OM88-8-C-105

MIDWAY MINES & ENERGY CORP.

STREET TOWNSHIP PROPERTY

Sudbury Mining Division
District of Sudbury, Ontario

James E. Tilsley & Associates Ltd.
Consulting Geologists and Engineers
Aurora, Ontario, Canada
L4G 3G8

July 02, 1987
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JAMES E. TILSLEY & ASSOCIATES LTD.

SUMMARY AND CONCLUSIONS

Midway Mines & Energy Corp. has entered into an option agreement in regard to a six claim property located in the southwest corner of Street township, Sudbury Mining Division, Ontario.

The property is underlain by Gowganda Formation sediments which have been intruded by a large body of Nipissing gabbro.

Near to the interpreted contact between the gabbro and the sediments there is an airborne geophysical anomaly which suggests a pipe-like conductive body that also has a distinct magnetic expression. There is no record or other evidence of exploration in the area of this recently (December 1984) detected conductive and magnetic body. This is the prime exploration target on the property.

The exploration program recommended herein is designed to locate the position of the anomaly on the ground and test it by trenching and diamond drilling as may be appropriate. The proposed program will also investigate the entire claim group for other sorts of mineralized zones that are known to occur in the area.

The cost of the recommended program is estimated to be $141,955.00.
INTRODUCTION

Midway Mines & Energy Corp. has retained James E. Tilsley & Associates Ltd. to review data on a group of six mining claims located in the southwest corner of Street township, Sudbury Mining Division, Ontario.

The claims lie east of the eastern limit of the Sudbury Basin, within one mile of the Grenville Front Boundary Fault. The property is underlain by sedimentary rocks of Huronian Age that have been intruded by Nipissing gabbro bodies. The sediments within the southeastern corner of the property are mapped as Serpent Formation arkoses and wackes, with conglomerate and pebbly wacke. The northwestern part of the claim group is underlain by wackes of the Gowganda Formation. On the property the two sedimentary formations are separated by a body of Nipissing gabbro that traverses the claims in a northeasterly direction.

The claims were staked to cover a conductive feature with coincident magnetic expression that appears to lie in sediments near the north contact with the Nipissing gabbro. The coincident conductivity and magnetic anomalies were detected by airborne geophysical surveying done in late 1984 and have not been tested by trenching or diamond drilling.

Exploration of the claims with special emphasis on the area of the geophysical anomalies indicated by the airborne survey is warranted.

The estimated cost of the recommended work is $141,955.00
LOCATION AND ACCESS

The property includes six contiguous mining claims located in Street township, Sudbury Mining Division, Ontario. The six claims lie in the southwestern corner of the township between the boundary with Falconbridge township and the Wanapitei River, about one mile north of the common south corner post.

Approximate co-ordinates:
46° 33' 00" N; 80° 39' 00" W:

The claim groups can be reached from Sudbury Airport in about three quarters of an hour via Highway 17 East to the Awrey - Dryden township line, then north approximately one mile to the Wanapitei River on the first gravel road about one half mile past the township line. The claims can be reached by boat on the Wanapitei River from the Silver Birch Camp, where boats and motors are available for hire. The eastern boundary of the claims lies about 500 feet inland from the first west bay on the Wanapitea River, about one and one half miles upstream from the Silver Birch Camp.

The claims can also be reached by bush road from Dryden and Falconbridge townships. The last three miles of these roads are passable to snowmobiles in winter and all-terrain vehicles in summer. With moderate repair to the existing trails, access to the western part of property can be provided for light trucks.
CLIMATE

The area has a continental climate typical of central Canada. Precipitation totals approximately 34 inches (863mm) per annum, relatively well spread throughout the year. Snow accumulations of 700 to 1300mm are frequently observed in average winters, with first significant falls in late October or early November. Continuous cover can be expected from early December until mid-April in most years.

Summer-time maximum temperatures may exceed 30° Celcius and winter minimums in the range of -40°C are not uncommon in January and February. Mean summer maximums are approximately 23° Celcius and mean summer minimums about 12°C. Winter mean maximums are in the range of -7°C and mean minimums -21°C.

TOPOGRAPHY

Lake Wanapitei has an elevation of 269m (882') above sea level. There is a power dam on the Wanapitei River at Timmins Chute about two and one half miles southwest of the claims. This has created an empoundment that has an elevation of approximately 837' or 255m above sea level. Within the southwestern corner of Street Township the land rises to approximately 290m to 300m (950' to 1000').

In general, the surface is rolling, with occasional abrupt hillocks of bedrock that form low cliffs. Relief is usually less than 30m (100'). There are some low-lying swampy areas but
the greater part of the land in the southwestern corner of the Township is relatively dry.

Drainage from the western part of the property is to the west via the east branch of Emery Creek. The eastern claims drain to the Wanapitei River.

There are no permanent lakes within the property boundaries, although a portion of a tributary of the east branch of Emery Creek on the western boundary of the group has been dammed by beavers so consistently that it is shown on the topographic sheet as a small lake. At the time of our visit there was no significant amount of water in that pond, and it appeared that it had been recently drained. The tributary and swamp located at the northwest corner of the property is currently experiencing beaver activity and is partially flooded.

LOCAL RESOURCES

Sudbury is a city with a population of approximately one hundred and sixty thousand. There is a long history of mining and smelting with a skilled work force in both mining and related support functions. Men, equipment, supplies, and services are all available locally.

Medical facilities are excellent, with several clinics and hospitals in the city.

Rail, highway, and air transportation are excellent to southern Ontario and points east and west of Sudbury.

