EVALUATION

OF HELITEM®

MAGNETIC/ELECTROMAGNETIC

HELICOPTER-BORNE SURVEY

McFAULDS SOUTH PROPERTY

JAMES BAY LOWLANDS

ONTARIO

By: Dr. Zbynek Dvorak
And James R. Trusler P Eng.

TORONTO, ONTARIO           JANUARY, 2012
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INTRODUCTION

In late August, 2011, Platinex Inc. contracted services of Fugro Airborne Surveys to conduct a helicopter-borne geophysical HELITEM® electromagnetic/magnetic survey over three blocks of claims in the McFaulds South Area (Figure 1) situated in the James Bay Lowlands (NTS reference 43D/7 and 43D/10). The blocks are located approximately 550 km northeast of the city of Thunder Bay. The closest full-service community with year-round road access is Nakina, some 320 km to the south. Winter-only road access is available from about 65 km northeast of Pickle Lake to First Nations communities at Eabametoong (Fort Hope), Neskantaga (Lansdowne House) and Webequie, the latter being about 60 km northwest of the property.

Fugro Airborne Surveys conducted the HELITEM® survey between September 15th and 25th, 2011. The base of operations was established at McDonald Mines’ Butler Camp, Ontario, and maintained from September 10th to 26th, 2011. Total survey amount flown over the three blocks designated as Area A, Area B, and Area C (Figure 2) was 593.1 line-km, 210.5 line-km, and 416.5 line-km, respectively, for the total of 1220.1 line-km. The survey was designed with two objectives in mind: to improve and better understand the subsurface geology and to locate bedrock conductors that may be of exploration interest to Platinex Inc. The former objective is mainly based on the utilization of magnetic data, whereas the latter one is based on the assumption that mineralization of potential exploration and economic interest exhibits a recognizable degree of electric conductivity.

The magnetic and electromagnetic (EM) data were processed and compiled to produce images and profiles that could be used to derive magnetic and conductive properties of rocks within the survey blocks. A GPS electronic navigation system used during the survey ensured accurate positioning of the geophysical data with respect to the base maps. The survey equipment, procedures, logistics, data acquisition, processing and presentation of results are described in detail in a report entitled LOGISTICS AND PROCESSING REPORT, Airborne Magnetic and HELITEM Survey, McFAULDS LAKE SOUTH AREAS, ONTARIO, CANADA, Project No. 11076, Platinex Inc.

The purpose of the present report is to review the geophysical data from the HELITEM®/magnetic survey over the three blocks and to select suitable targets for further follow-up work. The Total Magnetic Intensity (TMI), Calculated Magnetic Vertical Gradient (CVG), Apparent Conductivity derived from the Z component of the B-field channel 16, Decay Constant from the Z component of the B-field, and profile data were used for the interpretation purposes.
AREA A

Area A located over the northern portion of Goods Lake and in its immediate vicinity is defined by its corners in UTM 16N, WGS84, as follows:

<table>
<thead>
<tr>
<th>Corner</th>
<th>Easting (m)</th>
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<tbody>
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Magnetic data collected during the present survey along traverse lines spaced at 100 meters confirmed, in principal, the original interpretation and in the same time improved the special resolution of the patterns and their locations.

The south-eastern portion of Area A is dominated by an oval-shaped magnetic high that occurs within the mafic and ultramafic rocks near their contact with a suite of mafic to intermediate metavolcanic rocks in the south-west, and with metasedimentary rocks in the northeast. Similar magnetic highs, but smaller in their lateral extent, occur to the west and south-west of this oval-shaped high. They are separated from this high by a low magnetic zone that is gently curved at its southern end, but becomes nearly linear further north-east. This low zone extends along the interpreted base of the ‘Ring of Fire’ (RoF) intrusion. As mentioned above, in the south-west there is a series of magnetic highs; they are situated on the east side of the interpreted base of RoF intrusion and are believed to reflect a suite of mafic to intermediate metavolcanic rocks.

An H-shaped magnetic high of moderate strength occurs in the central portion of the western boundary of Area A. Though its nature is not clear at this time, the anomaly has been interpreted as reflecting mafic and ultramafic rocks of a limited areal extent. This is partly based on the results of field mapping the outcrops in the area. West of the central anomalies that indicate the interpreted base of the RoF intrusion, both the total magnetic intensity and the CVG patterns show the presence of numerous trends of nearly north-south orientation. They may reflect faults or shears that appear to pre-date the aforementioned magnetic highs.

The data collected during the present survey do not directly confirm the extension of the chromium horizon from the central part of the RoF arc (some 30 to 50 kilometers to the northeast) into Area A. More precisely, the data cannot prove or disprove that the magnetic anomalies are the same as those associated with the chromite horizon. The individual magnetic anomalies within Area A are not associated with any conductive features as indicated by the Apparent Conductivity and Decay Constant maps derived from the Z component of the B field. This general lack of electromagnetic (EM) anomalies suggests that either the chromite or other conductive mineralization is not present in any significant amount, or that, if present, it occurs at great depth beyond the HELITEM® depth of exploration, which is estimated to be in excess of 200 meters.
However, there are two, possibly significant, exceptions. (Figure 3.) They occur in the south portion of the Area within, or close to, the boundary of the mafic to intermediate metavolcanics. The first one is associated with the rim of a generally circular magnetic feature on the west side of the interpreted base of the RoF intrusion. Its main conductive part is located at 515960mE, 5819930mN, and its secondary part some 200 meters to the west. The situation is reversed on the Decay Constant map where the western part is more prominent that the eastern part of the anomaly. This may indicate that the size of the causative body is greater in the west than in the east. However, the profile data does not support such an interpretation; the most likely explanation is that of a body striking at a shallow angle to the flight line. The conductor was previously tested by drilling (Macdonald Mines, Temex Resources, and Canadian Orebodies AD-08-01) and showed slightly anomalous Cu values. While it may be somewhat interesting, the fact that it occurs outside the Platinex claims makes it a lower priority target.

The second EM anomaly occurs on lines 10950 and 10960 at fiducial 83407 and 83612, respectively. They are located within a triangular CVG magnetic feature that occurs at the contact of mafic to intermediate metavolcanics with the mafic and ultramafic rocks. Both EM anomalies are very poorly defined, i.e., they display low amplitudes (particularly on the X component), which makes their interpretation difficult. The Apparent Conductivity map shows poor response but the Decay Constant data shows a clearly defined, oval-shaped anomaly. The causative body may be striking at a shallow angle to the flight lines and extend to a moderate depth. The anomaly occurs outside the Platinex claims.

In addition, there are two weak and poorly defined EM responses, both at the Area boundaries. The first one occurs on line 11060 near fiducial 45245 within Goods Lake. It is associated with magnetic anomalies, both on the TMI and CVG maps; it has produced a recognizable Decay Constant anomaly. Its weak nature and its location with the lake make this EM anomaly suspect; it may reflect a man-made source. The other EM anomalous feature occurs on line 10020 near fiducial 65888, where it appears to reflect a thin vertical tabular body. The anomaly is associated with a short magnetic anomaly but the data is inconclusive as to its exploration significance. The anomaly occurs outside the Platinex claims.

**AREA B**

Area B, with its centre located approximately ten kilometres southwest from the southern boundary of Area A, is defined by its corners in UTM 16N, WGS84 as follows:

<table>
<thead>
<tr>
<th>Corner</th>
<th>Easting (m)</th>
<th>Northing (m)</th>
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The magnetic data collected during the present survey extends the areal coverage – as compared to the government data released in August, 2011 – in the south-westerly direction by approximately three kilometres, thus providing additional information suitable for exploration purposes. The TMI data indicates the presence of a large zone of intermediate strength values along the eastern boundary of the Area. The zone appears to extend further east beyond the survey boundary; it is believed to reflect rocks of foliated tonalite suite. The central part of the
Area contains an elongated composite zone of high magnetic values that is appended to the tonalite rocks. One of the present survey goals was to investigate this elongated zone and to establish its relation to the interpreted base of the RoF intrusion. While both the TMI and CVG patterns suggest that the interpreted base of the RoF intrusion may extend from Area A into Area B, there is a degree of uncertainty as to where the base may go. Its continuation toward the south-western corner of the Area is one of the possible interpretations; the other, more plausible - and in accordance with the previous interpretation – is that the base of the RoF intrusion is confined to the elongated zone of high magnetic values mentioned above; it may peter out beyond this zone. (Figure 4.) Regional magnetic and airborne gravity data suggest that the elongated magnetic high is part of an oval-shaped narrow zone that is located to the east and south-east of Area B and that may reflect an intrusion, probably unrelated to the RoF intrusion. The north portion of the elongated magnetic high, which occurs entirely within the Platinex claims, correlates well with a narrow gravity anomaly that is part of the rim of the intrusion, thus making it a target of potential interest. West of the two main zones mentioned above the magnetic patterns exhibit low-to-moderate values and are interpreted to reflect gneissic tonalite rocks.

No electromagnetic responses were detected in Area B. Both the Apparent Conductivity and the Decay Constant data are near zero (Apparent Conductivity) or show merely statistical fluctuations from the norm (Decay Constant). This would indicate that the units within Area B either do not contain any significant amount of conductive mineralization, or that, if present, it occurs at great depth beyond the HELITEM® depth of exploration, which is estimated to be in excess of 200 meters.

AREA C

Area C is located in the north-west part of the McFaulds South property. It extends over Sature Lake and its vicinity and is defined by its corners in UTM 16N, WGS84 as follows:

<table>
<thead>
<tr>
<th>Corner</th>
<th>Easting (m)</th>
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<tbody>
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The magnetic patterns within Area C are complex. (Figure 5.) There are several zones of high magnetic values in the eastern, west-central, and north-west parts of the Area. They occur within the mafic and ultramafic rocks; in the west-central and north-western parts of the Area they are located at, or close to, the contact with the foliated tonalite suite of rocks. In the north the zone of moderate magnetic responses is believed to reflect mafic to intermediate metavolcanics. This is an important rock unit in as much as it hosts a number of VMS deposits further north-east. The data suggests that the western contact of this unit with mafic and ultramafic rocks may occur further west than presently thought.

Breaks and distortions of the magnetic patterns indicate the presence of several possible faults of generally east-west orientation. It would appear that in the central part of the Area lateral displacement may have occurred along one of these breaks. North of the break, the magnetic
patterns are curved and indicate northeast-southwest strikes. In contrast, south of the break the strikes are nearly north-south parallel to the assumed contact between the foliated tonalite rocks to the west and mafic and ultramafic rocks to the east. Further east along the break in the eastern corner of the Area there is a suite of generally narrow strong magnetic anomalies of possible exploration interest. The strongest and best defined anomaly extends from approximately 509030mE and 583016mN to 510120mE and 583216mN. The anomaly occurs completely within the mafic and ultramafic rocks but it does not show any correlation with the regional geologic features postulated in the past. However, the anomaly is associated with a very strong and well defined Apparent Conductivity anomaly and a pair of high Decay Constant zones that occur as lobes on the sides of the Apparent Conductivity anomaly. This ‘lobe’ affect may indicate that the causative body is quite thick.

Another narrow magnetic anomaly extends from approximately 508760mE and 583171mN to the Area boundary (and beyond) at approximately 509280mE and 583316mN. This is a somewhat confusing feature due to its very limited Apparent Conductivity response but quite distinct Decay Constant values. The anomaly appears to extend in a discontinuous manner to the south, where it may occur as a well defined magnetic, Apparent Conductivity, and Decay Constant zone between approximately 508260mE and 583140mN and 508380mE and 583650mN.

The electromagnetic responses within Area C are active over the eastern corner of the Area; limited responses were also observed toward the eastern end of lines 30420 and 30430 and on lines 30480 to 30520. Those in the eastern corner of the Area dominate the Apparent Conductivity and Decay Constant maps; those mentioned last are weak.

