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The Application of Geophysics to the Discovery of the Hellyer Ore Deposit, Tasmania

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Introduction

In August 1983, a drill hole aimed at a deep conductor in Northwestern Tasmania, Australia intersected 24m of high grade base and precious metal mineralization at a depth of 120m. This intersection proved to be the small, shallow end of the 15-20 million Tonne Hellyer deposit (Sise and Jack, 1984; Eadie and Silic, 1984). The ore body is covered by greater than 100m of flat-lying volcanics, making the story of it's discovery technically impressive.

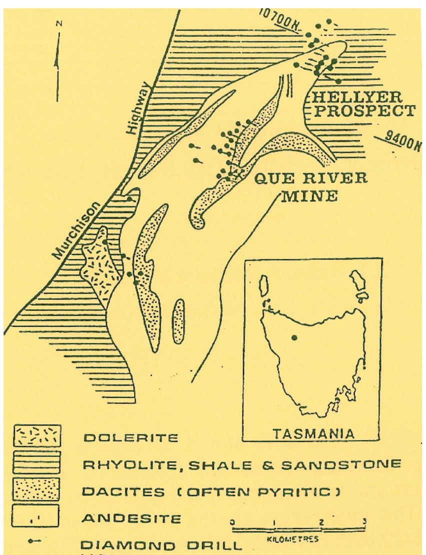

Figure 1: Geology and location map, Que River Area, Tasmania, Australia.

Past exploration in the Hellyer—Que River area

Modern exploration in the Hellyer—Que River area for Pb/Zn dates back to the 1960s when the volcanics (see Figure 1) were recognised as being similar to those hosting the Mount Lyell and Rosebery orebodies.

In 1970, the Aberfoyle group commenced a regional stream sediment geochemical survey followed in 1972 by coverage of a 400 km^2 block with helicopter-borne electromagnetics (EM). Ground follow-up of one of the few good discrete conductors, which was in te vicinity of anomalous stream geochemistry, resulted in the 1974 discovery of the Que River ore deposit.

The discovery and subsequent work at Que River is well-documented by Webster and Skey (1979). One of the conclusions drawn from this work was that the main ore lens (PQ) was effectively nonconductive due to the large amounts of sphalerite but that it responded well to induced polarisation (IP). This conclusion was supported in later years by test surveys with moving loop SIROTEM and Crone PEM which both responded to the shallow S lens (detected by the original helicopter EM survey) but not to the deeper, base metal-rich PQ lens. Because of this, IP became the favoured geophysical tool. In the following 10 years, several IP anomalies, generally supported by high geochemistry, were drilled showing uneconomic concentrations of sulphides.

In 1979, new light was shed on the exploration problem when UTEM (Lamontagne et al., 1978), a fixed-transmitter boradband EM system, was tested at Que River. This experiment showed that the PQ lens was in fact more conductive than the S lens, and had been missed by the other EM systems because of its relatively large depth to top and its proximity to the shallow S lens.

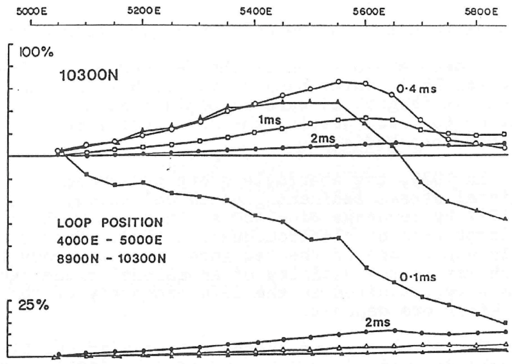

Figure 2: UTEM data from line 10300N (anomaly first detected).

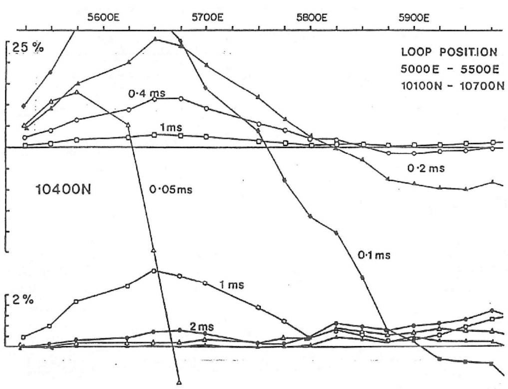

Figure 3: UTEM data from line 10400N (loop repositioned).

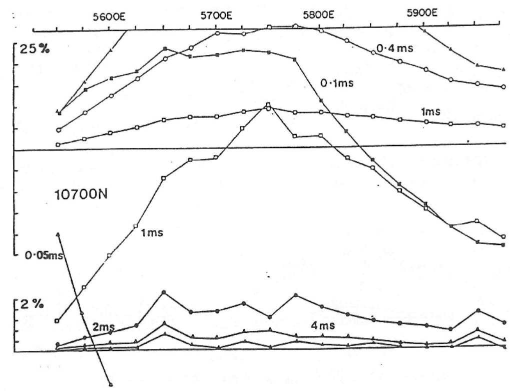

Figure 4: UTEM data from line 10700N (loop repositioned).