The claims are forested with second growth birch and
poplar, with alders and willows in the low ground to the west of the claim group. There are rare mature red and white pines, but there is no significant quantity of merchantable timber on the property. The birch and poplar are generally less than 6" in diameter. Growth is moderately open on the high ground. Small spruce and balsam fir are occasionally present in young thickets near damp ground. The forest cover on the claims was burned in the last thirty years, but a reasonable forest mull layer remains.

Industrial power is now available within two miles of the property from major transmission lines that parallel the Trans Canada Highway.

Telecommunications are possible from locations on the Trans Canada Highway just south of the Wanapitei River.

PROPERTY

The properties consist of a group of six mining claims, located in the southwest corner of Street township, between the Wanapitei River and the boundary with Falconbridge Township.

The claims require filing of 20 days work on or before January 5, 1988, the first anniversary of recording.
Claims location map

MIDWAY MINES & ENERGY CORP.
STREET TWP. PROPERTY, SUDBURY MINING DIV., DISTRICT, ONTARIO
LIST OF CLAIMS

S-943513  S-943514
S-943825  S-943826  S-943827
S-943828

These claims were recorded on January 5th, 1987.

SURFACE RIGHTS

The claims cover Crown Lands, use of which is governed by the standard regulations.
HISTORY

The mineral potential of the Sudbury area was first indicated in 1856 during surveying for subdivision of north-eastern Ontario. The discovery was brought to the attention of Alexander Murray who was mapping in the area for the Geological Survey of Canada, but it was not until 1883 when the railway reached the area that development began at the Murray Mine. The first production of ore from the area was in 1886 from the Copper Cliff Mine. The ores were thought to contain only copper until smelting difficulties resulted in test work that identified nickel to be present in approximately equal amounts.

Sudbury became the prime source of the world's nickel supply and maintained that position until after World War II. Copper has been the most important co-product of the Sudbury ores through the years. In addition, the Sudbury nickel-copper ores currently provide sufficient platinum group metals to maintain Canada as the third largest producer. Outside the Sudbury Basin proper in the Huronian sediments and in addition to mineralization associated with the Sudbury Event-related offset dykes, the metal of most interest has been gold. Gold was first discovered in the area east of the Sudbury Basin during the surveying that was indirectly responsible for discovery of the copper-nickel ores within the basin. The literature suggests that the first discoveries were made in the late 1800s, concurrent with copper-nickel discoveries.
In the area east of the basin and south of Lake Wanapitei gold mineralization is hosted by Huronian sediments and Nipissing gabbro. The nearest significant deposits are located in Falconbridge township (Falcon Mine) and in Scadding township (Orofino Resources Limited, Scadding Mine).

There is no record of results of exploration work on the Midway Mines & Energy Corp. claim group, other than the ground being included in airborne geophysical coverage, (magnetic and electromagnetic surveys in 1956) and the recent work completed in early December 1984.
Reconnaissance geological mapping in the Sudbury area was done as early as 1853 when Alexander Murray conducted river and lakeshore traverses that included the Wanapitei River and parts of the shoreline of Lake Wanapitei. Bell and Barlow worked in the Sudbury Basin beginning in 1888 and included part of the Wanapitei Lake area in their map published in 1891. Collins worked to the south of Lake Wanapitei in 1912 and reported his results in 1914.

Quirke, in his capacity as an officer of the Geological Survey of Canada, mapped the area around Wanapitei Lake in 1921. Fairbairn mapped Street township as part of his 1938 Ashigami Lake project. Cooke et al., prepared the Falconbridge sheet in 1946 and revised Quirke's 1922 map. The most recent published study in the area is based on field work by Dressler and assistants in 1977 and 1978 described in Ontario Geological Survey Report 213, which deals with the area immediately to the north of Street township. More recent work in the area, also by Dressler and assistants, has been released as Preliminary Map No. P2603 (1983). This covers Street township and the area of the claims.

The geological succession in the area adjacent to the eastern margins of the Sudbury Basin is summarized in the following table from Dressler (1982) and applies to the portions of Street, Falconbridge, and Dryden townships adjacent to the
Street township lies just to the east of the eastern range of the Sudbury Basin structure, the claim group being approximately five miles east of the Falconbridge Smelter. The Sudbury Basin is generally thought to have resulted from impact of an asteroid-sized body (1 to 3km in diameter) at about 1850Ma before present.

The area was glaciated during Pleistocene time. Deposits of till, outwash sands and gravels, and clay and silt cover much of the bedrock. Depth of overburden is generally less than 1.5m on higher ground but may be considerably thicker in intervening till and glacial outwash-filled swales and swampy areas. The last ice advance was from the northeast with most striae indicating a direction five to twenty degrees east of true north.

Consolidated rocks of the area range in age from Early Precambrian to Late Precambrian. The sedimentary rocks are dominated by Huronian Supergroup clastic and carbonate formations, and igneous rocks by Nipissing gabbro and related phases. The Grenville Front Boundary Fault follows the Wanapitei River about one mile south of the claim group. South of the Boundary Fault lie highly deformed and metamorphosed rocks typical of the Grenville Province.

The Huronian rocks mapped in the the southeast quarter of Falconbridge and the southwest quarter of Street townships, where the property lies, include Espanola Formation limestones
and Serpent Formation arkosic sediments, of the Quirke Lake Group, and conglomerates, pebbly wacke, minor arkoses and wackes of the Bruce Formation. Huronian sediments are cut by gabbros assigned to the Nipissing intrusive suite.

The attitude of the sedimentary units in the area of the claims is variable. Strikes are generally to the northeast and dips range from 15° to 80°. A synclinal axis extends into the property from the northeast. The sediments dip to the north on the southeast of the axis and to the south on the northwest.

