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ELECTRICAL GEOPHYSICAL MAPPING SURVEYS,

RUM JUNGLE AREA, N.T., 1974

by

D.C. Stuart and R.D. Ogilvy

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SUMMARY

In the period June to August 1974 the Bureau of Mineral Resources carried out electrical geophysical surveys in the Rum Jungle area N.T., to assist in the mapping of a concealed contact between rocks of the Coomalie Dolomite and the Golden Dyke Formation.

Work was conducted at four areas around the Rum Jungle and Waterhouse Complexes, and comprised mainly resistivity and induced polarisation profiling techniques, and induced polarisation and resistivity soundings. Interpretation of the field data was assisted by a program of stratigraphic drilling, and laboratory measurements of the electrical properties of core samples.

The results of physical property measurements on core samples and the interpretation of induced polarisation/resistivity soundings established that rocks of the Golden Dyke Formation have in general a higher induced polarisation effect and a lower resistivity than rocks of the Coomalie Dolomite, which are invariably highly resistive.

The resistivity and induced polarisation surveys were only partially successful in mapping the contact between Coomalie Dolomite and Golden Dyke Formation rocks in the four survey areas. The principal problems were the influence of a variable conductive overburden, the intrinsic lack of resolution of resistivity methods, and the transitional nature of the contact.

Nonetheless, the results of the electrical mapping surveys suggest that with adequate geological and geophysical controls, resistivity and induced polarisation methods can assist in delineating the contact zone and perhaps indicate subtle changes in the lithology of rock units from area to area.

1. INTRODUCTION

In the period June to August 1974 the Bureau of Mineral Resources (BMR) carried out geophysical surveys in the Rum Jungle area, N.T. The surveys were requested by the Geological Branch of BMR to assist in revising the geology of the Rum Jungle district special sheet area (BMR, 1960).

An important objective of the geophysical surveys was to map the contact between the Coomalie Dolomite and Golden Dyke Formation in four areas where the contact is concealed. The location of the four areas in relation to the interpreted solid geology of the Rum Jungle area is shown in Plate 1.

The methods used to study the Coomalie Dolomite/Golden Dyke Formation boundary were: electrical profiling using induced polarisation (IP), resistivity, and transient electromagnetic (TEM) methods; electrical sounding techniques; laboratory rock property measurements; and detailed gravity traverses. The results of the electrical surveys and rock property measurements are described in this record. Results of the detailed gravity surveys have been described by Major (1977).

The electrical geophysical surveys at Rum Jungle were conducted by a party led by R. Ogilvy who also prepared a preliminary report on the work. Reporting and interpretation of the survey were completed by D..Stuart.

2. GEOLOGY

The Rum Jungle area lies in the northwest of the Pine Creek Geosyncline (Walpole & others, 1968) and consists primarily of the Rum Jungle and Waterhouse basement complexes, which are unconformably overlain by regionally metamorphosed lower Proterozoic sediments. The lower Proterozoic sediments are extensively overlain by Cainozoic and Quaternary sand, laterite, and alluvium. An interpretation of the stratigraphy and solid geology of the Rum Jungle area is indicated in Plate 1. A detailed description of the geology of the Rum Jungle area is provided by Johnson (1974).

The Coomalie Dolomite is the uppermost unit of the Batchelor Group and is characterised by algal dolomite, silicified dolomite (in places coarsely crystalline), dolomitic marl, and coarse marble. Carbonate outcrop is sparse and exposures are commonly silicified or lateritised. The Golden Dyke Formation, which forms the lower member of the Goodparla Group, commonly overlies the Coomalie Dolomite. The Golden Dyke Formation is represented by a heterogeneous sequence of siltstone-mudstone, dolomitic and carbonaceous black shale, siltstone, quartzite, chert, and ironstone. Pyrite is a common constituent of the carbonaceous rocks.

Owing to the heterogeneous nature of the Golden Dyke Formation, the boundary between the Coomalie Dolomite and the Golden Dyke Formation may be characterised by the juxtaposition of various lithologies. East, southeast, and southwest of the Rum Jungle Complex, a transition zone occurs near the base of the Golden Dyke Formation, consisting of interbedded dolomitic and carbonaceous shale. East of the Waterhouse Complex, the transition zone is more gradational, varying from dolomitic marble of the Coomalie Dolomite to calcareous siltstone of the Golden Dyke Formation. To the south and southwest of the Waterhouse Complex, the Coomalie Dolomite is disconformably overlain by the Burrell Creek Formation, which consists mainly of greywacke and siltstone.

