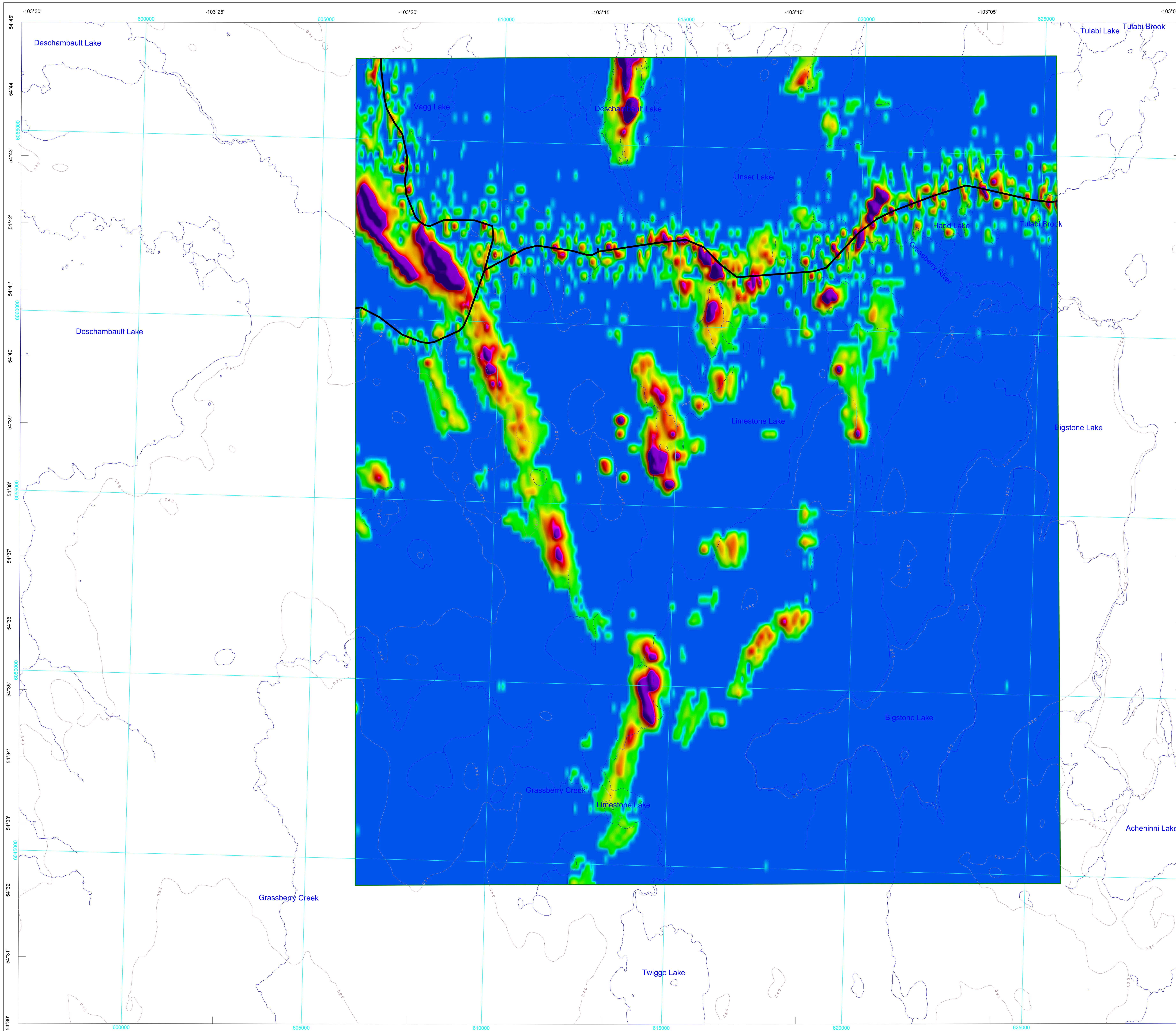
Natural Resources Canada / Ressources naturelles Canada

APPARENT CONDUCTIVITY - LATE CHANNEL 30 (8.272 ms)



The Creighton area electromagnetic and magnetic survey was funded by the Saskatchewan Ministry of Energy and Resources in support of the province's Mineral Development Strategy. It also complements a National Geological Survey Committee (NGSC) pilot project in the Creighton/Flin Flon area that demonstrates how public geoscience supports Canada's junior mining sector. Natural Resources Canada provided survey oversight and data processing, and produced the maps as part of the Targeted Geoscience Initiative (TGI) program of the Lands and Minerals Sector, Natural Resources Canada.

Technical Information

This map was compiled from data acquired during an airborne electromagnetic/magnetic survey carried out by CGG Canada Inc. utilizing CGG's HELITEM 35C Time-Domain Electromagnetic (TDEM) system. The system was mounted on a Eurocopter AS350 B3 helicopter (registration C-GFUG) and the survey was carried out between March 30 and June 13, 2018. The helicopter flight altitude was maintained at an average ground clearance of 80 m with an average speed of 90 km/h. Aircraft navigation used a 14-channel NovaTel dual frequency GPS system. Post-flight differential corrections were applied to finalize the flight path position. A vertically mounted video camera was used to record images of the ground. The radar height was recorded ten times per second using a Honeywell altimeter and the barometric altitude was recorded five times per second using a Motorola precision pressure transducer. The magnetic data were recorded 10 times per second using a Scintrex CS-3-A cesium magnetometer.

