Northern Gold N.L.
Suite 1603
National Mutual Centre
44 Market Street
Sydney NSW 2000
(02) 29 3106

GPO Box 5326
Sydney NSW 2001

50 Barker Road
Howard Springs NT 5791
(089) 831 568

EXPLORATION LICENCE 2806

HOWLEY, NORTHERN TERRITORY

ANNUAL REPORT

OPEN FILE

Licensee: J. W. Benger
Operator: Northern Gold N. L.
Period: 12th September 1983 - 11th September 1984
Submitted: October 1984
Author: A. P. Bravo
Location: Pine Creek 1:250,000 SD 52-B
Batchelor 1:100,000 5171

NORTHERN TERRITORY
GEOLOGICAL SURVEY

incorporated in the Northern Territory

R 84/242
# LIST OF CONTENTS

<table>
<thead>
<tr>
<th>SUMMARY</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. LOCATION AND ACCESS</td>
<td>1</td>
</tr>
<tr>
<td>3. TITLE</td>
<td>2</td>
</tr>
<tr>
<td>4. GEOLOGICAL SETTING</td>
<td>2</td>
</tr>
<tr>
<td>5. EXPLORATION ACTIVITIES</td>
<td>4</td>
</tr>
<tr>
<td>5.1 HOWLEY SIDING</td>
<td></td>
</tr>
<tr>
<td>5.1.1 GEOLOGY</td>
<td></td>
</tr>
<tr>
<td>5.1.2 GEOPHYSICS</td>
<td></td>
</tr>
<tr>
<td>5.2 HOWLEY, 11E</td>
<td></td>
</tr>
<tr>
<td>5.2.1 GEOLOGY</td>
<td></td>
</tr>
<tr>
<td>5.2.2 GEOPHYSICS</td>
<td></td>
</tr>
<tr>
<td>6. CONCLUSIONS</td>
<td>8</td>
</tr>
<tr>
<td>7. REFERENCES</td>
<td>8</td>
</tr>
<tr>
<td>8. STATEMENT OF EXPENDITURE</td>
<td>9</td>
</tr>
</tbody>
</table>

**FIGURE 1.** Northern Gold N. L. Exploration Licences and Mining Tenements, Howley - Bridge Creek Areas.

## PLATES

| 1. Locality Map showing Tenements and RRMIP grids. |
| 3. MMR Contour Plan, arrays 8, 24, 25 and 26, Howley. |
| 4. RPS Contour Plan, arrays 8, 24, 25 and 26, Howley. |
| 5. RRMIP Survey Interpretation Plan, arrays 8, 24, 25 and 26, Howley. |
| 7. MMR Contour Plan, arrays 9 and 11, Howley. |
| 8. RPS Contour Plan, arrays 9 and 11, Howley. |
| 9. RRMIP Survey Interpretation Plan, arrays 9 and 11, Howley. |
SUMMARY

Exploration Licence 2806, comprising seven blocks, is located 150 kilometres south east of Darwin in the Howley Siding area.

Northern Gold N. L. has been exploring the area for gold under a joint venture agreement with J. W. Benger.

Exploration during the past year consisted of interpretive photo geological mapping, grid geological mapping and Rapid Reconnaissance Magnetic Induced Polarisation electrical geophysical surveys in two areas.

The induced polarisation response was found to be associated with mapped Koolpin Formation comprising blue-grey haematitic siltstone interbedded with carbonaceous shale, lenticular dolomite units and often capped by ferruginous gossan.

The results, which were considered highly encouraging, were interpreted to indicate disseminated sulphide content, in places, representing up to 10 per cent sulphide by volume.

Reconnaissance geological traverses outside of the two test areas have shown the Koolpin Formation, considered to be stratigraphically equivalent to the gold-bearing horizon at Cosmopolitan Howley, to be present extensively throughout EL 2806.

Consequently, besides assessing the results in the two test areas, additional exploration is required around the southern margin of the Burnside Granite.
APPENDIX


1. **INTRODUCTION**

Exploration Licence 2806 covers the eastern limb of the Howley Creek Syncline which wraps around the southern margin of the Burnside Granite pluton.

The geological environment is noted for its past gold production from the Zapopan, Britannia and Brocks Creek mines. Current exploration activity by Northern Gold N. L. has been directed towards locating high grade gold mineralisation, associated with sulphides in quartz veins, along strike from the old workings.

Exploration carried out in 1983/84 has comprised interpretive air photo geological mapping, grid geological mapping at 1:2500 scale and two periods of geophysical surveying, using the Rapid Reconnaissance Magnetic Induced Polarisation (RRMIP) electrical technique, with the aim of locating zones of hard-rock gold mineralisation worthy of costean and/or drill testing.

