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GLENCORE CANADA CORPORATION

VTEM^{TM} MAX AND AEROMAGNETIC SURVEY REPORT
APRIL-MAY 2019

STURGEON LAKE PROPERTY
ONTARIO, CANADA

Report completed on November 4, 2020

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SUMMARY

An heli-borne geophysical survey has been flown from April 25, 2019, to May 15, 2019, over the Sturgeon Lake property owned by Glencore Canada Corporation. This survey has been performed by Geotech Ltd and covered an area of 133 km^2. Two main geophysical sensors have been used which are a versatile time domain electromagnetic (VTEM^{TM} Max) system and a caesium magnetometer. Ancillary equipment included a GPS navigation system and a radar altimeter.

The objective of this survey was to identify conductors that could correspond to a volcanic massive sulphide deposit type. The results of the survey are presented in the following maps (WGS84 Datum, UTM Zone 15 North) in Appendix D:

- VTEM B-Field Z component profiles - Time gates 0,220 – 7,036 ms over total magnetic intensity
- VTEM B-Field Z component channel 25 - Time gate 0,440 ms
- VTEM dB/dt Z component profiles – Time gates 0,220 – 7,036 ms
- Fraser filtered dB/dt X component channel 28 – Time gate 0.667 ms
- dB/dt calculated time contant (Tau)
- Total magnetic intensity (TMI)
- EM Anomalies

1.0. INTRODUCTION

Sturgeon Lake property owned by Glencore Canada Corporation has been a prolific mining camp over the years hosting multiple producing base metal mines.

This technical report has been prepared by Glencore Canada Corporation in order to report assessment work under the provisions of the Mining Act of Ontario R.S.O. 1990.

2.0. LOCALISATION

Sturgeon Lake property is located in the Ontario Province at approximately 70 kilometres north-northeast of Ignace town and approximately 85 kilometres east-southeast of Sioux Lookout Town (Figure 1). The property is located in NTS sheets 52G14 and 52G15.

From Thunder Bay, the property can be reached by travelling northwest on Trans-Canada Highway (17) to the town of Ignace then by driving northeast on road 599. The property can be accessed via a private partly paved and gravelled road located roughly 500 metres north of Silver Dollar lodge on road 599. This private and secure road leads to the old mine site of Mattabi which is roughly in the centre of the Sturgeon Lake property (Figure 2).

The Sturgeon Lake property is located within the Bell Lake, Six Miles Lake, Valora Lake and Penassi Lake areas in the Patricia Mining Division of Ontario. It consists of 58 mining claims[1], 23 mining leases and 14 patents (See full list in Appendix A and full-size map in Appendix F). The property is held by Glencore Canada Corporation.

The property exhibit minimal relief with elevation ranging from 404 to 495 metres above mean sea level. Various rivers and streams running through the survey area which connects various small

[1] There was 169 claims when the work was completed but they have been amalgamated into 58 claims in the meanwhile

lakes and wetlands. There are also several small roads and trails going through the property as well as power lines, railroad and mining areas (Figure 3).