GEOLOGY OF THE PROPERTY

The claims are shown on Ontario Department of Mines geological Map No. 48 and Ontario Geological Survey Map 2491 to be underlain by Gowganda Formation conglomerates and wackes.

A large body of Nipissing gabbro extends from the southeast corner of Street township northeasterly to the Wanapitei River. The contact of the gabbro passes through the claim group in a northeasterly direction. Approximately 25% of the property appears to be underlain by gabbro.

The contact relationships between the sedimentary rocks and the intrusive gabbro are not well known. The Nipissing gabbro is present in the area as both flat lying and nearly vertical dikes.

Approximately 20% of the property has rock exposure. The overburden elsewhere does not appear to be more than two meters deep, excepting in swales and under swampy areas. The detailed
relationship between the sediments and the Nipissing gabbro appear to be somewhat more complicated than shown on the regional maps, and will require close observation along control lines.

The claims lie between the Norduna Fault, on the northeast, and the Bailey Corners Fault, to the southwest. Both of these northwest-trending dislocations terminate against the Grenville Front Boundary Fault, about one mile southeast of the property.

PRODUCTION

There has been no recorded production of metals from the property.

RESERVES

There are no known mineral reserves on the property.

EXPLORATION POTENTIAL

Although there are no known mineral deposits within the Midway Mines & Energy Corp. claims, the property covers rocks that host at least four types of metal deposits in the eastern margin of the Sudbury Basin.

1. Quartz-carbonate veins localized in fault zones cutting the Huronian sediments and the Nipissing mafic intrusive rocks are known to carry base metals with gold and silver.

2. Breccia pipes in sediments of the Quirke Lake Group,
(Serpent and Espanola Formations) have been explored in Scadding township, at the Orofino Resources Limited deposit, where reserves of 136,500 tons containing 28,665 ounces of gold are reported.

3. Massive and disseminated sulphides containing copper, nickel, gold, silver, and platinum group metals have been deposited in an apparently hydrothermal system developed along a fault/fracture zone at the edge of the Wanapitei gabbronorite intrusive in Rathbun township (Rathbun township type).

4. Massive and disseminated sulphide-bearing 'pipes' that carry copper, nickel, gold, silver, and platinum group metals, and that are believed to be related to the Sudbury Event. These are usually related to the 'Offset dikes' and are characterized by sulphide-bearing gabbroic rocks.

All four types of mineralized zones are possible within the Midway Mines & Energy Corp. Street township claim group. Cumulate type mineral concentrations may have developed at the bottom of parts of the Nipissing gabbronorite sheet. There is some geochemical evidence of Cu, Ni, Ag, Au, Pd, and Pt, enrichment toward the base of the gabbronorite sheet in Rathbun township to the north of the Street township area being considered. (Dressler, 1982, op. cit.) While this possibility should be borne in mind during interpretation of results of geophysical and geochemical surveys, and any sulphide concentrations within or adjacent to the Nipissing intrusive should be
checked for gold and platinum group metals, we do not suggest that this type of mineralization is a prime exploration target on the property.

Quartz-carbonate veins are possible throughout all of the sedimentary and intrusive rocks of the property. Breccia bodies similar to those on the Orofino Resources Limited property may, in our opinion, be hosted by any rocks older than the Nipissing intrusives.

The area most favourable for development of the Rathbun township type of hydrothermal mineralization within the claims under consideration is along the northwestern contact of the Nipissing gabbro body which passes northeasterly through the southern portion of the property.

There is geophysical evidence of a pipe-like conductive body with coincident magnetic expression lying in sediments just north of the interpreted position of the gabbro contact. This is the prime exploration target within the claims. There is no record of any exploration work on this target which was identified during airborne surveying in late November and early December, 1984. (Description of the equipment used and data presentation is included in Appendix II.)

EXPLORATION PROGRAM

Exploration for vein type mineralization in both the sedimentary and igneous rocks of the properties can use electro-
magnetic and magnetic geophysical techniques for definition of structural features likely to host this sort of deposit. Geochemical surveying along such structural features has been proven to give information which assists in location of base and precious metal-bearing zones. Stripping, mapping and sampling of targets indicated by results of geophysical and geochemical work is a necessary further step in the evaluation of any indicated or suspected mineralized zone.

The breccia type mineralized zones have relatively small surface areas. Magnetic expression can be either positive or negative, and is restricted to the zone of alteration that is associated with base and precious metal values. In general, line spacing of 50 to 100 meters with stations not more than 10 meters apart is appropriate in the areas underlain by sediments. However, the density of magnetic determinations in areas where breccia pipes are thought to be possible must be high enough to ensure that a relatively detailed sampling of the magnetic features of the zone are well documented and limits can be defined accurately. This may require stations established at 2 to 5 meter intervals on lines 10 to 15 meters apart.

The breccia zones themselves are not likely to be indicated directly by electromagnetic surveying unless sulphide mineralization is particularly strong and consistent. However, zones of fracturing and faulting which might exert some control on breccia formation may be outlined by such surveys.

Geochemical surveying will indicate the presence of base
and precious metals through overburden cover that is not of excessive depth. We have found collection of forest mull (or 'humus') to be the most effective geochemical survey sampling technique in the area east of the Sudbury Basin, since this material will indicate the chemistry of the soils and rocks penetrated by the roots of the trees and shrubs from which it is derived. This gives a greater depth of effective sampling than can be expected when inorganic material is collected from the uppermost soil horizons developed on transported overburden such as covers most of the properties. Normally, humus samples are taken on a relatively wide spacing since there tends to be a dispersion and mixing of leaves, needles and bark fragments from individual trees or groups of trees growing on mineralized ground with similar material from trees not in contact with mineralized bed rock. This results in broad, low amplitude, metal anomalies from restricted source areas.

