We are committed to providing accessible customer service.
If you need accessible formats or communications supports, please contact us.

Nous tenons à améliorer l’accessibilité des services à la clientèle.
Si vous avez besoin de formats accessibles ou d’aide à la communication, veuillez nous contacter.

Temagami Gold property
remote sensing technical report

District of Nipissing, Ontario
NTS 31M/04

Prepared for:

Temagami Gold Inc.

1 Presley Street, P.O. Box 699
Cobalt, Ontario, POJ 1C0

Remote sensing report for
submission for assessment credits
Ministry of Northern Development and Mines
Ontario, Canada

December 6, 2018

Author: Serge Robert
Eagle Géosciences
223, Murdoch Av., Rouyn-Noranda,
Quebec, J9X 1E5

Table of Contents

List of Tables

List of Figures

1 Summary

Temagami Gold Inc. mandated Eagle Geosciences to prepare a remote sensing technical report covering the Temagami Gold property in the Nipissing district, Northeastern Ontario, Canada.

Works began, September 25, 2018, with the existing data collection; property limit, lithology, geology, magnetics, etc. Data acquisition of Sentinel-2 scene. Eagle Geoscience proceeded to process the remote sensing data for integration as geoscientific layers into a GIS database. Finally, Serge Robert interpreted the data, prepared the present report maps and delivered the present report for Temagami Gold Inc., on December 7, 2018.

The remote sensing works primary objective consisted in adding layers of information for mineral exploration purposes. We selected Sentinel-2 data from the European Space Agency Sentinel missions launched in 2015 (Sentinel-2A) and 2017 (Sentinel-2B). Both satellites are equipped with the state-of-the-art MSI (Multispectral Imager) instrument, that offers high-resolution optical imagery.

Using open source SNAP software toolboxes and GIS software resulted in a multispectral carbonate, a multispectral silicate, a color index and a structural interpretation maps. Extra figures include location and mining title maps.

We used WGS84/UTM 17N geographic coordinate system as indicated on all the maps, throughout our works.

2 Abbreviations and acronyms

Table 1 provides a descriptive list of all abbreviations and acronyms used in the report.

3 Property description

The data acquired for this work centers on the Temagami Gold property, Temagami, Ontario.

The Temagami Gold property covers part of the Chamblers, Strathy, Cassels, Briggs and Strathcona townships. The Sentinel image area also covers the Riddell township, and part of the: Aston, Banting, Best, South Lorrain, Eldridge, Hartle, Askin, Law, Yates, Phyllis, Joan and Cynthia townships.

Vehicular access to the properties is via Trans Canada Highway 11 and railroad access via Ontario Northland tracks, less than a kilometer north of Temagami.

Table 1: Abbreviations and acronyms

Abbreviations	Description
km	kilometer, 10^{+3}
nm	nanometer, 10^{-9}
Acronym	**Description**
CI	Color index
ESA	European Space Agency
GCS	Geographic Coordinate System
MDNM	Ministry of Northern Development and Mines
MSI	MultiSpectral Instrument
NTS	National Topographic System
SNAP	Sentinel Application Platform
UTM	Universal Transverse Mercator
WGS	World Geodetic System

The Temagami Gold property consists of XXX mining titles covering XXXX hectares in the Sudbury Mining Division. Temagami Gold Inc. holds 100% of the claims listed in table 2.

Table 2: Mining titles
All claims are active.
All claims held 100% by Temagami Gold Inc.

Cell #	Issue date	Anniversary date	Area (Ha)
117002	yyyy-mm-dd	2022-06-01	xx.x
275404	yyyy-mm-dd	2021-06-01	xx.x

4 Property location and access

The property extends from Provincial Highway 11 immediately north of Temagami, in eastern central Ontario.

Figure 2 display the Temagami Gold property over the main topographic features, township boundaries, NTS divisions and UTM coordinates.

5 History

The Geological Survey of Canada contracted A.E. Barlow to map the area between 1887 and 1895. During the late 1890s and early 1900's the Temagami Greenstone Belt experienced an explosion in mining exploration activities. This focus on the region resulted in multiple sulphides, gold, molybdenum, iron, cobalt, and silver discoveries.

The fundamental geological work in this region was completed by the Ontario Department of Mines and its successor the Ontario Geological Survey. During the period 1978 to 1996 the area was closed to staking of mineral claims through the Temagami Land Caution, a moratorium linked to settlement of First Nations land claims. The caution was lifted in 1996 and the area was covered by new claims.

6 Geology

In his geological report [1], Bending summarized the geology:

> The Temagami Gold property lies within the Archean Temagami greenstone belt which hosts diverse metallic mineral deposits including gold in veins and shear zones, volcanogenic massive polymetallic sulphides, Ni-Cu-PGM-Au in mafic—ultramafic rocks and banded ironstones (both iron production and significant gold prospects).

7 Data description

7.1 Geographic coordinate system

We used Universal Transver Mercator (UTM) conformal projection Zone 17N and the World Geodetic System of 1984 (WGS84) ellipsoid at the property scale, figure 2 to 7. Figure 1 uses latitude and longitude (CGS). The coordinate system and cartographic projection appear on all maps.

7.2 Source of remote sensing imagery

In this report, Eagle Geosciences processed data acquired by the European Space Agency Sentinel-2 satellite multispectral instrument (MSI).

Light reflected up to the MSI instrument from the Earth and its atmosphere is collected by a three-mirror telescope and focused onto two focal plane assemblies: one for the ten visible and near infra-red wavelengths and one for the three short wave infra-red wavelengths.

SENTINEL-2 is a wide-swath, high-resolution, multi-spectral imaging mission, which can be processed to monitor the soil, vegetation and water cover.

