# ASSESSMENT WORK REPORT

# for CELL CLAIMS 277042, 277041, 131127, & 329881

### arising from LEGACY CLAIMS 4282444, 4282707, & 4286187

## Lorrain Township

## Larder Lake Mining Division

**Claim Holder - Brian Anthony (Tony) Bishop client #108621**

*Photo A: Unpicked till sample concentrates – 0.25-0.5mm*

**Report prepared and submitted by Tony Bishop**

**June 18, 2018**

# Table of Contents

# ASSESSMENT REPORT FOR CELL CLAIMS 277042, 277041, 131127, & 329881 arising from LEGACY CLAIMS 4282444, 4282707, & 4286187 LORRAIN TOWNSHIP, LARDER LAKE MINING DIVISION

***Prepared by Brian A. (Tony) Bishop, submitted June 18, 2018***

## INTRO:

Hereby submitted by Brian Anthony (Tony) Bishop [Client No. 108621, 100% holder on record], on June 18, 2018, an assessment report for work completed on contiguous Legacy Claims no. L 4282444, L4282707, and L4286187 in Lorrain Township**,** in respect of cell claims 277042, 277041, 131127, and 329881, in grid cells 31M05H265, 31M05H265, 31M05H284, and 31M05H305, Larder Lake Mining Division [see Appendix 4: Maps 1 & 11, pages 55 & 64].

As of April 10, 2018, these legacy claims are now comprised of cell claims located in the Provincial Grid as follows:

| Legacy Claim # | Associated Full Cell Claim # | Grid Cell ID | Associated Boundary Cell Claim # | Grid Cell ID |
|---|---|---|---|---|
| **4282444**<br>Staked Oct 22, 2016 by Mike Barrette. Recorded Oct 24, 2016 (1 unit) | 277042* | **31M05H265** | **131127***<br>269300*<br>**277041*** | **31M05H284**<br>31M05H264<br>**31M05H265** |
| **4282707**<br>Staked Nov 5, 2016 by Patrick (Mike) Harrington. Recorded Nov 14, 2016 (3 units) | **277042***<br>**329881*** | **31M05H285**<br>**31M05H305** | **131127***<br>139060*<br>247076*<br>317177* | **31M05H284**<br>31M05H286<br>31M05H306<br>31M05H314 |
| **4286187**<br>Staked Apr 1, 2017 by Patrick (Mike) Harrington. Recorded Apr 6, 2017 (6 units) | 199542*<br>252459<br>**329881***<br>341583* | 31M05H346<br>31M05H325<br>**31M05H305**<br>31M05H326 | 205232<br>247076*<br>301121<br>302849*<br>317177* | 31M05H324<br>31M05H306<br>31M05H344<br>31M05H345<br>31M05H304 |

Work completed to date includes grass roots prospecting, a research component, a carefully planned and mapped out series of till sampling, screening, concentrating, sorting and examining potential kimberlite indicator minerals (KIMs), microphotography, and recording these and other findings. Laboratory services were obtained from Geoscience Lab, Sudbury (EMP on 31 grains; SEM on 7 grains), and Overburden Drilling Management, Nepean.

Traverses occurred on the following of these new claim numbers: Traverse 1: 277041, 277042, 131127, 329881; Traverse 2: 131127, 329881; Traverse 3: 277042, 131127, 329881; Traverse 4: 329881.

Appendices include detailed methodologies for field work and till sample processing (including results of processing efficiency test and flowchart for concentrating), narratives, maps and field notes for 4 traverses, a brief narrative on area history, notes on structural geology, and discussion points on the importance of non-magnetic signatures and geo-chemical and structural geology for advances in diamond exploration in Canada, as well as in-depth discussions of the importance of various types of kimberlitic & non-kimberlitic grains. A Map Appendix includes general claim location and road access, geological types, faults, glacial directions, magnetics, and Google Earth views of the claim.

## PURPOSE:

The purpose of staking legacy claims L 4282444, 4282707, and 4286187 and the goal of the assessment work done to date and included in this report is to look for evidence and test the hypothesis that the claim up-ice may contain a kimberlite pipe which manifests in the post-glacial topography as a small semi-circular lake, named Little Grassy Lake, aka the target.

## ACCESS:

Access to these claims can be made from the town of North Cobalt.

Access to the claims is most easily gained by taking Highway 567, heading East and South from Highway 11B in North Cobalt for 6.5 km to a right turn onto a gated, former logging road, and travelling ~7 kilometres where a truck can be parked south of this target.

As the crow flies, the claims are 2.5 km from the nearest year-round road, 7 km from the Cobalt train station, 23 km from the Trans-Canada Highway 11, 120 km from North Bay, and 400 km from Toronto. Lake Temiskaming lies a short distance to the east.

## PREVIOUS WORK and significance to Claims 4282444, 4282707, & 4286187:

Although there is now an identified kimberlite field in the region, no known pipes have been established in the immediate area around claim L 4282444, 4282707, or 4286187, and no previous work of any kind on these claims has been recorded to date, according to overlays researched at the Mining Recorder's Office in Kirkland Lake; however, on Map 2052 (Ontario Department of Mines, 1964), three small pits are shown close to Grassy Lake to the west, and on an earlier version of Google Earth, an abandoned shaft is shown on the small island on Nicol Lake (on 4286187).

For a brief history of development and abstract of human activity near the claims, please see Appendix 1: History of Development in the Cobalt Area [page 48].

## GEOLOGY:

### STRUCTURAL GEOLOGY:

Little Grassy Lake (aka the Kimberlite Pipe Target) is situated in diabase, 0.5 km to the east of a large area of granite that is labelled ambiguously 'Nicol Lake Diabase Basin'. This area could be very important to cobalt/silver exploration.

A fault runs northeast-southwest through Little Grassy Lake. This is very important for diamond exploration, as is the Cross Lake Fault 1.3 km to the west.

In Lac de Gras diamondiferous kimberlite pipes are found in areas of contacts and near contacts of granite and diabase combined with nearby major faults and cross faults.

A short distance to the northwest of Little Grassy Lake are three diamondiferous kimberlite pipes, found the same distance to the east of this Cross Lake Fault. A cross fault runs through this lake in a northeast-southwest direction.

Cobalt I and its precursors have tried to option my claims in this area several times, and Doug Robinson (P.Eng) explained the potential of the Nicol Lake Diabase Basin nearby, so there is also cobalt and silver potential.

For a more detailed write-up on the structural geology, please see Appendix 2 [page 49].

**SURFICIAL TOPOGRAPHIC FEATURES:**

The area in and surrounding claim 4282444 is comprised of some bedrock and thin till covering bedrock. On the OGS Map 2685, Quaternary Geology, this area is identified as Bedrock-Drift Complex: thin drift cover, sufficiently thick in places to subdue the bedrock topography.

**FIELDWORK:**

Taking many smaller till samples from various locations down-ice was deemed appropriate to mitigate the extreme nugget effect caused by KIMs potentially being restricted to thin stratigraphic horizons in the till [see Appendix 6: Methodologies for Field Work & Till Sampling, Diagrams R & S, page 81].

27 till samples were collected on 4 traverses. General prospecting and site examination was undertaken on each traverse.

## DISCUSSION/CONCLUSIONS & RECOMMENDATIONS: **Further discussion is presented on page 31.**

## TRAVERSES: **Please refer to Appendix 5 for Traverses for detailed narratives, maps, and coordinates/field notes.**

## METHODOLOGIES: **Please refer to Appendix 6 for Methodologies for Fieldwork and Till Processing**

# RESULTS:

**Geoscience Lab Results from Sudbury:**

Of the thirty-eight grains from claims 4282444, 4282707, and 4286187 that were analysed at Geoscience Lab in Sudbury, one was a G1, nine were G9s, one was a G10, three were G11S, and two were G12s. Almandine, Titanite, Spessartine, Staurolite, Quartz, Fe-Oxide, and Silicate were also identified.

| Lab Findings EMP | Sample Label | Features | Dimensions |
|---|---|---|---|
| G1 | S-G8 | Deep purple | 1.0 x 1.2 mm |
| G9 | S-G5 | ‘lilac’ purple | 0.25 x 0.4 mm |
| G9 | S-G6 | Best purple | 1.0 x 1.6 mm |
| G9 | S-G10 | Med purple | 0.5 x 1.0 mm |
| G9 | S-G11 | Med purple | 0.3 x 0.5 mm |
| G9 | S-G15 | Light purple | 0.5 x 0.8 mm |
| G9 | S-G16 | Purple | 0.25 x 0.6 mm |
| G9 | S-G90 | Purple | 0.25 x 0.5 mm |
| G9 | S-G93 | Purple | 0.3 x 0.8 mm |
| G9 | S-G94 | Purple | 0.4 x 0.6 mm |
| G10 | S-G91 | Purple | 0.3 x 0.5 mm |
| G11 | S-G92 | Purple fractured | 0.3 x 0.7 mm |
| G12 | S-G89 | Purple, frosted-some coating | 0.25 x 0.5 mm |
| G12 | S-G95 | Purple  coated one side | 0.25 x 0.8 mm |
| **G11** | S-G17 | Purple - non-magnetic* | 0.3 x 0.7 mm |
| **G11** | S-G22 | Red-frosted, non-mag* | 0.5 x 0.8 mm |
| **Almandine** | S-G18 | Pink non-mag* | 0.5 x 1.0 mm |
| Titanite | S-G3 | Deep purple | 1.0 x 1.0 mm |
| Titanite | S-G19 | Purple non-mag* | 0.4 x 0.5 mm |
| Titanite | S-G21 | Black/red? Non-mag* | 0.5 x 0.7 mm |
| Titanite | S-G88 | Dark R-O-P? frosted | 0.6 x 1.2 mm |
| Spessartine | S-G4 | Purple | 0.5 x 0.8 mm |
| Spessartine | S-G13 | Red purple | 0.25 x 0.4 mm |
| Spessartine | S-G14 | Purple | 0.25 x 0.5 mm |
| Spessartine | S-G85 | Red | 0.8 x 1.2 mm |
| Spessartine | S-G86 | Red | 1.0 x 1.0 mm |
| Almandine | S-G7 | Odd ‘lilac’ pink purple | 1.0 x 1.7 mm |
| Almandine | S-G12 | Pink purple | 1.0 x 1.2 mm |
| Almandine & Quartz | S-G9 | Med. Dark purple | 1.0 x 1.8 mm |
| Staurolite | S-G20 | Orange/red weird colour, coated and sculpted | 0.7 x 0.8 mm |
| Altered Silicate (Serpentine?) | S-G87 | Red orange, all sides frosted | 0.8 x 1.4 mm |

| Lab Findings SEM CRT-17-0107-03 | Sample Label | Features | Dimensions |
|---|---|---|---|
| Quartz | S-D2 | Crystal on one side, colourless, with light coloured inclusions – bright, doesn't fluoresce | 0.6 x 0.8 mm |
| Quartz | S-D7 | Yellow | 0.4 x 0.6 mm |
| Quartz | S-D8 | F-transparent, colourless, fluoresces medium bright white LW | 0.6 x 1.0 mm |
| Fe-Oxide | S-D3 | Odd reddish multi crystal | 0.7 x 0.7 mm |
| Silicate (Almandine?) | S-D4 | Pink, transparent | 0.4 x 0.5 mm |
| Silicate (Epidote?) | S-D5 | Yellow, hydrophobic | 0.5 x 0.8 mm |
| Silicate (Epidote?) | S-D6 | Yellow | 0.5 x 0.8 mm |

**MICROSCOPE PHOTOS OF KIMs:**

*Photos of grains from ODM cons that were picked for KIMs by ODM and then repicked by me from the till sample from 4282444 sent to ODM.*

*SG x 3.2 & +1.0 Amp magnet, therefore inert mag, therefore garnets are not crustal*


Photo 1 – GLPPp – 1.4mm


Photo 2 – GdkO, GMDO, GLP – 0.5-0.9mm


Photo 3 – GdkOR – 0.5mm


Photo 4 – GMPpf – 0.25mm


Photo 5 – unknown grain


Photo 6 – blue (possible sapphire), yellow grain


Photo 7 – GLPp – 0.3mm


Photo 8 – Not quartz – 0.3mm


Photo 9 – GLPp – 0.4mm

*The next grains are ODM picked & I compared colour change under different LED lamps*


Photo 10 – GO – (MDO) – 0.4mm

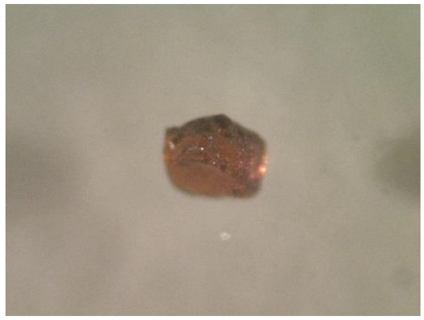


Photo 11 – same garnet as Photo 10, darker but no colour change

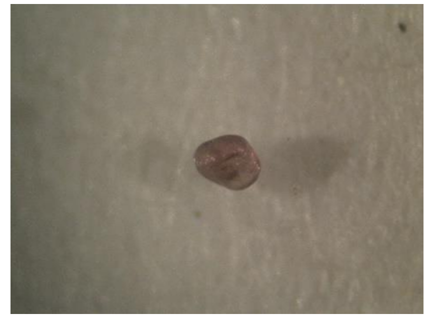


Photo 12 – GLPp – 0.25mm


Photo 13 – same garnet as Photo 12, with colour change


Photo 14 – GLPPp – 0.3mm

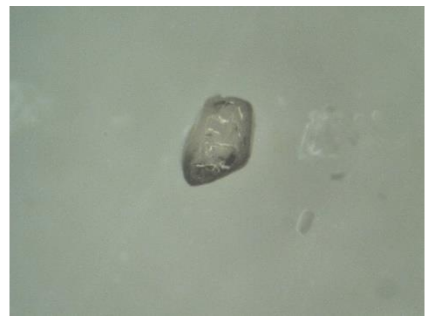


Photo 15 – Same garnet as Photo 14, with dramatic colour change


Photo 16 – Some Cr Pyrope picked by ODM – 0.25-0.5mm

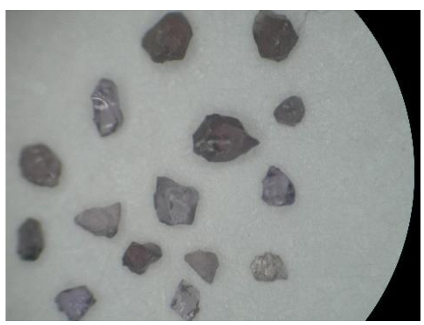


Photo 17 – Same garnets in Photo 16, with colour change

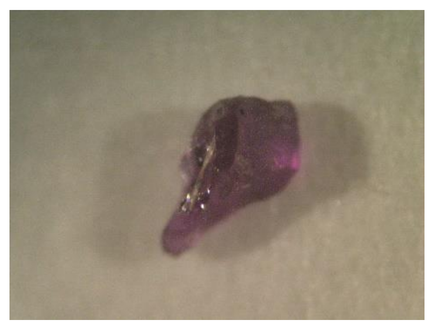


Photo 18 – GDPp – 1.0mm


Photo 19 – Same garnet in Photo 18, with colour change

*Cr Pyropes – GeoLab*

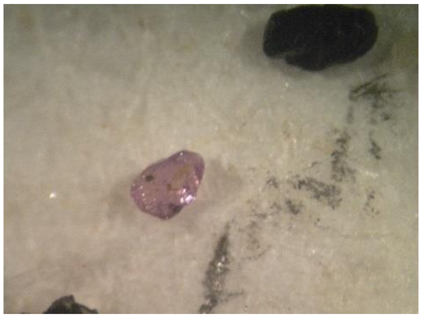


Photo 20 – SG-5 – G9 – LPp – 0.3mm


Photo 21 – SG-15 – G9 – LPPp – 0.8mm


Photo 22 – SG-16 – G9 – LPpf – unfractured – 0.6mm

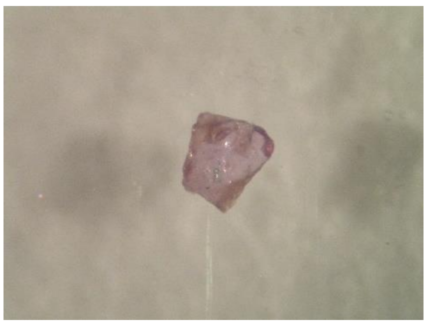


Photo 23 – SG-90 – G9 – LPPp – 0.5mm

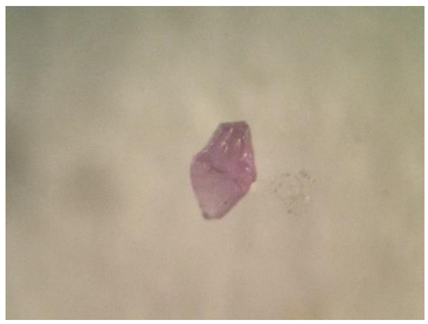


Photo 24 – SG-93 – G9 – LPp – 0.8mm

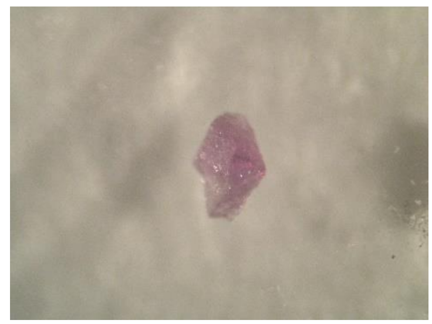


Photo 25 – SG-94 – G9 – LPPp – 0.6mm

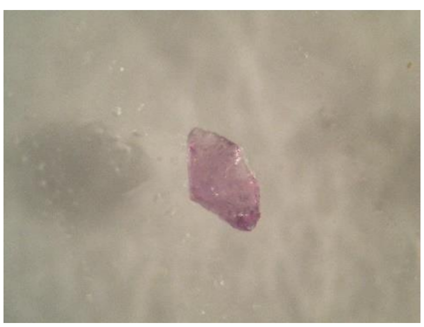


Photo 26 – SG-91 – G10 – lppPf – 0.5mm

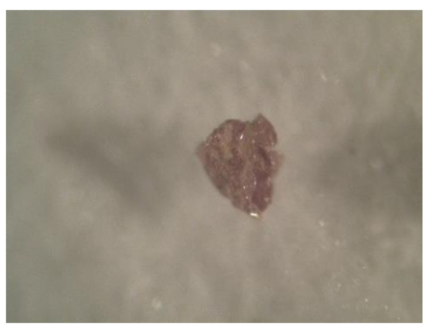


Photo 27 – SG-92 – G11 – MPp – 0.7mm

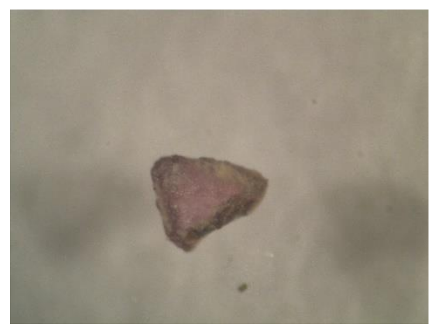


Photo 28 – SG-89 – G12 – LPpf – 1.2mm

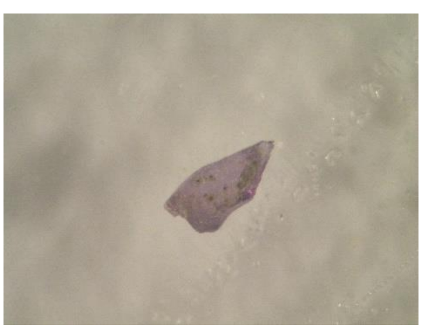


Photo 29 – SG-95 – G12 – MPp – 0.8mm

*Non-Mag garnets (inert – diamagnetic)*

Photo 30 – SG-17 – G11 – MPp – 0.7mm – Inert mag – 8.064% FeO

Photo 31 – SG-18 – almandine – LP – 1.0mm – Inert mag – this is especially strange…

Photo 32 – SG-22 – G11 – MPpf – unfractured – 0.8mm – inert mag – 6.696% FeO

Photo 33 – garnets with zero pickup, ~no iron

*Garnets – GeoLab*

Photo 34 – SG-4 – Spessartine – DPp – 0.8mm Very unusual colour

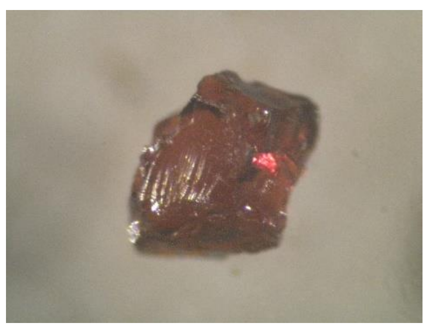


Photo 35 – SG-85 – Spessartine – RO – 1.0mm

Photo 36 – SD-4 – Silicate (almandine?) pink colourless – 0.4mm

Photo 37 – SG-87 – Altered silicate (serpentine?) – 1.4mm – All sides frosted, etc

*Grains – GeoLab*


Photo 38 – SD-5 – Silicate (Epidote?) 0.5mm – Hydrophobic – SEM


Photo 39 – same as 4718


Photo 40 – SD-7 – Silicate (Epidote) – 0.8mm


Photo 41 – SD-7 – Quartz – 0.6mm


Photo 42 – SG-19 – Titanite – 0.5mm – non-mag


Photo 43 – SG-20 – Staurolite – 0.7mm – non-mag – 13.308% FeO

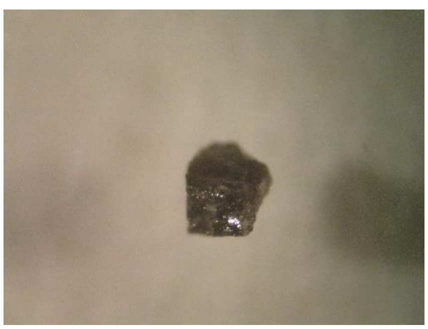


Photo 44 – SG-21 – Titanite – 0.7mm – non-mag

*4 Photos, SD-3 – FeO – 0.7mm - SEM Sudbury GeoLab*

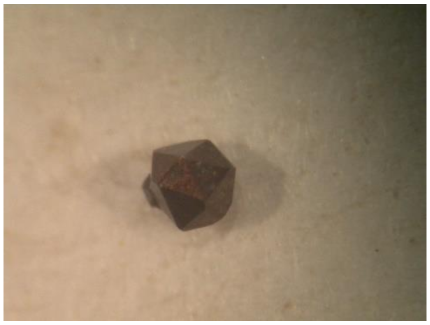


Photo 45 – SD-3 – FeO – 0.7mm

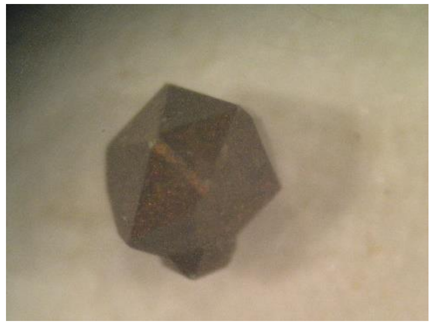


Photo 46 – SD-3 – FeO – 0.7mm

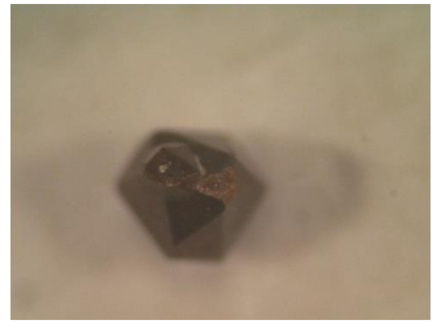


Photo 47 – SD-3 – FeO – 0.7mm

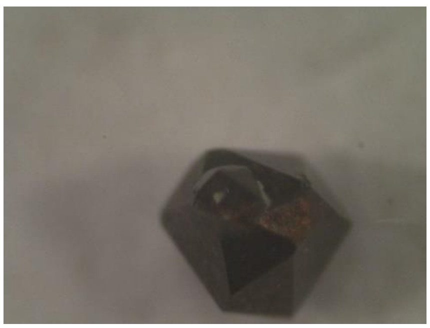


Photo 48 – SD-3 – FeO – 0.7mm

*Grains*

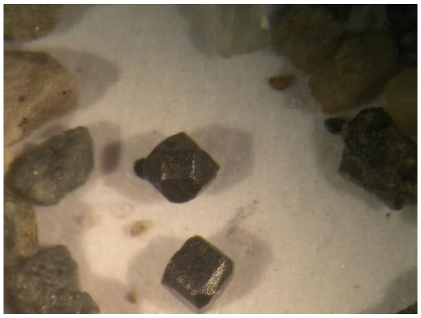


Photo 49 – Chromites, euhedral, 1.0mm


Photo 50 – chromite – dissolution pattern – 1.5mm


Photo 51 – orthopyroxene – 2.5mm


Photo 52 – chromite – 1.0mm


Photo 53 – ilmenite – 0.5mm


Photo 54 – ilmenite – 0.6mm


Photo 55 – orthopyroxene – 0.8mm

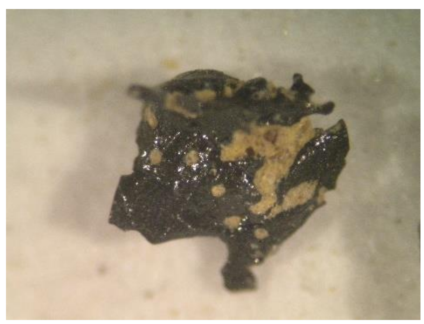


Photo 56 – back view of 4573


Photo 57 – 0.5 x 3.0mm grain

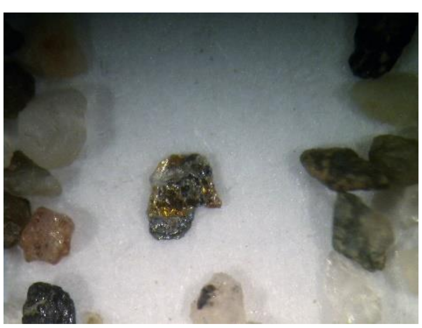


Photo 58 – Bornite – 1.0mm


Photo 59 – yellow stone

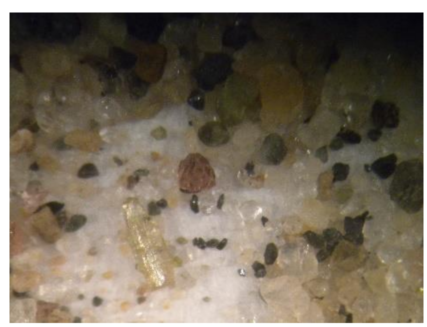


Photo 60 – long yellow-green crystal – kyanite?

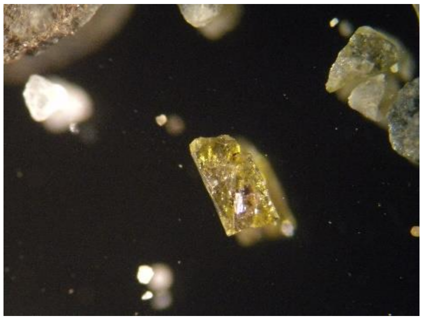


Photo 61 – yellow-green crystal


Photo 62 – yellow-orange (forsterite?) – 1.2mm

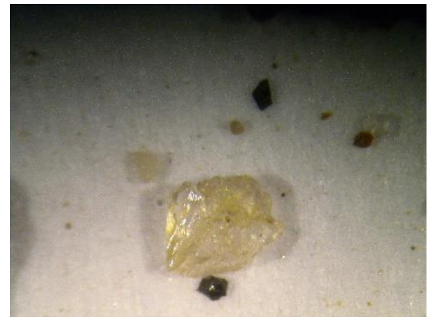


Photo 63 – unknown grain

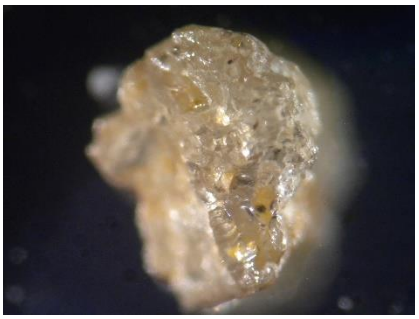


Photo 64 – grain photographed on mirror – 3.0mm


Photo 65 – yellow-orange – 1.2mm


Photo 66 – 1.3mm


Photo 67 – 1.3mm


Photo 68 – 0.8mm – same as 4721 – silicate (epidote)

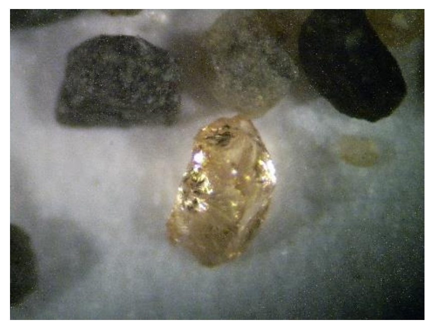


Photo 69 – hydrophobic – 0.8mm – same as Photo 68 - silicate (epidote?)


Photo 70 – white stone – 0.8mm


Photo 71 – 1.3mm with inclusions


Photo 72 – 1.2mm with large black inclusions


Photo 73 – 1.0mm – irregular


Photo 74 – olivine in kimberlite – 2.0mm


Photo 75 – olivine in kimberlite – 2.0mm

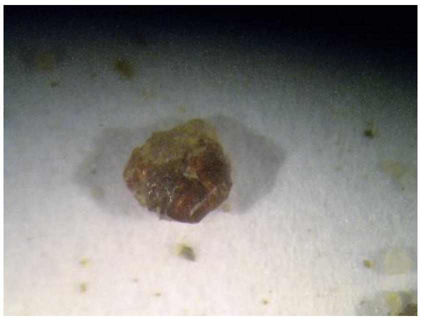


Photo 76 – GMLO – 1.5mm – fractured


Photo 77 – GLOR – 1.0mm


Photo 78 – GROf – 1.0mm


Photo 79 – GDKO – 1.0mm


Photo 80 – GLOR – 1.0mm – fractured


Photo 81 – black inclusions – 1.5mm


Photo 82 – GMLO – 0.9mm


Photo 83 – GMLO – 1.5mm


Photo 84 – GRO – 1.0mm


Photo 85 – GRO


Photo 86 – GLR – 1.2mm

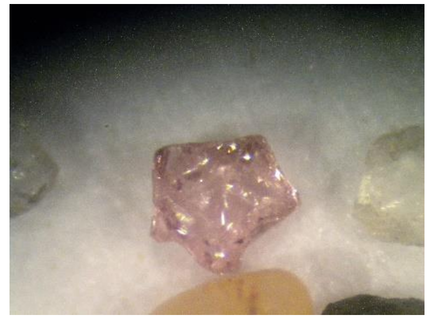


Photo 87 – GLP – 0.6mm


Photo 88 – GMO – 0.9mm


Photo 89 – GDpRf – 1.0mm


Photo 90 – GdkOR – 0.8mm

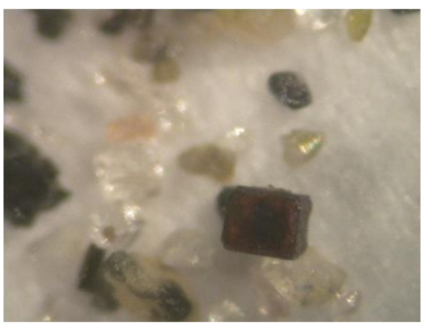


Photo 91 – brown cube – probable titanite


Photo 92 – Cr diopside – sculpted – 0.8mm


Photo 93 – Cr diopside - 1.0mm


Photo 94 – Cr diopside – 0.8mm

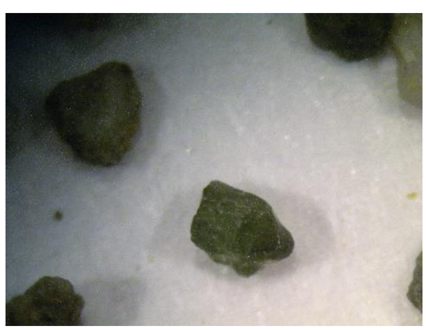


Photo 95 – Cr diopside – 0.9mm


Photo 96 – Cr diopside – 0.5mm


Photo 97 – Cr diopside – 1.0mm


Photo 98 – Cr diopside – 0.5mm

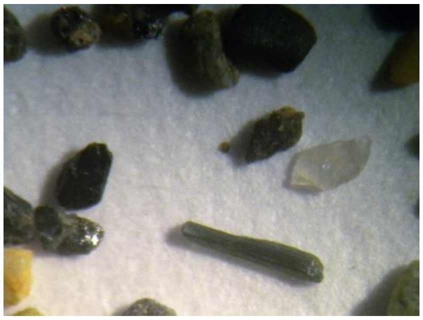


Photo 99 – maybe kyanite – +2.0mm


Photo 100 – maybe kyanite – 0.9mm


Photo 101 – Cr diopside – 0.8mm – with unknown grains


Photo 102 – Cr diopside (?) – 1.2mm


Photo 103 4 – Green grossular or Cr Diopside – 0.6mm


Photo 104 – Cr diopside – 0.4mm


Photo 105 – actinolite/kyanite


Photo 106 – GMPp – 1.0mm

*Cr Pyropes in Unpicked Cons*

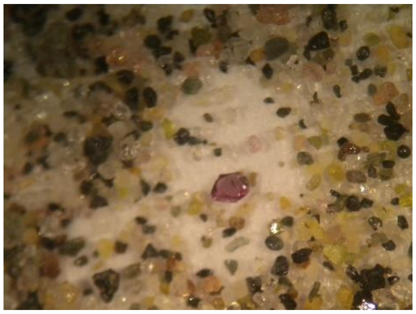


Photo 107 – GMPp – 0.5mm

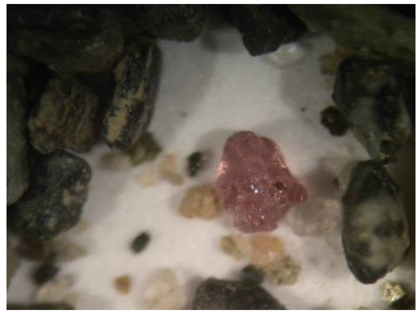


Photo 108 – GLP – 1.2mm


Photo 109 – GDkP – 1.5mm

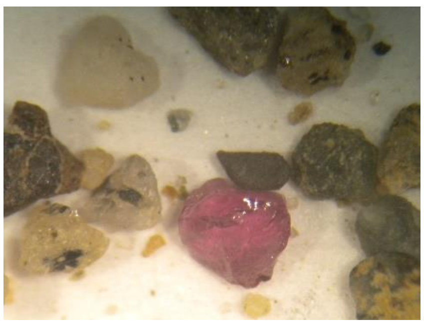


Photo 110 – GLPPp – 2.0mm


Photo 111 – GMPp – 1.5mm


Photo 112 – GLP – 1.3mm


Photo 113 – GLP  - 0.5mm – fractured


Photo 114 – GDPp – 1.3mm


Photo 115 – GLPpf – 0.6mm


Photo 116 – GDOo 0 2.7mm


Photo 117 – GDPp – 2.5mm

*Cons – Grains photographed in unpicked concentrate from GoldCube*

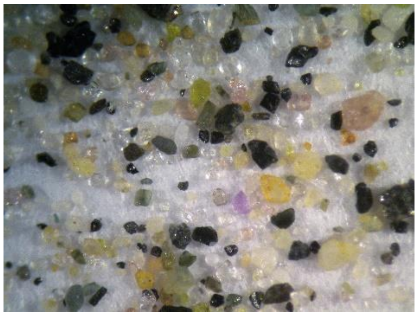


Photo 118 – unpicked cons from GoldCube

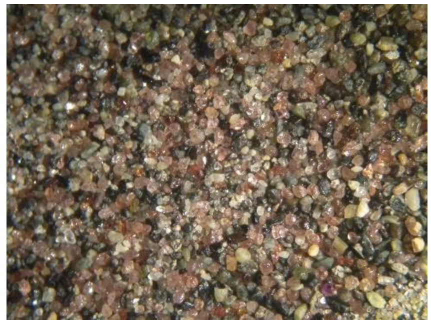


Photo 119 – unpicked cons from GoldCube – Fine-to-medium sand fraction

Photo 120 – unpicked cons – 0.5-1.0mm – from GoldCube

*Grains with attached kimberlite (?)*

Photo 121 – GMPp – 1.8mm

Photo 122 – G similar to Photo 121 – 1.8mm

**LEGEND FOR MICROSCOPE PHOTO LABELS,**
**according to classification from 'The Canadian Mineralogist' (McLean, Banas, et al. 2007):**

G – Garnet

f – Frosted surface texture

Pp – Purple

P – Pink

RO – Red orange

Dk – Dark in colour

M – Medium in colour

L – Light in colour

Ex. GLPPp = garnet light pink-purple

# DISCUSSION/CONCLUSIONS & RECOMMENDATIONS:

The south of Little Grassy Lake is a half-round lake, ~80m wide and ~150m long. A fault runs through the lake with steep hills on the east and west sides.

