DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK NO. 91/3

MILTALIE MINE INDUCED POLARIZATION/ RESISTIVITY SURVEY

by

T. V. HARVEY
(Consultant Geophysicist)

and

A. R. DODDS

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INTRODUCTION

At the suggestion of SADME regional geologist Dr. John Parker and consultant geophysicist Dr. David Tucker, a brief IP/resistivity survey programme was carried out in the Miltalie Mine area during the period 5th-9th March 1990 inclusive. The aims of this survey were two-fold: to assess the applicability of the IP/resistivity technique in the Miltalie Mine environment, and, to provide sub-surface electrical information which might assist the siting of diamond drillholes proposed for the area.

This report sets out the parameters of the survey, presents the results obtained, and provides an interpretation of those results.

SURVEY DETAILS

Equipment

The equipment used for the Miltalie Mine IP/resistivity survey comprised the SADME Austral T842 time & frequency domain IP transmitter powered by the SADME Wisconsin-Homelite motor generator set, and a Scintrex-hired IPR10A time domain IP receiver. The survey was conducted in the time domain mode, employing a transmitter cycling time of 2 seconds (i.e. 8 second period); IP effects (chargeabilities) were recorded over three windows in the decay curve (see Figure 1). These chargeability values are designated M_{231}, M_{232} and M_{233} respectively. The Scintrex IPR10A receiver `normalizes' these chargeability values for the Standard Induced Polarization Decay Curve as determined by Newmont Exploration Limited (see IPR8 or IPR10A manuals) allowing a simple comparison of the three values.

Configuration

The IP equipment was deployed in a dipole-dipole array, with transmitter-receiver dipole separations of 1, 2, 3 & 4 times the common dipole size. A dipole size of 50 metres was used for all work except for a detailed (25 metre dipole size) survey over the old mine site. Transmitter current electrodes comprised alfoil sheets bedded in 0.5m x 0.5m x 0.2m (deep) pits; receiver ground-contact points were copper sulphate porous pots positioned in smaller adjacent pits. Transmitter electrodes and receiver reading sites were prepared and well-watered in advance, then re-watered immediately prior to use. All alfoil sheeting was recovered after the survey, and the electrode and porous pot pits backfilled.

Extent

The Miltalie Mine IP/resistivity survey comprised a single, approximately east-west 1450 metre traverse (line 2) of 4 level, 50 metre dipole-dipole readings across the old mine site, with 250 metres of detailed 4 level, 25 metre dipole-dipole readings centred directly on the mine site itself, followed by subparallel 1000 metre traverses of 4 level, 50 metre dipole-dipole readings 350 metres to the south (line 1) and 500 metres to the north (line 3). Traverse positions were marked out by Parker and Tucker; line pegging was carried out by the IP crew.

The survey (including travel time ex Adelaide) was undertaken over the period Monday 5th March to Friday 9th March 1990 inclusive (see Table 1).

Table 1
Miltalie Mine IP/Resistivity Survey Statistics

Day	Activity	Production
Mon 5th	Travel Adelaide-Cowell	
	Peg & prepare part line 2	
Tues 6th	IP/res survey line 2, 0-1000E	1000m (50m)
	Prepare line 2, E ext. & detail	
	Peg & prepare part line 1	
Wed 7th	IP/res survey line 2, 1000E-1450E	450m (50m)
	IP/res survey line 2, detail	250m (25m)
	IP/res survey line 1, 500E-1000E	500m (25m)
	Prepare remainder line 1	
Thur 8th	Peg & prepare line 3	
	IP/res survey line 1, 0-500E	500m (50m)
	IP/res survey line 3, 0-1000E	1000m (50m)
Fri 9th	Travel Cowell-Adelaide	
TOTALS		3450m (50m)
		250m (25m)

Results

IP/resistivity surveying conditions were quite good, with transmitter currents in excess of 1 ampere normally achievable (range 0.6 to 2.25 amperes), generating receiver signal strengths ranging from 1.5mV (minimum n=4) to 472mV (maximum n=1). Some telluric noise was observed at the receiver in the lower signal strength range (less than 5mV), and occasional transmitter-related noise attributable to instability in individual transmitter dipoles was also noted, particularly at the sandy eastern end of traverse 1. These noise levels were not sufficient to seriously compromise the validity of the results.