Uranium and base metal mineralisation is found close to the Coomalie Dolomite/Golden Dyke Formation boundary. Economic orebodies have been worked at Dysons, Whites, Intermediate, Mount Burton, and Rum Jungle Creek South mines.

3. METHODS

IP/resistivity

IP/resistivity surveys included profiling and sounding techniques. Most surveys were carried out with a 2.5 kW Huntec time-domain transmitter and Huntec Mk II receiver. Some IP/resistivity surveys were conducted in the frequency domain.

Sounding surveys were conducted using the Schlumberger array, and profiling surveys included the gradient, two-electrode, and Schlumberger arrays.

Schlumberger soundings were interpreted as one-dimensional IP and resistivity structures using computer modelling techniques.

TEM

The TEM survey was carried out with the Russian-built MPPO-1 equipment, which uses a large horizontal loop for transmitting and receiving transient electromagnetic fields. A comprehensive account of the method and the equipment used has been given by Spies (1974).

4. LABORATORY MEASUREMENTS

The electrical and magnetic properties of Coomalie Dolomite and Golden Dyke Formation rocks were investigated by laboratory measurements on core samples obtained during BMR stratigraphic drilling in 1973 and 1974 (Johnson & others, 1979). Results of the laboratory measurements are shown in Appendix I.

The measurements show some overlap between the electrical properties of the Golden Dyke Formation and the Coomalie Dolomite. However, the Golden Dyke Formation does appear to have a consistently higher conductivity and chargeability than the Coomalie Dolomite. Some rocks within the Golden Dyke Formation exhibit very high conductivities and chargeabilities.

5. SURVEYS IN AREA 1

Area 1 is south of the Rum Jungle Complex around and to the east of Batchelor. In this area the boundary between the Coomalie Dolomite and Golden Dyke Formation is obscured by Quaternary cover. Eleven traverses (1, 2, 3, 7, 8, 10, 17, 19, 21, 22, and 23) were made in order to map the position of the boundary. The location of the traverses, the results of drilling, and the outcrop geology in Area 1 are indicated in Plate 2.

IP/resistivity soundings

The electrical properties of the Coomalie Dolomite, Golden Dyke Formation, and weathered surface rocks in Area 1 were investigated by IP/resistivity soundings at two sites located on Traverses 1 and 2 (Plate 2).

The soundings were made using the Schlumberger array and were expanded in both north-south and east-west directions to an electrode spacing of 200 m. Site 1 was located over Coomalie Dolomite at station 400S on Traverse 1. Site 2 was located over Golden Dyke Formation on Traverse 2 at station 760S.

The results of the soundings are shown in Plate 3, and the interpreted geoelectric section at each sounding site is described in Appendix II. The geoelectric sections indicate a substantial difference in the bulk electrical properties of fresh rocks between the Coomalie Dolomite and Golden Dyke Formation. In Area 1, the Coomalie Dolomite appears to have a resistivity of approximately 800 ohm-m and a chargeability of less than 5 ms; the Golden Dyke Formation appears to have a resistivity of approximately 200 ohm-m and a chargeability of approximately 15 ms. The geoelectric section also indicates that the depth of weathering is approximately 20 m over both Golden Dyke Formation and Coomalie Dolomite rocks. Note that the weathered zone has a relatively low resistivity which will to some extent limit the ability of profiling surveys to map electrical contrasts in the underlying rocks.

IP/resistivity and TEM surveys, Traverse 1

IP/resistivity and TEM surveys were made along Traverse 1 to determine the ability of the methods to detect and map the Coomalie Dolomite/Golden Dyke boundary in this area.

Traverse 1 straddles the Coomalie Dolomite/Golden Dyke Formation in an area where outcrop is limited owing to Quaternary cover. However, BMR stratigraphic drilling provides a fair indication of the rock types and the position of the Coomalie Dolomite/Golden Dyke boundary.

A geological cross-section along Traverse 1 and the results of the various geophysical surveys conducted along the traverse are shown in Plate 4.

IP/resistivity profiles: To determine the most effective method of IP/resistivity profiling to map electrical contrasts in unweathered rocks, trial surveys were made using gradient, Schlumberger, and two-electrode arrays.