The HELITEM® profiles for lines 30010 to 30290 show two long main, and several shorter conductors to occur in the north-east corner of Area C. The west conductor extends in a discontinuous manner from line 30010, fiducial 47525 (and probably beyond the Area boundary) toward line 30280, fiducial 54233. It is hardly recognizable on lines 30120 to 30130 where it is interrupted by an east-west striking fault. Similar interruption occurs on line 30190 and on lines 30220 and 30230. The conductor is due to a thin nearly vertical plate with occasional westerly dip; its top is estimated to occur at a depth of between 50m and 150m. South of line 30190 the conductor shows no or marginal magnetic association. In its northern part, however, it is mostly associated with a narrow, occasionally strong magnetic anomaly. Although this may be a formational conductor, it should be noted that it occur on the general strike with several VMS deposits some six kilometers to the north-east. It constitutes a target of interest and its further investigation should be considered, particularly south of line 30170 where both the Apparent Conductivity and Decay Constant show interesting high values. The conductor had been tested by drilling. However, the log assay results were never published and the claims were abandoned.

The eastern conductor has produced EM responses that indicate that it is due to a thick conductive body of nearly vertical, but occasionally westerly dip, in combination with a thin plate body. The eastern edge is more conductive and on some lines it appears as a separate conductor. Due to the combined effects of the two (or more) bodies it is hard to estimate the depth of burial. North of line 30090 the conductor shows little or no magnetic association. Further south, it shows mostly direct, or associated, magnetic correlation. The conductor may extend south beyond the Area boundary. It could be a formational conductor such as a graphitic unit. The associated thin plate body could be due to sulphides at the contact with this unit or higher grade sulphides. Results show that there is a good correlation between the Apparent Conductivity/Decay Constant and the interpreted east-westerly faults that caused both values to increase south of the fault. The
The eastern conductor had been previously detected during the James Bay Resources Limited survey and drill tested by hole JBR 08-09 collared at 509004mE and 5830524mN (azimuth of N135°E and dip of 50°). The analysis of the drill data concluded that the ‘conductive zone appears to be in a mafic metavolcanic host rock environment with minor felsic volcanics’. The drill hole intersected ‘massive to semi massive sections of pyrrhotite with minor pyrite and trace chalcopyrite within mafic metavolcanic host rocks’ that ‘ranged from 10 cm to 1 m in thickness in a mafic to intermediate metavolcanic host’. From the present data it would appear that the hole should have intersected a portion of the main (thick) body. There is a possibility that the drill hole was collared too far east and that the main thick conductor was not intersected. The drill results should be considered for a review with the aim of establishing the source of the conductor. Similar to the western conductor, this eastern conductor is on strike with a group of VMS deposits nine kilometers to the north-east; it constitutes a priority target. Its portions in the vicinity of the proposed faults should be explored further.

The area confined between lines 30180 and 30260, and bounded by the two aforementioned conductors contains a group of generally short conductors of a variety of dips but mainly near vertical. The conductors are closely spaced and their EM responses are overlapping, which makes it hard to properly estimate their dips and depth of burial. In general, the conductors do not exhibit magnetic correlation though there is an occasional associated moderate magnetic response.

The interruptions and terminations of magnetic patterns that are interpreted to reflect faults occur at places where the electromagnetic response also show weakening or disruptions of the conductive features. This is seen as providing support for the proposed fault interpretation.

Additionally a much weaker conductive feature, occurs further south on lines 30490 to 30520 near their eastern limit. These EM responses are well defined but weak; they are believed to reflect an arcuate, shallow(?) conductive feature with possible easterly dip to nearly flat. On its north and west sides the conductor abuts against two magnetic anomalies. In the past, James Bay Resources Limited drilled a hole JBR 08-10 collared at 506821mE and 5828391mN at an azimuth of 90° and a dip of 50°. It would appear from the present data that the drill hole was collared to assess the flank of the magnetic anomaly rather than the EM response.

An EM anomaly was intersected on lines 30420 and 30430 near fiducials 81528 and 81409, respectively. These weak responses are believed to reflect a flat lying, or sub-parallel to the flight lines, body at the end of the north magnetic anomaly mentioned just above. They may occur within, or be confined to, one of the proposed east-west striking fault.

**CONCLUSIONS AND RECOMMENDATIONS**

The magnetic data collected during the present survey over three separate blocks (Area A, Area B, Area C) of the McFaulds South Property provided information for a new, more detailed assessment of geology of the Property. The electromagnetic data over the three survey blocks indicates which parts of the individual blocks may contain mineralization of exploration interest.
In Area A the data basically confirms the original interpretation of geology though the boundaries of the individual units are shifted in their positions. Four weak EM anomalies were detected that occur at or near the interpreted base of the Ring of Fire intrusion. The general lack of the EM anomalies suggests that either the conductive mineralization is not present in any significant amount, or that, if present, it occurs at great depth beyond the HELITEM® depth of exploration. All of the EM anomalies fall just outside the Platinex claim group. Possibility of getting the owners of the appropriate claims interested in further work should be considered.

While the survey extended the areal coverage of the government data in Area B by approximately three kilometres in the south-westerly direction, both the magnetic and electromagnetic data provide little information of consequence. In particular, the magnetic data did not seem to improve on the present position of the base of the Ring of Fire intrusion. Similarly, the electromagnetic data, which is completely void of any anomalies of possible interest, did not indicate the presence of conductive mineralization. Comparison of the present data with the regional magnetic and gravity data published previously suggests that the suite of narrow magnetic anomalies along the interpreted base of Ring of Fire intrusion in the central portion of the Area is part of an oval-shaped narrow zone that is located to the east and south-east of the Area that may reflect an intrusion, probably unrelated to the Ring of Fire intrusion. The north part of the elongated magnetic high shows direct correlation with gravity data. It is considered an exploration target and is recommended for further follow-up work.

Data collected during the present survey show that Area C has potential to host mineralization of exploration interest. In its northern part it extends over a mafic to intermediate metavolcanic rocks that host several VMS deposits further north-east at a distance of roughly six to nine kilometres. The north-east corner of the Area contains strong magnetic and conductive anomalies that are interpreted to reflect long conductors of exploration significance. They appear to be interrupted by a series of faults, mostly of east-west strike. The western conductor that occurs in a discontinuous manner is due to a thin, near vertical body. Its portions, which show magnetic association, should be investigated further. They include (line/fiducial): 30070/45299 to 30110/46434, 30160/50990 to 30180/51539, and 30250/53600 to 30260/53721. The latter portion of the conductor does not show direct magnetic association but it occurs on the flank of a very strong magnetic anomaly. While the conductor occurs on the claims adjacent to the Platinex ground, it appears to extend through the south-east corner of Platinex claim 4216979. It should be considered for drill hole testing.

The eastern conductor is more continuous than the western one but it also shows weakening or change of character at the proposed faults. South of line 30060, i.e., south of the proposed fault, the EM responses are very strong and complex showing the presence of several bodies. Due to the combined effects of these multiple bodies it is difficult to evaluate depth and dip; it would appear that the overall effect is that of a thick body of near vertical of gently westerly dip. The conductor was drill tested by James Bay Resources Limited and dismissed as non-interesting. The present results do not exclude a possibility that the drill hole missed the conductor or its main part. Similar to the western conductor also this one is located outside the Platinex claims. Its further testing may be problematic.

The survey detected two other weak conductors. They are located in the southern part of the survey Area, just outside or close to the block boundary. James Bay Resources drilled a hole in the vicinity of the southern conductors, apparently to test ‘different geological environment – airborne magnetism indicated that geology was trending north-south’. No change in geology was
observed. The two conductors appear to be closely related to, but not coincident with, two arcuate magnetic anomalies; the northern conductor (on lines 30420 and 30430) forms an extension of one of the magnetic anomalies and appears to be confined to the proposed fault. It should be considered for further work on a low priority bases. Both conductors are located outside the Platinex claim group and their testing may be problematic.
REFERENCES

Fugro Airborne Surveys, 2011, Logistics and processing report, Airborne Magnetic and HELITEM Survey, McFaulds Lake South Area, Ontario, Canada, Project No. 11076, Platinex Inc.

Leonard, B., 2008, Helicopter- Supported diamond drilling program on the James Bay Lowlands Property, Ontario, Canada

LIST OF ILLUSTRATIONS

Figure 1. McFaulds South Property Location.

Figure 2. Survey Areas.

Figure 3. Area A, Calculated Vertical Gradient, Precambrian Geology Interpreted from Aeromagnetic Data.

Figure 4. Area B, Calculated Vertical Gradient, Precambrian Geology Interpreted from Aeromagnetic Data.

Figure 5. Area C, Total Magnetic Intensity, Precambrian Geology Interpreted from Aeromagnetic Data.
STATEMENT OF QUALIFICATIONS
CURRICULUM VITAE – Z. DVORAK

As a Consulting Geophysicist, Z. Dvorak provides services mainly to the mineral mining industries and supporting services. His academic and research background have been supplemented by hands-on experience in the mining industry, in other airborne geophysical survey companies, and in private consulting. His many skills include planning, crisis management, execution and supervision of surveys, and the processing and interpretation of data generated from these surveys. Throughout his 48-year career, Zbynek has continuously expanded on his technical knowledge to cover all aspects of ground and airborne geophysics, radiation spectrometry, and geology.

PROFESSIONAL EXPERIENCE
Consulting Geophysicist, Toronto, Ontario, (2001-Present): Planning and preparation of surveys for clients; Management and supervision of surveys; Evaluation and interpretation of survey results; Reporting and follow-up recommendations.

General Manager, Fugro Airborne Surveys, Mississauga, Ontario, (2000): Responsibility for overall integration of the newly merged helicopter survey division of the Company; General management of the branch that provided worldwide services for Fugro; Promotion and sales of the Company products and services.

Chief Geophysicist/Partner, High-Sense Geophysics Limited and Urquhart Dvorak Limited Toronto, Ontario, (1984-2000): Responsibilities included administrative management of the Company; Sales of airborne surveys and services; Interpretation of airborne electromagnetic and radiometric data; Processing and interpretation of all types of ground electromagnetic and magnetic data; Management and supervision of surveys for other clients; Software development including the testing and modification of experimental programs; Training of foreign nationals. As a partner of High-Sense Geophysics Limited, ZD shared the responsibility for day-to-day operations as well as overseeing the timely completion of client contracts and reports. He was involved in forward planning, financing and organization of High-Sense Geophysics and its software division Geopak Systems. He has personally completed some over 350 reports for both private and government agencies since becoming a partner in the Company.


Chief Geophysicist, Teck Corporation, Toronto, Ontario, (1979-1984): Responsible for geophysical surveys carried out by Teck's four Canadian offices, and partial responsibility for Australian operations. Mandate included determining exploration goals, planning survey parameters, data analysis and interpretation of the results. Follow-up of airborne anomalies with ground surveys and the selection of drill targets.

Geophysicist, Scintrex Limited, Concord, Ontario, (1976-1978): Field geophysicist responsible for supervising ground and airborne survey field crews and for data quality. Acted as liaison officer for clients with regards to the selection of survey types, instrumentation and parameters. Interpretation and report preparation were an intimate part of the job description.

Visiting Professor, Department of Geology, University of New Brunswick, Fredericton, New Brunswick, (1975-1976): Taught undergraduate courses in applied geophysics.
Researcher and Lecturer, Department of Geophysics, University of Western Ontario, London, Ontario, (1970-1975): Research into the high pressure/high temperature dependence of the physical properties (electrical and thermal) of rocks and minerals. Vacuum, x-ray and high-pressure synthesis studies. Studies to determine the feasibility of laboratory based modelling of elevated conductivity layers within the upper mantle. Taught third/fourth year undergraduate courses in applied geophysics and supervised undergraduate B.Sc. theses topics.


Radiation Physicist, Jachymov Uranium Mines, Western Bohemia, Czechoslovakia (1961): Monitoring and detection of radiation levels in the mine and processing facilities.

Research Assistant, Mining Institute, Czechoslovakian Academy of Sciences, Prague, Czechoslovakia, (1960-1961): Coal-strength testing.

PUBLICATIONS
Nineteen scientific papers published. The subject matter includes ground electromagnetics, physical properties of rocks, and high-pressure synthesis. Also authored and co-authored over 500 survey and assessment reports for various clients including private and public companies, governments and international agencies, all concerning the interpretation of ground and airborne geophysical data.

