

## A COMPARISON OF GEOCHEMICAL EXPLORATION TECHNIQUES: CURNAMONA PROVINCE

A.J. Fabris<sup>1</sup>, J.L. Keeling<sup>1</sup>, R.W. Fidler<sup>2</sup>

<sup>1</sup>CRC LEME/PIRSA, PO Box 1671 Adelaide, South Australia, 5001

<sup>2</sup>PIRSA, PO Box 1671 Adelaide, South Australia, 5001

### INTRODUCTION

Stratiform and stratabound Pb-Zn and Cu-Au mineralisation are commonly associated with a regional redox boundary within the Willyama Supergroup. This boundary can be identified from aeromagnetic data; however, the rocks are mostly covered by 10-150m of transported regolith. Discovery of new mineral deposits in the area would be enhanced by an effective surface geochemical technique that allows detection of mineralisation through this thick cover. PIRSA as part of a CRC LEME project, are investigating techniques at the Kalkaroo (Cu-Au-Mo), Polygonum (multi-element) and Christmas Ball (Cu-Au) and Goulds Dam (U) Prospects within the Curnamona Province.

A number of geochemical techniques were investigated including: partial leach soil geochemistry – aqua regia, Deep Leach 11, 20 and 26 (Amdel Ltd), MMI-M (WAMTECH) and electrogeochemistry – CHIM.

Samples were collected from 10-25cm and 60-300 cm (auger) below the surface. Deeper samples targeted the zone of maximum evaporation associated with the precipitation of calcium carbonate and sulphates (gypsum). All samples were sieved using an 80# screen and pH and conductivity measured.

CHIM (CHastichnoe Izvlechennye Metallov) is an electro-geochemical method for the measurement of ions. Appropriately prepared electrodes were placed in 20cm deep pits, nitric acid added and the pits filled in. A current was applied for 48 hours, after which time the electrodes were exhumed and the coatings carefully removed and analysed. Soil samples were taken from each set of electrode pits.

### GEOCHEMICAL SURVEYS

#### **Kalkaroo Prospect**

Samples at 20m spacing were collected along four survey lines of 500m. Mineralisation being targeted on each traverse was located from approximately 110m below the surface and beneath 35-70m of transported regolith with decreasing cover thickness from Line A to D.

#### ***Line A***

Of the methods used, CHIM most accurately indicated the area overlying the highest grade mineralisation (elevated levels of Cu, Au and U). Soil samples produced quite different results to the CHIM. Deep Leach 26 analysis on soil samples collected by auger gave a one point Zn-Pb anomaly over the zone of mineralisation. A corresponding Zn anomaly was seen in surface soil results using Deep Leach 11 and 26. MMI-M in addition to elevated Zn values displayed a ‘rabbit ear’ anomaly in U.

#### ***Line B***

There were no apparent anomalies over highest-grade mineralisation intersected by drilling.

#### ***Line C***

A W-Au CHIM anomaly was found over inferred primary mineralisation but not over identified supergene mineralisation. Although some soil anomalies have been obtained using W, the mineralisation is not known to contain appreciable W (Law, 2002). Elevated Zn over the same zone was evident in many of the techniques trialled. Near-surface soil results gave an intense Mo-Au-Cu-U anomaly to the east of known mineralisation. The anomaly may result from drilling contamination, although, lies directly over the extension of mineralisation to the base of cover. This anomaly was not visible in the CHIM or deeper soil sample results. Interestingly, Ag in all soil samples, highlighted a change in the underlying rock unit with a general trend of elevated response over pelitic hanging wall rock units.

#### ***Line D***

Anomalous levels of Bi-Nb-Sn-Ti were measured using MMI-M on surface soil samples over mineralisation. Although encouraging, the lack of elevated response in elements directly associated with mineralisation casts doubt the anomaly is directly associated with underlying mineralisation.

### **Polygonum Prospect**

Success had been reported in previous geochemical surveys using carbonate zone samples at the Polygonum Prospect in spite of over 100m of transported cover (Hedger and Dugmore, 2001; Leyh and Corbett, 2001). To reproduce the anomalies and determine if surface soil sampling could be as effective a sampling strategy, a 3500m survey line (50m sample spacing) was laid out.

