



AIRBORNE MAGNETIC & VLF-EM SURVEY

MACASSA CREEK PROPERTY

DAVID LAKES AREA

SAULT STE. MARIE MINING DIVISION ONTARIO

for

SAN PAULO EXPLORATIONS INC.

by

TERRAQUEST LTD. Toronto, Canada

February 26, 1990

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420045E0015 2.13230 DAVID LAKES

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1.0 INTRODUCTION

This report describes the specifications and results of an airborne geophysical survey carried out for SAN PAULO EXPLORATIONS INC. of 1010-65 Queen Street West, Toronto, Ontario, M5H 2M5 by Terraquest Ltd., 240 Adelaide Street West, Toronto, Canada. The field work was carried out on December 7, 1989 and the data processing, interpretation and reporting from December 8,1989 to February 26, 1990.

The purpose of a survey of this type is two-fold. First to prospect directly for anomalously conductive and magnetic areas in the earth's crust which may be caused by, or at least related to, mineral deposits. A second is to use the magnetic and conductivity patterns derived from the survey results to assist in mapping geology, and to indicate the presence of faults, shear zones, folding, alteration zones and other structures potentially favourable to the presence of gold and base-metal concentration. To achieve this purpose the survey area was systematically traversed by an aircraft carrying geophysical instruments along parallel flight lines spaced at even intervals, 100 metres above the terrain surface, and aligned so as to intersect the regional geology in a way to provide the optimum contour patterns of geophysical data.

2.0 THE PROPERTY

The property is located in David Lake Area (Plan G-3765), in the Sault Ste. Marie Mining Division of Ontario about 60 kilometres northwest of the town of Wawa. The claims form a thin irregular shaped block with the long axis stretching form Macassa Creek to East Pukaskwa River to the north. The claims are approximately 6 kilometres overland west from Mishibishu Lake.

The latitude and longitude are 48 degrees 05 minutes, and 85 degrees 33 minutes respectively, and the N.T.S. reference is 42C/4.

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The claim numbers are shown in figure 2 and listed below:

SSM	1062311-1062326	(16)		
	1062331	(1)		
	1062333-1062336	(4)		
	1095373	(1)		
	1095433-1095434	(2)		
	1096417-1096418	(2)total	26	claims

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3.0 GEOLOGY

Map References

 Map 2220: Manitouwadge-Wawa Geological Compilation Series. scale 1:253,440 ODM 1972

2. Map 2332: Pukaskwa River. scale 163,360 ODM 1976

The survey area is underlain by an east to northeast trending belt of sedimentary and metavolcanic rocks that are bounded to the north and south by granitic batholithic rocks. Mafic to intermediate metavolcanics occur at the south and north ends of the survey block. The southern unit is substantially wider and contains felsic to intermediate metavolcanics. The southern unit is along strike from the metavolcanics located south of Mishibishu Lake, and the northern unit is along strike from the metavolcanics north of Mishibishu Lake. Mineralization has been discovered within these rock types, both north and south of Mishibishu Lake.

The central portion of the survey block is mapped as primarily fine to medium grained metasediments represented by greywacke, arkose, slate and argillite. Three narrow congolmeratic units also occur in this area.

A west to northwest trending diabase dyke has been mapped in the centre of the claim block.

4.0 SURVEY SPECIFICATIONS

4.1 Aircraft and Instruments

The survey was carried out using a Cessna 206 aircraft, registration C-GGLS, which carries a magnetometer and a VLF electromagnetic detector.

The magnetometer sensor is a high sensitivity, optically pumped cesium vapour magnetometer mounted in an extension boom attached to the tail of the aircraft. It's specifications are as follows:

Working range:	20.000-100.000 gammas
Sensitivity:	0.005 gammas
Sampling rate:	0.2 seconds
Model:	BIW 2321H8
Manufacturer:	Scintrex, Concord Ontario.

The magnetometer processor is a PMAG 3000 and the data acquisition system is a PDAS 1000, both manufactured by Picodas Group Inc.

The VLF-EM sensor is mounted in the port wingtip. It uses three

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orthogonal detector coils to measure (a) the total field strength of the time-varying EM field and (b) the phase between the vertical coil and both the "along line" coil (LINE) and the "cross-line" coil (ORTHO). The LINE coil is tuned to a transmitter station that is ideally positioned at right angles to the flight lines, while the ORTHO coil transmitter should be in line with the flight lines. It's specifications are:

Accuracy:	1%		
Reading Interval:	0.2 second		
Model:	TOTEM 2A	·	
Manufacturer:	Herz Industries,	Toronto,	Canada

Other instruments are:

- * King KRA-10A radar altimeter
- PDAS-1000 data processor with 40 mByte cassette tape and 3 1/2" disk recorder manufactured by Picodas Group Inc.
- * Trimble TRANS GPS satellite and Loran-C navigation
- Video tape flight path confirmation, 1/10th second fiducial intervals and with electronic attitude compensation