Till sampling for KIMs and other heavy minerals performed ~500-1000m down-ice of the lake. A recent (10 year old) logging road was very conveniently located for ease of sampling. This is reflected in my traverse choices.

The only time kimberlite (boulders) are regularly found is in freshly disturbed ground – loggings roads, gravel pits, etc. Freshly exposed kimberlite is a distinctive green but quickly turns to mud with surface exposure.

On this logging road in several locations, pits had been dug with a hi-hoe in the till. This gave us access to deeper layers for a better cross section of glaciated till from the lake. In a ditch at the south end of the sampling area, a kimberlite boulder was uncovered in a water-logged sampling hole. Another smaller kimberlite was found in a deeper pit closer to the north end of the sampling area. Both were in a line of samples taken in a down-ice direction of the suspected kimberlite under the lake. Both locations were in recently disturbed till.

Very high KIM results were found, and a select few grains were sent to GeoLab in Sudbury for microprobing. These are described elsewhere in the report.

In ODM-OFR Report 6088 (Reid, 2002, Sample 181, p29), a G10 was found near Martineau Bay. This result was hard to explain until I realised that it was found in an alluvium sample in the drainage system that flowed out of Grassy Lake as the glacier was melting.

Detailed drone mag flyovers have now been done on two of my targets just southeast of Grassy Lake and are also planned for Grassy and Lightning Lakes. These will be reported on in the near future.

A small number of photographs of various interesting grains were included in this report, picked from over 1000 microphotographs that I took of grains picked from till concentrates from this target.

Basically, the next step is to drill the target to test for kimberlite.

**ON CITRINE (QUARTZ):**

Doug Robinson and I have talked about the brilliance and colour of the 'crustal' minerals I've recorded from various till samples. From many hours of internet research, I've come to find that these crustal grains have often been found as inclusions in diamonds and occasionally diamonds included in these mineral grains (Daniels et al, 1996). The intensity of the colour is more related to kimberlite mineral grains, such as the vivid yellow grains identified as epidote or quartz than most similar crustal grains [see Results: Microscope Photos 38- 41, page 12]. However, epidote is usually some shade of green and, far less commonly, yellow. Yellow quartz is known as citrine. Virtually all commercial citrine is oven heat-treated amethyst or smoky quartz. Natural citrine is exceedingly rare to the extent that citrine on the market is assumed to be heat-treated. Natural citrine is created in the mantle, so the citrine I'm finding was probably brought to the surface in a kimberlite eruption (see Citrine, 2013).

The grain seen in Photo 41 [see Results: Microscope Photos, page 12] GeoLab tested as quartz (citrine, because it's yellow). However, it is yellow on the outer edge/surface and near colourless at its centre, much like heat-treated citrine. 'Natural' citrine should be uniformly yellow.

This could be explained, however, if an ascending kimberlite encountered other forms of quartz. The heat range and ascent time is about the same as is required to produce man-made citrine, which could explain the colour difference and rounded texture of the grain.

Photo 8 [see Results: Microscope Photos, page 8] shows a yellow grain, S.G > 3.2 and from the non-magnetic fraction from ODM, therefore is probably sphene (titanite).

*About Yellow Grains from ODM till concentrates [see Results: Microscope Photos, Photo 8, page 8]*

From research, I've determined the following for testing grains with minimal information:

- If using heavy liquid and is >3.2 SG, must be Garnet (Grossular) or Sphene (Titanite)
    - If using heavy liquid and is magnetic, must be Garnet
    - If using heavy liquid and is non-magnetic, must be Sphene
- Without using heavy liquid and is magnetic, must be Garnet
- Without using heavy liquid and is non-magnetic, can be Sphene or Quartz (Citrine)

  So:
- All yellow grains found in till samples from 'Bishop Claims' are shiny and transparent, mostly without inclusions, and pretty much identical visually
- One was identified as Quartz at GeoLabs (Sudbury)
- A statistically large number are greater than 3.2 SG (ODM). One from ODM (SEM) tested as Garnet (Grossular), but some are non-magnetic (Sphene)
- All are moderately rare mineral types
    - All 3 in a till sample, from below (down-ice of) a lake (heavy trap), is very improbable under normal conditions
- In one till sample, a yellow Grossular Garnet was identified (ODM), and in another a green Grossular Garnet, which are relatively rare minerals

Photo 43 [see Results: Microscope Photos, page 12] tested by microprobe as staurolite, a partially yellow/brown grain with a red centre, transparent to translucent. The microprobe measured 13.308% FeO. Four similar grains were found on other claims, and also tested ~13% FeO. Staurolite is **rarely found** as **transparent** crystals, dark red, **and highly magnetic**. Too rare to facet except for collectors (Feral, K, website: gemstonemagnetism.com).

This grain [see Results: Microscope Photos, Photo 43, page 12] was tested by me with a very strong neodymium magnet, and exhibited no response, therefore is inert (diamagnetic), which means either the microprobe was wrong or the FeO is a non-magnetic form of iron, Fe(II), austenite [see Discussion/Conclusions & Recommendations: On FeO & Austenite, Diagram A, page 25 ]. This would suggest the grain was formed in the diamond formation zone of the mantle.

Photos 45-48 [see Results: Microscope Photos, page 13] are of grain SD-3 which appears to be (maybe) a garnet from research on similarly shaped stones. Microprobe analysis shows it to be FeO. As time permits I'll recheck my cons and KIMs picked, check for magnetic susceptibility and perhaps microprobe several more. I'll consult with Doug Robinson on this and other grains for a follow-up report.

At first glance, Photo 37, SG-87 [see Results: Microscope Photos, page 11] appears to be a frosted orange garnet (GO) (but has a purple-red zoning towards the middle) or possibly titanite. However, it microprobed as 'Altered Silicate (serpentine?)'. Research on serpentine reveals it to be a greenish, opaque to translucent mineral, which this definitely is not. Unusual as well was that the microprobe only returned results for 86.6% of the grain.

I picked this lightly frosted, transparent, robin egg-blue grain shown in Photo 6 [see Results: Microscope Photos, page 8] from the previously picked ODM sample. From my trip visiting Rob Towner In Montana and finding a pound or so of sapphires, I could see a very close similarity. Further testing would be required to confirm identification.

I've also found blue grains in till concentrates from my targets that are elongated crystals with striations that are very likely kyanite. As well, I've found very similar crystals in yellowish → green; these might be chrome kyanite which have been reported found in kimberlites from various diamond pipes. Other blue grains are bornite, etc. but this one is different and has the frosted appearance typical of other KIMs and diamonds that ascend in kimberlite eruptions [see Results: Microscope Photos, Photo 6, page 8].

Photo 33 [see Results: Microscope Photos, page 11] shows garnets that show zero reaction to a neodymium magnet the first time I checked picked KIMs for this response (I was testing if I could remove high Fe crustal garnets by holding the magnet at different heights with various magnets of different strengths) knowing that all garnets of this size should pick up, I realised these inert grains were an anomaly. I chose three to send for microprobing: two purple, and one pink grain. I figured there should be no iron in them.

When the results came back from GeoLab, it was confusing as the pink grain [see Results: Microscope Photos, Photo 31, page 11] was labelled (non-kimberlitic) almandine with 30.772% FeO, the purple grain [see Photo 30, page 11] and frosted purple grain [see Photo 32, page 11] were both G11 kimberlitic grains with 8.064% and 6.696% FeO respectively.

All the obvious (dull lustre/colour, etc.) crustal garnets of this size which have between ~20-40% Fe will pick up from an inch or so away from the magnet. Here I had a pink garnet (which is actually considered a rare and desirable colour for a garnet gemstone – and when I'm finding high levels of 'normal' KIMs there are hundreds to thousands of pink garnets as well – these are generally ignored by other labs while picking KIMs) which tests inert (diamagnetic) – no pick-up response and labelled a crustal garnet by GeoLab (McLean, Banas, et al. 2007).

Very coincidentally two of three G11s I found are the non-magnetic grains I tested. The third G11 was not tested for magnetic susceptibility and now is encased in epoxy from GeoLab.

I have recently been testing more picked KIMs from various other targets and have been finding a considerable number of these garnets, especially in the eclogitic orange garnets, these will be sent out for microprobing in the future.

Eventually, I researched 'non-magnetic iron' and discovered Fe(II). I have written extensively about my research into Fe(II) austenite in other reports but will explain its importance again elsewhere in this report [see Discussion/Conclusions & Recommendations: On FeO & Austenite, page 25].

**ON ORTHOPYROXENE:**

Orthopyroxene is a common accessory mineral in Diabase (Doug Robinson, P.Eng – personal conversation) and is honey-brown in colour.

When till sampling a number of my potential kimberlites, I was finding, on occasion, very odd, delicate, black, pristine grains unlike any I had come across in three years of diamond/kimberlite research.

Early on I showed a microphotograph of one grain to Mike Leahy (a local, very knowledgeable prospector) and he said it looked mafic but again, unlike anything he'd seen before.

Photos 55 and 56 [see Results: Microscope Photos, page 14] show one of the delicate glass-like black grains I've come to think is very important to diamond/kimberlite exploration, but which has seemingly been ignored (or overlooked). My research has led me to label it orthopyroxene originating in kimberlite xenocrysts.

Within the last year I acquired a piece of kimberlite that Jack Crouch had collected in the 1980s/90s while working on an article for the Northern Daily News. Jack had recently passed away, but the family knew it came from a Kirkland Lake area kimberlite [see Photo B, page 24].

*Photo B: The green Cr Diopside xenocryst at the foreground is ~2.5cm wide*

When I recently decided to look closely at it under my Nikon microscope, I could see glassy black grains here and there in a beautiful Cr Diopside xenocryst. These black grains appeared to be identical to those I had picked from my concentrates, but still didn't know what they were. Then, several months later while researching kimberlite related articles, I came across a photograph almost identical to Jack's specimen.

It was labelled as a mantle-peridotite xenolith dominated by green peridot olivine, with rare grass-green diopside and black orthopyroxene [see Photo C below].

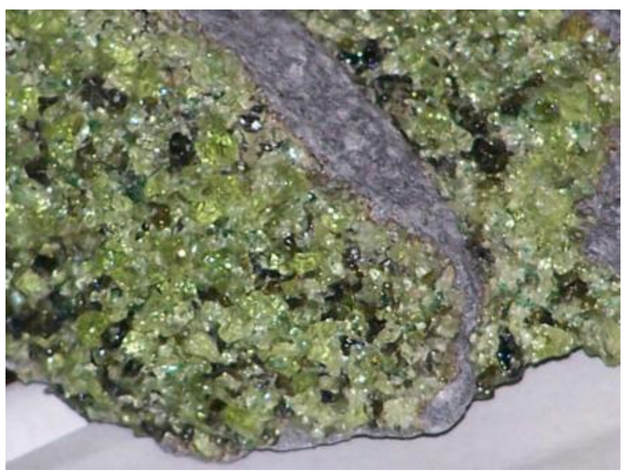


*Photo C: Black Orthopyroxene (n.d.). Image referenced from https:en.wikipedia.org/wiki/Pyroxene*

This explained a great deal about these delicate black grains as their irregular shape can be explained as basically pseudocrystalline from growing around the Cr Diopside and olivine in a kimberlitic xenocryst.

So, the black grains most likely originated in a piece of kimberlite that has been transported locally from a pipe by glaciation. Kimberlite typically weathers completely away when exposed to the elements. Chrome Diopside will weather to serpentine (mud) in a very short period of time. Orthopyroxene, however, is very stable in the environment, hence if it originated in a Cr Diopside xenocryst it would eventually very gently be deposited in the till in undamaged condition.

I have also been finding these down-ice of a number of my 'target's, for example, from a few till samples from the trench [see Bishop, 2018] I found a couple dozen of these odd grains all in pristine condition. One was lace-like and broke in two when I picked it up with tweezers. I also discovered these grains are non-magnetic, unlike other similar black mineral grains.

Orthopyroxene is a common component of kimberlites. I also found these grains taken from till Sample 9, Traverse 3, very close to where I discovered the kimberlite boulder [see Results: Microscope Photos 55-56, page 14].

**ON FEO & AUSTENITE:**

Also found down-ice of 4282444 are round, frosted grains with a brownish to black glassy surface, first described in Report 4282172 [see Bishop, 2017c, p12, Photo S-D23, & p15]. These grains vary from totally inert magnetically and then others vary in response to a magnet. Some of these inert grains microprobed as FeO which (with much research) can only be Fe(II) or austenite.

This is very interesting, as iron exists as Fe(I) (ferrous iron, rust, very magnetic), Fe(II) (non-magnetic), and Fe(III) (hematite, weakly magnetic – paramagnetic). These spheroids tested non-magnetic by me and are described as Fe(II) in various science journals and are exceedingly rare. Basically, they are found in meteorites and in impact ejecta in nature, they can also be found as the 'sparks' that fly off when plasma arc welding, and that is pretty much it. Similar grains are mentioned in some volcanos, but are Fe(I) – magnetite, as dendrites in a glassy matrix. It is estimated that as much as 9% of the mantle is composed of Fe(II) but normally only exists in the upper mantle at the pressure/temperature coincidentally found where diamonds might form. Unless they undergo cooling in a very short time in a reducing environment, they turn into Fe(I) – magnetic iron. Austenite is only stable above 910°C in bulk metal form. Recent theories suggest that in an ascending kimberlite a pressurised 'froth'/foam of CO2 precedes the 'solid' constituent. This acts as a 'super-cooling' wave, much like a freezer in your house, while the kimberlite ascends that has been theorised might actually flash-freeze the kimberlite when it reaches the surface. This helps to explain why diamonds don't always oxidise (burn) when ascending to the surface. It seems it might also preserve these Fe(II) spherules (as well as the non-magnetic garnets I'm finding). As such, I propose that if these non-magnetic spherules of iron oxide are found in with KIMs, it might show that if diamonds are also present in the kimberlite then the conditions might be favourable for their preservation as well. It is already known that a higher ratio of Fe2+ as compared to Fe3+ is necessary for higher diamond (preservation) content. Iron (II) oxide has been found as inclusions in diamonds and its presence indicates a highly reducing environment. However, I cannot find reference to Fe(II) spheroids in the published results of sampling programs by other diamond producing companies. Fe(II) apparently is an allotrope of iron (gamma phase iron) called Austenite, a metallic non-magnetic iron, or a man-made solid solution of iron with an alloying element (see Austenite, n.d.). Basically, from 914°C to 1394°C, Fe(I) alpha iron turns into Fe(II) gamma iron, so I compared the pressure-temperature diamond formation range with that for austenite (940°-1400°C) and found an interesting possible relationship between diamond and Fe(II) formation [see Diagram A below].

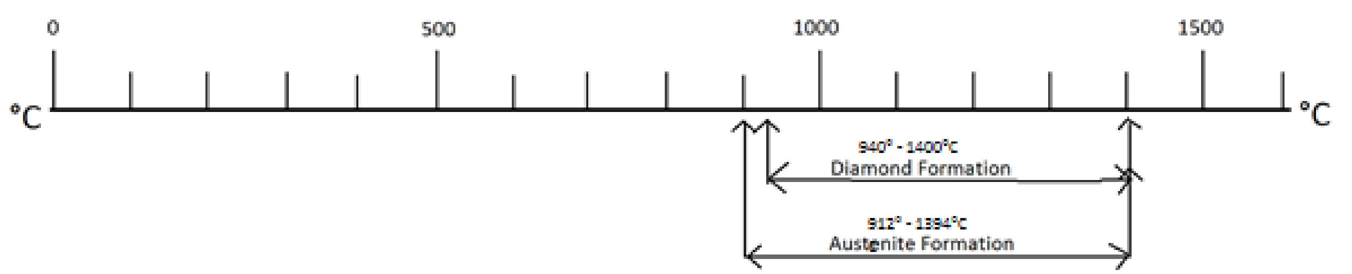



*Diagram A: Diamond and Austenite Formation*

By adding certain alloying elements such as manganese and nickel and cooling in a reducing environment (nitrogen), a more stable austenitic iron that doesn't form in nature is made – 'stainless steel'.

Visually similar spherules are quite common in volcanic ejecta and major impacts by asteroids, etc. (like the one that killed the dinosaurs), from fly ash, from various industrial processes, automotive exhaust, etc., but they are all Fe(I) magnetite (ferromagnetic) and less commonly silicon nodules (with no iron – non-magnetic), sometimes which have dendritic magnetite throughout the matrix (therefore magnetic).

So, if these spherules are found in concentrates with (other) KIMs and are diamagnetic (inert) and test as FeO, it would appear to be an indicator of originating in a kimberlite that sampled the diamond formation part of the mantle and was preserved in a strongly reducing environment as the kimberlite ascended, perfect for diamond preservation as well.

So, diamond and Fe(II) both form in the same pressure/temperature area of the mantle. To be preserved, they both require rapid cooling in a reducing environment. If cooled too slowly in an oxidising environment, diamond turns to carbon and diamagnetic Fe(II) turns to ferromagnetic Fe(I) ferric iron or paramagnetic Fe(III).

This concept, perhaps, can be expanded to included non-magnetic garnets, ilmenites, and perhaps other grains, such as chromite.

I've been finding non-magnetic garnets in my cons.

**ON FE(II) GARNETS:**

As shown in various articles, diamonds with inclusions have been tested in which the original structure/chemistry of the inclusion was maintained under the original pressure conditions inside the diamond (Tschauner et al (2018)). The same could be said, and in fact is documented in garnets (Kiseeva, et al, 2018), so might Fe(II), austenite, a non-magnetic form of iron, be maintained inside a garnet [see Discussion/Conclusions & Recommendations: On FeO & Austenite, page 25, and also Bishop, 2017c, p 15/16].

Briefly, there is Fe(I) – very magnetic (ferromagnetic), the iron we use extensively; Fe(III) – weakly magnetic (paramagnetic), hematite; and Fe(II) – (diamagnetic), austenite, totally inert which only (in nature) exists in the mantle at high pressure/temperature and sometimes in meteorites. The importance for this report is that all garnets are accepted in scientific journals as being greater or lesser magnetic. However, I'm finding (totally) inert (diamagnetic) garnets which at first glance should be impossible.

This is especially evident when utilising a very powerful N-$52^{+}$ neodymium magnet and the very small grains 0.25-2.0mm of KIM size, where all types of garnets will pick up. Larger mass gem size stones might or might not do so (see 'Magnetism in Gemstones' Feral (2011)).

> "For Gem identification a pick up response to a strong neodymium magnet separates garnet from all other natural transparent gemstones" (Feral (2011))

This is utilised by mineral testing labs using various strengths of magnetic fields (ODM and others use a variable electromagnet and different amperages) to remove the ferro, para, and diamagnetic fractions of concentrates. The strongest magnetic fields are not used to separate KIMs as all garnets (crustal and kimberlitic) would be removed.

| **Magnetic Susceptibility Index for Gemstones** (Kirk Feral (2010)) | | | |
|---|---|---|---|
| **Gemstone** | **Response Range** | **SI X 10 (-6) Range** | **Cause of Colour** |
| **Garnet Group**<br>**Almandine Garnet** | Picks Up | 1926-3094 | Iron |
| **Andradite Garnet**<br>Demantoid Garnet | Picks Up | 2253-2752 | Iron, Chromium |
| Brown Andradite & Topazolite | Picks Up | 2559-2907 | Charge Transfer Involving Iron |
| Melanite (black) Garnet | Picks Up | 1866 SI | Charge Transfer Involving Iron |
| **Grossular Garnet**<br>Hessonite (pale to dark yellow/orange) | Moderate to Strong | 91-345 | Charge Transfer Involving Iron |
| Hydrogrossular (green, pink) | Weak to Strong | 74-339 | Iron, Chromium., Manganese |
| Green Grossular (including Tsavorite & Merelani) | Weak to Strong | 20-309 | Vanadium, Chromium, Iron |
| **Pyrope Garnet**<br>Standard Pyrope Garnet | Picks Up | 1163-1971 | Iron, Chromium, Vanadium |
| Chrome Pyrope | Drags to Pick Up | 454-999 | Chromium, Iron |
| **Spessartine Garnet**<br>Spessartine Garnet | Picks Up | 4301-4728 | Manganese, some Iron |
| **Uvarovite Garnet** | Picks Up | 998 SI | Chromium Vanadium |

In many 1000s of samples tested by microprobe in OGS and other reports, non-kimberlitic (crustal garnets) vary approximately between 20-40% FeO, others eclogitic and Cr poor megacrysts can be from 10-20%, G9/G10 garnets vary from 5-10% FeO.

However, a while back ago I tested a small group of concentrates picked from KIMs from Little Grassy Lake with a very powerful, small neodymium magnet, and **discovered a few inert (diamagnetic) garnets** [see Results: Microscope Photos, Photo 33, page 11] **which when microprobed had normal iron levels (two of three G11s are diamagnetic)**. This mystery led me to a type of iron called austenite [see Discussion/Conclusions & Recommendations: On FeO & Austenite, page 25].

Then recently, with this information in mind as reported in my previous Work Assessment Report on Legacy claim 4282142 [see Bishop 2018, p11], I rechecked the concentrates and picked KIMs from the Trench samples to test for the magnetic susceptibility of the garnets. Many of the orange garnets were non-magnetic.

I then recalled another report that was very useful for a different reason. In several years of extensive research and from conversations with a prominent lab, it appears that **most companies and labs** involved in the quest for **KIMs pick eclogitic garnets based on an orange colour; the deeper, brighter (pretty) garnets were at the top of the picking list**. However, I had found an article titled 'Garnet xenocrysts from the Diavik mine, NWT, Canada: Composition, color, and paragenesis' (McLean, Banas, et al. (2007), p 1136, 1138, 1139), which in part I've included below. As can be clearly seen, the basically ugly Lo (light orange), MLo (medium light orange), and MDo (medium dark orange) & Do (dark orange) garnets (at least at the Diavik Mine) encompasses the majority of G3 and G4s which have (recently?) become of great interest in diamond exploration.

In addition, this article drew attention to the importance of pink garnets, which I'm finding in very high numbers in my heavy concentrates along with KIMs. No company or lab reports pink garnets that I've found in three years of research, except for this article. From the charts made on Diavik garnets (they only tested a few pinks), the pink garnets seem to be far more likely than other colours to be G10s. Only purple garnets are more likely to be G10s.


*Diagram B (McLean, Banas, et al. (2007), p 1136)*

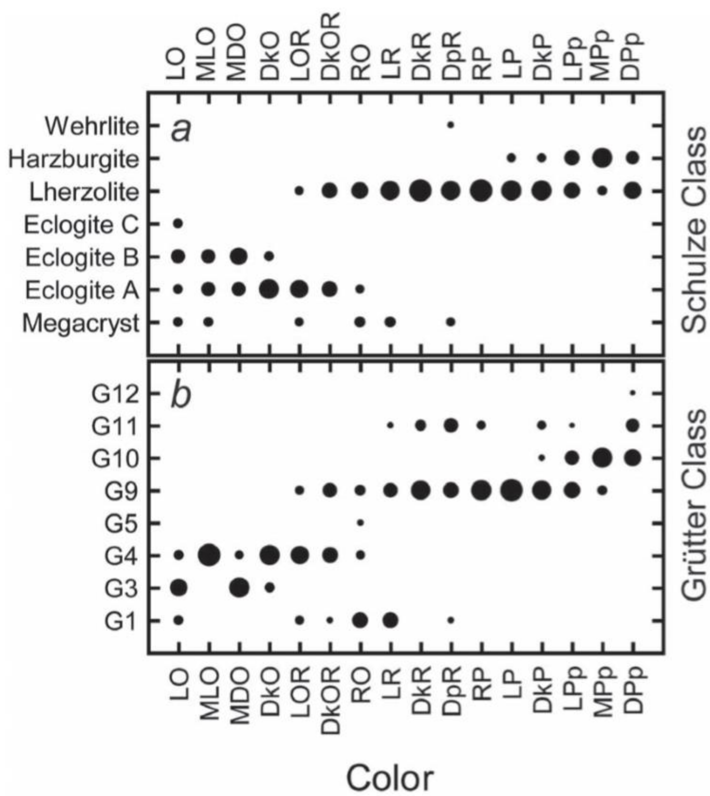



FIG. 4. Correlation diagrams showing garnet classes represented by each color group. Note that most colors are comprised of several types of garnet. (a) Classification scheme of Schulze (2003). (b) Classification scheme of Grütter *et al.* (2004). Grütter classes represented at Diavik are: G1: low-Cr megacrysts, G3: eclogitic (high-Ca), G4: eclogitic (low-Ca), pyroxenitic or websteritic, G5: pyroxenitic, G9: lherzolitic, G10: harzburgitic, G11: high-Ti peridotitic, G12: wehrlitic.

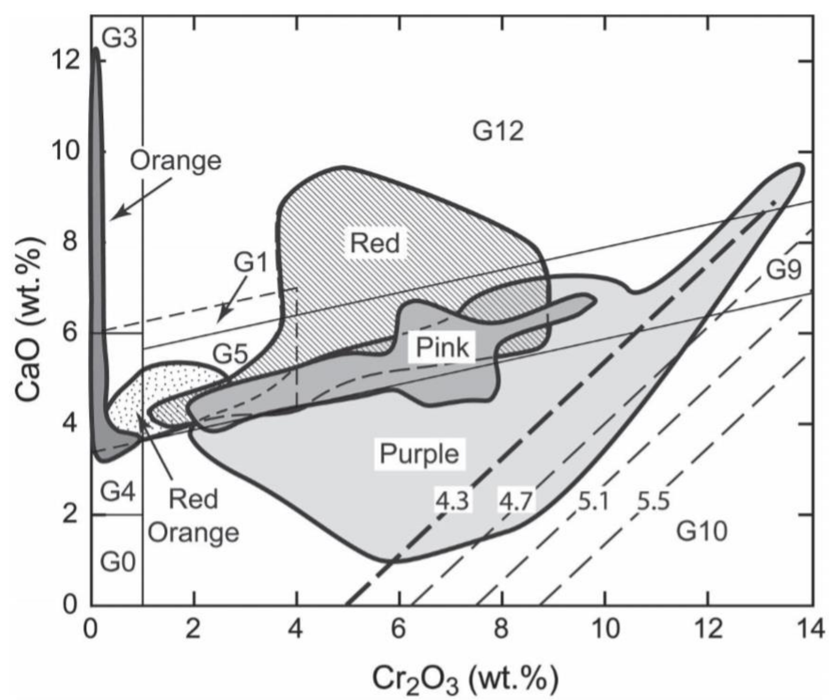



FIG. 5. $CaO$–$Cr_2O_3$ diagram, showing the compositional ranges of garnet xenocrysts of different color. For clarity, the classes were consolidated into Orange (LO, MLO, MDO, DkO), Red Orange (LOR, DkOR, RO), Red (LR, DkR, DpR), Pink (LP, DkP), and Purple (LPp, MPp, DPp). Solid lines and fields after Grütter *et al.* (2004). Dashed lines are isobars from the Cr–Ca barometer of Grütter *et al.* (2006). Numbers on isobars are pressure in GPa; the 4.3 GPa isobar is emphasized because it represents the graphite–diamond transition along a 38 $mW/m^2$ geotherm.

*Diagrams C & D (McLean, Banas, et al. (2007) p 1138, 1139)*

**ON ILMENITES:**

Presently, most companies will not consider a diamond prospect/pipe unless the 'chemistry' of the indicators are a certain value. Specifically the chemistry for ilmenite, **although they are not a kimberlite (mantle) mineral**, are 'picked up' from the country rock by the ascending kimberlite volcano.

Many properties are made or ignored based on this premise. I recently encountered this when a major I spoke with wanted to see the ilmenite chemistry (expensive to test for 15 individual targets at the prospecting level) and from the company's past history, the results are treated as gospel for pipe/diamond content.

However, as quoted below showing various viewpoints on this, perhaps they should reconsider their long ago entrenched beliefs.

> "… the importance of ilmenite composition during the evaluation of a pipe for diamond content may be related to diamond preservation (McCallum and Waldman 1991). … the magma may be subjected to later near-surface oxidizing environments. Such oxidation may show up as high $Fe^3/Fe^{2+}$ ratios … in ilmenite. In such cases, it has been suggested that … diamonds in the host magma may be substantially resorbed to produce graphite, $CO_2$, or CO.
>
> "Survival of diamond at elevated temperatures … is linked to low oxygen fugacity; elevated oxygen levels favor resorption. Ferrimagnetic ilmenite high in $Cr_2O_3$ is found in some diamond-poor kimberlites, and these ilmenites characteristically show exsolution texture.
>
> "In contrast, homogenous ilmenites are found in kimberlites that are interpreted to have risen comparatively rapidly. … typically results in later ilmenites that have lower MgO and $Cr_2O_3$ contents.
>
> "It has been reported that ilmenite in equilibrium with diamond contains almost no $Fe^{3+}$
>
> "High $Cr_2O_3$ and MgO components in ilmenite relate to low oxygen fugacity. This association has led to the use of $Cr_2O_3$/MgO plots to evaluate ilmenite trends for diamond preservation.
>
> "Gurney (1989) and Gurney, Helmstadt, and Moore (1993) report that 'ilmenites with low $Fe^{3+}/Fe^{2+}$ ratios are associated with higher diamond content than those with more $Fe^{3+}$, whereas **diamonds are not associated with ilmenites of high $Fe^{3+}$ content at all.**'
>
> "**However, this association is not supported by all observations.** As pointed out by Schulze et al. (1995) and Coopersmith and Schulz (1996), on the basis of ilmenite geochemistry, an exploration geologist would be forced to conclude that finding diamonds in the Mir, Frank Smith, DeBeers, Monastery, and Kelsey Lake mines would be unlikely because these kimberlites all have ilmenites with high hematite [Fe(III)] component. Yet, unresorbed diamonds and relatively high ore grades are found in kimberlites at Mir (200 carats/100 tonnes), Frank Smith (known for its sharp-edged octahedrons), DeBeers (90 carats/100 tonnes), and Monastery (50 carats/100 tonnes). Low diamond grades are reported at the Kelsey Lake mine, but the diamonds are excellent and include many spectacular gem-quality octahedrons with little evidence of resorption. The ilmenite geochemistry of Kelsey Lake shows as much as 38% hematite component (Schulze et al. 1995; Coopersmith and Schulze 1996) which would lead to a prediction, based on ilmenite geochemistry, that these kimberlites would be devoid of diamond. However, diamond production at the mine includes a large percentage of high-quality gemstones with octahedral habit indicating that diamond preservation was favorable.
>
> "In all probability, many picroilmenite nodules did not coexist with the magma at the time they were incorporated in to the kimberlite. Therefore, … their oxidation state would have little bearing on the diamond resorption potential (Schulze et al. 1995; Coopersmith and Schulze 1996)"
> (Erlich and Hausel, 2002).

I'm also investigating the value of using a neodymium magnet to differentiate between 'crustal' ilmenite ($FeTiO_3$) and 'kimberlitic' magnesian ilmenite – geikielite ($MgTiO_3$); however, there is a 'third' ilmenite: pyrophanite ($MnTi0_3$).

**To determine oxygen fugacity as previously stated [see page 11], an Fe(III) to Fe(II) ratio should be able to be determined with a similar neodymium magnet test that I'm using for garnets. More results will be forthcoming**.

> **[G10s]** "Some diamondiferous pipes, such as the Argyle, contain few (if any) G10 garnets, whereas some barren pipes such as Zero and Buljah, Western Australia, contain abundant G10 garnets." (Erlich & Hausel (2002). p 330-331.) [see Discussion/Conclusions & Recommendations for Future Work: Ilmenites, page 11]

**ON GLACIATION AND DETERMINING SOURCE OF KIMS:**

If only the large-scale Ice Flow Movement map [see Appendix 4: Map 5, page 59] is referred to then it would lead to the conclusion of a northwest → southeast glacial flow when tracing KIMs back to their source, in the whole area of the map.

However, locally I plotted 89 recent glacial striae on a map that takes in an area from the New Liskeard/Haileybury kimberlites to the north and the Bishop Claims to the south. These were utilised to create the Detailed Ice Flow Movement map. Next, utilising Cobalt 31M5 Map, Google Earth, and the Ministry of Natural Resources and Forestry, I shaded in the height of land (i.e. hills) above the $30^{+}$M and $60^{+}$M as compared to the New Liskeard kimberlites.

As you can see the glacial flow from the striae indicates flowing around the hills the glaciers encountered. On a smaller scale, this is very nicely shown on the 'Nip Hill' in Cobalt, which on the west side, the deep striae are basically to the southwest, and on the hilltop – to the south and on the east side are oriented somewhat to the southeast.

So utilising this map, for claim 4282444 there is a very slim possibility for transport from the distance to the known kimberlites. As well, 4282444 is ~50m uphill from the New Liskeard kimberlites which makes transport from ~12+km to the north unlikely. Therefore, it is very probable the KIMs found here are from close by (proximal).

> "Basal sliding occurs only where a glacier is at pressure melting point at its base. Most of the fast ice flow associated with ice streams comes about because of basal sliding. Wet glacier ice on a smooth surface is slippery. The sliding at the ice-bed interface is controlled by freezing to the bed, bed roughness, the quantity of water at the bed, and the amount of rock debris in the basal glacier ice.
>
> "Glacier beds are rough [i.e. bedrock], not smooth. Bumps in the surface of the glacier bed cause melting on the upstream side, and re-freezing on the downstream side. This is called regelation, and it occurs because pressures mount up from behind obstacles to ice flow. Ice melts under pressure, and this lubricates the bed of the glacier.
>
> "Meltwater at the ice-bed interface reduces the adhesion of the glacier to its bed, making it more slippery and enhancing sliding. If a glacier is flowing over a rock bed, a water film may enhance sliding and submerge minor obstacles, making the bed smoother." (Davies, B. (2017))

So, as you can see from the Local Glacial Flow Direction map [see Appendix 4: Map 6, page 60], **when the glacier encounters a hill**, pressure builds up and the ice will flow much like water in a creek flows around a boulder. This of course forces material in the creek to flow with it. As such, any **heavy materials in the water/ice flow will be forced around the obstacle, not over it**. Ignoring this effect when interpreting a regional or local sampling program will cause misinterpretation of results.

