Conclusion

Field studies show that explanations for negative TEM responses are not always obvious. In most cases negative responses can be attributed to IP effects, but further investigation is required into situations where the conductor itself appears to be non-polarisable.

References

McCracken, K. G. & Buselli, G. (1981)—'Current gathering effects in TEM; In: 'Fifty-First Annual International Meeting and Exposition, Society of Exploration Geophysicists, Los Angeles, 1981', Technical Papers, **I**, 586–607.

Weidelt, P. (1982)—'Response characteristics of coincident loop transient electromagnetic systems', *Geophysics* **47**, 1325–1330.

OLYMPIC DAM DEPOSIT — GEOPHYSICAL CASE HISTORY

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The Olympic Dam deposit with a resource of 2000 x 10^6 tonnes averaging 1.6% copper, 600 ppm uranium oxide and 0.6 ppm gold, is located 520 kilometres north-north-west of Adelaide, the capital of South Australia (Fig. 1). The deposit occurs in sedimentary breccias in a basement graben structure beneath 330 metres of flat lying Proterozoic and early Cambrian stable shelf sediments. It was located in 1975 by Western Mining Corporation by the drilling of coincident magnetic, gravity and tectonic targets identified on the basis of a conceptual geological model.

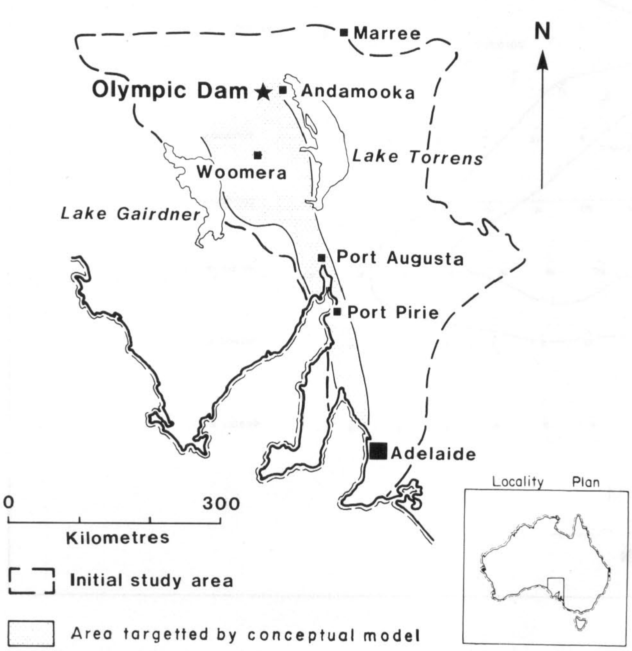

FIGURE 1
Location of Olympic Dam copper deposit and initial study area.

The mineralization occurs in a sequence of sedimentary breccias ranging from matrix-poor granite breccias to matrix-rich polymict breccias (Roberts and Hudson 1983) (Fig. 2).

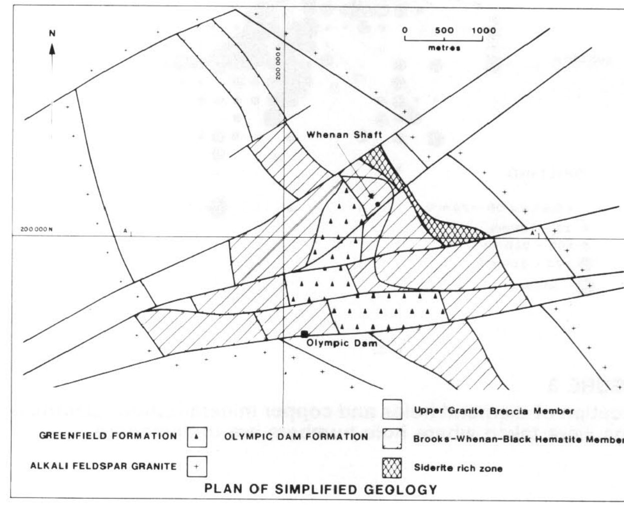

FIGURE 2
Generalised geologic plan of the Olympic Dam deposit at the −450 m level. (After Roberts and Hudson, 1983.)