Reconnaissance sampling is recommended to cover all of the property, with more closely spaced sampling in the area of any precious metal anomalies indicated by results of the reconnaissance sampling. The spacing for reconnaissance sampling should be in the order of 30m to 50m along lines not more than 100m apart. Detailed sampling would have samples on not more than a 40m square grid, with 20m square grid density in selected areas.

The humus samples respond well to analysis by neutron
activation techniques and are particularly suitable for determination of gold content in the parts per billion range. We have found that other elements are often useful indicators of mineralization and usually opt for the total 16 element package (Au, Sb, As, Ba, Br, Cr, Co, Fe, Mo, Se, Ag, Ta, Th, W, U, and Zn) at a slight additional analysis charge. In the Street township area, copper and nickel analyses may prove useful in evaluating certain environments of mineralization.

Interpretation of geological and geochemical results with reference to information collected during geological mapping of the survey area should be followed by trenching, stripping, washing, geological mapping, sampling and assaying, as required and possible under overburden and drainage conditions existing in those areas where data indicate the possibility of mineralized bodies.

Rathbun Lake type deposits appear most likely to be developed in the claims along the contact of the gabbronorite that extends northeasterly through the southern part of the group.

Since this type of mineralization is localized by faulting and fracturing in the gabbronorite and likely to contain some pyrrhotite and possibly magnetite, both magnetic and electromagnetic techniques are appropriate. The strike length of this type of mineralization can be expected to be in the order of 15m to 45m. Therefore, the control grid line spacing for both magnetic and electromagnetic surveying should be adequate to cut
any zone of these dimensions on at least one line, and station interval should be close enough to detect the magnetic response from a body of these dimensions.

The exploration program should include the activities discussed above concentrated in areas of detailed investigation selected with reference to results of reconnaissance geophysical and geochemical surveys, and geological mapping.

The primary objective of exploration on the property should be to locate the position of the airborne geophysical responses on the ground, and to determine the cause of the anomalies detected as quickly as possible.

In this regard, trenching, pitting, and diamond drilling, such as are appropriate considering local overburden and drainage conditions, will be important parts of the investigation recommended.
ESTIMATED EXPLORATION COSTS

The cost of the recommended exploration work is estimated as follows:

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<td><strong>TOTAL</strong></td>
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REFERENCES

Aerodat Limited

Dressler, Burkhard O.

Fairbairn, H.W.
1939: Geology of the Ashigami Lake Area, Ontario Department of Mines, Volume 48, 1939, Accompanied by Map 48m (Ashigami Lake Area)

Martins, J.M., et al

Pye, E.G., et al, (Editors)
1984: The Geology and Ore Deposits of the Sudbury Structure, Ontario Geological Survey, Special Volume 1, 603 p. Accompanied by Map 2491, at a scale of 1:50 000, Map NL-16/17-AM Sudbury, at a scale of 1:1 000 000, and 3 charts.

Thompson, J.E.
CERTIFICATE

I, James E. Tilsley, of the town of Aurora, Province of Ontario, hereby certify:

1. I am a Consulting Geologist and reside at 5 Steeplechase Avenue, Aurora, Ontario.

2. I am a graduate of Acadia University, 1959, B.A., Geology.

3. I am a member of the Association of Professional Engineers of Ontario, The Association of Professional Engineers of Manitoba, The Association of Professional Engineers of Nova Scotia, Chartered Engineers (Great Britain), and designated Consulting Engineer, Ontario Association of Professional Engineers, 1975.

4. I have been employed as a geologist since graduation, with consulting groups since 1964 and in private practice since 1980.

5. This report is based on study of records relating to the property as available from the assessment files of the Ministry of Natural Resources, province of Ontario, reports of the Geological Survey of Canada, maps and reports published by the Ontario Bureau of Mines, the Ontario Department of Mines, and the Ontario Geological Survey, current technical literature, review of activities on the claims as recorded in the assessment files of the Mining Recorder at Sudbury, and observations made while visiting the area during the past three years in the course of supervising an exploration program in the northeastern part of Scadding township. The claims discussed were visited on June 18, 1987 specifically in regard to preparation of this report.

6. I have no interest, direct or indirect, in the properties or securities of Steel Investments Limited, Midway Mines & Energy Corp., or any affiliates, nor do I expect to receive any such interest.

Dated at Aurora, Ontario this 02 day of June, 1987.
APPENDIX I

CLAIM ABSTRACTS
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This Abstract is a copy of the entries in the Record Book and is not to be considered as assurance of the validity of the claim.

JUN 19 1987

MINING

Soil and Mining Division
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STREET TWP. (M. 1145)

RESERVATIONS — 400 FOOT SURFACE RIGHTS RESERVATION AROUND ALL LAKES AND RIVERS, SAND AND GRAVEL RESERVED, PEAT RESERVED.

FILE NO. 1

S.943513
EDWARD JEROME

Clairview, P.O. Box 473, Val Caron, Ont., P0M 3A0

STREET TWP. (M. 1145)

RESERVATIONS — 200 FOOT SURFACE RIGHTS RESERVATION AROUND ALL LAKES AND RIVERS. SAND AND GRAVEL RESERVED. PEAT RESERVED.

This Abstract is a copy of the entries in the Record Book and is not to be considered as assurance of the validity of the claim.

JUN 19 1987

SUDBURY MINING DIVISION
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RESERVATIONS — 400 FOOT SURFACE RIGHTS RESERVATION AROUND ALL LAKES AND RIVERS. SAND AND GRAVEL RESERVED. PEAT RESERVED.