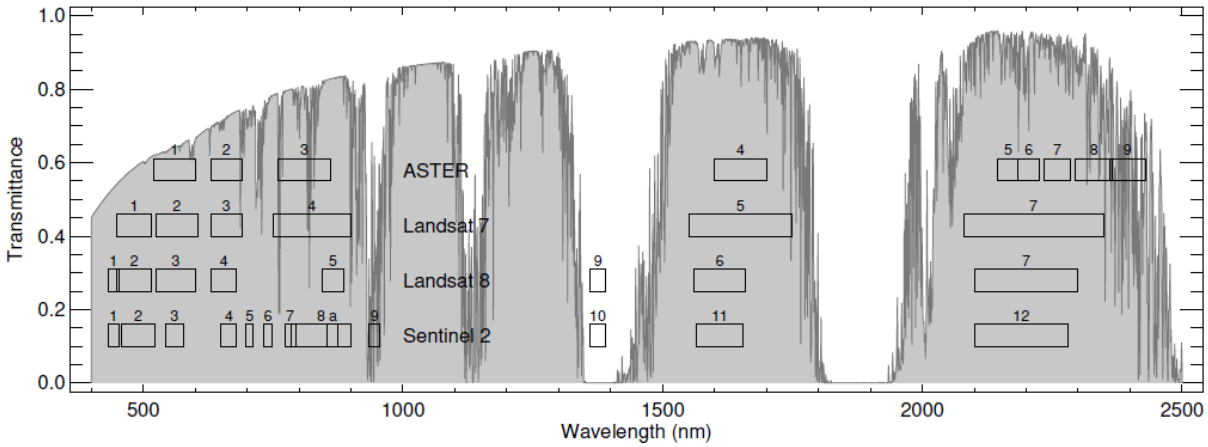


Figure 8: Transmittance comparison

Source: van der Weff and van der Meer [2]

The width, wavelength positions and numbers of the Sentinel-2A MSI (MultiSpectral Instrument) spectral bands, in comparison to Landsat 8 OLI (Operational Land Imager), Landsat 5 TM (Thematic Mapper) and ASTER (Advanced Spaceborne Thermal Emission and Reflectance Radiometer). Atmospheric transmittance is plotted on the y-axis.

7.3 Method of data collection

The SENTINEL-2 Multispectral Instrument (MSI) samples 13 spectral bands: four bands at 10 meters, six bands at 20 meters and three bands at 60 meters spatial resolution. The current works used the Sentinel-2 data as described in table 3.

Radiometric resolution typically range from 8 to 16 bits. The MSI instrument's radiometric resolution is 12 bit. Hence, image light intensity values, or reflectance, are assigned values from 0 to 4095 (2^{12}).

Table 3: Sentinel-2 data specifications

Band	Wavelength (nm)	Bandwidth (nm)	Resolution (m)
1	443	27	60
2	490	98	10
3	560	45	10
4	665	38	10
5	705	19	20
6	740	18	20
7	783	28	20
8	842	145	10
8a	865	33	20
9	940	26	60
10	1375	75	60
11	1610	143	20
12	2190	242	20

7.4 Granules and Tiles

The elementary level of Sentinel-2 MSI products are granules of a fixed size. The granule size is dependent on the product level. For orthorectified products (Level-2A): The image is divided into 100 km tiles in UTM/WGS84 projection.

The data items include:

- image data in granules or tiles and covering the product Area of Interest (AOI)
- preview data, that provides an overview of the product for subsequent image browsing and user selection purposes
- ancillary data from the satellite telemetry
- auxiliary data information describing the parameters used
- quality indicator data, describing the product relative to radiometric, geometric and image properties.

8 Data processing methods and software

8.1 Software

The software used to process data, interpret results and prepare maps for the present report are:

- ArcGIS, ESRI
- Global Mapper, Blue Marble Geographics
- SNAP, European Space Agency

Remote sensing techniques have wide range of applications in mineral exploration. The applications include:

- Lithological mapping
- Mineral exploration
- Structural mapping
- Lineament mapping
- Geo hazard mapping

The European Space Agency has developed open source toolboxes for the scientific exploitation of the Sentinel missions. The Sentinel-2 Toolbox consists of a rich set of visualisation, analysis and processing tools for the exploitation of MSI data from the Sentinel-2 mission.

8.2 Methods and input parameters

The Level-2A processing includes a scene classification and an atmospheric correction applied to top-of-atmosphere Level-1C orthoimage products. Level-2A main output is an orthoimage bottom-of-atmosphere corrected reflectance product.

Additional outputs include a quality indicators for cloud and snow probabilities at 60 m resolution. Level-2A output image products are re-sampled and generated with an equal spatial resolution for all bands, based on the requested resolution (10 m, 20 m or 60 m). A 10 m resolution product contains the spectral bands 2, 3, 4 and 8 and an aerosol optical thickness map resampled from 20 m. A 20 m product contains bands 2 - 7, the bands 8A, 11 and 12 and an aerosol optical thickness and water vapor map. A 60 m product contains all components of the 20 m product and additionally the 60 m bands 1 and 9. The cirrus band 10 is omitted, as it does not contain surface information.

The processor algorithm is a combination of state-of-the-art techniques for performing atmospheric corrections (including cirrus clouds correction [3, Richter, 2011]), which have been tailored to the SENTINEL-2 environment together with a scene classification module described in [4, Louis, 2010].

The scene classification algorithm allows detection of clouds, snow and cloud shadows and generation of a classification map, which consists of four different classes for clouds (including cirrus), together with six different classifications for shadows, cloud shadows, vegetation, soils/deserts, water and snow. The algorithm is based on a series of threshold tests that use as input top of atmosphere reflectance as input from the SENTINEL-2 spectral bands. In addition, thresholds are applied on band ratios and indexes like Normalised Difference Vegetation Index and Normalised

Difference Snow and Ice Index. The algorithm uses the reflective properties of scene features to establish the presence or absence of clouds in a scene. Cloud screening is applied to the data in order to retrieve accurate atmospheric and surface parameters, either as input for the further processing steps below or for being valuable input for processing steps of higher levels.

The aerosol type and visibility or optical thickness of the atmosphere is derived using the dense dark vegetation algorithm [5, Kaufman, 1988]. This algorithm requires that the scene contains reference areas of known reflectance behaviour.

Water vapour retrieval over land is performed with the atmospheric pre-corrected differential absorption algorithm [6, Schläpfer, 1998]. It is applied to bands 8a and 9. Band 8a is the reference channel in an atmospheric window region. Band 9 is the measurement channel in the absorption region. The absorption depth is evaluated in the way that the radiance is calculated for an atmosphere with no water vapour assuming that the surface reflectance for the measurement channel is the same as for the reference channel. The absorption depth is then a measure of the water vapour column content.

Atmospheric correction is performed using a set of look-up tables generated via libRadtran. Baseline processing is the rural/continental aerosol type.

The Sentinel Application Platform (SNAP) reunites all Sentinel Toolboxes in order to offer the most complex platform for this mission.

9 Results

The author used ESA's SNAP toolboxes to interpret geological structures based on a Sentinel-2 principal component analysis image processing.

Similarly, we included a Multispectrals Carbonate map and the Multispectrals Silicate map using band 11 over 12 ration and 12 over 11 ratio.