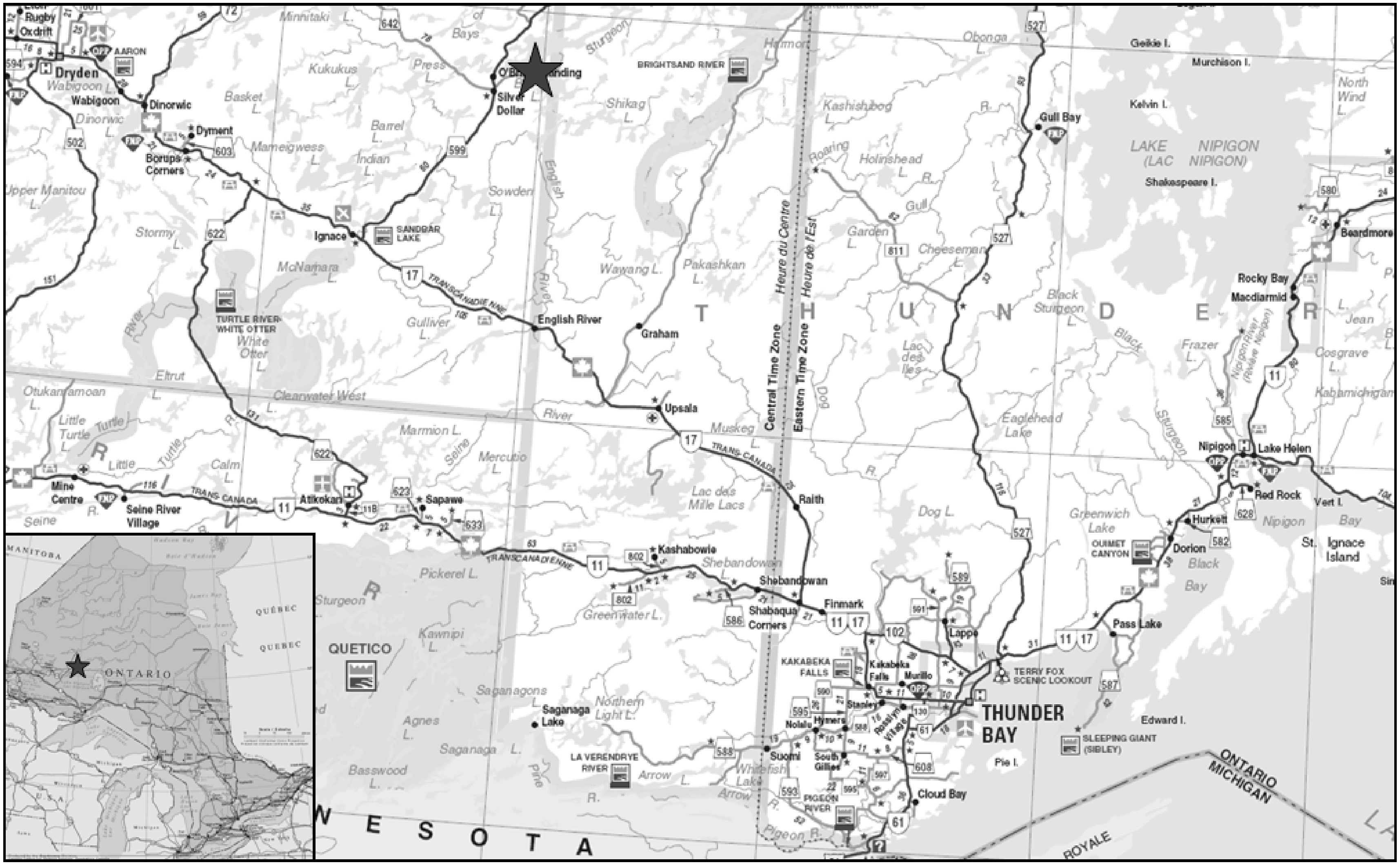

Figure 1 : Sturgeon Lake Property Location Map

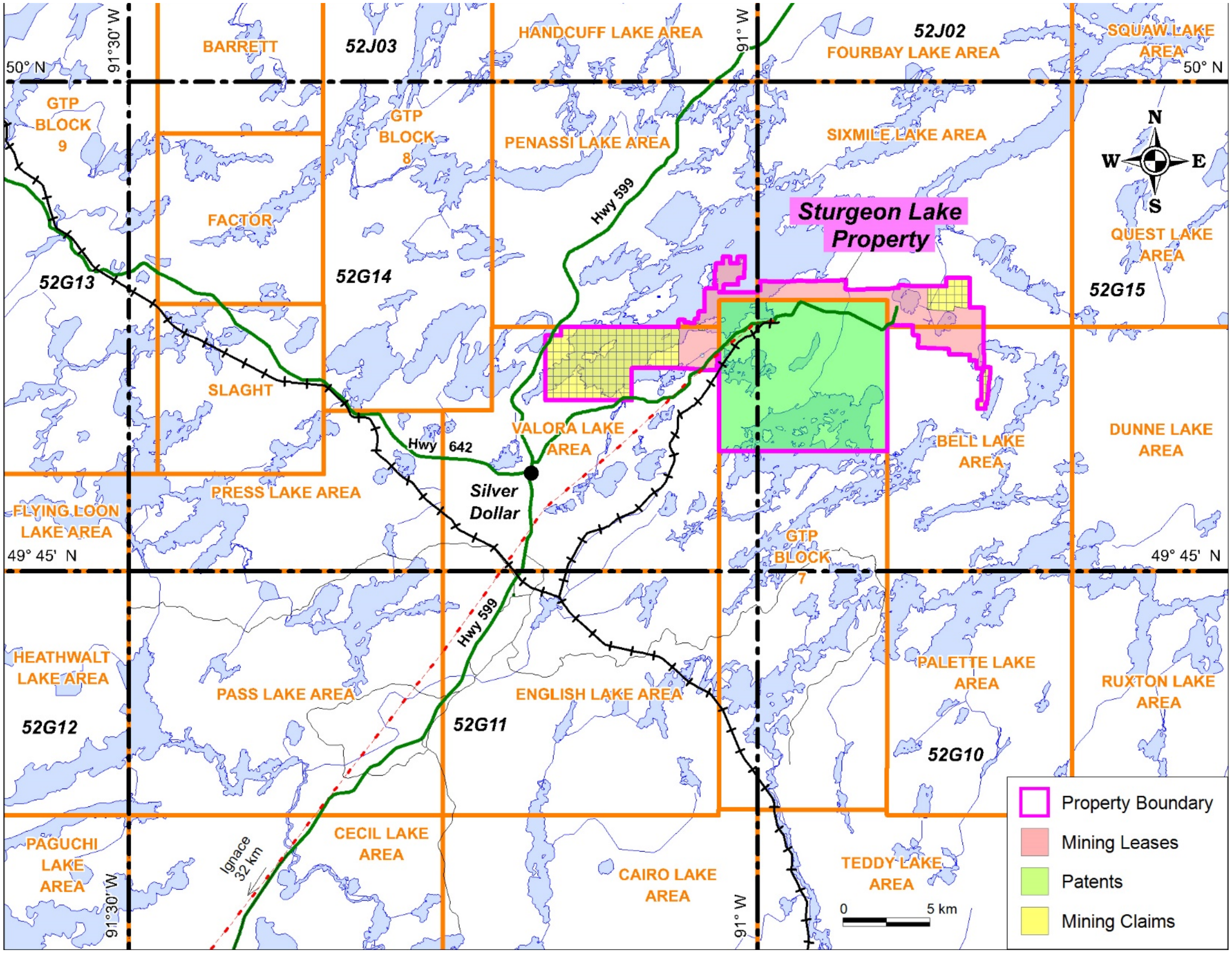

Figure 2 : Sturgeon Lake Property Regional Location Map (Long/Lat NAD 83)