This Abstract is a copy of the entries in the Record Book and is not to be considered as assurance of the validity of the claim.

JUN 19 1987

SUDBURY MINING DIVISION
Mining Claim
The Mining Act

CLAIM NO. S.943827

EDWARD JEROME, C.32301

473727

CLAIM NO. S.943827

Ministry of Northern Development and Mines

OFFICE USE ONLY

DATE RECORDED

DESCRIPTION OF CLAIM

STREET TWP. (M.1145)

RESERVATIONS - 400 FOOT SURFACE RIGHTS RESERVATION AROUND ALL LAKES AND RIVERS. SAND AND GRAVEL RESERVED. PEAT RESERVED.

JUN 19 1987

SUDBURY MINING DIVISION

This Abstract is a copy of the entries in the
Register Book and is not to be considered as
assurance of the validity of the claim.
AUDIT NUMBER
473728

EDWARD JEROME

ADDO.
5 Clairview, P.O. Box 473, Val Caron, Ont., P0M 3A0

DATE
Jan. 3/87 @ 9:30 a.m.

STREET TWP. (M.1145)

RESERVATIONS — 400 foot surface rights reservation around all lakes and rivers. Sand and gravel reserved. Peat reserved.

Including land under water.

This Abstract is a copy of the entries in the Record-Book and is not to be considered as assurance of the validity of the claim.

JUN 1 9 1987

MINING
RECORDS

LUXURY MINING DIVISION
REPORT ON
COMBINED HELICOPTER-BORNE
MAGNETIC, ELECTROMAGNETIC AND VLF-EM
SURVEY
- SUDbury AREA, ONTARIO

AERODAT LIMITED

July, 1985
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1. INTRODUCTION

During the period of November 26 to December 2, 1984, Aerodat carried out an airborne geophysical survey in an area to the northeast of Sudbury, Ontario. Equipment operated included a three frequency HEM and VLF electromagnetic system, a magnetometer and a radar positioning system.

This report refers to a survey of 169 kilometers flown at a line spacing of 100m.
2. SURVEY AREA LOCATION

The index map below identifies the location of the property to which this report refers. The property outline and related claim numbers are indicated on the maps accompanying the report. The flight line direction was N 31° E.
3. AIRCRAFT AND EQUIPMENT

3.1 Aircraft

The helicopter used for the survey was an Aerospatiale 350D owned and operated by Maple Leaf Helicopters Limited. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey aircraft was flown at a mean terrain clearance of 60 meters.

3.2 Equipment

3.2.1 Electromagnetic System

The electromagnetic system was an Aerodat 3-frequency system. Two vertical coaxial coil pairs were operated at 932 and 4510 Hz and a horizontal coplanar coil pair at 4137 Hz. The transmitter/receiver separation was 7 meters. Inphase and quadrature signals were measured simultaneously for the 3 frequencies with a time-constant of 0.1 seconds. The electromagnetic bird was towed 30 meters below the helicopter.
3.2.2 VLF-EM System

The VLF-EM system was a Herz Totem 1A. This instrument measures the total field and quadrature component of the selected frequency. The sensor was towed in a bird 12 meters below the helicopter. The transmitting station used was NAA (Cutler, Maine 24.0 kHz). NSS (Annapolis, Maryland, 21,4 kHz) was used for lines 600 - 640.

3.2.3 Magnetometer

The magnetometer was a Geometrics G803 proton precession type. The sensitivity of the instrument was 1 gamma at a 0.5 second sampling rate. The sensor was towed in a bird 12 meters below the helicopter.

3.2.4 Magnetic Base Station

An IFG proton precession type magnetometer was operated at the base of operations to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system.
3.2.5 **Radar Altimeter**

A Hoffman HRA-100 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude for maximum accuracy.

3.2.6 **Tracking Camera**

A Geocama tracking camera was used to record flight path on 35 mm film. The camera was operated in strip mode and the fiducial numbers for cross-reference to the analog and digital data were imprinted on the margin of the film.

3.2.7 **Analog Recorder**

An RMS dot-matrix recorder was used to display the data during the survey. In addition to manual and time fiducials, the following data was recorded.

<table>
<thead>
<tr>
<th>Channel</th>
<th>Input</th>
<th>Scale</th>
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</thead>
<tbody>
<tr>
<td>00</td>
<td>Low Freq. Inphase</td>
<td>2 ppm/mm</td>
</tr>
<tr>
<td>01</td>
<td>Low Freq. Quadrature</td>
<td>2 ppm/mm</td>
</tr>
<tr>
<td>02</td>
<td>High Freq. Inphase</td>
<td>2 ppm/mm</td>
</tr>
</tbody>
</table>
### 3.2.8 Digital Recorder

A Perle DAC/NAV data system recorded the survey on magnetic tape. Information recorded was as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM</td>
<td>0.1 second</td>
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<tr>
<td>VLF-EM</td>
<td>0.5 second</td>
</tr>
<tr>
<td>Magnetometer</td>
<td>0.5 second</td>
</tr>
<tr>
<td>Altimeter</td>
<td>0.5 second</td>
</tr>
<tr>
<td>MRS III</td>
<td>0.5 second</td>
</tr>
</tbody>
</table>

### 3.2.9 Radar Positioning System

A Motorola Mini-Ranger (MRS III) radar navi-
A navigational system was utilized for both navigation and track recovery. Transponders located at fixed known locations were interrogated several times per second and the ranges from these points to the helicopter measured to several meter accuracy. A navigational computer triangulates the position of the helicopter and provides the pilot with navigation information. The range/range data was recorded on magnetic tape for subsequent flight path determination.
4. DATA PRESENTATION

4.1 Base Map and Flight Path Recovery

The base is a screened topographic map at a scale of 1:15,000.