To further complicate KIM emplacement, local to the Cobalt area one must also take into account the final stages of glaciation melt which formed Lake Ojibway/Barlow (see reference (Roy, M. et al, 2015, p14-23) for more information). Basically, 8400 years ago there was a staggeringly huge lake in and around the Cobalt area covering much of Northern Ontario that rose to 272-299 metres above sea level. Coincidentally, **the Bishop Claims are between 300-394m above sea level** [see Diagram E, page 32]. However, **the kimberlites in the New Liskeard area are 30-60m below** that (230-270m above sea level), so water movement and wave action would have spread out and diluted heavy mineral concentrates disrupting a classic till KIM emplacement profile in the kimberlites in that area. Further, when the 'dam' finally broke when the water level was 250m above sea level, the massive water flow locally followed the Montreal River and Lake Timiskaming/Ottawa River systems, further disrupting KIM emplacement.

From Haileybury Map 5024 (Roed and Hallett, 2004), claim 4282172 (and to a lesser extent 4282402, Hound Chute Lake) is the only claim in the Bishop Claims group to be affected by glaciofluvial deposits.

So, the point of all this is that it is **highly unlikely** that the high numbers of KIMs I'm finding on Claim 4282444 and the rest of the Bishop Claims could have originated from the known kimberlites in the New Liskeard area.

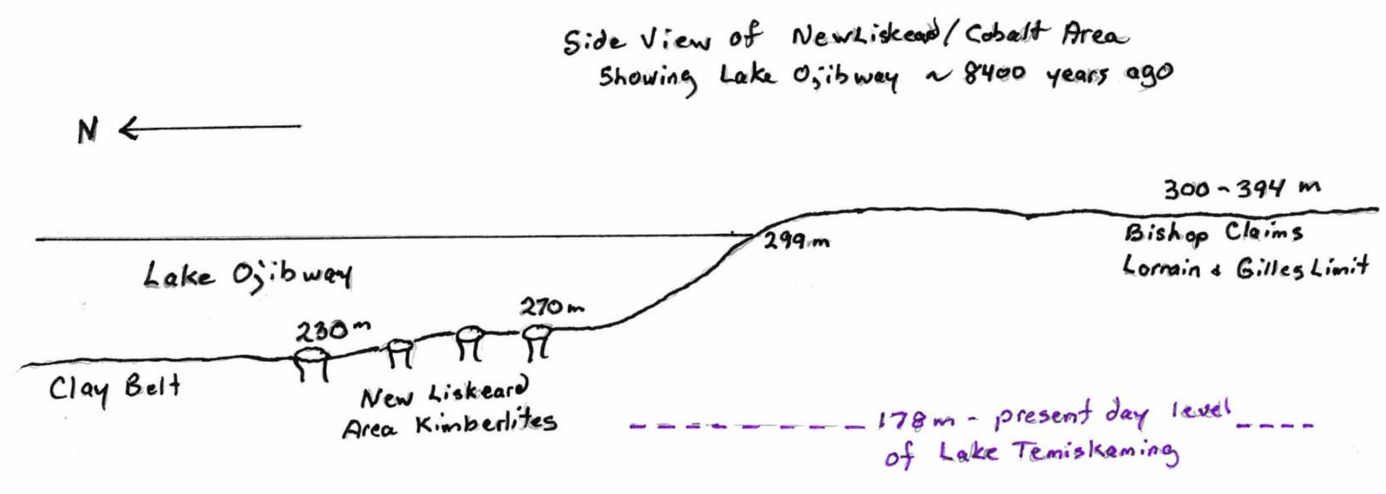
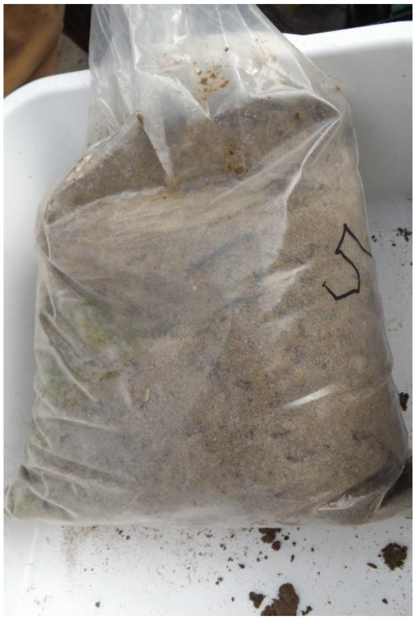


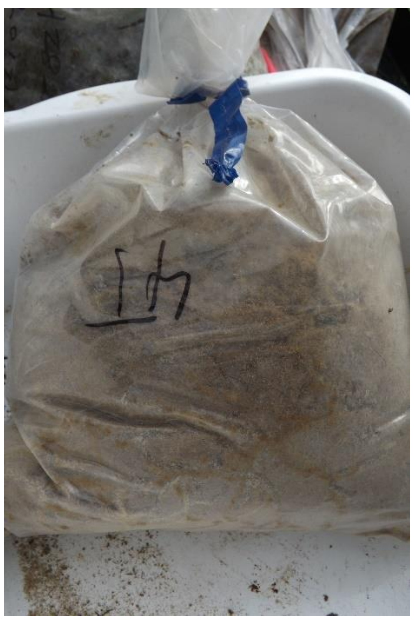

*Diagram E – Side view of New Liskeard/Cobalt Area, showing Lake Ojibway ~8400 years ago*

**ON TILL SAMPLING COMPARED TO ALLUVIUM SAMPLING:**
What makes the results that I'm finding in my concentrates interesting is that they are taken in till. Most samples weigh from 1-3kg unscreened, as compared to the 10-30kg screened to <5mm samples recommended in OGS-OFR and other reports. This effect makes my typical samples 10-20x smaller when screened to <5mm.

*Photos D & E: From Traverse 4, Sample 3 – Wet Clay/Till*



*Photos F & G: From Traverse 4, Sample 6 – Till/Gravel*



*Photos H & I: From Traverse 4, Sample 8 – Sandy till*

Of five OGS-OFR reports of KIM and other heavy mineral regional and sampling surveys, namely 6060 (Bajc and Crabtree, 2001), 6043 (Allan, 2001), 6088 (Reid, 2002), 6119 (Reid, 2004), and 6124 (Guidon and Reid, 2005), only 6060 took till samples, 400 of them which produced 13 pyrope garnet grains (G9s), recovered from 12 of the 400 samples. 1 in $33^{1}/_{3}$, or only 3 in every 100 samples produced a single Cr pyrope.

As such, after this the other reports relied almost exclusively on alluvium (creek) samples, or less so esker or beach deposits. A creek can concentrate heavy minerals 100-1000x+ over unconsolidated till which is why the KIM count increased considerably in the next four OGS-OFR reports. For example, 6043 took 256 alluvium and 2 till; 6088 – 254 alluvium, 14 glaciofluvial, 1 beach, and 8 till; 6119 – 175 alluvium, 6 glaciofluvial, and 2 till; 6124 – 317 alluvium, 22 glaciofluvial, 2 beach, and 6 till. Grand total: 876 pre-concentrated alluvium, etc. samples and 18 till results in 1371(G9) and 45(G10) or 12 Cr pyropes in every 19 samples. This is 21x higher results than till samples alone.

**ON KIM GRAIN SIZE RECOVERED WHEN SAMPLING:**

An interesting read is GSC-Open File 7111. This report's basic premise is

> "indicator minerals break down (comminute) during transport [(glaciation)] as they contact each other or the bed … which causes a decrease in mineral frequency and size … and an increase in mineral roundness downflow in dispersal trains … the larger, more numerous and more angular … the closer the ore body source." (Cummings et al. (2014))

So the investigators tumbled each individual type of KIMs (**importantly they were sourced from various kimberlites**) with stainless steel shot and at various intervals, checked the results for grain size and mass lost to 'mud'. The KIMs were pyrope garnet, ilmenite, and Cr diopside. However, chromite and olivine were not tested due to problems related to equipment and test parameters. Chromite, however, is typically considered to be very durable.

The results were surprising as they contradict many previous assumptions (other previous test experiments used **non-kimberlitic** industrial garnets), particularly related to garnet durability. Kimberlitic garnets lost mass and broke into small 'pieces' way faster than other KIMs.

> "The experimental results have several implications for mineral exploration. One of these relates to the use of KIM abundance as an indicator for proximity to source. Kimberlite indicator minerals are typically picked and counted from a portion of the sand fraction … If larger pyrope garnets, such as those analyzed in the experiment, were present in the kimberlite source rock, break down of these grains at the head of the dispersal train could flood the sand fraction with garnet fragments. This could potentially lead to an *increase* in the number of garnet and total KIM fragments moving downflow, with a commensurate increase in angularity of garnet grains [Fig. 7]. In situations where this occurs, **the total mass of KIM fragments in the sand and gravel fraction might serve as a better proxy for transport distance than KIM counts**, given that it [total mass of grains] should always decrease downflow in dispersal trains due to some combination of comminution, dilution, and/or selective sorting." (Cummings et al. (2014))

In a nutshell, one large KIM grain (especially garnet) is equivalent to many smaller grains and better indicates proximity to a pipe.

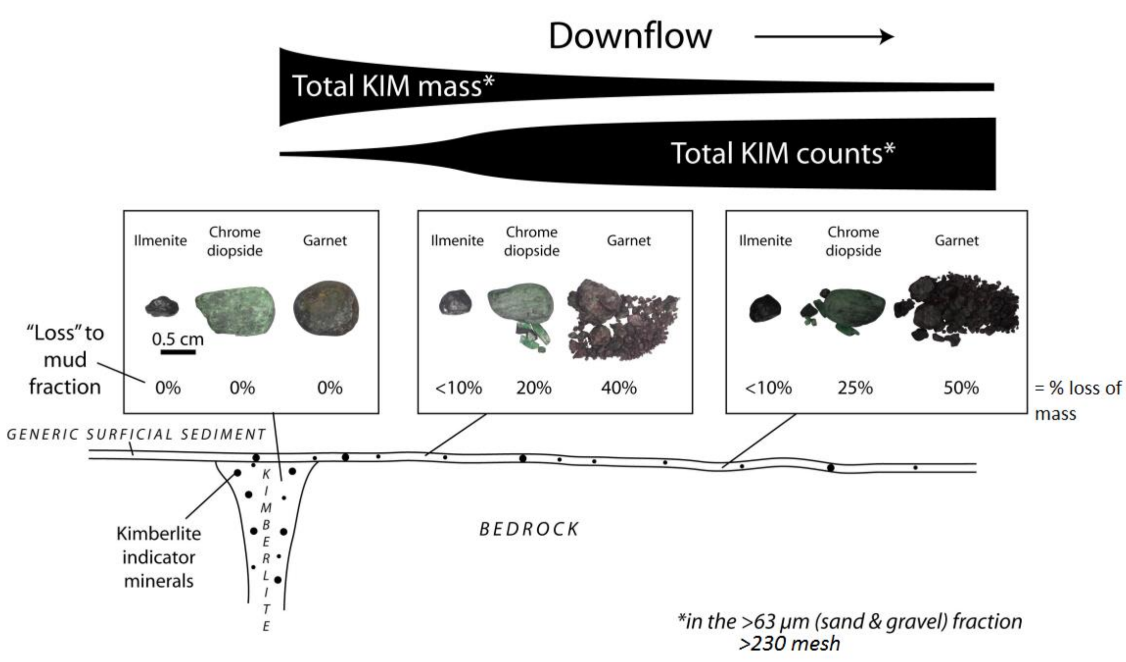



*Diagram F: Farther downflow, total KIM counts would decrease, assuming continued comminution (in addition to selective sorting and/or dilution). (Cummings et al. (2014))*

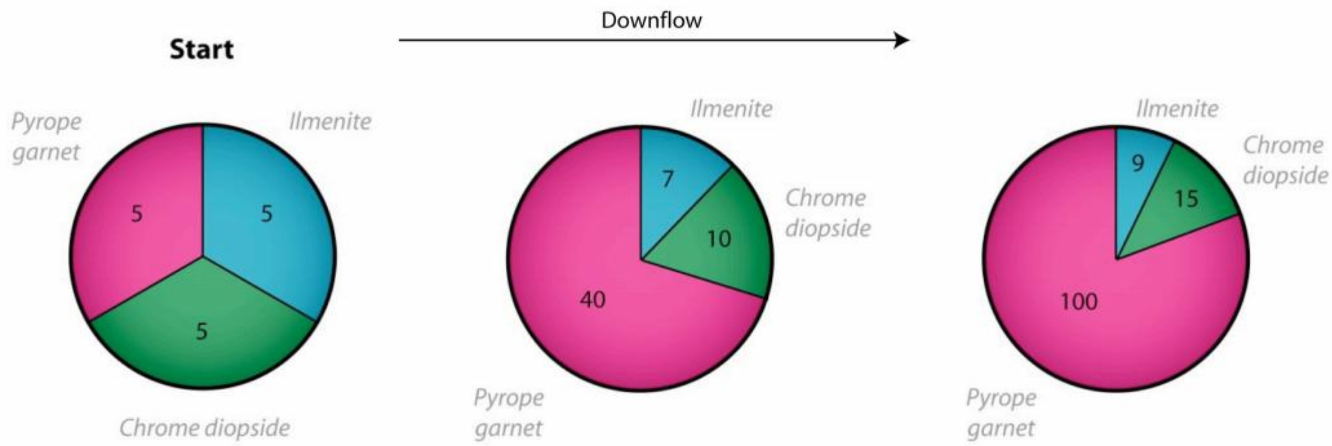



*Diagram G: Downflow evolution of indicator mineral assemblages … in which rapid break down of larger pyrope garnets produces abundant sand-sized grains. … Numbers refer to grain counts. (Cummings et al. (2014))*

So, for interest's sake and interpretation of sampling results for KIMs, I produced the following charts. For simplicity in calculations, I assumed rounded grains. These charts show the relative masses/volume of various sizes of KIM grains and the numbers of smaller grains required to equal the mass of each successive larger size.

Using the formula for volume of a sphere ($V = \frac{4}{3}\pi\, r^3$), where r = radius of the grain, will reflect an equal relative increase in mass in KIMs from 0.25mm to 2.5mm in diameter, as shown in the following chart.

**Kim Grains**

| Diameter (mm) | Radius (mm) | Volume ($mm^3$) |
|---|---|---|
| 0.25 | 0.125 | 0.00818 |
| 0.375 | 0.1875 | 0.028 |
| 0.5 | 0.25 | 0.065 |
| 0.75 | 0.35 | 0.22 |
| 1.0 | 0.5 | 0.52 |
| 1.5 | 0.75 | 1.77 |
| 2.0 | 1.0 | 4.19 |
| 2.5 | 1.25 | 8.18 |

The next chart shows the total number of smaller grains required to equal the mass of larger grains (number of grains increases as size decreases). (Read: left to right)

**Size of grain (mm) → decreases**

| **2.5** | **2.0** | **1.5** | **1.0** | **0.75** | **0.5** | **0.375** | **0.25** | **Grain Size** |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 1.95 | 4.6 | 15.7 | 37 | 126 | 292 | 1000 | **# of grains required to maintain same total mass** |
| | 1.0 | 2.4 | 8 | 19 | 64.5 | 150 | 512 | |
| | | 1.0 | 3.4 | 8 | 27 | 63 | 216.4 | |
| | | | 1.0 | 2.4 | 8 | 18.6 | 63.5 | |
| | | | | 1.0 | 3.4 | 8 | 27 | |
| | | | | | 1.0 | 2.3 | 8 | |
| | | | | | | 1.0 | 3.4 | |
| | | | | | | | 1.0 | |

So, as you can see **finding one 2.5mm grain is potentially equivalent to 1000 0.25mm grains**. Companies generally recommend only looking in the 0.25-0.5mm fraction for KIMs in order to maximise returns – this chart explains why.

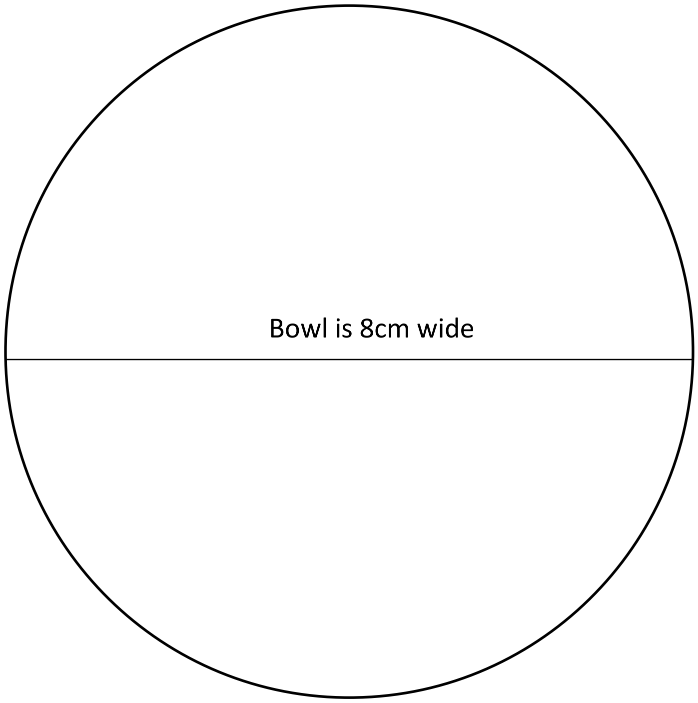
Therefore, looking for 1.0-2.0mm and 2.0-3.0mm grains becomes much more important (especially Cr pyropes) as one or two of this size indicates a proximal source, even (especially) if many small grains are also encountered. Knowing this, **a few larger grains should be given more value than many smaller grains.** I'm regularly finding Cr pyropes and other KIMs in the 1.0-2.0mm and often +2.0mm sizes. **I'm also finding intact larger garnets with 'visible' fractures, which indicates minimal transport distance.**

*Photo J: Unpicked till sample concentrates from the GoldCube®, 0.25-0.5mm*

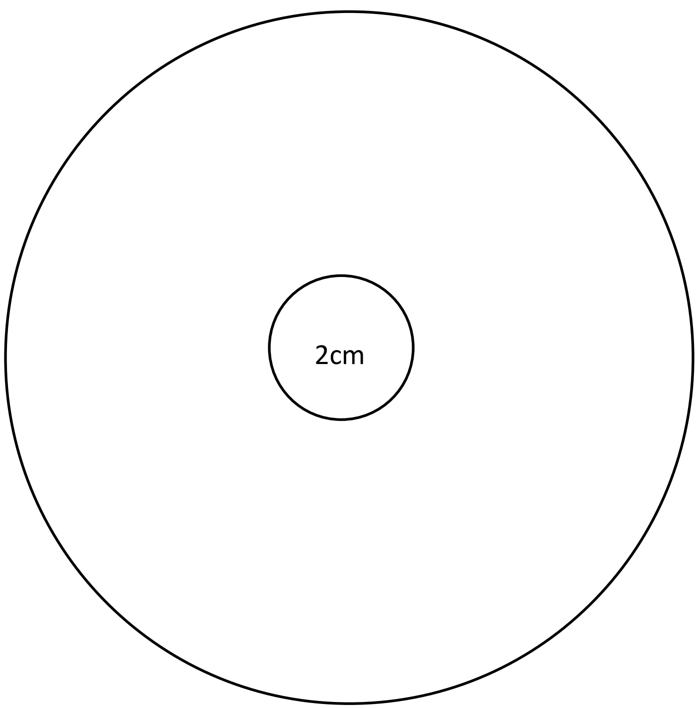
The following section explains how I attempted to estimate KIM numbers in this sample.

**ON ESTIMATING HIGH NUMBERS OF KIMS IN A SAMPLE from Legacy Claim 4282444 Target:**

**-40 Cons, Fine Sand Fraction**




- The concentrate was placed in a white porcelain bowl with a flat bottom and steep sides




- View under Nikon SMZ-2B Binocular Microscope at 10x is 2cm across
- Make a circular groove in -40 cons with toothpick at edge of view at 10x
- Then within that 2cm diameter circle counted various KIMs at 25x several times in a row for each type and averaged amount

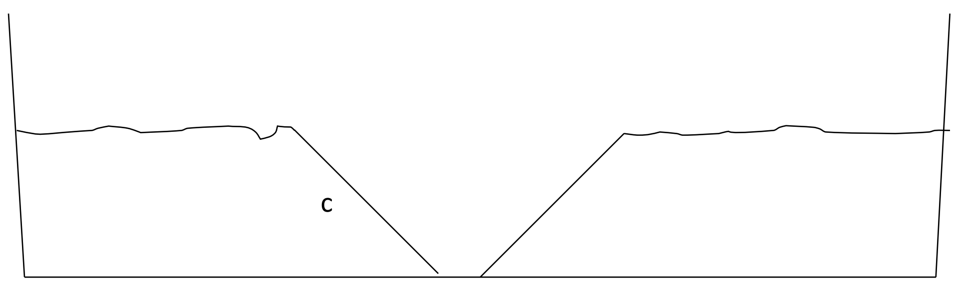
- Using $Area = \pi r^2$ (to calculate Area of a circle)
    - Area of 2cm diameter circle = 3.14 $cm^2$
    - Area of 8cm diameter circle = 50.24 $cm^2$
- 50.24 ÷ 3.14 = 16
- ∴ Sixteen 2cm diameter circles are enclosed by the 8cm diameter plate
- ∴ The KIMs counted within the 2cm diameter circle can be multiplied by 16 to estimate total on surface layer of plate

Width of viewing diameter under Nikon SMZ-2B at various magnifications

| Magnification | Viewing Diameter (cm – inches) |
|---|---|
| 8x | = 2.5 cm – 1 |
| 10x | = 2 cm – $^{7}/_{8}$ |
| 15x | = 1.5 cm – $^{9}/_{16}$ |
| 20x | = 1 cm – $^{7}/_{16}$ |
| 30x | = 0.6cm – $^{1}/_{4}$ |
| 40x | = 0.5 cm – $^{6}/_{32}$ |
| 50x | = 0.4 cm – $^{5}/_{32}$ |

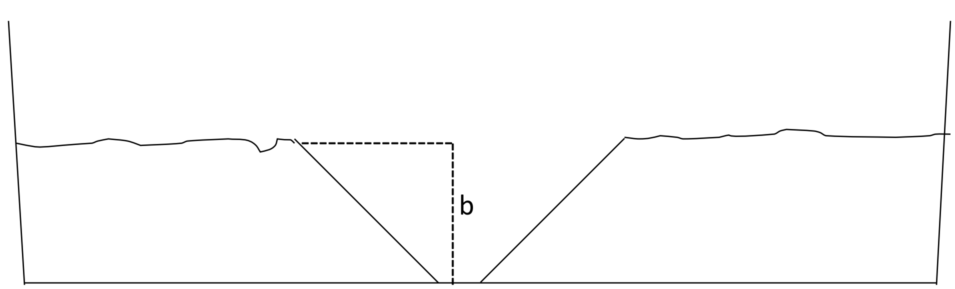
To estimate the number of layers of cons in the plate/bowl I dug a cone shaped hole to the plate/bowl's bottom. [see Diagram H below]

*Diagram H:*



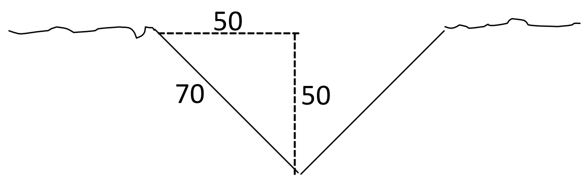

- I then at 25x counted the grains from top to bottom of side 'c' = 70 grains
- The sides of the cone were ~45° to the vertical
- So assuming a right-angled triangle with the hypotenuse 'c' being 70 grains of ~ equal size, I then calculated the vertical length 'b' (same as 'a') which gives a =50, b = 50 for a vertical count of 50 grain layers deep

*Diagram I:*



- So the total KIM count can now be calculated to be ~ (# of KIMs counted) x 16 x 50 for each type

*Diagram J:*




Results: the numbers of potential KIMs comes out in the 10,000+ range, much more if various orange shades of garnets are counted, much much more if shades of pink garnets are counted (which are not picked traditionally, but do not show up in off-ice samples on my various claims/targets, but there are always high numbers in my down-ice cons). In fact, of the grains we sent to be microprobed at Geo Labs in Sudbury, one is a pink, surface-frosted (and non-magnetic) garnet that tested as one of 3 G11s from 4282444. More on that elsewhere in this report.

**ON G3 GARNETS:**

*Photo K, "Kimberlite Indicator Minerals. From top left-clockwise: picroilmenite (Mg-rich ilmenite); eclogitic Fe-Mg-Ca almandine G3 garnets; peridotitic chrome pyrope G9/G10 garnets; chromites; chrome diopsides; Ti-Cr-Mg pyrope G1/G2 garnets; and olivines in the centre" (Quirt, 2004, p 2).*

- According to my research, G1 and especially G4 garnets are orange. There are no G2 garnets, so I think this (G2) is a typo, and should read "G1/G4 garnets" (McLean, Banas et al. 2007)

This is the only picture I've been able to find that shows eclogitic G3 garnets. They appear to be mostly colourless (although a few seem to be slightly orange) transparent grains. This colour is not picked by labs (that I know of) and has not been mentioned in any other article I've found in three years of research. The closest comparison is shown on Diagram B [page 28] (McLean, Banas et al. 2007), which shows G3s in light, medium-dark, and dark orange colours. In Diavik tests all eclogitic G1, G3, and G4 grains were various shades of orange. So, as I write elsewhere, if a magnetic grain is colourless and transparent (with no inclusions), then it must be a garnet (unless it is one of my unusual grains which are inert (non-magnetic) and require a microprobe to fully identify them as garnets). Also, a truly colourless garnet is extremely rare.

More research on garnets reveals that the only known colourless (white) garnet is a type of grossular called a leuco garnet.

> "Most [leuco garnets] are not completely colorless. Most have a strong tinge of yellow or green. They also tend to be heavily included." (AJS Gems)

Blue and white are the rarest garnets with a colourless garnet being so rare it is seldom used in jewellery. I found a 1.54 carat colourless garnet gemstone being sold for $994 USD ($645/carat). Colour change purple garnets also bring a very high price. Garnet gemstones cannot be enhanced, the colour is always natural. Colour change in purple garnets is the criteria ODM and others use as proof of a kimberlite Cr pyrope.

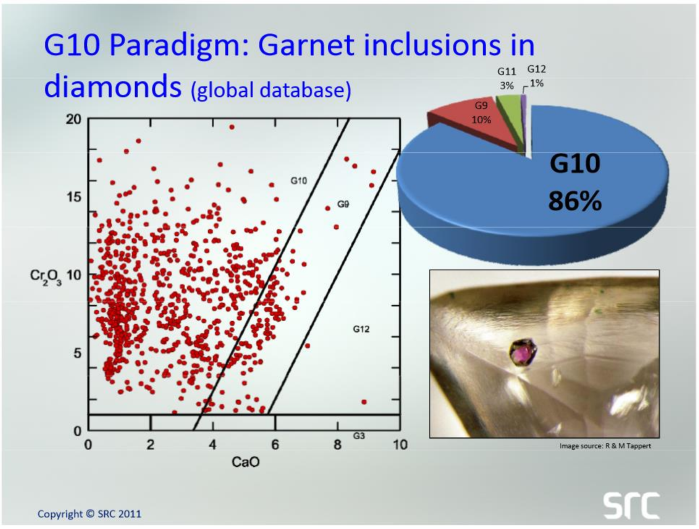
**ON G11 GARNETS:**

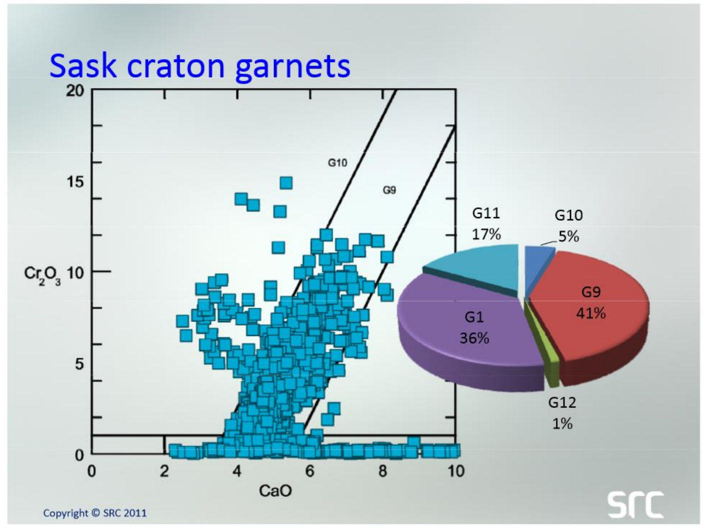
As previously mentioned, two of the G11s microprobed are inert (diamagnetic) garnets. One has a frosted surface which is a common characteristic of kimberlitic grains (a number of articles state that it is diagnostic for some kimberlitic grains); this frosted surface also appears on the FeO spherules I'm finding. This brings G11s to the foreground of my attention in the hunt for diamondiferous pipes (especially big diamonds like the Nipissing Diamond) [see Bishop, 2018, for more on the hunt for the 'source of the 800 carat Nipissing Diamond']. So, imagine my surprise when an aforementioned representative of a major diamond producer stated that he was unfamiliar with G11 garnets. Information on G11s is hard to come by, but I did find some articles. An important one is referring to a short promotional paper by Shore Gold in 2011, represented by Diagrams K-P on the following page [page 42].

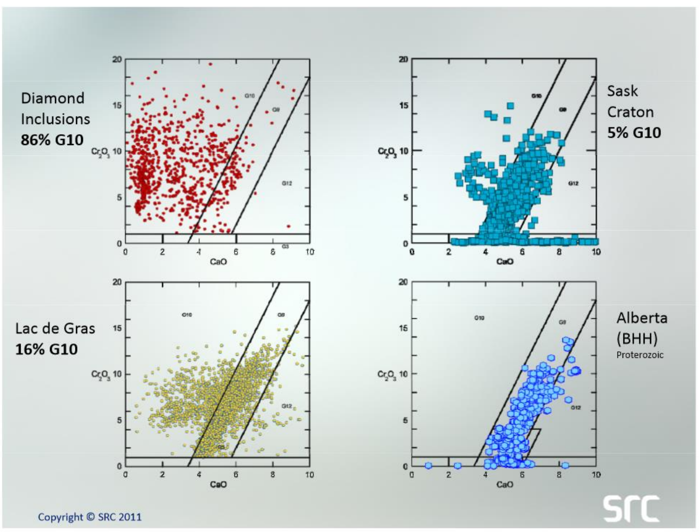
**ON G1 GARNETS:**

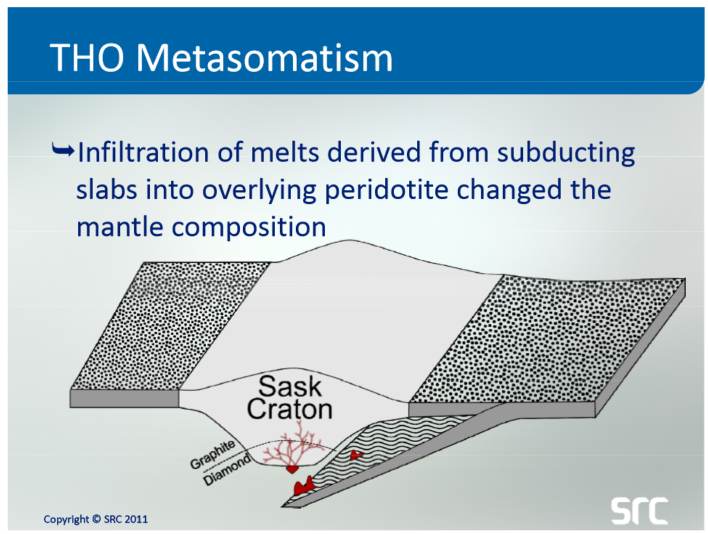
In Diagram K [page 42], the chart shows large numbers of G11 garnets but no G1s on the Global Database. In Photo K [page 40], G1s are shown to be orange, while colour is not mentioned in Diagram K.

One of the deep purple garnets from Little Grassy Lake is a G1.




## Metasomatism: Effects on bulk rock and garnet composition

- Increased Ca, Fe and Ti
- Dilution/diffusion of Cr
- Net result: G10 to G9; G9 to G11 and G1



src

## Conclusions

- Sask cratonic lithospheric mantle was originally depleted
- THO subduction caused extensive metasomatic alteration
- G10 garnets converted to G9, G11 and G1
  - G10 paradigm won't work well
- Proterozoic cratons?



src

*Diagrams K – P: Diamond exploration on the Sask craton: a challenge for current paradigms (Creighton, Harvey, Read, 2011)*

From the Northern Miner about Shore Diamond (formerly Shore Gold):

> "Shore expects to see some … high-value stones above 100 carats."
> ('Diamonds in Canada', Hiyate, 2017, p10)

Then, I found a chart studying grains from Diavik Mine [see Figure Q, below], and what is interesting is that of all the garnet types, the G11s are modestly represented at all depths including the traditional diamond zone (~130-150km) but are the largest population (or only) of garnets in the deep diamond depths – where the big diamonds originate.