2. **LOCATION AND ACCESS**

The licence is located in the Howley Siding - Brocks Creek area on the eastern side of the Stuart Highway approximately 150 kilometres south east of Darwin.

Access is possible from the Fountainhead Road then west via a track which runs beside the disused North Australia Railway. The dirt track is suitable only for 4WD vehicles beyond Brocks Creek.

The licence area is contained within Pastoral Lease 865 - Ban Ban Springs located on the Pine Creek 1:250,000 Sheet.
It forms part of a group of licences being explored in the general area by Northern Gold N. L. (see Fig.1)

3. TITLE

Exploration Licence 2806 consisting of seven blocks of approximately 23.3 square kilometres was granted to J. W. Benger on 12th September 1981.

The area is being explored by Northern Gold N. L. as a result of a joint venture agreement with the licensee.

4. GEOLOGICAL SETTING

In the Howley Siding - Brocks Creek area the eastern limb of a major synform - the Howley Creek Syncline - extends around the western and southern margin of the Burnside Granite. The axial plane of the syncline was broadly refolded about a NE trending axis during a second phase of deformation related to intrusion of the granite. Consequently, bedding directions change from NW to NE around the southern end of the granite.

The Burnside Granite, consisting of homogeneous, fine to medium grained biotite adamellite has intruded the basal units of the Koolpin Formation, locally, producing reddish-grey knotted chiastolite schist.

Besides carbonaceous shale and minor banded iron units the Koolpin Formation includes, towards the base, lenses of silicified dolomite containing disseminated pyrite/pyrrhotite mineralisation. (Crick, 1975).

Higher in the stratigraphy, dolerite has selectively intruded the Koolpin Formation at or close to a distinctive purple-grey haematitic siltstone horizon which is often capped by
LEGEND

Cret Kp - Petrel Fm
Pg - Burnside Granite
Pdz - Zamu Dolerite
Pt - Burrell Creek Fm
Pso - Mt. Bonnie Fm
Pg - Gerowie Tuff
Psk - Koolpin Fm
Ppw - Wildman Siltstone

SYMBOLS

* - Old workings
- - Anticline
- - Syncline
- - Overturned anticline

FIGURE 1
NORTHERN GOLD N.L.
EXPLORATION LICENCES AND MINING TENEMENTS
HOWLEY — BRIDGE CREEK AREAS
ferruginous gossan.

These rocks are overlain by acid tuff, mudstone and laminated siliceous shale (Gerowie Tuff) followed by banded quartzite/BIF, greywacke and reddish-brown phyllite (Mt. Bonnie Formation).

The Mt. Bonnie Formation, containing an increasing volume of greywacke units with reduced volcaniclastic component, appears to be transitional between Gerowie Tuff and Burrell Creek Formation.

Gold mineralisation mostly occurs in zones of quartz-sulphide veining hosted by Gerowie Tuff and Mt. Bonnie Formation. Sulphides, mainly pyrite and arsenopyrite, comprise 1 to 10 per cent of mineralised occurrences.

The old workings are located in competent lithologies closely related to major axial fold zones and associated with structural features such as puckering in the axis of secondary drag folds, saddle reef situations or cross-cutting faults.

5. EXPLORATION ACTIVITIES

5.1. HOWLEY SIDING

5.1.1 Geology

To facilitate geological mapping and the geophysical survey, a grid, with base line at 325° magnetic was laid out using topofil and hand held compass.

The area was mapped on 50 metre traverses and plotted at 1:2500 scale. The geological plan is included as Plate 2.

Lithologies, including blue-grey haematitic siltstone, ferruginous crenulated schist and carbonaceous shale containing sulphides were identified as Koolpin Formation.
Interbedded, lenticular dolomite identified in BMR B24 (Crick, 1975) was recognisable at surface as friable saccharoidal sandstone but was rarely seen in outcrop. Nodules, upto 5cm in diameter and composed of similar granular sandstone were noted at certain horizons within the siltstone. However, the so-called nodular conglomerate appears to be prominent at a number of stratigraphic levels, including within Gerowie Tuff, where it was seen to be associated with grey siltstone containing sulphide casts.

Dolerite has preferentially intruded the Koolpin Formation and as a result of selective weathering subdued outcrop of Koolpin Formation is found between rugged strike ridges of dolerite around the margin of the granite.