The flight path was derived from the Mini-Ranger radar positioning system. The distance from the helicopter to two established reference locations was measured several times per second, and the position of the helicopter mathematically calculated by triangulation. It is estimated that the flight path is generally accurate to about 10 meters with respect to the topographic detail of the base map. The flight path is presented with fiducials for cross-reference to both the analog and digital data.

4.2 Electromagnetic Profile Maps

The electromagnetic data was recorded digitally at a sample rate of 10/second with a time constant of 0.1 seconds. A two stage digital filtering process was carried out to reject major sferic events, and to reduce system noise. The process is outlined below.

Local atmospheric activity can produce sharp, large
amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with a geological phenomenon. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal to noise ratio was further enhanced by the application of a low pass digital filter. It has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 0.25 seconds. This low effective time constant permits maximum profile shape resolution.

Following the filtering processes, a base level correction was made. The correction applied is a linear function of time that ensures that the corrected amplitude of the various inphase and quadrature components is zero when no conductive or permeable source is present. The filtered and levelled data was then presented in profile map form.

The inphase and quadrature responses of the 932 Hz and 4510 Hz coaxial configuration coils were presented on separate maps in profile form with flight path and
electromagnetic anomaly information. As well, the inphase and quadrature profiles of the 4137 Hz coplanar have been presented with flight path information on the topographic base map.

4.4 Total Field Magnetic Contours

The aeromagnetic data was corrected for diurnal variations by subtraction of the digitally recorded base station magnetic profile. No correction for regional variation was applied.

The corrected profile data was interpolated onto a regular grid at a 25 m true scale interval using a cubic spline technique. The grid provided the basis for threading the presented contours at a 5 gamma interval.

The aeromagnetic data has been presented with electromagnetic anomaly information on the base map.

4.4 VLF-EM Total Field Contours

The VLF-EM signal from NAA (Cutler, Maine) or NSS (Annapolis, Maryland) was compiled in map form.

The mean response level of the total field signal was removed and the data was gridded and contoured at
an interval of 2%.

The VLF-EM data has been presented with electromagnetic anomaly information on the base map.
5. INTERPRETATION

Electromagnetic anomalies were identified from the electromagnetic profiles, and subsequent conductor axes interpreted for the entire survey area. The selection of anomalies was based on a number of geophysical considerations, which are outlined in Appendix I and expanded upon in the paragraphs following. The interpretation of conductor axes from these anomalies is discussed, along with descriptions of selected groups thereof.

Anomaly Selection

The single most important feature of anomaly recognition is the response profile shape. Several properties of the source can be determined from this information using characteristic curves for Aerodat's coaxial/coplanar coil configuration. Anomalies that exhibit profile shapes characteristic of a thin steeply dipping conductive body are generally considered to be of bedrock origin, while those with profile shapes characteristic of a thin flat-lying body are often attributed to a conductive overburden source.

For each anomaly, the apparent conductance has been calculated based on the model of a vertical half-plane. Conductance values of less than approximately 4 mhos suggest electrolytic conduction as in faults or shears,
or possible minor disseminated mineralization. A higher conductance value is indicative of electronic conduction, which is characteristic of significant sulphide or graphite mineralization.

When the exploration target is gold formations, the emphasis for conductor identification is placed on the conductor's probability of being of bedrock as opposed to overburden origin. The conductor's estimated conductance is not a stressed factor. Although gold itself is highly conductive, it cannot be expected to exist in sufficiently large and well connected quantity to yield a direct airborne electromagnetic response. However, accessory mineralization such as sulphide or graphite may produce a good conductance as an indirect indication. Gold might be located within a fault, shear zone or contact that may produce a significant response due to contained clay or conductive fluids. This type of conductor, referred to as "structural" is usually associated with low conductances, less than 4 mhos.

When sulphide mineralization is the exploration target, greater emphasis can be placed on individual anomaly characteristics, including profile shape, estimated conductance, and conductor axis strike length. As mentioned in the Appendix, the response profile shape is largely deter-
mined by the geometrical orientation, physical size, and depth of the causative body. High conductance values, say greater than 10 mhos, are a positive indication of either sulphide or graphite mineralization. When the strike length of a conductor axis is long, shorter sections containing "anomalies" within the anomalous zone are generally of greatest interest.

**Electromagnetic Conductor Axes**

Conductor axes have been interpreted from the electromagnetic anomalies based on the geophysical considerations discussed above. Many axes exhibit response profile characteristics that suggest a probable source geometry, while others feature less distinctive profile shapes. Those with profile characteristics indicative of a bedrock origin have been coded as such, while those with marginal electromagnetic responses are labelled "possible bedrocks".

In general, a conductor's probability of being of bedrock origin is greater when it is associated, either directly or indirectly, with a magnetic anomaly. For this reason, the conductors have been coded as to the nature of their magnetic association where applicable.
Three anomalous zones in this survey block have been interpreted as having bedrock origins. Zone 1, a one-line anomaly, exhibits a dip to the south, and lies to the north of a magnetic linear. Zone 2 flanks an outlying magnetic anomaly. The electromagnetic response at the north end of this zone indicates a deep, possible lens type conductor. Zone 3, a weak electromagnetic anomaly, is coincident with a local magnetic anomaly between two lows and a flanking magnetic linear.

Numerous possible bedrock conductor axes have been identified. Some of these may be upgraded based on their magnetic association if located in a geologically favourable environment.
6. RECOMMENDATIONS

Electromagnetic conductor axes have been interpreted in the surveyed claim block. On the basis of the geophysical results alone, the axes may be due to bedrock sources or possibly narrow channels of conductive overburden.