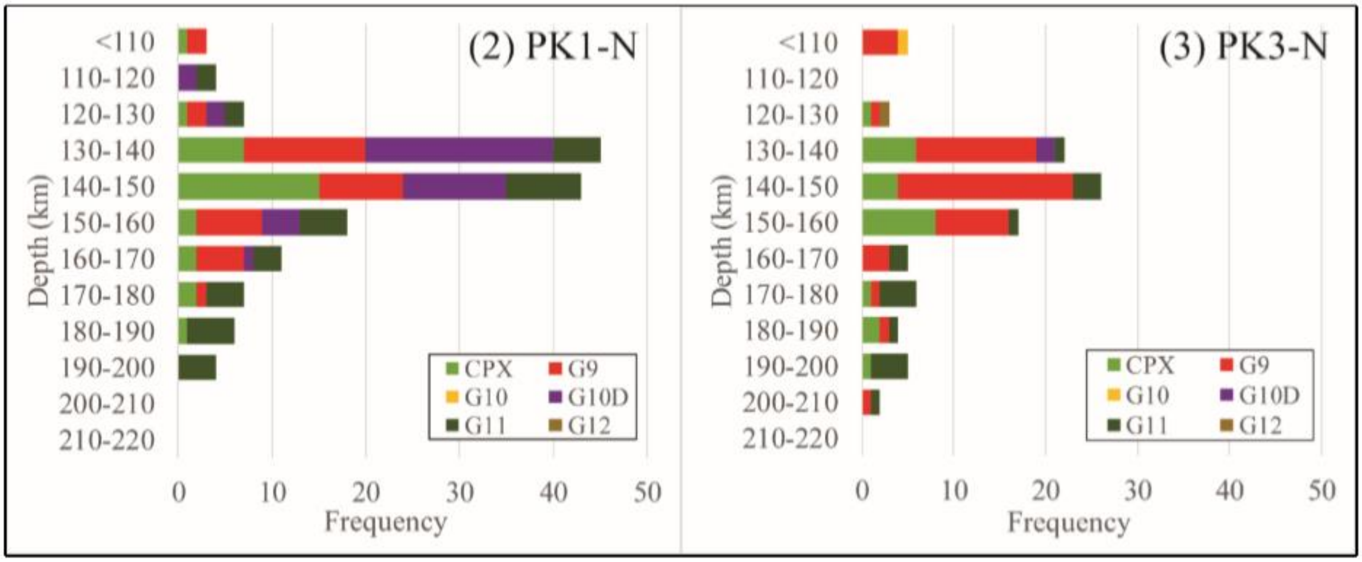



*Figure Q: "Calculated source depths for clinopyroxene and peridotitic garnets. Thermobarometry techniques described by Nimis and Taylor (2000) and Ryan et al. (1996) were applied to PK1-N and PK3-N, and converted to equivalent depths. Parentheses indicate relative timing of emplacement of kimberlite source magmas within A154N. Peridotitic garnets classified using Grutter et al. (2004): G9 = lherzolitic garnet; G10 = harzburgitic garnet; G10D = harzburgitic garnet consistent with inclusions in diamond; G11 = High-Ti peridotitic garnet; G12 = wehrlitic garnet." (Moss, Kobussen, et al, 2017, p3)*

**ON TANDEM-1:**

> "The Tandem-1 pattern may represent **two garnet populations that have been metasomatically altered**. The Tandem-1 pipe has [recovered micro-diamonds and] one of the highest … G-10 content … along the Lake Temiskaming Structural Zone trend … would suggest Tandem-1 is more favourable to hosting diamond than other kimberlite pipes" (Sage, 2000, p14).

> "The pipe was discovered in February 1997 during drilling for gold mineralizations. The Tandem-1 kimberlite pipe, as with … other kimberlite pipes located in Guibord Township, have been found while prospecting for gold. **The Tandem-1 kimberlite is poorly defined by the total field isomagnetic contour pattern and its presence could not be determined by total field magnetic patterns. … Consequently, second derivative maps are of limited value**" (Sage, 2000, p12)

Note: it was found by accident while drilling for gold mineralisation.

**ON RECOMMENDATIONS FOR MINERAL EXPLORATION IN ONTARIO:**

"The diamond potential of a kimberlite can not be determined until all the phases are properly tested. …

"The Kirkland Lake area has not yet been prospected for kimberlites displaying magnetic low signatures. …

"It is anticipated that only a small fraction of the kimberlite pipes that actually exist have been found. **Most of the known kimberlite pipes have not been adequately tested for diamond content, considering these are complex multi-phase intrusions in which diamond content could vary drastically**" (Sage, 2000)

This is all very important. My report on legacy claim 4282142 goes into detail on the finding of an 800-carat yellow diamond in the Cobalt area [see Bishop, 2018, p28-32]. This would, in all probability, come from the deep diamond zone I've been describing. **This is where garnets other than the traditional G10s come into play and where my various non-magnetic grains (two of the three G11s from 4282444 are non-magnetic) become interesting, and when non-magnetic pipes become very important to locate and test**.

**ABOUT THE CLAIMS:**

In the breadth of two townships, Gillies Limit and Lorrain, in a line ~15km long trending southwest-northeast, are 12 targets being considered as potential kimberlites, and the easternmost targets intersect a northwest-southeast line paralleling the Cross Lake Fault ~6km long that comprises another 7 targets also being considered as potential kimberlites. All are near major faults and many have cross faults running through or near to them. These comprise the 'Bishop Claims'. Kimberlites are commonly found in 'clusters'.

One of **The** Majors who visited me verbally stated that they had not looked at this area and that the published and in-house mag flyovers at 200m spacing could easily have missed them, as typically diamondiferous pipes in Canada are between 60-200m wide, and although I did try to explain that having a weak to no mag signature in many Canadian kimberlites consistently correlates to higher diamond content so no recognisable mag signature might be a good thing [see Appendix 3: Advances in Diamond Exploration in Canada, page 50], the senior representative insisted on the importance of a 'solid' mag signature as important to the company (which is true in some areas of the world), although the much younger geologist who accompanied him agreed with me (not surprisingly, the senior rep. informed me shortly after the meeting that the geologist was 'no longer with the company').

These targets comprise nearly perfectly round to half-round – when faulted, lakes of the same size range as the diamond pipes found in the Lac de Gras area where virtually all kimberlites are found beneath round lakes, as are all my targets. Attawapiskat, having been covered by the post-glacial Tyrell Sea, however, has a pretty much flat, featureless surface, but with pipes having approximately the same size as Lac de Gras. Attawapiskat varies somewhat in magnetics as well with a non-magnetic sedimentary host rock covering the area.

As Appendix 3 [page 50] demonstrates, if my targets are diamondiferous kimberlite pipes, then utilising geophysics will cost lots but might provide little in the way of useful diagnostic results. Basically, productive pipes in Canada often/usually have no demonstrable mag, EM, or gravity anomalies; however, drone mag flyovers are new and amazing and inexpensive. A company from Timmins (Zen GeoMap Inc) did a recent magnetometer flyover at a bargain cost (compared to a helicopter survey) with high quality results over two of my targets.

Therefore, I will continue to sample till and report the results. I will continue to look for kimberlite boulders, which although difficult in overgrown, rough terrain, is strong evidence for proximity to a close up-ice pipe. Three samples of kimberlite have been found on my other claims along with one other possible sample. Continued sampling and prospecting is also planned.

Another excellent advantage of the ‘Bishop Claims’ is location. They are all on high/dry ground. Driveable roads are within a kilometre, year-round roads (including the Trans Canada Hwy 11) are less than 10km distant. Cobalt, one of the most important historical mining communities in Canada, is nearby with its railway system and infrastructure. There is no developed private land adjoining any claim, it’s mostly undeveloped Crown land in all directions. Nearby, there are natural gas pipelines (one crosses part of my most westerly claim), one large-scale wind farm, and three hydroelectric plants in the vicinity.

This target and several others like it are in a line close by and to the east of the Cross Lake Fault (as are three diamondiferous kimberlites a short distance to the northwest near Haileybury). This target, as well as some of my others, has a cross fault cutting nearby or ,through it. This is crucial to the emplacement of a kimberlite and aids in the preservation of diamonds in an ascending kimberlite volcano.

## EXPENSES of Cell Claims 277042, 131127, 277041, & 329881, Resulting from work on contiguous Legacy Claims 4282444, 4282707, & 4286187 for October 30,2016 – June 18,2018

| Work Type | Units of Work | Cost per Unit of Work | Portion re: 277042 | Portion re: 131127 | Portion re: 277041 | Portion re: 329881 | Total Cost |
|---|---|---|---|---|---|---|---|
| Prospecting/sampling/field supervision/ODM collection re: 4 traverses | Tony Bishop: 4 days | $500 per day | $500 | $500 | $500 | $500 | $2,000 |
| Field assistants for 2 of 4 traverses | Mike (Patrick) Harrington: 1 day | $285 per man day | $72 | $70 | $71 | $72 | $570 |
| | Graeme Bishop: 1 day | | $95 | $95 | | $95 | |
| P.Eng for ODM independent/split sample collection for unbiased sample | David Crouch, P.Eng: 1 day + assistant | $850 per day | | | | $850 | $850 |
| Till sample processing, HMC, separating into multiple size fractions, sorting, microscope picking, interpretation of KIMs and logging results, storage of picked grains & concentrates picked (total 27 samples collected – Traverse 1, two samples at 50% | Tony Bishop: 26 samples | $500 per sample | $500 | $1000 | | $11,500 | $13,000 |
| Microphotography of select grains & KIMs picked, selection of photos for report from among 1000+ grains photographed, labelling & computer storage of microphotos | 124 microphotos in report from 1000+ in storage | $5 per microphoto used | $155 | $155 | $155 | $155 | $620 |
| Sampling plans, report preparations, map compilations, interpretations | Tony Bishop: 10 days | $500 per day | $1,250 | $1,250 | $1,250 | $1,250 | $5,000 |
| Selection and mounting of grains for EMP & SEM analysis | Tony Bishop: ½ day | $500 per day | $100 | $25 | $25 | $100 | $250 |
| **GeoLab** EMP & SEM invoice 12021117006 | EMP 31 grains | $16.27 per grain (inc. HST) = $504.37 | $226 | $60 | $$60 | $226 | $572 |
| | SEM 7 grains of 35 | Prorated 7/35 x $336.18 (inc. HST) = $67.34 | | | | | |

## EXPENSES of Cell Claims 277042, 131127, 277041, & 329881 – continued

| Work Type | Units of Work | Cost per Unit of Work | Portion re: 277042 | Portion re: 131127 | Portion re: 277041 | Portion re: 329881 | Total Cost |
|---|---|---|---|---|---|---|---|
| **ODM** sample preparation [see Appendix 5: Traverse 4, page 75] | Tony Bishop: 1 day | $500 per day | | | | $500 | $500 |
| **ODM** Laboratory Services Sample L444 invoice 917052 Sept 30/17 | Lab Service | $424 | | | | $424 | $424 |
| Clerical support for reports & technical computer support | Chloë Bishop | $1,000 | $250 | $250 | $250 | $250 | $1,000 |
| Field work supplies: sample collection bins | Dollarama (47) | $47 | $41 | $41 | $41 | $42 | $165 |
| Office supplies: Bristol/tape to mount grains, computer paper/printer ink | Dollarama (4)<br>Northern Lights (114) | $118 | | | | | |
| Transportation based on OPA OEC rate | 4 return trips @ 248km = 1136km | $0.50 per km x 1136km | $124 | $124 | $124 | $124 | $496 |
| Food re: traverses | 7 man days | $35 per man day | $35 | $70 | $70 | $70 | $245 |
| **Total Value of Assessment Work** | | | **$3,348** | **$3,640** | **$2,546** | **$16,158** | **$25,692** |

Appendix 1

# History of Development in the Cobalt Area

Before 1900, when the surveyors for the right-of-way of the Temiskaming and North Ontario (T.&N.O.) Railway worked north from North Bay past Long Lake Station [Cobalt, ON] up to Cochrane, there was limited activity in what is now Lorrain Township. Some early fur trading and logging expeditions entered Lake Temiskaming after coming up the Ottawa River from Montreal as early as the late 1700s and some mid-to-late 1800s colonization of Lake Temiskaming on the Quebec shore. A farming community was settled in the 1880s on a bay a bit south and east of the Bishop claims in Lorrain Township, in addition to a mission of oblate Fathers, and the posts of the Northwest Company and Hudson Bay Trading Companies not far away on Lake Temiskaming. Charles Farr founded Haileybury in the late 1880s and petitioned the government for railway access to facilitate colonization of the area. A colonization road did exist which reached the southernmost part of Lake Temiskaming on the Ontario side, but was never widely used.

The first government infrastructure nearest the claim was the building of the T. & N.O. railway which passed to the west, reaching Cobalt, Ontario in 1903-1904, where a silver and cobalt-nickel arsenide deposit was discovered. The mining boom which followed the discovery of silver at Cobalt often dominated the geological interest in the area for many decades, and although prospectors and geologists closely explored the terrain all around Cobalt (leading to the settling of Silver Centre south of these claims in 1907-08), most of the exploration was guided by the search for more silver and cobalt-nickel arsenide deposits.

In the 1980s, there was renewed interest in the geology of the area, this time in search of diamond-bearing kimberlite pipes, stimulated in part by the discovery of an 800-carat yellow diamond by a settler “somewhere in the Cobalt area” in or around 1904 (which was subsequently tested and confirmed and cut into gemstones by Tiffany’s), but became overshadowed by the vastly rich silver discoveries of the day. Soil sampling and geophysics by companies like Cabo, Tres-Or Resources Ltd., DeBeers, and others in addition to exploration by the Ontario Geological Survey, uncovered more than 50 known kimberlite pipes, some diamondiferous, which helped to outline the existence of a Lake Temiskaming Kimberlite Field on the Lake Temiskaming structural zone, which appears to have intruded the Canadian Shield in this region approximately 148 million years before present. Deep sonar has also revealed circular features beneath the water of Lake Temiskaming itself which are inferred to be kimberlite pipes.

As well, a number of diamondiferous lamprophyres have been discovered near Cobalt, including one just NW of Latour Lake in the south part of Lorrain Twp, and another on the “Nip” Hill in Cobalt, as well as others.

Appendix 2

## Structural Geology

"Kimberlite intrusions tend to occur in clusters or fields, with the large-scale distribution possibly controlled by deep seated structural features and local emplacement by shallow zones of weakness such as faults or the margins of diabase dykes." (Power & Hildes, 2007, p 1025)

The claim is near intrusives including upper and the lower contacts of the diabase sills which are specifically noted as priority targets for silver where favourable mineralization is found within 150 metres of the contact. Although silver/cobalt is not our primary mineral of interest, there is good potential for locating this type of mineralization.

The claim is well situated within the Lake Temiskaming Structural Zone (LTSZ) which is known as host for a large number of diamond projects undertaken by a number of notable explorers and Public Junior Mining Companies. Locally over a dozen kimberlite pipes and lamprophyres, many diamondiferous, have been found mainly by testing magnetic anomalies. But, as is now well accepted, many of the most highly diamondiferous kimberlite pipes found and continuing to be found in Canada are not detectable by mag or often by EM. Gravity can be useful in these cases but often companies are now returning to high KIM results in till and stream samples and then looking for visual round pipe-sized anomalies, either as lakes or circular depressions in the topography.

A key feature of a number of significant projects within the LTSZ is the Cross Lake Fault. Locally, this deep, regional fault is in close proximity to the west of the claim, approximately 1km away.

Publicly available OGS Geophysical Data and subsequent correlations were instrumental in the decision to stake this land given a high probability of its potential for diamonds and other mineral occurrences. This information was related to products released by the Ontario Geological Society. Lorrain & Gillies Limit have ideal conditions for kimberlite/diamond exploration.

The claim has conjugate, perpendicular structures relating to the Cross Lake Fault and such structures are proven to bear diamondiferous kimberlite pipes in the New Liskeard Kimberlite Field, especially on the east side of the Cross Lake Fault where the pipes are higher in diamond grade in the New Liskeard Area.

The Cross Lake Fault dips steeply to the East to a great depth. This would provide an easy method of transport for an ascending kimberlite and would also allow for faster ascension which is necessary for diamond preservation. This is demonstrated in the New Liskeard area pipes, where the three pipes, Bucke, Gravel, and Peddie, on the east side of the fault are all more highly diamondiferous than the many known pipes on the west side of the fault.

Eight of my kimberlite targets are on the east side of the Cross Lake Fault, very close to the same distance away from the fault as these three pipes in New Liskeard and there are cross faults near or through all of these.

As well, the nature of the rugged Archean terrain of the Lorrain Batholith is important to the diamond potential. The Granite and Diabase are both very hard and when fractured it is reasonable to infer that they are deeply fractured just as the Cross Lake Fault is a deep, regional fracture, which is still active today as part of the Ottawa-Bonnechere Graben System.

As a result, the claims' location within diabase and nearby the Lorrain Granite Batholith offers a prime setting to allow for Kimberlite Material to transport readily to surface and allow for better preservation of diamondiferous kimberlites. Glacial erosion would have been limited owing to the hardness of the rock when compared to softer terrains. This may allow for a preservation of a greater volume of pipe than those discovered in glacially eroded terrains. Rapid transportation of diamond bearing magma is essential to the preservation of diamond stability during transport.

*Adapted in part from Prairie C – The Lorrain Batholith Project*
*http://www.geocities.ws/Eureka/Account/6322/PcProprt.html*

Appendix 3

# Advances in Diamond Exploration in Canada: Understanding the Importance of Non-Magnetic Signatures and Geo-Chemical and Structural Geology

There seems to be a general misconception concerning the necessity of having a “magnetic bullseye” as being the primary method of locating kimberlite pipes and indeed, during the 1980s-1990s, a necessity. The following articles will help dispel that outdated belief, given more recent research and outcomes from Canadian-producing mines, including advances in geo-chemical and structural geology analysis:

From Energie et Ressources naturelles Quebec*, Exploration Methods,* accessed online at: https://www.mern.gouv.qc.ca/english/mines/industry/diamond/diamond-methods.jsp:

- “Anomalies may be negative or positive and locally very close together (Sage, 1996; Saint-Pierre, 1999). **A few diamondiferous lamproite and kimberlite intrusions do not create magnetic anomalies** (Atkinson, 1989; Brummer *et al*., 1992; Fipke *et al.*, 1995).”

- **“Geophysical Surveys:** Kimberlites often form swarms that are generally associated with large, deep fractures (or faults) and with the intersection of major weakness zones in the earth’s crust**….** In exploration programs for diamond-bearing kimberlite pipes between 100 m and 1,000 m in diameter world-wide (average of 300 m), the optimal flight line spacing in aeromagnetic surveys is believed to be 100 m, but a line spacing of 200-250 m is considered sufficient [for much of the world, however diamond pipes in Canada tend to be only ~50m to 200m in diameter, i.e., Lac de Gras and Attawapiskat]….In general, the cost of airborne surveys increases exponentially as the line spacing narrows. Magnetic or electromagnetic surveys spaced at 100 m are very expensive. The investment for this type of exploration can quickly become exorbitant. It is therefore important to use other techniques to target locations for conducting these surveys. The most commonly used technique consists of identifying indicator minerals in the heavy fraction of glacial deposits.

- **“Indicator Minerals:** For both kimberlites and lamproites, the “indicator minerals” must present a very specific chemical composition that reflects the prevailing pressure, temperature, and oxidation-reduction conditions for the formation or preservation of diamonds. It is therefore very important to chemically analyze as many “indicator minerals” as possible in order to ensure that a number of grains possess the right chemical composition. This unavoidably results in high costs for analyzing and interpreting results.

- **“Tracer minerals:** This is the most common method used in diamond exploration, especially in the early stages of exploration well before the considerably expensive geophysical methods are used. This method consists of looking in secondary environments (soil, streams, rivers, etc.) for minerals characteristically associated with diamond-bearing kimberlites and retracing them back to their source…. In northern regions, glaciers have eroded kimberlite rocks, dispersing the minerals that compose these rocks over large distances, either in tills or eskers….Studying glacial movement provides information on the directions and distances that glaciers traveled and makes it possible to go back to the source of the dispersal. A number of sampling campaigns based on relatively tight grids will be needed depending on progress made in the work. These sampling campaigns will take place over a number of years. They will also be difficult to carry out and very expensive.”

From Geophysical Survey Methods in Diamond Exploration
Posted by: Maiko Sell in Exploration Geophysics, Exploration Methods. Accessed online at https://www.geologyforinvestors.com/geophysical-survey-methods-diamond-exploration/ :

- “Gravity surveys can be time consuming and expensive. When choosing to do a gravity survey at the exploration level, one is generally expecting to find kimberlites that have no discernible magnetic or electromagnetic response.”

From http://www.pdac.ca/docs/default-source/publications---papers-presentations---conventions/jaques.pdf?sfvrsn=4

- "These companies reported **the discovery of 4 new non-magnetic** satellite **pipes** surrounding Aries kimberlite pipe using the Falcon airborne gravity gradiometer. **Subsequent microdiamond sampling indicated that all were diamondiferous** including the most recently discovered Niobe pipe." From page 20 of presentation at PDAC conference

From http://www.adamera.com/i/pdf/ppt/Amaruk-Project-Presentation.pdf page 9:

- "**In Lac de Gras all economic kimberlites are** strong EM conductors **with weak magnetic signatures**."
- "Many of the >200 kimberlites discovered on the Slave Craton are magnetic discoveries, often tested with only one diamond drill hole. **Non-magnetic kimberlites are often *more diamondiferous*** than magnetic kimberlites, and these kimberlitic phases would be missed if only magnetic anomalies were tested."

From http://www.metalexventures.com/html/attawapiskat.html on **magnetics not evident on most productive pipes in Attawapiskat**

From http://resourceclips.com/tag/add_ca/ Arctic Star/Margaret Lake Diamonds form JV, follow Kennady's approach to NWT kimberlites, **by Greg Klein | November 15, 2016**

- "De Beers considered Kelvin and Faraday low grade, based on their lack of prominent magnetic anomalies, according to the **Arctic**/**Margaret** JV. **Mountain Province** then spun out **Kennady** to explore the pipes. That company "applied ground geophysics, **gravity and Ohm mapper EM, which revealed** extensions to these **kimberlites that were not revealed in the magnetics**," the Diagras partners stated. "Subsequent drilling and bulk sampling has shown that these **non-magnetic phases of the kimberlites have superior diamond grades** to the magnetic phases and significantly increase the tonnage potential." Looking at some nearby deposits, the JV states that **certain kimberlites at the Rio Tinto NYSE:RIO/Dominion Diamond TSX:DDC Diavik mine and the high-grade portions of Peregrine Diamonds' (TSX:PGD)** majority-held **DO-27 kimberlite "are non-magnetic, proof that a magnetic-only approach in the Lac de Gras field could miss significant diamondiferous kimberlite bodies**."

From **http://www.grizzlydiscoveries.com/index.php/investor-relations/news/91-grizzly-provides-update-for-diamond-exploration-in-northern-alberta**

- "The potential for discovery of additional diamondiferous kimberlites within Grizzly's Buffalo Head Hills properties is considered high, based upon the favourable regional geological setting and the positive results of exploration conducted to date, including the identification of numerous priority geophysical targets. Grizzly's past work has shown that **the focus should be on kimberlites with a weak magnetic signature** with or without an accompanying electromagnetic, gravity and/or seismic signature, **which have tended to yield better diamond counts** in the Buffalo Head Hills kimberlite field."

From Kennedy, C.M. (2008). The Physical Properties of the Lac de Gras Kimberlites and Host Rocks with Correlations to Geophysical Signatures at Diavik Diamond Mines, NWT: http://research.library.mun.ca/10786/1/Kennedy_Carla.pdf

- "To date, the majority of kimberlites discovered using magnetic surveys have been negative magnetic anomalies. These small, circular, negative anomalies are easy to pick out in the comparatively positive magnetic background. It is **assumed that there are still many kimberlites that have not yet been discovered due to their neutral** or positive **magnetic responses**" (Kennedy, 2008, p 5).

- "In the Diavik area, **diabase dykes have large positive magnetic signatures making pipes located close to these dykes difficult to detect**. There is also the issue of remanent magnetization obscuring magnetic signatures" (Kennedy, 2008, p 149).

From: http://www.arcticstar.ca/s/NewsReleases.asp?ReportID=684168&_Title=Arctic-Announces-new-100-owned-Property-in-the-heart-of-the-Lac-de-Gras-dia... November 18, 2014
Arctic Announces new 100% owned Property in the heart of the Lac de Gras diamond field:

- “Twenty years of diamond exploration on the Slave Craton has proven that kimberlites can be small with complex shapes (dykes, sills, and multi-phase pipes) with complex geophysical signatures. …Many of the >200 kimberlites discovered on the Slave Craton are magnetic discoveries…**Non-magnetic kimberlites are often more diamondiferous than magnetic kimberlites, and…would be missed if only magnetic anomalies were tested.** The Kennady Diamonds Property (TSXv-KDI) is a recent examples of exploration **success** that resulted **from exploring for non-magnetic kimberlite**. Close-spaced airborne gravity, ground gravity, and ground EM techniques discovered high diamond grade kimberlites…. On the adjacent Ekati property, 6 new kimberlites were discovered by a modern heli-borne gravity survey. **One kimberlite… is significantly diamondiferous. …The Diavik mine itself consists of non-magnetic kimberlite**, detected by electromagnetic (EM) surveys. …**These new discoveries represented separate, usually volcanic pyroclastic events which were always more diamondiferous than their magnetic partners. We also found diamondiferous kimberlites with no magnetic and EM signature using gravity techniques**.”

From Kjarsgaard, B. A. (2007). Kimberlite Pipe Models: Significance for Exploration. In B. Milkereit. *Proceedings of Exploration 07: Fifth Decennial International Conference on Mineral Exploration.* (pp. 667-677). Retrieved from http://www.dmec.ca/ex07-dvd/E07/pdfs/46.pdf

- “The physical and geochemical signatures of the host rocks are widely variable in terms of their magnetic response, electrical resistivity, density and elemental distributions. **Hence a variety of kimberlite** – host rock **responses are possible** i.e. positive anomaly, negative anomaly, **or no anomaly**” (Kjarsgaard, B.A., 2007, p 674).

From Shigley, J.E., Shor, R., Padua, P., Breeding, Shirey, S.B., Ashbury, D. (2016). Mining Diamonds in the Canadian Arctic: The Diavik Mine. Gems & Gemology, Summer 2016, Vol. 52, No. 2. Retrieved from https://www.gia.edu/gems-gemology/summer-2016-diamonds-canadian-arctic-diavik-mine

- “Because kimberlites weather and decompose faster than much older surrounding rocks, **the pipes often occur in topographic depressions beneath lakes**. …The pipes are capped by several meters of glacial till, a thin layer of lacustrine sediments, and 15–20 meters of lake water. … With the retreat of the glaciers, the pipe locations often became depressions in the land surface, which filled with water to become lakes. The lakes at pipe locations are generally deeper than those formed by just glacial action.” (Shigley et al, 2016).

From Kono, M (Ed) (2010): Geomagnetism: Treatise on Geophysics. Elsevier, May 11, 2010. *Science* pp205. Retrieved from https://books.google.ca/books?id=_YDNCgAAQBAJ&pg=PA205&lpg=PA205#v=onepage&q&f=false

- “**Kimberlite pipes are often found in geographically localized groups, frequently under lakes** because of differential erosion, and the remanence directions within those groups is often similar**. Kimberlite pipes are often associated with diabase dikes**, and are also commonly intruded along pre-existing zones of weakness regional faults, geological contacts.” (Kono (Ed), 2010, p 205)

From Kjarsgaard, B. A. (2007). Kimberlite Pipe Models: Significance for Exploration. In B. Milkereit. *Proceedings of Exploration 07: Fifth Decennial International Conference on Mineral Exploration.* (pp. 667-677). Retrieved from http://www.dmec.ca/ex07-dvd/E07/pdfs/46.pdf

- “Known, economically viable kimberlites range in size from thin (1 - 4 m) dykes or sills, to small pipes of ~75 m in diameter to very large pipes with sizes of ~1.5 km diameter. Just about any type of rock can host kimberlite bodies. …Kimberlites in the Lac de Gras field tend to be small (50-200m diameter) steep sided bodies…” (Kjarsgaard, B.A., 2007, p 674).

From Power, M., Hildes, D. (2007). *Geophysical strategies for kimberlite exploration in northern Canada*. Paper 89 in "Proceedings of Exploration 07: Fifth Decennial International Conference on Mineral Exploration" edited by B. Milkereit, pp1025-1031. Retrieved from https://www.911metallurgist.com/blog/wp-content/uploads/2015/10/Geophysical-strategies-for-kimberlite-exploration-in-northern-Canada.pdf

- "**Kimberlite intrusions tend to occur in clusters or fields**, with the large-scale distribution possibly controlled by deep seated structural features and local emplacement **controlled by shallow zones of weakness such as faults or the margins of diabase dykes**" (Power & Hildes, 2007, p 1025).

From Erlich, E.I., Hausel, W.D. (2002). *Diamond Deposits: Origin, Exploration, and History of Discovery*. Society for Mining, Metallurgy, and Exploration, Inc. (SME). Littleton, CO, USA

- "**Gravity.** The high relative density of kimberlite and lamproite should make these rocks detectable by gravity and seismic surveys. However, most diamondiferous intrusives are small and weathered, and gravity and seismics are generally not sensitive or practical enough to use in the search for kimberlite or lamproite. For example, Hausel, McCallum, Woodzick (1979) noted that **diamondiferous kimberlite intruded in granite** in the Wyoming craton **showed no detectable density differences with the host granite**." (Erlich & Hausel, 2002, p 313)

From Daniels, L.R.M., Tshireletso A. Dira, T.A., Kufandikamwe, O. (2017). The magnitude of termites to the future of kimberlite exploration in Botswana. 11th International Kimberlite Conference Extended Abstract No. 11IKC-4555, 2017

- "**The future of new kimberlite discoveries, mainly poorly magnetic to non-magnetic, is once again dependent on soil sampling for kimberlite indicator minerals**." (Daniels et al, 2017)

Appendix 4

# Map Appendix Overview

**MAP 1**: Claim Location

**MAP 2:** Road Access

**MAP 3:** Geological Compilation (portion of Ontario Department of Mines Map 2052)

**MAP 4:** Mag Map (portion of OGS Map 82 067)

**MAP 5:** Ice Flow Movement (from OGS OFR 6088)

**MAP 6:** Local Glacial Flow Direction

**MAP 7:** Lake Temiskaming Structural Zone (from OGS OFR 6088)

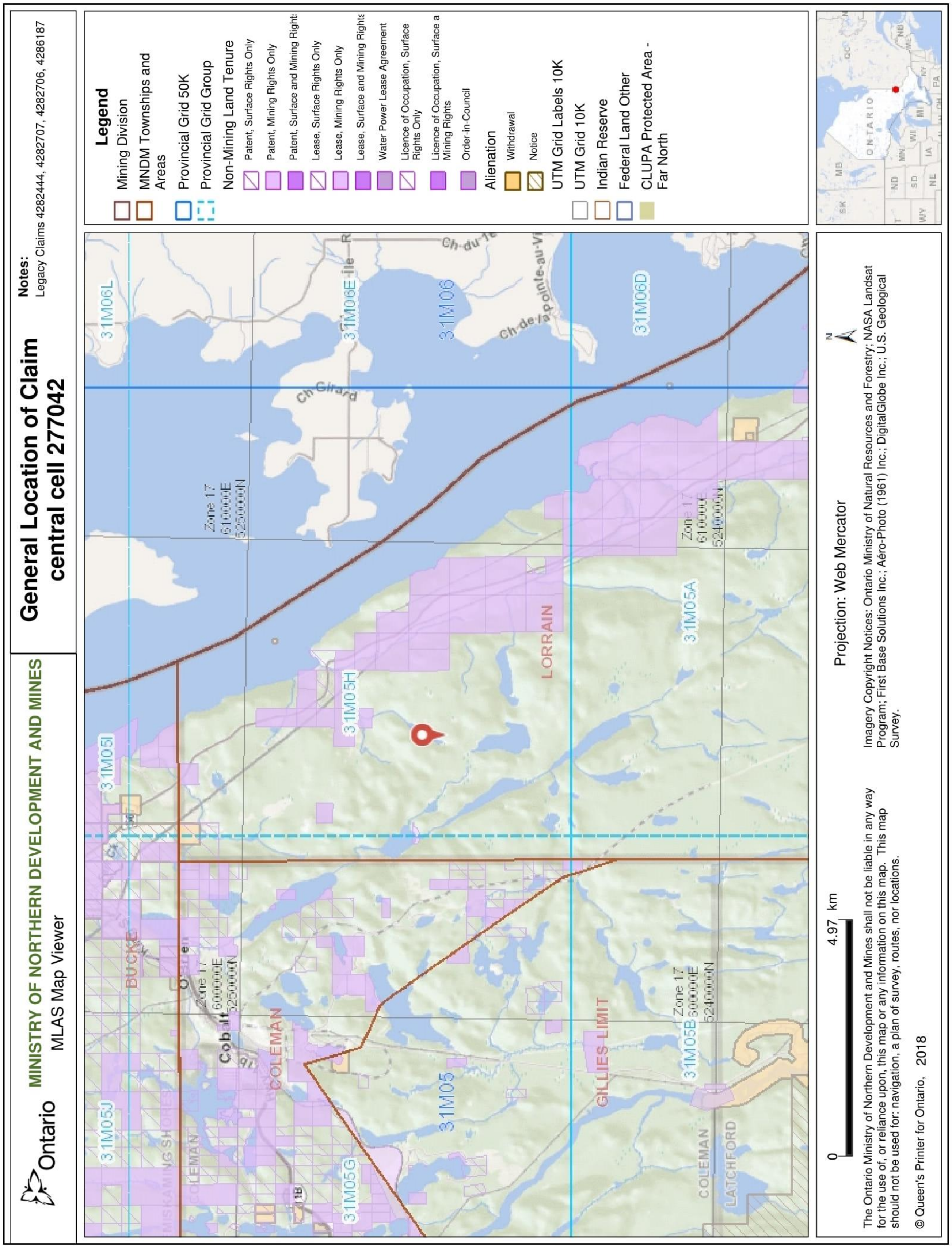
**MAP 8:** Detailed Local Faults

**Map 9:** Down-ice glacial direction – tilted view (Google Earth)

**Map 10:** Straight-down view of Little Grassy Lake (Google Earth)

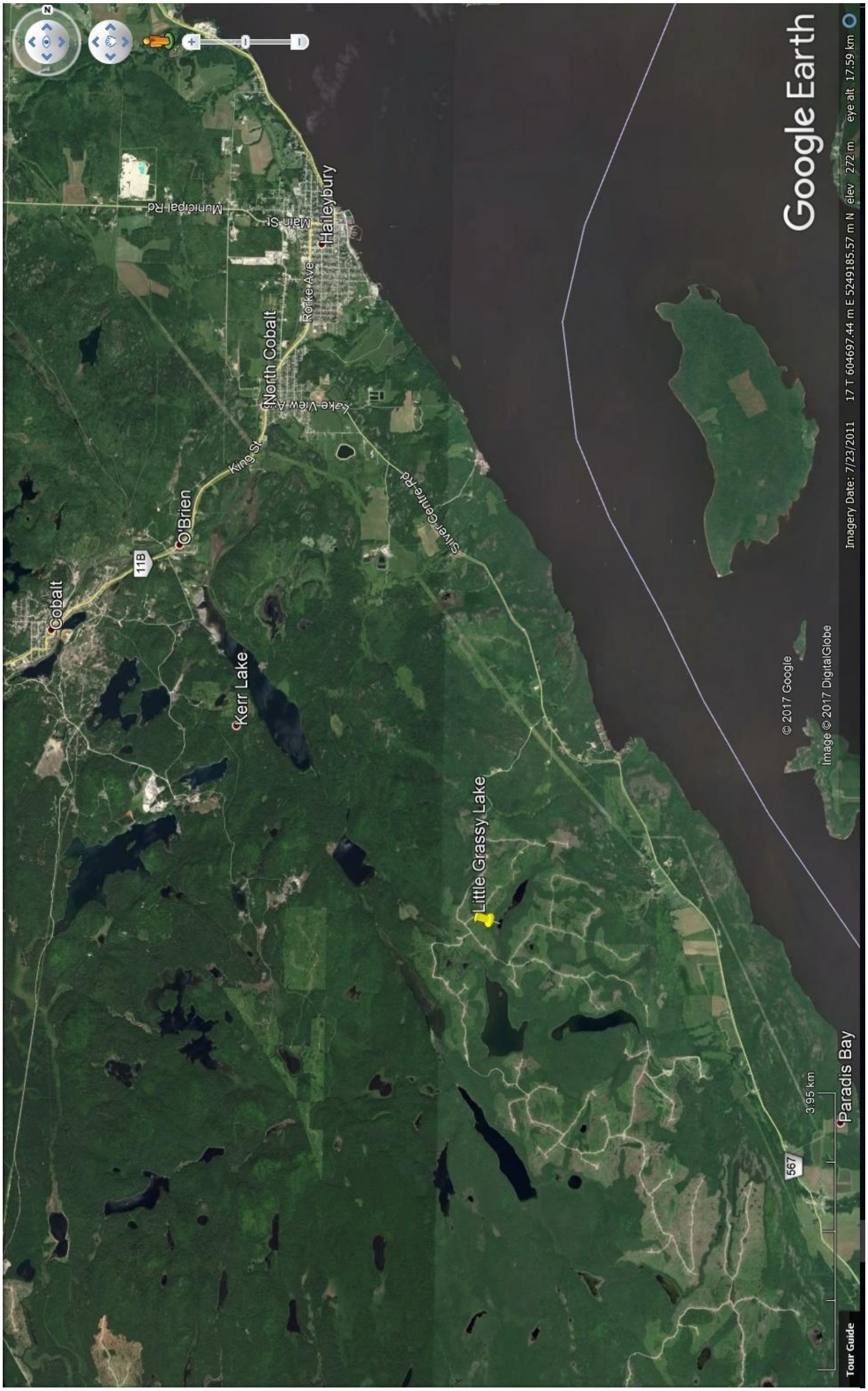
**Map 11:** Contiguity of legacy claims 4282444, 4282707, & 4286187

