The Application of Geophysics on the West Coast of Tasmania

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Summary

The Tasmanian Mines Department recently initiated a large-scale project to assist exploration in Western Tasmania, one of the world's most mineralised regions. The geophysical component of the project was designed to determine the geophysical signatures of the type deposits and the effectiveness of the techniques being used in Tasmania, particularly in areas of thick cover.

The study has shown that the replacement tin and polymetallic volcanogenic deposits are good targets for TEM surveys, although small occurrences of non-conducting zinc-rich deposits have been found. A comparison of FEM, TEM and CSAMT surveys over a series of moderate conductors emphasised the limitations of fixed transmitter surveys and demonstrated the potential of CSAMT for discriminating deep targets.

Discussion

The West Coast of Tasmania is highly mineralised and contains a wide variety of mines, some of world-class size and grade. They include the Rosebery, Que River and Hellyer volcanogenic basemetal deposits; the Renison and Cleveland tin mines; Savage River iron ore; Kara and King Island tungsten and the Mt Lyell copper-gold ore bodies. To better understand these deposits and to assist in the search for more minerals, the Tasmanian Mines Dept recently instigated a large project combining mapping, geochemistry, alteration studies and geophysical surveys. The geophysical component had the following specific aims: (1) To determine the signatures of type deposits, alteration zones and country rocks; (2) To evaluate the application of the various techniques presently available, especially in areas with thick glacial or basaltic cover; (3) To experiment with new or modified techniques.

The skarns are strongly magnetic, although their signatures may be hard to recognise beneath basalt cover. Geophysically, the best targets are the replacement tin bodies. Their cassiterite-pyrrhotite ore is strongly magnetic and highly conductive. TEM surveys give strong responses through to late times. Figure 1 shows a UTEM response from a Renison deposit at a depth of about 130 m. The base-metal deposits have a higher density, but are non-magnetic, and less conductive. The UTEM response over Hellyer (Figure 2) has a weaker response than that at Renison, partly due to its geometry and partly because of its lower conductivity. Mt Lyell contains a number of ore-bodies; from low- to high-grade copper and their conductivity varies accordingly, even though the total sulphide content may be fairly constant.

A series of sub-economic deposits at Mt Lyell were used to evaluate the various EM systems in use in Tasmania and to try some modifications. Figure 3 shows the original Turam survey over these deposits and the 1986 repetition survey. Both surveys used two grounded wire sources. Four distinct anomalies are shown, one over each deposit. UTEM, SIROTEM (Figure 4), ZONGE and EM37 surveys were carried out using closed loops laid out over the same cross lines as were occupied for the Turam survey. Similar results were obtained for all four methods: a good conductor in the FW lens and a poor conductor at EP17, but no responses were detected over WTh or at EP16. This may be due to shielding and the results highlight one of the limitations of fixed transmitter loop surveying.