The colour index algorithm was developed to differentiate soils in the field - Pouget et al.(1990). Low valued CIs have been shown to be correlated with the presence of a high concentration of carbonates or sulfates.

10 Recommendation

Integrated the GIS geoscientific compilation, the magnetic data inversion, the diamond drill hole data, the past producing mine data and complementary data into a 3D model.

Given the advances in remote imagery data, repeat the processing with a minimum vegetation cover (spring season) image.

11 Certificate of Qualifications

Provide a dated and signed CERTIFICATE OF QUALIFICATIONS from the author, or provide a signature page with a signed and dated stamp for authors registered with a professional organization (P.Eng, and P.Geo);

References

[1] Bending, D., "Geological report and summary of field examination — O'Connor Property, Strathy and Chambers Townships, Temagami, Ontario" July 24, 2014

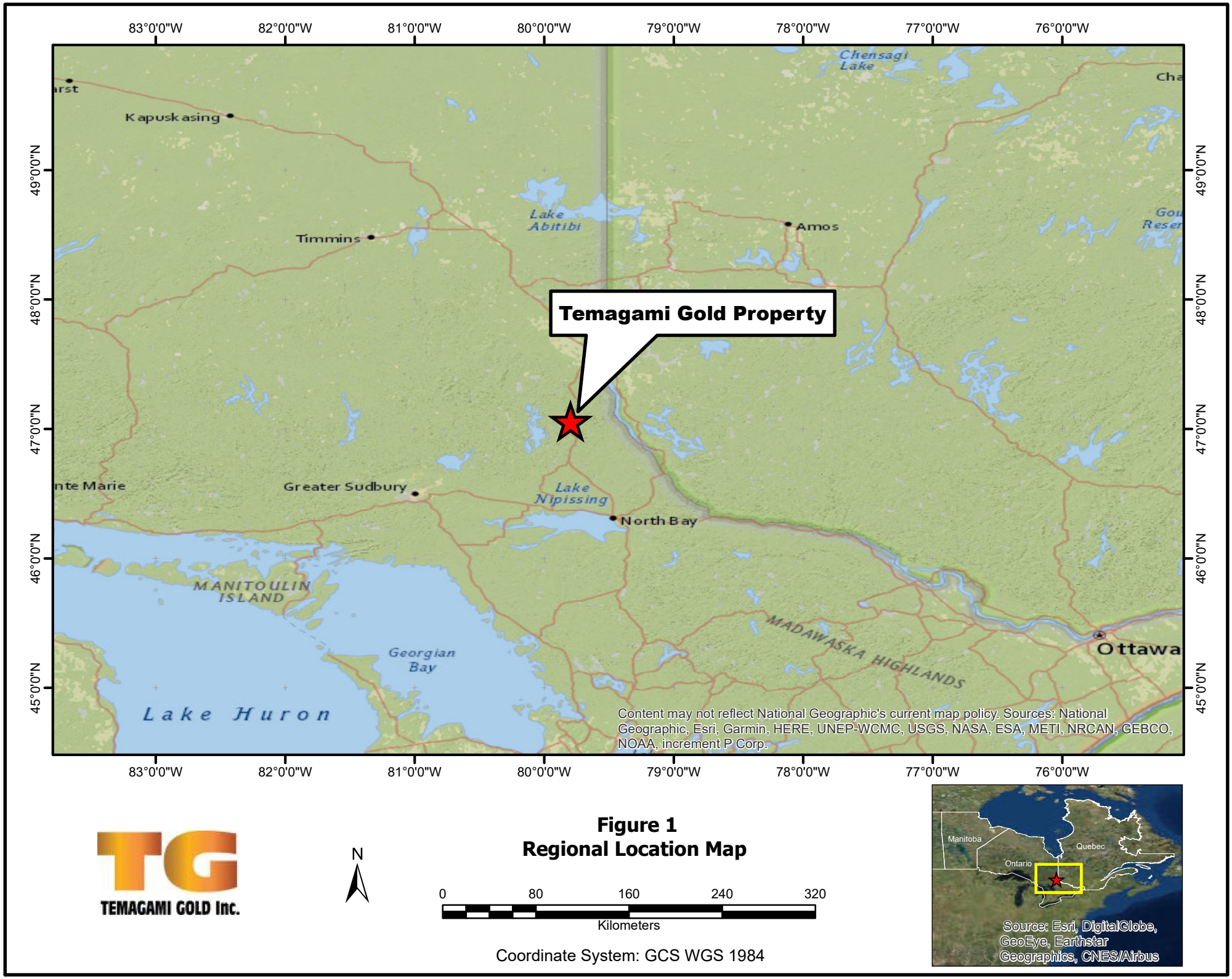
[2] van der Werff, Harald; van der Meer, Freek. 2016. "Sentinel-2A MSI and Landsat 8 OLI Provide Data Continuity for Geological Remote Sensing." Remote Sens. 8, no. 11: 883.

[3] Richter, R., Wang, X., Bachmann, M., and Schlaepfer, D., "Correction of cirrus effects in Sentinel-2 type of imagery", Int. J. Remote Sensing, Vol.32, 2931-2941, 2011.

[4] J. Louis, A. Charantonis and B. Berthelot, "Cloud Detection for Sentinel-2", Proceedings of ESA Living Planet Symposium (2010).

[5] Kaufman, Y., Sendra, C., "Algorithm for automatic atmospheric corrections to visible and near-IR satellite imagery", International Journal of Remote Sensing, Volume 9, Issue 8, 1357-1381 (1988).

[6] Schläpfer, D. et al., "Atmospheric precorrected differential absorption technique to retrieve columnar water vapour", Remote Sens. Environ., Vol. 65, 353366 (1998).



TEMAGAMI GOLD Inc.