Appendix 4



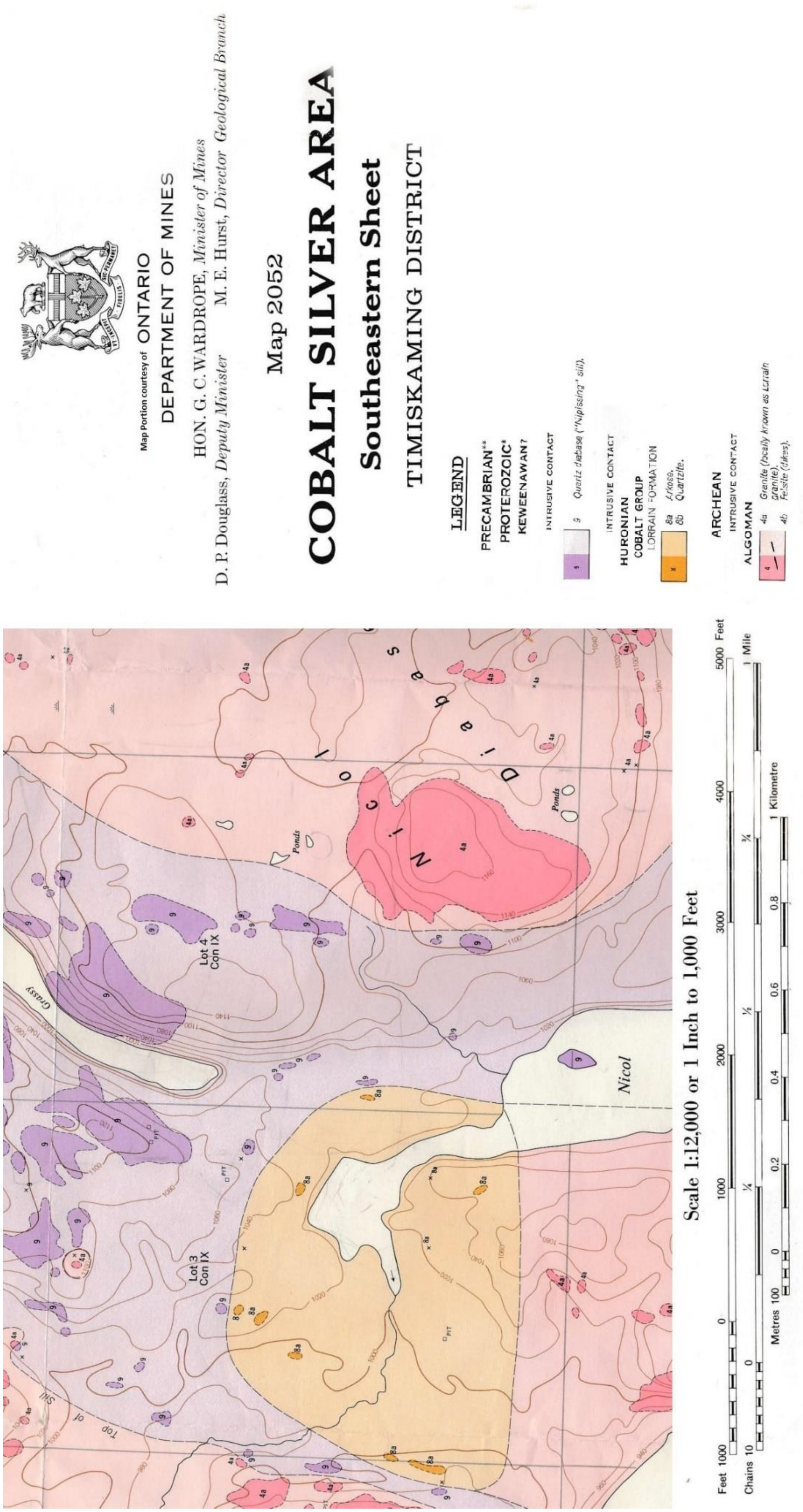

*Map 1*

Appendix 4




*Map 2*

Appendix 4

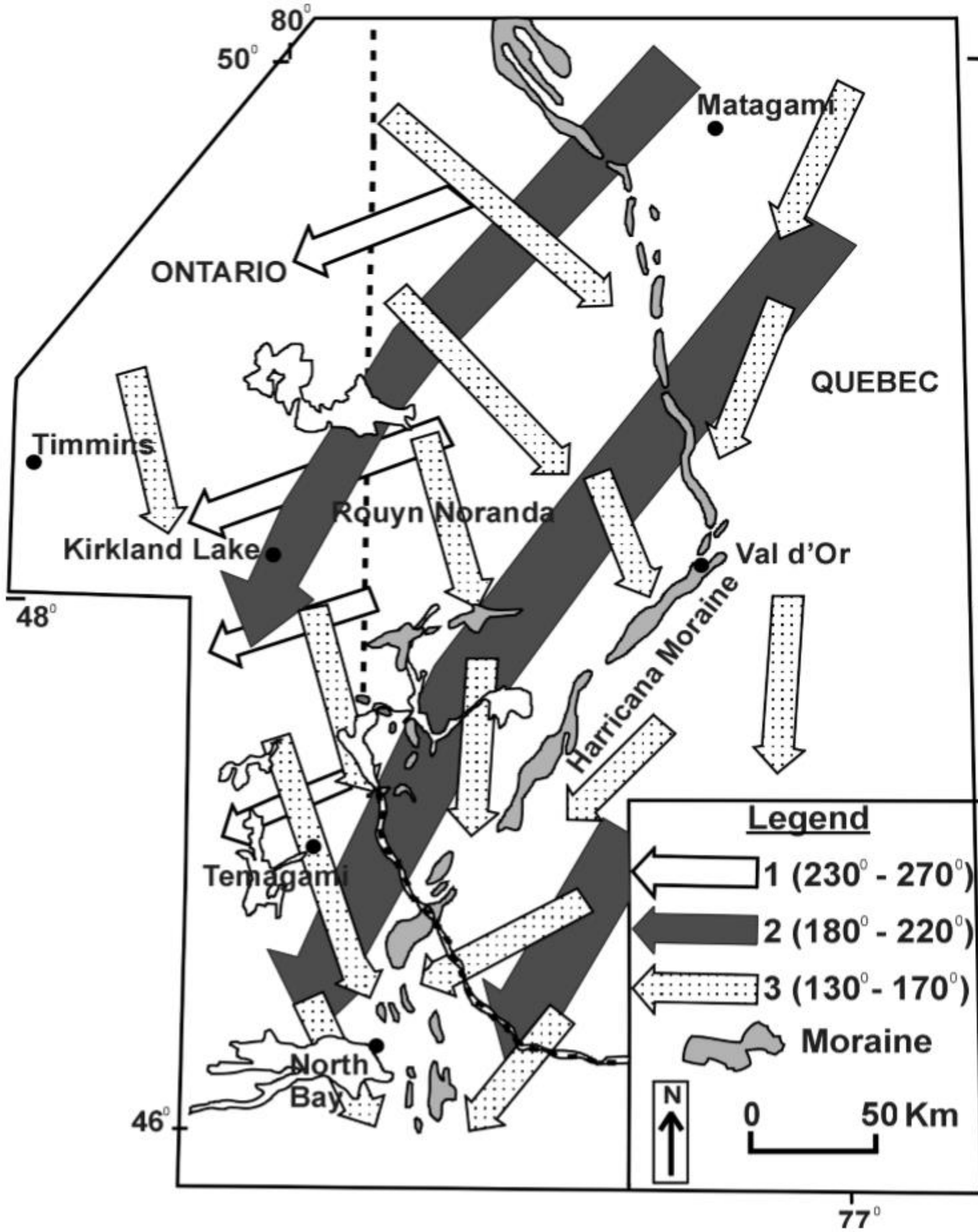



*Map 3*

Appendix 4


*Map 4*

Appendix 4

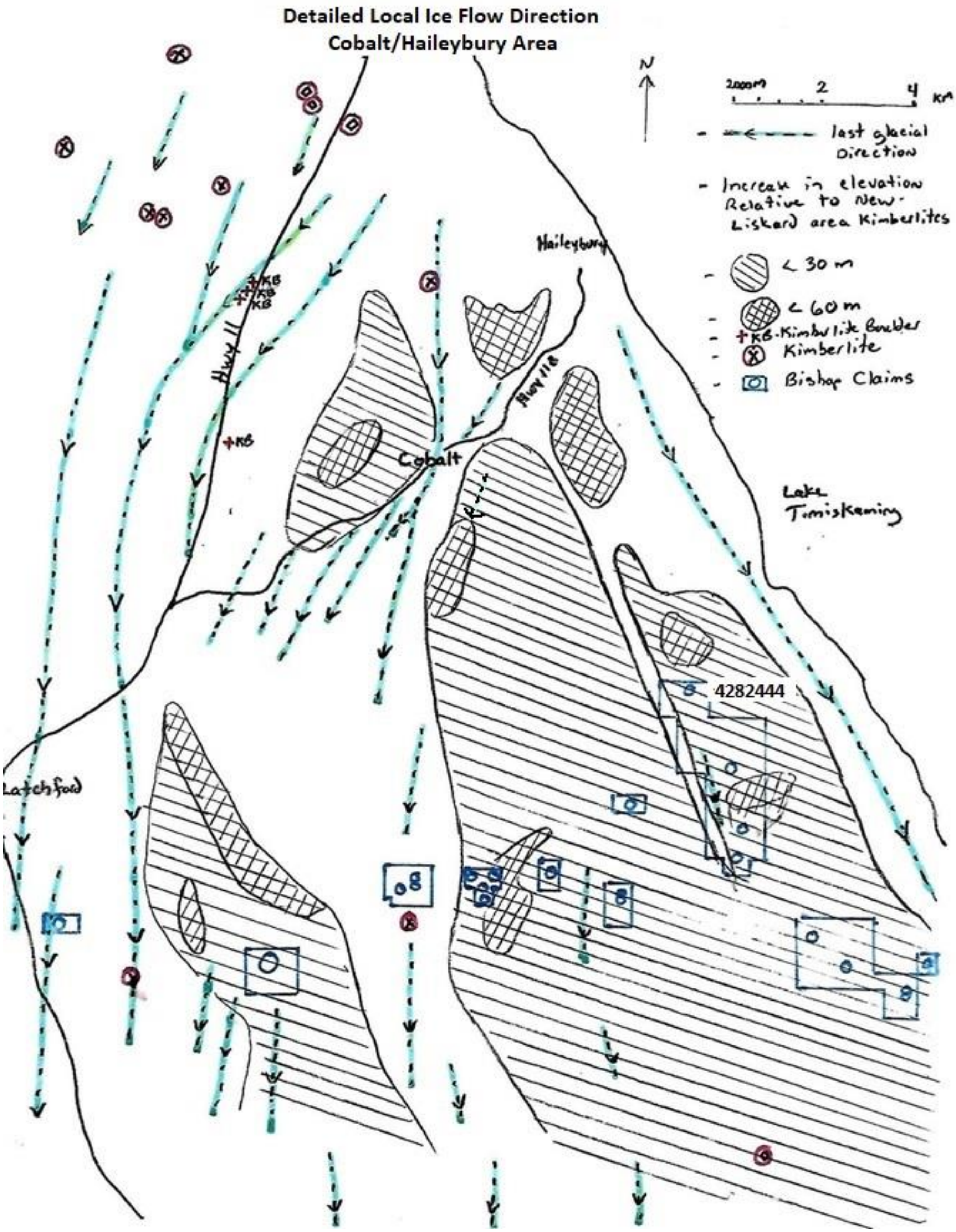



Ice flow movement in the Abitibi-Temiskaming area. The oldest ice flow event is the number 1 movement, the youngest the number 3 movement (after Veillette 1986).

Used courtesy of
Ontario Geological Survey
Open File Report 6088

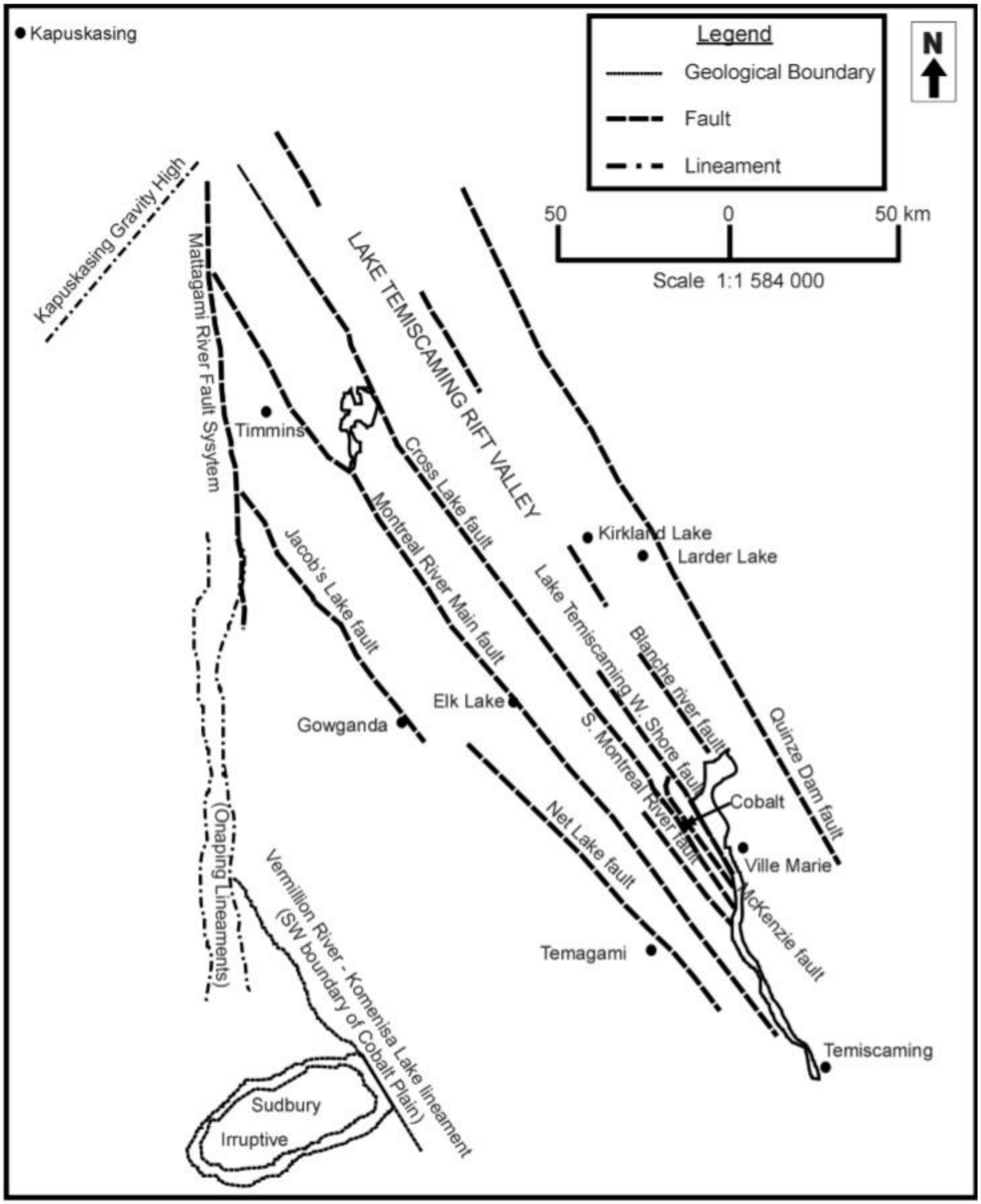
*Map 5*

Appendix 4




*Map 6*

Appendix 4



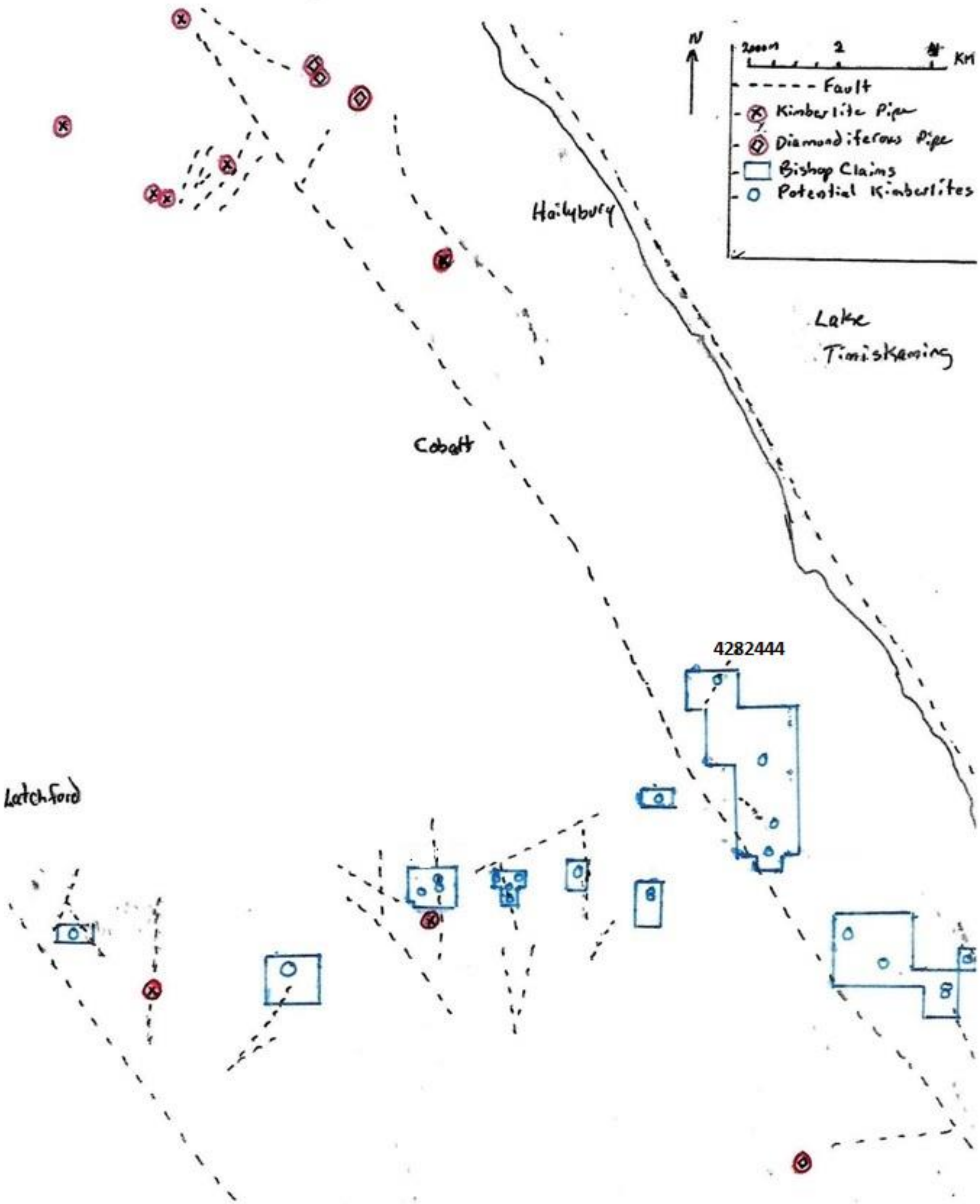

The Lake Temiskaming Rift Valley (also known as the Lake Temiskaming Structural Zone) (after Lovell and Caine 1970).

Used courtesy of
Ontario Geological Survey
Open File Report 6088

*Map 7*

Appendix 4

# Detailed Local Faults



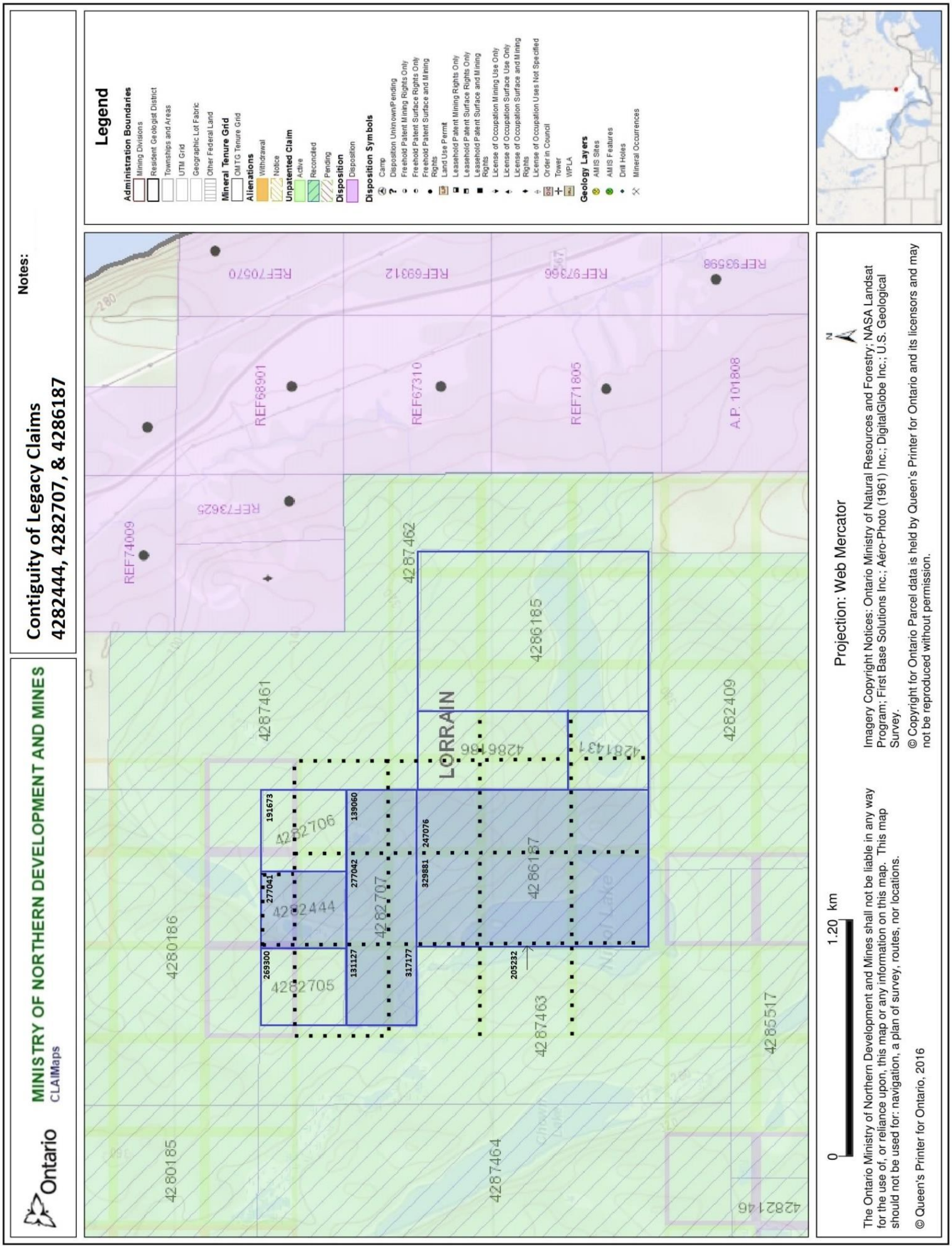

*Map 8*

Appendix 4


*Map 9*


*Map 10*

Appendix 4




*Map 11*

Appendix 5

# Traverses Appendix Overview

| | | |
|---|---|---|
| **TRAVERSE 1:** | October 30, 2016 | – Fieldwork, Map, & Field Notes |
| **TRAVERSE 2:** | November 16, 2016 | – Fieldwork, Map, & Field Notes |
| **TRAVERSE 3:** | June 3, 2017 | – Fieldwork, Map, & Field Notes |
| **TRAVERSE 4:** | July 20, 2017 | – Fieldwork, Map, & Field Notes |

Appendix 5

## FIELDWORK: **Please refer to Appendix 6 for Methodologies for Field Work and Till Sample Processing**

**L 4282444**

## Traverse 1: fieldwork October 30, 2016 Brian A. (Tony) Bishop, Mike Harrington

Mike Harrington and I parked the truck at TP. From there, we walked approximately northeast to #3 post of 4282444 (WP1). From there, we more or less paralleled the claim line until we reached an area west of Little Grassy Lake where we encountered some areas of bedrock (diabase).

From previous research, on Map 2052 (Ontario Department of Mines, 1964), the area around the lake is all diabase and two pits are shown, probably silver/cobalt prospector pits. We spent some time looking for them (WP2), but with the early Cobalt Silver heyday being 100+ years before, they are probably overgrown, and we did not find them.

We checked many boulders as we prospected but no mineralisation was observed on this trip. At the head of Little Grassy Lake, we found a place to cross a bit of swampy/wet area, and then paralleled in an approximate southwest direction the east side of the half-round lake that I'm investigating for possibility of being a kimberlite pipe. The ridge/cliff here is steep. No kimberlite boulders were found. At the bottom of the lake we followed the trend of the hill and continued prospecting mostly through the logged area (WP3) on our way back to the road (WP4). We then returned to the truck.

As expected from Map 2052, diabase was by far the dominant rock type found. Although I'm focussing primarily on diamond mineralisation, we watched also for calcite/quartz veins and any cobalt/silver mineralisation which generally would create an easy-to-see distinctive pink or green oxidation.

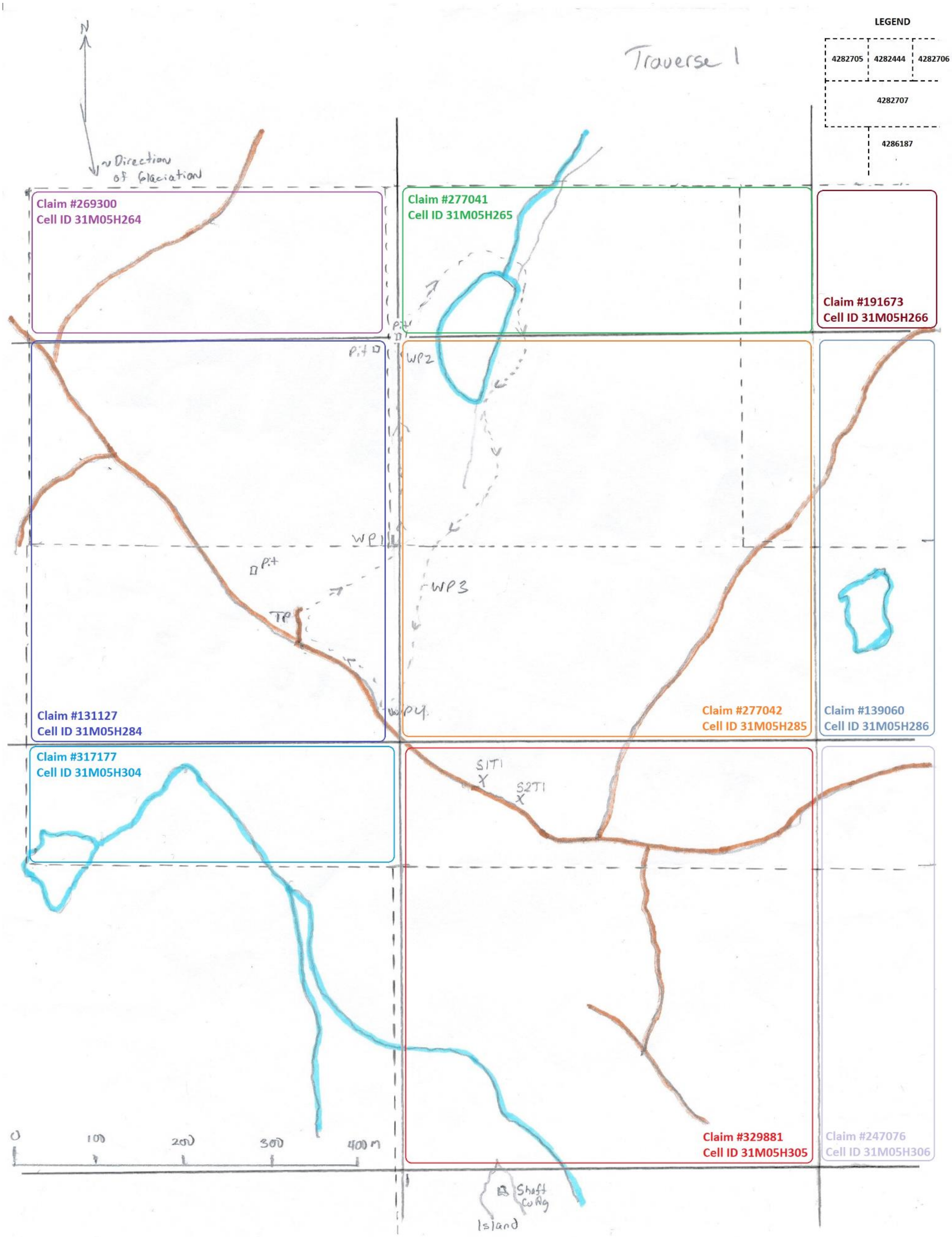
Three pits are shown on the Traverse 1 map. These were taken from Map 2052 and are approximate locations only and are difficult to accurately plot on a more modern map. Perhaps with more field work they could be located in a future prospecting trip. The new growth on the logged area made it very difficult to locate previous work.

Before leaving, I drove to an area approximately 450m down-ice of the lake in a bit of a low-lying trough and took two till samples near the edge of the road. We then returned home.

Appendix 5

**L 4282444**

## Traverse 1: map    October 30, 2016    Brian A. (Tony) Bishop, Mike Harrington



Appendix 5

**L 4282444**

## Traverse 1: field notes

October 30, 2016

Brian A. (Tony) Bishop, Mike Harrington

| Sample # | Coordinates 17T UTM | Weight | Activity/Description |
|---|---|---|---|
| T1S1 | 0605827_E<br>5245382_N | ~3kg | Brown, sandy till |
| T1S2 | 0605875_E<br>5245382_N | ~2.5kg | Brown, Sandy till |

| Location # | Coordinates 17T UTM |
|---|---|
| Truck Park | 0605607_E/5245598_N |
| WP1 | 0605712_E/5245692_N |
| WP2 | 0605717_E/5245911_N |
| WP3 | 0605752_E/5245642_N |
| WP4 | 0605736_E/5245471_N |

| Claim # | Cell ID |
|---|---|
| 277041 | 31M05H265 |
| 277042 | 31M05H285 |
| 329881 | 31M05H305 |
| 131127 | 31M05H284 |

Appendix 5

**L 4282444, L 4282707**

## Traverse 2: fieldwork November 16, 2016 Brian A. (Tony) Bishop

After Traverse 1, the two till samples were processed and checked for KIMs. As I hoped, a surprisingly high number of nice (potential) KIMs were found. With these results combined with my original hypothesis of the lake on claim 4282444 being a kimberlite pipe, I contracted Mike Harrington to stake claims around and down-ice of this lake. Three claims to the east, west, and south (legacies #4282705, 4282706, and 4282707) were staked on November 5th, 2016 and recorded on November 14th, 2016.

Another sampling plan was drawn up by me. Traverse 2 samples were taken from down-ice of Little Grassy Lake (claim 4282444). The samples were taken from several locations on claim 4282707 down-ice of the assumed kimberlite. The logging roads were fortuitously located directly down-ice at approximately 500± metres from the lake which is a correct sampling distance when looking for glaciated indicators down-ice of a suspected kimberlite.

We parked at the same location as Traverse 1 to start. Much time was spent checking areas that had been dug up on both sides of the road during the construction by hi-hoe/bulldozers. Kimberlite boulders can generally only be found in freshly disturbed ground. This is similar to, in certain locations, hunting gravel pits to find kimberlite boulders, especially after a rainfall.

In suitable locations we dug and bagged a till sample and left it flagged on the road for later pickup.

