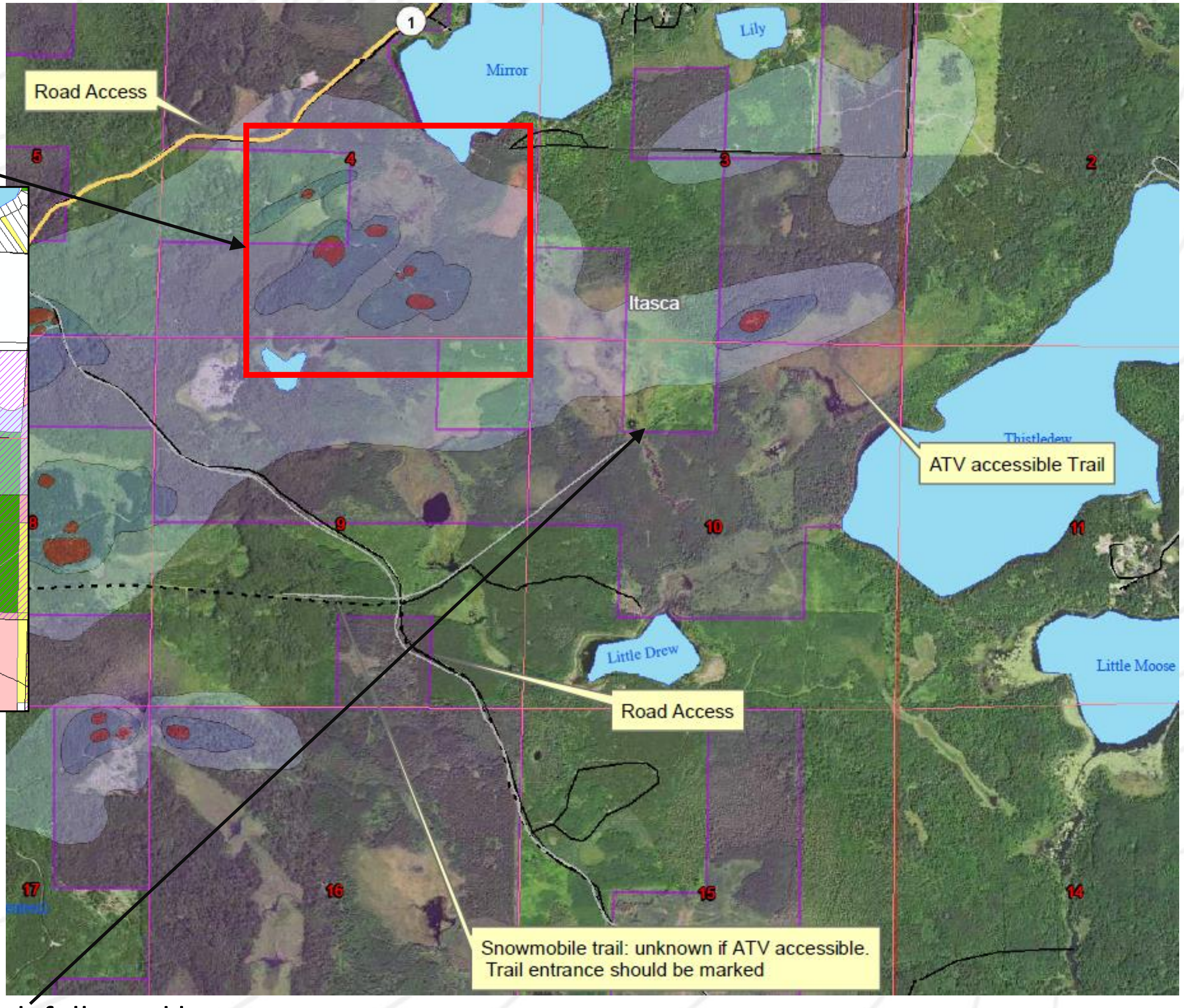
North Ran Lease Area: Primary Mapping Areas – AREA 1

Access:
- County road and forest road access to main exposures
- Some walk-in access
- Potential ATV trail use with UTV

Surface Ownership:
- Timber (main exposures)
- Federal
- State
- Private (mainly from a right-of-way)

