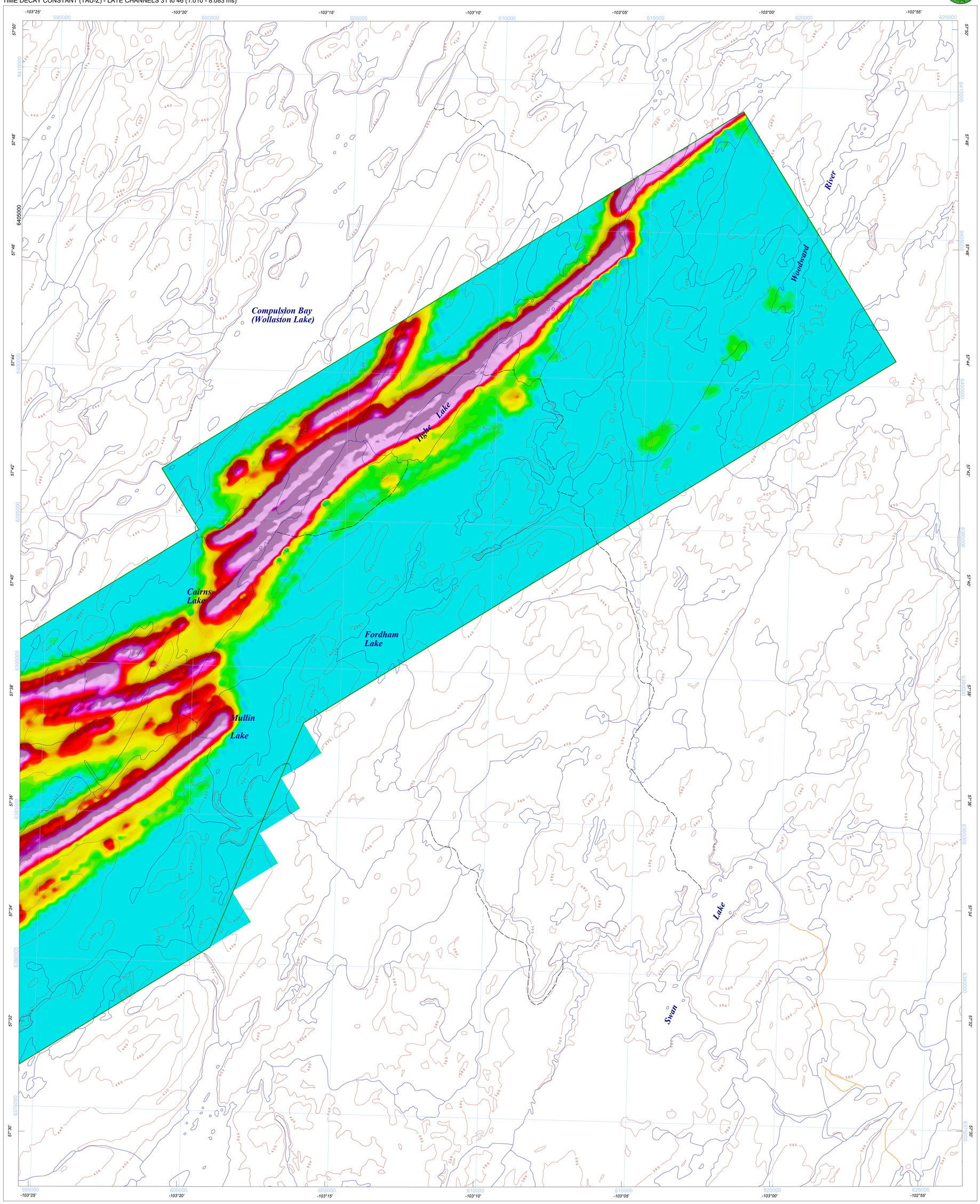
Natural Resources Canada | Ressources naturelles Canada

TIME DECAY CONSTANT (TAU-Z) - LATE CHANNELS 31 to 46 (1.010 - 8.083 ms)



Technical Information
This map was compiled from data acquired during an airborne electromagnetic/magnetic survey carried out by Geotech Canada Inc. utilizing Geotech's VTEM Max Time-Domain Electromagnetic (TDEM) system. The system was mounted on a Eurocopter AS350 B3 helicopter (registration C-GLHX) and the survey was carried out between December 1, 2022 and March 13, 2023. The helicopter flight altitude was maintained at an average ground clearance of 94.6 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 TRA3000 altimeter. The magnetic data were recorded 10 times per second using a Geometrics G-823A cesium magnetometer installed in a bird 10 m below the helicopter.