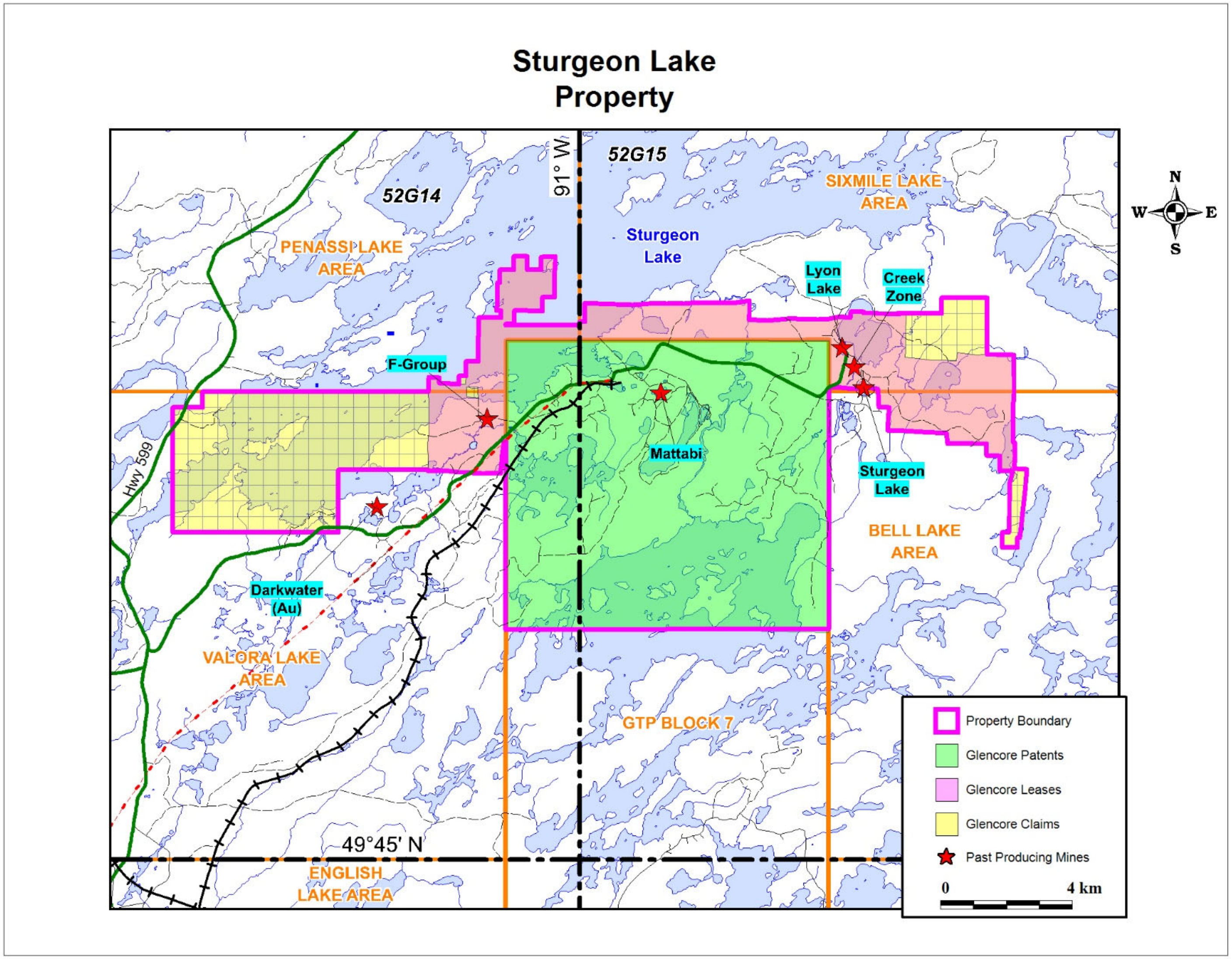

Figure 3 : Sturgeon Lake property map (Long/Lat NAD 83)

3.0. HISTORY OF THE PROPERTY

Sturgeon Lake property has been a prolific mining camp over the years hosting multiple producing base metal mines combining a total production of 19,8 million tons at an average of 8.50% Zn, 1.06% Cu, 0.91% Pb and 119.7 g/t Ag (**Error! Reference source not found.**) (Franklin, 1996).

Table 1 – Historical production of the Sturgeon Lake Mining Camp (Franklin, 1996)

		Grade			
Deposit	**Metric Tons**	**Zn (wt. %)**	**Cu (wt. %)**	**Pb (wt. %)**	**Ag (g/t)**
F Group	340,000	9.51	0.64	0.64	60.4
Mattabi	12,550,000	8.28	0.74	0.85	104.0
Lyon Creek and SubCreek Zone	3,950,000	6.53	1.24	0.63	141.5
Creek Zone	910,000	8.80	1.66	0.76	141.5
Sturgeon Lake	2,070,000	9.17	2.55	1.21	164.2
TOTAL	19,820,000	8.50	1.06	0.91	119.7

Sturgeon Lake property has been acquired by Glencore Canada Corporation in 2013 during the acquisition of Xstrata. The property has a complex history which is the results of numerous companies merging, company acquisition, joint venture, land acquisition and claim resignation over the years. Work completed since 2010 is listed in Table 2 . A non-exhaustive list of the work done on the claims and leases of the Sturgeon Lake property since 1966 according to the Mining Lands Administration System (MLAS) archives is also available in Appendix B.

Table 2 - Sturgeon Lake property work history since 2010

Year	**Company**	**Work Type**	**Assessment file No.**
2010	Xstrata Zinc Canada Corp	Geological Mapping/Sampling	20000005556
2010	Xstrata Zinc Canada Corp	Airborne Mag and EM	20000006888
2011	Xstrata Zinc Canada Corp	Drilling and BHEM	20000007677

2013	Xstrata Zinc Canada Corp	Drilling	20000013530
2013	Glencore Canada Corporation	Drilling	20000014747
2019	Glencore Canada Corporation	Drilling	20000018459
2019	Glencore Canada Corporation	Airborne Mag and EM	Current Report

4.0. REGIONAL GEOLOGY

The Archean Savant Lake-Sturgeon Lake greenstone belt is located within the Wabigoon volcano-sedimentary subprovince which is part of the Superior province. Covering most part of the property, the South Sturgeon Sequence in the south part of the Savant Lake-Sturgeon Lake belt is recognized to host the Sturgeon Lake Caldera Complex (Hudak et al., 2003).

The caldera is up to 25 km in strike length and is approximately 3 kilometres thick with north-facing vertical to steep north dipping (55°) intracaldera felsic to mafic tholeiitic/calcalkalic volcanics rocks mixed with volcanoclastic units and sediments locally intruded by syn- to post-volcanic plutons sills and dykes (Morton et al. 1991; Morton et al, 1999)

The caldera hosts multiple volcanic massive sulphide occurrences which are interpreted to have formed within an evolved, continental margin oceanic arc (Sanborn-Barrie et al. 2001; Galley, 2002) that contained magmas derived from back-arc basalts (Galley, 2003) which haven't been contaminated to any large extent by the older Wabigoon Province continental crust (Bernier et al. 1999). Zircon ages of the ash flow tuff and late dome lava had an age of 2,735 million years plus or minus 1,5 million years (Davis et al., 1985)

Pre-caldera mafic volcanic rocks at the base of the caldera complex are intruded by the sill-like syn-volcanic Beidelman Bay Intrusive Complex and by the Pike Lake Layered Complex. Those two intrusive units are interpreted to have provided the thermal energy required to drive the hydrothermal system that led to volcanic massive sulphide (VMS) generation in the mining camp (Franklin et al., 1975; Campbell et al., 1981; Hudak, 1989; Jongewaard, 1989; Morton et al., 1991; Galley et al., 2000; Galley, 2002; Holk et al., 2002, Galley, 2003).