EDUCATION
Ph.D., Geophysics, Czechoslovak Academy of Sciences, Prague, Czechoslovakia (1967)  
Thesis: Investigation of high temperature dependence of electrical conductivity of selected minerals.  
M.Sc., Geophysics, Charles University, Prague, Czechoslovakia (1961)

RESEARCH FUNDING
NRC grants received in 1970 and 1973 to conduct studies on the electric properties of rocks and minerals, and for the Deep Sea Drilling Project.

During his mineral exploration career Z. Dvorak was a member of the Society of Exploration Geophysicists and Canadian Exploration Geophysical Society.  
He resides at 146 Three Valleys Drive, North York, Ontario, M3A 3B9.  
His work for Platinex Inc. has been performed as an independent consultant with no material interest in Platinex Inc.  
The underlying signature provides certification that the above statement of qualifications is accurate and true.

Signed:

Zbynek Dvorak, Ph.D.
Certificate of Qualifications: James R. Trusler

I, James R. Trusler at 11 Algonquin Crescent, Aurora, Ontario do hereby certify that:

1) I am a Geological Engineer employed as President and CEO and the principal shareholder of Platinex Inc.;

2) I graduated from the University of Toronto with BA.Sc. in Geological Engineering in 1967. I obtained a Master of Science (Geology) from Michigan Technological University in 1972. I have practiced my profession full-time from 1967-1969 and from 1970 to present;

3) I am a Professional Engineer registered with the Professional Engineers Ontario (PEO #47064019);

4) I have not received, nor do I expect to receive, any interest, directly or indirectly, in the McFaulds South property;

5) As of the date of this certificate, to the best of my knowledge, information and belief, this report contains all scientific and technical information that is required to be disclosed to make the Evaluation of the HELITEM® MAGNETIC/ELECTROMAGNETIC HELICOPTER-BORNE SURVEY not misleading;

6) I have read National Instrument 43-101 and this Evaluation of the HELITEM® MAGNETIC/ELECTROMAGNETIC HELICOPTER-BORNE SURVEY has been prepared in compliance with the intent of National Instrument 43-101 and Form 43-101F1 but is not a Technical Report as defined by National Instrument 43-101;

7) I have collaborated with Dr. Zbynek Dvorak who prepared Evaluation of the HELITEM® MAGNETIC/ELECTROMAGNETIC HELICOPTER-BORNE SURVEY under my supervision;

8) I have not visited the property. I have visited many properties within greater Ring of Fire area including the Big Trout Lake Intrusive Complex and supervised exploration thereon in the far north of Ontario and;


Dated at Aurora, ON

January 30, 2012
Figure 1. McFaulds South Property Location.
Figure 2.

Survey Areas

McFaulds South Property
Figure 3.

Area A
Calculated Vertical Gradient

Precambrian Geology Interpreted from Aeromagnetic Data
Figure 4.

Area B
Calculated Vertical Gradient

Precambrian Geology Interpreted from
Aeromagnetic Data
Figure 5.

Area C
Total Magnetic Intensity

Precambrian Geology Interpreted from Aeromagnetic Data
LOGISTICS AND PROCESSING REPORT
Airborne Magnetic and HELITEM® Survey

McFAULDS LAKE SOUTH AREAS
ONTARIO, CANADA

Project No. 11076

Platinex Inc.
LOGISTICS AND PROCESSING REPORT
AIRBORNE MAGNETIC AND HELITEM® SURVEY
McFAULDS LAKE SOUTH AREAS
ONTARIO, CANADA

PROJECT NO. 11076

Client: Platinex Inc.
114-445 Apple Creek Blvd.,
Markham, Ontario, L3R 9X7
Canada

Date of Report: 12 December 2011
FUGRO AIRBORNE SURVEYS

Fugro Airborne Surveys was formed in early 2000 through the global merger of leading airborne geophysical survey companies: Geoterrex-Dighem, High-Sense Geophysics, and Questor of Canada; World Geoscience of Australia; Geodass and AOC of South Africa. Sial Geosciences of Canada joined the Fugro Airborne group in early 2001; Spectra Exploration Geosciences followed thereafter. In mid 2001, Fugro acquired Tesla 10 and Kevron in Australia, and certain activities of Scintrex. Fugro also works with Lasa-Geomag located in Brazil, for surveys in South America. With a staff of over 400, Fugro Airborne Surveys now operates from 12 offices worldwide.

Fugro Airborne Surveys is a professional services company specializing in low altitude remote sensing technologies and collects, processes and interprets airborne geophysical data related to the subsurface of the earth and the sea bed. The data and map products produced have been an essential element of exploration programs for the mining and oil & gas industries for over 50 years. Engineers, scientists and others with a need to map the earth's subsurface geology use Fugro Airborne Surveys for environmental and engineering solutions. From mapping kimberlite pipes and oil and gas deposits to detecting water tables and unexploded ordnance, Fugro Airborne Surveys designs systems dedicated to specific targets and survey needs. State of the art geophysical systems and techniques ensure that clients receive the highest quality survey data and images.

Fugro Airborne Surveys acquires both time domain and frequency domain electromagnetic data as well as, magnetic, radiometric and gravity data from a wide range of fixed wing (airplane) and helicopter platforms. Depending on the geophysical mapping needs of the client, Fugro Airborne Surveys can field airborne systems capable of collecting one or more of these types of data concurrently. The company offers all data acquisition, processing, interpretation and final reporting services for each survey.

Fugro Airborne Surveys is a founding member of IAGSA, the International Airborne Geophysics Safety Association. Our quality management system has successfully achieved certification to the international standard ISO 9001:2000 Quality Management Systems - Requirements.
SUMMARY

This report describes the logistics, data acquisition, processing and presentation of results of a HELITEM® electromagnetic/magnetic survey flown from September 15th to 25th, 2011 for Platinex Inc. over the McFaulds Lake South Areas near Webequie, Ontario. The McFaulds Lake South survey consists of three survey blocks. Total coverage of the survey blocks amounted to 1220.1 km.

The purpose of the survey was to determine the existence and locations of bedrock conductors and for better understanding of the subsurface geology within the survey areas. The EM data and the magnetic data were processed to produce images and profiles that are indicative of the magnetic and conductive properties of the survey areas. A GPS electronic navigation system ensured accurate positioning of the geophysical data with respect to the base maps.

The survey data were processed and compiled in the Fugro Airborne Surveys Toronto office. Maps and data in digital format are provided with this report.

Respectfully submitted,

FUGRO AIRBORNE SURVEYS CORP.
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Survey Operations

Locations of the Survey Blocks

Figure 1 shows the locations of the McFaulds Lake South survey blocks near Webequie, Ontario, Canada. The base of operations was setup at McDonald Mines’ Butler Camp, Ontario, from September 10th to 26th, 2011. Total coverage of the blocks amounted to 1220.1 km.

Figure 1. Survey Location.
Table 1 lists coordinates of the corner points of the survey blocks.

<table>
<thead>
<tr>
<th>Block</th>
<th>Corners</th>
<th>X-UTM (E)</th>
<th>Y-UTM (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11076</td>
<td>1</td>
<td>514290.0</td>
<td>5820300.0</td>
</tr>
<tr>
<td>McFaulds</td>
<td>2</td>
<td>522310.0</td>
<td>5829160.0</td>
</tr>
<tr>
<td>Lake South</td>
<td>3</td>
<td>525572.6</td>
<td>5826206.5</td>
</tr>
<tr>
<td>Block A</td>
<td>4</td>
<td>518956.2</td>
<td>5819065.0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>517665.5</td>
<td>5820233.0</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>516263.8</td>
<td>5818513.5</td>
</tr>
<tr>
<td>Block B</td>
<td>1</td>
<td>504530</td>
<td>5811145</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>508730</td>
<td>5815655</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>510690</td>
<td>5813830</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>506420</td>
<td>5809365</td>
</tr>
<tr>
<td>Block C</td>
<td>1</td>
<td>501927</td>
<td>5831157</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>507077</td>
<td>5835657</td>
</tr>
<tr>
<td></td>
<td>3</td>
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<td>5831680</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>505400</td>
<td>5827180</td>
</tr>
</tbody>
</table>

Table 1. Area Corners in UTM 16N, WGS84
System Information

Figure 2. HELITEM® System in Flight
Figure 2 depicts the HELITEM® system in flight. The HELITEM® system is composed of a 51.9 m cable to which is attached a receiver platform 22.4 m along the cable below the Helicopter, a magnetometer attached to the transmitter loop 47 m below the helicopter in flight. The top of the cable is attached to a helicopter and when in flight it drags to form a 25 degree angle from the vertical. The real time navigation GPS antenna is on the tail boom of the helicopter, the barometric altimeter, radar altimeter, video camera and data recorder are all installed in the helicopter. One GPS antenna is attached near the centre of transmitter loop to give positional information of the loop.

**Aircraft and Geophysical On-Board Equipment**

**Aircraft:** AS 350 B3 Helicopter  
**Operator:** Great Slave Helicopters  
**Registration:** C-FIDA  
**Survey Speed:** 55 knots / 65 mph / 30 m/s  
**Magnetometer:** Scintrex CS-3 caesium vapour, attached to transmitter loop, sensitivity = 0.01 nT, sampling rate = 0.1 s, ambient range 20,000 to 100,000 nT. The general noise envelope is kept below 0.5 nT. The nominal sensor height is ~35 m above ground.  
**Electromagnetic system:** HELITEM® 30 channel multicoil system  
**Transmitter:** Vertical axis loop slung below helicopter  
  - **Loop area:** 708 m²  
  - **Number of turns:** 2  
  - **Nominal height above ground:** 35 m  
**Receiver:** Multicoil system (X, Y and Z) with a final recording rate of 10 samples per second, of 30 channels of X, Y and Z component data. The nominal height above ground is ~62 m.  
**Base frequency:** 30 Hz  
**Pulse width:** 4 ms  
**Pulse delay:** 0.163 ms  
**Off-time:** 12.646 ms  
**Point value:** 8.14 µs  
**Transmitter Current:** 1270 A  
**Dipole moment:** 2x10⁶Am²
<table>
<thead>
<tr>
<th>Gate</th>
<th>Start time (ms)</th>
<th>End time (ms)</th>
<th>Midpoint (ms)</th>
<th>Width (ms)</th>
<th>Status</th>
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<tr>
<td>1</td>
<td>0.049</td>
<td>0.301</td>
<td>0.175</td>
<td>0.252</td>
<td>On time</td>
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<td>2</td>
<td>0.301</td>
<td>1.538</td>
<td>0.920</td>
<td>1.237</td>
<td>On time</td>
</tr>
<tr>
<td>3</td>
<td>1.538</td>
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<td>2.161</td>
<td>1.245</td>
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</tr>
<tr>
<td>4</td>
<td>2.783</td>
<td>4.020</td>
<td>3.402</td>
<td>1.237</td>
<td>On time</td>
</tr>
<tr>
<td>5</td>
<td>4.224</td>
<td>4.240</td>
<td>4.232</td>
<td>0.016</td>
<td>Off time</td>
</tr>
<tr>
<td>6</td>
<td>4.240</td>
<td>4.264</td>
<td>4.252</td>
<td>0.024</td>
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<td>7</td>
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<td>4.297</td>
<td>4.281</td>
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<td>4.297</td>
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<td>4.313</td>
<td>0.033</td>
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<td>9</td>
<td>4.329</td>
<td>4.370</td>
<td>4.350</td>
<td>0.041</td>
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<td>4.370</td>
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<tr>
<td>11</td>
<td>4.419</td>
<td>4.484</td>
<td>4.451</td>
<td>0.065</td>
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<td>12</td>
<td>4.484</td>
<td>4.557</td>
<td>4.521</td>
<td>0.073</td>
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<tr>
<td>13</td>
<td>4.557</td>
<td>4.639</td>
<td>4.598</td>
<td>0.081</td>
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<td>0.106</td>
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<td>4.875</td>
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<td>4.952</td>
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<td>0.187</td>
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<td>18</td>
<td>5.216</td>
<td>5.444</td>
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<td>0.228</td>
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<td>5.444</td>
<td>5.713</td>
<td>5.579</td>
<td>0.269</td>
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<tr>
<td>20</td>
<td>5.713</td>
<td>6.047</td>
<td>5.880</td>
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<td>6.047</td>
<td>6.437</td>
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<td>23</td>
<td>6.917</td>
<td>7.495</td>
<td>7.206</td>
<td>0.578</td>
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<td>24</td>
<td>7.495</td>
<td>8.195</td>
<td>7.845</td>
<td>0.700</td>
<td>Off time</td>
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<td>8.195</td>
<td>9.033</td>
<td>8.614</td>
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<td>26</td>
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<td>10.050</td>
<td>9.542</td>
<td>1.017</td>
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</tr>
<tr>
<td>27</td>
<td>10.050</td>
<td>11.279</td>
<td>10.665</td>
<td>1.229</td>
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<td>28</td>
<td>11.279</td>
<td>12.752</td>
<td>12.016</td>
<td>1.473</td>
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</tr>
<tr>
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<td>12.752</td>
<td>14.543</td>
<td>13.647</td>
<td>1.790</td>
<td>Off time</td>
</tr>
<tr>
<td>30</td>
<td>14.543</td>
<td>16.667</td>
<td>15.605</td>
<td>2.124</td>
<td>Off time</td>
</tr>
</tbody>
</table>

**Table 2. HELITEM® Gate positions**
Figure 3. HELITEM® System Waveforms

Digital Acquisition System: Fugro Airborne Surveys HeliDAS.