The breccias are divided into two main lithostratigraphic units. The Greenfield Formation which lies conformably above the Olympic Dam Formation, contains the very-hematite rich portions of the stratigraphy. Although all the sedimentary units contain mineralization, the richest intersections are in the Olympic Dam Formation and lower members of the Greenfield Formation. The mineralized sedimentary sequence lies within a north-west trending graben bounded by a medium to course grained alkali-feldspar granite. The base of the mineralized sequence has yet to be intersected by drilling. Hematite is a common matrix component and clast mineral in much of the deposit. Copper sulphides occur mainly as uniform disseminations with minor amounts as veinlets. Sulphides constitute up to 10% of the rock, but typically average 5–8% within ore zones (J. Reeve, *pers. comm.* 1986). The broad copper distribution is shown in Fig. 3.

The deposit coincides with a 170 mm.s^{-2} gravity anomaly because of the close association between copper-uranium mineralization and hematite-rich polymict breccias. The source of the broad 1000 nT magnetic anomaly spatially related to the deposit with an interpreted source depth of 1500 m–2000 m has yet to be intersected by drilling, though shorter wavelength components of the anomaly probably reflect dolerite dykes and other sources within the mineralized stratigraphy.

Early attempts at detecting the deposit with the induced polarisation method were unsuccessful because of electromagnetic coupling and low signal-to-noise ratios. Subsequently, using a high power transmitter and digital IP receiver, the whole deposit was covered by 400 m dipole-dipole lines at a spacing of approximately 800 m, revealing

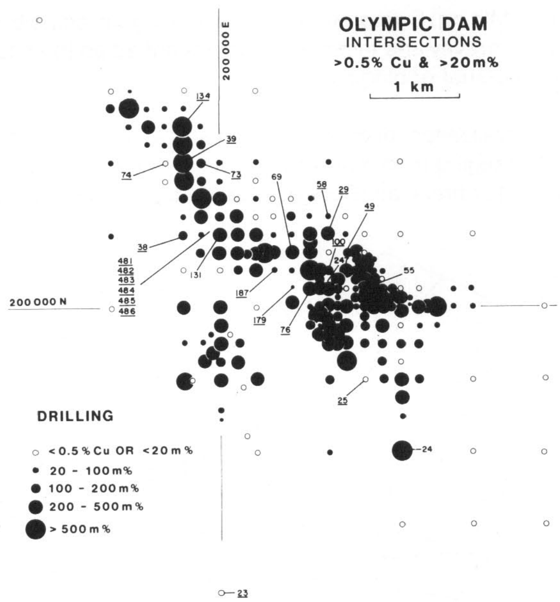

FIGURE 3

Location of diamond holes and copper mineralization. Electrical logs were taken where hole numbers are underscored.

a close correlation between anomalous phase angle response and significant copper intersections (Figs. 3 & 4). Fig. 5 illustrates the dipole-dipole pseudo-section on line 200600N. An apparent resistivity low is restricted to the central and southern portions of the deposit.

Electrical logs of the holes within a restricted area of the mineralization revealed a consistent pattern in the cover sequence of essentially non-polarisable units with resistivities ranging from 10 to 150 ohm-metres. In the breccia units hosting the mineralization, the phase angle response typically varied from 20 mrad to in excess of 120 mrad; the resistivities varied from 2 ohm-metres to several thousand ohm-metres (Fig. 6). Electrical data were collected using pole-dipole type arrays employing spacings of 1.5 m, 4.5 m and 4.5 m, 13.5 m between transmit and receive electrodes. In general there is a good correlation between resistivity and phase angle; higher resistivities tend to be associated with higher phase angles. Sulphide-rich units have low resistivity and low phase response. This result is presently attributed to the occurrence of stratabound mineralization within high porosity breccias containing a high percentage of black crystalline hematite. It is hypothesized that the low resistivity and phase response results, primarily, from conduction by saline ground water within the pores of the rock. If a significant portion of the