The results of the resistivity profiling surveys shown in Plate 4 indicate that the apparent resistivity recorded over Coomalie Dolomite is generally greater than the apparent resistivity recorded over the Golden Dyke Formation. However, the highest resistivities are recorded over suboutcropping rocks of the Golden Dyke Formation at 950S, and it seems probable that major changes in apparent resistivity may reflect changes in overburden thickness and weathering as well as changes in the intrinsic resistivity of the fresh rocks.

In contrast to the resistivity results, the apparent IP profiles show a more consistent crontrast between the Golden Dyke Formation and the Coomalie Dolomite. For example, chargeability levels of 20-50 ms were recorded over Golden Dyke Formation rock units irrespective of the observed resistivity, whereas chargeabilities of less than 5 ms were recorded over the Coomalie Dolomite. The chargeability profiles indicate that the contact between Golden Dyke Formation and Coomalie Dolomite occurs at about station 750S, which is in good agreement with the results obtained by drilling.

The gradient, Schlumberger, and two-electrode array results are generally similar but owing to differing array geometry they vary in resolution and anomaly amplitude. A comparison of the resistivity values recorded over the Coomalie Dolomite with those recorded for the Schlumberger and two-electrode arrays highlights the greater depth of sampling obtained with the gradient array. Although the Schlumberger and two-electrode arrays potentially offer a greater resolution of lateral changes in resistivity, the gradient array's greater depth of sampling is clearly an advantage in the Rum Jungle area.

TEM results: The TEM profile using 40 m loops shows two anomalies occurring over the Golden Dyke Formation. The anomalies were recorded for sample times from 0.8 to 5 ms and suggest the presence of fairly good but shallow conductors. The TEM anomaly at 1050S corresponds well with the IP high and resistivity low which are probably associated with conductive carbonaceous shales intersected in RJ4. However, the TEM anomaly at 800S is not associated with a well-defined IP or resistivity anomaly and is probably the result of a shallow, surficial conductor.

Discussion: The results of IP/resistivity and TEM surveys along Traverse 1 indicate that IP is the most diagnostic parameter by which to discriminate rocks of the Golden Dyke Formation from those of the Coomalie Dolomite. However, resistivity and TEM surveys do assist in the interpretation of the IP data. Owing to its superior depth of sampling and ease of execution, the gradient array is preferred to the Schlumberger or two-electrode arrays for IP/resistivity profiling surveys in the Rum Jungle area.

IP/resistivity and TEM surveys, Traverses 2, 3, 7, 8, 10, 17

As shown in Plate 2 these traverses form a grid of lines approximately 1½ km apart which are normal to the expected contact between Golden Dyke Formation and Coomalie Dolomite. Gradient-array IP surveys were made on all traverses. However, a time-domain system was used for Traverses 2 and 3, and a frequency-domain system for Traverses 7, 8 and 17. TEM surveys were made on Traverses 1, 2 and 3 only. The TEM work was discontinued owing to the poor correlation between the resistivity and TEM results, and evidence that TEM sources were of a surfical nature. The results of the geophysical surveys on Traverses 2,3, 7, 8, 10, and 17 are shown in Plate 5. Survey details for these IP/resistivity surveys are described in Appendix III.

Traverse 2: The IP/resistivity results on Traverse 2 are similar to those observed on Traverse 1. The fairly consistent increase in chargeability and conductivity to the south suggests a contact between Golden Dyke Formation and Coomalie Dolomite at about 700S.

Traverse 3: The IP/resistivity results from Traverse 3 show a continuous but gradual increase in chargeability south of 800S and suggest a contact between Golden Dyke Formation and Coomalie Dolomite at about 900S. The apparent resistivity results appear to be strongly influenced by very low surface resistivities south of 1000S.

Traverse 7: The IP/resistivity results along Traverse 7 also exhibit a zone of low resistivity on the southern end of the traverse. The resistivity profiles for Traverses 3 and 7 are very similar and suggest a continuity of resistivity features between these traverses. The contact between Golden Dyke Formation and Coomalie Dolomite can again be interpreted from the chargeability profile, and the gradual increase in chargeability on the southern half of the traverse suggests a contact at about 750S.

Traverse 8: The resistivity results from Traverse 8 are similar to those observed on Traverses 3 and 7,and exhibit very low resistivities on the southern half of the line. In view of the low chargeabilities recorded on the southern half of Traverse 8 it is most likely that the low resistivity is the result of surficial conductors and not black shales of the Golden Dyke Formation.

