Short Note

Field Examples of Resistivity Gradient Array Anomalies

M.F. Middleton

Department Geology and Geophysics. University of Sydney.

The gradient array is described by Kunetz (1966) and Whiteley (1973). Essential features of the configuration are shown in figure 1. Limitations in this method due to electrode spacings are discussed by Pratt and Whiteley (1974). The aim of this note is to look at field examples of resistivity gradient array anomalies.

The examples are taken from a survey done in an area in the eastern portion of the Precambrian suite of rocks in north-western Queensland (Duchess SF54-6, 1:250,000 sheet, near latitude 21°51'S, longitude 140°48' E). The local geology consists of the highly metamorphosed Soldiers Cap Formation (mica schists, quartzites and amphibolites) of Proterozoic age which is intruded by scattered outcrops of the Williams Granite (Carter, Brooks and Walker, 1961). The region is extensively folded and faulted with brecciation and graphitic shearing being common. Alluvial and eluvial soils of various depths cover most of the survey area.

The resistivity survey was carried out with AB spacings of 1600 m to 2000 m and an MN spacing of 25 m

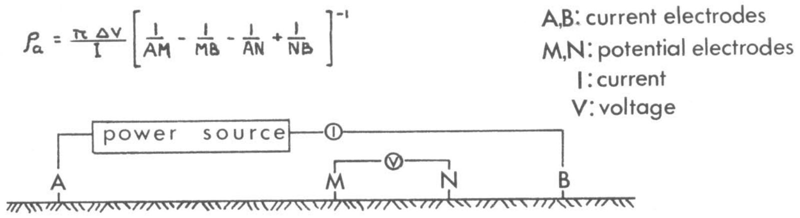

Figure 1
The resistivity gradient array.

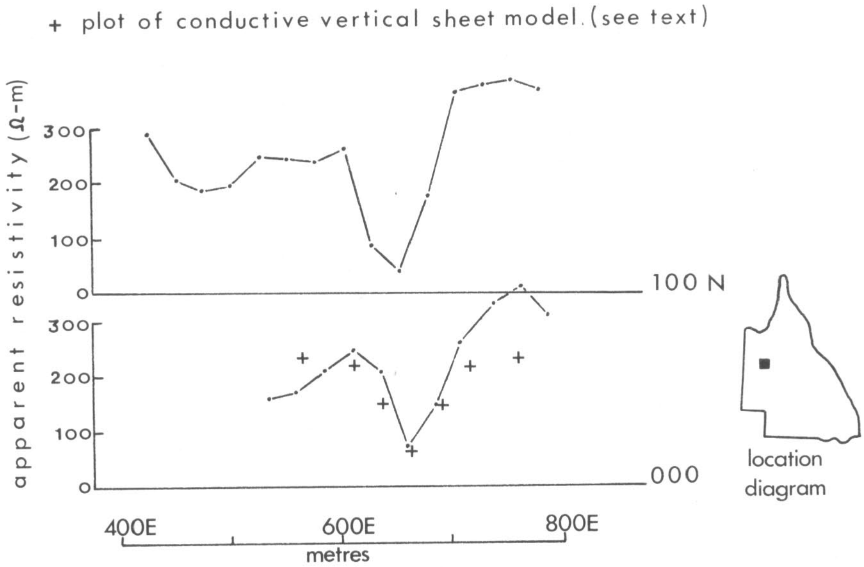

Figure 2.
Field example A of resistivity gradient array anomalies.

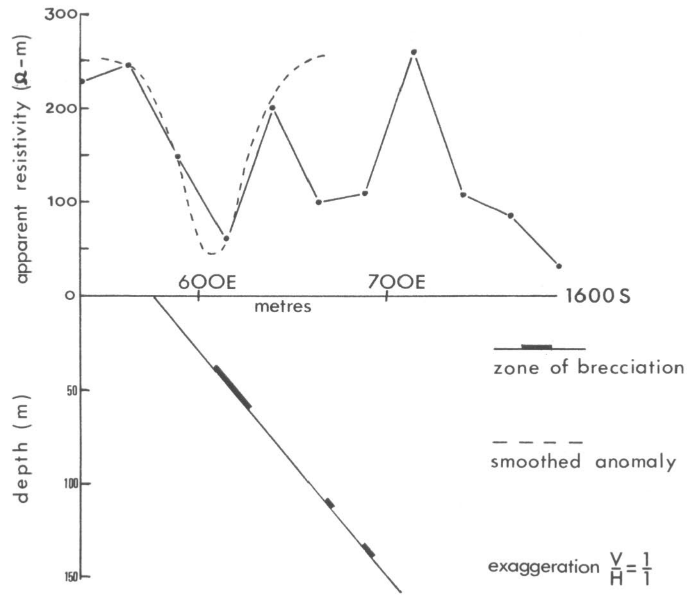

Figure 3.
Field example B with associated drilling information.