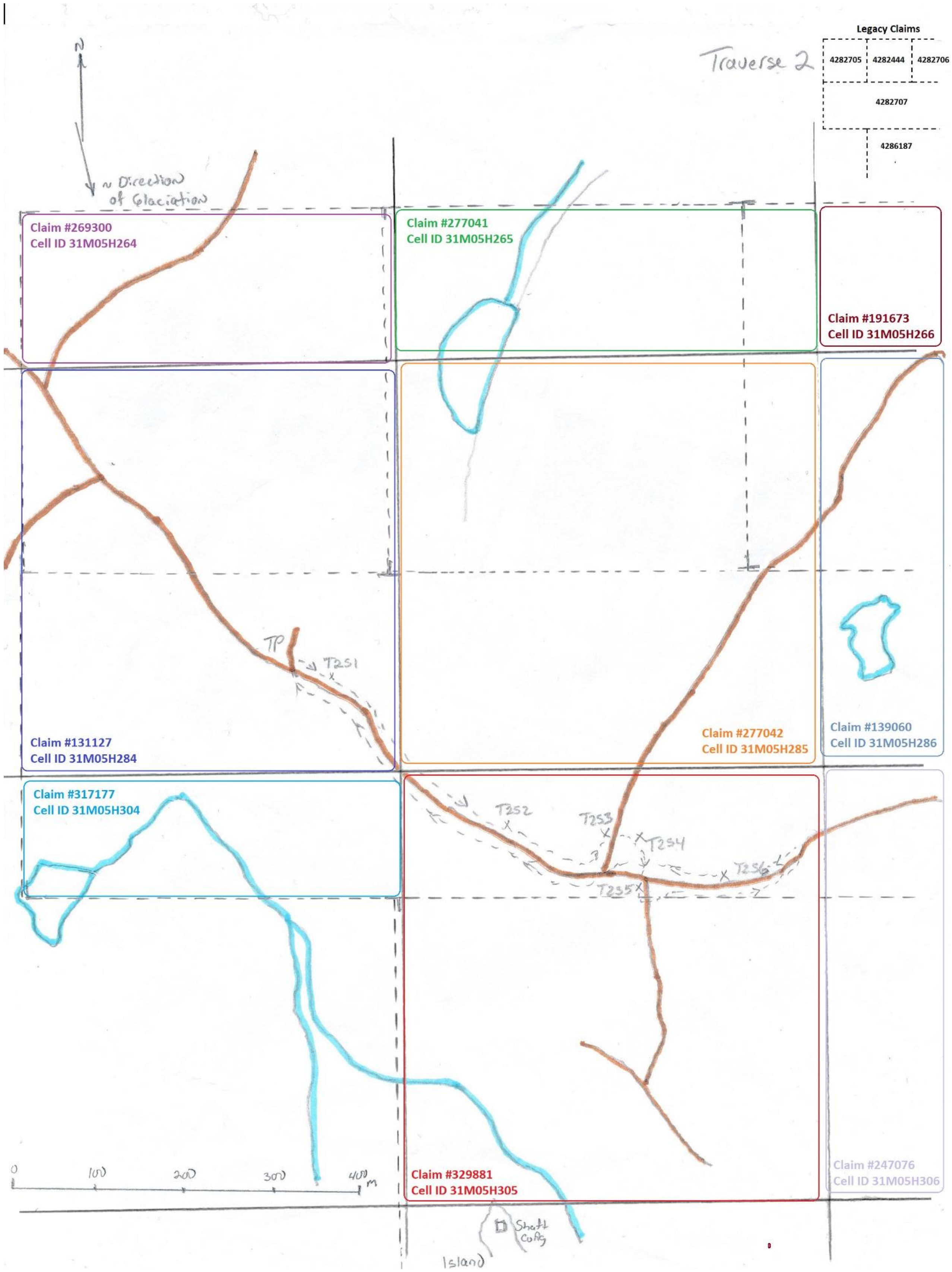
Appendix 5

**L 4282444, L 4282707**

## Traverse 2: map

November 16, 2016

Brian A. (Tony) Bishop



Appendix 5

**L 4282444, L 4282707**

## Traverse 2: field notes November 16, 2016 Brian A. (Tony) Bishop

| Sample # | Coordinates<br>17T UTM | Weight | Activity/Description |
|---|---|---|---|
| T2S1 | 0605675_E<br>5245536_N | 4.1kg | Brown sand/gravel |
| T2S2 | 0605845_E<br>5245392_N | 3.9kg | Brown sandy gravel |
| T2S3 | 0605955_E<br>5245392_N | 3.6kg | Brown sandy gravel from deep pit by road |
| T2S4 | 0606000_E<br>5245380_N | 3.9kg | Fairly deep pit, 10-12' deep, ~15' across; sample taken from near the bottom; brownish sand/gravel |
| T2S5 | 0606006_E<br>5245332_N | 3.4kg | From a ~10' deep, fairly large pit dug beside the road' brown till – sand/gravel/rocks |
| T2S6 | 0606113_E<br>5245339_N | 2.7kg | Dark brown clay, sand, gravel from low-lying gully oriented towards Grassy Lake |

| Location # | Coordinates 17T UTM |
|---|---|
| Truck Park | 0605607_E/5245598_N |

| Claim # | Cell ID |
|---|---|
| 131127 | 31M05H284 |
| 329881 | 31M05H305 |

Appendix 5

**L 4282444, L 4282707, L 4286187**

## Traverse 3: fieldwork June 3, 2017 Brian A. (Tony) Bishop, Graeme Bishop

Following up on the high KIM counts from samples taken on Traverses 1 & 2, a new sample plan was drawn up which resulted in the staking of 4286187 prior to sampling. In addition to the diamond potential, Cobalt I and its predecessors expressed interest in certain and then all my claims. Doug Robinson and I were looking over Map 2052 (Ontario Department of Mines, 1964) and Doug looked at an area above Lightning Lake (Legacy claim 4281431). Doug is very knowledgeable about cobalt/silver and he said I should seriously consider staking the Nicol Lake Diabase Basin area for its similarity to the Silverfields Mine geology. This would also nicely tie together my other kimberlite targets to the south of 4282444. I again hired Mike Harrington to stake legacy claims 4286185, 4282186, and 4286187. These were recorded April 6th, 2017.

I then travelled back to the area down-ice of Grassy Lake with Graeme to resample close to some spots where I had found excellent KIM results. These locations had been chosen taking advantage of pits dug by heavy machinery and also areas where lower areas formed miniature valleys oriented in the direction of the lake, possibly from old water flows or from glaciation.

From where the truck was centrally parked we first walked the road's edge and often a short way into the bush in a northwest direction, prospecting and taking three samples (T3S1, T3S2, & T3S3). We then switched sides of the road and brought the samples back to the truck.

This was repeated in an easterly walk and finally to the south.

After carefully placing the samples, we headed home.

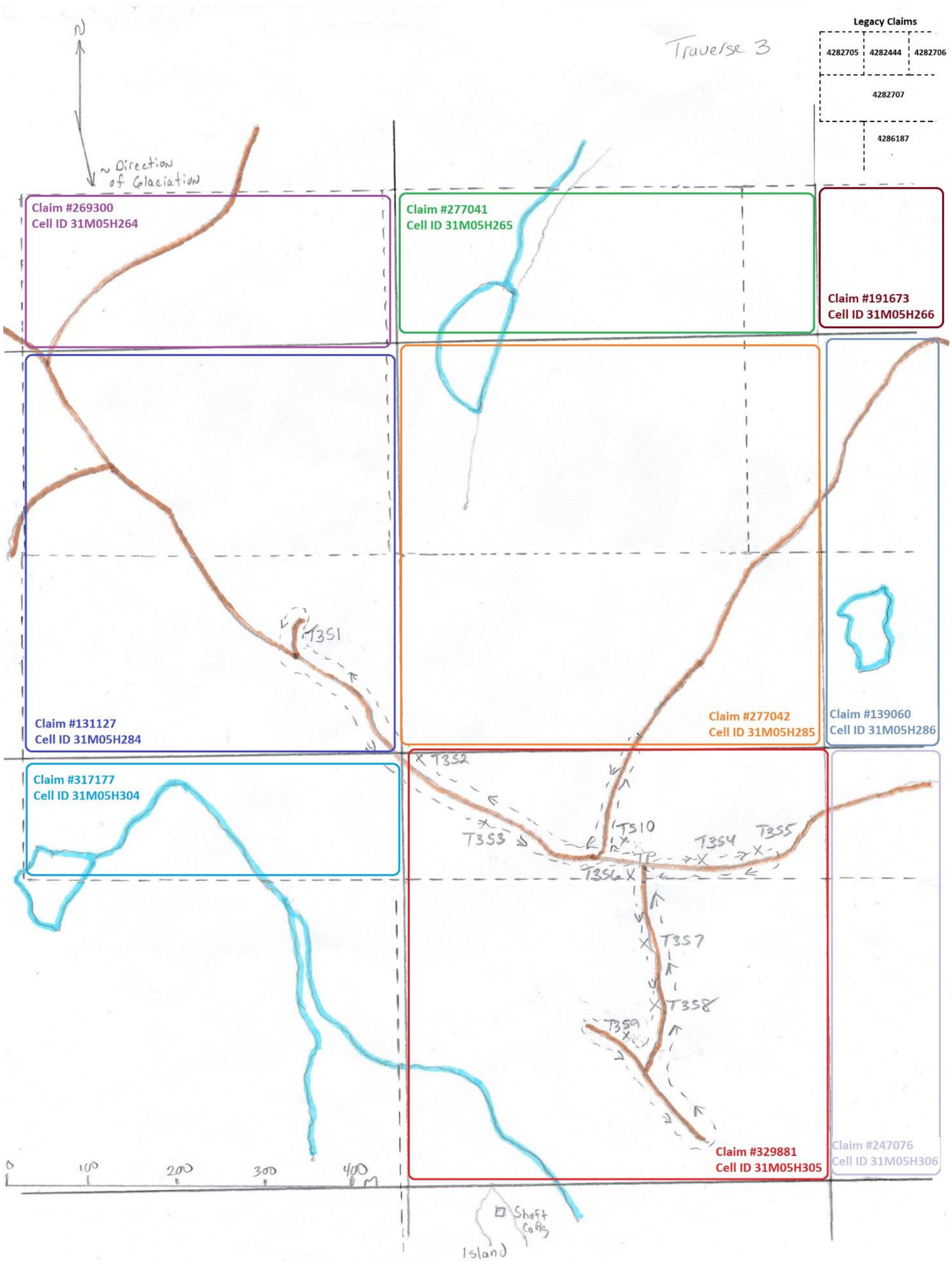
Appendix 5

**L 4282444, L 4282707, L 4286187**

## Traverse 3: map

June 3, 2017

Brian A. (Tony) Bishop, Graeme Bishop



Appendix 5

**L 4282444, L 4282707, L 4286187**

## Traverse 3: field notes June 3, 2017 Brian A. (Tony) Bishop, Graeme Bishop

| Sample # | Coordinates 17T UTM | Elevation | Weight | Activity/Description |
|---|---|---|---|---|
| T3S1 | 0605611_E 5245604_N | 316m | 5.9kg | Brown, sandy, gravelly |
| T3S2 | 0605759_E 5245459_N | 315m | 4.1kg | Brown, sandy, gravelly till |
| T3S3 | 0605837_E 5245387_N | 317m | 3.9kg | Brown, sandy, gravelly |
| T3S4 | 0606089_E 5245354_N | 328m | 3.8kg | Medium brown, sandy, gravelly, with bits of clay from a dug out area beside road, tightly packed big boulders, hard to sample; old creek bed? |
| T3S5 | 0606148_E 5245365_N | 331m | 5.4kg | Darker brown, clay sand/gravel from nearby where T2S6 was taken from |
| T3S6 | 0606000_E 5245328_N | 325m | 4.1kg | Darker brown, sand/gravel |
| T3S7 | 0606027_E 5245257_N | 325m | 3.6kg | Darker brown, clay sand/gravel |
| T3S8 | 0606033_E 5245183_N | 326m | 5.9kg | Sand/gravel till, grayish brown |
| T3S9 | 0606006_E 5245135_N | 323m | 4.5kg | Wet blue/grey clay/rocks |
| T3S10 | 0605992_E 5245390_N | 326m | 3kg | From pit where T2S4 was taken from |

| Location # | Coordinates 17T UTM |
|---|---|
| Truck Park | 0606006_E/5245339_N |

| Claim # | Cell ID |
|---|---|
| 131127 | 31M05H284 |
| 277042 | 31M05H285 |
| 329881 | 31M05H305 |

Appendix 5

**L 4282444, L 4286187**

## Traverse 4: fieldwork   July 20, 2017   ODM Collection   Brian A. (Tony) Bishop, David Crouch (P.Eng)

Due to excellent results in previous sampling, I decided to resample down-ice of Little Grassy Lake in a similar manner as Traverse 3. The purpose was to take a number of samples from nearby the previous locations and send them to Overburden Drilling Management (ODM). Nine till samples were collected by David Crouch (P.Eng) and his assistant Grant Morgan for ODM and nine till samples were collected by me close to and at the same depth as the other samples. Time was also spent prospecting along the way.

After David and Grant took a sample, I took another from nearby. T4S2 was taken from a one metre deep ditch, into which we then dug a ~2' deep hole to collect the sample. In the hole I dug, I encountered a soccer ball-sized decomposed boulder with a greenish hue that looked the same as several of the kimberlite specimens at the Kirkland Lake Mine's office. The boulder crumbled with the pressure of the shovel and water was quickly filling up the hole. I bagged it separately and took another till sample nearby.

When taking a sample near T4S7 in the 12' deep pit, my shovel broke a crumbly rock which I suspected was a kimberlite and I bagged it separately [see Photo L below]. Since then I've looked closer and showed it to other knowledgeable people, and it does appear to be a kimberlite.

As is best for local sampling [see Diagrams R & S, page 81], David and I washed each of his samples to remove silt and screened to -6 mesh. Each sample was then partially dried over several days to a damp consistency in order to be able to create a homogenous concentrate when mixed. Then ~+- 1.0kg was removed from each sample to create close to ideal 10kg. I then put this into an industrial tumbler for ½ hour. This mixture was then bagged and carefully packaged to send to ODM. An identical split was kept by me to concentrate as a comparison. My split-half has been concentrated but still requires the time-consuming KIM picking and sorting under the microscope. Findings will be included in a subsequent report. The nine samples I took were individually concentrated and picked by me at a later date.

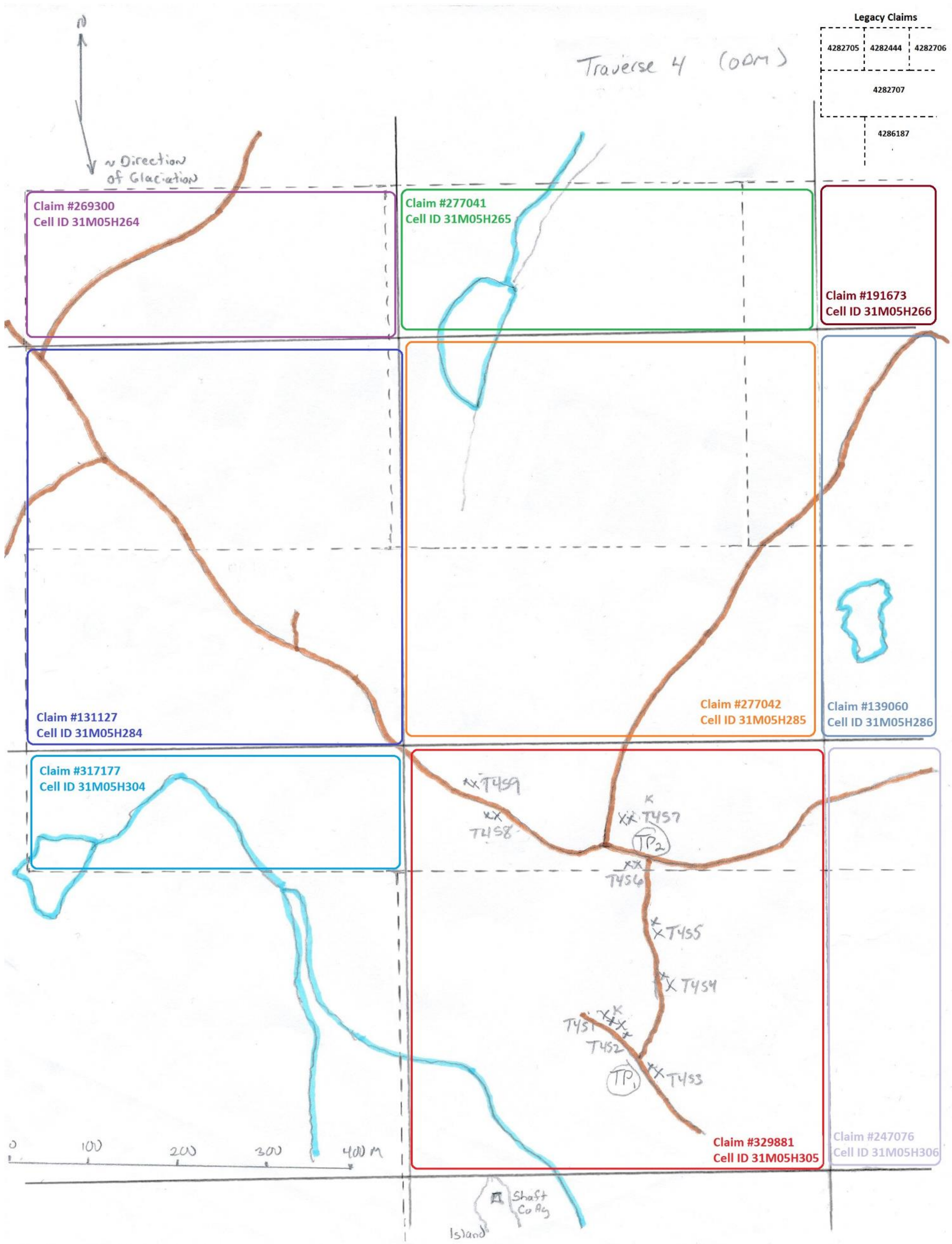
One day prep time to split, screen, remove silt, and dry and bag ODM samples for shipping.

*Photo L: kimberlite found on T4S7, 0.272kg*

Appendix 5

**L 4282444, L 4286187**

**Traverse 4: map** July 20, 2017 ODM Collection Brian A. (Tony) Bishop, David Crouch (P.Eng)



Appendix 5

**L 4282444, 4286187**

## Traverse 4: field notes July 20, 2017 ODM Collection Brian A. (Tony) Bishop, David Crouch (P.Eng)

All samples were doubled up close to each other by David Crouch (for ODM samples) and a control by me.

| Sample # | Coordinates 17T UTM | Tony's Sample Weights | David's Sample Weights | Activity/Description |
|---|---|---|---|---|
| T4S1 | 0605978_E 5245157_N | 3.9kg | 4.1kg | Light brown clay |
| T4S2 | 0606000_E 5245148_N | 4.1kg (kimberlite) | 2.7kg | Wet blue/grey clay/rocks |
| T4S3 | 0606044_E 5245101_N | 2.3kg | 2.9kg | Brown sandy gravel |
| T4S4 | 0606045_E 5245200_N | 2.5kg | 3.2kg | Grey/brown sand/gravel |
| T4S5 | 0606038_E 5245255_N | 2.7kg | 3.2kg | Brownish sand/gravel |
| T4S6 | 0606005_E 5245331_N | 2.9kg | 3.6kg | Brown sandy gravel pit ~10' deep for road fill beside road |
| T4S7 | 0605995_E 5245389_N | 4.1kg (kimberlite) | 3.2kg | Brown till, pit ~12' deep for road fill |
| T4S8 | 0605847_E 5245386_N | 2.5kg | 2.7 | Brown sand/gravel |
| T4S9 | 0605820_E 5245419_N | 2.3kg | 2.5kg | Brown sand/gravel |

| Location # | Coordinates 17T UTM |
|---|---|
| Truck Park 1 | 0606021_E/5245120_N |
| Truck Park 2 | 0606011_E/5245337_N |

| Claim # | Cell ID |
|---|---|
| 329881 | 31M05H305 |

Appendix 6

# Methodologies for Field Work and Till Sample Processing

**PREFACE:**

Diamond exploration is unlike that for any other mineral resource. Search areas are 'limited' to ancient 'cratons' (such as the 'Canadian Shield') which in themselves are vast areas. Geological maps are, in a general sense, of little to no use, as economic kimberlite pipes, relatively small circular to semi-circular, vertical volcanoes, when found may have no direct correlation to local rock types, although locating faults and contacts between different rock types, such as granite/diabase, can be very useful once a kimberlite field has been located by geophysics or till sampling.

**Locating a pipe is largely a matter of detective work**. Typically, mag maps have been utilized in the search for magnetic 'bulls-eyes' which are then, as funds permit, drilled to see if it is kimberlite or some other magnetic target. **However, in Canada so far most of the production pipes have little to no magnetic signature**. As well, EM surveys often don't work for the same reason, as is also true of gravity surveys (i.e. no detectible mag, EM, or gravity anomaly). [See Appendix 3]

**Soil sampling, either in till or streams, is the simplest and most common method of looking for kimberlites**. In fact, though, the search is not directly for diamonds but for kimberlite indicator minerals (KIMs), which include certain garnets, chrome diopsides, ilmenites, chromites, zircons and others.

Stream sediment surveys are for larger scale drainage basins to initially locate KIMs. Till sampling should be then utilized to best zero in on a pipe's location.

These grains must be separated by utilizing their slightly greater specific gravity (SG) compared to most other minerals in the 'soil' samples. However, these grains are generally only 0.25mm to 2.0mm in diameter. This, and the very slightest difference in SG, make it very difficult to concentrate and recognize and pick KIMs from. Basically, commercial-grade microscopes, tweezers, and concentrators must be acquired at great initial cost with trained operators.

As a result, most exploration companies utilize a dedicated lab at a cost of $500 and up per sample for concentrating, visual identification and estimate of KIM grain numbers.

Old-fashioned gold panning for KIMs as one would with gold grains is next to impossible: gold has a specific gravity (SG) of ~20 and therefore is roughly 7 times heavier than the other soil and rocks in a sample. KIMs have an SG 3.3 to 4.3, only very slightly (i.e. <1.4 times) more than most other grains in a field sample. (Common non-KIMs have an SG of ~2.6 to 2.9). As well, size matters. Even experienced individuals can have trouble with separating gold grains the size of KIMs from till or stream gravels, and one basically cannot pan gold this size out of 'black sands', i.e. magnetite. Magnetite (SG of 5.2) is commonly found in kimberlites and hence is also found with KIMs, further complicating concentration of a sample, as magnetite is actually heavier.

| Specific Gravities | | | |
|---|---|---|---|
| | Gold | - | 19.3 |
| (KIM) | Magnetite | - | 5.2 |
| (KIM) | Zircon | - | 4.6-4.8 |
| (KIM) | Ilmenite | - | 4.3 |
| (KIM) | Garnet | - | 3.5-4.3 |
| (KIM) | Pyrope | - | 3.56 |
| (KIM) | Diamond | - | 3.52 |
| (KIM) | Cr. Diopside | - | 3.3 |
| (KIM) | Olivine | - | 3.3 |
| | Mica | - | 2.9 |
| | Dolomite | - | 2.85 |
| | Conglomerate | - | 2.8 |
| | Gabbro | - | 2.8 |
| | Calcite | - | 2.7 |
| | Granite | - | 2.7 |
| | Quartz | <= | 2.65 |
| | Feldspar | - | 2.6 |
| | Clay | - | 2.2 |

With the right equipment however, an individual with some background, specifically in placer-type deposits, can concentrate and pick KIMs from till samples.

To further complicate issues, due to a number of glaciations in Canada in different directions, samples must be taken from tens of metres to several kilometres down-ice (usually along the last glacial direction) of the potential kimberlite source. This requires the bulk of meaningful sampling to be done off claim, sometimes a long way off claim, which then cannot be applied for assessment work to maintain that claim in good standing. Direct sampling of a kimberlite target is only accomplished by bulk sampling with a large diamond drilling program, or if near surface, directly with heavy machinery (both very costly and permit-intensive).

These initial obstacles can only be overcome by a lone prospector with determination, knowledge, the use of a collection of specialized and costly equipment, and lots of time (and patience). Even for established commercial labs the bulk of the time and cost comes down to an individual meticulously picking KIMs with a pair of tweezers while viewing the concentrates from a sample under a microscope. This lengthy time-consuming process is such that if large numbers of indicators are encountered, only a portion of the sample is picked for KIMs in a lab and then averaged (i.e. ‘guesstimated’) to the full sample, possibly risking losing the few/any all-important G10s and other similar grains in the remaining portion.

**As such, this Appendix is rather lengthy and details largely the method of processing till and stream samples by the author and achieving meaningful results.**

## METHODOLOGY/OVERVIEW OF FIELD WORK & TILL SAMPLE COLLECTION:

Standard 38cm x 28cm sample bags are used for collecting till samples. Small shovels are used to dig a 1' to 3' deep hole below the humus line and the bags filled ½ to ⅔ full, taped shut, and labelled. When possible, the sample is screened through a 4-mesh screen (typically just creek samples), or if not, then larger rocks and roots are removed by hand. If a sample site is very near to the transport vehicle I just remove larger cobbles and take a larger sample to be screened later, before concentrating. In between samples the equipment is cleaned as well as possible to avoid cross-contamination. GPS coordinates are taken at each sample site and then recorded if not matching the prechosen map coordinates.

The base of logging roads is basically composed of till collected immediately adjacent to the road as it is constructed. This makes for a very useful till sampling location, namely the area beside the road where the heavy machinery dug down from several to 10+ feet deep. This creates the possibility to collect from a number of horizons at various locations without mechanized equipment, thereby increasing the possibility of finding KIMs.

Whereas most approaches initially involve a regional sampling survey and then trace up-ice to the possible target, I start with identifying a potential target based on structural, glacial, landscape features, and publicly available OGS reports. I then take multiple samples to determine the likelihood of my target hypothesis, down-ice and off-ice for comparison.

My intent is basically to determine kimberlite pipe/or not a kimberlite pipe, based on a visual identification and number of KIMs picked from my till sample concentrates, and EMP analysis of an affordable minimal # of grains selected and sent for lab analysis. Interestingly, a number of exploration companies as well as ODM in Nepean have stated (within the last 5 years) that visually picked KIM grains and total number of KIMs are their criteria for continued interest in an area rather than analysis of grains. ODM said recently in an email that most companies have been adopting this approach (from personal research it also appears that many of the most successful companies at finding new discoveries of diamondiferous kimberlite pipes now are looking for non- to low-mag and EM targets utilizing gravity surveys, which do not always produce usable results, and finally results in till sampling for KIMs as the primary prospecting tool), especially in a region with known kimberlites.

In their sampling programs, OGS Open File Reports on Alluvium Sampling Surveys recommend creek samples for a far more pre-concentrated material for heavy minerals including KIMs (not for some distance down-ice/water flow of a lake due to its being a heavy mineral trap), and so recommend to "maximise the distance between the sample site and the lake", so I then thought that this is not true if the lake (heavy trap) is the source of KIMs. Large distances between sample spacing and large 10-30kg samples however, are more applicable to doing regional surveys while hunting for a 'target', i.e. in this case a kimberlite pipe. Also, creeks are rarely conveniently placed directly down-ice of a pipe-sized target (in Canada typically 50-200m in diameter) and they concentrate material from a large area, so when sampled can strongly skew results to high numbers of KIMs compared to till samples. In my case, where the lake itself is a potential kimberlite pipe, I take many (5-20) small 1-3 kg unscreened till samples, relatively closely spaced, from between ±50 to 1000 metres down-ice of the target, and generally combine the results into one larger sample, creating a more representative sampling of post-glacial conditions for emplacing KIMs into till.

As you can see, due to the lake being a heavy mineral trap for material up-ice/water flow, all the samples I take from 'close' proximity down-ice/water flow can in all probability be attributed to that lake (or in theory, a hidden pipe in very close proximity down-ice of the lake). So, any of these samples below a proposed pipe can individually or collectively statistically be attributed to this discrete target. Taking many smaller till samples from various locations down-ice was deemed appropriate to mitigate the extreme nugget effect caused by KIMs potentially being restricted to thin stratigraphic horizons in the till.

Side View – Till Sampling Program

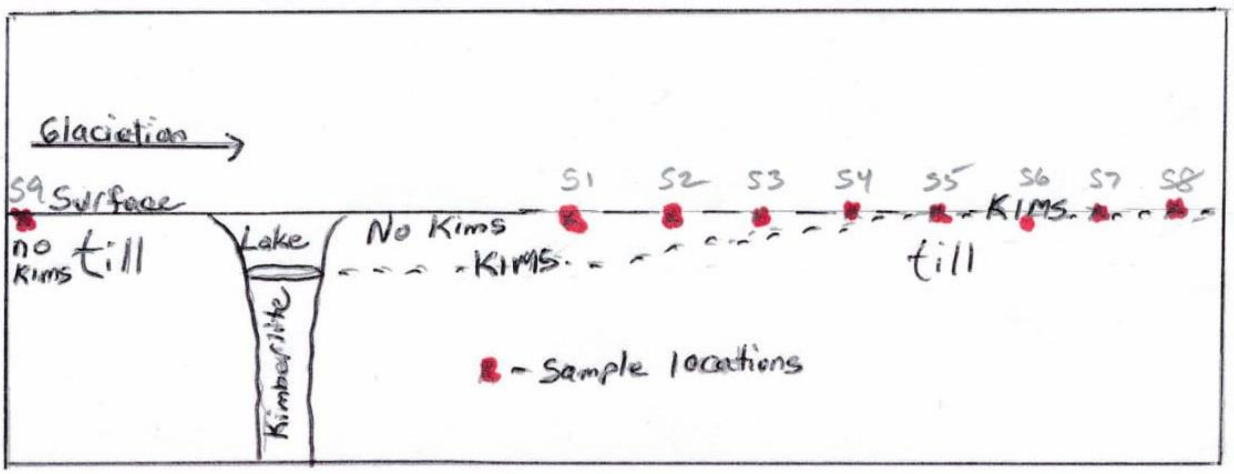



*Diagram R*

- If only S1 and/or S2 and/or S3 and/or S4 in till were sampled, one would find no KIMs and conclude no kimberlite up-ice
- If any one of S5, S6, S7, or S8 were sampled one might get favourable results for KIMs
- If the S1 ↔ S8 results, after concentrating and picking KIMs, are combined to a single larger sample result the chance of finding KIMs increases dramatically even though only 'one' or more samples contained KIMs initially. This is demonstrably more efficient and accurate at predicting proximity to a kimberlite pipe than only one larger sample would do
- Up-ice, S9 is a check and should statistically contain little to no KIMs
- Further sampling can then help verify/delineate the source of the KIMs

Top View – Till Sampling Program

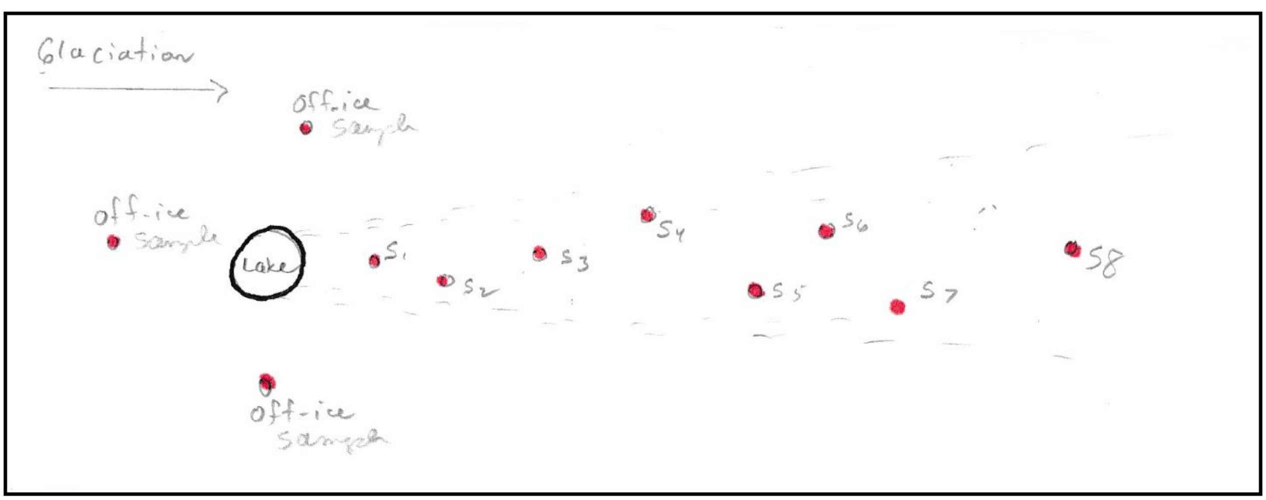



*Diagram S*

- Same as Diagram R, with off-ice samples containing little-to-no KIMs if lake is a kimberlite pipe

My blended till samples increases finding one or more that are confined to the appropriate KIM emplacement zone: I concentrate off-ice samples individually/separately. When KIM counts in off-ice samples drop to very few to zero, it adds to the probability of a favourable target location.

After concentrating the individual till samples, picking KIMs is done under a variable power binocular microscope with multiple lighting arrangements. I try to pick all KIMs, unless, as in some cases, they are in the thousands, then numbers are estimated. This of course takes many hours to days (sometime weeks) of work, especially when photographing and entering the photos into the computer correctly labelled, along with many hours of research identifying unusual/uncommon grains.

Also, to maximize local topography in the field, my knowledgeable samplers or I can make on the spot decisions in the field to sample near but not on my pre-planned coordinates (e.g., an upended tree root nearby etc.), and GPS coordinates are accepted by field workers as possibly being $\pm$ 10-50 metres off on any given day.

The up-ice samples are processed separately and considered separately. This initial sampling program was performed to obtain a yes/no probability of my target hypothesis. Additional sampling program(s) help further delineate these preliminary results.

Included in picking pyrope garnets are red, pink, and purple colours. Typically, Cr pyrope (by definition) garnets, in most literature, are considered to be red (colour comes from enhanced chromium and/or iron content) or purple depending on the article; however, McLean et al (2007) shows that the colours in the Canadian Diavik Mine A154-S kimberlite pipe garnets, in order of Chromium content which is important for diamond exploration, are as follows:

- "Orange xenocrysts have <1 wt.% $Cr_2O_3$, and are inferred to have eclogitic derivation
- There is a general increase in Cr content from orange → red → pink → purple. A similar trend may be seen in the data of Hawthorne et al. (1979) for garnets from the Dokolwayo kimberlite and Hlane paleoalluvial deposits in Swaziland
- Red grains increase in Cr from light → dark red
- Purple xenocrysts are more likely than pink or red to be harzburgitic (G10 or G10D), but colour alone cannot be used as a definitive test"

Pink garnets, however, are not commonly mentioned in diamond exploration literature. In samples from Canadian kimberlites, the Cr content of the pink-purple garnets seem to exceed that of the darker purple garnets when tested at the lab in Sudbury (verbal communication, Dave Crabtree, Geoscience Lab), (McLean et al, 2007), (Grutter et al, 2004); therefore, I am including pink garnets in pyrope garnet counts. This is, of course, subject to change as I continue to sample and have picked garnet grains analysed.

From reading a great number of articles it seems that there is no definitive rule concerning kimberlite minerals, colours of G10s can vary, some diamond pipes have no G10s at all and many other differences also occur. The differences are so numerous and interesting that a future paper or book could be compiled. A certain part of these findings will be presented in this report when applicable to certain claims.

In targeting and evaluating potential kimberlite pipes it is important also to note an article on 'Following kimberlite indicator minerals to source' in GSC OF-7374, "**The corollary for exploration at Chidliak is that any source of high garnet counts in sediment samples is considered worthy of pursuit, regardless of garnet compositions**" (Pell et al, 2013, p 51). With that in mind, if I attempt to normalize my results vs. sample size as compared to say, the OGS-OF report 6088 (see p 13 & 17), taking into account my samples were unscreened (until processed in the sluice and/or GoldCube®), the number of KIMs I picked could be averaged up a considerable amount in quantity.

Of course, while till sampling a large part of the day/traverse is spent investigating boulders by removing moss, etc. and in this case specifically looking for kimberlite boulders (which have been located on 2 claims so far with other possible grain sized pieces that might be) or other interesting rocks with mineralization. Because this target and sampling area is in and down-ice of a large expanse of diabase, nearly all boulders and outcrops are diabase with minor amounts of granite, dolomite, etc. As stated earlier, oversize from the sluice is bagged and viewed as time permits. No attempt will be made to identify every possible cobble if it is well worn and unrelated to kimberlite prospecting.

So… I'm sampling unconsolidated till, down-ice of a heavy mineral trap (lake) and taking comparatively small samples and getting high to very high in KIM anomalous results, which in classic teachings should result in poor→ no results. Unless of course the heavy mineral trap (lake) is the source of the heavy minerals.