4.2 Lines and Data

Total survey area.....60 kilometres Claim group coverage....52 kilometres Line direction......360 degrees azimuth Line interval.....100 metres Tie line interval.....2 kilometres Terrain clearance.....100 metres Average ground speed....193 kilometres/hour Data point interval: Magnetic.....11 metres VLF-EM......11 metres

Channel 1 (LINE).....NAA Cutler, 24.0 kHz Channel 2 (ORTHO)....NSS Annapolis, 21.4 kHz

4.3 Tolerances

Line spacing: Any gaps wider than twice the line spacing and longer than 10 times the line spacing were filled in by a new line.

Terrain clearance: Portions of line which were flown above 125 metres for more than one kilometre were reflown if safety considerations were acceptable.

Diurnal magnetic variation: Less than ten gammas deviation from a smooth background over a period of two minutes or less as seen on the base station analogue record. The survey was flown in entirety on November 28th but the diurnal was beyond

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tolerance levels and the survey had to be reflown on December 7th.

Manoeuvre noise: nil

4.4 Navigation and Recovery

The satellite navigation system was used to ferry to the survey site and to survey along each line using UTM coordinates. The real time accuracy is variable depending on the number and condition of the satellites, however it is less than twenty five metres and typically in the ten to fifteen metre range. The post processing accuracy is in the range of plus or minus three metres.

For assisting the navigation of the aircraft and the recovery of the flight path, semi-controlled mosaics of aerial photographs were made from existing air photos. Each photograph forming the mosaic was adjusted to conform to the NTS map system before the mosaic was assembled. These mosaics are also used as a base for the data and interpretation maps and thereby allow detailed ground locations for follow-up investigations and further mapping.

In addition, flight path recovery was also carried out in the field using a video tape viewer to observe the flight path as recorded by the Geocam video camera system. The flight path recovery was completed daily to enable reflights to be selected where needed for the following day and to provide correlation between the satellite navigation/recovery data and the photomosaic base maps.

5.0 DATA PROCESSING

The magnetic data was levelled in the standard manner by tying survey lines to the tie lines. The IGRF has not been removed. The total field was contoured by computer using a program provided by Dataplotting Services Inc. To do this the final levelled data set is gridded at a grid cell spacing of 1/10th of an inch at map scale.

The vertical magnetic gradient is computed from the gridded and contoured total field data using a method of transforming the data set into the frequency domain, applying a transfer function to calculate the gradient, and then transforming back into the spatial domain. The method is described by a number of authors including Grant, 1972 and Spector, 1968. The computer program for this purpose is provided by Paterson, Grant and Watson Ltd. of Toronto.

The VLF data was treated automatically so as to normalize the non conductive background areas to 100 (total field strength) and zero (quadrature). The algorithms to do this were developed by Terraquest and will be provided to anyone interested by application to the company.

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All of these data processing calculations and map contouring were carried out by Dataplotting Services Inc. of Toronto.

Grant, F.S. and Spector A., 1970: Statistical Models for Interpreting Aeromagnetic Data; Geophysics, Vol 35 Grant, F.S., 1972: Review of Data Processing and Interpretation

Methods in Gravity and Magnetics; Geophysics Vol 37-4 Spector, A., 1968: Spectral Analysis of Aeromagnetic maps; unpublished thesis; University of Toronto.

6.0 INTERPRETATION

6.1 General Approach

To satisfy the purpose of the survey as stated in the introduction, the interpretation procedure was carried out on both the magnetic and VLF-EM data. On a local scale "geological" units were interpreted from the magnetic gradient contour patterns based on their characteristic patterns and intensities, or "signatures". The contacts are typically located along the steepest section of the gradient; therefore the vertical magnetic gradient format was used primarily to delineate stratigraphy. The total magnetic field format was used to determine the relative magnetic intensity of the interpreted unit. Where possible these units were related to existing geology (known outcrops) to provide a geological identity to the units.

Magnetic anomalies that are caused by iron deposits of ore quality are usually obvious owing to their high amplitude, often in tens of thousands of gammas. Mafic to felsic metavolcanics are usually characterized by respectively strong to weak magnetic intensities. Clastic metasediments generally possess very low magnetic susceptibilities and therefore correlate with very low magnetic responses, and in some cases, the observed responses are overwhelmed by the magnetic field from the surrounding lithologies.

Alteration zones can show up as anomalously quiet areas, often adjacent to strong, circular anomalies that represent intrusives, or along an otherwise magnetically active horizon. In some cases contact metamorphic aureoles are characterized by magnetic anomalies.

On a regional scale the total magnetic field contour patterns were used in the same way to delineate bodies of larger dimensions.