Figure 1
Regional Location Map

Coordinate System: GCS WGS 1984

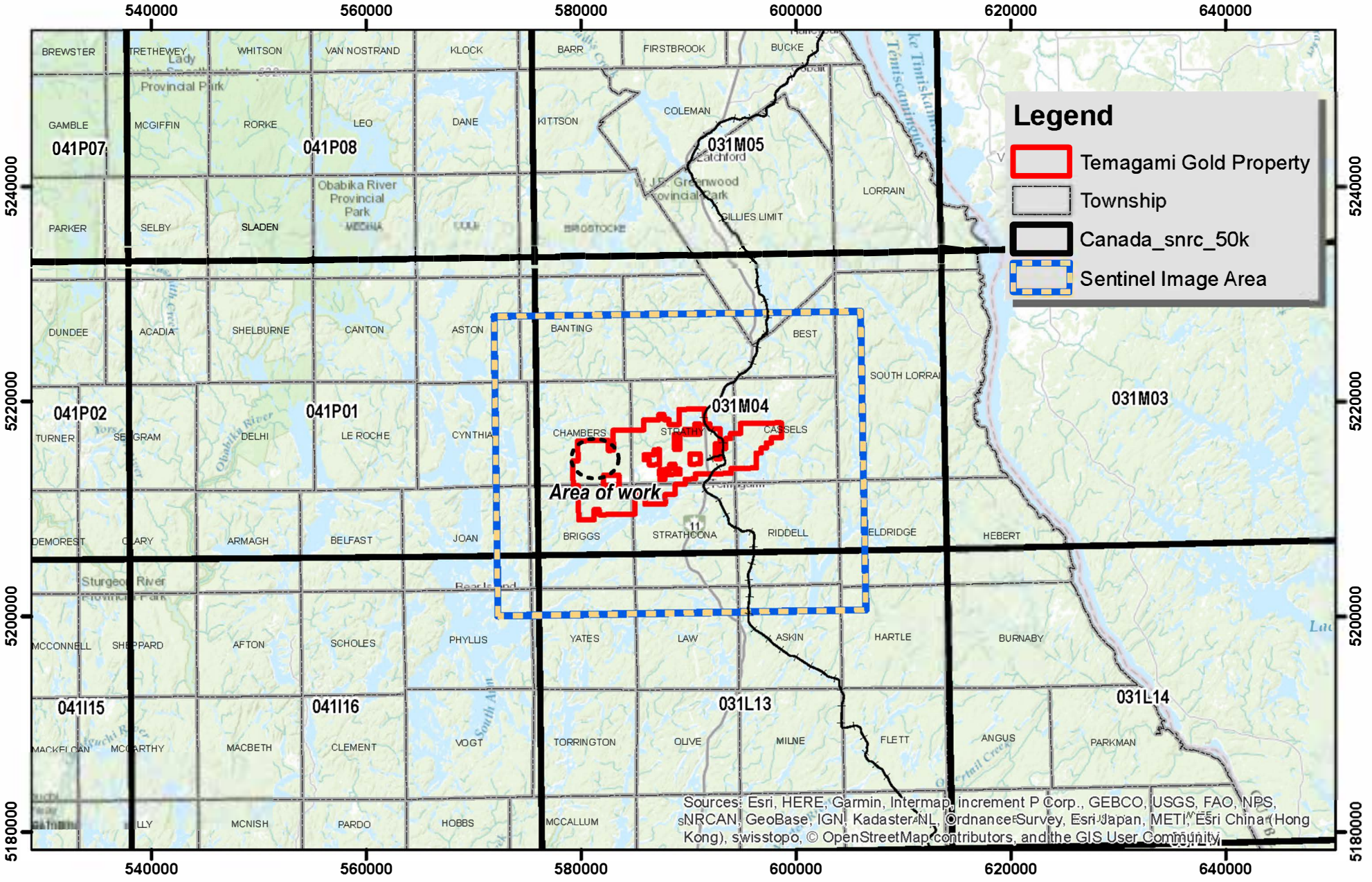


Figure 2
Property Location Map

TEMAGAMI GOLD Inc.