West of the dolerite the Gerowie Tuff sequence comprises finely laminated tuffaceous siltstone interbedded with brown phyllite-argillite. This sequence changes laterally westward to siliceous siltstone and then laminated quartzite interbedded with reddish-brown phyllite. In the western half of the grid a large amount of semi-conformable quartz veining is locally characteristic of the Gerowie Tuff.

5.1.2 Geophysics

A Rapid Reconnaissance Magnetic Induced Polarisation survey consisting of one standard array was carried out initially in October 1983 as part of a larger programme completed by Scintrex Pty. Ltd. for Northern Gold N. L.

The objective of the survey was to locate and define segregations of sulphides in quartz reefs or arsenopyrite/pyrite gold mineralisation in units of the Koolpin Formation and Gerowie Tuff.
Later, in July 1984 the survey area was extended to the south to include three additional standard arrays.

The location of the four arrays 8W, 24W, 25W and 26E and their field orientation is shown on Plate 1.

Description and explanation of the method, parameters measured, their measuring and data presentation are set out in the Appendix to this report.

The form of the MMR response (Plate 3) is consistent with the mapped geology and highlights the contact between Koolpin Formation and dolerite along the eastern edge of the grid as well as the conductive lithologies in the western array 26E.

The RPS data (Plate 4) indicate a broadly sinuous internal polarisation response throughout the length of the arrays 8W, 24W and 25W. This distinct and substantial IP response coincides closely with mapped Koolpin Formation, proximal to its contact with dolerite, on the eastern edge of the grid.

The geophysicist indicated that the source of this IP response (i) is steeply dipping, (ii) extends to considerable depth, (iii) lies on or close to the dolerite contact, (iv) is substantially due to disseminated sulphide content.

The IP response centred at 39800E/39400N is in a zone where nodular conglomerate was mapped in association with siliceous siltstone which contained iron-stained casts of disseminated sulphide. It was suggested that this feature which plunges north is attributable to a disseminated resistive (perhaps silicified) sulphide source at a maximum depth of 125+ metres.
A summary interpretation plan of the data prepared by Scintrex Pty. Ltd. is included (Plate 5).

5.2 HOWLEY, II E

5.2.1 Geology

The grid was laid out using topofil and handheld compass on a base line bearing 360° magnetic.

Air photo interpretation and preliminary mapping at 1:2500 scale (Plate 6) established that the gridded area is located over a tightly folded zone corresponding to the axis of a NW trending syncline as traced out by surficial ferruginous gossan and ridges of dolerite outcrop.

The mapped lithologies belonging to the Koolpin Formation, are similar to those described earlier from Howley Siding.

5.2.2 Geophysics

The RRMIP survey in this area consisted of two standard arrays laid out at right angles to one another in Koolpin Formation.

The work was completed in October 1983. The location of the two arrays, 9S and 11E, and their field orientation is shown on Plate 1.

A description of the work carried out and comments on the results is included in the Appendix.

Both the MMR and RPS response data were complex. The MMR results appear to be in accord with mapped fold structure. Likewise, as at Howley Siding the RPS data shows an IP response corresponding to Koolpin Formation.
The geophysicist commented that the RPS anomalies are of major interest.

Extrapolating from other surveys it was suggested the response could represent disseminated sulphides between 10 to 20 per cent by volume.

6. CONCLUSIONS

Koolpin Formation, containing carbonaceous shale, haematitic siltstone, lenticular silicified dolomite and nodular siltstone/conglomerate, extends throughout EL 2806 around the southern margin of the Burnside Granite. Lithologically, it is similar to the ore horizon units at Cosmopolitan Howley and is considered to be at the same stratigraphic level.

The RRMIP survey provided encouraging results in the two areas where it was tested over Koolpin Formation. The IP response was considered indicative of a significant volume percentage sulphide content which could be of the order of 10 per cent.

In the light of the known prospects and mineralisation in the area the anomalies are of prime interest requiring additional exploration and follow up work throughout the licence.

7. REFERENCES

Crick, I.H. (1975) Shallow Stratigraphic Drilling in the Burnside Granite Area, Batchelor 1:100,000 Sheet, N. T.
B.M.R. Record 1976/101
8. **EXPENDITURE**

**STATEMENT OF EXPENDITURE - EL 2806**

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<td><strong>Total</strong></td>
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PRIVATE AND CONFIDENTIAL

REPORT ON
RAPID RECONNAISSANCE
MAGNETIC INDUCED POLARIZATION SURVEYS
OVER VARIOUS PROSPECTS
HOWLEY, NORTHERN TERRITORY
ON BEHALF OF
NORTHERN GOLD N.L.
IN ASSOCIATION WITH
TECHNOMIN AUSTRALIA N.L.