Electromagnetics

The TDEM system operating at a base frequency of 30 Hz transmits a 8.0 ms half sine signal from a four-turn, 962 m^2 horizontal loop mounted approximately 34.6 m below and 8 m behind the helicopter GPS. This configuration generates a dipole moment of 827 000 Am^2. The response of conductors in the subsurface is recorded at 192 kHz over the entire waveform using a three axis (X, Y and Z) electromagnetic receiver coincident with the transmitter loop (In-Loop Transmitter-Receiver). The EM system records data in a continuous stream for each of the three components. The EM receiver directly measures the change in the magnetic field with respect to time (dB/dt) from which the secondary total magnetic field (B) is numerically integrated. High-altitude background sections flown at the start and end of each flight allow a first-order removal of system drift.

Apparent Conductivity

The apparent conductivity values (mS/m) were derived from the electromagnetic decays using a selected early channel 5 (0.118 ms), middle channel 16 (0.802 ms) and late channel 30 (8.272 ms) of the off-time signal. The nomogram indicates the correspondence between the value of dBz/dt (nT/s) and halfspace conductivity. Forward thin plate modeling is used to estimate the depth to the top of target (m) for the HELITEM 35C TDEM system.

Electromagnetic Decay Constant

Decay constant (Tau) values are obtained by fitting the data from selected early Z channels 6 to 10 (0.130 ms to 0.309 ms), middle channels 15 to 19 (0.618 ms to 1.440 ms) and late channels 26 to 30 (3.906 ms to 8.960 ms) of the off-time signal to a single exponential. In semi-log space, the slope of this function will reflect the exponential decay rate of the transient field and, therefore, the strength of the conductivity. A slow rate of decay, reflecting a high conductivity, will be represented by a high decay constant value.

Magnetics

The magnetic field was sampled 10 times per second using a cesium vapour magnetometer (sensitivity = 0.001 nT) mounted on the EM transmitter loop. Differences in magnetic values at the intersections of control and traverse lines were analysed to obtain a mutually levelled set of flight-line magnetic data. The levelled values were then interpolated to a 50 m grid. The International Geomagnetic Reference Field (IGRF) defined at a mean GPS altitude (378 m) for a constant mid-survey date (May 6, 2018) was then removed. Removal of the IGRF, representing the magnetic field of Earth's core, produces a residual component related essentially to magnetizations within Earth's crust.

The first vertical derivative of the magnetic field is the rate of change of the magnetic field in the vertical direction. Computation of the first vertical derivative removes long-wavelength features of the magnetic field and significantly improves the resolution of closely spaced and superposed anomalies. A property of first vertical derivative maps is the coincidence of the zero-value contour with vertical contacts at high magnetic latitudes (Hood, 1965). The first vertical derivative of the magnetic field was calculated using the fast Fourier transform on the gridded total magnetic field with a grid cell size of 50 m.

Digital versions of this map are available for free download through GEOSCAN (http://geoscan.nrcan.gc.ca/). Corresponding digital profile and gridded data as well as similar data for adjacent airborne geophysical surveys can be downloaded, at no charge, from Natural Resources Canada's Geoscience Data Repository for Geophysical Data at http://gdr.agg.nrcan.gc.ca/index_e.html. The same products are also available, for a fee, from the Geophysical Data Centre, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8. Telephone: 613-995-5326, email: infogdc@nrcan.gc.ca.

Acknowledgments

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Reference

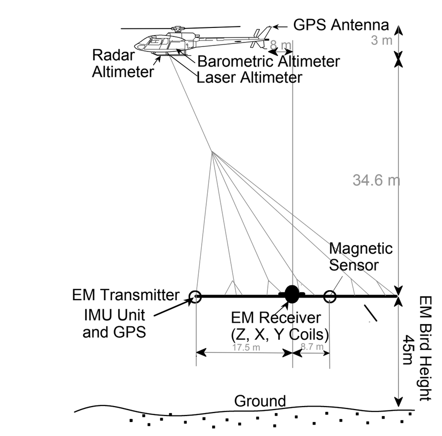
Hood, P.J., 1965. Gradient measurements in aeromagnetic surveying; Geophysics, v. 30, p. 891-902.