0 10 20 30 40
Kilometers

N

Coordinate System: WGS 1984 UTM Zone 17N

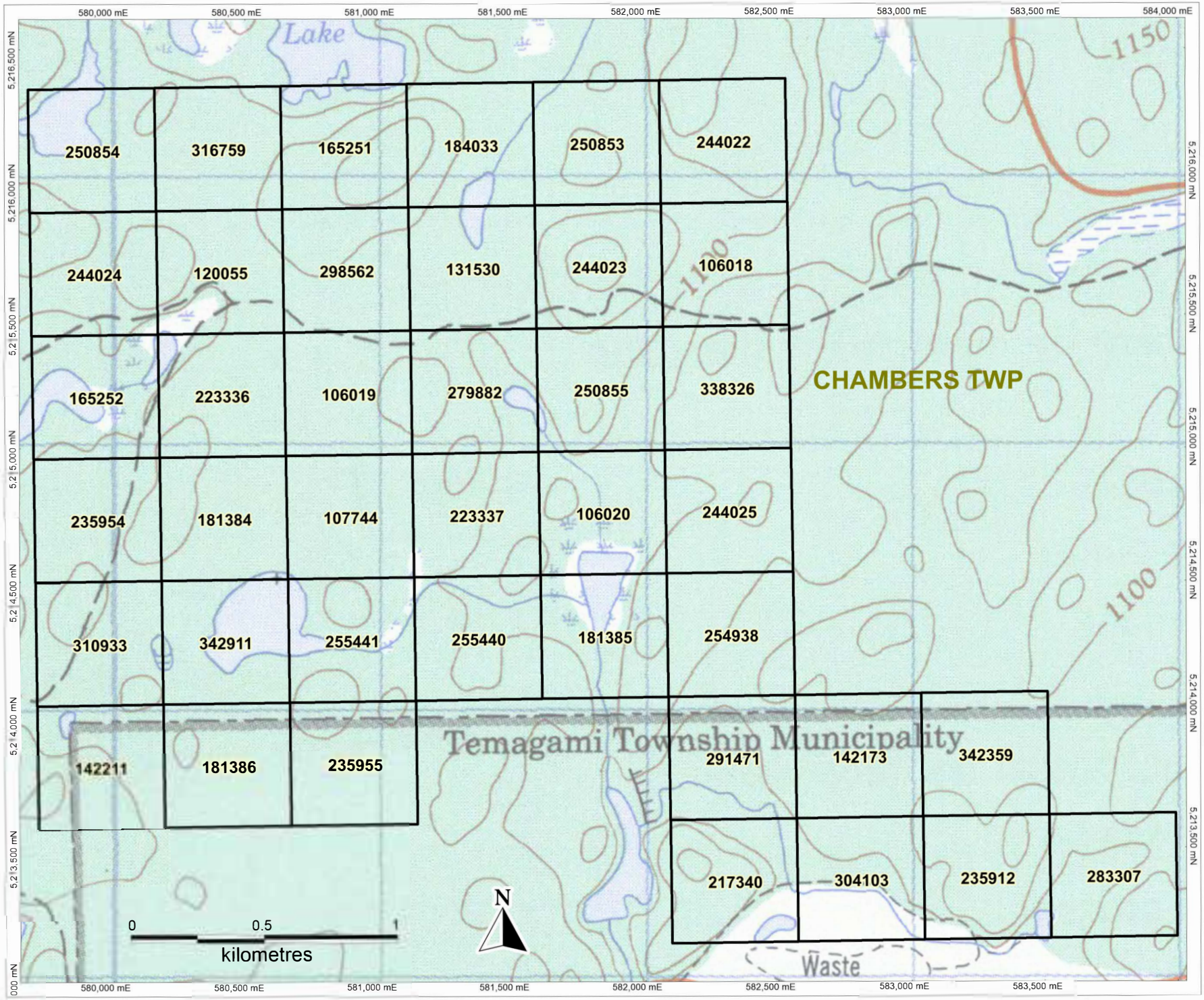


Figure 3 Mining Claim Numbers Map

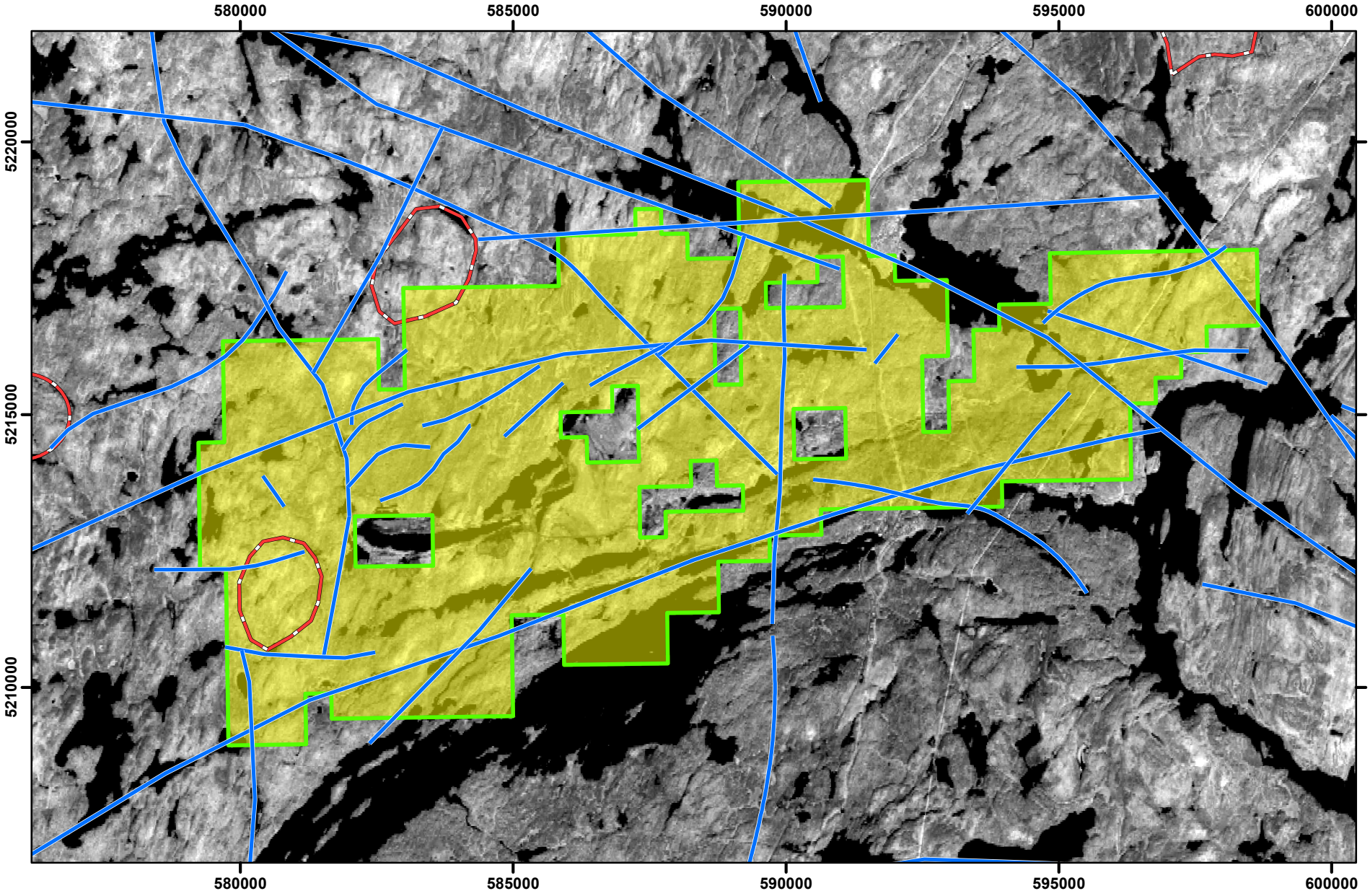


Figure 4
Structural Interpretation Map

TEMAGAMI GOLD Inc.