BY

A.W. HOWLAND-ROSE
MSc,DIC,FIHM,MAusIMM,FAIG,FGS,CEng.
GEOPHYSICIST

SYDNEY, N.S.W.                   DECEMBER, 1983
NT-032R
SUMMARY

A series of RMTP surveys undertaken over various prospective areas around Howley, south of Darwin, have revealed a number of weak to substantial internal polarization responses typical of disseminated sulphides from less than 1% to over 10%.

At a number of sites the geometry of the source is complex, and significant anomalies are often open. Further work to detail known anomalies, and trace others would appear desirable prior to drilling.

The results of these surveys would appear most encouraging, geophysically at least.
INTRODUCTION

At the request of Mr. G. Kater, BSc, MAusIMM, MAIME, Director of Northern Gold N.L., Scintrex Pty. Ltd. executed a series of RRMIP surveys over various prospects in the Howley area (see location sketch map). The work was authorised by Mr. I. Shulman, Chairman of Technomin Australia N.L., and was carried out between 27th September and 12th October, 1983. Scintrex senior geophysicist Mr. D. Webb, MSc, DIC., and second operator Mr. R. Laver, carried out the surveys, assisted by a pegging crew provided by Northern Gold N.L. Northern Gold N.L. also provided all logistical support.

The objective of these surveys was to locate and define segregations of sulphides. While the detailed geology of the areas is not available to the author at the time of writing, the gold deposits are understood to occur in sulphidic quartz reefs in the Big Howley and Chinese Howley. These deposits would be expected to yield type A RRMIP responses (see appendix). At the Cosmopolitan Howley, arsenopyrite-pyrite-gold mineralisation is related to the carbonaceous schist/chlorite schist contact. Thus, the response expected may vary from type B, C or E (see Appendix).

Comments on the RRMIP parameters measured and their meaning; the method and data presentation, are set out in the appendices to this report. It is strongly recommended that those unfamiliar with the method study these carefully before attempting to evaluate these data.
DISCUSSION

As indicated by the location map, the survey grid lies within the rock units known as Zamu Dolerite.

A single standard 1.2 kilometre current dipole array was surveyed. The MMM data shows the centre line at 4000E(+) dominated by a +70% to +90% MMM conductor. The form suggests a multiple source and a west dip (although the latter interpretation depends on a fairly uniform source). A significant relative resistor is inferred to lie to the east of the survey grid.

The form of the RPS data is remarkable, particularly when compared with the MMM data. A substantial RPS response to +7.0° in the south, to +4.0° in the north, was defined between 40133E/40000N across line 40100N at 40100E to 40200E on line 40600N. This linear zone of internal polarization has greater amplitudes on the north and south ends of the grid, implying the source to be narrow. The gradual fall-off in amplitude across strike implies the source extends to depth, while the generally steeper gradients on the western flanks imply an east dip to the source (although this will be required to be checked by a detailed array). Now, the strike of the anomaly itself is not parallel to the strike of the conductor axis, or to the contact between the more conductive and resistive rocks along which its southern section runs. Thus either the source runs across the strike (as indicated by the MMM) or the source may show variable dip along its strike which may give an apparent angle between the MMM and RPS. (Note that the anomaly maxima doesn't lie over the nearest surface manifestation, but WITHIN the source.)
Therefore if the source is vertical, the anomaly will lie over the source, whereas if the source is dipping, the anomaly will lie down dip of the source.

The source is inferred to have good depth extent (400 metres+). Quite obviously the target is of major geophysical interest as a sulphide source, however, the actual dip of the body is not clear and would require detailing by a series of single lines using a short dipole. It is possible that local geological input may throw some light on the dip.

Should this response occur in an area of prime interest, it is strongly recommended that the anomaly be followed grid north and south, and that detailed work be carried out to ascertain depth, dip and detail within the source.

CONCLUSIONS

1. The MMR data is dominated by a broad relative conductor striking grid north south and centred almost along the current line (400000E +50 metres). The form of the response suggests a west dip, and that the body extends to great depth.

2. The RPS data bears practically no relationship to the above. This is dominated by a grid 015° striking RPS axis from +4.0° to +7.5°. The form suggests a west dip in the south and an east dip in the north.

3. The 15° angle between the axis of the MMR feature and the RPS must have a geological rather than a geophysical explanation. Perhaps this chargeable disseminated sulphide rich zone was either intruded into the sequence or
perhaps plunges within the limb of a fold. In any event further work is recommended as follows:

a) Further standard arrays to the north and south to trace the continuity,

b) Small detailed arrays (or even lines) to ascertain the dip direction and perhaps

c) Use Edwards arrays to clarify the cross-sectional structure of the source if (a), (b) and the geology indicate the source to be complex.
HOWLEY EL 2806 (ARRAYS 9 & 11)

DISCUSSION

These two arrays were laid out at right angles to one another within the Koolpin Formation. The precise reason for this array placement is not known to the author, but presumably this is because the strike direction changes sharply.