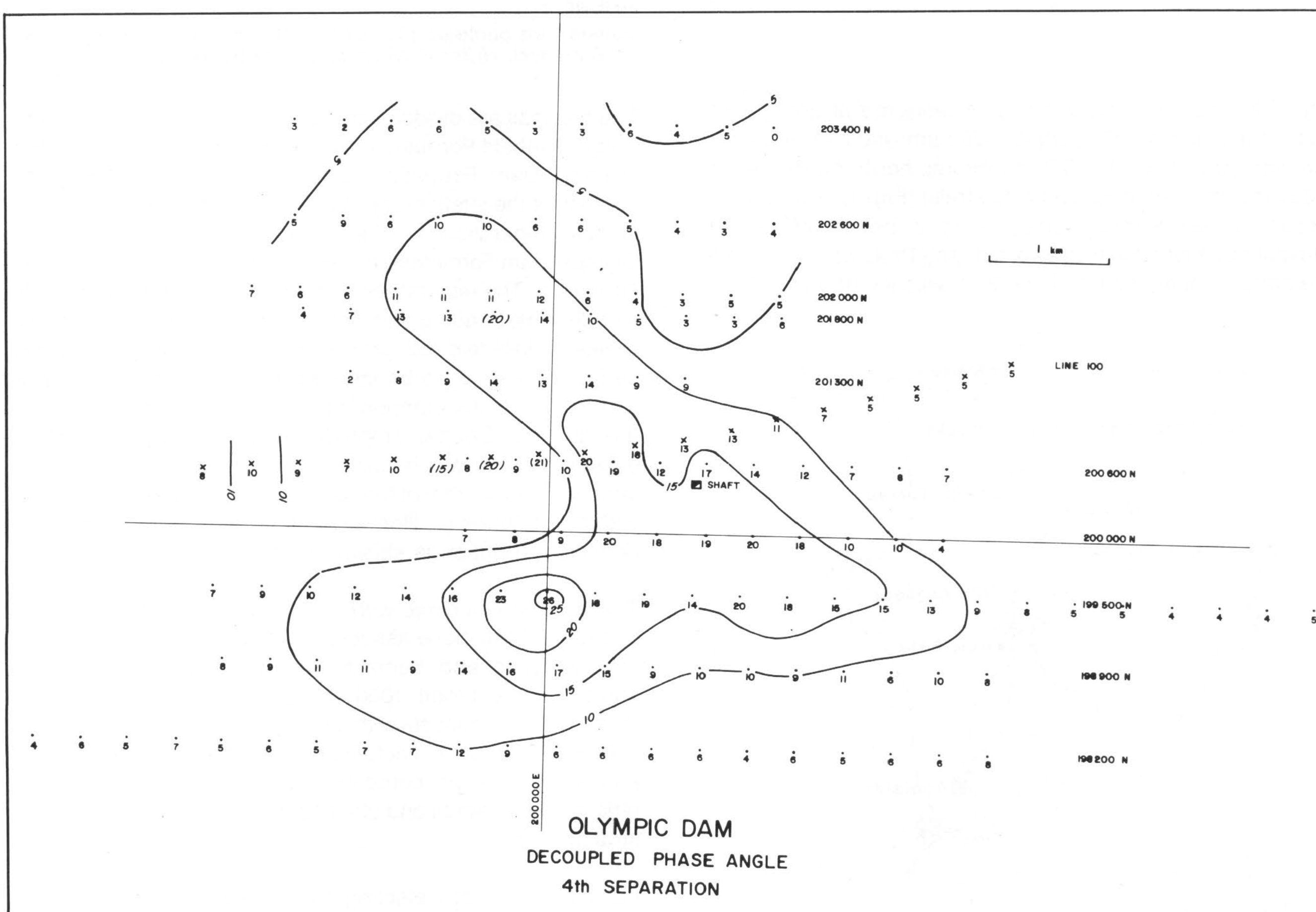

FIGURE 4

Contours of decoupled phase angle, in milliradians, at the fourth separation of the dipole-dipole surveys at Olympic Dam. Dipole length is 400 m. Brackets denote readings which are probably influenced by casing. Decoupled phase angle computed from 8/3 $\phi_{0.125\ hz}$ − 2 $\phi_{0.25\ hz}$ + 1/3 $\phi_{0.5\ hz}$.