Barometric Altimeter: Motorola MPX4115AP analog pressure sensor with a pressure sensitivity of 150mV/kPa and a 10 Hz sample interval, mounted in the helicopter.

Radar Altimeter: Honeywell RT300 short pulse modulation 4.3 GHz, sensitivity 1 ft, range 0 to 2500 ft, 10 Hz recording interval mounted in the helicopter.

Camera: Panasonic WVCD/32 Colour Video Camera.

Electronic Navigation: Novatel OEMV4/V, 0.5 sec recording interval. Antenna mounted on the tail of the helicopter.

Positional Data: Novatel OEMV4/V, 0.5 sec recording interval. Antenna mounted on the tail of the helicopter.
Base Station Equipment

During the survey a base station GPS was set up to collect data to allow post processing of the positional data for increased accuracy. The locations of the GPS base stations are recorded in Table 3.

<table>
<thead>
<tr>
<th>Status</th>
<th>Location Name</th>
<th>WGS84 Latitude (deg-min-sec)</th>
<th>WGS84 Longitude (deg-min-sec)</th>
<th>Orthometric Height EGM96 (m)</th>
<th>Date Setup</th>
<th>Date Shut Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Camp</td>
<td>52 45 32.23 N</td>
<td>86 48 20.82 W</td>
<td>150.815</td>
<td>11-Sep-11</td>
<td>25-Sep-11</td>
</tr>
<tr>
<td>Secondary</td>
<td>Camp</td>
<td>52 45 32 N</td>
<td>86 48 20 W</td>
<td></td>
<td>11-Sep-11</td>
<td>25-Sep-11</td>
</tr>
</tbody>
</table>

Table 3. GPS Base Station Locations

The magnetic base stations were setup near the GPS base stations to record diurnal data. The magnetic base station locations and base value (calculated for primary only) are listed in Table 4.

<table>
<thead>
<tr>
<th>Status</th>
<th>Location Name</th>
<th>WGS84 Latitude (deg-min-sec)</th>
<th>WGS84 Longitude (deg-min-sec)</th>
<th>Base Level (nT)</th>
<th>Date Setup</th>
<th>Date Shut Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Camp</td>
<td>52 45 32 N</td>
<td>86 48 20 W</td>
<td>60997</td>
<td>11-Sep-11</td>
<td>25-Sep-11</td>
</tr>
<tr>
<td>Secondary</td>
<td>Camp</td>
<td>52 45 32 N</td>
<td>86 48 20 W</td>
<td>61007</td>
<td>11-Sep-11</td>
<td>25-Sep-11</td>
</tr>
</tbody>
</table>

Table 4. Magnetic Base Station Locations

GPS
Novatel OEM4/V receiver system

Magnetometer
CS-3 (primary) caesium vapour sensor with timing provided by CFI Marconi GPS receiver.
Survey Specifications

Block Summary

Table 5 summarizes the survey specifications for the Mitchell Property block, including line spacing and flight directions.

<table>
<thead>
<tr>
<th>BLOCK</th>
<th>LINES FROM</th>
<th>LINES TO</th>
<th>FLIGHT DIRECTION</th>
<th>LINE SPACING</th>
<th>MEASURED LINE km</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10010</td>
<td>11200</td>
<td>NW-SE (132°)</td>
<td>100 metres</td>
<td>535.5</td>
</tr>
<tr>
<td></td>
<td>19010</td>
<td>19050</td>
<td>NE-SW (42°)</td>
<td>1000 metres</td>
<td>57.6</td>
</tr>
<tr>
<td>B</td>
<td>20010</td>
<td>20620</td>
<td>NW-SE (133°)</td>
<td>100 metres</td>
<td>190.6</td>
</tr>
<tr>
<td></td>
<td>29010</td>
<td>29030</td>
<td>NE-SW (43°)</td>
<td>1200 metres</td>
<td>19.9</td>
</tr>
<tr>
<td>C</td>
<td>30010</td>
<td>30690</td>
<td>NW-SE (139°)</td>
<td>100 metres</td>
<td>394.6</td>
</tr>
<tr>
<td></td>
<td>39010</td>
<td>39030</td>
<td>NE-SW (49°)</td>
<td>2500 metres</td>
<td>21.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TOTAL:</td>
<td>1220.1</td>
</tr>
</tbody>
</table>

Table 5. Summary of Survey Specification

Survey Elevation

Optimum survey elevations for the helicopter and instrumentation during normal survey flying are:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Helicopter</td>
<td>82 metres</td>
<td></td>
</tr>
<tr>
<td>HELITEM® Receiver</td>
<td>62 metres</td>
<td></td>
</tr>
<tr>
<td>Magnetometer</td>
<td>35 metres</td>
<td></td>
</tr>
<tr>
<td>HELITEM® Transmitter</td>
<td>35 metres</td>
<td></td>
</tr>
</tbody>
</table>

Survey elevations will not deviate by more than 20% over a distance of 2 km from the contracted elevation.

Survey elevation is defined as the measurement of the helicopter radar altimeter to the tallest obstacle in the helicopter path. An obstacle is any structure or object which will impede the path of the helicopter to the ground and is not limited to and includes tree canopy, towers and power lines.

Survey elevations may vary based on the pilot's judgement of safe flying conditions around man-made structures or in rugged terrain.
Noise Levels

Electromagnetic Data

The noise levels of the EM data as indicated on the raw traces of dB/dt & B field channel 30 shall not exceed the following tolerances continuously over a horizontal distance of 1000 metres under normal survey conditions:

- dB/dt X and Z  ± 5 nT/s
- B-Field X and Z  ± 12.5 pT

Airborne High Sensitivity Magnetometer

Magnetic total-field intensity data will be recorded on-board the aircraft as follows:
- Sample interval will be 0.1 second (10 samples/second)
- Magnetometer sensitivity will be 0.1 nT

Magnetometer noise level will not exceed ±1.0 nT for a distance of 1 km or more.

Ground Base Station Magnetometer

Base station magnetometer information will be recorded digitally at 1.0 second intervals.

For acceptance of the magnetic data, non-linear variations in the magnetic diurnal should not exceed 10 nT over a chord of 60 seconds.

Field Crew

The field crew for the survey were as follows:

Data Processor: Mikhail Maslennikov, Amanda Heydorn
Pilot: Greg Charbonneau
Electronics Operators: Darcy Blouin, Ali Allam, Dejo Oyediran
Maintenance Engineer: Sean Barr, Matt Kelly
Data Processing

Field

All digital data were verified for validity and continuity. The data from the aircraft and base station were transferred to the field PC. Basic statistics were generated for each parameter recorded, these included: the minimum, maximum, and mean values; the standard deviation; and any null values located. Data were checked in the field by the FUGRO AIRBORNE SURVEYS field geophysicist for adherence to the survey specifications as outlined in the survey specifications section. Any failure to meet the survey specifications resulted in a re-flight of the line or portion of the line unless aircraft safety was at risk or the client’s on site representative approved the data.

Flight Path Recovery

The quality of the GPS navigation was controlled on a daily basis by recovering the flight path of the aircraft. The correction procedure uses the raw ranges from the base station to create improved models of clock error, atmospheric error and satellite orbit. These models are used to improve the conversion of aircraft raw ranges to differentially corrected aircraft position.

To check the quality of the positional data the aircraft speed is calculated using the differentially corrected x, y and z data. Any sharp changes in the speed are used to flag possible problems with the positional data. Where speed jumps occur the data are inspected to determine the source of the error. The erroneous data are deleted and interpolated if less than two seconds in length. If the error is greater than two seconds the raw data are examined and if acceptable may be shifted and used to replace the bad data. The GPS z component is the most common source of error. When it shows problems that cannot be corrected by recalculating the differential correction the barometric altimeter is used as a guide to assist in making the appropriate correction.

Altitude Data

Radar altimeter data is de-spiked by applying a one and a half second median and smoothed using a one and a half second Hanning filter. The data are then subtracted from the GPS elevation to create a digital terrain model that is gridded and consulted in conjunction with profiles of the radar altimeter and flight path video to detect any spurious points.

Base Station Diurnal Magnetics

The raw diurnal data are sampled at 1 Hz are imported into a database. The data are filtered with a 5 second median filter and then a 5 second Hanning filter to remove spikes and smooth short wavelength variations. A nonlinear variation is then calculated and a flag channel is created to indicate where the variation exceeds the survey tolerance. Acceptable diurnal data are interpolated to a 10 Hz sample rate and the local regional field value calculated from the average of the first day’s diurnal data is removed to leave the diurnal variation. This diurnal variation is then ready to be used in the processing of the airborne magnetic data.
**Airborne Magnetics**

**Total Magnetic Intensity (TMI)**

The TMI data collected in flight are profiled on screen along with a fourth difference channel calculated from the TMI. Spikes were removed manually where indicated by the fourth difference. The de-spiked data were then corrected for lag by 24 samples. The diurnal variation extracted from the filtered ground station data was then removed from the de-spiked and lagged TMI. The TMI is then tie line levelled, manually corrected and micro-levelled if necessary.

**Calculated Vertical Gradient (CVG)**

The first vertical derivative was calculated in the frequency domain from the final gridded TMI values to enhance subtleties related to geological structures. A separate vertical derivative was calculated from the profile TMI data for display on the multi-parameter profiles.

**Electromagnetics**

**dB/dt Data**

Lag correction: 0 samples

Data correction: The X, Y and Z component data are re-processed from the raw stream to produce the 30 raw channels at 10 samples per second.

The following processing steps are applied to the dB/dt data from all coil sets:

a) The raw stream data is re-processed post-flight using start-of-flight and end-of-flight calibrations to remove spheric spikes, coil oscillation and system drift.

b) Noise filtering is done using an adaptive filter technique based on time domain triangular operators. Using a second difference value to identify changes in gradient along each channel, minimal filtering (21 points) is applied over the peaks of the anomalies, ranging in set increments up to a maximum amount of filtering in the resistive background areas (35 points for both the X and the Z component data);

c) The filtered X, Y and Z component data are then levelled in flight form for any residual and nonlinear drift that was not adequately corrected during the drift correction.

d) Finally, line-based levelling and microlevelling are applied as required.

**B-field Data**

The data acquisition system produces 30 B-field channels each for X, Y and Z components in real-time during flight, however these channels are only used for field QC. For delivery, mapping and generation of derived products, the final B-field channels are derived from the final levelled dB/dt data.
Coil Oscillation Correction

The electromagnetic receiver sensor of the HELITEM® is housed in a platform container which is slung below the helicopter using a cable and attached to the transmitter loop through a network of cables. The platform design reduces the rotation of the receiver coils in flight as well as improves the stability of the receiver-transmitter geometry. However sudden changes in airspeed of the aircraft, strong variable crosswinds, or other turbulence can still result in sudden moves of the platform. This can cause the induction sensors inside the platform to rotate about their mean orientation. The effect of coil oscillation on the data increases as the signal from the ground (conductivity) increases and may not be noticeable when flying over areas which are generally resistive.