Electromagnetics
The TDEM system operated at a base frequency of 30 Hz and transmits a 7.0 ms half square signal from a four-turn, 940 m² horizontal loop mounted approximately 48 m below and 8 m behind the helicopter. This configuration generates a peak dipole moment of 733 200 Am². The response of conductors in the subsurface was 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 recorded 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 magnetic field (B) is numerically integrated. High-altitude background sections flown at the start and end of each flight allowed a first-order removal of system drift.

Apparent Conductivity
The apparent conductivity values (mS/m) were derived from the electromagnetic decays using selected early channels 4 to 14 (0.021 - 0.096 ms), middle channels 15 to 30 (0.110 - 0.880 ms) and late channels 31 to 46 (1.010 - 8.083 ms) of the off-time signal. The nomogram indicates the correspondence between the value of dB/dt (nT/s) and halfspace conductivity. Forward thin plate modeling is used to estimate the depth to the top of target (m) for the VTEM™ MAX TDEM system.

Electromagnetic Decay Constant
Decay constant (Tau) values were obtained by fitting the data from selected early Z channels 4 to 14 (0.021 - 0.096 ms), middle channels 15 to 30 (0.110 - 0.880 ms) and late channels 31 to 46 (1.010 - 8.083 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). Differences in magnetic values at the intersections of control and traverse lines were analyzed 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 (530 m) for a constant mid-survey date (January 20, 2023) 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 geologic contacts at high magnetic latitudes (Hood, 1965). The first vertical derivative of the magnetic field reduced to the pole was calculated using the fast Fourier transform with a grid cell size of 50 m.

Availability
This map is available for free download through GEOSCAN (https://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 https://geophysical-data.canada.ca/. For more information, please contact the Geophysical Data Centre, Geological Survey of Canada, 601 Booth Street, Ottawa, Ontario K1A 0E8. Email: infogdc-infocdg@nrcan-rncan.gc.ca.

Acknowledgments
The authors thank the Geotech Canada Inc. team, David Hitz, Adrian Sarmasag, Adam Shubert, Tai-Chyi Shei, Marta Orta and Moyosore Lanisa for their contributions. The authors thank Jim Craven and Mark Pilkington for helpful comments and suggestions to improve the maps. We thank Douglas Oneschuk for his cartographic design expertise.

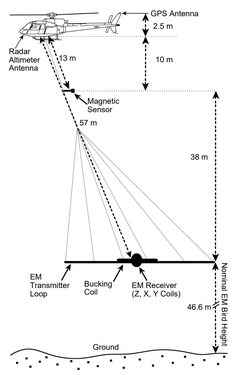
References
Hood, P.J., 1965. Gradient measurements in aeromagnetic surveying; Geophysics, v. 30, p. 891-902.
Meju, M.A., 1998. Short Note: A simple method of transient electromagnetic data analysis; Geophysics, v. 63, p. 405–410.
McNeill, J.D., 1980. Applications of Transient Electromagnetic Techniques, Technical Note TN-7, p. 5, Geonics Limited, Mississauga, Ontario.

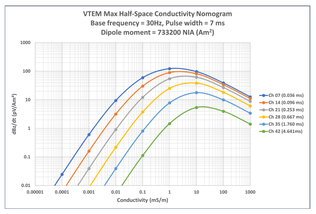
Survey Area Parameters:

Traverse line azimuth	N147°E
Traverse line spacing	200 m
Tie line azimuth	N57°E
Tie line spacing	1200 m
Aircraft average clearance	94.6 m
EM transmitter nominal clearance	46.6 m
Magnetic sensor nominal clearance	84.6 m
EM receiver nominal clearance	46.6 m

Electromagnetic System Specifications:

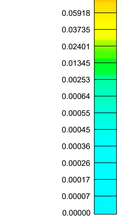
Base frequency	30 Hz
Waveform	Polygonal
Transmitter pulse width	7 ms
Transmitter area	940 m²
Transmitter off-time	8.7 ms
Transmitter loop diameter	34.6 m
Transmitter peak current	195 A
Dipole moment (peak)	733 200 Am² (4 turns)
Windowed data sampling rate	10 Hz
Receiver	3-component induction coils (Z, X, Y)
Measured response	Voltage (dB/dt)
Digital recording	Z: 4-46 channels X,Y: 20-46 channels
1st off-time Z channel	Channel 4 at ~0.021 ms after pulse turn off
Tx-Rx configuration	In-loop concentric