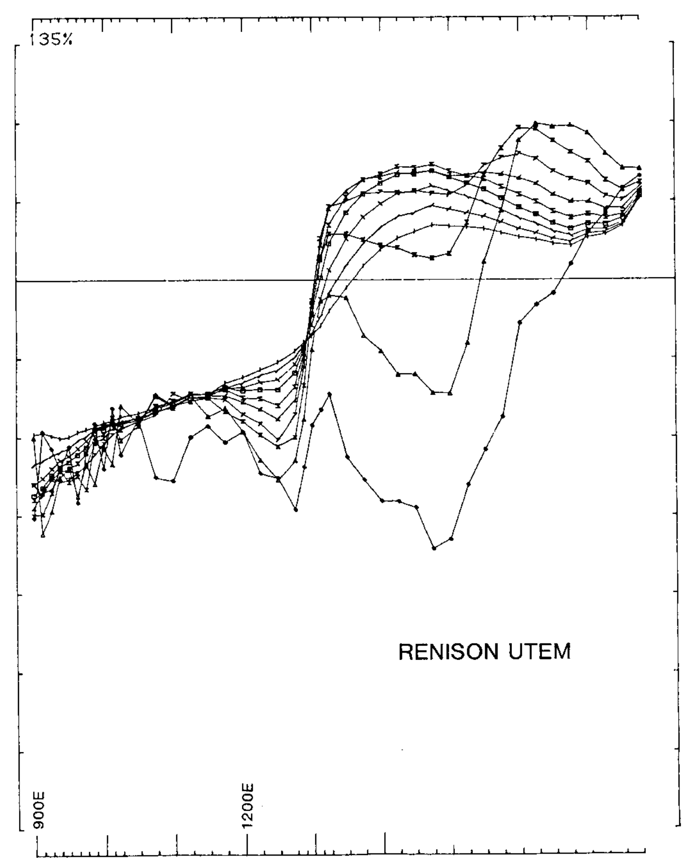

FIGURE 1
UTEM results over a buried massive cassiterite-pyrrhotite deposit at Renison.

A significant part of the West Coast is covered by Tertiary basalt or Pleistocene glacial material. The subsurface topography is often rugged and the depth unknown prior to drilling. Seismic refraction, gravity, EM sounding and resistivity surveys have been carried out to demonstrate the

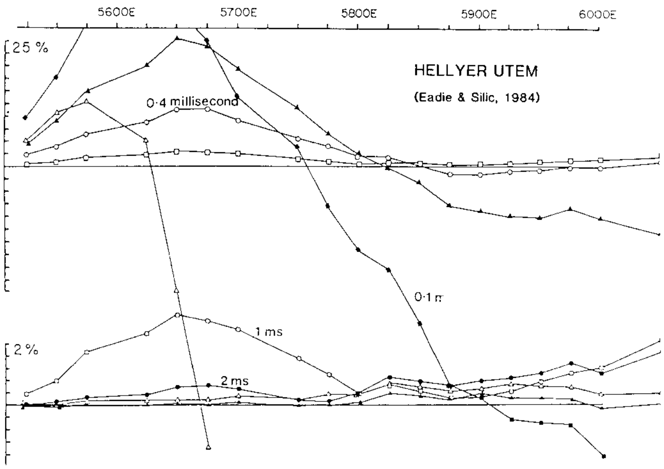

FIGURE 2
UTEM results over the Hellyer deposit.

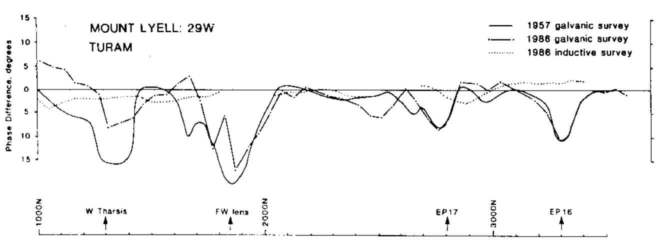

FIGURE 3
TURAM results from line 29W, Mt Lyell.