The stratigraphy is characterized by thirteen supracrustal successions that have been grouped in four stratigraphic sequences (Hudak, 1996): The Pre-caldera Sequence (PCS), the Early Caldera Sequence (ECS), the Late Caldera Sequence (LCS) and the Lyon Lake Fault Sequence (LLFS). Contact between those stratigraphic intervals host sub-seafloor replacement style volcanic massive sulphide (VMS) deposits (Doyle and Allen, 2003). Known copper-molybdenum porphyric style mineralization in the area as described by Poulsen and Franklin (1981) is anterior to the caldera formation (Galley et al. 2000; Galley, 2002)

Three type of fault has been identified within the area: synvolcanic faults, post-volcanic high-angle faults and post-volcanic low angles shear zones which may represent thrust faults within the caldera (Gibson et al. 1999).

A full size regional geological map is available in Appendix G.

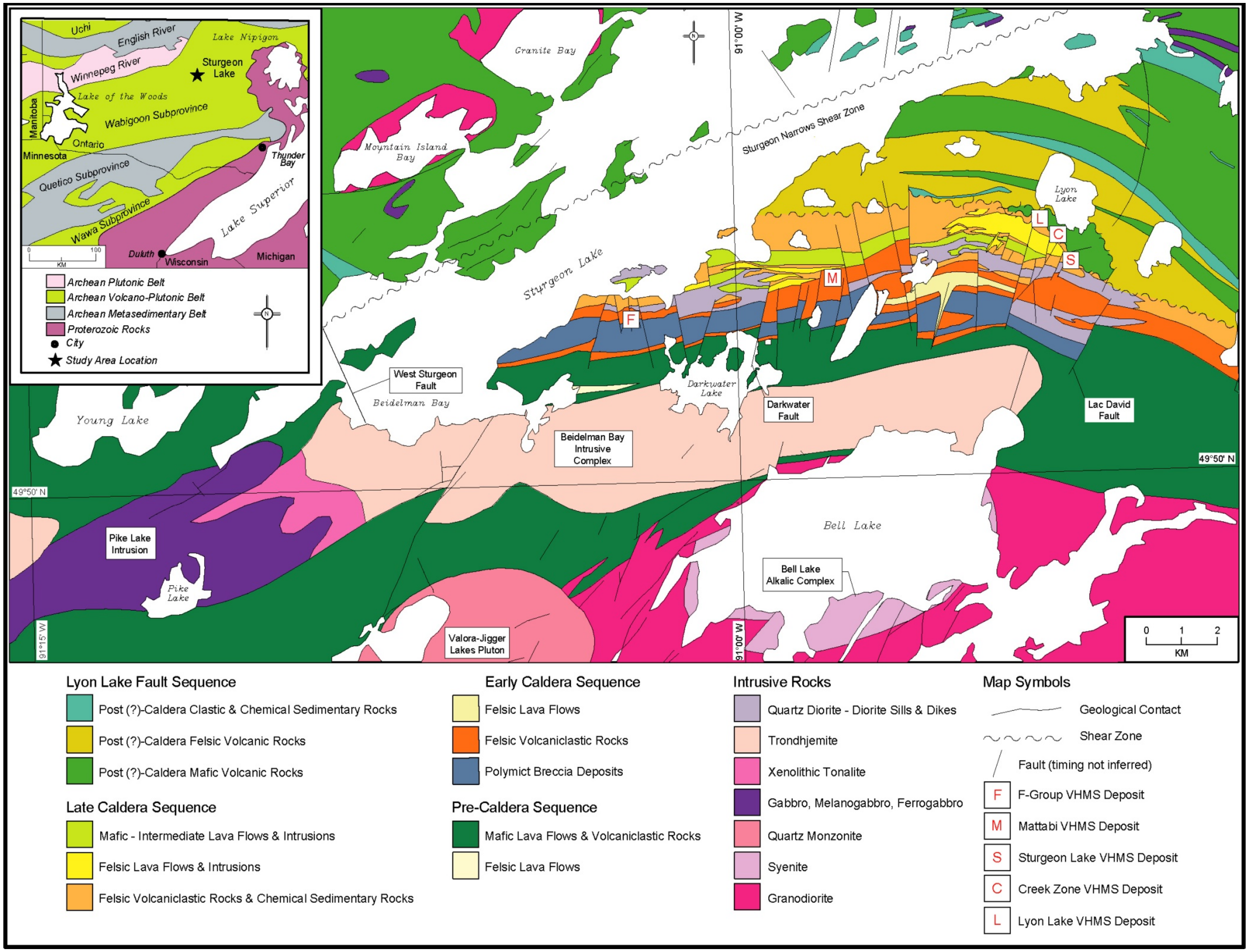

Figure 4 : Geology of the Sturgeon Lake caldera complex (Morton and al.,1991; Hudak and al., 2003) (Long/Lat NAD 83)