The prime check on the validity of individual chargeability readings was the comparison of the normalised M_{231}, M_{232} and M_{233} values at each site. A variation range in these values of less than 10% was considered indicative of an acceptable chargeability reading. As a further check on reading validity, two reciprocally-repeated readings were recorded at the centre of each transmitter set-up, and a further two reciprocally-repeated readings were recorded at the overlap of adjacent set-ups. Reciprocally-repeated resistivity values were invariably within 5% of each other; most reciprocally-repeated M_{232} chargeabilities were within 10%. No direct transmitter-receiver calibrations were taken during the survey.

Presentation

The results of the Miltalie Mine IP/resistivity survey are presented as pseudosections of apparent resistivity and apparent chargeability (M_{232})) in Figures 2, 3 and 4.

INTERPRETATION

Introduction

The Miltalie Mine IP/resistivity survey recorded a weak-moderate strength chargeability response over the old mine site, with possible along-strike extensions to the north and south. A series of apparently subparallel, moderate strength chargeability zones occur to the east of this feature; only background-strength chargeabilities were noted to the west.

Miltalie Mine Response

The Miltalie Mine site responded as a weak-moderate strength coherent chargeability anomaly, in an area of variable resistivity response, centred at 400E on line 2, figure 4. Resurveying the site with 25 metre dipole IP/resistivity confirmed the chargeability anomaly (peak values over 14mV/V), showing it to lie between a sharp shallow low resistivity zone in the east (which was not seen on the 50 metre data), and shallow higher resistivities in the west (see Figure 3).

Consideration of the chargeability anomaly alone suggests a relatively broad zone (say 25 metres) of weak sulphide(?) mineralization topped at 25 metres depth. The apparent east dip of this anomaly is at odds with the known west dip of the sulphide mineralization. The anomaly may be indicating a steeply east(?)-dipping geological unit, or the east dip may be an artificial effect generated, perhaps, by asymmetry in the resistivity environment.

The coincidence of the shallow low resistivity zone at 425E with the surface position of the line of lode suggests that this narrow feature relates to preferential weathering of the lode. Correlation of this shallow low resistivity zone with the top of the deeper chargeability anomaly does result in a west dip for an interpreted source.

Similar weak-moderate strength chargeability anomalies, each associated with a variable resistivity response, were recorded to the south, at 300E on line 1, and to the north, at 400E on line 3 (figure 4). In both cases, the chargeability anomalies have an apparent west dip. Correlation of these features implies an along-strike extent of 800 metres for the Miltalie Mine response. However, the weakness of the response, combined with the multiplicity of such responses and the relatively wide line spacing, make such a correlation suspect. The shallow low resistivity zone detected at 425E on line 3 is of particular interest, given the coincidence of just such a shallow low resistivity zone with the surface position of the line of lode at the Miltalie Mine.

A second discrete zone of weak-moderate strength chargeabilities in a higher resistivity environment occurs to the east of Miltalie Mine at 575E on line 2, and may possibly correlate with responses on lines 1 and 3.

Eastern Zones

Three moderate strength chargeability anomalies (designated Zones 1, 2 & 3) were detected on line 2, to the east of the Miltalie Mine response.

Zone 1, centred at 850E, comprises a zone of moderately anomalous chargeabilities (peak M_{232} values over 20mV/V) associated with locally lower resistivities (<100ohm-m) within an otherwise resistive environment (>200ohm-m).

Zone 2, centred at 1150E, comprises a broad zone of moderate-strong chargeabilities (peak M_{232} values over 25mV/V) associated with high resistivities at surface and a resistivity gradient at depth.

Zone 3, located at the eastern end of line 2, is incompletely surveyed, but apparently comprises a moderate-strong chargeability anomaly (peak M_{232} values over 25mV/V) associated with markedly lower resistivities (<15ohm-m).