Owing to the masking effect of the low-resistivity surface layer south of 900S, it is very difficult to interpret a contact from the chargeability data. However the combination of high resistivity and gradual increase in chargeability between 700S and 900S is very similar to features observed on Traverses 3 and 7. Hence, it seems likely that the Golden Dyke Formation/Coomalie Dolomite contact occurs at about 750S. This proposition was tested by BMR stratigraphic holes RJ73 and RJ74 which respectively intersected massive crystalline dolomite of the Coomalie Dolomite and a calcareous sandstone tentatively described as a basal transition bed of the Golden Dyke Formation.

<u>Traverse 17</u>: The IP/resistivity results on Traverse 17 are somewhat similar to the results obtained on Traverses 1, 2 and 3. The increase in chargeability south of 800S suggests a contact between Golden Dyke Formation and Coomalie Dolomite at about 900S.

<u>Traverse 10</u>: The IP/resistivity results from Traverse 10 exhibit a consistently high resistivity with a fairly uniform, low to moderate chargeability. Extension of this traverse to 2000S showed no change in this pattern.

The lack of evidence for a contact on Traverse 10 may result from folding of the contact in this area such that the traverse is parallel to the contact. This proposition was tested by IP/resistivity surveys on Traverses 19, 21, 22, and 23 which form a grid at right angles to Traverse 10 (Plate 2).

<u>IP/resistivity surveys, Traverses 19, 21, 22, and 23</u>

The results of these IP traverses are shown in Plate 6 and details of the surveys are described in Appendix III.

The results from Traverses 19 and 21 are similar and the increase in chargeability east of 500W indicates a contact between Golden Dyke Formation and Coomalie Dolomite at about 450W on both traverses. The boundary between Golden Dyke Formation and outcropping Coomalie Dolomite east of Traverses 19 and 21 does not appear to have been crossed by either of the IP/resistivity traverses.

The results from Traverses 22 and 23 are distinctly different from the results from Traverses 19 and 21. The moderate and uniform chargeabilities are characteristic of Coomalie Dolomite and indicate the absence of Golden Dyke Formation along these traverses. This interpretation is supported by the results of BMR stratigraphic holes RJ62, RJ63, RJ64, RJ65, and RJ66 all of which intersected rocks identified as Coomalie Dolomite.

Interpretation of the Golden Dyke Formation/Coomalie Dolomite boundary in Area 1

Throughout Area 1 there is sufficient contrast in induced polarisation characteristics between the Golden Dyke Formation and Coomalie Dolomite for IP to broadly delineate the contact between these formations. However, owing to the poor resolution of the mapping technique, it is not possible to locate the position of the contact to better than a few hundred metres.

Interpretation of the IP/resistivity data in Area 1 suggests that east of Traverse 8 the contact is fairly straight and strikes roughly northeast. To the west of Traverse 8 the contact appears to be folded. The interpreted position of the Golden Dyke Formation/Coomalie Dolomite boundary is shown in Plate 2.

6. SURVEYS IN AREA 2

Area 2 is six kilometres west of Batchelor where the Giants Reef Fault displaces a wedge of the Waterhouse Complex. Outcrop in the area is sparse. No outcrops of Golden Dyke Formation are known, but small isolated outcrops of Coomalie Dolomite occur and BMR stratigraphic drilling indicates the presence of Golden Dyke Formation. Two IP/resistivity traverses (11 and 14) were made in Area 2 with a view to locating the Golden Dyke Formation/Coomalie Dolomite contact. The location of the traverses in Area 2 and the outcrop geology are indicated in Plate 7. Details of the IP/resistivity profiling traverses in Area 2 are shown in Appendix 3.

IP/resistivity sounding

The electrical properties of Golden Dyke Formation rocks intersected by BMR stratigraphic drilling were investigated by an IP/resistivity sounding at 100N on Traverse 11.

Interpretation of the sounding data is described in Appendix 2 and suggests that fresh rocks of the Golden Dyke Formation in this area might be relatively resistive but polarisable, and covered by up to 10 m of alluvium and weathered rocks. However, interpretation of the resistivity and chargeability of the fresh rocks is in this case not very reliable owing to the large resistivity contrast between fresh and weathered rocks, and possible lateral resistivity changes.

IP/resistivity profiling

Results of the IP/resistivity profiling surveys on Traverses 11 and 14 are shown in Plate 8. The IP/resistivity results in Area 2 have many similarities to the IP/resistivity results obtained in Area 1. Projection of logs from BMR stratigraphic drill-holes RJ41, RJ42, and RJ43 onto Traverse 11 indicates that a zone of relatively high IP effect and low resistivity can be correlated with pyritic carbonaceous black shales of the Golden Dyke Formation. As in Area 1 the Coomalie Dolomite is characterised by a higher resistivity and a low but uniform chargeability.