Using the changes in the coupling of the primary field, it is possible to estimate the pitch, roll and yaw of the receiver sensors. Only the pitch, which affects mainly the X and Z components, was considered for correction. The nominal pitch can be computed using the ideal system geometry. The pitch angles during flight are estimated and corrected to this nominal value, removing the effects caused by the deviation of the receiver sensor from its nominal position.

For the present datasets the data from all 30 channels of dB/dt and B-Field parameters have been corrected for coil oscillation.

dB/dt Z Data

Except for extremely conductive areas, the amplitude of the dB/dt Z component increases with the conductivities of the earth. Due to the geometry of the HELITEM® system, the Z component response from a near vertical discrete conductor peaks at either side but nulls where the transmitter is on top of the conductor. This results an “M” shaped Z component anomaly over a vertical conductor. The amplitudes of, and the distance between the two peaks can be used to indicate the dip angle and dip direction of the conductor.

Apparent Conductivity from Z data

Fugro has developed an algorithm that converts the response in any measurement window (on-time or off-time) into an apparent conductivity. This is performed using a look-up table that contains the response at a range of half-space conductivities and altimeter heights.

The apparent conductivity is calculated by fitting all 30 channels of the Z-coil response of the dB/dt or B-Field component to a homogeneous half-space model (or thin sheet model). Prior to the fitting, the data are deconvolved to the step response in order to provide a linear relationship as the conductivity of the ground increases from the resistive limit to the inductive limit.

The apparent conductivity for the present dataset was calculated using a middle off-time channel of the Z component of the B-field to obtain an overview of the resistivity of the survey area.

Decay Constant (TAU)

The decay constant values are obtained by fitting the channel data from either the complete off-time signal of the decay transient or only a selected portion of it (as defined by specific channels) to a single exponential of the form:

\[ Y = Ae^{-t/\tau} \]

where \( A \) is amplitude at time zero, \( t \) is time in microseconds and \( \tau \) is the decay constant, expressed
in microseconds. A semi-log plot of this exponential function will be displayed as a straight line, the slope of which will reflect the rate of decay and therefore the strength of the conductivity. A slow rate of decay, reflecting a high conductivity, will be represented by a high decay constant.

As a single parameter, the decay constant provides more useful information than the amplitude data of any given single channel, as it indicates not only the peak position of the response but also the relative strength of the conductor. It also allows better discrimination of conductive axes within a broad formational group of conductors.

For the present dataset, the decay constant was calculated by fitting the response of the Z component of the B-field for a range of early delay times (0.264 - 0.582ms after turnoff).
Final Products

Digital Archives
Line and grid data in the form of Geosoft database (*.gdb) and Geosoft grids (*.grd) have been written to a DVD. The formats and layouts of these archives are further described in Appendix C (Data Archive Description). Hardcopies of all maps have been created as outlined below.

Maps
Scale: 1:20,000
Parameters: Total Magnetic Intensity
Calculated Vertical Gradient from the Total Magnetic Intensity data
Apparent Conductivity derived from Z B-field channel 16
Decay constant (Tau) Z B-field Component at 0.264-0.582ms from the end of pulse
Media/Copies: PDF and 2 paper copies

Profile Plots
Horizontal Scale: 1:20,000
Parameters: Multi-parameter presentation of Radar Altimeter, Transmitter height above the EGM96 Geoid, Terrain (also above Geoid), Total Magnetic Intensity, Calculated Vertical Gradient, 23 channels (08-30) of both dB/dt and B field of X and Z component, and Powerline Monitors.
Media/Copies: PDF

Report
Media/Copies: PDF and 2 paper copies

Flight Path Videos
Media/Copies: 1 DVD (.Bin/BDX format)

All grids and maps have been produced with the following coordinate system.

Projection: Universal Transverse Mercator (UTM Zone 16N)
Datum: NAD83
Central meridian: 87° West
False Easting: 500000 metres
False Northing: 0 metres
Scale factor: 0.9996
Figure 1: Digital Terrain Model, block A
Figure 4: Total Magnetic Intensity, block A
Figure 5: Total Magnetic Intensity, block B
Figure 6: Total Magnetic Intensity, block C
Figure 7: Calculated Vertical Magnetic Gradient, block A
Figure 8: Calculated Vertical Magnetic Gradient, block B
Figure 9: Calculated Vertical Magnetic Gradient, block C
Figure 10: Apparent Conductivity from Z B-field channel 16, block A
Figure 11: Apparent Conductivity from Z B-field channel 16, block B
Figure 12: Apparent Conductivity from Z B-field channel 16, block C
Figure 13: Decay constant (Tau) Z B-field at 0.264-0.582ms from the end of pulse, block A
Figure 14: Decay constant (Tau) Z B-field at 0.264-0.582ms from the end of pulse, block B
Figure 15: Decay constant (Tau) Z B-field at 0.264-0.582ms from the end of pulse, block C
Appendix A

Data Archive Description
Data Archive Description:

Survey Details
Survey Area Names: McFaulds Lake South A, B, C, Ontario
Job number: 11076
Client: Platinex Inc.
Survey Company Name: Fugro Airborne Surveys
Flown Dates: September 15th to 25th, 2011
Archive Creation Date: 12 December 2011

Geodetic Information for map products
Projection: Universal Transverse Mercator (Zone 16N)
Datum: NAD83
Central meridian: 87° West
False Easting: 500000 metres
False Northing: 0 metres
Scale factor: 0.9996

Grid Archive:

Geosoft Grids:

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<td>nT</td>
</tr>
<tr>
<td>McFauldsLakeSth_*_CVG</td>
<td>Calculated Vertical Gradient from TMI</td>
<td>nT/m</td>
</tr>
<tr>
<td>McFauldsLakeSth_*_DTM</td>
<td>Digital Terrain Model</td>
<td>m ASL</td>
</tr>
<tr>
<td>McFauldsLakeSth_*_AppCond_BZ_16</td>
<td>Apparent Conductivity derived from Z B-field channel 16</td>
<td>mS/m</td>
</tr>
<tr>
<td>McFauldsLakeSth_*_Decay_BZ_early</td>
<td>Z Decay Constant at 0.264-0.582ms from the end of pulse</td>
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Linedata Archive:

Geosoft Database Layout (11076_McFauldsLakeSth_*_.gdb):

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<td>m</td>
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<td>AltRad</td>
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<td>GPSZ</td>
<td>Helicopter height above geoid (EGM96)</td>
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</tr>
<tr>
<td>DTM</td>
<td>Digital terrain model above geoid (EGM96)</td>
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</tr>
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<td>8</td>
<td>Height above surface from radar altimeter</td>
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<tr>
<td>9</td>
<td>Helicopter height above geoid (EGM96)</td>
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<td>Digital terrain model above geoid (EGM96)</td>
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<td>16</td>
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<td>dB/dt Y component channels 1 – 30 - levelled</td>
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<td>77-106</td>
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137-166  B field Y component channels 1 – 30 - levelled  10.3  pT
167-196  B field Z component channels 1 – 30 - levelled  10.3  pT

Geosoft XYZ Archive File Layout (11076_McFauldsLakeSth_*_raw.xyz):

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<td>Northing NAD83</td>
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<td>Fiducial</td>
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<td>m</td>
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<td>Helicopter height above geoid (EGM96)</td>
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<td>Digital elevation model above geoid (EGM96)</td>
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Maps:
PDF files of delivered maps for each block at a scale of 1:20,000.

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<tr>
<th>File</th>
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<td>Z Decay Constant at 0.264-0.582ms from the end of pulse</td>
<td>μs</td>
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Profiles:
PDF files of Multi-parameter profiles at a scale of 1:20,000, one line per sheet:

Prof_LINE.pdf
where \textit{LINE} is the survey line number.

\textbf{Report:}

A logistics and processing report for Project \#11076 in PDF format:

\textit{R11076_McFauldsLakeSouth.pdf}

\textbf{Video:}

Digital video in BIN/BDX format are archived for all survey flights. To view the files, a video viewer is included.

\textit{FUGROVIDEOVIEWER.ZIP (Stand alone)}

\textbf{Flight Logs:}

A PDF file of all the survey flights:

\textit{11076 Flight logs.pdf}

\textbf{Reference Waveform Description:}

The information shown below is only an example.

```
/Calibration Data [FLT 99041 Cal# 1 Start FID 50172 End Fid 50293]
/Base Frequency : 30 Hz
/Sample Interval: 8.1380208 µs
/ ---------------------------------------------------------------
/ XYZ REF WAVEFORM EXPORT
0 0.512 1.570 1.439 -0.803 -2.479 13.000 0.877
1 0.512 -1.756 3.954 -3.239 -2.496 12.984 0.886
2 0.512 -3.027 -2.154 -1.877 -2.477 12.94 0.921
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
509 -0.513 3.593 -2.359 4.060 0.141 -0.002 0.031
510 -0.513 9.231 -3.096 0.690 0.102 -0.028 -0.013
511 -0.512 0.194 0.533 -1.855 0.002 0.006 -0.020
```

The first column is the sample number. There are a total of 2048 samples representing a half-wave cycle or one pulse. The subsequent columns are: transmitter current, measured X primary field, measured Y primary field, and measured Z primary field for dB/dt and B-Field.

If you have any problems with this archive please contact
Appendix B

Helicopter Airborne Electromagnetic Systems
HELICOPTER AIRBORNE ELECTROMAGNETIC SYSTEMS

General

The operation of a helicopter time-domain electromagnetic system (EM) involves the measurement of decaying secondary electromagnetic fields induced in the ground by a series of short current pulses generated from a towed transmitter. Variations in the decay characteristics of the secondary field (sampled and displayed as windows) are analyzed and interpreted to provide information about the subsurface geology.

A number of factors combine to give the helicopter platforms good signal-to-noise ratio, depth of penetration and excellent resolution: 1) the principle of sampling the induced secondary field in the absence of the primary field (during the “off-time”), 2) the large dipole moment 3) the low flying height of the system and spatial proximity of the transmitter and receiver. Such a system is also relatively insensitive to noise due to air turbulence. However, sampling in the “on-time” can also result in excellent sensitivity for mapping very resistive features and very conductive geologic features (Annan et al, 1991, Geophysics v.61, p. 93-99).

Methodology

The Fugro time-domain helicopter electromagnetic system (HELITEM®) uses a high-speed digital EM receiver. The primary electromagnetic pulses are created by a series of discontinuous sinusoidal current pulses fed into a two-turn transmitting loop towed below the helicopter. The base frequency rate is selectable, with 25, 30, 75 and 90 currently being available. The length of the pulse can be tailored to suit the targets. Standard pulse widths available are 2.0 and 4.0 ms. The available off-time can be selected to be as great as 16 ms. The dipole moment depends on the pulse width and base frequency used on the survey. The specific dipole moment, waveform and gate settings for this survey are given in the main body of the report.

The receiver sensor is a three-axis (x, y & z) induction coil set housed in a platform suspended on the tow cable below the helicopter and above the transmitter. The tow cable is non-magnetic to reduce noise levels. The tow cable is 51.9 m long. The receiver is 26.7 m above and 12.9 m ahead of the transmitter in flight.

For each primary pulse a secondary magnetic field is produced by decaying eddy currents in the ground. These in turn induce a voltage in the receiver coils, which is the electromagnetic response. Good conductors decay slowly, poorer conductors more rapidly.

Operations, which are carried out in the receiver, are:

1. **Primary-field removal:** In addition to measuring the secondary response from the ground, the receiver sensor coils also measure the primary response from the transmitter. During flight, the receiver sensor position and orientation changes slightly, and this has a very strong effect on the magnitude of the total response (primary plus secondary) measured at the receiver coils. The variable primary field response is distracting because it is unrelated to the ground response. The primary field is measured by flying at an altitude such that no ground response is measurable. These calibration signals are used to define the shape of the primary waveform. By definition this primary field includes the response of the current in the transmitter loop plus the response of any slowly decaying eddy currents induced in the
helicopter. We assume that the shape of the primary will not change as the receiver sensor position changes, but that the amplitude will vary. The primary-field-removal procedure involves solving for the amplitude of the primary field in the measured response and removing this from the total response to leave a secondary response. Note that this procedure removes any “in-phase” response from the ground which has the same shape as the primary field.