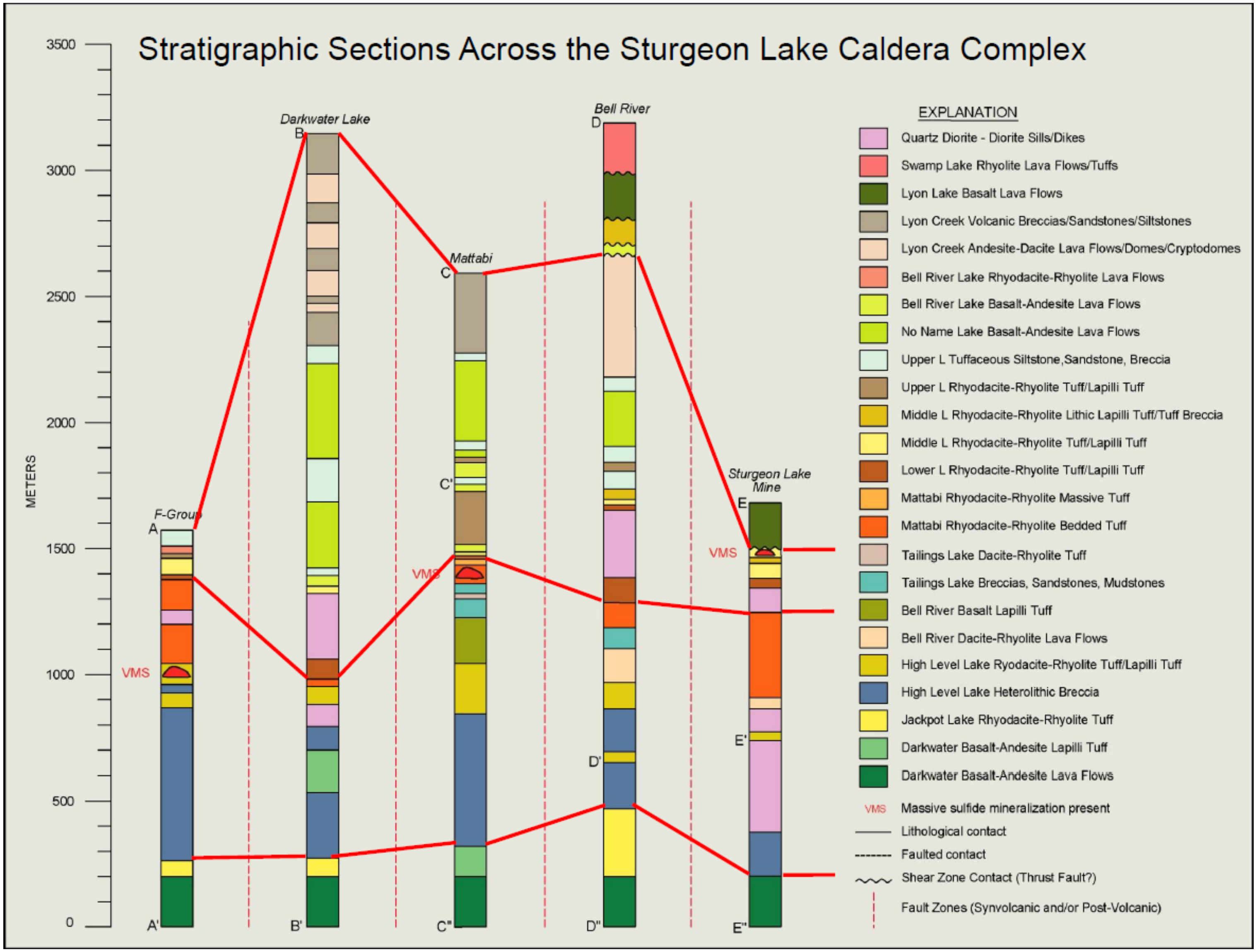

Figure 5 – Sturgeon Lake stratigraphic sequence (Hudak, Unpublished)

5.0. EXPLORATION TARGETS

The goal of the survey was to improve the understanding of the regional geology while identifying conductors that could correspond to polymetallic Zn-Cu-Pb-Au-Ag massive sulphide deposits.

6.0. SURVEY

Information presented in the following section has been extracted from Geotech Ltd report completed in July 2019 (*REPORT ON A HELICOPTER-BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM™max) AND AEROMAGNETIC GEOPHYSICAL SURVEY*) annexed in Appendix C and from Geotech Ltd report (EM ANOMALY SUMMARY ON A HELICOPTER-BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM™*max*) AND AEROMAGNETIC GEOPHYSICAL SURVEY) annexed in appendix D.

6.1. Instrumentation

6.1.1. Helicopter

The survey was flown using a Eurocopter Aerospatiale (A-star) 350 B3 helicopter. The helicopter is owned and operated by Geotech Aviation. Installation of the geophysical and ancillary equipment was carried out by Geotech Ltd crew.

6.1.2. VTEM™ Max

The electromagnetic system used was a Geotech Time Domain EM (VTEM™ Max) full receiver-waveform streamed data recorded system (Table 3). The full waveform VTEM™ system uses the streamed half-cycle recording of transmitter and receiver waveforms to obtain a complete system response calibration throughout the entire survey flight.

The VTEM™ receiver and transmitter coils were in concentric-coplanar and Z-direction oriented configuration. The receiver system for the project also included a coincident-coaxial X-direction coil to measure the in-line dB/dt and calculate B-Field responses. The transmitter-receiver loop was towed at the mean distance of 48 metres below the aircraft.

VTEM^{TM} decay time consisted of forty-three-time measurement gates in the range from 0.021 msec to 8.083 msec. Zero time from the off-time sampling scheme is defined as the time near the end of the turn-off ramp where the dI/dt waveform falls to half of its peak value.

Table 3 – VTEM^{TM} system specification

Transmitter	Receiver
• Loop diameter: 34.6 m • Number of turn: 4 • Effective loop area: 3761 m^2 • Base frequency: 30 Hz • Peak current: 174 • Pulse width: 6.52 • Waveform shape: Bipolar trapezoid • Peak dipole moment: 654.994 nIa • Average loop terrain clearance: 51 m above the ground	• X coil diameter: 0.32 m • X Number of turn: 245 • X Effective coil area: 19.69 m^2 • Z coil diameter: 1.2 m • Z Number of turn: 100 • Z Effective coil area: 113.04 m^2