Further evaluation of the significance of the data is best left to those most familiar with the geology of the area and with access to additional geological and geophysical information.

Respectfully submitted,

AERODAT LIMITED

July 17, 1985

Glenn A. Boustead, B.A.Sc.
APPENDIX I

GENERAL INTERPRETIVE CONSIDERATIONS

Electromagnetic

The Aerodat 3 frequency system utilizes 2 different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at 2 widely separated frequencies and the horizontal coplanar coil pair is operated at a frequency approximately aligned with one of the coaxial frequencies.

The electromagnetic response measured by the helicopter system is a function of the "electrical" and "geometrical" properties of the conductor. The "electrical" property of a conductor is determined largely by its conductivity and its size and shape; the "geometrical" property of the response is largely a function of the conductors shape and orientation with respect to the measuring transmitter and receiver.

Electrical Considerations

For a given conductive body the measure of its conductivity or conductance is closely related to the measured phase shift between the received and transmitted electromagnetic field. A small phase shift indicates a relatively high conductance, a large phase shift lower conductance. A small phase shift results in a large in-phase to quadrature
ratio and a large phase shift a low ratio. This relationship is shown quantitatively for a vertical half-plane model on the accompanying phasor diagram. Other physical models will show the same trend but different quantitative relationships.

The phasor diagram for the vertical half-plane model, as presented, is for the coaxial coil configuration with the amplitudes in ppm as measured at the response peak over the conductor. To assist the interpretation of the survey results the computer is used to identify the apparent conductance and depth at selected anomalies. The results of this calculation are presented in table form in Appendix II and the conductance and in-phase amplitude are presented in symbolized form on the map presentation.

The conductance and depth values as presented are correct only as far as the model approximates the real geological situation. The actual geological source may be of limited length, have significant dip, its conductivity and thickness may vary with depth and/or strike and adjacent bodies and overburden may have modified the response. In general the conductance estimate is less affected by these limitations than is the depth estimate, but both should be considered as relative rather than absolute guides to the anomaly's properties.
Conductance in mhos is the reciprocal of resistance in ohms and in the case of narrow slab-like bodies is the product of electrical conductivity and thickness.

Most overburden will have an indicated conductance of less than 2 mhos; however, more conductive clays may have an apparent conductance of say 2 to 4 mhos. Also in the low conductance range will be electrolytic conductors in faults and shears.

The higher ranges of conductance, greater than 4 mhos, indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials that conduct electronically are limited to certain metallic sulphides and to graphite. High conductance anomalies, roughly 10 mhos or greater, are generally limited to sulphide or graphite bearing rocks.

Sulphide minerals with the exception of sphalerite, cinnabar and stibnite are good conductors; however, they may occur in a disseminated manner that inhibits electrical conduction through the rock mass. In this case the apparent conductance can seriously underrate the quality of the conductor in geological terms. In a similar sense the relatively non-conducting sulphide minerals noted above may be present in significant concentration in association with minor conductive
sulphides, and the electromagnetic response only relate to the minor associated mineralization. Indicated conductance is also of little direct significance for the identification of gold mineralization. Although gold is highly conductive, it would not be expected to exist in sufficient quantity to create a recognizable anomaly, but minor accessory sulphide mineralization could provide a useful indirect indication.

In summary, the estimated conductance of a conductor can provide a relatively positive identification of significant sulphide or graphite mineralization; however, a moderate to low conductance value does not rule out the possibility of significant economic mineralization.

Geometrical Considerations

Geometrical information about the geologic conductor can often be interpreted from the profile shape of the anomaly. The change in shape is primarily related to the change in inductive coupling among the transmitter, the target, and the receiver.

In the case of a thin, steeply dipping, sheet-like conductor, the coaxial coil pair will yield a near symmetric peak over the conductor. On the other hand the coplanar coil pair will pass through a null couple relationship and yield a minimum over the conductor, flanked by positive side lobes. As the dip of the conductor decreases from vertical, the coaxial
anomaly shape changes only slightly, but in the case of the coplanar coil pair the side lobe on the down dip side strengthens relative to that on the up dip side.

As the thickness of the conductor increases, induced current flow across the thickness of the conductor becomes relatively significant and complete null coupling with the coplanar coils is no longer possible. As a result, the apparent minimum of the coplanar response over the conductor diminishes with increasing thickness, and in the limiting case of a fully 3 dimensional body or a horizontal layer or half-space, the minimum disappears completely.

A horizontal conducting layer such as overburden will produce a response in the coaxial and coplanar coils that is a function of altitude (and conductivity if not uniform). The profile shape will be similar in both coil configurations with an amplitude ratio (coplanar/coaxial) of about \(4/1^*\).

In the case of a spherical conductor, the induced currents are confined to the volume of the sphere, but not relatively restricted to any arbitrary plane as in the case of a sheet-like form. The response of the coplanar coil pair directly over the sphere may be up to \(8^*\) times greater than that of the coaxial coil pair.
In summary, a steeply dipping, sheet-like conductor will display a decrease in the coplanar response coincident with the peak of the coaxial response. The relative strength of this coplanar null is related inversely to the thickness of the conductor; a pronounced null indicates a relatively thin conductor. The dip of such a conductor can be inferred from the relative amplitudes of the side-lobes.