2. **Digital Stacking:** Stacking is carried out to reduce the effect of broadband noise in the data.

3. **Windowing of data:** The digital receiver samples the secondary and primary electromagnetic field at 2048 points per EM pulse and windows the signal in up to 30 time gates whose centres and widths are software selectable and which may be placed anywhere within or outside the transmitter pulse. This flexibility offers the advantage of arranging the gates to suit the goals of a particular survey, ensuring that the signal is appropriately sampled through its entire dynamic range.

4. **Primary Field:** The primary field at the receiver sensor is measured for each stack and recorded as a separate data channel to assess the variation in coupling between the transmitter and the receiver sensor induced by changes in system geometry.

One of the major roles of the digital receiver is to provide diagnostic information on system functions and to allow for identification of noise events, such as sferics, which may be selectively removed from the EM signal. The high digital sampling rate yields maximum resolution of the secondary field.

### System Hardware

The airborne EM system consists of the helicopter, the on-board hardware, and the software packages controlling the hardware.

#### Transmitter System

The transmitter system drives high-current pulses of an appropriate shape and duration through the coils towed below the helicopter.

#### System Timing Clock

This subsystem provides appropriate timing signals to the transmitter, and also to the analog-to-digital converter, in order to produce output pulses and capture the ground response. All systems are synchronized to GPS time.

#### Platform Systems

A three-axis induction coil sensor is mounted inside a platform on the tow cable. The platform is connected to the transmitter loop through a network of cables to ensure a more robust and better stability of the transmitter-receiver geometry. A magnetometer sensor is attached to the transmitter loop near its centre.
Appendix C

Airborne Transient EM Interpretation
Interpretation of transient electromagnetic data

Introduction
The basis of the transient electromagnetic (EM) geophysical surveying technique relies on the premise that changes in the primary EM field produced in the transmitting loop will result in eddy currents being generated in any conductors in the ground. The eddy currents then decay to produce a secondary EM field which may be sensed in the receiver coil.

The HELITEM® airborne transient (or time-domain) EM system incorporates a high-speed digital receiver which records the secondary field response with a high degree of accuracy. Most often the earth’s total magnetic field is recorded concurrently.

Although the approach to interpretation varies from one survey to another depending on the type of data presentation, objectives and local conditions, the following generalizations may provide the reader with some helpful background information.

The main purpose of the interpretation is to determine the probable origin of the responses detected during the survey and to suggest recommendations for further exploration. This is possible through an objective analysis of all characteristics of the different types of responses and associated magnetic anomalies, if any. If possible the airborne results are compared to other available data. Certitude is seldom reached, but a high probability is achieved in identifying the causes in most cases. One of the most difficult problems is usually the differentiation between surface conductor responses and bedrock conductor responses.

Types of Conductors

Bedrock Conductors
The different types of bedrock conductors normally encountered are the following:

1. **Graphites.** Graphitic horizons (including a large variety of carbonaceous rocks) occur in sedimentary formations of the Precambrian as well as in volcanic tuffs, often concentrated in shear zones. They correspond generally to long, multiple conductors lying in parallel bands. They have no magnetic expression unless associated with pyrrhotite or magnetite. Their conductivity is variable but generally high.

2. **Massive sulphides.** Massive sulphide deposits usually manifest themselves as short conductors of high conductivity, often with a coincident magnetic anomaly. Some massive sulphides, however, are not magnetic, others are not very conductive (discontinuous mineralization or sphalerite), and some may be located among formational conductors so that one must not be too rigid in applying the selection criteria.

   In addition, there are syngenetic sulphides whose conductive pattern may be similar to that of graphitic horizons but these are generally not as prevalent as graphites.

3. **Magnetite and some serpentinized ultrabasics.** These rocks are conductive and very magnetic.

4. **Manganese oxides.** This mineralization may give rise to a weak EM response.
Surficial Conductors

1. Beds of clay and alluvium, some swamps, and brackish ground water are usually poorly conductive to moderately conductive.

2. Lateritic formations, residual soils and the weathered layer of the bedrock may cause surface anomalous zones, the conductivity of which is generally low to medium but can occasionally be high. Their presence is often related to the underlying bedrock.

Cultural Conductors (Man-Made)

3. **Power lines.** These frequently, but not always, produce a conductive type of response. In the case when the radiated field is not removed by the power line comb filter, the anomalous response can exhibit phase changes between different windows. In the case of current induced by the EM system in a grounded wire, or steel pylon, the anomaly may look very much like a bedrock conductor.

4. **Grounded fences or pipelines.** These will invariably produce responses much like a bedrock conductor. Whenever they cannot be identified positively, a ground check is recommended.

5. **General culture.** Other localized sources such as certain buildings, bridges, irrigation systems, tailings ponds etc., may produce EM anomalies. Their instances, however, are rare and often they can be identified on the visual path recovery system.

Analysis of the Conductors

The rate of decay of a conductor is generally indicative of the conductivity of the anomalous material. However, the decay rate alone is not generally a decisive criterion in the analysis of a conductor. In particular, one should note:

- its shape and size,
- all local variations of characteristics within a conductive zone,
- any associated geophysical parameter (e.g. magnetism),
- the geological environment,
- the structural context, and
- the pattern of surrounding conductors.

The first objective of the interpretation is to classify each conductive zone according to one of the three categories which best defines its probable origin. The categories are cultural, surficial and bedrock. A second objective is to assign to each zone a priority rating as to its potential as an economic prospect.

Bedrock Conductors

This category comprises those anomalies which cannot be classified according to the criteria established for cultural and surficial responses. It is difficult to assign a universal set of values which typify bedrock conductivity because any individual zone or anomaly might exhibit some, but
not all, of these values and still be a bedrock conductor. The following criteria are considered indicative of a bedrock conductor:

1. An intermediate to high conductivity identified by a response with slow decay, with an anomalous response present in the later windows.

2. For vertical conductors, the anomaly should be narrow, relatively symmetrical, with two well-defined z-component peaks and a null between the peaks.

3. If the conductor is thin, the response characteristics varies as a function of depth and dips. If the conductor is wider, the responses might look more similar to the sphere responses.

4. A small to intermediate amplitude. Large amplitudes are normally associated with surficial conductors. The amplitude varies according to the depth of the source.

5. A degree of continuity of the EM characteristics across several lines.

6. An associated magnetic response of similar dimensions. One should note, however, that those magnetic rocks which weather to produce a conductive upper layer will possess this magnetic association. In the absence of one or more of the characteristics defined in 1, 2, 3, 4 and 5, the related magnetic response cannot be considered significant.

Most obvious bedrock conductors occur in long, relatively monotonous, sometimes multiple zones following formational strike. Graphitic material is usually the most probable source. Massive syngenetic sulphides extending for many kilometres are known in nature but, in general, they are not common. Long formational structures associated with a strong magnetic expression may be indicative of banded iron formations.

In summary, a bedrock conductor reflecting the presence of a massive sulphide would normally exhibit the following characteristics:

- a high conductivity,
- an appropriate anomaly shape,
- a small to intermediate amplitude,
- an isolated setting,
- a short strike length (in general, not exceeding one kilometre), and
- preferably, with a localized magnetic anomaly of matching dimensions.

**Surficial Conductors**

This term is used for geological conductors in the overburden, either glacial or residual in origin, and in the weathered layer of the bedrock. Most surficial conductors are probably caused by clay minerals. In some environments the presence of salts will contribute to the conductivity. Other possible electrolytic conductors are residual soils, swamps, brackish ground water and alluvium such as lake or river-bottom deposits, flood plains and estuaries.

Normally, most surficial materials have low to intermediate conductivity so they are not easily mistaken for highly conductive bedrock features. Also, many of them are wide and their anomaly shapes are typical of broad horizontal sheets.
When surficial conductivity is high it is usually still possible to distinguish between a horizontal plate (more likely to be surficial material) and a vertical body (more likely to be a bedrock source) thanks to the characteristic shapes of the two anomalies and the differences in the x-component responses.

One of the more ambiguous situations as to the true source of the response is when surface conductivity is related to bedrock lithology as for example, surface alteration of an underlying bedrock unit. At times, it is also difficult to distinguish between a weak conductor within the bedrock (e.g. near-massive sulphides) and a surficial source.

In the search for massive sulphides or other bedrock targets, surficial conductivity is generally considered as interference but there are situations where the interpretation of surficial-type conductors is the primary goal. When soils, weathered or altered products are conductive, and in-situ, the responses are a very useful aid to geologic mapping. Shears and faults are often identified by weak, usually narrow, anomalies.

Analysis of surficial conductivity can be used in the exploration for such features as lignite deposits, kimberlites, paleochannels and ground water. In coastal or arid areas, surficial responses may serve to define the limits of fresh, brackish and salty water.

**Cultural Conductors**

The majority of cultural anomalies occur along roads and are accompanied by a response on the power line monitor. This monitor is set to 50 or 60 Hz, depending on the local power grid. In some cases, the current induced in the power line results in anomalies which could be mistaken for bedrock responses. There are also some power lines which have no response whatsoever.

The power line monitor, of course, is of great assistance in identifying cultural anomalies of this type. It is important to note, however, that geological conductors in the vicinity of power lines may exhibit a weak response on the monitor because of current induction via the earth.

Fences, pipelines, communication lines, railways and other man-made conductors can give rise to responses, the strength of which will depend on the grounding of these objects.

Another facet of this analysis is the line-to-line comparison of anomaly character along suspected man-made conductors. In general, the amplitude, the rate of decay, and the anomaly width should not vary a great deal along any one conductor, except for the change in amplitude related to terrain clearance variation. A marked departure from the average response character along any given feature gives rise to the possibility of a second conductor.

In most cases a visual examination of the site will suffice to verify the presence of a man-made conductor. If a second conductor is suspected the ground check is more difficult to accomplish. The object would be to determine if there is (i) a change in the man-made construction, (ii) a difference in the grounding conditions, (iii) a second cultural source, or (iv) if there is, indeed, a geological conductor in addition to the known man-made source.

The selection of targets from within extensive (formational) belts is much more difficult than in the case of isolated conductors. Local variations in the EM characteristics, such as in the amplitude, decay, shape etc., can be used as evidence for a relatively localized occurrence. Changes in the character of the EM responses, however, may be simply reflecting differences in the conductive
formations themselves rather than indicating the presence of massive sulphides and, for this reason, the degree of confidence is reduced.

Another useful guide for identifying localized variations within formational conductors is to examine the magnetic data in map or image form. Further study of the magnetic data can reveal the presence of faults, contacts, and other features which, in turn, help define areas of potential economic interest.

Finally, once ground investigations begin, it must be remembered that the continual comparison of ground knowledge to the airborne information is an essential step in maximizing the usefulness of the airborne EM data.
Appendix D

Multicomponent Modeling
**Multicomponent helicopter airborne EM modelling**

**PLATE MODELING**

The PLATE program has been used to generate synthetic responses over a number of plate models with 75 m of burial depth and varying dips (0, 45, 90 and 135 degrees). The geometry assumed for the HELITEM® system is shown in Figure 3. In all cases the plate has a strike length of 200m, with a strike direction into the page. The width of the plate is 200m. As the flight path traverses the center of the plate, the Y component is zero and has not been plotted.

Figure 4 shows the model results as flying from left to right and Figure 5 shows the modeling results flying from right to left.

The plotting point is the transmitter receiver midpoint.

![Figure 2 Geometry of the HELITEM® System](image-url)
HeliGEOTEM Plate Models

Plate: dip = 45°; depth = 75

Plate: dip = 0°; depth = 75

Plate: dip = 135°; depth = 75

Plate: dip = 90°; depth = 75

Figure 3 Plate model with a flying direction of left to right
Figure 4 Plate model with flying direction from right to left
Appendix E

Glossary
GLOSSARY OF AIRBORNE GEOPHYSICAL TERMS

Note: The definitions given in this glossary refer to the common terminology as used in airborne geophysics.

**altitude attenuation**: the absorption of gamma rays by the atmosphere between the earth and the detector. The number of gamma rays detected by a system decreases as the altitude increases.

**apparent-**: the physical parameters of the earth measured by a geophysical system are normally expressed as apparent, as in “apparent resistivity”. This means that the measurement is limited by assumptions made about the geology in calculating the response measured by the geophysical system. Apparent resistivity calculated with HEM, for example, generally assumes that the earth is a homogeneous half-space – not layered.