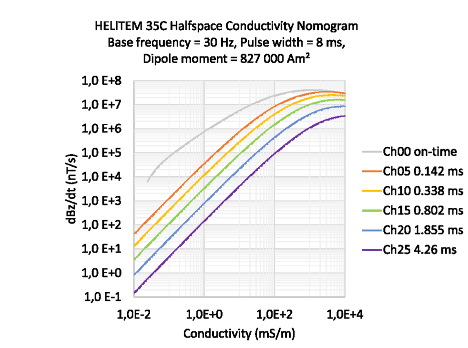
Survey Area Parameters:

Traverse line azimuth	N88°E
Traverse line spacing	200 m
Tie line azimuth	N358°E
Tie line spacing	1200 m
Aircraft average clearance	80 m
EM transmitter nominal clearance	45 m
Magnetic sensor nominal clearance	45 m
EM receiver nominal clearance	45 m

Electromagnetic System Specifications:

Base frequency	30 Hz
Waveform	Half sinusoid
Transmitter pulse width	8 ms
Transmitter area	962 m^2
Transmitter off-time	8.9 ms
Transmitter loop diameter	35 m
Transmitter current	215 A
Dipole moment (approximately)	827 000 Am^2 (4 turns)
Windowed data sampling rate	10 Hz
Receiver	3-component induction coil (Z, X, Y)
Measured response	Voltage (dB/dt)
Digital recording	Z,X,Y: 5-30 channels
1st off-time Z channel	Channel 5 at ~8 ms after pulse turn off
Tx-Rx configuration	In-loop concentric





PLANIMETRIC SYMBOLS

- Drainage
- Power Line
- Topographic Contours (Contour Interval = 20 m)
- Building
- Trail
- Flight Path L12370> 62500
- Project Limit

Sheet 1: Time Decay Constant (Tau-Z) - Early Channels (6 to 10)
Sheet 2: Time Decay Constant (Tau-Z) - Mid Channels (15 to 19)
Sheet 3: Time Decay Constant (Tau-Z) - Late Channels (26 to 30)
Sheet 4: Apparent Conductivity - Early Channel 5 (0.118 ms)
Sheet 5: Apparent Conductivity - Mid Channel 16 (0.802 ms)
Sheet 6: Apparent Conductivity - Late Channel 30 (8.272 ms)
Sheet 7: Residual Total Magnetic Field
Sheet 8: First Vertical Derivative of the Magnetic Field
Sheet 9: Interpretation

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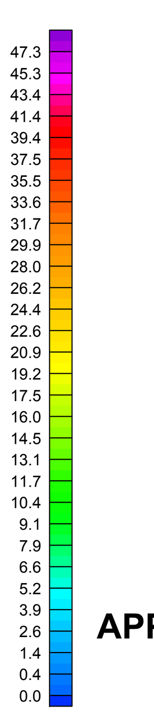
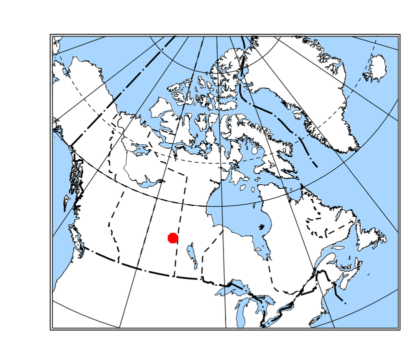
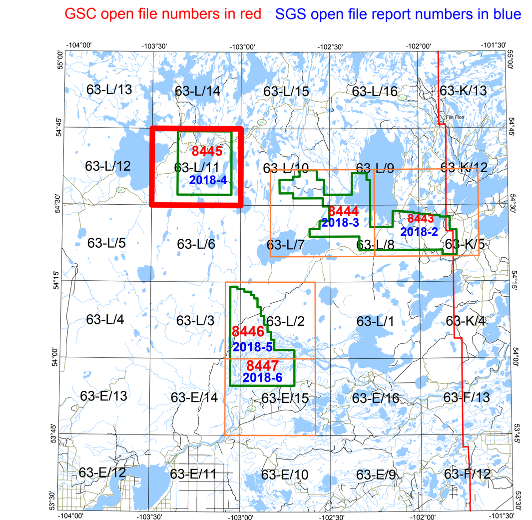




MAP LOCATION

NTS map sheet numbers in black

GSC open file numbers in red SGS open file report numbers in blue



NATIONAL TOPOGRAPHIC REFERENCE SYSTEM AND GEOPHYSICAL MAP INDEX

GEOLOGICAL SURVEY OF CANADA OPEN FILE 8445
SASKATCHEWAN GEOLOGICAL SURVEY OPEN FILE REPORT 2018-4

ELECTROMAGNETIC SURVEY OF THE CREIGHTON AREA

SASKATCHEWAN
Part of NTS 63-L/11

APPARENT CONDUCTIVITY - LATE CHANNEL 30 (8.272 ms)

Scale 1:50 000

1000 0 1000 2000 3000
(metres)
WGS 84 / UTM zone 13N

Map projection Universal Transverse Mercator, zone 13N. World Geodetic System 1984

Topographic data from Natural Resources Canada
Contour interval 20 metres

OPEN FILE / DOSSIER PUBLIC
8445
GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
2018

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OPEN FILE REPORT
RAPPORT DE DOSSIER PUBLIC
2018-4
SASKATCHEWAN GEOLOGICAL SURVEY
COMMISSION GÉOLOGIQUE DE LA SASKATCHEWAN
2018

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