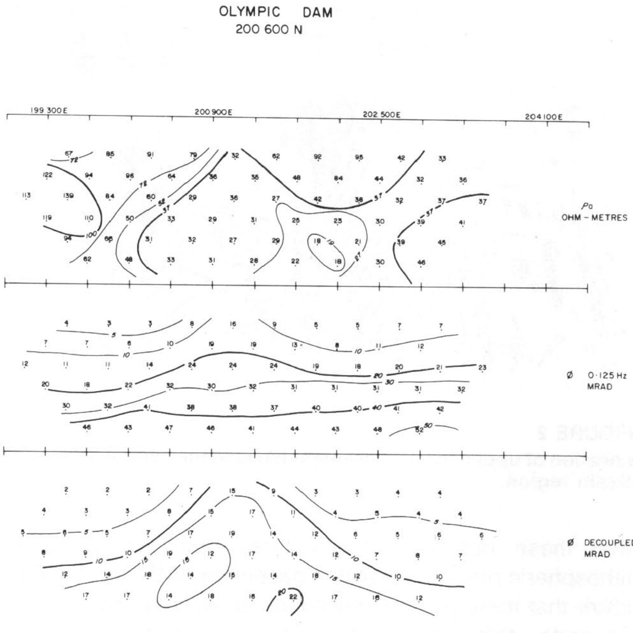

FIGURE 5
IP pseudo-section for line 200600N. Dipole length 400 m.

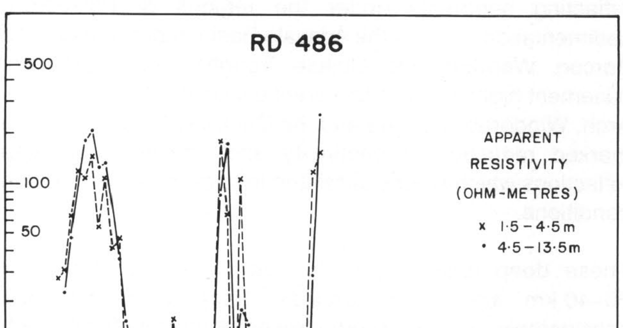

FIGURE 6
Geological log, average copper assay, resistivity and polarisation log for RD 486.

current did flow through the semi-conducting black hematite, a significant phase angle response should be associated with the low resistivity results. Interpretation of the borehole logs and measurement of a single sample suggest water resistivities of less than 0.5 ohm–metres in the pores of hematite–rich material. Higher phase responses are measured in less porous rocks, typically with higher clast contents, where transgressive mineralization and other polarisable minerals are present. The relatively close association of transgressive and stratabound styles of mineralization accounts for the strong correlation between thickness and grade of copper intersections and anomalous phase angle response measured by 400 m dipole-dipole arrays.

Interpreted polarisation source depths in the cover sequence and poor correlation in phase angle between surveys done at different stages of drilling indicate that steel drill casing influences the dipole-dipole results. Two and three dimensional modelling suggest that, with the exception of a single line, the influence of casing is relatively minor; most of the IP anomaly can be attributed to sources in the basement.

The authors gratefully acknowledge permission from Western Mining Corporation and Roxby Management Services to release this data.

Reference

Roberts D. E., and Hudson, G. R. T. (1983)—'The Olympic Dam copper-uranium-gold deposit, Roxby Downs, South Australia', *Econ. Geol.* **78**, 779–822.

3-DIMENSIONAL IMAGE OF THE LOWER CRUST UNDER AN INTRA-CONTINENTAL BASIN IN EASTERN AUSTRALIA

D. M. Finlayson and J. H. Leven

Introduction

Seismic investigations of deep crustal features under the central Eromanga Basin in eastern Australia were conducted during 1980–82 and these provided a network of seismic reflection traverses with, in some places, coincident wide-angle reflection and refraction traverses (Fig. 1). This network enables a new insight into deep structures under a major intra-continental sedimentary basin on a scale not commonly available in other parts of the world, and at the intersection points of traverses the 3-dimensional structure of deep features can be examined. Generally, reflection profiling data provide deep structural information and the wide-angle reflection and refraction data provide complementary velocity information which is required to evaluate possible rock compositions at depth.