Past exploration in the Hellyer—Que River area (continued)

When UTEM became readily available in Australia in 1983, the northern two-thirds of the andesite unit was surveyed. The grid was extended far enough north to determine the UTEM response of some disseminated sulphides encountered when drilling an IP/geochemical anomaly in 1982. The most northern line was placed at 10300N, where an anomaly was detected (see Figure 2) which as quickly recognised to be as strong as the one over Que River. This was the only moderately strong response on the whole grid of over 100 line kilometres.

The survey was immediately extended another 400m to the northern extent of the outcropping volcanics. Detailed UTEM work in this area defined a deep, moderately conductive body. Concurrent with the geophysical work, geological mapping of new exposure caused by Hydro Electric Commission preparation for a new transmission line, revealed a pod of barite and intense alteration concentrated into the nose of an anticline overlying the conductor, which was in an area that had long been known to have anomalous PB and Zn in soils. The combination of these factors made this a very high-priority target, which management thought merited three drill holes. The first of these holes intersected 24m of base metal mineralisation; the discovery of the Hellyer ore body.

Analysis of the geophysical data

The ability of the UTEM to detect the Hellyer deposit where IP, airborne EM (McPhar H400), and Max-Min had failed (Eadie and Silic, 1984), shows well the power of fixed loop, time domain EM systems. The three most critical lines of UTEM data are shown in Figures 2, 3, and 4 (Hz component only).

At station 5675E on 10300N, the anomaly occurred that inspired the extension of the rid to the north. This anomaly, which was interpreted to be from a deep, moderately-conductive body, is apparent in the data from 0.2 to 2 ms (milliseconds). The fact that the anomaly lasted until 2 ms made this by far the most conductive feature on the grid.

Figures 3 and 4 display the results from lines 10400N and 10700N respectively. The amplitude of the response is much lower on these follow-up lines than on 10300N because:

The second transmitter loop was located to be maximum-coupled with the expected vertical body and ended up being almost totally null-coupled with the (actually) flat-lying body;

There is less enhancement due to current gathering because the second loop is much closer to the target conductor.

However, the data was good enough to interpret a continuous body from 10300N to 10700N, plunging to the north and open in the same direction.

In spite of the fact that the anomaly on 10700N continued to the later time of at least 4 ms, the first drillhole was located on 10400N and there was no chance of the data being influenced by the encroaching shales as there would be on 10700N (see Figures 5 and 6). The first hole of the drilling programme, HL 3, successfully intersected the target, as did the third hole, HL 5, on 10700N.

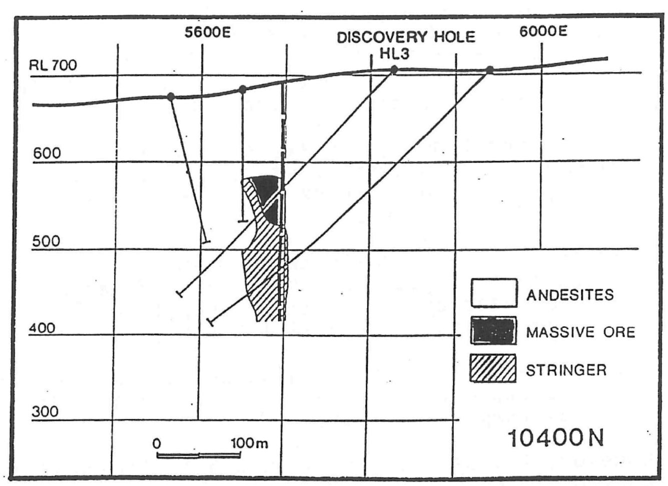

Figure 5: Ore body cross section line 10400N.

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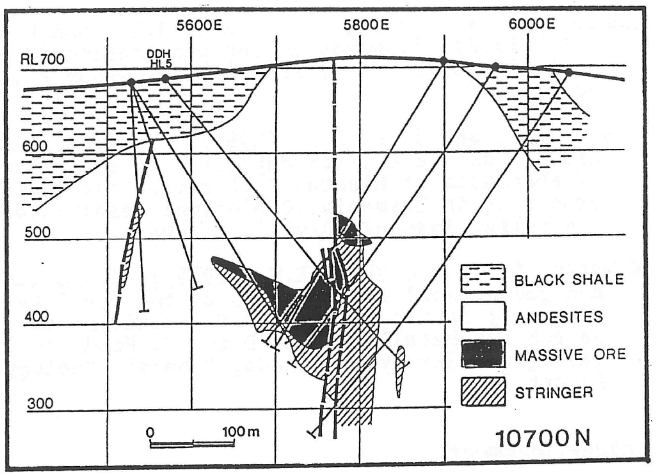

Figure 6: Ore body cross section line 10700N.

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Acknowledgements

The authors would like to acknowledge Gary McArthur, the ore reserve geologist at Hellyer, for his excellent work and for preparing the geological cross sections. We would also like to acknowledge Hugh Skey and John Sise for the inspiration and support they supplied throughout the exploration period, and the staff of Aberfoyle Exploration, in particular Errol Smith, for invaluable help with the field work.

We would also like to thank Aberfoyle and Paringa for permission to publish this paper.