Massive conductors that could be approximated by a conducting sphere will display a simple single peak profile form on both coaxial and coplanar coils, with a ratio between the coplanar to coaxial response amplitudes as high as 8.*

Overburden anomalies often produce broad poorly defined anomaly profiles. In most cases the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ratio of 4.*

Occasionally if the edge of an overburden zone is sharply defined with some significant depth extent, an edge effect will occur in the coaxial coils. In the case of a horizontal conductive ring or ribbon, the coaxial response will consist of two peaks, one over each edge; whereas the coplanar coil will yield a single peak.
It should be noted at this point that Aerodat's definition of the measured ppm unit is related to the primary field sensed in the receiving coil without normalization to the maximum coupled (coaxial configuration). If such normalization were applied to the Aerodat units, the amplitude of the coplanar coil pair would be halved.
Magnetics

The Total Field Magnetic Map shows contours of the total magnetic field, uncorrected for regional variation. Whether an EM anomaly with a magnetic correlation is more likely to be caused by a sulphide deposit than one without depends on the type of mineralization. An apparent coincidence between an EM and a magnetic anomaly may be caused by a conductor which is also magnetic, or by a conductor which lies in close proximity to a magnetic body. The majority of conductors which are also magnetic are sulphides containing pyrrhotite and/or magnetite. Conductive and magnetic bodies in close association can be, and often are, graphite and magnetite. It is often very difficult to distinguish between these cases. If the conductor is also magnetic, it will usually produce an EM anomaly whose general pattern resembles that of the magnetics. Depending on the magnetic permeability of the conducting body, the amplitude of the inphase EM anomaly will be weakened, and if the conductivity is also weak, the inphase EM anomaly may even be reversed in sign.
VLF Electromagnetics

The VLF-EM method employs the radiation from powerful military radio transmitters as the primary signals. The magnetic field associated with the primary field is elliptically polarized in the vicinity of electrical conductors. The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component of the polarization ellipse.

The relatively high frequency of VLF 15-25 kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce measurable VLF signals. For the same reason, poor conductors such as sheared contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally produce VLF anomalies. The method can therefore be used effectively for geological mapping. The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In conductive ground the depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from a transmitting station will be
in a maximum coupled orientation and thereby produce a
stronger response than a similar conductor at a different
strike angle. Theoretically it would be possible for a
conductor, oriented tangentially to the transmitter to
produce no signal. The most obvious effect of the strike
angle consideration is that conductors favourably oriented
with respect to the transmitter location and also near
perpendicular to the flight direction are most clearly
rendered and usually dominate the map presentation.

The total field response is an indicator of the existence
and position of a conductivity anomaly. The response will
be a maximum over the conductor, without any special filtering,
and strongly favour the upper edge of the conductor even in
the case of a relatively shallow dip.

The vertical quadrature component over steeply dipping sheet
like conductor will be a cross-over type response with the
cross-over closely associated with the upper edge of the
conductor.

The response is a cross-over type due to the fact that it
is the vertical rather than total field quadrature component
that is measured. The response shape is due largely to
geometrical rather than conductivity considerations and
the distance between the maximum and minimum on either side
of the cross-over is related to target depth. For a given
target geometry, the larger this distance the greater the
The amplitude of the quadrature response, as opposed to shape is function of target conductance and depth as well as the conductivity of the overburden and host rock. As the primary field travels down to the conductor through conductive material it is both attenuated and phase shifted in a negative sense. The secondary field produced by this altered field at the target also has an associated phase shift. This phase shift is positive and is larger for relatively poor conductors. This secondary field is attenuated and phase shifted in a negative sense during return travel to the surface. The net effect of these 3 phase shifts determine the phase of the secondary field sensed at the receiver.

A relatively poor conductor in resistive ground will yield a net positive phase shift. A relatively good conductor in more conductive ground will yield a net negative phase shift. A combination is possible whereby the net phase shift is zero and the response is purely in-phase with no quadrature component.

A net positive phase shift combined with the geometrical cross-over shape will lead to a positive quadrature response on the side of approach and a negative on the side of departure. A net negative phase shift would produce the reverse. A further sign reversal occurs with a 180 degree
change in instrument orientation as occurs on reciprocal line headings. During digital processing of the quadrature data for map presentation this is corrected for by normalizing the sign to one of the flight line headings.
AIRBORNE ELECTROMAGNETIC SURVEY

APPROXIMATE CLAIM BOUNDARY

SCALE
One Inch = One-half Mile

AIRBORNE MAGNETIC SURVEY
SURVEY LEGENDS

80° 47' 46° 46'

WANAPITEI LAKE

FALCONBRIDGE

Midway Mines & Energy Corp. Property.

AIRBORNE ELECTROMAGNETIC SURVEY INTERPRETATION MAP
SUDBURY AREA
ONTARIO

EM Anomaly A, in-phase amplitude 7 p.p.m.
Sensor elevation 32 m

Interpreted bedrock conductor axis

Possible bedrock conductor axis

Cultural conductor

EM RESPONSE
Conductivity thickness in mhos

• >8

○ 4-8

△ 2-4

□ 1-2

○ 0-1
TOTAL FIELD MAGNETIC MAP

SUDBURY AREA
ONTARIO

LEGEND
5 gammas
25 gammas
125 gammas
OM 88-8-C-125

THIS SUBMITTAL CONSISTED OF VARIOUS REPORTS, SOME OF WHICH HAVE BEEN CULLED FROM THIS FILE. THE CULLED MATERIAL HAD BEEN PREVIOUSLY SUBMITTED UNDER THE FOLLOWING RECORD SERIES (THE DOCUMENTS CAN BE VIEWED IN THESE SERIES):

1. Exploration program-1988 (geol; geophys; geochem); Midway Mines & Energy Corp; R.O.W. W8907-005 R.P. Mueller/ H. Veldhuyzen; Feb/89 W8907-028

2. Magnetometer Survey; Midway Mines & Energy Corp; J.E. Tilsley; Aug/88 R.O.W. W8807-167