**amplitude**: The strength of the total electromagnetic field. In frequency domain it is most often the sum of the squares of in-phase and quadrature components. In multi-component electromagnetic surveys it is generally the sum of the squares of all three directional components.

**analytic signal**: The total amplitude of all the directions of magnetic gradient. Calculated as the sum of the squares.

**anisotropy**: Having different physical parameters in different directions. This can be caused by layering or fabric in the geology. Note that a unit can be anisotropic, but still homogeneous.

**anomaly**: A localized change in the geophysical data characteristic of a discrete source, such as a conductive or magnetic body: something locally different from the background.

**B-field**: In time-domain electromagnetic surveys, the magnetic field component of the (electromagnetic) field. This can be measured directly, although more commonly it is calculated by integrating the time rate of change of the magnetic field \( \frac{dB}{dt} \), as measured with a receiver coil.

**background**: The “normal” response in the geophysical data – that response observed over most of the survey area. Anomalies are usually measured relative to the background. In airborne gamma-ray spectrometric surveys the term defines the cosmic, radon, and aircraft responses in the absence of a signal from the ground.

**base-level**: The measured values in a geophysical system in the absence of any outside signal. All geophysical data are measured relative to the system base level.

**base frequency**: The frequency of the pulse repetition for a time-domain electromagnetic system. Measured between subsequent positive pulses.

**bird**: A common name for the pod towed beneath or behind an aircraft, carrying the geophysical sensor array.

**bucking**: The process of removing the strong signal from the primary field at the receiver from the data, to measure the secondary field. It can be done electronically or mathematically. This is done in frequency-domain EM, and to measure on-time in time-domain EM.
**calibration coil**: A wire coil of known size and dipole moment, which is used to generate a field of known **amplitude** and **phase** in the receiver, for system calibration. Calibration coils can be external, or internal to the system. Internal coils may be called Q-coils.

**coaxial coils**: [CX] Coaxial coils in an HEM system are in the vertical plane, with their axes horizontal and collinear in the flight direction. These are most sensitive to vertical conductive objects in the ground, such as thin, steeply dipping conductors perpendicular to the flight direction. Coaxial coils generally give the sharpest anomalies over localized conductors. (See also **coplanar coils**)

**coil**: A multi-turn wire loop used to transmit or detect electromagnetic fields. Time varying **electromagnetic** fields through a coil induce a voltage proportional to the strength of the field and the rate of change over time.

**compensation**: Correction of airborne geophysical data for the changing effect of the aircraft. This process is generally used to correct data in **fixed-wing time-domain electromagnetic** surveys (where the transmitter is on the aircraft and the receiver is moving), and magnetic surveys (where the sensor is on the aircraft, turning in the earth’s magnetic field).

**component**: In **frequency domain electromagnetic** surveys this is one of the two **phase** measurements – **in-phase** or **quadrature**. In “multi-component” electromagnetic surveys it is also used to define the measurement in one geometric direction (vertical, horizontal in-line and horizontal transverse – the Z, X and Y components).

**Compton scattering**: gamma ray photons will bounce off electrons as they pass through the earth and atmosphere, reducing their energy and then being detected by **radiometric** sensors at lower energy levels. See also **stripping**.

**conductance**: See **conductivity thickness**

**conductivity**: \([\sigma]\) The facility with which the earth or a geological formation conducts electricity. Conductivity is usually measured in milli-Siemens per metre (mS/m). It is the reciprocal of **resistivity**.

**conductivity-depth imaging**: see **conductivity-depth transform**.

**conductivity-depth transform**: A process for converting electromagnetic measurements to an approximation of the conductivity distribution vertically in the earth, assuming a **layered earth**. (Macnae and Lamontagne, 1987; Wolfgram and Karlik, 1995)

**conductivity thickness**: \([\sigma t]\) The product of the **conductivity**, and thickness of a large, tabular body. (It is also called the “conductivity-thickness product”) In electromagnetic geophysics, the response of a thin plate-like conductor is proportional to the conductivity multiplied by thickness. For example a 10 metre thickness of 20 Siemens/m mineralization will be equivalent to 5 metres of 40 S/m; both have 200 S conductivity thickness. Sometimes referred to as conductance.

**conductor**: Used to describe anything in the ground more conductive than the surrounding geology. Conductors are most often clays or graphite, or hopefully some type of mineralization, but may also be man-made objects, such as fences or pipelines.
coplanar coils: [CP] In HEM, the coplanar coils lie in the horizontal plane with their axes vertical, and parallel. These coils are most sensitive to massive conductive bodies, horizontal layers, and the halfspace.

cosmic ray: High energy sub-atomic particles from outer space that collide with the earth’s atmosphere to produce a shower of gamma rays (and other particles) at high energies.

counts (per second): The number of gamma-rays detected by a gamma-ray spectrometer. The rate depends on the geology, but also on the size and sensitivity of the detector.

culture: A term commonly used to denote any man-made object that creates a geophysical anomaly. Includes, but not limited to, power lines, pipelines, fences, and buildings.

current channelling: See current gathering.

current gathering: The tendency of electrical currents in the ground to channel into a conductive formation. This is particularly noticeable at higher frequencies or early time channels when the formation is long and parallel to the direction of current flow. This tends to enhance anomalies relative to inductive currents (see also induction). Also known as current channelling.

decay constant: see time constant.

decay series: In gamma-ray spectrometry, a series of progressively lower energy daughter products produced by the radioactive breakdown of uranium or thorium.

decay: In time-domain electromagnetic theory, the weakening over time of the eddy currents in the ground, and hence the secondary field after the primary electromagnetic pulse is turned off. In gamma-ray spectrometry, the radioactive breakdown of an element, generally potassium, uranium, thorium, or one of their daughter products.

dB/dt: As the secondary electromagnetic field changes with time, the magnetic field component induces a voltage in the receiving coil, which is proportional to the rate of change of the magnetic field over time.

depth of exploration: The maximum depth at which the geophysical system can detect the target. The depth of exploration depends very strongly on the type and size of the target, the contrast of the target with the surrounding geology, the homogeneity of the surrounding geology, and the type of geophysical system. One measure of the maximum depth of exploration for an electromagnetic system is the depth at which it can detect the strongest conductive target – generally a highly
conductive horizontal layer.

differential resistivity: A process of transforming apparent resistivity to an approximation of layer resistivity at each depth. The method uses multi-frequency HEM data and approximates the effect of shallow layer conductance determined from higher frequencies to estimate the deeper conductivities (Huang and Fraser, 1996)

dipole moment: [NIA] For a transmitter, the product of the area of a coil, the number of turns of wire, and the current flowing in the coil. At a distance significantly larger than the size of the coil, the magnetic field from a coil will be the same if the dipole moment product is the same. For a receiver coil, this is the product of the area and the number of turns. The sensitivity to a magnetic field (assuming the source is far away) will be the same if the dipole moment is the same.

diurnal: The daily variation in a natural field, normally used to describe the natural fluctuations (over hours and days) of the earth’s magnetic field.

dielectric permittivity: [$\varepsilon$] The capacity of a material to store electrical charge, this is most often measured as the relative permittivity [$\varepsilon_r$], or ratio of the material dielectric to that of free space. The effect of high permittivity may be seen in HEM data at high frequencies over highly resistive geology as a reduced or negative in-phase, and higher quadrature data.

drape: To fly a survey following the terrain contours, maintaining a constant altitude above the local ground surface. Also applied to re-processing data collected at varying altitudes above ground to simulate a survey flown at constant altitude.

drift: Long-time variations in the base-level or calibration of an instrument.

eddy currents: The electrical currents induced in the ground, or other conductors, by a time-varying electromagnetic field (usually the primary field). Eddy currents are also induced in the aircraft’s metal frame and skin; a source of noise in EM surveys.

electromagnetic: [EM] Comprised of a time-varying electrical and magnetic field. Radio waves are common electromagnetic fields. In geophysics, an electromagnetic system is one which transmits a time-varying primary field to induce eddy currents in the ground, and then measures the secondary field emitted by those eddy currents.

energy window: A broad spectrum of gamma-ray energies measured by a spectrometric survey. The energy of each gamma-ray is measured and divided up into numerous discrete energy levels, called windows.

equivalent (thorium or uranium): The amount of radioelement calculated to be present, based on the gamma-rays measured from a daughter element. This assumes that the decay series is in equilibrium – progressing normally.

exposure rate: in radiometric surveys, a calculation of the total exposure rate due to gamma rays at the ground surface. It is used as a measurement of the concentration of all the radioelements at the surface. See also: natural exposure rate.

fiducial, or fid: Timing mark on a survey record. Originally these were timing marks on a profile or
film; now the term is generally used to describe 1-second interval timing records in digital data, and on maps or profiles.

**Figure of Merit: (FOM)** A sum of the 12 distinct magnetic noise variations measured by each of four flight directions, and executing three aircraft attitude variations (yaw, pitch, and roll) for each direction. The flight directions are generally parallel and perpendicular to planned survey flight directions. The FOM is used as a measure of the *manoeuvre noise* before and after compensation.

**fixed-wing:** Aircraft with wings, as opposed to “rotary wing” helicopters.

**footprint:** This is a measure of the area of sensitivity under the aircraft of an airborne geophysical system. The footprint of an *electromagnetic* system is dependent on the altitude of the system, the orientation of the transmitter and receiver and the separation between the receiver and transmitter, and the conductivity of the ground. The footprint of a *gamma-ray spectrometer* depends mostly on the altitude. For all geophysical systems, the footprint also depends on the strength of the contrasting *anomaly*.

**frequency domain:** An *electromagnetic* system which transmits a *primary field* that oscillates smoothly over time (sinusoidal), inducing a similarly varying electrical current in the ground. These systems generally measure the changes in the *amplitude* and *phase* of the *secondary field* from the ground at different frequencies by measuring the *in-phase* and *quadrature* phase components. See also *time-domain*.

**full-stream data:** Data collected and recorded continuously at the highest possible sampling rate. Normal data are stacked (see *stacking*) over some time interval before recording.

**gamma-ray:** A very high-energy photon, emitted from the nucleus of an atom as it undergoes a change in energy levels.

**gamma-ray spectrometry:** Measurement of the number and energy of natural (and sometimes man-made) gamma-rays across a range of photon energies.

**gradient:** In magnetic surveys, the gradient is the change of the magnetic field over a distance, either vertically or horizontally in either of two directions. Gradient data is often measured, or calculated from the total magnetic field data because it changes more quickly over distance than the *total magnetic field*, and so may provide a more precise measure of the location of a source. See also *analytic signal*.

**ground effect:** The response from the earth. A common calibration procedure in many geophysical surveys is to fly to altitude high enough to be beyond any measurable response from the ground, and there establish *base levels* or *backgrounds*.

**half-space:** A mathematical model used to describe the earth – as infinite in width, length, and depth below the surface. The most common halfspace models are *homogeneous* and *layered earth*.

**heading error:** A slight change in the magnetic field measured when flying in opposite directions.

**HEM:** Helicopter ElectroMagnetic, This designation is most commonly used for helicopter-borne,
frequency-domain electromagnetic systems. At present, the transmitter and receivers are normally mounted in a bird carried on a sling line beneath the helicopter.

herringbone pattern: A pattern created in geophysical data by an asymmetric system, where the anomaly may be extended to either side of the source, in the direction of flight. Appears like fish bones, or like the teeth of a comb, extending either side of centre, each tooth an alternate flight line.

homogeneous: This is a geological unit that has the same physical parameters throughout its volume. This unit will create the same response to an HEM system anywhere, and the HEM system will measure the same apparent resistivity anywhere. The response may change with system direction (see anisotropy).