N

0 2 4 6 8
Kilometers

Coordinate System: WGS 1984 UTM Zone 17N

Legend

- Structure
- Circular Feature
- Temagami Gold Property

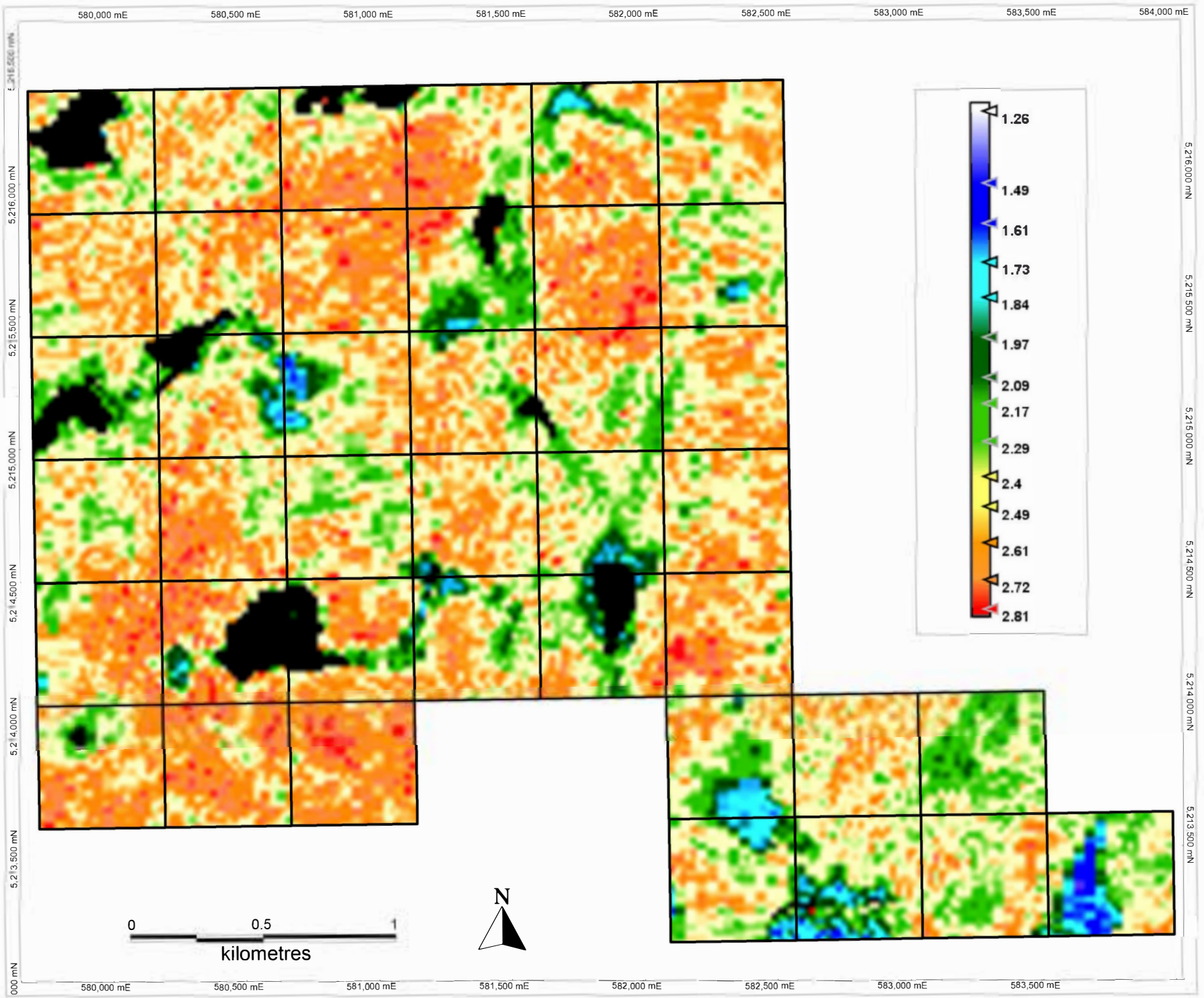


Figure 5 Multispectral Map (Carbonate)

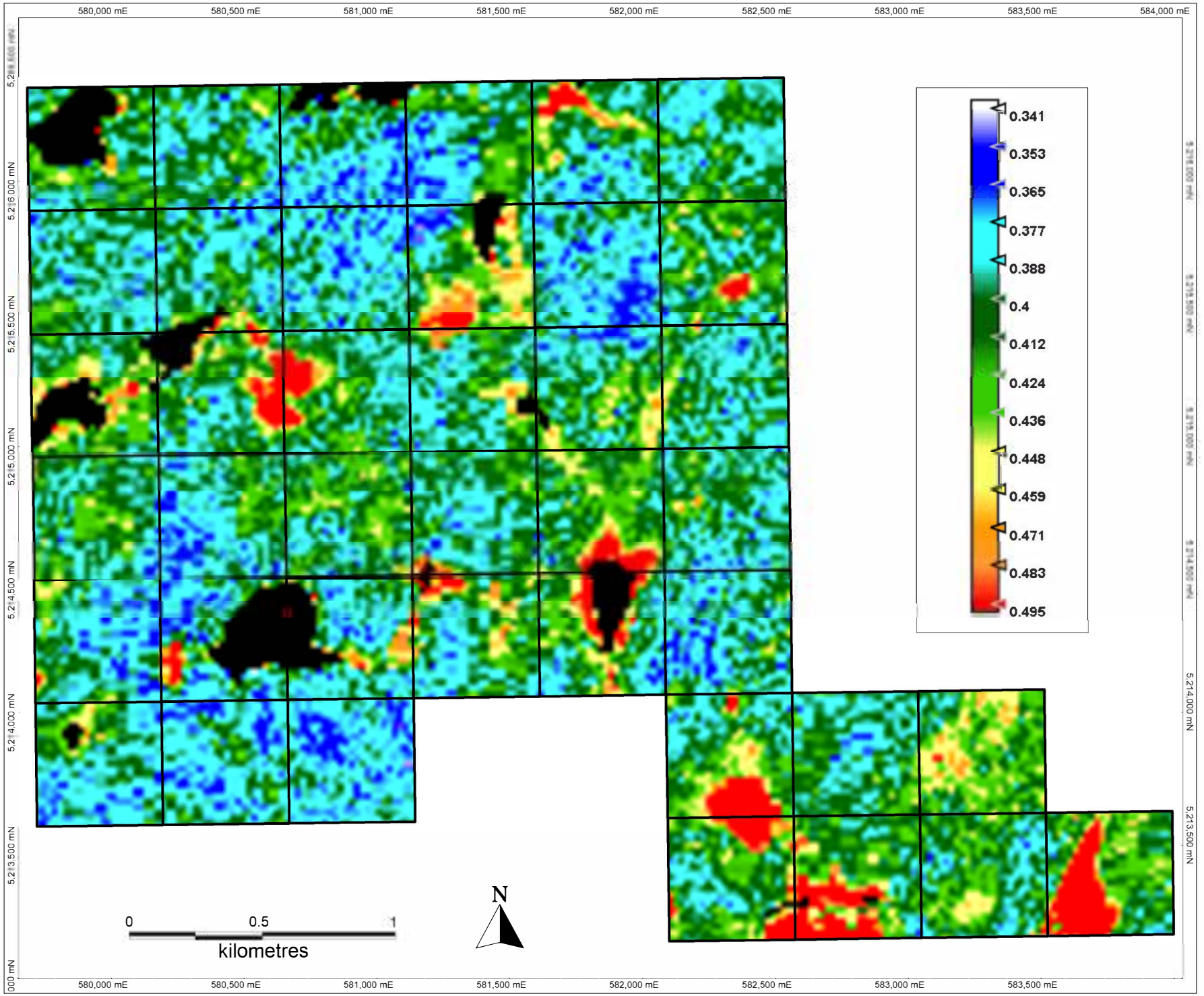


Figure 6 Multispectral Map (Sillicate)