The MMR data has a very 'blocky' appearance which generally indicates that the current flow direction is at a steep angle (i.e. over 30°) to the strike of the underlying formations. An exception to this is the southern flank of array 9S where a generally less resistive unit was defined striking about grid 090° in the west to grid 065° in the east.

North of 50100N to 50600N the MMR data suggests first a grid east west strike changing to grid north south from about 50200N/49850E to 50600N where a distinct break appears. A resistor axis is inferred as shown on the interpretation map, however, the evidence is flimsy.

Between lines 50500N and 50600N, a distinct 'break' is in evidence with the geological strike to the north thereof being grid 010°.

The RPS data displays a series of spectacular internal polarization responses from +8.0° to +13.5° RPS. These are characteristic of significant volume percent sulphides (+graphite) to 10%-20% in other regions. However, their form is complex and will very definitely require detailed work to resolve their three dimensional geometry.
The supposed dislocation between lines 50500N and 50600N as interpreted from the MMR data, makes its presence felt on the RPS data also, as a pronounced fall-off in internal polarization to this boundary has been logged. However, this may imply that the source of the chargeability plunges steeply north-north-west to north or fishtail out in this direction. In any event the RPS to the north of 50600N is of little interest.

The main response was seen on the southern (9S) array as an axis trending from about 49700N/49600E to 49975N/49900E. Now, this anomaly runs at a steep angle to the inferred geology as seen from the MMR, thus the geometry of the source is complex. One interpretation is that the source lies within a plane which strikes parallel to the MMR data. The explanation for the apparent divergence of the internal polarization axis from the MMR strike is that as the distance from the eastern electrode (at 50000N/53000E) increases, the current centre will descend within the source until the centre of the array is reached (i.e. maximum theoretical current penetration within the source). Thereafter the axis would be expected to approach the western electrode. In this case this does not occur perhaps because (a) the source actually plunges within this plane, or (b) pinches out to the west. This general explanation then implies an almost east-west (+) strike with the surface trace of the source lying at or to the north of 50000N. This interpretation would be required to be checked by locating a detailed array (or arrays) with the east west current line slightly displaced south of the interpreted surface trace. Of course some geological input would also be required to assist in the three-dimensional interpretation of this section of the array. For instance should the source tend to veer from grid east west in the centre to grid 065° in the east (as could be inferred from the MMR data) this would influence, although not materially change, the above explanation.
The above interpretation holds for the RFS responses south of 50000N. The explanation for the significant responses between 50000N and 50500N requires a change in the geometry of the source. Firstly, looking only at array 11E for lines 50300N to 50600N. Here a significant and substantial anomaly of +8.0° RPS was defined at 49733E on line 50300N. This anomaly trends almost grid 330° and decreases rapidly in amplitude. Considering the location of the southern energising electrode for this array at 49800E/50000N, the anomaly could be explained by (a) a vertical source striking along the axis of the anomaly, pinching out to the north-north-west, or plunging to the north-north-west, or

(b) a more grid north south striking feature which lies on a plane which dips west. In this case the feature also plunges or pinches out to the north, but here the surface trace would be expected to exist as far east as perhaps 49900E.

The latter explanation is considered the most likely if it is considered that both anomalies are related to the same geological source and in view of the additional maxima seen on array 9S on line 49900E between 50200N and 50300N. In this case should the strike of the source be north south (t), the current flow from the electrode at 50000N/53000E will be almost at right angles to the source, and thus the anomaly would be expected to emanate from high up in the source. Thus this section of the anomaly could represent (almost) the surface trace of the zone. The reason it is seen at all is that the shallow dip effectively increases the width of the source.

The interpreted surface trace of the source that would represent the anomaly from a single geological entity is shown in the interpretation diagram. It should be realised that this three-dimensional interpretation requires to be checked in detail by detailed arrays. It should be regarded as a working model only.
CONCLUSIONS

1 Spectacular internal polarization responses of up to 13.5° RPS were defined in this area in a complex three-dimensional relationship which cannot be unambiguously resolved without additional detailed arrays being run.