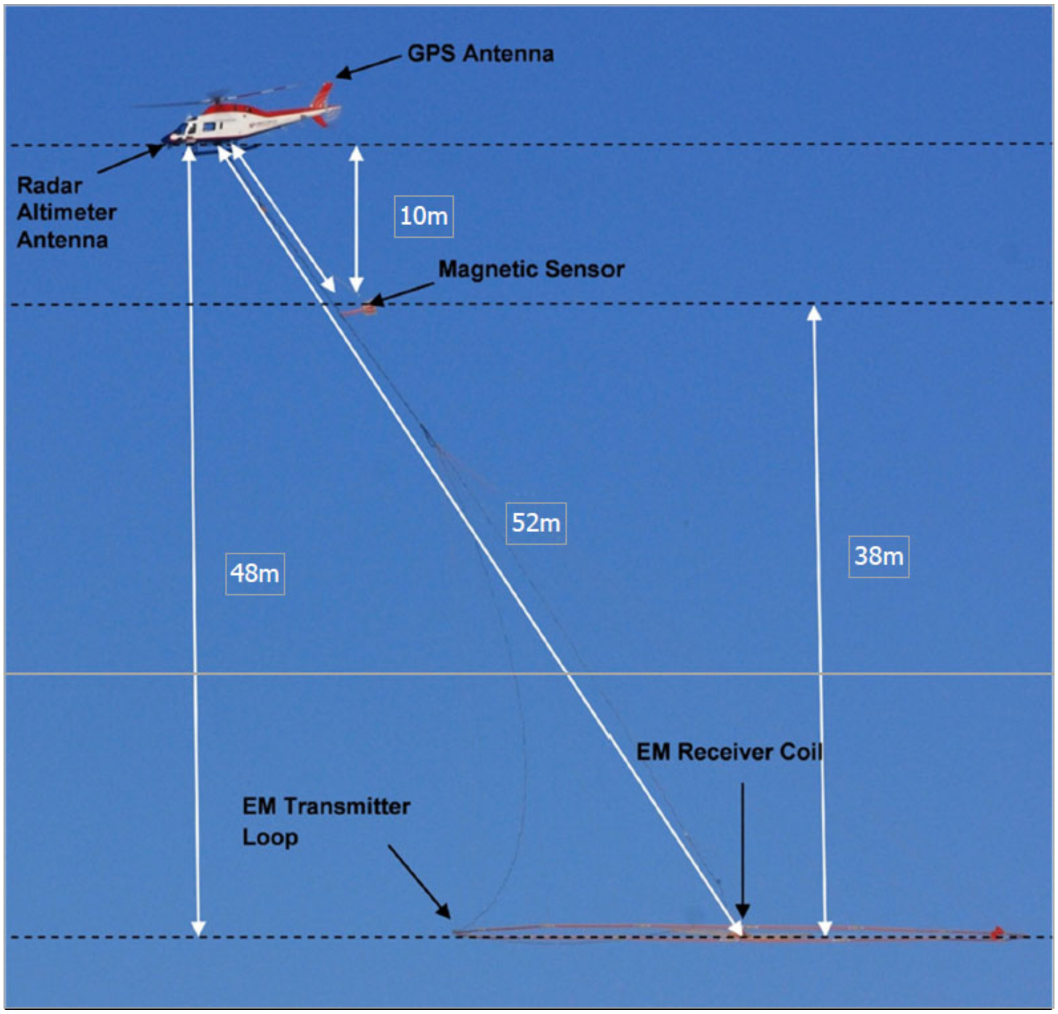

Figure 6 –System configuration

6.1.3. Airborne Magnetometer

The magnetic sensor utilized for the survey was Geometrics optically pumped caesium vapours magnetic field sensors mounted 10 metres below the helicopter, as shown in Figure 6. The sensitivity of the magnetic sensor is 0.02 nanoteslas (nT) at a sampling interval of 0.1 seconds.

6.1.4. Radar Altimeter

A Terra TRA 3000/TRI 40 radar altimeter was used to record terrain clearance. The antenna was mounted beneath the bubble of the helicopter cockpit (Figure 6).

6.1.5. GPS Navigation System

The navigation system used was a Geotech PC104 based navigation system utilizing a NovAtel's WAAS (Wide Area Augmentation System) enabled GPS receivers, Geotech navigate software, a full-screen display with controls in front of the pilot to direct the flight and a NovAtel GPS antenna mounted on the helicopter tail (Figure 6). As many as 11 GPS and two WAAS satellites may be monitored at any one time. The positional accuracy or circular error probability (CEP) is 1.8 m, with WAAS active, it is 1.0 m. The coordinates of the survey area were set-up prior to the survey and the information was fed into the airborne navigation system.

6.1.6. Digital Acquisition System

A Geotech data acquisition system recorded the digital survey data on an internal compact flash card. Data is displayed on an LCD screen as traces to allow the operator to monitor the integrity of the system. The data type and sampling interval as provided in Table 4.

Table 4 – Acquisition sampling rates

Data Type	Sampling
TDEM	0.1 sec
Magnetometer	0.1 sec
GPS position	0.2 sec
Radar altimeter	0.2 sec
Inclinometer	0.1 sec

6.1.7. Base station

A combined magnetometer/GPS base station was utilized on this project. A Geometrics Caesium vapour magnetometer was used as a magnetic sensor with a sensitivity of 0.001 nT. The base station was recording the magnetic field together with the GPS time at 1 Hz on a base station computer.

The first base station magnetometer sensor was installed in a secured location away from culture and electric transmission lines and moving ferrous objects such as motor vehicles. The base station data were backed up to the data processing computer at the end of each survey day.

6.2. Methodology

6.2.1. General consideration

The survey was performed by Geotech Ltd. on behalf of Glencore Canada Corporation. The crew was based in Sioux Lookout town for the acquisition phase of the survey.

The on-board operator was responsible for monitoring the system integrity. He also maintained a detailed flight log during the survey tracking the times of the flight as well as any unusual geophysical or topographic features.

On return to the base camp, the survey data was transferred from a compact flash card to the data processing computer. The data were then uploaded via ftp to the Geotech office in Aurora for daily quality assurance and quality control by qualified personnel.

Michel Allard from Inter Géophysique Inc, represented Glencore Canada Corporation during the data acquisition and data processing phases of this project. Data quality control, quality assurance and preliminary data processing were carried out daily during the acquisition phase of the project. Final data processing followed immediately after the end of the survey by Geotech Ltd and Michel Allard.

6.2.2. Flight Specifications

The survey area was flown in a north to south (N 0°E) line direction at 100-metre line spacing. Tie lines were flown perpendicular at 1000 metres spacing. 1484 kilometres of lines have been done on 1436 kilometres planned (Table 5). On this number, 1327 kilometres of line (89.42%) was flown over the mining lands for which the assessment work is to be credited.

Table 5 – Survey Specifications

Survey Block	Line Spacing (m)	Area (km^2)	Planned Line-km	Actual Line-km	Flight direction	Line numbers
Sturgeon Lake	Traverse: 100	133	1436	1484	N0°E – N180°E	1000-3130
	Tie: 1000				N90°E – N270°E	5000-5100

TOTAL	133	1436	1484	

Survey operation has been done from April 25, 2019, to May 15, 2019. The Table 6 shows the timing of the flying.