Mineralisation at the Polygonum Prospect occurs at a variety of stratigraphic levels and includes four styles of mineralisation. These are:

1. Stratiform to stratabound Cu-Au-Mo zone in albitic +/- magnetite metasediments,
2. Stratiform to stratabound Zn-Pb-Ag (Mn, W, Mo, As, Co, Cu) zone in interbedded calc-silicate and albite-altered metasediments,
3. Broken Hill-type (BHT) Pb-Zn-Ag in fine-grained, garnet-rich interbedded pelite and psammite,
4. Inferred McArthur River-Mt Isa-style Zn-Ag-Pb (Cu), stratigraphically above the other target zones in pelitic rock units.

Geochemical anomalies were obtained for 3 of the 4 styles of mineralisation, confirming the anomalous zones defined in previous surveys. Using Deep Leach 11 and samples from the top of the carbonate zone, a broad and locally intense Ag-Co-Zn (Cr, U) anomaly over the stratigraphic position prospective for McArthur River style mineralisation was evident (Figure 1; Leyh and Corbett, 2001). A lower magnitude Ag anomaly over the same zone was recorded using Deep Leach 11 on surface soil samples.

Broad, low-order, multi-element anomalies were obtained using surface soil samples and these outlined both BHT and stratiform to stratabound Zn-Pb-Ag mineralisation identified in drilling. Deep Leach 11 was moderately effective in highlighting the zone over BHT style mineralisation, as was Deep Leach 26 and MMI-M for the stratiform to stratabound Zn-Pb-Ag mineralisation (Figure 1). Results from soil samples from the top of the carbonate zone were only barely anomalous over the same intervals.

### **Christmas Ball Prospect**

Unlike the other prospects, the Christmas Ball Prospect has limited transported cover (<2m) with weak mineralisation from 33m and highest grades from 100m below the surface (Law, 2002).

Soil samples collected from both sampling intervals were moderately useful in detecting the underlying mineralisation. Deep Leach 11 was the preferred digest with elevated levels of Co-As-Ag in shallow samples and Pb-Bi-Mo (Co, Ag) from the deeper sample interval. Deep Leach 26 analysis of soils from both sample intervals was also able to highlight mineralisation with elevated levels of Ag. A broad zone of increased conductivity in soil samples outlined the area of mineralisation. Higher pH values were obtained from the fringes of the mineralisation. This may correspond to the 'rabbit ears' described by Govett et al (1976), attributed to electrochemical dispersion of H<sup>+</sup> ions from an ore body.

### **Goulds Dam Prospect**

Uranium mineralisation at the Goulds Dam Prospect is hosted by Tertiary palaeochannel sands and covered by approximately 110m of transported sediment. A 460m CHIM survey was conducted, however, comparative surveys are either in progress or awaiting results.

An anomaly of 4 times background in As was recorded over known mineralisation, however, As has no known relationship to the Goulds Dam mineralisation and is therefore most likely coincidental. Elevated levels were recorded in Rb, Cu, W and V over mineralisation, but are not considered to be sufficiently above background to be significant.

### **CONCLUSION**

Considering the difficult geochemical circumstances, no method was necessarily expected to produce a satisfactory result. It is therefore not surprising that many of the methods did not clearly reflect mineralisation. However, easily the most outstanding anomaly was that of the Ag at the Polygonum Prospect from the top of the carbonate zone which was many times background and similar to the previous survey of Platsearch NL (in joint venture with Inco Limited; Leyh and Corbett, 2001).

Elsewhere, less clear-cut anomalies were obtained which may be improved by the use of different soil size fractions or extractants. These include a CHIM W-Au anomaly obtained on 'Line C' of the Kalkaroo

Prospect, Ag-Pb-Co (U) anomalies at Polygonum Prospect using Deep Leach 11 on surface soil samples and Cu (U-Au) anomalism at Kalkaroo Prospect 'Line A' using the CHIM.

Although not universally applicable, Deep Leach 11 clearly was the most effective digest, although MMI-M and Deep Leach 26 showed promise. Soil sampling gave quite different element patterns to the CHIM method reflecting the fundamental differences in the methods.

Near-surface sampling produced better results than samples collected using an auger at the Kalkaroo Prospect, although, survey lines did not extend far enough over background.

Soil samples from the near surface and 'top of carbonate zone' were both required to outline the broad spectrum of mineralisation identified at the Polygonum Prospect. Concerns as to the origin of these soil anomalies remain, due to the possibility of mineralised colluvium from the Barrier Ranges.

Soil surveys did not clearly show mineralisation at the Christmas Ball Prospect as hoped. Samples collected from the top of the carbonate zone most accurately indicated the known location of mineralisation. Conductivity and pH measurements outlined the zone of mineralisation and along with surface soil results, suggest additional mineralisation exists to the north.

