REPORT ON A PROGRAM OF

GEOELECTROCHEMICAL EXPLORATION

WITHIN EL 32 / 1997 AND EL 11 / 1998

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SUMMARY

Geoelectrochemical exploration conducted within EL 32/1997 and EL 11/1998 has indicated two principal anomalous areas:

- THE SOUTHERN ANOMALOUS AREA, a continuation of the Hellyer Mine structure, and other parallel structures. This anomalous feature can be evaluated as a zone of mineralisation, which might contain local prospective ore zones.

- THE CENTRAL ANOMALOUS AREA, primarily a copper area with local gold anomalies. Further detailed work could identify gold-copper mineralisation.

1. INTRODUCTION

This report is based on the results of geochemical exploration within EL 32/1997 and also EL 11/1998 (the North Hellyer Project area). The soil sampling program covered an area of some 180 sq km, with a sampling density of 2 samples per sq km on a regular grid.

The samples were analysed at NPO Rudgeofizika (St. Petersburg, Russia) using the MPF and TMGM methods. The geochemical map preparation and interpretation of results was carried out at IONEX Pty Ltd by Dr. I.Goldberg, Dr. G.Abramson and E.Belin.

The objective of the exploration was to locate economic Cambrian VHMS deposits concealed beneath Tertiary basalt, or economic precious metal deposits within the Cambrian rocks.

2. GEOLOGY

The exploration area is located north of the Hellyer Mine (Fig.1) and consists of volcanogenic and volcanic-sedimentary rocks which are part of the Cambrian Mount Read Volcanic Belt (A.J. Crawford, K.D. Corbett, and J.L. Everard, 1992). In this area the Mount Read Volcanic Belt consists of an early sequence of feldspar – porphyritic lava and volcaniclastic rocks (Central Volcanic Complex) overlain by a volcanic-sedimentary sequence of volcaniclastics, greywacke, siltstone, and shale.

Almost 80 % of the sampled area is covered by Tertiary basalt of varying thickness (up to 300 metres). The Late Cambrian - early Ordovician Denison Group (largely conglomerate) and Cambrian Mount Read Volcanics outcrop in the southern part of the area.

3. METHODS

Two partial extraction exploration methods were used – MPF and TMGM.

As a rule, it is advisable to employ both in a regional geoelectrochemical exploration program.

The MPF method involves the selective extraction of fulvatic and humatic complexes, followed by separate analysis for carbon and nominated metals. The data analysis shows the ratio of metal to carbon.

The TMGM method involves the selective extraction of oxides and hydroxides of Fe and Mn from the soil. The extraction takes place after thermal treatment of these oxides and hydroxides, which transforms them into magnetic minerals. For MPF and TMGM, sensitive methods of chemical analysis are used for the extracted forms of the target metals.

Applying both methods increases the reliability of the results. Each method is designed for different forms of element occurrence, which have varying mobility in the soil. Therefore there may be differences in the data produced by these methods; This could affect the positions of the anomalies and their configurations. Depending on the specific conditions of the the local environment a single method could be effective. However, since there was no prior experience of working with these methods in this particular area, both methods were used.

3.1. Sampling

Two samples were taken at each point. MPF samples were taken from the surface layer of soil and TMGM samples were taken at a depth of 30-50 cm. Sampling density was 2 samples per km^2 (Fig.2 and Fig.3).

3.2. Analysis of samples

The soil samples were dried, screened, quartered and then sent to the laboratory at NPO Rudgeofizika (St. Petersburg, Russia).

The samples were analysed in two steps:

a) Firstly, all the MPF samples were analysed (Fig.2).

b) Secondly, after the interpretation of MPF data, the TMGM samples were analysed with a density of 1 sample per km^2 (Fig.3). It had been expected that the MPF data would clearly indicate outstanding anomalies, which would then be verified and detailed with the TMGM method. However, no such outstanding anomalies were detected.

It was decided to carry out TMGM analysis of the whole area with a reduced density.

The soil samples were analysed for Pb, Zn, Cu, Ag, As, Au, Co, Ni, Mn, V, Ti, and C.