## METHODOLOGY FOR PROCESSING TILL SAMPLES: **Please also see Sluice Efficiency Test Results Chart [Appendix 7] and Flow Sheet for Concentrating and Retrieving KIMs from Till and Stream Samples [Appendix 8]**

**EQUIPMENT:**

**1) GOLDFINDER CUSTOM MADE SLUICE** *(since modified by the author for the efficient processing ~10 to 100+ lb soil samples, for initial kimberlite indicators / heavy mineral concentration)***:**

The Goldfinder sluice (see Equipment photo 1) is manufactured with aircraft grade aluminum in 3 sections, with sturdy fast connecting latches. It is 14' long, 14" wide, and has height adjustments at front and back of the top section, and front and back of the fully assembled sluice. From the manufacturer, it excels at saving very fine flour as well as coarser gold. The ability to save 90%+ of flour gold in any sluice is exceedingly rare [The Goldfinder sluice was tested extensively in the 1970s by designer and developer Wayne Loewen on the Saskatchewan River as well as in-house tests with known gold grains counted before and after running through the sluice]. (This particular sluice was rented from me by the then Resident Geologist Gerhard Meyer and District Geologist Gary Grabowski, both of the Kirkland Lake MRO, for testing for gold in eskers on the shores of Abitibi Lake). I determined that with certain beneficial modifications from stock it could also be very good at saving kimberlite indicator minerals (KIMs) from larger till samples.

Saving gold by gravity methods is comparatively easy as gold is about 7x heavier than indicator minerals or diamonds. To use the sluice to obtain a primary concentrate of KIMs, I removed the Hungarian riffles and the solid-backed 'miner's moss' carpet. I used a thicker, slightly more open-weave miner's moss, and overlying the miner's moss, a specific 4 mesh nylon classifying screen. This was cut to fit in the top of the sluice and overlaps the original grizzly bars to reduce the size of the feed material being concentrated prior to the miners' moss sections, and to spill the +4mm feed off the end of the top section which spills into a bucket and saved to visually check for kimberlites or other minerals of interest. A heavy duty ¾ HP submersible sump pump with a large flow rate replaced the 6 ½ HP Honda high pressure pump for a more correct water flow for the lighter material being run. This gave a 1" depth of water running above the top of the miner's moss. The sluice was run at a less steep angle than for gold to further enhance saving potential KIMs, with the first top section of the sluice adjusted to an angle with a drop of ½" over 36". The larger bottom section drops 3" every 5'. Great care must be exercised to level the sluice in the 14" width to provide an even water flow across its surface.

The modified sluice considerably reduced the original volume of material, but most importantly the modified wrap around spray bar [see Equipment photo in Appendix 10] blasts apart clay and other clumped material very quickly and the water flow then also quickly removes very fine silt, humus, and plant matter as well as +4mm rocks (previously, I would spend 1 – 2 hrs or more trying to break this clay and such by hand with various utensils and water spray, and afterwards would have to screen out the humus and then pan and classify with various screens). Efficiently saving the 1mm and smaller grains from clay/till strictly by hand methods is nearly impossible.

To test efficiency after the initial trial run using this equipment, I cleaned and kept separate the 4 carpet sections and the overflow of the sluice, which after further processing resulted in 25 separate samples of various meshes, and then checked the results under the microscope for indicators to determine if any losses were incurred and where. With this information, I was then able to make further modifications and retest to compare efficiencies which I continue to do and modify as needed.

The sluice concentrates <1.0mm are ran through the GoldCube® and the trays are cleaned (i.e. washed for concentrates). The rejects are saved and are again ran through the GoldCube®. The new rejects are discarded. Concentrates from the 1st and 2nd run are then blended and reran through the GoldCube®. The 1st tray is then cleaned and saved separately, as are the 2nd and 3rd trays. These rejects are then saved separately. These will all be dried and demagnetized and screened into a number of different mesh fractions, and these, if individually too large to directly pick for KIMs, are carefully panned to a manageable size. Although time consuming, this results in a very efficient and consistent method of concentrating till for KIMs and other heavy minerals.

Interestingly, many professional labs still list panning as the final concentration technique. This preliminary work was all necessary to determine the efficiency of sluicing till samples for KIMs and other heavy minerals with this particular sluice. Surprisingly, the first top section with no miner's moss had an interesting number of potential KIMs as well as a 1.5mm purple garnet in my sluice efficiency test. The next carpet had very many indicators, the next a sizable number of indicators, the final carpet and overflow had no KIMs or magnetite etc. that would typically comprise a heavy concentration [see Sluice Efficiency Test Results in Appendix 7].

**2) GOLDCUBE®:**

The GoldCube® is a 'new' and excellent concentrator built for gold, but after much testing I've discovered it works very well for kimberlite indicators minerals and is uncomplicated and easy to use. After numerous tests (much the same as for the sluice), I determined it is very efficient for smaller sized 1-4kg till/creek samples, after wet screening the samples to 1.0-2.0mm and <1.0mm which are ran through the concentrator individually. It has a very high recovery rate for <1.0mm heavy minerals and for removing virtually all the silt sized grains, and it's easy to clean after use. This piece of equipment has become indispensable and very efficient at concentrating individual till samples.

**3) TYLER PORTABLE SIEVE SHAKER:**

The Tyler sieve shaker (Equipment photo 2) is utilized for larger samples. For individual small samples, screening is done by hand with standard sieve screens and larger diamond screens.

**4) MANSKER JIG:**

I also acquired and compared the efficiency of using a Mansker Jig for concentrating till samples, as some labs and explorationists use this device extensively for this purpose. I purchased one Coleparmer 8" HHSS #40 sieve for KIMs, and one Coleparmer 8" HHSS #100 sieve for lamprophyre indicators. Based on my findings I have determined a preference for my sluicing and Goldcube® methodology, as this appears to be superior to the Mansker Jig in concentrating KIMs, more so when considering a several thousand US dollar price tag.

**5) CAMEL SPIRAL CONCENTRATOR:**

A Camel Spiral Concentrator, which is used by some commercial labs, was also tested for KIM concentrates and I found it to be the worst of the lot – essentially useless.

**6) HIGH-SPEED CENTRIFUGE:**

I acquired and tested a high-speed centrifuge to separate the final concentrate into specific gravity layers. The centrifuge only seems to work to an extent on the finest fraction of concentrates. For now I will continue to use a high quality pan for final concentrating.

**7) OTHER:**

I considered the use of Polytungstate for heavy liquid separation but at $2500 US for 500 ml and special licensing and equipment requirements to use this product I quickly nixed that idea.

**8) MICROSCOPE:**

After these steps the indicators are then visually picked out (or a number estimated, and/or photographed under the microscope if too many to pick out or count) from each fraction under a Nikon SMZ-2B 8-50x binocular microscope with the help of Pelco (ceramic or carbon-fibre tipped) medical grade tweezers, and colour correct LED lamps for top, left and right, and below lighting. LW and SW ultraviolet lamps are also used in conjunction with the microscope to further identify various mineral grains. I have also been researching and experimenting with the use of switching between incandescent, fluorescent, and LED light, as some/many kimberlite garnets are also rare colour-change garnets.

**9) PHOTOGRAPIC RECORDING:**

An extra but very important (and time consuming) step is to photograph many of the large/important/unusual potential KIM or other heavy mineral through the microscope ocular, recording the type, size, colour, etc. of each grain, and storing and labelling the images on the computer for later viewing or to aid when consulting with geologists and other experts in the field of mineralogy, especially as related to diamond exploration of which a number of interesting grains are represented in this report. Many photographs were taken for this claim of concentrates/various grains have been taken and stored. As well, when dealing with grains that are from 0.25 to <3.0mm in size, one simply cannot easily find a certain one in picked KIMs and show it to individuals to ascertain their potential importance, and once sent to a lab for microprobe analysis, important physical characteristics such as kelyphitic rims and physical wear are lost. Photographing all KIMs picked (or many representative grains if too numerous) also helps estimate total numbers in the sample.

**10) LIGHTING:**

Another useful tool for picking kimberlitic Cr Pyropes was discovered in my research.

> "Pyrope grains larger than 0.5mm and have a higher Cr content (Cr203) showed a metameric colour change from purplish in incandescent light to grey, blue-grey, or blue in daylight type fluorescent light (Springfield and Manslar, 1985) which is useful qualitative and for picking garnets with higher Cr content." (Carter Hearn Jr. (2004), p 481)

> "[A] color change garnet is an especially rare and valuable … garnet" (GemSelect (2018))

> "[A] color change garnet is one of the most rare, interesting, and unique of all gemstones." (AJS Gems)

> "Cr pyropes are picked at ODM by switching light sources (LED and Fluorescent) to find colour change garnets which are from this and other sources indication of kimberlitic chrome pyrope garnets" (personal communication)

Over the last several years, I've tried many (several dozen) types and colours of bulbs and a number of lamp configurations. The latest and so far best is a pair of desk-sized gooseneck LED lamps (Jansjö LED Lamp from Ikea) which gives a true colour image under the microscope and in a microphotography image, and a variable intensity ring light (AmScope – 144 Bright White LED Ring Light) that mounts directly onto the lower part of the microscope and provides a very white (daylight) illumination.

After finding a Cr Pyrope (pink → purple), I can switch from one light to the other separately.

The results are dramatic with a colour change from lilac-purple to grey.

**PREPARATION OF FIELD SAMPLES FOR SHIPPING TO LAB (ODM):**

Individual samples are washed to remove silt-sized particles and are wet screened to <4mm. These are then partially dried over several days until they are of slightly damp consistency. Each sample is thoroughly mixed and split into two 'identical' fractions of the same weight, bringing the ODM sample weight to their recommended 10 kg size. One fraction (half of each of the nine samples) is retained for concentration by me as a comparison check. The second fraction containing half of each of the four samples is put in a large tumbler and blended for one hour. For shipping, the blended till is placed in a clear garbage bag and then sealed in a white 'feed' bag which is then labelled for shipping to Overburden Drilling Management (ODM) for concentrating and KIM picking.

# Sluice Efficiency Test Results

Appendix 7

| **Overflow Chart: collected in stainless steel pan after exiting sluice** | | | |
|---|---|---|---|
| **Dry weight from sluice = 3160 grams** | | | |
| | **Screened dry weight (grams)** | **Magnetic portion (grams)** | **After panning dry weight (grams)** |
| -4+10 mesh = | 1469 | | 24 |
| -10+20 mesh = | 290 | 3 | 25 |
| -20+28 mesh = | 141 | 2 | 19 |
| -28+35 mesh = | 171 | 2 | 23 |
| -35 mesh = | 1058 | x | |
| **Total =** | **3129** | | |

| **Sluice Top: expanded metal over classifying screen – no carpet** | | | |
|---|---|---|---|
| **Dry weight from sluice = 940 grams** | | | |
| | **Screened dry weight (grams)** | **Magnetic portion (grams)** | **After panning dry weight (grams)** |
| -4+10 mesh = | 241 | 15 | 24 |
| -10+20 mesh = | 128 | 6 | 25 |
| -20+28 mesh = | 66 | 3 | 19 |
| -28+35 mesh = | 80 | 3 | 23 |
| -35 mesh = | 419 | x | |
| **Total =** | **934** | | |

| **Sluice 1: classifying screen over miner's moss** | | | |
|---|---|---|---|
| **Dry weight from sluice = 2860 grams** | | | |
| | **Screened dry weight (grams)** | **Magnetic portion (grams)** | **After panning dry weight (grams)** |
| -4+10 mesh = | 136 | 6 | 26 |
| -10+20 mesh = | 495 | 20 | 18 |
| -20+28 mesh = | 258 | 6 | 19 |
| -28+35 mesh = | 336 | 7 | 17 |
| -35 mesh = | 1610 | x | |
| **Total =** | **2835** | | |

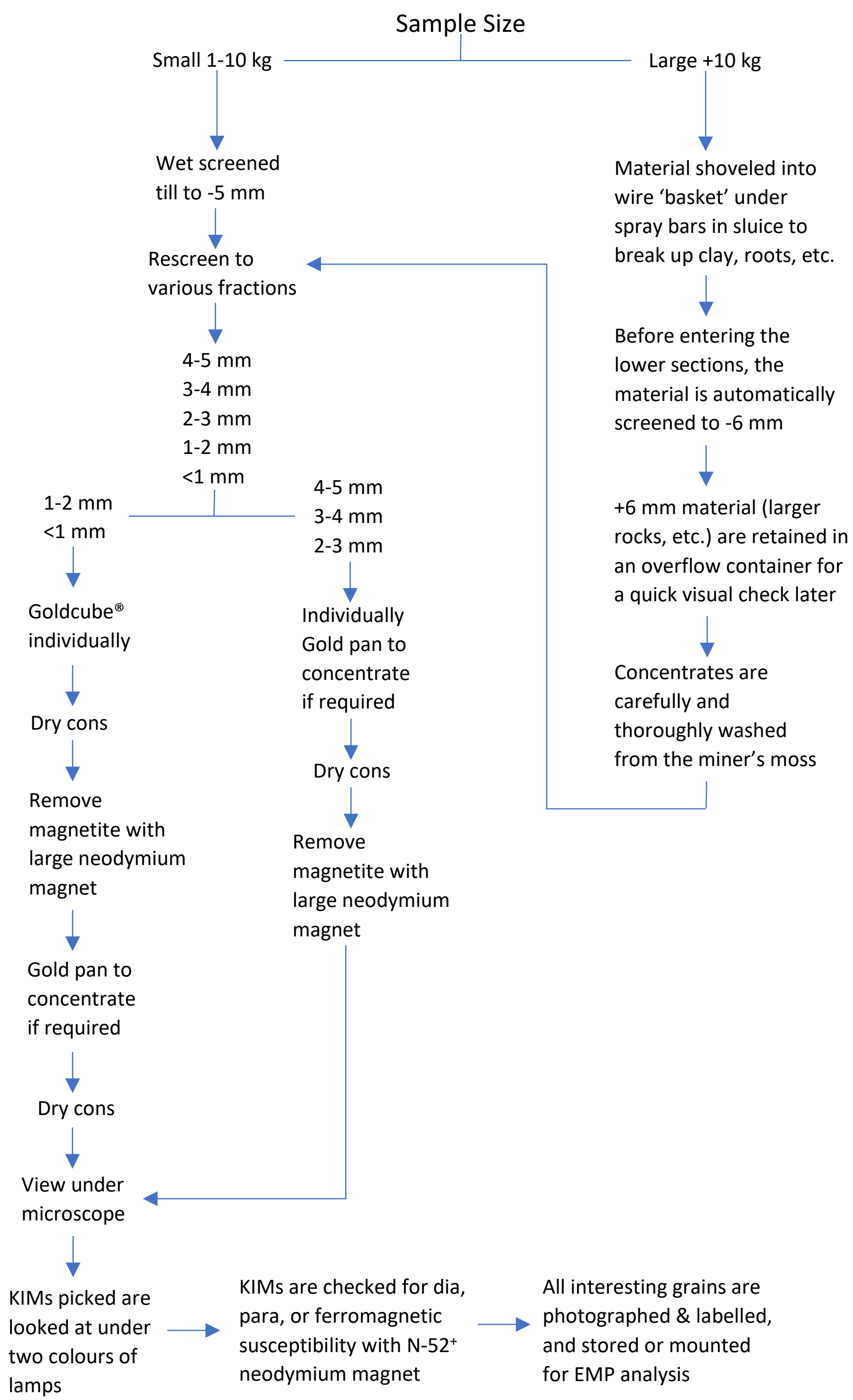
| **Sluice 2: classifying screen over miner's moss** | | | |
|---|---|---|---|
| **Dry weight from sluice = 3020 grams** | | | |
| | **Screened dry weight (grams)** | **Magnetic portion (grams)** | **After panning dry weight (grams)** |
| -4+10 mesh = | 29 | 1 | 22 |
| -10+20 mesh = | 269 | 8 | 18 |
| -20+28 mesh = | 248 | 6 | 20 |
| -28+35 mesh = | 359 | 7 | 17 |
| -35 mesh = | 2106 | x | |
| **Total =** | **3011** | | |

| **Sluice 3: classifying screen over miner's moss** | | | |
|---|---|---|---|
| **Dry weight from sluice = 2550 grams** | | | |
| | **Screened dry weight (grams)** | **Magnetic portion (grams)** | **After panning dry weight (grams)** |
| -4+10 mesh = | 220 | 10 | 15 |
| -10+20 mesh = | 441 | 13 | 17 |
| -20+28 mesh = | 198 | 5 | 16 |
| -28+35 mesh = | 210 | 4 | 16 |
| -35 mesh = | 1425 | x | |
| **Total =** | **2494** | | |

(note: slight differences in sluice and screen weights could be accounted for by moisture differences and loss during screening, tumbling, and container transfers, but are statistically inconsequential)

Appendix 8

# Flow Sheet for Concentrating and Retrieving KIMs from Till & Stream Samples



Appendix 9

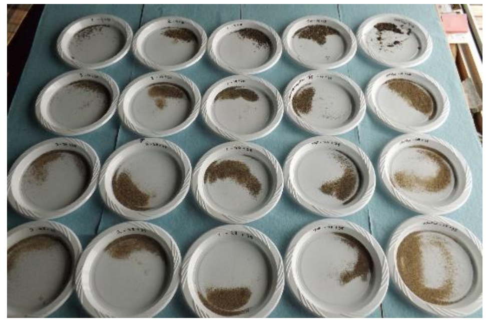
## Equipment List

- Mansker Jig
- Camel Spiral Concentrator
- Custom designed proprietary tube/spiral concentrator for fine to very fine material
- Diamond sieves
- Tyler – 8 sieve Motorized Portable Sieve Shaker
- Various test sieves from -4 to -100 mesh
- 12V and 120V and motorized water pumps for concentrators as needed
- Garrett Au Pans:  15" super sluice, 10"
- Keene's Engineering Au Pans: 14", 12", 10"
- Heavy duty 18" x 16" rubber panning tub
- Goldcube® fine Au/heavy mineral concentrator
- Goldspears (2 of) with extra 4' extensions for precious metal and magnetite soil testing, wet & dry
- Scintrex-Scintillation Counter Model BGS-1S
- Rock saws: 10", 18", 24", 36"
- Various metal/mineral detectors:  MineLab Pro-find Pinpointer, Garrett's BFO, ADS VLF 5khz, AT-Gold 15 khz, ATX multi-frequency pulse
- Goldfinder 14' aircraft aluminum collapsible sluice with ¾ hp 120V submersible pump, 6 ½ hp Honda pump, dredging (3") capability, custom designed Hungarian and expanded metal riffles, -4 mesh classifying screen
- Digiweigh digital scale, readability 0.1 gram
- Mettler PM30, 0-60lb, 0.1g scales
- Fujifilm Finepix SL, Nikon Coolpix digital cameras, custom microscope adapter for Coolpix
- Canon EOS Rebel SLR, with commercial microscope adapter
- Zeiss OPMI-1 stereo 4-25x microscope with thru the lens variable halogen lighting, 6' articulating boom stand
- Zeiss Jena 4-25x compound microscope with separate oculars to 80x
- Bristal 40-1000x microscope
- Nikon SMZ 2B continuously variable 8-50x microscope with adjustable boom stand
- Turnstile microscope viewing platform
- Diamond Selector II
- Superbright 2000SW and Superbright II LW370 portable ultraviolet lights /battery/120V
- Inova multi-wavelength LW UV LED flashlight
- Jansjö LED gooseneck microscope lamps
- AmScope 144 bright-white variable intensity ring light
- Clay-Adams high speed centrifuge
- 2" Neodymium magnet in waterproof ABS shell
- Weaker 4" x 6" flat magnet cut to fit Au pans
- Various shovels, auger, containers, compasses, GPS, maps, etc. as needed for soil/rock sampling
- Electronic pH tester and pH strips
- Toyota Tacoma 4x4
- 8' Boler, 14' Boler trailers/portable camps

# Equipment Photos

Appendix 10

1 - Goldfinder Sluice



1a - Panned and dried concentrates from sluice efficiency test ready to pick for KIMs under microscope

2 -Tyler motorized portable sieve shaker

3 - Goldcube®

4 - Variable speed industrial tumbler

5 - Microscopes

6 - 2-inch neodymium magnet

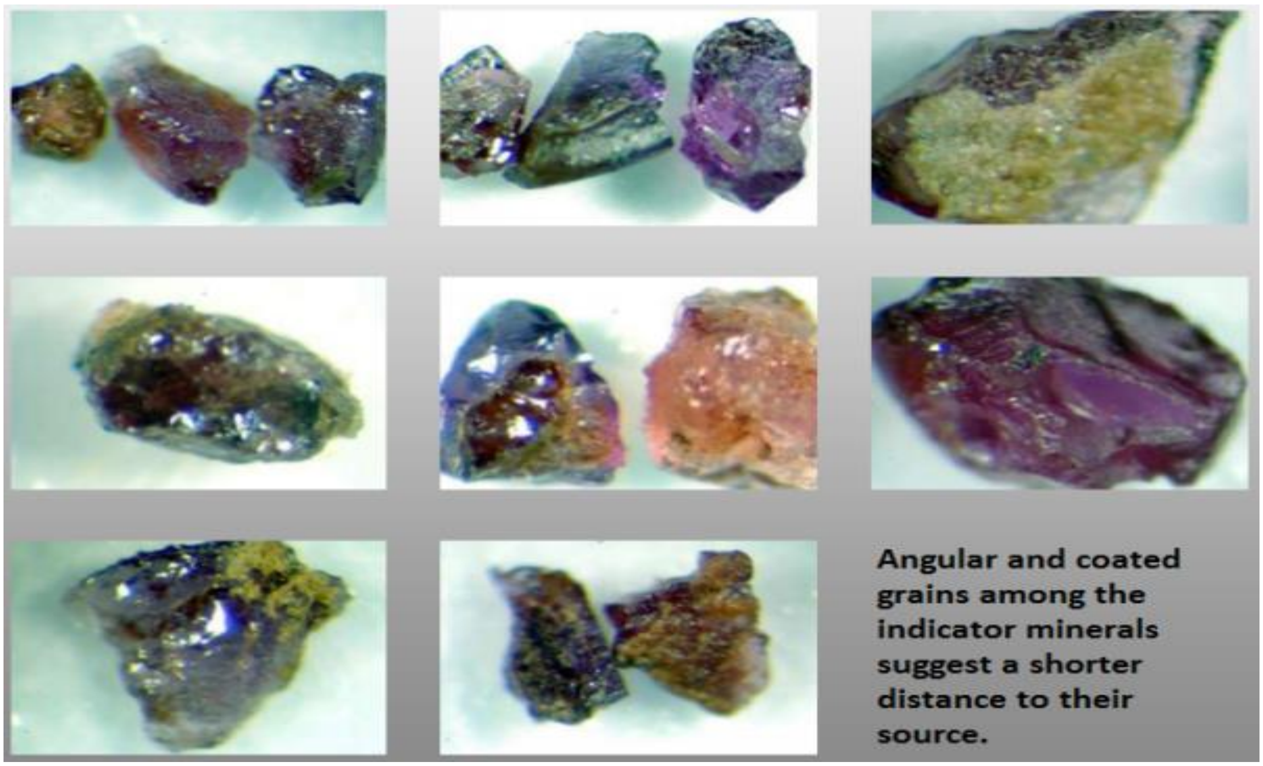
7 - Portable camp near claim

Appendix 11

## Reference Photos

"Angular and coated grains among the indicator minerals suggest a shorter distance to their source" ("Arctic Star Presentation", 2016, p13)

**Arctic Star and North Arrow Announce Drilling at Redemption Diamond Project**




"Studies of the indicator minerals from the South Coppermine train, some of which are imaged to the right, show very angular habits, some with soft alteration rims, (kelphyite for pyrope and lucoxene for ilmenite), all evidence for close proximity to source. Mineral grains lose their coats and become rounded as they travel down ice in the glacier. The angular/coated grains were most abundant at the head of the South Coppermine train. One grain with kimberlite attached was also noted." ("Arctic Star Presentation", 2016, p13)

Appendix 12

# Geoscience Labs – Certificate of Analysis & Invoice

Ontario

CERTIFICATE OF ANALYSIS

**GEO LABS**

**GEOSCIENCE LABORATORIES**

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| Issued To: | Mr. T. Bishop<br><br>440 Grenfell Rd<br>Swastika, ON P0K 1T0 Canada |
| Phone: | 705-642-3937 |
| Fax: | |
| Email: | bishop.ts@gmail.com |
| Client No: | 1599 |

| | |
|---|---|
| Certificate No: | CRT-17-0107-03 |
| Certificate Date: | 06/09/2017 |
| Project Number: | |
| Geo Labs Job No: | 17-0107 |
| Submission Date: | 06/06/2017 |
| Delivery Via: | Email |
| QC Requested: | Y |

**Method Code reported with this certificate: SEM-101**

| Method Code | Description | QTY | Test Status |
|---|---|---|---|
| EMP-100 | Microprobe Analysis / Grain | 1 | Completed |
| SEM-101 | SEM: Rental With Operator | 1 | Completed |

Please refer to the Geo Labs Job No. 17-0107 if you have any questions.

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**Date:** Sept 8 2017

Page 1 of 1

John Beals, GeoServices Senior Manager

Appendix 12

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# GEO LABS

## GEOSCIENCE LABORATORIES

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| Issued To: | Mr. T. Bishop<br><br>440 Grenfell Rd, RR#2<br>Swastika, ON P0K 1T0 Canada | Certificate No:<br>Certificate Date:<br>Project Number: | CRT-17-0107-04<br>22/09/2017<br> |
| Phone:<br>Fax:<br>Email:<br>Client No: | 705-642-3937<br><br>bishop.ts@gmail.com<br>1599 | Geo Labs Job No:<br>Submission Date:<br>Delivery Via:<br>QC Requested: | 17-0107<br>06/06/2017<br>Email<br>Y |

**Method Code reported with this certificate:** **EMP-100**

| Method Code | Description | QTY | Test Status |
|---|---|---|---|
| EMP-100 | Microprobe Analysis / Grain | 1 | Completed |
| SEM-101 | SEM: Rental With Operator | 1 | Completed |

REVISED
DATE: Sep 22/2017.
RE Certificate # CRT-17-0107-02

Please refer to the Geo Labs Job No. 17-0107 if you have any questions.

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John Beals, GeoServices Senior Manager

**Date:** Sept 22 2017

Page 1 of 1

Appendix 12

Ontario

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| Client No: | 1599 |

| | |
|---|---|
| Certificate No: | CRT-17-0279-01 |
| Certificate Date: | 02/10/2017 |
| Project Number: | |
| Geo Labs Job No: | 17-0279 |
| Submission Date: | 09/14/2017 |
| Delivery Via: | Email |
| QC Requested: | Y |

**Method Code reported with this certificate:** **EMP-100**

| Method Code | Description | QTY | Test Status |
|---|---|---|---|
| EMP-100 | Microprobe Analysis / Grain | 1 | Completed |

Please refer to the Geo Labs Job No. 17-0279 if you have any questions.

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**Date:** Oct 2 2017

Page 1 of 1

Except by special permission, reproduction of these results must include any qualifying remarks made by this Ministry with reference to any sample. Results are for samples as received.

Appendix 13

# Geoscience Labs – Results

**EMP-100:**

| | |
|---|---|
| **Client** | **Tony Bishop** |
| **Mineral** | **Garnet** |
| **Sample** | **Various** |
| **Job #** | **17-0107** |
| **Analyst** | **D. Crabtree** |
| **Analyst Approved** | **September 20th 2017** |

**GEOSCIENCE LABORATORIES REPORT**
**ELECTRON MICROPROBE ANALYSIS**
Data reviewed by Dave Crabtree

| Sample Label | SiO2 | TiO2 | Al2O3 | V2O3 | Cr2O3 | MgO | CaO | MnO | $FeO^t$ | Na2O | K2O | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cr-Pyrope Garnet Analyses** | | | | | | | | | | | | |
| **G10 Harzburgite Garnet (Grutter Classification)** | | | | | | | | | | | | |
| S-G74 | 41.683 | 0.010 | 20.756 | 0.023 | 4.499 | 22.088 | 3.284 | 0.410 | 7.065 | 0.016 | 0.000 | 99.834 |
| S-G83 | 42.142 | 0.017 | 21.101 | 0.019 | 4.059 | 21.869 | 4.078 | 0.413 | 6.779 | 0.017 | 0.000 | 100.494 |
| S-G91 | 40.929 | 0.026 | 19.480 | 0.029 | 5.713 | 20.867 | 3.765 | 0.377 | 8.595 | 0.018 | 0.000 | 99.799 |
| **G9 Lherzolite Garnet (Grutter Classification)** | | | | | | | | | | | | |
| S-G1 | 41.928 | 0.016 | 21.103 | 0.026 | 4.033 | 20.266 | 5.397 | 0.400 | 7.324 | 0.012 | 0.003 | 100.508 |
| S-G5 | 41.536 | 0.069 | 20.875 | 0.021 | 4.178 | 20.355 | 4.939 | 0.497 | 7.630 | 0.027 | 0.000 | 100.127 |
| S-G6 | 41.726 | 0.027 | 22.573 | 0.013 | 1.678 | 20.498 | 4.551 | 0.438 | 8.892 | 0.017 | 0.000 | 100.413 |
| S-G10 | 42.109 | 0.002 | 21.274 | 0.013 | 3.680 | 21.500 | 4.587 | 0.377 | 6.724 | 0.013 | 0.003 | 100.282 |
| S-G11 | 40.175 | 0.230 | 18.840 | 0.026 | 5.538 | 17.109 | 5.951 | 0.478 | 11.335 | 0.035 | 0.000 | 99.717 |
| S-G15 | 41.776 | 0.201 | 21.270 | 0.029 | 3.128 | 20.819 | 4.698 | 0.404 | 7.977 | 0.041 | 0.000 | 100.343 |
| S-G16 | 41.404 | 0.018 | 19.656 | 0.028 | 5.856 | 20.577 | 4.915 | 0.473 | 7.274 | 0.019 | 0.000 | 100.220 |
| S-G24 | 41.729 | 0.023 | 20.961 | 0.015 | 3.940 | 20.956 | 4.978 | 0.423 | 7.441 | 0.019 | 0.000 | 100.485 |
| S-G25 | 41.460 | 0.000 | 20.893 | 0.019 | 3.984 | 20.437 | 5.489 | 0.476 | 7.215 | 0.005 | 0.001 | 99.979 |
| S-G29 | 41.719 | 0.007 | 21.406 | 0.017 | 3.476 | 21.136 | 4.402 | 0.479 | 7.215 | 0.014 | 0.000 | 99.871 |
| S-G30 | 41.503 | 0.017 | 20.215 | 0.019 | 5.003 | 20.494 | 5.446 | 0.434 | 7.096 | 0.016 | 0.002 | 100.245 |
| S-G36 | 41.606 | 0.018 | 20.361 | 0.020 | 5.000 | 20.641 | 4.962 | 0.470 | 7.182 | 0.025 | 0.000 | 100.285 |
| S-G37 | 41.793 | 0.322 | 20.707 | 0.039 | 3.442 | 21.317 | 5.098 | 0.287 | 6.903 | 0.030 | 0.002 | 99.940 |
| S-G38 | 41.417 | 0.010 | 19.838 | 0.032 | 5.016 | 18.963 | 5.786 | 0.489 | 8.566 | 0.010 | 0.001 | 100.128 |
| S-G40 | 41.701 | 0.193 | 19.902 | 0.033 | 5.028 | 20.928 | 4.995 | 0.356 | 7.049 | 0.043 | 0.000 | 100.228 |
| S-G41 | 41.636 | 0.228 | 20.473 | 0.024 | 3.980 | 21.250 | 4.802 | 0.392 | 7.312 | 0.046 | 0.000 | 100.143 |
| S-G42 | 41.890 | 0.105 | 20.707 | 0.028 | 4.167 | 20.214 | 5.370 | 0.399 | 7.368 | 0.018 | 0.000 | 100.266 |
| S-G47 | 41.392 | 0.199 | 19.758 | 0.034 | 5.005 | 19.983 | 5.281 | 0.436 | 8.052 | 0.044 | 0.000 | 100.184 |

All concentrations are reported as wt%.

| Sample Label | SiO2 | TiO2 | Al2O3 | V2O3 | Cr2O3 | MgO | CaO | MnO | $FeO^t$ | Na2O | K2O | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-G48 | 41.823 | 0.131 | 21.166 | 0.029 | 3.545 | 20.549 | 4.863 | 0.460 | 8.058 | 0.022 | 0.002 | 100.648 |
| S-G49 | 41.206 | 0.034 | 19.937 | 0.024 | 5.113 | 20.139 | 5.461 | 0.439 | 7.403 | 0.017 | 0.000 | 99.773 |
| S-G50 | 41.392 | 0.004 | 20.500 | 0.031 | 4.361 | 20.182 | 5.593 | 0.423 | 7.696 | 0.006 | 0.000 | 100.188 |
| S-G51 | 41.411 | 0.045 | 21.135 | 0.012 | 3.717 | 20.487 | 4.885 | 0.513 | 7.675 | 0.026 | 0.001 | 99.907 |
| S-G52 | 41.938 | 0.145 | 21.202 | 0.037 | 3.486 | 20.141 | 4.947 | 0.409 | 8.014 | 0.027 | 0.000 | 100.346 |
| S-G64 | 41.903 | 0.040 | 20.716 | 0.026 | 4.495 | 20.754 | 5.220 | 0.402 | 7.244 | 0.016 | 0.000 | 100.816 |
| S-G65 | 41.437 | 0.197 | 19.624 | 0.038 | 5.553 | 20.689 | 5.265 | 0.396 | 7.063 | 0.037 | 0.000 | 100.299 |
| S-G66 | 41.859 | 0.087 | 21.601 | 0.021 | 3.016 | 20.770 | 4.634 | 0.403 | 7.960 | 0.022 | 0.002 | 100.375 |
| S-G67 | 41.066 | 0.320 | 18.159 | 0.025 | 7.077 | 20.068 | 5.831 | 0.379 | 6.983 | 0.040 | 0.000 | 99.948 |
| S-G68 | 41.768 | 0.043 | 21.777 | 0.031 | 2.836 | 20.080 | 5.030 | 0.393 | 8.451 | 0.017 | 0.000 | 100.426 |
| S-G69 | 41.530 | 0.173 | 19.667 | 0.033 | 5.482 | 20.247 | 5.293 | 0.425 | 7.422 | 0.044 | 0.000 | 100.316 |
| S-G70 | 41.382 | 0.097 | 19.462 | 0.020 | 5.673 | 20.360 | 5.528 | 0.443 | 7.222 | 0.031 | 0.003 | 100.221 |
| S-G71 | 41.412 | 0.066 | 20.628 | 0.022 | 4.183 | 19.342 | 5.800 | 0.581 | 8.397 | 0.016 | 0.000 | 100.447 |
| S-G72 | 41.289 | 0.102 | 19.620 | 0.029 | 5.599 | 20.507 | 5.391 | 0.442 | 7.134 | 0.029 | 0.000 | 100.142 |
| S-G75 | 41.079 | 0.002 | 19.948 | 0.024 | 5.155 | 19.497 | 6.385 | 0.481 | 7.247 | 0.009 | 0.001 | 99.828 |
| S-G77 | 41.383 | 0.005 | 19.975 | 0.031 | 5.052 | 20.504 | 5.488 | 0.422 | 7.331 | 0.015 | 0.000 | 100.206 |
| S-G80 | 41.298 | 0.090 | 19.228 | 0.043 | 5.653 | 20.267 | 5.683 | 0.364 | 7.399 | 0.023 | 0.000 | 100.048 |
| S-G81 | 41.550 | 0.094 | 20.943 | 0.025 | 3.855 | 19.930 | 4.953 | 0.465 | 8.400 | 0.024 | 0.000 | 100.239 |
| S-G84 | 41.347 | 0.000 | 20.916 | 0.020 | 3.747 | 20.100 | 5.208 | 0.506 | 8.039 | 0.013 | 0.000 | 99.896 |
| S-G90 | 40.920 | 0.047 | 19.879 | 0.019 | 5.116 | 19.037 | 5.711 | 0.573 | 8.330 | 0.026 | 0.001 | 99.659 |
| S-G93 | 41.128 | 0.084 | 18.771 | 0.040 | 6.828 | 20.239 | 5.396 | 0.450 | 7.128 | 0.010 | 0.000 | 100.074 |
| S-G94 | 40.699 | 0.208 | 19.110 | 0.031 | 5.984 | 20.344 | 5.144 | 0.430 | 7.529 | 0.047 | 0.000 | 99.526 |
| S-G96 | 41.056 | 0.202 | 18.569 | 0.034 | 6.389 | 20.215 | 5.720 | 0.376 | 7.221 | 0.028 | 0.000 | 99.810 |
| **G11 Hi-Ti Peridotitic Garnet (Grutter Classification)** | | | | | | | | | | | | |
| S-G17 | 41.268 | 0.807 | 18.398 | 0.054 | 5.169 | 19.570 | 6.396 | 0.303 | 8.064 | 0.032 | 0.000 | 100.061 |
| S-G22 | 41.330 | 1.014 | 17.583 | 0.046 | 6.727 | 20.524 | 6.135 | 0.273 | 6.696 | 0.060 | 0.000 | 100.388 |
| S-G92 | 41.535 | 0.658 | 19.707 | 0.040 | 4.495 | 21.091 | 5.267 | 0.303 | 7.206 | 0.061 | 0.000 | 100.363 |
| **G1 Low-Cr Megacryst Garnet (Grutter Classification)** | | | | | | | | | | | | |
| S-G45 | 41.804 | 0.468 | 21.449 | 0.034 | 1.818 | 20.562 | 4.605 | 0.323 | 8.880 | 0.048 | 0.003 | 99.994 |
| S-G8 | 42.153 | 0.694 | 22.048 | 0.039 | 1.223 | 21.071 | 4.604 | 0.324 | 8.513 | 0.067 | 0.001 | 100.737 |