#### REFERENCES

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Acknowledgements: Thanks to all companies involved in the work mentioned in this abstract. Special thanks go to Havilah Resources NL and Platsearch NL for access to data held in confidential files. CRC LEME are thanked for project support.

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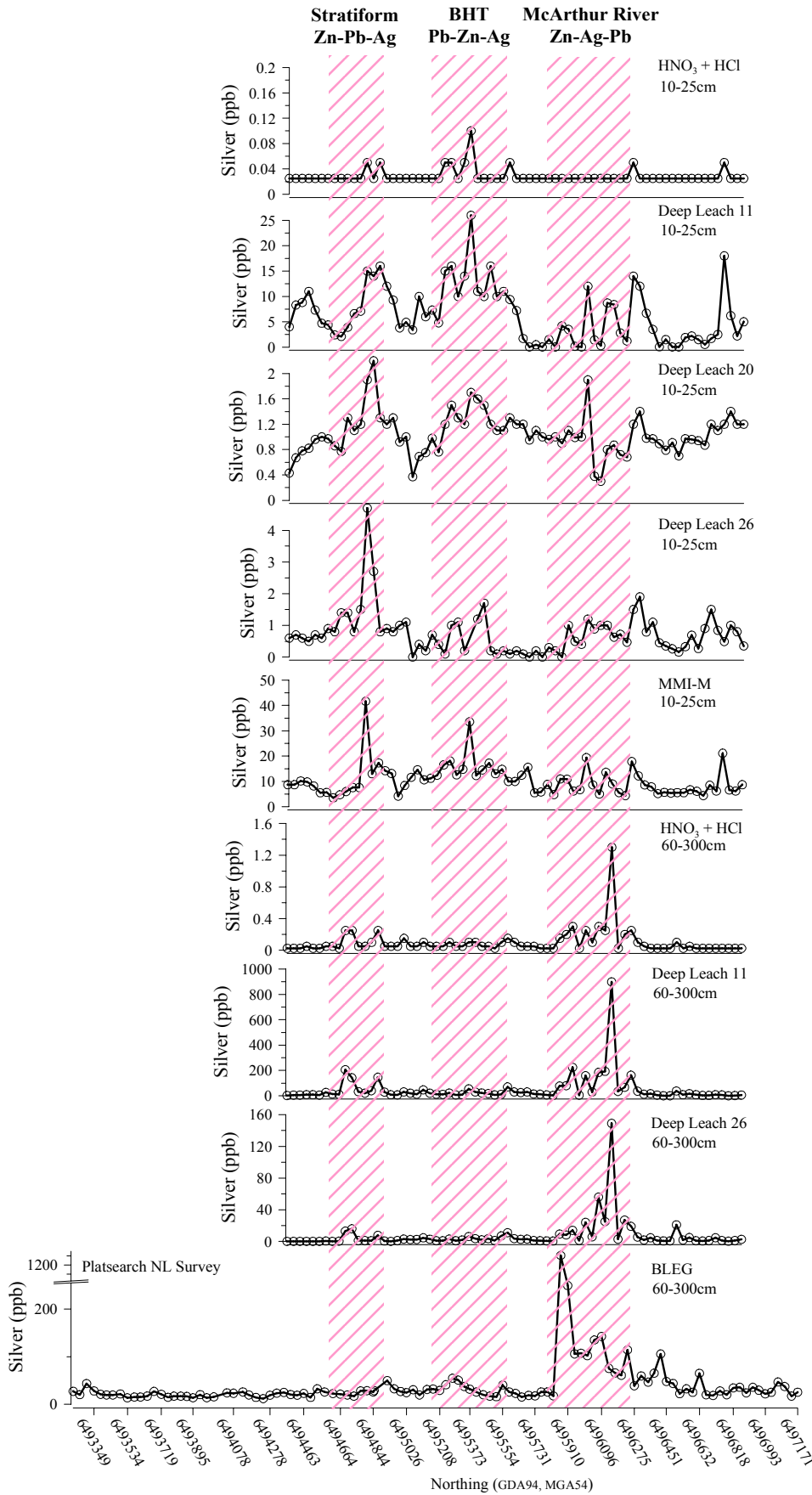


Figure 1. Comparison of geochemical techniques for the element silver, at the Polygonum Prospect, Curnamona Province.