2 An interpretation of the data suggests that in the south an approximate grid east west striking body whose surface trace is situated at 50000N(+?) between say 49500E and 49700E dips shallowly south. The source is then interpreted as striking grid north south(+) with its surface trace being at about 49900E(+?) between 50200N and 50500N (or beyond). The source is then interpreted to dip west. As stated above this interpretation is tentative and requires geological input. The data further is interpreted to imply a plunge or lensing out (or both) as indicated on the interpretation map.

3 The RPS anomalies are of major interest and elsewhere such anomalies (type B) of this amplitude have yielded disseminated sulphides between 10% and 20%.

4 The depth to source and dip is difficult to assess, particularly due to the difficult geometry of the bodies with respect to one another. However, at 49833N on 49700E the current axis appears to be of the order of 200 metres, and should the interpretation of the surface trace be 'reasonable', this would indicate a 'moderate' (45°+?) dip to the south for the southern body. No such guesstimates are possible in the north.
GENERAL COMMENTS AND CONCLUSIONS

1 When the geometry of the source is simple, reasonable estimates of depth to source and dip direction can be made providing the source is assumed to show 'sharp' electrical contact with the enclosing rocks. If these assumptions are not correct, either geological information or preferably some detailed arrays are required to give an unambiguous interpretation. When the geometry is complex as for the areas covered by arrays 8, 9 and 11, some detailing is definitely required.

2 The substantial RPS responses observed in areas covered by array 9/11, 8 and 10/2, indicate the presence of significant sulphides (+graphite). In the light of the known gold occurrences, these anomalies are of prime interest. The other arrays indicate lesser sulphide volume percent to be present.

3 The author is most eager to discuss these results in detail once the known geology on, or in close proximity to the geophysical grid is available. Some discussion prior to siting of drill holes is desirable, especially in the more complex areas such as 9/11.

Respectfully submitted on behalf of:

SCINTEX PTY. LTD.

A.W. HOWLAND-ROSE, MSc, DIC, FIMMM, MAusIMMM, FGAIG, FGS.CEng.
Geophysicist
APPENDIX

DATA ACQUISITION AND PRESENTATION
DATA ACQUISITION AND PRESENTATION

Data Recorded:

The following parameters were recorded:

- $H_p$, the incident magnetic field due to the current flow in the current dipole
- RPS, the magnetic induced polarization effect at each station by reference to the Relative Phase Shift of the primary and third harmonic.
- PFE, the magnetic induced polarization effect by reference to the Percent Frequency Effect observed from the relative amplitudes of the first and third harmonics.
- The offsets for RPS and PFE for each array.
- The energising current ($I$) and the frequency of energisation.

Data Processing:

The data has been computed and the following parameters have been calculated for each station.

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<td>$H_N$</td>
<td>Normalised horizontal magnetic field</td>
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<td>Geometric factor</td>
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APPENDIX

BRIEF DESCRIPTION OF METHOD AND MEANING OF PARAMETERS
A brief and simple description of the method is given below for those unfamiliar with the basic principles behind the Rapid Reconnaissance Magnetic Induced Polarization (RRMIP) method. However, it is strongly recommended that the enclosed appendix be studied in detail for a more complete description of the method, and for those who are to make a geophysical assessment of the data, it is recommended that the papers referred to in the appendix be read also. The references therein give the current major papers dealing with MMR and MIP methods by various authors.

There are two significant electrical properties of rocks and ore bodies which are of great assistance in identifying zones of potential economic interest. The first is resistivity. This can be described as the resistance of a rock to the passage of electric current through it. Obviously those sections which are less resistive will allow greater quantities of current to flow than those which are more resistive. Massive sulphide zones, fault zones, zones of deeper and more intense oxidation and graphite horizons, are examples of units which will allow greater quantities of current to pass. In RRMIP, the measurement of resistivity is made with a very sensitive horizontal field magnetometer. This senses the volume of current flowing in the section below by virtue of the fact that current is simply the number of electrons flowing, and each of these electrons carries a magnetic field with it as it moves. Thus the magnetic field observed by the magnetometer is proportional to the current flowing through the volume of overburden and rock below the sensor. This measurement is called Magnetometric Resistivity (MMR). Positive values define areas of relative
conductivity, and negative values areas which are relatively resistive. This property can be used as a method for tracing rocks having different resistivities beneath conductive overburden, as well as to define conductors which may of themselves be of potential economic interest.

The second and more significant property is known as induced polarization. This phenomenon involves the storage of some of the electrical energy at the grain boundaries of sulphide(or graphite) grains, and the water contained between grain boundaries in rocks and ore bodies. If a pulsed current is used, the sulphide (or graphite) zones will charge during periods of current flow, and discharge during periods when the current ceases to flow. It is this discharge of stored energy which is the induced polarization effect, and the magnetic sensor is sufficiently sensitive to define these minute magnetic fields. The magnetic induced polarization effects are measured in terms of Relative Phase Shift (RPS). Positive values denote internal polarization from within sulphides or graphite, while negative values generally denote the discharge of the polarization effect external to the source.