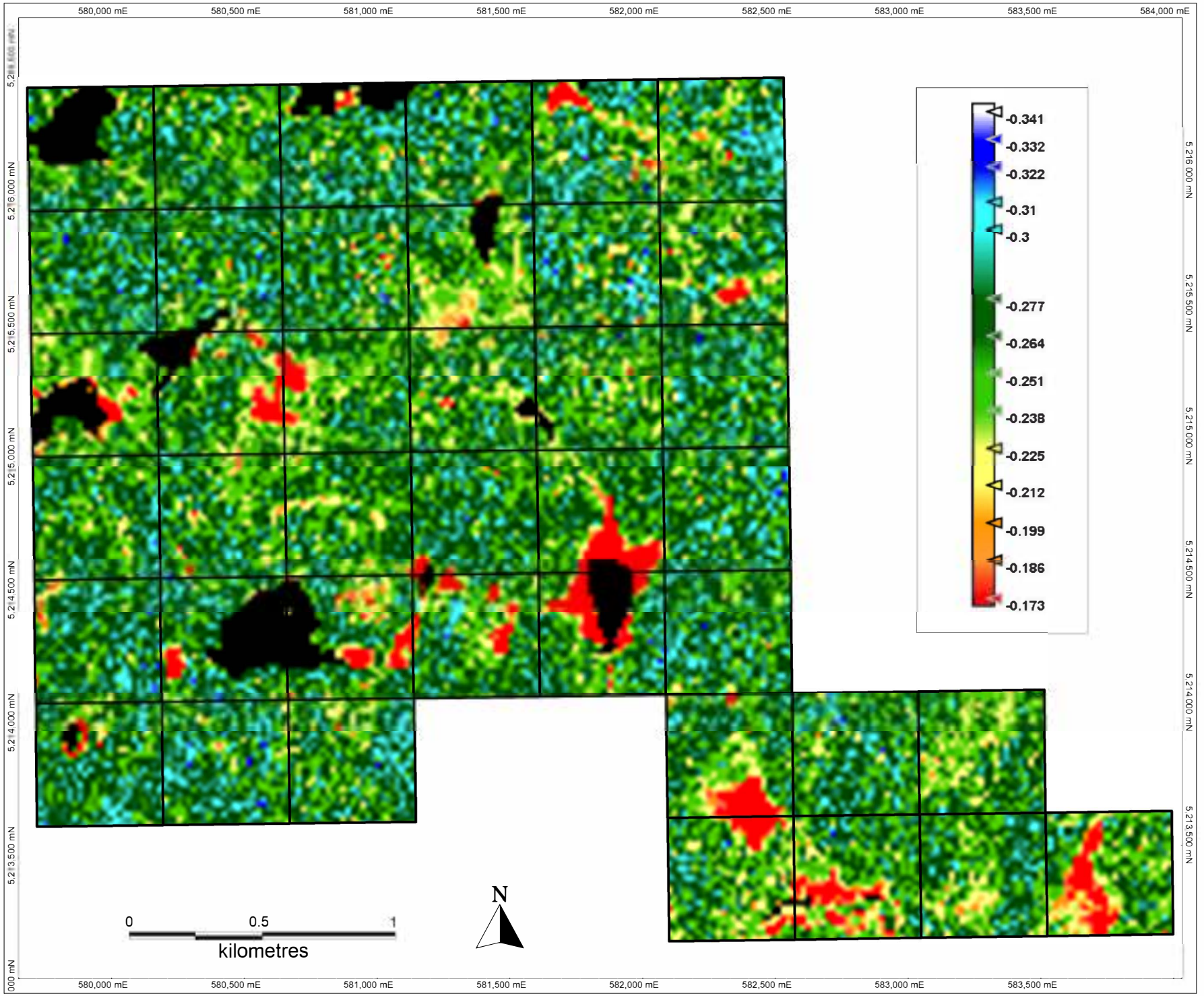


Figure 7 Multispectral Map (Color Index)

Native Consultation Record

David Laronde
TFN Mineral Resource Advisor

Type: Emails/Calls

Date	Subject	Time Length	Company
David Laronde			
Year 2018			
Oct 27	Names of TFN Members on the Field Trip.	1hr	PM
Oct 25	Per Diem payment for TFN members in attendance on Field Trip Discussion.	1hr	PM
Oct 24	2 Emails regarding the use of the Roosevelt Road MOU as template or example for new updated MOU with TG/PM + PM property overview.	2hrs	PM
Oct 22	2 Emails confirmation of Field Tour of PM properties for Oct 23.	2hrs	PM
Oct 21	5 Emails to TFN for tour set up and discussion.	3hrs	PM
Oct 10	2 Emails Invitation to TFN to see PM/TG properties and discussion.	2hrs	PM
Oct 1	Email to TFN and Chris Reynolds (PM - President) regarding property tour and discussion.	1hr	PM
Sept 6	Apologises email from Laronde on behalf of TFN for conduct of TFN member Verna Friday Leveled at Gino Chitaroni personally and TG and discussion.	2hrs	PM

Sept 5	Open House on Bear Island		
Sept 4	Times for water taxi to g to Bear Island for Open House and discussion.	1hr	PM/ECM
Aug 29	Agenda for Open House on Bear Island	1hr	PM/ECM
Aug 27	4 Emails regarding the NI 43101 Report and update to shareholders (copy) for ECM and a short discussion on PM's progress.	2hrs	ECM/PM
Aug 21	TFN request to for PM website and a Discussion on its status.	1hr	PM
Aug 2	Invitation to Sept 5 Open House on Bear Island.	1hr	PM/ECM
July 17	TFN's Deepwater Festival Invite.	1hr	PM/ECM
July 12	TG/PM Gold email with attachment of the company's claim package/maps.	1hr	PM
July 11	Donation to Deepwater Festival discussion by PM.	1hr	PM
June 29	Deepwater Festival sponsorship and Permit and discussion approvals for ECM properties in Briggs Twp, etc....	2hrs	ECM
May 30	Deepwater Music Festival flyer.	1hr	ECM/PM
May 24	Email of Gold Corporation's press release on "All Electric Mining Concept" to achieve a modern green mining standard to be environmental sensitive to local interests discussion as model for the Lake Temagami Area/Greater Temagami Area.	3hrs	ECM/PM
April 27	Discussion on the "Approval of the TFN MOU with ECM" – MOU signed!	2hr	ECM
April 25	3 Emails regarding ECM's MOU progress with TFN and the recent staking activity for PM and ECM. Plus a discussion on the ECM's	3hrs	ECM/PM