Table 6 – Survey schedule

Date	**Comments**
April 25, 2019	Crew and equipment arrive in Sioux Lookout
April 26, 2019	System assembly
April 27, 2019	System assembly
April 28, 2019	System testing
April 29, 2019	System testing
April 30, 2019	Production flight
May 1, 2019	Production flight
May 2, 2019	No production due to weather
May 3, 2019	Production flight
May 4, 2019	No production due to weather
May 5, 2019	No production due to weather
May 6, 2019	Production flight
May 7, 2019	Production flight
May 8, 2019	Production flight
May 9, 2019	No production due to weather
May 10, 2019	Production flight
May 11, 2019	Production flight
May 12, 2019	No production due to weather
May 13, 2019	Production flight
May 14, 2019	Production flight
May 15, 2019	Production flight – Flight path completed

During the survey the helicopter was maintained at a mean altitude of 99 metres above the ground with an average survey speed of 80 kilometres per hour. This allowed for an actual average transmitter-receiver loop terrain clearance of 51 metres and a magnetic sensor clearance of 89 metres.

6.2.3. Calibration

A calibration was performed on the complete VTEM™ system installed in and connected to the helicopter, using special calibration equipment. This calibration takes place on the ground at the start of the project prior to surveying.

The procedure takes half-cycle files acquired and calculates a calibration file consisting of a single stacked half-cycle waveform. The purpose of the stacking is to attenuate natural and man-made magnetic signals, leaving only the response to the calibration signal.

This calibration allows the transfer function between the EM receiver and data acquisition system and also the transfer function of the current monitor and data acquisition system to be determined. These calibration results are then used in VTEM full waveform processing.

6.2.4. Data processing

Data compilation and processing were carried out by the application of Geosoft OASIS Montaj and programs proprietary to Geotech Ltd.

6.2.4.1. Flight path

The flight path, recorded by the acquisition program as WGS 84 latitude/longitude, was converted into the WGS84 Datum, UTM Zone 15 North coordinate system in Oasis Montaj.

The flight path was drawn using linear interpolation between x, y positions from the navigation system. Positions are updated every second and expressed as UTM easting's (x) and UTM northing's (y). A flight path map can be found in appendix H.

6.2.4.2. Electromagnetic data

The full waveform EM specific data processing operations included:

- Half cycle stacking (performed at the time of acquisition)

- System response correction
- Parasitic and drift removal

A three stages digital filtering process was used to reject major sferic events and to reduce noise levels. Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal-to-noise ratio was further improved by the application of a low pass linear digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 1 second or 15 metres. This filter is a symmetrical 1 sec linear filter.

The results are presented as stacked profiles of EM voltages for the time gates, in linear - logarithmic scale for the B-field Z component and dB/dt responses in the Z and X components. B-field Z component time channel recorded at 0.440 milliseconds after the termination of the impulse is also presented as a colour image.

VTEM™ has two receiver coil orientations. Z-axis coil is oriented parallel to the transmitter coil axis and both are horizontal to the ground. The X-axis coil is oriented parallel to the ground and along the line-of-flight. This combined two coil configurations provide information on the position, depth, dip and thickness of a conductor.

In general X-component data produce crossover type anomalies: from "+ to – "in flight direction of flight for "thin" sub vertical targets and from "- to +" in direction of flight for "thick" targets. Z component data produce double peak type anomalies for "thin" sub vertical targets and single peak for "thick" targets.

The limits and changeover of "thin-thick" depends on dimensions of a TEM system. Because of X component polarity is under line-of-flight, convolution Fraser Filter (Figure 7) is applied to X component data to represent axes of conductors in the form of grid map. In this case positive FF anomalies always correspond to "plus-to-minus" X data crossovers independent of the flight direction.

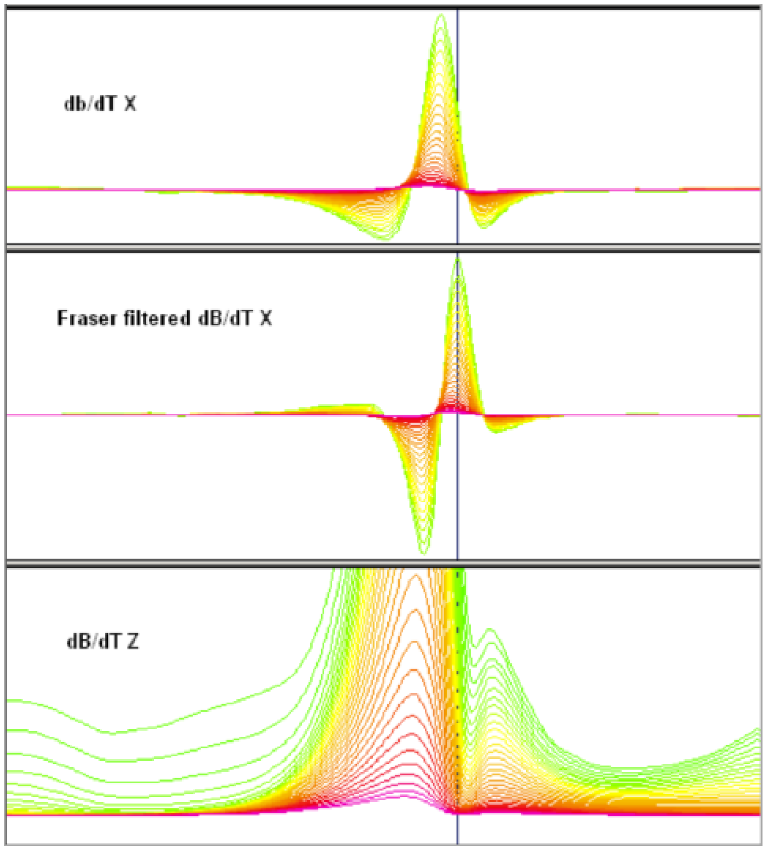

Figure 7 – Z, X and Fraser filtered X (FFx) components for « thin » target

6.2.4.3. Magnetic data

The processing of the magnetic data involved the correction for diurnal variations by using the digitally recorded ground base station magnetic values. The base station magnetometer data was edited and merged into the Geosoft GDB database on a daily basis. The aeromagnetic data was corrected for diurnal variations by subtracting the observed magnetic base station deviations.

Tie line levelling was carried out by adjusting intersection points along traverse lines. A micro-levelling procedure was applied to remove persistent low-amplitude components of flight-line noise remaining in the data.

The corrected magnetic data was interpolated between survey lines using a random point gridding method to yield x-y grid values for a standard grid cell size of approximately 25 metres at the mapping scale. The Minimum Curvature algorithm was used to interpolate values onto a rectangular spaced regular grid.