The reason for a magnetic sensor being used rather than simple electrical contact with the surface of the ground is that the conductive surface areas effectively mask the major changes in resistivity (MMR) beneath the conductive surface layer, and invariably either completely short out the induced polarization effect, or render it unrecognisable against background noise. The current is injected into the ground through current electrodes placed from 1 to 3 kilometres apart. These large current electrodes enable current to penetrate
the weathering into the fresh rocks below that hold the sulphides which are the subject of our exploration search.

THE PHYSICAL MEANING OF RRMIP PARAMETERS

A summary of the main characteristics of each of the features highlighted in the interpretation map follow in order that the reader can fully appreciate the geological implications of the data.

Conductor Axes

These represent the axes of the MMR conductor. To be significant they must have (i) a significant cross-sectional area conductivity contrast with the immediate enclosing rocks, and (ii) a significant strike length with respect to the current dipole used to energise the array. A diminution of either (i) or (ii) with respect to background resistivity of the rocks, or current dipole respectively, will result in a diminution of the observed response.

One further consideration with respect to the magnitude of the response is that should the current dipole be 'small' and the conductivity width of the overburden 'great', then a diminution of response will occur also. (For details see MIP appendix, page 12, fig. 7.)

One major point to bear in mind is that horizontal layering will not be observed on the MMR, while lateral changes will be emphasised.
Resistor Axes
These represent the axes of the significant MMR resistors, which in turn represent the area of the most resistive rock units. All the remarks above for conductors apply to the resistor axes.

Contacts
Where significant gradients are observed in the MMR data, a line has been drawn along the inflexion point (or approximately so, allowing for various 'local' distortions). This line will, for vertical dipping bodies show the approximate location, and certainly the strike length of major rock type changes.

Dislocations
These are located on the interpretation maps to emphasise a significant along strike discontinuity in both MMR and RPS features. They represent faults, flexures in strike direction or perhaps lensing of significant resistors and conductors.

Internal Polarization Axes
These represent above background zones of anomalous internal polarization. They are caused by segregations of sulphides, graphite and more rarely, by serpentine, mafic mineral content and magnetite.

These features can be distorted by electromagnetic coupling, by current channelling, particularly when MMR curves show a steep (25° to 30°) angle with the energising current, and by wire effects should the energising frequency be excessive with respect to the conductivity width of the overburden.
On the flanks of arrays, the precise location of the axes may not necessarily be mapped, but can be inferred. In such cases additional limited detailed work is required. Where this is done, the axes can be identified.

Significance of the Three RRMIP Parameters, MMR, RPS and HSEQ/I

As discussed elsewhere, the positive MMR values denote the relative bulk conductors, while the negative values denote relative bulk resistors. The positive RPS values emphasise internal polarization within low current density areas. (Please refer to the papers for further explanation.)
SCINTREX

EIP & MIP
ENERGIZATION

Fig. 1
SCINTREX

EIP & MIP
DISCHARGE OF INDUCED POLARIZATION

MIP Sensor

Sum of internal and external fields

EIP potential difference

Disseminated chargeable source

Magnetic field due to internal polarization (H_s)

Magnetic field due to external polarization (H_e)

Internal polarization

Fig 2.
PRIVATE AND CONFIDENTIAL

COMMENTS ON
RAPID RECONNAISSANCE
MAGNETIC INDUCED POLARIZATION SURVEYS
OVER VARIOUS EXPLORATION LICENCES,
NEAR HOWLEY, NORTHERN TERRITORY
ON BEHALF OF
NORTHERN GOLD N.L.

BY

A.W. HOWLAND-ROSE
MSc,DIC,FIMM,MAusIMM,FAIG,FGS,CEng.
GEOPHYSICIST

SYDNEY, N.S.W.  AUGUST, 1984
NT-036R
SUMMARY

Further RMNIP surveys have been carried out in the Howley Creek area on behalf of Northern Gold N.L. At Bridge Creek and Fountainhead very large internal polarization anomalies have been defined from conductive sources. These are interpreted to be due to high volume (20%+?) sulphides in disseminated to semi-massive form high in pyrite but with little or no chalcopyrite or pyrrhotite.

At Big Howley and Howley the anomalies were of much lower amplitude and indicate significantly less volume percent sulphide (say 5%?).