(figure 1). The centre two thirds of the spread between the current electrodes A and B was surveyed. Two resistivity anomalies from traverses of the survey will be discussed.

Figure 2 shows field example A. A resistivity low is evident on two successive traverses. Also shown (on the lower profile) is the anomaly due to a vertical conductive sheet, of resistivity 0.1 ohm metres and thickness 25 m, buried to a depth of 62.5m in a medium with a resistivity of 250 ohm m (after Quick, 1975). The model has the purpose only of suggesting possible dimensions of a causative body. The anomaly in example A may be attributed to :

a) a graphitic shear between two resistive blocks covered by approximately 25 metres of resistive overburden.
b) a near vertically dipping bed (presumably graphitic) overlain by Recent alluvium.
c) a zone of brecciation at a depth less than 25 metres.

The asymmetrical shape of anomalies may represent a dip of the body of the west (Grant and West, 1965, p.429), but is more likely due to differing resistivities on either side of the conductive body.

Figure 3 shows example B. This is a profile further to the south of the previous example. Geological control is available in this case in the form of a drill hole (figure 3). Dipole-dipole resistivity data confirms the existence of two discrete resistivity lows at 600E and 675E. At least one anomaly (600E) appears to be due to a zone of brecciation. If the causative body is assumed to have limited depth extent, the rule of thumb depth interpretation for a sphere (Middleton, 1974) might approach the correct depth of the conductive body. It should be mentioned here that there is no accurate knowledge of the geometry of this zone of brecciation apart from the drill information. Hence, at this stage of interpretation, the simplest model may suffice provided it fits the data. Upon smoothing the field data to give a "sphere type" anomaly (dashed line in figure 3), the rule of thumb depth is 46 metres. This is in good agreement with the depth of the zone of brecciation intersected by the drill hole.

The cause of the resistivity low situated at 675E is less definite. It may be due to the deeper zones of brecciation intersected by the drilling. These zones are thin at the depth intersected.However, they may be thicker at shallower depths. Rule of thumb interpretation, assuming a spherical source body, places its centre at a depth of approximately 72 metres. If the zones of brecciation tend to peter out with depth as the thin deeper intersections may indicate, then this anomaly may be due to a thick zone centred at a depth of about 70 metres. This is an attempt to interpret the anomaly with known geological information. Other undetected causes should not be dismissed because there is insufficient information about the source of this anomaly.

Two comments will now be made in conclusion. Firstly, the potential electrode spacing (MN = 25 m) is too large to define adequately the anomalies in example B. This spacing is, however, adequate for good definition of anomalies caused by the body in example A. This is a limitation in the method brought about by the necessity for finite potential electrode spacings. Secondly, care should be taken in choice of model of interpretation for ill defined anomalies. The sphere model assumed in example B, while giving good depth agreement, may give a completely misleading geometry.

ACKNOWLEDGEMENTS

The author would like to acknowledge Amoco Minerals Australia Company for permission to use the data exhibited in this note. He would, further, like to thank Mr. R.J.Whiteley for useful comments concerning the manuscript.

References

Carter, K.E., Brooks, J.H., and Walker,K.R., 1961. The Precambrian Mineral Belt of North-Western Queensland. Bur.Miner. Res. Bull., No.51.

Grant, F.S., and West, G.F., 1965. Interpretation Theory in Applied Geophysics, McGraw-Hill.

Kunetz, G., 1966. Principle of Direct Current Resistivity Prospecting, Geo-exploration Monographs, Ser.1, No.1.

Middleton, M.F., 1974. On Rule of Thumb Interpretation of Resistivity Gradient Array Data. Bull. Aust. Soc. Explor. Geophys., v.5, pp.134-135.

Pratt, D.A., and Whiteley, F.J., 1974. Computer Simulation and Evaluation of Electrode Array Responses in Resistivity and I.P. Prospecting. Bull. Aust. Soc. Explor. Geophys., v.5, pp.65-87.

Quick, D.H., 1975. The Interpretation of Gradient Array. Chargeability Anomalies. Geophys. Prosp., 221, pp.736-746.

Whiteley, R.J., 1973. Electrode Arrays in Resistivity and I.P. Prospecting: A Review. Bull.Aust. Soc. Explor. Geophys., v.4, pp. 1-29.