Along-strike correlation with somewhat similar features on lines 1 and 3 is possible for Zone 1, and possibly Zone 2; neither of these lines extended sufficiently to the east to cover the along-strike expression of Zone 3.

The sources of these three zones may be sulphidic or graphitic rock types, with the low resistivities associated with Zone 3 suggesting graphite as the more likely source material there. All three zones appear untopped in the 50 metre results for line 2, suggesting shallow depths to sources along that line.

OTHER GEOPHYSICAL SURVEYS

A Fixed Transmitter-Roving Receiver SIROTEM survey was carried out by Billiton in 1986, the results being now on open file. The 600x300m transmitter loop was located to the west of the mine, with the nearer edge coinciding with the road (see Fig. 4). Three lines at 200m intervals were surveyed, the centre one passing close to the Miltalie Mine and roughly coinciding with IP line 2. X (E-W) and Z components of the field were measured, using standard delay times (channel 1 at 0.4ms)

The response is relatively flat on all lines, apart from the normal effect of migrating background currents. However, in the early channels there are two subtle anomalies indicating weak conductors. The anomalies show as flexures in the Z-component and highs in the X-component. The locations are shown on Figure 4, Line 2, with the IP interpretation.

The correlation between the TEM anomaly at 600E and the IP anomaly at 575E, which are sufficiently close to coincident considering the grid positioning uncertainty, is particularly interesting. This is the stronger and more convincing of the two TEM anomalies, and correlates with similar features on the TEM lines 200m north and south of this one. The result is a curvilinear feature with a generally north-easterly strike. While the conductor producing this response is weak and near-surface, the correlation with a chargeability response indicates the probability of a sulphide or graphite source, and favourable geology might make it a worthwhile target for follow-up.

DRILLING

Two holes drilled under the old mine site encountered satisfactory sources for the IP responses. However, a hole drilled to investigate Zone 1, Wilklow DDH-1 collared at 775E on line 2 and plunging 60 degrees east, failed to encounter other than very sparse sulphides/graphite. The most probable reason for this failure is the lack of lateral control in the IP survey. While an anomaly certainly exists at 850E on line 2, the lack of confirming anomalies on lines located within a reasonable distance to the north and south means that the source may not be located directly under this survey line. Alternatively, the source could dip to the east, so that the hole did not reach 'live ground'. However, it is understood that this is geologically improbable.

CONCLUSIONS AND RECOMMENDATIONS

Over the period 5th-9th March 1990, 3700 metres of 4 level, mainly 50 metre dipole-dipole time domain induced polarization and resistivity were successfully surveyed along three traverses in the Miltalie Mine area.

The Miltalie Mine IP/resistivity survey outlined a weak-moderate IP effect response over the old mine site, with a shallow low resistivity zone coincident with the surface position of the line of lode.

The interpreted along-strike extensions to the Miltalie Mine IP/resistivity response are also recommended for further investigation, with particular attention directed to the shallow low resistivity anomaly at 425E on line 3. Geochemical surveying is suggested as an appropriate first test phase.

The three eastern anomaly zones have been interpreted as indicative of sulphidic and/or graphitic rock types. Further work on these zones is contingent upon geological criteria; given their apparent shallow depth on line 2, geochemical surveying appears to be the most appropriate initial technique.

A further investigation of the combined TEM/IP anomaly at 575E on line 2 should include an early time TEM fixed loop survey, which would detail the anomaly satisfactorily. There are two possible benefits of this. First, there is evidence that the weathering of sulphides causes a weak, near-surface low resistivity anomaly. Second, lead-zinc mineralisation does not necessarily give rise to a highly conductive target, particularly if the sphalerite content is high and the iron sulphies are sparse. In such a case, an early time TEM survey would give a clearer response.

Further drilling of IP targets should be preceded by the surveying of closer spaced survey lines (200m maximum) to fully outline the lateral extent of the target.