Correlation with known geology, structure and geochemistry will allow an evaluation of the internal polarization responses observed in this survey.
INTRODUCTION

Between 17th July and 5th August, 1984, Scintrex Pty. Ltd. executed a series of reconnaissance and detailed RRMIP surveys over various exploration licences in the Howley Creek area, south of Darwin, Northern Territory. These surveys were carried out at the request of Mr. G. Kater, Director of Northern Gold N.L. and with the authority of Mr. I. Shulman, Chairman of Technomin Australia N.L. The field work was carried out by senior geophysical operator Mr. P. Brown, B.Sc., variously assisted by second operators Ms S. Turland and Mr. R. List. Support was provided by Northern Gold N.L. personnel.

These surveys follow similar surveys carried out in early October, 1983 and discussed by the author in Scintrex report NT-032R.

Appendices to this report set out the various data presentation formats and briefly describe the method.

Each of the areas is discussed separately.
DISCUSSION

A block of three arrays, 24W, 25W and 26E, were surveyed between coordinates 39100E/40000N, 40300E/40000N, 40300E/38800N, 39700E/38800N, 39700E/39400N and 39100E/39400N.

The MMR data shows strike directions varying from around grid north south in array 25 to around grid 010° on arrays 26 and 24, except for the extreme north-eastern corner of array 24 where they swing 330° grid. The relative conductors reach to +70% MMR but average perhaps +40% MMR, while the relative resistor axes range from +40% to -20%. The interpretation sheet summarises the major electrical features of the grid.

The most striking feature is an approximate grid north south boundary between resistive rocks to the east and conductive rocks to the west which was defined running sinuously from 40250E/38800N to 40200E/40000N. To the immediate west thereof a marked conductor axis was defined from about 40125E/38900N across 40100E/39400N (where it reaches its maximum response of +80%) to about 40100E/39600N where it becomes less well defined. The higher MMR values at the array boundary between 25W and 24W imply the conductor source to be narrow, while the good correlation between arrays implies a steep to vertical dip to the source. An enecheloning conductor is implied to run between about 40200E/39600N to 40100E/40000N. A subparallel conductor to the first abovementioned was defined between
x39975E/39000N and 40000E/39500N with higher values on the northern section of the array boundary. The form implies a narrow source which may plunge north. The most westerly MMR feature of note was recorded between 39775E/38800N crossing line 39200N at 39825E to terminate at about 39837E/39500N. The source appears narrow, and the good coincidence on the array boundary implies a steeply dipping source.

The other MMR features to the west are of minor importance.

The major feature seen on the RPS data is a strong internal polarization response trending from about 40162E/39900N, across line 39800N at 40200E where it reaches +27° RPS, line 39600N where it reaches over +23° RPS, to pass into array 25W at 40200E. The anomaly appears to break between lines 39300N and 39400N, with a maximum of 12.3° at 40162E/39300N and 12.8° on line 39200N at 40200E. From there through to 38900N at 40137E the amplitude decreases to +6.5°. Between lines 38900N and 38800N a break is interpreted from both the MMR and RPS data. A study of the form of the data suggests (i) the source is steeply dipping (ii) extends to great depth and, (iii) the source lies on, or very close to, a contact between resistive rocks to the east and conductive rocks to the west, but of itself does not appear to influence conduction substantially. Thus the source would appear to be substantially disseminated in origin. The depth to current source is everywhere deep, namely, 150 to 200 metres. Unfortunately no detail was carried out, so the dip and minimum depth cannot be assessed. Drilling of the target to 100 metres vertically below the maximum anywhere along its length appears equally valid, as the maxima
on lines 39800N, 39600N and 39200N are, in part, a function of penetration within the source.

The only other significant source was seen as a distinct "shoulder" on line 39400N at 40062E on array 24W, but on the overlap line for array 25W, as a very minor shoulder. This could indicate that the source plunges north.

Conclusions and Recommendations

A distinct and substantial internal polarization response was traced through the entire strike length of the grid between about 40162E/39900N and 40137E/39000N. The anomaly occurs on or close to a rock type change between conductive rocks to the west and resistive rocks to the east. The source extends to great depth; is 'narrow' and has current centres from 150 to 200 metres. The dip appears steep but lack of a detailed array makes this inconclusive. Drilling to ascertain the source can be carried out anywhere along the length of this feature, but lines 39600N and 39300N are favoured.

A short strike length zone 200(±) metres centred at 39800E/39400N, which could be plunging north, is also a feature worthy of note. The higher chargeabilities are associated with high resistivity, indicating a disseminated resistive (perhaps silicified) sulphide source at a maximum depth of the order of 125± metres.