HTEM: Helicopter Time-domain ElectroMagnetic, This designation is used for the new generation of helicopter-borne, time-domain electromagnetic systems.

in-phase: the component of the measured secondary field that has the same phase as the transmitter and the primary field. The in-phase component is stronger than the quadrature phase over relatively higher conductivity.

induction: Any time-varying electromagnetic field will induce (cause) electrical currents to flow in any object with non-zero conductivity. (see eddy currents)

induction number: also called the “response parameter”, this number combines many of the most significant parameters affecting the EM response into one parameter against which to compare responses. For a layered earth the response parameter is $\mu \omega \sigma h^2$ and for a large, flat, conductor it is $\mu \omega \sigma t$, where $\mu$ is the magnetic permeability, $\omega$ is the angular frequency, $\sigma$ is the conductivity, $t$ is the thickness (for the flat conductor) and $h$ is the height of the system above the conductor.

inductive limit: When the frequency of an EM system is very high, or the conductivity of the target is very high, the response measured will be entirely in-phase with no quadrature (phase angle =0). The in-phase response will remain constant with further increase in conductivity or frequency. The system can no longer detect changes in conductivity of the target.

infinite: In geophysical terms, an ‘infinite’ dimension is one much greater than the footprint of the system, so that the system does not detect changes at the edges of the object.

International Geomagnetic Reference Field: [IGRF] An approximation of the smooth magnetic field of the earth, in the absence of variations due to local geology. Once the IGRF is subtracted from the measured magnetic total field data, any remaining variations are assumed to be due to local geology. The IGRF also predicts the slow changes of the field up to five years in the future.

inversion, or inverse modeling: A process of converting geophysical data to an earth model, which compares theoretical models of the response of the earth to the data measured, and refines the model until the response closely fits the measured data (Huang and Palacky, 1991)

layered earth: A common geophysical model which assumes that the earth is horizontally layered – the physical parameters are constant to infinite distance horizontally, but change vertically.

magnetic permeability: [$\mu$] This is defined as the ratio of magnetic induction to the inducing magnetic field. The relative magnetic permeability [$\mu_r$] is often quoted, which is the ratio of the rock
permeability to the permeability of free space. In geology and geophysics, the magnetic susceptibility is more commonly used to describe rocks.

**magnetic susceptibility**\([k]\): A measure of the degree to which a body is magnetized. In SI units this is related to relative magnetic permeability by \(k=\mu^{-1}\), and is a dimensionless unit. For most geological material, susceptibility is influenced primarily by the percentage of magnetite. It is most often quoted in units of \(10^{-6}\). In HEM data this is most often apparent as a negative in-phase component over high susceptibility, high resistivity geology such as diabase dikes.

**manoeuvre noise**: variations in the magnetic field measured caused by changes in the relative positions of the magnetic sensor and magnetic objects or electrical currents in the aircraft. This type of noise is generally corrected by magnetic compensation.

**model**: Geophysical theory and applications generally have to assume that the geology of the earth has a form that can be easily defined mathematically, called the model. For example steeply dipping conductors are generally modeled as being infinite in horizontal and depth extent, and very thin. The earth is generally modeled as horizontally layered, each layer infinite in extent and uniform in characteristic. These models make the mathematics to describe the response of the (normally very complex) earth practical. As theory advances, and computers become more powerful, the useful models can become more complex.

**natural exposure rate**: in radiometric surveys, a calculation of the total exposure rate due to natural-source gamma rays at the ground surface. It is used as a measurement of the concentration of all the natural radionuclides at the surface. See also: exposure rate.

**noise**: That part of a geophysical measurement that the user does not want. Typically this includes electronic interference from the system, the atmosphere (sferics), and man-made sources. This can be a subjective judgment, as it may include the response from geology other than the target of interest. Commonly the term is used to refer to high frequency (short period) interference. See also drift.

**Occam’s inversion**: an inversion process that matches the measured electromagnetic data to a theoretical model of many, thin layers with constant thickness and varying resistivity (Constable et al, 1987).

**off-time**: In a time-domain electromagnetic survey, the time after the end of the primary field pulse, and before the start of the next pulse.

**on-time**: In a time-domain electromagnetic survey, the time during the primary field pulse.

**overburden**: In engineering and mineral exploration terms, this most often means the soil on top of the unweathered bedrock. It may be sand, glacial till, or weathered rock.

**Phase, phase angle**: The angular difference in time between a measured sinusoidal electromagnetic field and a reference – normally the primary field. The phase is calculated from \(\tan^{-1}(\text{in-phase/quadrature})\).

**physical parameters**: These are the characteristics of a geological unit. For electromagnetic surveys, the important parameters are conductivity, magnetic permeability (or susceptibility)
and dielectric permittivity; for magnetic surveys the parameter is magnetic susceptibility, and for gamma ray spectrometric surveys it is the concentration of the major radioactive elements: potassium, uranium, and thorium.

**permittivity:** see dielectric permittivity.

**permeability:** see magnetic permeability.

**primary field:** the EM field emitted by a transmitter. This field induces eddy currents in (energizes) the conductors in the ground, which then create their own secondary fields.

**pulse:** In time-domain EM surveys, the short period of intense primary field transmission. Most measurements (the off-time) are measured after the pulse. On-time measurements may be made during the pulse.

**quadrature:** that component of the measured secondary field that is phase-shifted 90° from the primary field. The quadrature component tends to be stronger than the in-phase over relatively weaker conductivity.

**Q-coils:** see calibration coil.

**radioelements:** This normally refers to the common, naturally-occurring radioactive elements: potassium (K), uranium (U), and thorium (Th). It can also refer to man-made radioelements, most often cobalt (Co) and cesium (Cs)

**radiometric:** Commonly used to refer to gamma ray spectrometry.

**radon:** A radioactive daughter product of uranium and thorium, radon is a gas which can leak into the atmosphere, adding to the non-geological background of a gamma-ray spectrometric survey.

**receiver:** the signal detector of a geophysical system. This term is most often used in active geophysical systems – systems that transmit some kind of signal. In airborne electromagnetic surveys it is most often a coil. (see also, transmitter)

**resistivity:** $[\rho]$ The strength with which the earth or a geological formation resists the flow of electricity, typically the flow induced by the primary field of the electromagnetic transmitter. Normally expressed in ohm-metres, it is the reciprocal of conductivity.

**resistivity-depth transforms:** similar to conductivity depth transforms, but the calculated conductivity has been converted to resistivity.

**resistivity section:** an approximate vertical section of the resistivity of the layers in the earth. The resistivities can be derived from the apparent resistivity, the differential resistivities, resistivity-depth transforms, or inversions.

**Response parameter:** another name for the induction number.

**secondary field:** The field created by conductors in the ground, as a result of electrical currents induced by the primary field from the electromagnetic transmitter. Airborne electromagnetic systems are designed to create and measure a secondary field.
Sengpiel section: a **resistivity section** derived using the **apparent resistivity** and an approximation of the depth of maximum sensitivity for each frequency.

**sferic:** Lightning, or the **electromagnetic** signal from lightning, it is an abbreviation of “atmospheric discharge”. These appear to magnetic and electromagnetic sensors as sharp “spikes” in the data. Under some conditions lightning storms can be detected from hundreds of kilometres away. (see **noise**)

**signal:** That component of a measurement that the user wants to see – the response from the targets, from the earth, etc. (See also **noise**)

**skin depth:** A measure of the depth of penetration of an electromagnetic field into a material. It is defined as the depth at which the primary field decreases to 1/e of the field at the surface. It is calculated by approximately 503 x \(\sqrt{\text{resistivity/frequency}}\). Note that depth of penetration is greater at higher **resistivity** and/or lower **frequency**.

**spectrometry:** Measurement across a range of energies, where **amplitude** and energy are defined for each measurement. In gamma-ray spectrometry, the number of gamma rays are measured for each energy **window**, to define the **spectrum**.

**spectrum:** In **gamma ray spectrometry**, the continuous range of energy over which gamma rays are measured. In **time-domain electromagnetic** surveys, the spectrum is the energy of the **pulse** distributed across an equivalent, continuous range of frequencies.

**spheric:** see **sferic**.

**stacking:** Summing repeat measurements over time to enhance the repeating **signal**, and minimize the random **noise**.

**stripping:** Estimation and correction for the gamma ray photons of higher and lower energy that are observed in a particular **energy window**. See also **Compton scattering**.

**susceptibility:** See **magnetic susceptibility**.

**tau:** \([\tau]\) Often used as a name for the **time constant**.

**TDEM:** **time domain electromagnetic**.

**thin sheet:** A standard model for electromagnetic geophysical theory. It is usually defined as a thin, flat-lying conductive sheet, **infinite** in both horizontal directions. (see also **vertical plate**)

**tie-line:** A survey line flown across most of the **traverse lines**, generally perpendicular to them, to assist in measuring **drift** and **diurnal** variation. In the short time required to fly a tie-line it is assumed that the drift and/or diurnal will be minimal, or at least changing at a constant rate.

**time constant:** The time required for an **electromagnetic** field to decay to a value of 1/e of the original value. In **time-domain** electromagnetic data, the time constant is proportional to the size and **conductance** of a tabular conductive body. Also called the decay constant.

**Time channel:** In **time-domain electromagnetic** surveys the decaying **secondary field** is
measured over a period of time, and the divided up into a series of consecutive discrete measurements over that time.

**time-domain**: Electromagnetic system which transmits a pulsed, or stepped electromagnetic field. These systems induce an electrical current (eddy current) in the ground that persists after the primary field is turned off, and measure the change over time of the secondary field created as the currents decay. See also frequency-domain.

**total energy envelope**: The sum of the squares of the three components of the time-domain electromagnetic secondary field. Equivalent to the amplitude of the secondary field.

**transient**: Time-varying. Usually used to describe a very short period pulse of electromagnetic field.

**transmitter**: The source of the signal to be measured in a geophysical survey. In airborne EM it is most often a coil carrying a time-varying electrical current, transmitting the primary field. (see also receiver)

**traverse line**: A normal geophysical survey line. Normally parallel traverse lines are flown across the property in spacing of 50 m to 500 m, and generally perpendicular to the target geology.

**vertical plate**: A standard model for electromagnetic geophysical theory. It is usually defined as thin conductive sheet, infinite in horizontal dimension and depth extent. (see also thin sheet)

**waveform**: The shape of the electromagnetic pulse from a time-domain electromagnetic transmitter.

**window**: A discrete portion of a gamma-ray spectrum or time-domain electromagnetic decay. The continuous energy spectrum or full-stream data are grouped into windows to reduce the number of samples, and reduce noise.

Version 1.5, November 29, 2005
Greg Hodges,
Chief Geophysicist
Fugro Airborne Surveys, Toronto
Common Symbols and Acronyms

\( k \) Magnetic susceptibility
\( \varepsilon \) Dielectric permittivity
\( \mu, \mu_r \) Magnetic permeability, relative permeability
\( \rho, \rho_a \) Resistivity, apparent resistivity
\( \sigma, \sigma_a \) Conductivity, apparent conductivity
\( \sigma_t \) Conductivity thickness
\( \tau \) Tau, or time constant
\( \Omega_m \) ohm-metres, units of resistivity
AGS Airborne gamma ray spectrometry.
CDT Conductivity-depth transform, conductivity-depth imaging (Macnae and Lamontagne, 1987; Wolfgram and Karlik, 1995)
CPI, CPQ Coplanar in-phase, quadrature
CPS Counts per second
CTP Conductivity thickness product
CXI, CXQ Coaxial, in-phase, quadrature
FOM Figure of Merit
\( f_T \) femtoteslas, normal unit for measurement of B-Field
EM Electromagnetic
\( k_{eV} \) kilo electron volts – a measure of gamma-ray energy
\( k_{MeV} \) mega electron volts – a measure of gamma-ray energy \( 1\text{MeV} = 1000\text{keV} \)
NIA dipole moment: turns x current x Area
\( nT \) nanotesla, a measure of the strength of a magnetic field
\( nG/h \) nanoGreys/hour – gamma ray dose rate at ground level
ppm parts per million – a measure of secondary field or noise relative to the primary or radionuclide concentration.
\( pT/s \) picoteslas per second: Units of decay of secondary field, dB/dt
\( S \) siemens – a unit of conductance
\( x \): the horizontal component of an EM field parallel to the direction of flight.
\( y \): the horizontal component of an EM field perpendicular to the direction of flight.
\( z \): the vertical component of an EM field.
References:


Yin, C. and Fraser, D.C. (2002), The effect of the electrical anisotropy on the responses of helicopter-borne frequency domain electromagnetic systems, Submitted to Geophysical Prospecting