3.3. Control of analysis (MPF)

Number of Samples : 11 (for Au : 9)
The significance threshold for 11 samples is 0.55, for 9 samples is 0.60

Table 1 Correlation coefficient between main and control samples

Elements/C %	Correlation coefficient
Pb/C	0.96
Zn/C	0.84
Cu/C	0.67
Ag/C	-0.02 *
As/C	0.70
Au/C	0.61
Ni/C	0.90
Co/C	0.68
Mn/C	0.15*
Ti/C	0.76

* no correlation

The control demonstrated that analysis for Pb, Zn, Cu, As, Au, Ni, Co, and Ti was quite reproducible (correlation coefficients more than the significance thresholds). Analyses for Ag and Mn were non-reproducible.

3.4. Interpretation

The following points were considered in the interpretation:

1) Diverse composition of the rock underlying the soil;
2) Regularity in the geochemical field structure, determined by the authors as ore targets. (Goldberg et al, 1997; Goldberg et al., 1999).

To briefly discuss these points:

Diverse composition of the rock underlying the soil

Soils in the area are formed over at least two types of rock: Tertiary basalt, which constitutes the principal part of the area, and Cambrian volcanic-sedimentary rocks, which host the ore mineralisation. A statistical analysis of the distribution of various metals in soil which forms above these two types of rock, has shown a significant influence of the composition of the rock on the value of the background. This allows one to determine the threshold of anomalism for certain metals (Tables 2 and 3). Thus for lead, the average abundance value in soil above volcanic-sedimentary rock, is greater than in soil above basalt. In the case of copper and cobalt the pattern is reversed. In the case of gold and zinc, no significant influence of underlying rocks is detected. As Tables. 2 and 3 show, this correlation is associated with the average concentration of elements in the rock.

This factor is important when outlining the various metal anomalies.

Table 2. Background values of metals in soil (MPF data) and abundance values of metals in rock. (Vinogradov, 1962)

Elements	Me / C% (soil) and Metal ppm (rock)			
	Soil above basalt Me / C%	Basalt ppm	Soil above volcanic-sedimentary rock, Me / C%	Volcanic-sedimentary rock ppm
Pb	$<0.45*10^2$	8	$0.45\text{-}0.89*10^2$	20
Zn	$1.25\text{-}2.80*10^2$	130	$1.25\text{-}2.80*10^2$	80
Cu	$1.18\text{-}2.40*10^2$	100	$<1.18*10^2$	57
Au	$0.16\text{-}0.45*10^4$	0.004	$0.16\text{-}0.45*10^4$	0.004
Co	$0.10\text{-}0.33*10^2$	45	$<0.10*10^2$	20

Table 3. Background values of metals in soil (TMGM data) and abundance values of metals in rock. (Vinogradov, 1962)

Elements	Metal ppm (soil) and metal ppm (rock)			
	Soil above basalt ppm	Basalt ppm	Soil above volcanic-sedimentary sequence - ppm	Volcanic-sedimentary sequence ppm
Pb	<4.38	8	4.38-7.61	20
Zn	57.6-135	130	<57.6	80
Cu	31.6-63.0	100	<31.6	57
Au	2.50-7.95	0.004	2.50-7.95	0.004
Co	12.5-44.7	45	<12.5	20

Regularity in the geochemical field structure.

Anomalies deemed prospective have the following qualities:

a) Polar zoning of target metals, which can be seen as a correlation of their positive and negative anomalies. The size of the negative anomalies ('depletion zones') and the correlation between positive and negative anomalies are criteria when judging prospectivity.
b) The presence of positive anomalies for the ferrous group of elements surrounding positive anomalies for ore elements.
c) Low values of concentration for mobile carbon (MPF data) within the limits of a positive anomaly for an ore element.

4. DESCRIPTION OF RESULTS

4.1 MPF Data

4.1.1. Lead (Pb/C %)

On the area of basalt cover small lead anomalies have been detected (<0.45*10^2%) in the northern and southern parts (Fig.4). In the exposed parts of the area, mainly in the south, on the continuation of the Hellyer deposit structure, there are positive anomalies with a concentration of > 0.89*10^2% . A parallel anomalous structure has been detected 5 km to west.

4.1.2. Zinc (Zn/C %)

In the eastern part of the area of basalt outcrop, small zinc anomalies have been detected (Fig. 5). They are concentrated in a northeast trending strip, which extends from the Cambrian rock outrcrop in the southern part of the area. In the exposed southern flank of the area, a zinc anomaly has been detected with partially coincides with the lead anomaly (Fig.4).