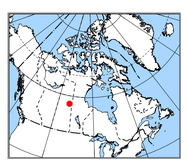


PLANIMETRIC SYMBOLS
Project Limit
Drainage
Topographic Contour
Road

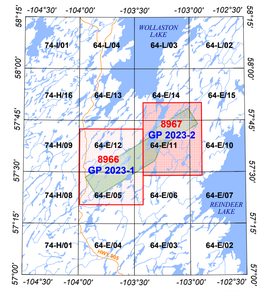
MAP SHEET SUMMARY
Sheet 1: Time Decay Constant (Tau-Z) - Early Channels 4 to 14 (0.021 - 0.096 ms)
Sheet 2: Time Decay Constant (Tau-Z) - Mid Channels 15 to 30 (0.110 - 0.880 ms)
Sheet 3: Time Decay Constant (Tau-Z) - Late Channels 31 to 46 (1.010 - 8.083 ms)
Sheet 4: Apparent Conductivity - Early Channels 4 to 14 (0.021 - 0.096 ms)
Sheet 5: Apparent Conductivity - Mid Channels 15 to 30 (0.110 - 0.880 ms)
Sheet 6: Apparent Conductivity - Late Channels 31 to 46 (1.010 - 8.083 ms)
Sheet 7: Residual Total Magnetic Field
Sheet 8: First Vertical Derivative of the Magnetic Field
Sheet 9: Interpretation



Authors: O. Boulanger, P. Vo, and F. Kiss
Data acquisition and data compilation by Geotech Canada Inc., Aurora, Ontario
Contract and project management by the Geological Survey of Canada, Ottawa, Ontario
Digital cartography by D. Oneschuk, Geological Survey of Canada
Permanent link: https://doi.org/10.4095/332167


MAP LOCATION

NTS Map Sheet numbers in black
Geological Survey of Canada Open File numbers in red
Saskatchewan Geological Survey
Geophysical Map series numbers in blue



NATIONAL TOPOGRAPHIC REFERENCE SYSTEM AND GEOPHYSICAL MAP INDEX

GEOLOGICAL SURVEY OF CANADA OPEN FILE 8967
SASKATCHEWAN GEOLOGICAL SURVEY GEOPHYSICAL MAP GP 2023-2

ELECTROMAGNETIC SURVEY OF THE EASTERN WOLLASTON AREA
SASKATCHEWAN
Parts of NTS 64-E/10, 11, 14 and 15

TIME DECAY CONSTANT (TAU-Z) - LATE CHANNELS 31 to 46 (1.010 - 8.083 ms)

Scale 1:50 000
1000 0 1000 2000 3000
(metres)

Universal Transverse Mercator Projection
North American Datum (CSRS) 1983
UTM zone 13N

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications
Contour interval 20 metres. Elevations in metres above mean sea level

OPEN FILE / DOSSIER PUBLIC
8967
GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
2023
Sheet 3 of 9 / Feuillet 3 de 9

Publications in this series have not been edited; they are released as submitted by the author.
Les publications de cette série ne sont pas révisées; elles sont publiées telles que soumises par l'auteur.

GEOPHYSICAL MAP
CARTE GÉOPHYSIQUE
GP 2023-2
SASKATCHEWAN GEOLOGICAL SURVEY
COMMISSION GÉOLOGIQUE DE LA SASKATCHEWAN
2023
Sheet 3 of 9 / Feuillet 3 de 9

Recommended citation
Boulanger, O., Vo, P., and Kiss, F., 2023.
Electromagnetic Survey of the Eastern Wollaston Area, Saskatchewan, Parts of NTS 64-E/10, 11, 14 and 15;
Geological Survey of Canada, Open File 8967;
Saskatchewan Geological Survey Geophysical Map GP 2023-2,
Scale 1:50 000. https://doi.org/10.4095/332167

The eastern Wollaston area electromagnetic and magnetic survey was funded by the Saskatchewan Ministry of Energy and Resources in support of the province's Mineral Development Strategy. 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.

Canada Saskatchewan