Access via forest road which splits through outcrop area





Access via forest road, followed by walk-in access for about 0.25 miles

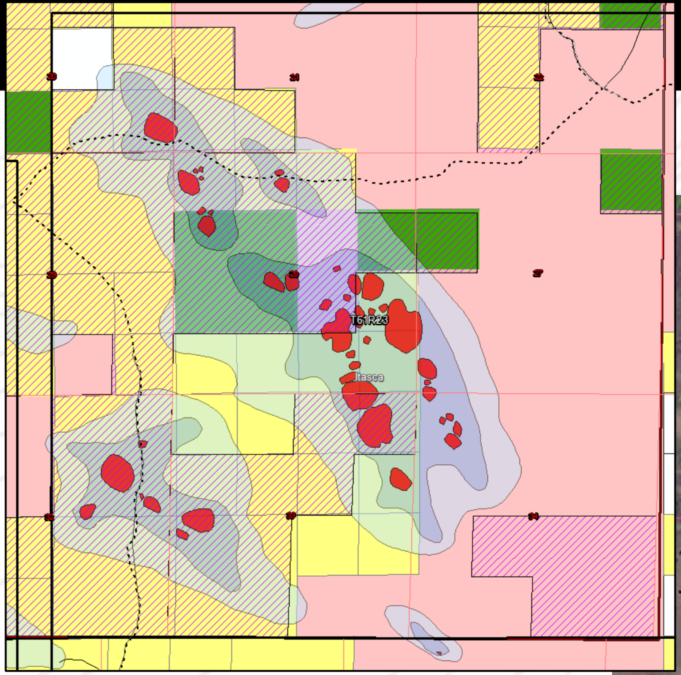
North Ran Lease Area: Primary Mapping Areas – AREA 2

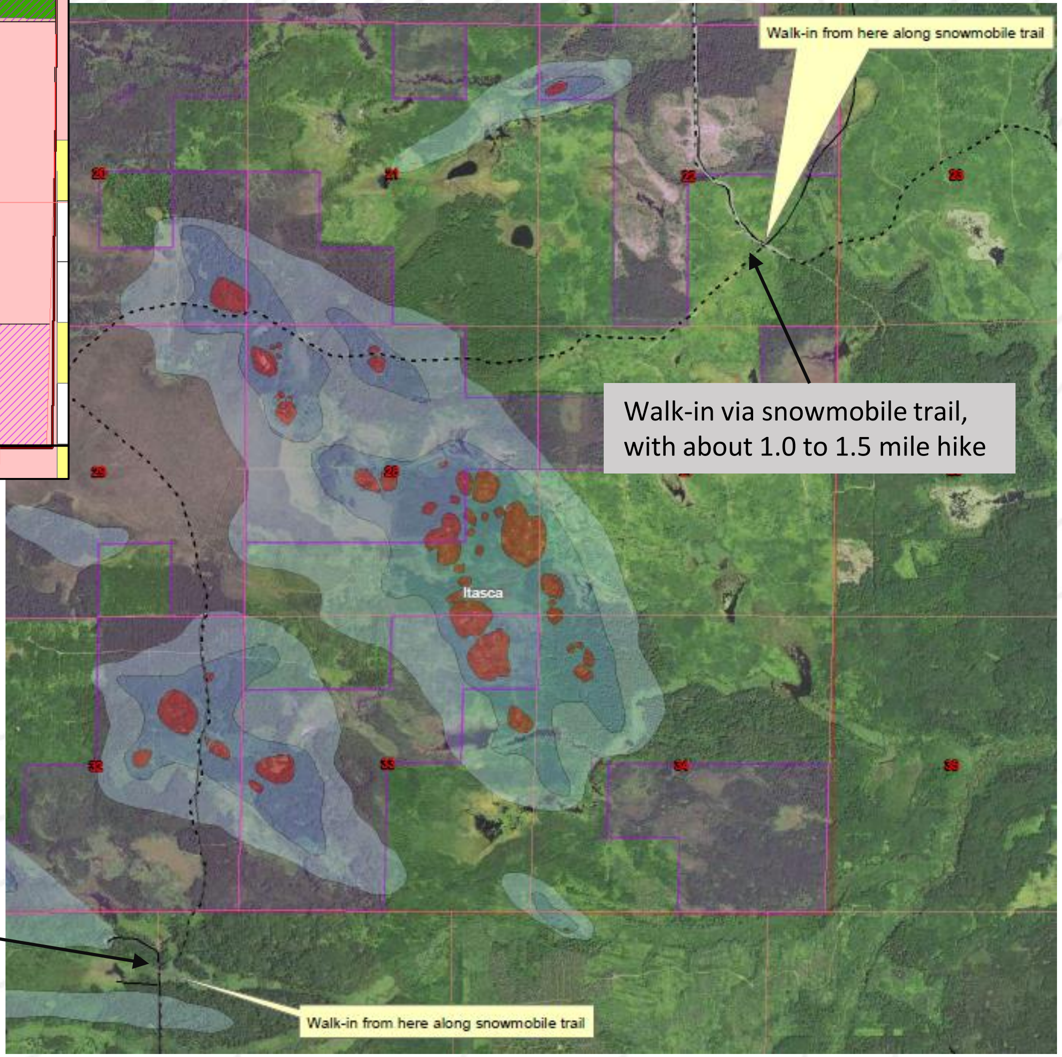
Access:

- Probably contains the most exposed outcrop by area
- Primarily walk-in access
- Travel by ATV prohibited on snowmobile trail

Surface Ownership:

- County
- State
- Timber





Walk-in via snowmobile trail, with about 0.5 to 1.0 mile hike

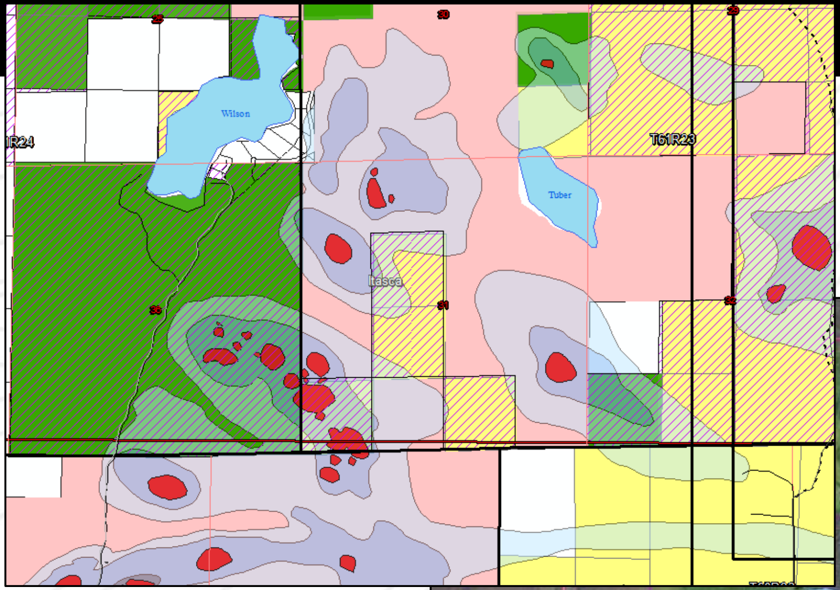
North Ran Lease Area: Primary Mapping Areas – AREA 3