Faults and shear zones were interpreted mainly from lateral

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displacements of otherwise linear magnetic anomalies but also from long narrow "lows". The direction of regional faulting and the topographic lineaments in the general area were taken into account when selecting the dominant fault orientations. Folding is usually seen as curved regional patterns.

VLF-EM anomalies are evaluated according to a) the relative intensities of the total field strength, b) correlation of the total field strength with magnetic, geologic and topographic features, and c) the intensity and nature of the quadrature or phase response.

Areas showing a smooth VLF-EM response somewhat above background (ie. 110 or so) are likely caused by overburden which is thick enough and conductive enough to saturate at these frequencies. In this case no response from bedrock is seen.

The VLF-EM conductor axes have been identified and evaluated according to the Terraquest classification system (Figure 4). This system correlates the nature and orientation of the conductor axes with stratigraphic, structural and topographic features to obtain an association from which one or more possible origins may be selected. Alternate associations are indicated in parentheses.

The phase response has been categorized according to whether the slope/direction is normal, reverse, or no phase at all. The significance of the differing phase responses is not completely understood although in general reverse phase indicates either overburden as the source or a conductor with considerable depth extent, or both. Normal phase response is theoretically caused by surface conductors with limited depth extent. In some cases, a change in the orientation of the conductor appears to affect the sense of the phase response.

6.2 Interpretation

The magnetic and VLF-EM data are shown in contoured format on maps at a scale of 1:10,000 in the back pocket. An interpretation map is also provided. The following notes are intended to supplement these maps.

The total magnetic field has a relief of approximately 500 gammas and shows the general trend of the lithology. The vertical magnetic gradient shows improved resolution and has been used to delineate the stratigraphy and structure.

Most of the interpreted lineaments strike at 045 and 130 degrees with fewer at 080, 090, 110 and 160 degrees.

The batholithic granitic rocks (Unit 6) to the north and south correlate with moderate strength uniform responses. The contact

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	FIGURE 4	
	TERRAQUEST CLASSIFICATION OF	VLF-EM CONDUCTOR AXES
SYMBOL	CORRELATION	ASSOCIATION: Possible Origins
a , A	Coincident with magnetic stratigraphy	Bedrock magnetic horizons: stratabound mineralogic origin or shear zone
b , B	Parallel to magnetic stratigraphy	Bedrock non-magnetic horizons: stratabound mineralogic origin or shear zone
c , C	No correlation with magnetic stratigraphy	Association not known: possible small scale stratabound mineralogic origin, fault or shear zone, overburden
d , D	Coincident with magnetic dyke	Dyke or possible fault: mineralogic or electrolyti
f , F	Coincident with topographic lineament or parallel to fault system	Fault zone: mineralogic or electrolytic
ob, OB	Contours of total field response conform to topographic depression	Most likely overburden: clayey sediments, swampy mud
cui , CUL	Coincident with cultural sources	Electrical, pipe or railway lines

NOTES

- 1 Upper case symbols denote a relatively strong total field strength
- 2 Underlined symbols denote a relatively strong quadrature response

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- 3 Mineralogic origins include sulphides, graphite, and in fault zones, gouge
- 4 Electrolytic origins imply conductivity related to porosity or high moisture content

along the northern edge of the survey area is characterized by high magnetic activity (Unit 6m). This is probably related to variable physio-chemical parameters of the depositional environment (particularly the oxygen fugacity influencing the state of iron).

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The mafic to intermediate metavolcanic rocks correlate with moderate magnetic responses (Unit 1) and narrow horizons characterized by stronger activity (Unit 1m). These may be related to increased concentrations of magnetic minerals such as magnetite or pyrrhotite, or to more mafic compositions including hypabyssal metavolcanics. The interpreted widths of some of these may be exaggerated due to the overwhelming effect commonly associated with strong magnetic susceptibilities. The strongest 1m horizon lies just inside the southern boundary and may be caused by a lean iron formation.

The magnetic responses from the felsic to intermediate metavolcanics (Unit 2) cannot be discriminated from those caused by the mafic to intermediate metavolcanics at this scale. The more felsic rocks may be too narrow and/or be characterized by weak magnetic susceptibilities.

The diabase dyke (Unit 8) in the central part of the property coincides with a narrow northwest trending magnetic anomaly. The reduced responses half way across the property along this dyke are probably related to alteration such as carbonatization.

The fine to medium grained metasediments (Unit 3) are associated with the lowest magnetic susceptibilities. There is a moderate correlation between the conglomerates (Unit 4) and subtle magnetic anomalies located within the metasedimentary terrane. Consequently all these magnetic expressions have been interpreted to originate from similar conglomerates. Alternatively, some may be derived from minor metavolcanic intercalations that have escaped mapping.