All concentrations are reported as wt%.

| Sample Label | $SiO_2$ | $TiO_2$ | $Al_2O_3$ | $V_2O_3$ | $Cr_2O_3$ | MgO | CaO | MnO | $FeO^t$ | $Na_2O$ | $K_2O$ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **G12 Wherlitic Garnet (Grutter Classification)** | | | | | | | | | | | | |
| S-G89 | 39.707 | 0.054 | 20.229 | 0.041 | 3.341 | 14.980 | 6.444 | 0.697 | 14.028 | 0.006 | 0.000 | 99.527 |
| S-G95 | 40.189 | 0.042 | 17.663 | 0.062 | 7.221 | 16.088 | 7.901 | 0.652 | 10.165 | 0.003 | 0.001 | 99.987 |

All concentrations are reported as wt%.

| Sample Label | SiO2 | TiO2 | Al2O3 | V2O3 | Cr2O3 | MgO | CaO | MnO | $FeO^t$ | Na2O | K2O | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Crustal Garnet Analysis** | | | | | | | | | | | | |
| **Typical Spessertine Garnet Analysis** | | | | | | | | | | | | |
| S-G39 | 36.838 | 0.105 | 20.363 | 0.006 | 0.001 | 1.813 | 5.502 | 8.620 | 26.595 | 0.008 | 0.000 | 99.851 |

**Other Grains: Non Kimberlite Indicator Minerals (Not analysed)**

| | |
|---|---|
| S-G7 | almandine |
| S-G9 | almandine |
| S-G12 | almandine |
| S-G18 | almandine |
| S-G26 | almandine |
| S-G27 | almandine |
| S-G32 | almandine |
| S-G33 | almandine |
| S-G57 | almandine |
| S-G73 | andradite |
| S-G34 | andradite |
| S-G46 | fe-oxide |
| S-G55 | fe-oxide |
| S-G76 | K-Feldspar |
| S-G87 | Mg-Si-Fe alt oli? |
| S-G20 | peraluminous silicate |
| S-G44 | peraluminous silicate |
| S-G78 | peraluminous silicate |
| S-G79 | peraluminous silicate |
| S-G82 | peraluminous silicate |
| S-G60 | quartz |
| S-G4 | spessertine |
| S-G2 | spessertine |
| S-G13 | spessertine |
| S-G14 | spessertine |
| S-G23 | spessertine |

All concentrations are reported as wt%.

| Sample Label | SiO2 | TiO2 | Al2O3 | V2O3 | Cr2O3 | MgO | CaO | MnO | $FeO^t$ | Na2O | K2O | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-G43 | spessertine | | | | | | | | | | | |
| S-G58 | spessertine | | | | | | | | | | | |
| S-G61 | spessertine | | | | | | | | | | | |
| S-G85 | spessertine | | | | | | | | | | | |
| S-G86 | spessertine | | | | | | | | | | | |
| S-G3 | titanite | | | | | | | | | | | |
| S-G19 | titanite | | | | | | | | | | | |
| S-G21 | titanite | | | | | | | | | | | |
| S-G28 | titanite | | | | | | | | | | | |
| S-G31 | titanite | | | | | | | | | | | |
| S-G35 | titanite | | | | | | | | | | | |
| S-G53 | titanite | | | | | | | | | | | |
| S-G54 | titanite | | | | | | | | | | | |
| S-G56 | titanite | | | | | | | | | | | |
| S-G59 | titanite | | | | | | | | | | | |
| S-G62 | titanite | | | | | | | | | | | |
| S-G88 | titanite | | | | | | | | | | | |
| S-G63 | zircon | | | | | | | | | | | |

*changes made to labels:*

S-G2 (17-0107-P02-001) originally labelled as S-G12

SG-34 andradite was originally lebelled as epidote

Job # was originally listed as 17-0170

All concentrations are reported as wt%.

Appendix 13

GEO LABS
GEOSCIENCE LABORATORIES

Ontario

Q.C. NOTE TO ACCOMPANY ANALYTICAL RESULTS

| | |
|---|---|
| Client | : Bishop |
| Job # | : 17-0107 |
| Test | : EMP-100 |
| Sample # | : see below |
| Date | : September 21, 2017 |

**Please Note:**

Labelling errors discovered in the report for job 17-0107 by the EMP-100 test method have been corrected. Please see the attached revised report. If you would like additional work please contact Kayla Kalmo at (705) 670-5632 or email kayla.kalmo@ontario.ca.

Sincerely,

Jennifer Hargreaves,
Quality Assurance Coordinator

Appendix 13

**EMP-100:**

| | | |
|---|---|---|
| **Client** | **Tony Bishop** | **GEOSCIENCE LABORATORIES REPORT** |
| **Mineral** | **Various** | **ELECTRON MICROPROBE ANALYSIS** |
| **Sample** | **Various** | Data reviewed by Dave Crabtree |
| **Job #** | **17-0279** | |
| **Analyst** | **D. Crabtree** | |
| **Analyst Approved** | **September 28th 2017** | |

**Note that low totals in some of the analyses are the result of hydration in the mineral structure, or in the case of andradite are due to the presence of $Fe^{3+}$**

| Sample Label | SiO2 | TiO2 | Al2O3 | Cr2O3 | MgO | CaO | MnO | FeO | ZnO | Na2O | K2O | F | Cl | Y2O3 | La2O3 | Ce2O3 | Pr2O3 | Nd2O3 | Sm2O3 | Gd2O3 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Titanite (Rare Earth Elements and Halogens included)** | | | | | | | | | | | | | | | | | | | | | |
| S-G53 | 29.830 | 36.360 | 1.145 | 0.024 | 0.000 | 27.398 | 0.050 | 1.690 | 0.003 | 0.026 | 0.000 | 0.307 | 0.000 | 0.143 | 0.311 | 0.845 | 0.120 | 0.513 | 0.040 | 0.104 | 98.909 |
| S-G56 | 29.772 | 35.814 | 1.147 | 0.020 | 0.014 | 26.999 | 0.037 | 1.851 | 0.009 | 0.032 | 0.007 | 0.484 | 0.000 | 0.156 | 0.342 | 0.865 | 0.139 | 0.519 | 0.071 | 0.092 | 98.370 |
| S-G59 | 30.263 | 37.306 | 1.460 | 0.013 | 0.007 | 27.952 | 0.098 | 1.186 | 0.000 | 0.000 | 0.000 | 0.265 | 0.000 | 0.097 | 0.032 | 0.279 | 0.045 | 0.227 | 0.000 | 0.045 | 99.275 |
| S-G62 | 29.802 | 37.337 | 1.044 | 0.096 | 0.018 | 27.392 | 0.050 | 1.153 | 0.000 | 0.014 | 0.000 | 0.335 | 0.007 | 0.200 | 0.117 | 0.439 | 0.078 | 0.325 | 0.077 | 0.092 | 98.576 |
| S-G19 | 29.419 | 35.727 | 1.117 | 0.018 | 0.027 | 26.646 | 0.070 | 2.041 | 0.000 | 0.090 | 0.010 | 0.471 | 0.001 | 0.207 | 0.363 | 0.937 | 0.180 | 0.671 | 0.108 | 0.211 | 98.314 |
| S-G21 | 29.681 | 35.867 | 1.023 | 0.030 | 0.015 | 26.796 | 0.085 | 1.801 | 0.000 | 0.026 | 0.001 | 0.361 | 0.009 | 0.164 | 0.334 | 0.897 | 0.137 | 0.516 | 0.092 | 0.123 | 97.958 |
| S-G28 | 30.285 | 36.374 | 1.205 | 0.027 | 0.000 | 27.776 | 0.048 | 1.456 | 0.000 | 0.002 | 0.007 | 0.335 | 0.009 | 0.104 | 0.127 | 0.470 | 0.070 | 0.331 | 0.080 | 0.084 | 98.790 |
| S-G31 | 29.853 | 37.179 | 1.019 | 0.042 | 0.000 | 27.330 | 0.060 | 1.173 | 0.003 | 0.028 | 0.012 | 0.200 | 0.002 | 0.143 | 0.172 | 0.751 | 0.100 | 0.486 | 0.065 | 0.146 | 98.764 |
| S-G88 | 29.299 | 35.937 | 0.478 | 0.040 | 0.012 | 25.091 | 0.104 | 2.047 | 0.007 | 0.181 | 0.004 | 0.111 | 0.000 | 0.380 | 0.543 | 1.823 | 0.281 | 1.194 | 0.209 | 0.223 | 97.964 |
| S-G3 | 29.529 | 35.406 | 0.901 | 0.054 | 0.018 | 26.497 | 0.072 | 2.440 | 0.000 | 0.096 | 0.000 | 0.448 | 0.000 | 0.200 | 0.407 | 1.113 | 0.157 | 0.627 | 0.087 | 0.206 | 98.258 |
| S-G35 | 29.673 | 36.179 | 1.284 | 0.032 | 0.000 | 26.710 | 0.055 | 1.322 | 0.006 | 0.022 | 0.000 | 0.313 | 0.007 | 0.240 | 0.119 | 0.742 | 0.169 | 0.807 | 0.201 | 0.161 | 98.042 |
| S-G54 | 29.982 | 36.496 | 1.565 | 0.000 | 0.002 | 27.507 | 0.070 | 1.524 | 0.024 | 0.001 | 0.000 | 0.339 | 0.005 | 0.288 | 0.024 | 0.307 | 0.086 | 0.402 | 0.073 | 0.115 | 98.810 |
| **Almandine** | | | | | | | | | | | | | | | | | | | | | |
| S-G57 | 37.463 | 0.029 | 21.448 | 0.009 | 4.703 | 1.075 | 1.488 | 34.373 | 0.000 | 0.000 | 0.004 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.592 |
| S-G33 | 38.233 | 0.002 | 22.049 | 0.059 | 8.309 | 1.060 | 0.579 | 30.437 | 0.002 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.730 |
| S-G18 | 37.454 | 0.013 | 21.730 | 0.000 | 7.361 | 0.899 | 1.268 | 30.772 | 0.000 | 0.000 | 0.001 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.498 |
| S-G32 | 37.403 | 0.099 | 21.211 | 0.040 | 3.545 | 1.641 | 3.045 | 33.609 | 0.000 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.593 |
| S-G12 | 37.263 | 0.020 | 21.325 | 0.048 | 7.015 | 0.679 | 1.764 | 30.373 | 0.003 | 0.000 | 0.006 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.496 |
| S-G7 | 36.983 | 0.026 | 21.340 | 0.024 | 3.955 | 1.445 | 5.286 | 31.175 | 0.000 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.234 |
| S-G9a | 37.144 | 0.134 | 20.782 | 0.014 | 2.581 | 4.170 | 0.318 | 34.531 | 0.006 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.680 |
| S-G26 | 37.386 | 0.003 | 21.393 | 0.016 | 4.404 | 1.098 | 4.417 | 32.203 | 0.000 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.920 |
| S-G27 | 37.334 | 0.000 | 21.476 | 0.003 | 4.559 | 1.502 | 4.076 | 31.301 | 0.000 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.251 |
| **Andradite** | | | | | | | | | | | | | | | | | | | | | |
| S-G73 | 36.118 | 0.648 | 6.572 | 0.024 | 0.087 | 32.441 | 0.886 | 20.648 | 0.015 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 97.439 |
| S-G34 | 37.161 | 0.138 | 10.456 | 0.000 | 0.000 | 31.077 | 0.088 | 19.728 | 0.000 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.648 |
| **Spessertine** | | | | | | | | | | | | | | | | | | | | | |
| S-G39 | 37.043 | 0.109 | 20.390 | 0.001 | 2.038 | 5.760 | 8.385 | 26.561 | 0.000 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.287 |
| S-G4 | 35.863 | 0.077 | 20.404 | 0.000 | 0.761 | 0.936 | 13.878 | 27.914 | 0.021 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.854 |
| S-G13 | 35.716 | 0.069 | 20.075 | 0.001 | 0.367 | 0.486 | 25.392 | 17.323 | 0.059 | 0.006 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.494 |
| S-G14 | 35.409 | 0.108 | 19.825 | 0.000 | 0.823 | 1.248 | 19.794 | 21.264 | 0.000 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.471 |
| S-G23 | 35.927 | 0.208 | 19.988 | 0.000 | 0.971 | 0.660 | 19.327 | 21.998 | 0.013 | 0.034 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.126 |
| S-G58 | 35.346 | 0.191 | 19.925 | 0.001 | 0.503 | 0.220 | 28.457 | 14.303 | 0.024 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.970 |
| S-G61 | 35.773 | 0.026 | 20.863 | 0.002 | 0.884 | 0.616 | 25.809 | 15.635 | 0.015 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.623 |
| S-G2 | 35.661 | 0.200 | 20.016 | 0.000 | 0.771 | 0.565 | 23.078 | 19.098 | 0.012 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.401 |
| S-G85 | 35.731 | 0.102 | 19.994 | 0.000 | 0.291 | 0.718 | 21.550 | 21.495 | 0.048 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.929 |
| S-G86 | 36.042 | 0.111 | 19.948 | 0.000 | 0.362 | 0.894 | 25.171 | 17.574 | 0.043 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.145 |
| S-G43 | 35.640 | 0.035 | 20.224 | 0.009 | 0.893 | 1.030 | 17.628 | 23.617 | 0.011 | 0.028 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.115 |

All concentrations are reported as wt%.

Appendix 13

| Sample Label | SiO2 | TiO2 | Al2O3 | Cr2O3 | MgO | CaO | MnO | FeO | ZnO | Na2O | K2O | F | Cl | Y2O3 | La2O3 | Ce2O3 | Pr2O3 | Nd2O3 | Sm2O3 | Gd2O3 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stauralite** | | | | | | | | | | | | | | | | | | | | | |
| S-G78 | 27.283 | 0.607 | 54.209 | 0.048 | 1.847 | 0.000 | 0.330 | 13.122 | 0.191 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 97.637 |
| S-G20 | 27.446 | 0.604 | 53.586 | 0.102 | 1.886 | 0.000 | 0.271 | 13.308 | 1.038 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.241 |
| S-G82 | 27.022 | 0.549 | 54.851 | 0.062 | 1.796 | 0.014 | 0.271 | 13.600 | 0.231 | 0.000 | 0.009 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.405 |
| S-G44 | 27.124 | 0.523 | 54.921 | 0.039 | 2.485 | 0.011 | 0.322 | 13.187 | 0.147 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.759 |
| S-G79 | 27.619 | 0.657 | 53.688 | 0.064 | 1.920 | 0.001 | 0.371 | 13.717 | 0.326 | 0.000 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 98.363 |
| **Quartz** | | | | | | | | | | | | | | | | | | | | | |
| S-G9b | 100.919 | 0.010 | 0.000 | 0.000 | 0.008 | 0.010 | 0.001 | 0.365 | 0.000 | 0.000 | 0.006 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 101.319 |
| S-G60 | 100.238 | 0.000 | 0.139 | 0.003 | 0.005 | 0.000 | 0.000 | 0.102 | 0.005 | 0.000 | 0.054 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 100.546 |
| **Feldspar** | | | | | | | | | | | | | | | | | | | | | |
| S-G76 | 64.499 | 0.000 | 18.427 | 0.009 | 0.000 | 0.000 | 0.000 | 0.040 | 0.000 | 0.672 | 15.877 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 99.524 |
| **Aletered silicate (serpentine?)** | | | | | | | | | | | | | | | | | | | | | |
| S-G87 | 41.519 | 0.028 | 1.785 | 0.000 | 36.743 | 0.183 | 0.062 | 6.234 | 0.034 | 0.014 | 0.000 | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 86.602 |

All concentrations are reported as wt%.

**SEM-101:**

**GEO LABS**
**GEOSCIENCE LABORATORIES**

Ontario

# Mineralogy Report

Client Contact: Mr. Tony Bishop
GL Job Number: 17-0107
Test Group: SEM-101
Date: August 29, 2017

**Client Request:**

Thirty five grains were submitted for energy dispersive (ED) x-ray analysis with the SEM in order to determine if any of the grains classify as diamond.

The samples were mounted on double-sided carbon tape and analysed non-polished and non-coated. The analysis is therefore only collected at the surface of the grain. This sample preparation technique makes it possible to identify the elements present in the grain, however this approach is not ideal for quantitative analysis. These results are therefore qualitative in nature.

**Results:**

None of the samples submitted for analysis were positively identified as diamond. See Appendix 1 for table of results.

**Table 1.** Table of results.

| Grain # | ID |
|---|---|
| S-D1 | quartz |
| S-D2 | quartz |
| S-D3 | fe-oxide |
| S-D4 | silicate (almandine?) |
| S-D5 | silicate (epidote?) |
| S-D6 | silicate (epidote?) |
| S-D7 | quartz |
| S-D8 | quartz |
| S-D9 | quartz |
| S-D10 | calcite |
| S-D11 | calcite |
| S-D12 | calcite |
| S-D13 | calcite |
| S-D14 | quartz |
| S-D15 | quartz |
| S-D16 | quartz |
| S-D17 | quartz |
| S-D18 | quartz + organics? |
| S-D19 | quartz |
| S-D20 | silicate (epidote?) |
| S-D21 | quartz? |
| S-D22 | quartz+Fe-oxide or Fe-carbonate? |
| S-D23 | Fe-oxide |
| S-D24 | organic material |
| S-D25 | mainly halite + Al, Si, K, P, Ca |
| S-D26 | mixed silicate coated with organic material |
| S-D27 | silicate (epidote?) |
| S-D28 | organic material |
| S-D29 | zircon |
| S-D30 | quartz |
| S-D31 | silicate (epidote?) |
| S-D32 | quartz |
| S-D33 | silicate (epidote?) |
| S-D34 | silicate (epidote?) |
| S-D35 | quartz |

Appendix 14

# ODM Lab – Results

ODM
Exploring Heavy Minerals

Overburden Drilling Management Limited
Unit 107, 15 Capella Court
Nepean, Ontario, Canada, K2E 7X1
Tel: (613) 226-1771 Fax: (613) 226-8753
odm@storm.ca www.odm.ca

## Laboratory Data Report

**Client Information**

Mr. David Crouch

Email:

Attention: Mr. David Crouch

**Data-File Information**

| | |
|---|---|
| Date: | August 28, 2017 |
| Project name: | L444 |
| ODM batch number: | 7538 |
| Sample numbers: | L444 |
| Data file: | 201747538 - Crouch - KIM - (L444) - August 2017 |
| Number of samples in this report: | 1 |
| Number of samples processed to date: | 1 |
| Total number of samples in project: | 1 |
| Preliminary data: | |
| Final data: | X |
| Revised data: | |

**Sample Processing Specifications**

1. Submitted by client: Sand/gravel sample prescreened to -5.0 mm in the field.
2. One 300 g archival split taken.
3. Sample panned for gold, PGMs and fine-grained metallic indicator minerals.
4. The shaking table concentrates refined by heavy liquid separation at S.G. 3.2 to create a heavy mineral concentrate ("HMC").
5. The 0.25-2.0 mm, nonferromagnetic HMC fractions picked for indicator minerals.

**Notes**

Don Holmes, P.Geo.
President

Appendix 14



## Primary Sample Processing Weights and Descriptions

Client: Mr. David Crouch
File Name: 201747538 - Crouch - KIM - (L444) - August 2017
Total Number of Samples in this Report: 1
ODM Batch Number(s): 7538

| | Weight (kg wet) | | | | | Screening and Shaking Table Sample Descriptions | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Clasts (+2.0 mm) | | | | Matrix (-2.0 mm) | | | | | | | | |
| | | | | | | | Percentage | | | | Distribution | | | | | Colour | | | |
| Sample Number | Bulk Rec'd | Archived Split | Table Split | +2.0 mm Clasts | Table Feed | Size | V/S | GR | LS | OT | S/U | SD | ST | CY | ORG | SD | CY | Class |
| L444 | 12.0 | 0.3 | 11.7 | 2.0 | 9.7 | G | 80 | Tr | 20 | 0 | S | MC | N | N | N | LOC | NA | SAND + GRAVEL |

Appendix 14

 Overburden Drilling Management Limited 2017-08-25

## Gold Grain Summary

Client: Mr. David Crouch
File Name: 201747538 - Crouch - KIM - (L444) - August 2017
Total Number of Samples in this Report: 1
ODM Batch Number(s): 7538

| Sample Number | Number of Visible Gold Grains | | | | Nonmag HMC Weight (g)* | Calculated PPB Visible Gold in HMC | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Reshaped | Modified | Pristine | | Total | Reshaped | Modified | Pristine |
| L444 | 4 | 4 | 0 | 0 | 38.8 | 1829 | 1829 | 0 | 0 |

* Calculated PPB Au based on assumed nonmagnetic HMC weight equivalent to 1/250th of the table feed.

Appendix 14



## Detailed Gold Grain Data

Client: Mr. David Crouch
File Name: 201747538 - Crouch - KIM - (L444) - August 2017
Total Number of Samples in this Report: 1
ODM Batch Number(s): 7538

| Sample Number | Dimensions (µm) | | | | Number of Visible Gold Grains | | | | Nonmag HMC Weight* (g) | Calculated V.G. Assay in HMC (ppb) | Metallic Minerals in Pan Concentrate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thickness | | Width | Length | Reshaped | Modified | Pristine | Total | | | |
| L444 | 5 | C | 25 | 25 | 1 | | | 1 | | 1 | No sulphides. |
| | 8 | C | 25 | 50 | 1 | | | 1 | | 2 | SEM checks: 2 of ~10 Sn-Ag |
| | 15 | C | 50 | 100 | 1 | | | 1 | | 15 | candidates = 2 Sn-Ag (25-50 µm; |
| | 50 | M | 300 | 625 | 1 | | | 1 | | 1812 | contamination). |
| | | | | | | | | 4 | 38.8 | 1829 | |

* Calculated PPB Au based on assumed nonmagnetic HMC weight equivalent to 1/250th of the table feed.

Appendix 14

 Overburden Drilling Management Limited 2017-08-25

## Laboratory Processing Weights

Client: Mr. David Crouch
File Name: 201747538 - Crouch - KIM - (L444) - August 2017
Total Number of Samples in this Report: 1
ODM Batch Number(s): 7538

| | Weight of -2.0 mm Table Concentrate (g) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.25 to 2.0 mm Heavy Liquid Separation S.G. 3.20 | | | | | | | | | | |
| | | | | | HMC S.G.>3.20 | | | | | | | | |
| | | | | | | | | Nonferromagnetic HMC | | | | | |
| | | | | | | | | | Processed Split | | | | |
| | | | | | | | | | Total | | | | |
| Sample Number | Total | -0.25 mm | Total | Lights S.G. <3.2 | Total | -0.25 mm (wash) | Mag | Total | % | Weight | 0.25 to 0.5 mm | 0.5 to 1.0 mm | 1.0 to 2.0 mm |
| L444 | 1087.6 | 689.5 | 398.1 | 374.0 | 24.1 | 2.1 | 4.0 | 18.0 | 100 | 18.0 | 11.0 | 4.7 | 2.3 |

Overburden Drilling Management Limited

2017-08-28

## Kimberlite Indicator Mineral Counts

Client: Mr. David Crouch
File Name: 201747538 - Crouch - KIM - (L444) - August 2017
Total Number of Samples in this Report: 1
ODM Batch Number(s): 7538

Number of Grains – Selected MMSIMs

| Sample Number | 1.0 to 2.0 mm | | | | | | 0.5 to 1.0 mm | | | | | | 0.25 to 0.5 mm | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Low-Cr diopside | | Cpy | | Gh | | Low-Cr diopside | | Cpy | | Gh | | Low-Cr diopside | | Cpy | | Gh | |
| | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P |
| L444 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 0 | 0 |

Number of Grains – KIMs

| Sample Number | 1.0 to 2.0 mm | | | | | | | | | | | | 0.5 to 1.0 mm | | | | | | | | | | | | 0.25 to 0.5 mm | | | | | | | | | | | | Total (KIMs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GP | | GO | | DC | | IM | | CR | | FO | | GP | | GO | | DC | | IM | | CR | | FO | | GP | | GO | | DC | | IM | | CR | | FO | | | |
| | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P |
| L444 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 2 | 3 | 3 | 15 | 15 | 1 | 1 | 0 | 0 | 21 | 21 | 22 | 22 | 3 | 3 | 71 | 71 |

T = Total number of grains in sample. Total is estimated if number is greater than number of picked grains.
P = Number of picked grains in sample.

Appendix 14



## Kimberlite Indicator Mineral Remarks

Client: Mr. David Crouch
File Name: 201747538 - Crouch - KIM - (L444) - August 2017
Total Number of Samples in this Report: 1
ODM Batch Number(s): 7538

| Sample Number | Remarks |
|---|---|
| L444 | Almandine-augite-hornblende/epidote-diopside assemblage. SEM checks from 0.5-1.0 fraction: 4 IM versus crustal ilmenite candidates = 2 IM, 1 crustal ilmenite and 1 CR; and 3 FO candidates = 3 FO. SEM checks from 0.25-0.5 mm fraction: 1 GO versus grossular candidate = 1 GO (Cr-poor pyrope); 2 DC versus Cr-garnet candidates = 1 Cr-grossular and 1 Cr-andradite; 6 IM versus crustal ilmenite candidates = 1 IM, 4 crustal ilmenite and 1 CR; and 5 FO versus diopside candidates = 3 FO, 1 diopside and 1 enstatite (KIM). 7 IM from 0.25-0.5 mm fraction have alteration mantles. Also picked 1 >250 µm wide gold grain from 0.25-0.5 mm fraction. See detailed gold grain data page. |

Appendix 15

## Geoscience & ODM Labs – Invoices & Receipts

Ontario

GEO LABS
GEOSCIENCE LABORATORIES

# Invoice Summary

**Geo Labs Job #:** 17-0107 / 17-0279
**Sample Submission Date:** 06/06/2017 / 14/09/2017
**PO/Work Order #:**
**Quote #:**
**IFIS Client #:**

**Invoice To:**
David Crouch
[redacted]

**Data Report To:**
Tony Bishop
[redacted]

| Quantity | Method Code | Description | Unit Price | Total |
|---|---|---|---|---|
| 52 | EMP-100 | Microprobe Analysis / Grain<br>*Job #17-0107* | $14.40 | $748.80 |
| 2 | SEM-101 | SEM: Rental With Operator<br>*Job #17-0107* | $148.75 | $297.50 |
| 43 | EMP-100 | Microprobe Analysis / Grain<br>*Job #17-0279* | $14.40 | $619.20 |
| | | | **Subtotal** | **$1,665.50** |
| | | | **HST** | **$216.52** |
| | | | **Balance Due** | **$1,882.02** |

For payment inquiries please contact the Financial Processing Operations Branch (FPOB) of Ontario Shared Services (OSS) accounts receivable customer service support centre at **(877) 535-0554**.
For billing inquiries please contact the Geoscience Laboratories at **(705) 670-5637** or geoscience.labs.ndm@ontario.ca.

Appendix 15

Ontario

# Invoice / Facture

1 / 1

| Customer #/Nº du client | Ministry / Ministère | Date |
|---|---|---|
| 890419 | MNDM-GEOLABS-ARIR-IMP | November 01, 2017 |

Payment Information / Renseignements sur la facture
TO / DESTINATAIRE

DAVID CROUCH
[redacted]

Billing Enquiry Renseignements - Facturation
1-877-535-0554

Invoice Number / Numéro de la facture: 12021117006

Due Date / Date d'échéance: December 01, 2017

| HST Registration No. / No d'inscription aux fins de la TVH | Purchase Order / Bon de commande | Payment Terms / Modalités de paiement |
|---|---|---|
| 124668666 | | 30 NET |

| Line No / Nº de ligne | Item Description / Description | Price / Prix | Quantity / Quantité | Amount / Montant | HST / TVH |
|---|---|---|---|---|---|
| 1 | 022-442510-GEO_LAB SERVICES-ANALYTICAL LABORATORY SER VICES | 1,665.50 | 1 | 1,665.50 | 216.52 |
| | | | | 1,665.50 | 216.52 |

06-5104 (2009/12)


**Interest will be charged on all past due accounts.**
**Des intérêts seront exigés sur tout compte en souffrance.**

Amount Due / Montant dû CAD$ **1,882.02**

BACK UP DOCUMENTATION ATTACHED

Detach here / Détachez ici

Ontario

Ministry of Finance / Ministère des Finances
Payment Processing Centre / Centre de traitement des paiements
33 King St. West / 33 Rue King Ouest
PO Box 647 / CP 647
Oshawa ON L1H 8X3

## Remittance Advice / Avis de remise

Please detach and return this portion with your payment in the enclosed envelope. Make your certified cheque or money order payable to the **Minister of Finance**. Veuillez détacher et retourner cette partie avec votre remise dans l'enveloppe ci-jointe. Libellez votre chèque certifié ou votre mandat à l'ordre du **ministre des Finances**.

DAVID CROUCH
[redacted]

Credit Card No. / Nº de la carte de crédit

O Visa O Master Card

Signature

Expiry / Expiration MM / YY MM / AA

Customer No. / Nº du client: 890419

Transaction Id / Code de transaction: 3333890

Invoice No. / Nº de la facture: 12021117006

Due Date / Date d'échéance: December 01, 2017

Amount Due / Montant dû CAD $ **1,882.02**

**Payment Amount / Montant remis**

**CAD $** .

40 IN AR 890419 3333890 00000188202 7

Appendix 15

**Overburden Drilling Management Limited**

107 - 15 Capella Court
Ottawa, Ontario K2E 7X1
Canada
Tel: (613) 226-1771
Fax: (613) 226-8753
odm@storm.ca

# INVOICE

Invoice No.: 917052
Date: Sep 30, 2017
Page: 1
Re: Sample Processing

**Sold to:**

**David Crouch**

| Quantity | Unit | Description | Unit Price | Amount | Tax |
|---|---|---|---|---|---|
| | | LABORATORY SERVICES – Sample L444 | | | H |
| 1 | Samples | Processed for KIMs + gold grains, basis 10 kg | 280.00 | 280.00 | H |
| 1 | Checks | SEM checks: 1st grain/sample - INCLUDED IN BASE PRICE | | | H |
| 20 | Checks | SEM checks: additional grains/sample | 4.60 | 92.00 | H |
| 1 | Samples | Disposal and handling | 3.00 | 3.00 | H |
| | | LABORATORY SERVICES -- Sample DC-ICL-TZ-72 | | | H |
| 1 | Samples | Processed for KIMs + gold grains, basis 10 kg | 280.00 | 280.00 | H |
| 1 | Hours | Extra panning (>30 visible gold grains) | 71.00 | 71.00 | H |
| 1 | Checks | SEM checks: 1st grain/sample - INCLUDED IN BASE PRICE | | | H |
| 28 | Checks | SEM checks: additional grains/sample | 4.60 | 128.80 | H |
| 1 | Samples | Disposal and handling | 3.00 | 3.00 | H |
| | | Subtotal: | | 857.80 | |
| | | H - HST 13%<br>HST_ON | | 111.51 | |

**Invoice Description:** Batches 7538, 7554 -- Samples L444, DC-ICL-TZ-72

Terms: Invoice payable upon receipt.
GST/HST No. 10403 0812 RT

**Total: 969.31**

## Statement of Qualifications:

I, Brian Anthony (Tony) Bishop p/l #A44063 of Kenogami (RR#2 Swastika, ON), hereby certify as follows concerning my report on Legacy Claims L 4282444, 4282707, and 4286187 in the Township of Lorrain, Larder Lake Mining Division:

I have been prospecting and placer mining part-time for 43+ years in Ontario, British Columbia, and Nova Scotia (which led to writing a book The Gold Hunter's Guide to Nova Scotia (Nimbus Publishing, 1988, ISBN 0-920852-93-9) which was used in prospecting courses in Nova Scotia). I have held an Ontario Prospector's License for 36+ years, and was issued a Permanent Prospector's License in 2005. I have completed a number of prospecting courses given by the Ministry, and have my Prospector's Blasting Permit. I was one of the directors on the Northern Prospectors Association (NPA) in the early years when Mike Leahy revitalized/resurrected the NPA in Kirkland Lake, and with Mike, initiated the annual gold panning event as part of Kirkland Lake Gold Days.

As well, I sold and used small scale mining and concentrating/processing equipment for over 20 years. This included instructing others in their use.

On short term contracts I have performed specialized work for Cobatec, Macassa, Castle Silver Mines Inc., Gold Bullion Development Corp, as well as short stints in Ecuador and Montana.

The last four years I have devoted to full-time diamond exploration. This has included 1,000+ hours of research from many diverse sources on exploration and processing techniques.

Drawing on this research and my many years of practical experience I have assembled a complete till processing lab I feel rivals many commercial ones. Importantly, I sometimes exceed their results by testing a wider range of samples' fraction sizes and as a result have found a number of kimberlite indicator minerals, notably a number of purple garnets all 1.0mm and larger in size (i.e., > 20 mesh) and other indicators that were larger than the usual upper cut-off for commercial labs' mesh sizes. Many redundancy tests are routinely performed to monitor potential losses of the KIMs and I feel my equipment and techniques closely match that of the industry.

Signed:

Brian Anthony (Tony) Bishop

June 18, 2018


*(Bill Watterson, Calvin & Hobbes)*

*"A new idea is delicate. It can be killed by a sneer or a yawn; it can be stabbed to death by a quip and worried to death by a frown on the right man' s brow."*

*- Charlie Brower*

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