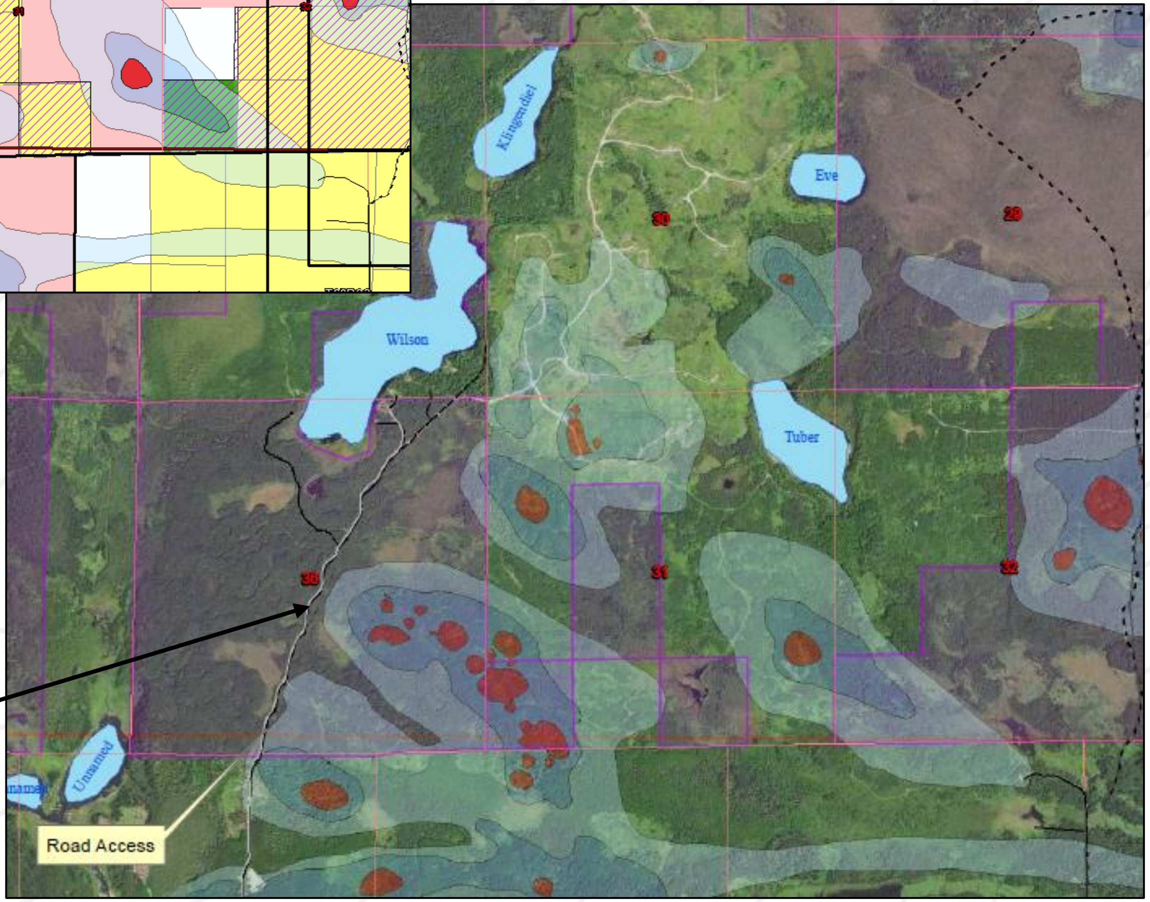
Access:

- Primarily walk-in access
- Walk-in access from Wilson Lake Road & old logging roads
- Some ATV and county road coverage outside of lease area where exposure may exist

Surface Ownership:

- State
- Timber
- County





Walk-in access from Wilson Lake Road & old logging roads

North Ran Lease Area: Primary Mapping Areas – AREA 4

Access:

- Primarily ATV trail access
- Walk-in access or ATV access from marked snowmobile trails

Surface Ownership:

- Timber (lots of known exposure on timber owned surface)
- State
- County

Can we use an ATV on this snowmobile trail or is this walk-in access only?

BIG ROCK EXPLORATION

Mapping Strategy Summary

Summary

- AGA directed BRE to plan and execute a reconnaissance mapping program on two of their lease areas with primary goals of collecting detailed data and information on various outcrop exposures and compiling data into a final ArcGIS geodatabase for AGA to integrate into their systems.
- Big Rock will complete the two-week mapping program beginning August 13th 2018
    - Option to add additional mapping as deemed necessary by AGA based on this initial 2 weeks
- Final deliverables will include:
    - All data, notes, photos, samples, etc. submitted to AGA
    - An updated ArcGIS geodatabase (GDB) containing all field data collected
        - Photos and notes will be linked in GDB
        - Sample locations and data spreadsheet
        - All geological observation data
    - PDF maps for areas of interest
        - Outcrop maps primarily as exposure will limit output abilities
    - Technical field summary report detailing work completed and key observations/interpretations
- Estimated completion of mapping, data compilation and field summary by mid-end of September

THANK YOU!

LET'S WORK TOGETHER.

1620 Central Ave NE, Ste 104, MPLS, MN 55413

www.bigrockexploration.com

info@bigrockexploration.com

(612) 236-4562