Most of the magnetically interpreted structures strike at 130 to 140 degrees azimuth and show a good correlation with the interpreted lineaments. Faults or shear zones parallel to the lithology are suspected to exist by the lineament pattern and the lack of continuity of the magnetically interpreted structures. However they would be difficult to identify by magnetic mapping as they would be parallel to the dominant magnetic fabric.

The VLF-EM survey has identified numerous conductive areas with a wide range of characteristics. Broad contours of high conductivity commonly occur over swamps and lakes suggesting that most of the conductive overburden is confined to topographic depressions.

Those conductor axes that coincide with lineaments or magnetically interpreted structures are associated with structural origins. This type of conductivity may be derived from a) minerals such as graphite, sulphides or gouge, or b) an ionic effect created by

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water or porosity within the structure or along the upper weathered and leached edge. Some of these may bear potential mineralization, especially when located adjacent to or along-structure from known syngenetic mineralization.

Four weak and three strong conductors coincide with magnetically active horizons and therefore possess potential for stratabound bedrock sources. These include graphite, massive to disseminated sulphides, or porous rocks such as porous flow tops. All seven should be investigated in detail on the ground using EM or IP to verify their existence and improve their resolution.

7.0 SUMMARY

An airborne combined magnetic and VLF-EM survey has been carried out at 100 metre line intervals with data reading stations at 11 metres along the flight lines. All data is produced on maps at a scale of 1:10,000.

The magnetic data has been used to modify and update the existing geology. The contact with the batholithic granite to the north is quite magnetic whereas the granites themselves are moderately and relatively uniformly magnetic. Several magnetic anomalies within the metavolcanic suite have been used to delineate the stratigraphy. The conglomerates appear to possess slightly higher magnetic susceptibilities than the fine to medium grained metasediments which are characterized by the lowest magnetic responses.

A number of VLF-EM conductor axes have been identified and classified. Conductive overburden appears to be confined to topographic depressions. Five conductor axes are associated with structural origins. Seven conductor axes coincide with magnetic anomalies and are interpreted to be derived from stratabound bedrock sources. These possess potential for sulphide origins and have been recommended for additional investigation.

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Charles Q. Barrie, M Geologist



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APPENDIX I

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PERSONNEL

- Field: Operator.....Andre Roy Pilot....Steve Venner Dataman....Michel Roy Completion Date...December 7, 1989
- Office: Manager.....Roger Watson, P.Eng Processing.....Dataplotting Services Inc. Interpretation....Charles Barrie, M.Sc.

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APPENDIX II

CERTIFICATE OF QUALIFICATION

I, Charles Q. Barrie, certify that :

- 1. I am registered as a Fellow with the Geological Association of Canada and work as a Professional Geologist.
- 2. I hold a honours B.Sc. degree in Geology from McMaster University, obtained in 1977.
- 3. I hold an M.Sc. degree in Geology from Dalhousie University, obtained in 1980.
- 4. I am a member of the Prospectors and Developers Association of Canada.
- 5. I have been working continuously as a geologist in the mineral industry for ten years.
- 6. I reside at 1373 Queen Victoria Avenue in the city of Mississauga, Ontario, L5H 3H2.
- 7. I am employed by and am an owner of Terraquest Ltd., specializing in high sensitivity airborne geophysical surveys.
- 8. The accompanying report has been prepared from airborne data collected by Terraquest Ltd. exclusively for SAN PAULO EXPLORATIONS INC. Reference material included geological maps published by the provincial government. I have not visited the property.
- 9. I have no interest in the property described nor the immediate area of the claims.

Toronto, Ontario February 26, 1990

SOIATION Signed CHARLES Q. BARRIE Charles Q. Berrie, M.Sc. Vice President TERRAQU LTD.

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Certification Verifying Benc	T Of Work	/	· [<u>)</u> ···			<u>_</u>	
I hereby certify that I have a	personal and intimate k	enowiedge of	the facts set	forth in the Report	of Work an	nexed hereto, ha	aving perform
or witnessed same during and	l/or after its completion	and the anr	exed report i	s true.			. in man

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CEP Consulting Suite-909-1110 111 Richmond Street West Toronto, Ontario M5H 2G4 Tel.: (416) 364-0001

1454 Westbury Avenue Burlington, Ontario L7P 1M2 Tel.: (416) 336-0707

April 11, 1990

Land Management Office, Ministry of Northern Development and Mines, 880 Bay Street, 3rd Floor, Toronto, Ontario. M5S 128

RECEIVED

Dear Sir:

APR 1 1 1990

Re: San Paulo Explorations Inc. MINING LANDS SECTION Report of Work File# W9005.057

Enclosed are two copies of the airborne survey covering the above Report of Work submission on the Company's property in David Lakes Area. For your reference I have also enclosed a copy of the Report of Work.

If insufficient or if conditions have not been met please contact at your earliest convenience.

Yours truly,

Pade

Consulting Geologist



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