7.0. RESULTS

Final maps were produced in .PDF and GEOTIFF format at scale of 1:20,000 for best representation of the survey size and line spacing (Appendix D). The coordinate/projection system used was WGS84 Datum, UTM Zone 15 North. The produced map are:

- VTEM B-Field Z component profiles - Time gate 0,220 – 7,036 ms over total magnetic intensity
- VTEM B-Field Z component channel 25 - Time gate 0,440 ms
- VTEM dB/dt Z component profiles – Time gates 0,220 – 7,036 ms
- Fraser filtered dB/dt X component channel 28 – Time gate 0.667 ms
- dB/dt calculated time contant (Tau)
- Total magnetic intensity (TMI)
- EM Anomalies

8.0. INTERPRETATION

In addition to the logistic report (Appendix C), Geotech produced an interpretation report (EM ANOMALY SUMMARY ON A HELICOPTER-BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM™ MAX) AND AEROMAGNETIC GEOPHYSICAL SURVEY) that is presented in Appendix D. The basic behind the EM methods and the physics of EM induction is summarized in the report as well as the anomaly picking process. The report concluded that most of the anomalies are related to conductors located along three distinct arcuate trends.

The interpretation report also contains a section explaining the origin of the AIIP (Airborne Inductively Induced Polarization) anomalies. Two examples are given, one originated from clay at the bottom of a lake and the other from a mine waste in a tailing pond.

Finally, the report mentions the presence of extensive cultural artifacts such as power lines, roads and buildings. The following 8.1 paragraphs are extracted from the interpretation report.

8.1 EM anomalies

The main objective of VTEM surveys over the Sturgeon Lake property was to identify local and discrete EM anomalies that could have been missed by previous airborne geophysical EM surveys, including INPUT, Aerodat and MEGATEM surveys.

The EM data was examined by Geotech geophysicists for anomalous responses using all-time channels of the dB/dt and B-Field profiles. A total of 554 anomalies were identified and classified into one of six categories, as shown in **Error! Reference source not found.**. Their corresponding anomaly symbols are reproduced on the anomaly map (Appendix D) at the position of the target's centre projected onto the surface. Each symbol is accompanied by a posting denoting the calculated dB/dt conductance, calculated dB/dt and B-field decay constant (Tau). Each symbol is also accompanied by an anomaly identification letter, e.g., A, B, C, etc. uniquely defined for each flight line. Double peak anomalies in the dB/dt data (sub-vertical and thin conductors) are distinguished by an orange dot inside the anomaly symbol. The anomalous responses are picked, reviewed and edited on a line-by-line basis to discriminate between bedrock and cultural conductors. Some discrete and localized anomalies with negative transients in the mid-to late-time channels are picked as Airborne Inductively Induced Polarization (AIIP) anomalies.

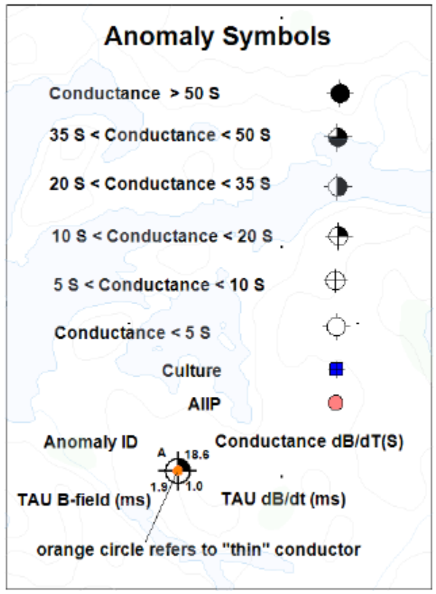

Figure 8 – EM anomaly legend

9.0. CONCLUSION AND RECOMMENDATIONS

Even if no new conductors were identified by the VTEM survey, some untested or not fully tested anomalous zones were underlined. A more detail work of geological compilation is necessary to validate them to determine if the context could be favourable for massive sulphide mineralization.

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11.0. CERTIFICATION AND SIGNATURES

I, Pascal Lessard, declare the following:

- I GRADUATED FROM L'UNIVERSITY DE MONTREAL IN B.SC. IN GEOLOGY IN 1994
- I AM A MEMBER OF THE ASSOCIATION OF PROFESSIONAL GEOSCIENTISTS OF ONTARIO (PGO) AS A FULL PRACTISING MEMBER UNDER MEMBER NUMBER 3138
- I HAVE BEEN WORKING WITH GLENCORE CANADA CORPORATION SINCE APRIL 1994
- THIS REPORT IS BASED ON MY PERSONAL KNOWLEDGE OF THE STURGEON LAKE PROPERTY
- I HAVE VISITED THE PROPERTY IN MULTIPLE OCCASIONS
- TO MY KNOWLEDGE, THE EXPENDITURES SUBMITTED ARE REASONABLE AND CONFORM TO THE WORK CARRIED OUT

PROFESSIONAL GEOSCIENTIST
PASCAL LESSARD
PRACTISING MEMBER
3138
ONTARIO

Pascal Lessard, P. Geo.
PGO member no. : 3138
Glencore Canada Corporation
November 4, 2020

CERTIFICATION AND SIGNATURE

I, Guillaume Ratthé, declare the following:

- I GRADUATED FROM L'UNIVERSITY DU QUEBEC A CHICOUTIMI (UQAC) IN ENGINEERING GEOLOGY IN 2014 AND COMPLETED A MASTER IN MINERAL EXPLORATION (UQAC) IN 2016
- I AM A MEMBER OF THE ASSOCIATION OF PROFESSIONAL GEOSCIENTISTS OF ONTARIO (PGO) AS FULL PRACTISING MEMBER UNDER MEMBER NUMBER 3136
- I HAVE BEEN WORKING WITH GLENCORE CANADA CORPORATION SINCE JANUARY 2017
- THIS REPORT IS BASED ON MY PERSONAL KNOWLEDGE OF THE STURGEON LAKE PROPERTY
- I HAVE VISITED THE PROPERTY IN MULTIPLE OCCASIONS
- TO MY KNOWLEDGE, THE EXPENDITURES SUBMITTED ARE REASONABLE AND CONFORM TO THE WORK CARRIED OUT

Guillaume Ratthé, M. Sc., P. Geo
PGO member no. : 3136
Glencore Canada Corporation
November 4, 2020