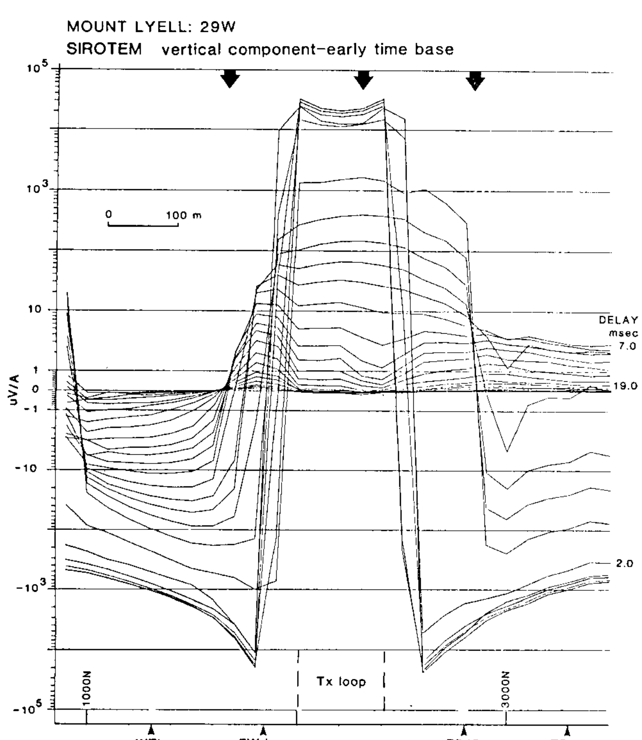

FIGURE 4
SIROTEM results from line 29W.

effectiveness of these methods in defining the shape and depth of the subsurface. CSAMT and TEM surveys have also been evaluated for their application in mapping the extent of prospective host rocks beneath thick basaltic cover.

Also shown on Fig. 3 are the results of an inductive Turam survey. This shows no anomalies at all. The difference in response between the inductive and galvanic surveys is considered to be due to the marginal conductivity at Mt Lyell: high enough to cause current channelling, but not sufficient to produce good inductive responses. A galvanic TEM survey was carried out (Fig. 5), but these results were not as good as the inductive TEM surveys and further experimentation is required with this technique. The best results were obtained from a CSAMT traverse. The processed resistivity data (Fig. 6) clearly shows a deep, good conductor at WTh, a shallow conductor at FW, another shallow conductor at 2200N agreeing with the TEM results, a moderate conductor at EP17 and a complex conductor at EP16. (The shallow response at the southern end of the line coincides with power lines and is not evident in the phase data.)

Apart from the grounded wire TEM surveys mentioned above, experimentation has included a traverse of MT stations to see if the regional shape and depth of the Mt Read Volcanics can be better defined. A large part of the geophysical program has consisted in collecting time domain IP *in situ* measurements at representative locations of economic and barren sulphides; black shales; zones of alteration and fresh country rock. This data has been processed using an inversion technique to obtain the Cole-Cole dispersion parameters and some discrimination of the various rock types has been achieved.

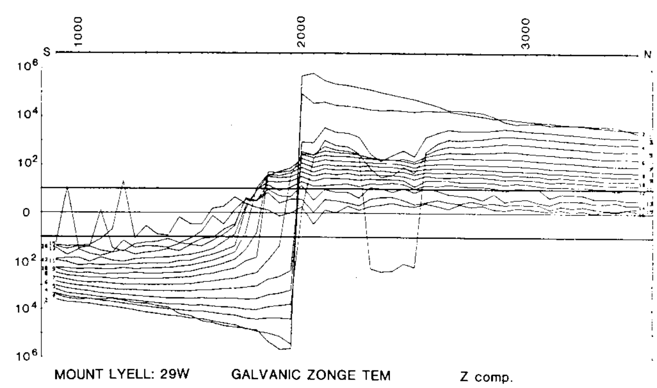

FIGURE 5
Grounded wire TEM results from line 29W.

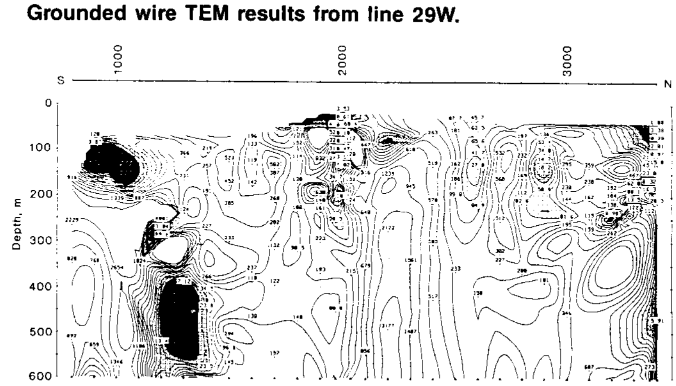

FIGURE 6
CSAMT profile over line 29W.