T V HARVEY
CONSULTANT GEOPHYSICIST

A R DODDS
GEOPHYSICIST

SCINTREX IPR10A IP RECEIVER DECAY CURVE PARAMETERS

Mode 3

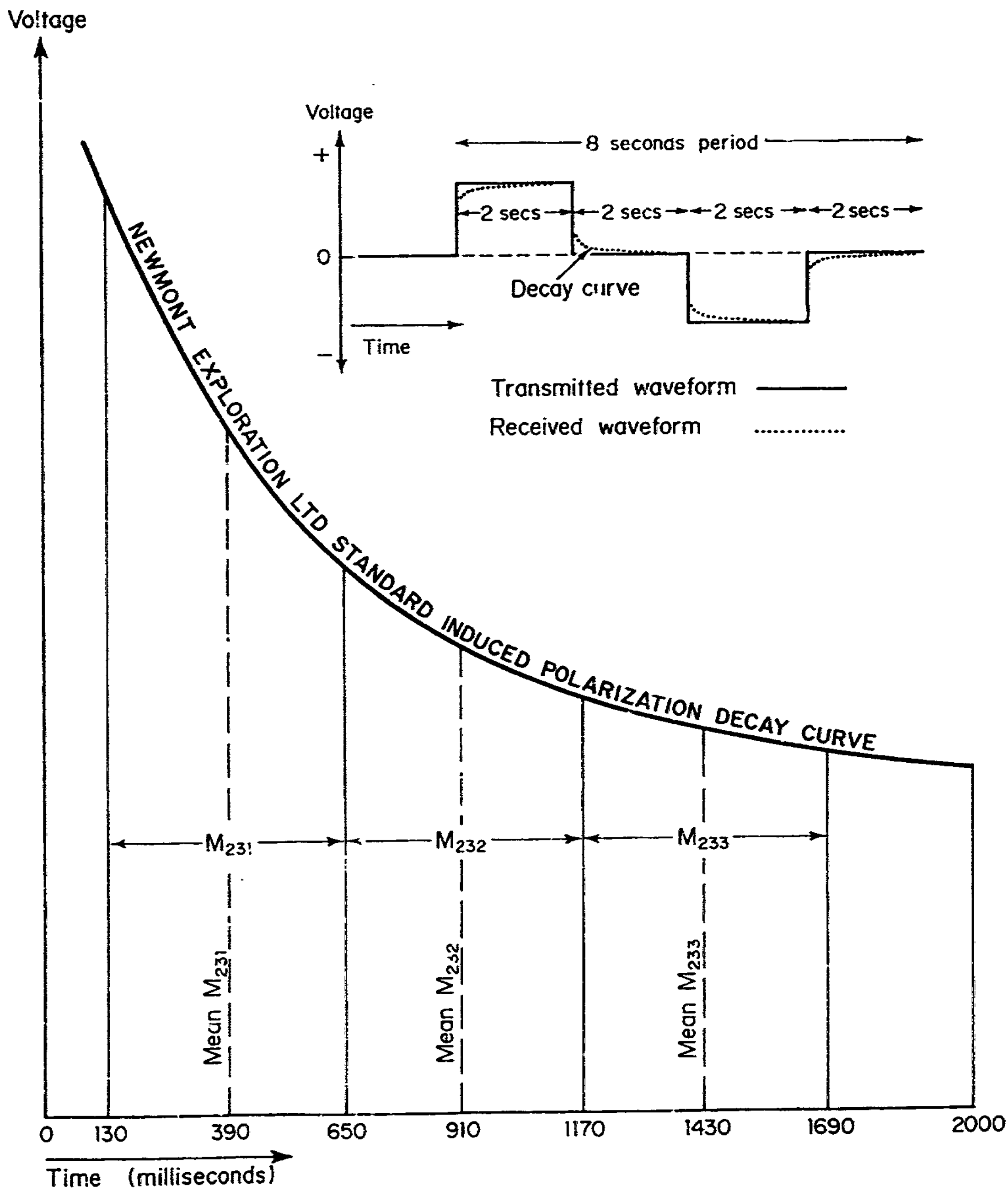

Figure 1

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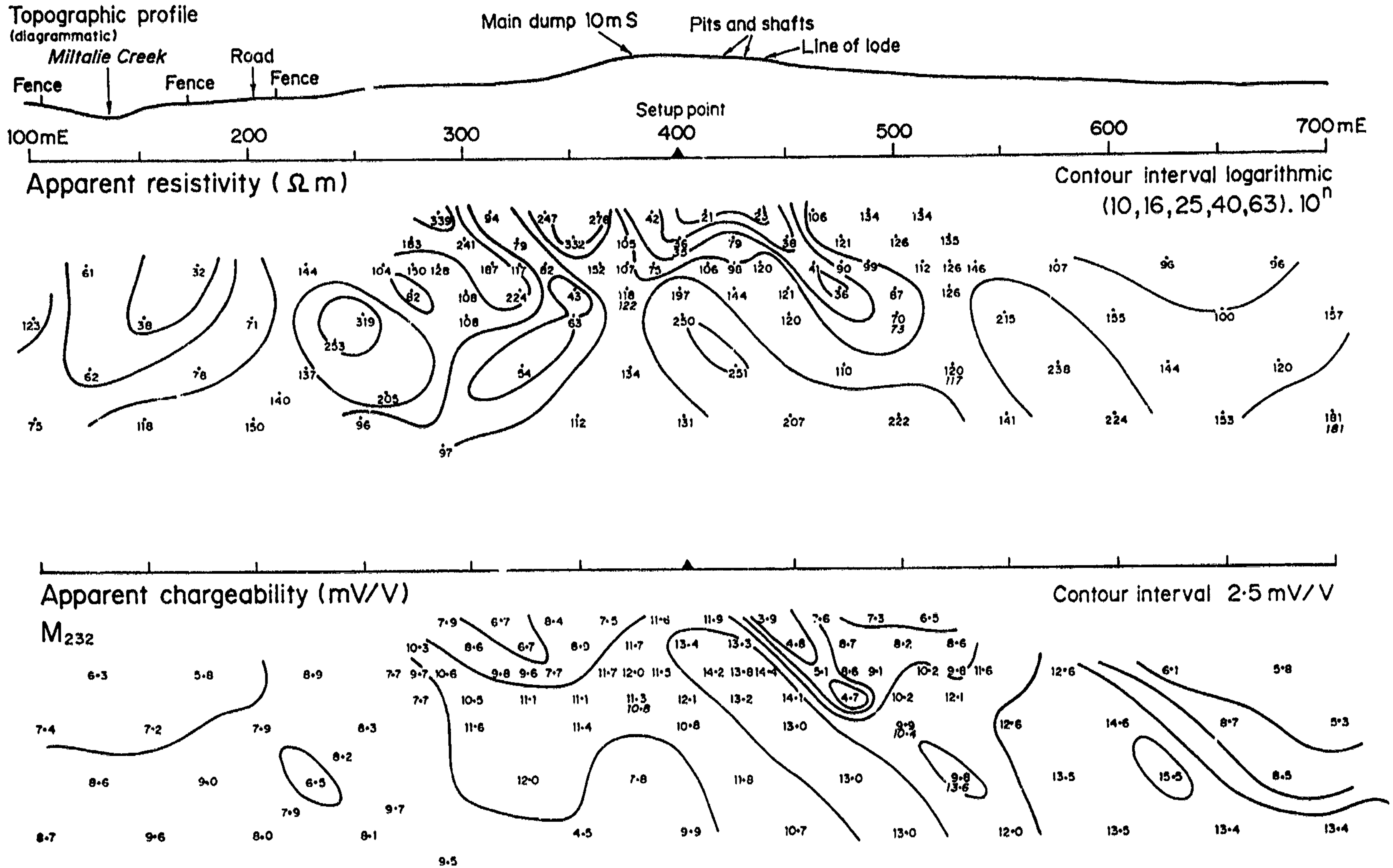