	Geotech VTEM Airborne Survey plus sent the survey maps.		
April 11	Recent Staking discussion at Lake Temagami and north near TG's ground (Strathy, Banting, Best, Brigstocke and Chambers Twps).	2 hrs	TG/PM ECM
April 6	MOU ready to be signed with TFN and ECM.	1hr	ECM
March 31	Notification and Discussion about the Fire that partially destroyed MNDM's Kirkland Lake Resident Geologist Office and its affect on exploration records as it pertains to Temagami region.	2hrs	TG/PM ECM
March 29	Amendments to MOU discussion.	1hr	ECM
March 21	ECM fact sheet and Powerpoint sent to TFN	1hr	ECM
March 20	Open House on Bear Island		
March 16	MOU with ECM "unsigned' version for amendments sent to ECM.	1hr	ECM
March 15	Timing for ECM Powerpoint presentation and TG's presentation at Open House and discussion of ice conditions for ice road to Bear Island.	2hrs	ECM/PM TG
March 12/13	Requests discussion for confirmation for March 20 Open House on Bear Island. Also discussion regarding a gift for retiring Doug McKenzie (a golf club putter was given to McKenzie by TG to be presented at Open House).	3hrs	ECM/TG PM
Feb 27	2 Emails regarding death of long time "First Nations" prospector, Tom Saville, and TG/ECM condolences.	1hr	TG/ECM PM

Note: Doug McKenzie has Retired as TFN's Mineral Resource Advisor and David Laronde has replaced him Feb 2018.

First Nation Community Open Houses

Year 2018

Open House:	Open House for TFN Community Consultation On Bear Island **March 20 2018**. Attendees: Gino Chitaroni (ECM/TG/PM), Dan Hachey (ECM), Fred Sharpley (ECM) and Martin Ethier (ECM/TG/PM)	8hrs	PM/ECM TG
Open House:	Open House for TFN Community Consultation on **Sept 5, 2018** Tuesday On Bear Island. Attendees: Brian Youngs (ECM/PM), Gino Chitaroni (ECM/PM), Martin Ethier (ECM/PM) and Dan Hachey (ECM)	8hrs	PM/ECM

Abbreviations Glossary

Companies

PM = Progenitor Metals
TG = Temagami Gold
ECM = East Copperfield Metals

First Nations

TFN = Temagami First Nation
TAA = Tema-Agauma-Anishnabi

Compiled By:

Gino Chitaroni
November 15-2018
Cobalt, Ontario

Native Consultation Record

Doug McKenzie
Former TFN Mineral Resource Advisor

And

TFN Open Houses for Consultation AND Property Tours

Type: Emails/Calls

Date	Subject	Time Length	Company
Doug McKenzie			
Year 2018			
January 9 & 30	Discussions on upcoming Open house for March 20 and calls.	2hrs	TG/ECM
April 11/12	Emails Discussion about Address updates for TG & ECM and a call and discussion on McKenzie's retirement.	2hrs	TG/ECM

Note: Doug McKenzie Retire as TFN's Mineral Resource Advisor and soon thereafter David Laronde replaces Him.

First Nation Community Open Houses and First Nation Property Tours

Year 2017

Tour of Temagami Gold's Property: **Monday Oct 23, 2017**	Tour of TG-Progenitor Properties TFN reps Were Arnold Paul (Chief, TFN), Randy Becker (Chief, TAA). Councillors: Mike Paul & Wayne Potts Mineral Resources Advisor: Doug McKenzie David Laronde advisor helper	8hrs	PM

Companies: Gino Chitaroni (TG/PM)
Dale Schultz (TG/PM)

Year 2018

Open House:	Open House for TFN Community Consultation On Bear Island **March 20 2018**. Attendees: Gino Chitaroni (ECM/TG/PM), Dan Hachey (ECM), and Martin Ethier (ECM/TG/PM)	8hrs	PM/ECM TG
Open House:	Open House for TFN Community Consultation on **Sept 5, 2018** Tuesday On Bear Island. Attendees: Brian Youngs (ECM/PM), Gino Chitaroni (ECM/PM), Martin Ethier (ECM/PM) and Dan Hachey (ECM)	8hrs	PM/ECM
Tour of Progenitor/Temagami Gold's Property:	**Tuesday October 23 2018**, Tour of TG-Progenitor Properties TFN reps were: Arnold Paul (Chief, TFN), Randy Becker (Chief, TAA). Councillors: Mike Paul & Doug McKenzie TFN Mineral Resources Advisor: David Laronde Companies: Gino Chitaroni (TG/PM) & Dale Shultz (PM/TG)	8hrs	TG/PM

Abbreviations Glossary

Companies

PM = Progenitor Metals
TG = Temagami Gold
ECM = East Copperfield Metals

First Nations

TFN = Temagami First Nation
TAA = Tema-Agauma-Anishnabi

Compiled By:

Gino Chitaroni
November 15-2018
Cobalt, Ontario

Native Consultation Record

Randy Becker
TAA Chief

Type: Facebook Conversation and Phone Calls
For Years 2018 and 2017.

Date	Subject	Time Length	Company
Year 2018			
October 28-2018	TAA/TFN First Nation Work potential and potential for TFN/TAA investment into ECM or TG/PM.	2 hrs	ECM + TG/PM
October 24-2018	Discussion regarding work for TG/PM On the Sherman Tailings.	1 hr	TG/PM
October 9-2018	Investment discussions into ECM and TG/PM regarding Gamet Gold and TFN.	1 hr	ECM + TG/PM
October 7-2018	Drill Core Storage discussion for drill training operations with respect to ECM and/or TG/PM.	1 hr	ECM + TG/PM
Year 2018			
October 13-2017	Discussion about Blasting Services and Kanichee Mine mill clean-up and millsite Storage uses.	2 hrs	TG
Sept 18-2017	Work in the Cobalt Area operations and ECM project progress.	1 hr	ECM
Sept 4-2017	Email and phone call regarding Progress on TG exploration programs.	1 hr	TG
June 22-2017	TFN and Gamet Gold discussions regarding Roosevelt Traprock Deposit project and Investment possibilities for TFN. Plus overall drilling services for availability for TG .	1 hr	Roosevelt Traprock and TG

June 6-2017	Field Office Discussion for the Kanichee Mine Road and TG progress.	1 hr	TG
May 14-2017	Discussion regarding the Kanichee Mine road improvement complaint by a local resident resident (non-native person).	1hr	TG
May 7-2017	Work Bidding issues for TFN/First Nations Discussion on area exploration projects for TFN, Nimkie etc... specific to Brush Hog work, Drilling etc...	2 hrs	TG

ECM = East Copperfield Metals

TG = Temagami Gold

PM = Progenitor Metals

Compiled By: Gino Chitaroni, B.Sc.
For ECM & TG/PM

October 29-2018
Cobalt, Ontario