4.1.3. Copper (Cu/C%)

Two geochemical environments for copper can be clearly observed (Fig.6): in the area of the basalt and in the area of the vulcanogenic-sedimentary rocks. In the area of basalt outcrop, the central part of the area, a significant cross-shaped anomaly has been detected. It is generally directed to the northeast. In the exposed southern part, there are small copper anomalies directly continuing from the Hellyer ore deposit.

4.1.4. Gold (Au/C%)

Gold (Fig.7) is seen in the form of a number of local anomalies. The most prominent of these is in the central part of the area, spatially associated with the copper anomalies (Fig.6). A local gold anomaly occurs in the south of the area and coincides with the lead (Fig.4), zinc (Fig.5) and copper (Fig. 6) anomalies.

4.1.5. Cobalt (Co/C%)

Cobalt (Fig.8) forms a set of local anomalies in the central part of the area. The most significant of these is located east of the copper (Fig.6) and gold (Fig.7)anomalies.

4. 2. TMGM Data.

4.2.1. Lead (Pb)

In the area covered with basalt, lead (Fig.9) forms small anomalies in the northeast part of the area against a background value of 4.38 ppm. In the exposed areas, lead anomalies have been detected against a background of 7.61 ppm. The most intensive anomalies can be observed in the southern part of the site in two parallel zones, and on the northeast corner of the area.

4.2.2. Zinc (Zn)

A number of low-contrast zinc anomalies have been detected over basalt in the central part of the area (Fig.10). In the exposed parts of the area there are no zinc anomalies.

4.2.3. Copper (Cu)

A clear cross-shaped anomaly for copper (Fig.11) has been detected in the area covered with basalt. A local anomaly with a concentration greater than 76.1 ppm was detected in the central part.

4.2.4. Gold (Au)

A number of local anomalies were detected (Fig.12). Some are located on the periphery of the cross-shaped copper anomaly (Fig.11). In the exposed areas of the south, the gold anomalies coincide with the main lead anomaly (Fig.9).

4.2.5. Cobalt (Co)

A significant cobalt anomaly (Fig.13) is located in the central part of the area. It seems to trend north-south, to the northeast of the copper anomaly (Fig.11).

5. DISCUSSION OF RESULTS

The MPF and TMGM results have identified two prospective anomalous sites:

- The southern anomalous site, which contains two anomaly zones 5km apart; one is a continuation of the Hellyer Trend. Lead and zinc anomalies were detected by MPF, while TMGM detected lead anomalies.

- The central anomalous site contains copper anomalies and some local gold anomalies. These were detected by both MPF and TMGM. The central copper anomaly conjugates with the cobalt anomalies to the east.

6. CONCLUSION AND RECOMMENDATIONS

The prospectivity of these sites was evaluated using the criteria described in section 3.4.

SOUTHERN ANOMALOUS SITE

The southermost flank of this site (0.8 – 1km north of the southern border) appears to be of greatest interest, being a continuation of the Hellyer Trend. Equally interesting is the apparently parallel structure 5 km to the west. However the 'parallel' anomaly is only a fragment of the geochemical field of the Hellyer deposit, and it can only be comprehensively evaluated upon investigation of the entire structure.

The following unfavourable factors must be considered:

- the absence of positive anomalies for the ferrous group of elements,
- the absence of negative anomalies ('depletion zones') for the ore elements,
- the lack of mobile carbon depletion.

Based on these criteria one could downgrade the economic prospectivity of this feature.

CENTRAL ANOMALOUS SITE

The prospective area contains positive anomalies for copper and local anomalies for gold. However they are not associated with negative anomalies for these elements. Also lacking are positive anomalies for other elements, such as lead and zinc. Cobalt (ferrous group of elements) anomalies have been observed to the north and east of the main copper anomaly. This might be an indicator of local anomalies for ore elements within the large cross-shaped copper anomaly.

OTHER POSSIBLE TARGETS

Apart from the anomalous sites mentioned, there are in the northeast exposed part of the survey area a number of lead and zinc anomalies. How prospective they are remains unclear, as these anomalies have not been adequately defined.

Detailed work in the next stage should be concentrated within the Southern and Central Anomalous Sites.

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