MILTALIE MINE – COMPOSITE PSEUDO-SECTIONS

Line 2 Dipole sizes 25m and 50m

Figure 2

SADME S 21661

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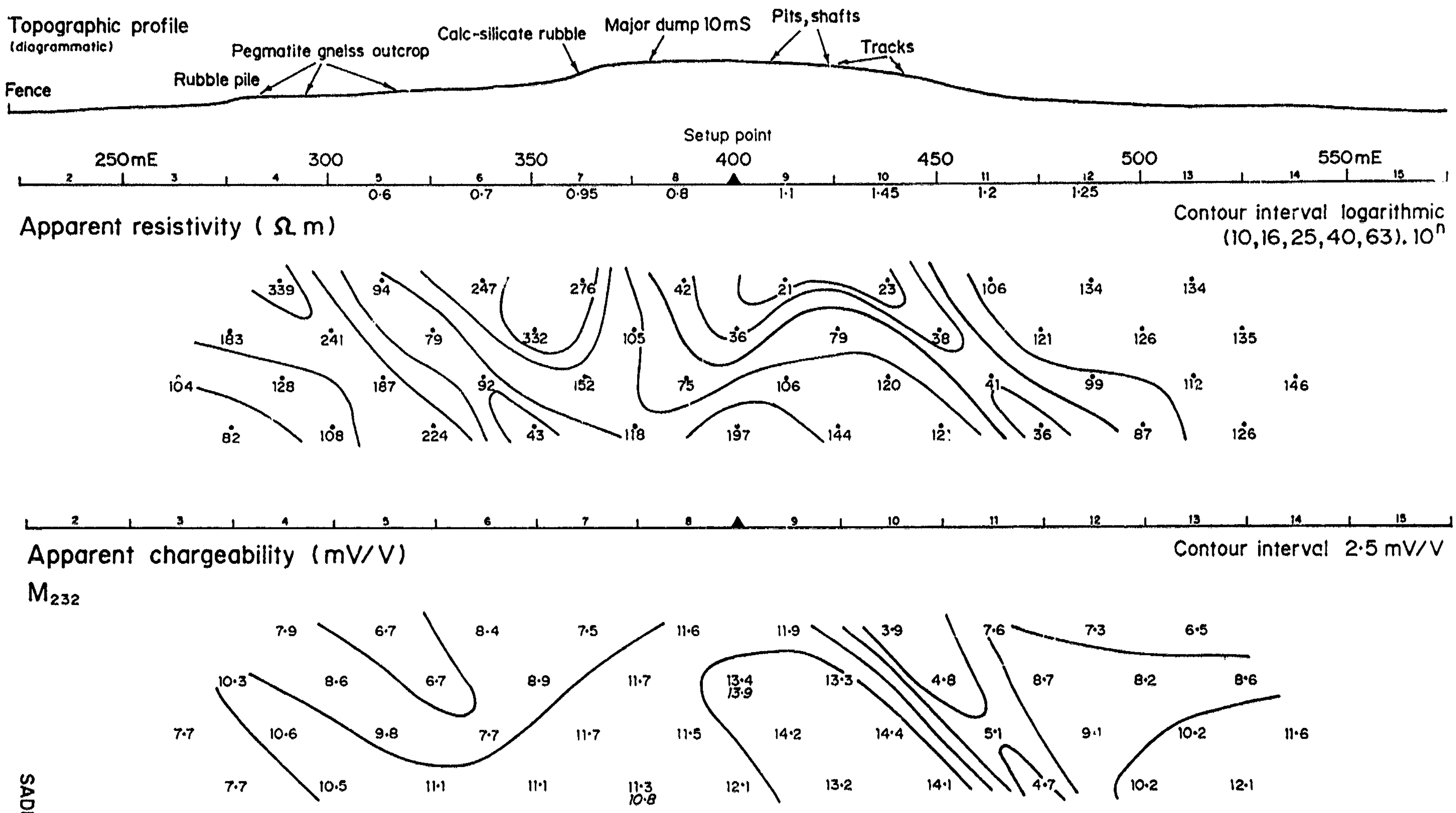

MILTALIE MINE - INDUCED POLARIZATION / RESISTIVITY PSEUDO-SECTIONS

Line 2 Dipole size 25m

Figure 3

SADME S21662

MILTALIE MINE

DIPOLE - DIPOLE INDUCED POLARISATION / RESISTIVITY PSEUDO-SECTIONS

Compiled by S. Dodds, Geophysicist, S.A. Dept of Mines and Energy
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Figure 4

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