Traverse 11: The IP/resistivity results on Traverse 11 correlate very well with the geological section inferred from stratigraphic drilling. The frequency effect and resistivity results indicate a contact between Golden Dyke Formation and Coomalie Dolomite at about 100S. The change in frequency effect and resistivity at 450N clearly reflects the high resistivity/low frequency effect of the Waterhouse Complex adjacent to the Giants Reef Fault.

Note that drill-hole RJ41 located 100 m east of station 50S penetrated only 4 m of black shale before penetrating Coomalie Dolomite. As such a thin body of Golden Dyke Formation is unlikely to have caused the IP effects observed north of Station 0, it seems probable that the Golden Dyke Formation/Coomalie Dolomite contact dips to the north in this area.

Traverse 14: The IP/resistivity results from Traverse 14 suggest contacts with the Golden Dyke Formation at approximately 650N and 1300N. The contact at 650N is probably with the Coomalie Dolomite, and the contact at 1300N reflects the presence of Waterhouse Complex rocks adjacent to the Giants Reef Fault.

Interpretation of the Golden Dyke Formation/Coomalie Dolomite boundary in Area 2

There is evidence of a contrast between the electrical properties of Golden Dyke Formation and Coomalie Dolomite in Area 2. The IP/resistivity results on Traverses 11 and 14 indicate that the contact strikes roughly northeast between the traverses. South of Traverse 14 the distribution of minor outcrops of Coomalie Dolomite suggests that the Golden Dyke Formation is truncated by the Giants Reef Fault. The interpreted position of the Golden Dyke Formation/Coomalie Dolomite boundary is shown in Plate 7.

7. SURVEYS IN AREA 3

Area 3 is on the eastern side of the Waterhouse Complex where the boundary between Coomalie Dolomite and Golden Dyke Formation rocks is concealed by extensive alluvial cover. BMR stratigraphic drilling (Johnson & others, 1979) roughly outlines the contact in this area. To delineate the contact further several IP/resistivity traverses and IP/resistivity soundings were made as shown in Plate 9.

IP/resistivity soundings

IP/resistivity soundings were made at sites on Traverses 4, 5, and 13 to investigate the electrical properties of Golden Dyke Formation and Coomalie Dolomite rocks in this area. Interpretation of these soundings is described in Appendix 2.

<u>IP/resistivity soundings, Traverse 4</u>: A sounding was made at station 800E on what are believed to be rocks of the Coomalie Dolomite. The interpretation indicates a relatively high resistivity and a moderate chargeability (12 ms). The depth of weathering appears to be approximately 20 m.

<u>IP/resistivity soundings, Traverse 5</u>: Five soundings were made across the inferred Coomalie Dolomite/Golden Dyke Formation contact on Traverse 5. As indicated in Appendix 3, few of these soundings were amenable to reliable interpretation. However, the results do suggest that the chargeability of the Golden Dyke Formation rocks is higher than that of the Coomalie Dolomite. The depth of weathering along this traverse would appear to be less than 10 m.

<u>IP/resistivity soundings, Traverse 13</u>: The three soundings along Traverse 13 are complex and not amenable to simple interpretation. However, the soundings at 400W and 880W indicate higher chargeabilities and lower resistivities for the bedrock at this location than at 1500W, which is probably over Coomalie Dolomite. Weathering along Traverse 13 appears to be at least 20 m and possibly up to 50 m thick.

<u>Discussion</u>: The results of resistivity and IP soundings in Area 3 are difficult to interpret owing to large resistivity contrasts between surface rocks and bedrock. Also lateral variations in resistivity do not allow analyses based on one-dimensional models. Nonetheless, as was observed in Areas 1 and 2, the Golden Dyke Formation rocks appear to have a higher chargeability than the Coomalie Dolomite rocks. The results also suggest that the resistivity of Golden Dyke Formation rocks is higher in Area 3 than Area 1, and that depth of weathering in Area 3 increases to the south.

The different resistivity observed for the Golden Dyke Formation in Areas 1 and 3 is undoubtedly due to changes in the lithology of the formation and might be an important factor in interpreting the economic geology of the area.

IP/resistivity surveys, Traverses 16, 20, 9, 5, 4, 13

As shown in Plate 9, these six traverses form a grid of lines 1½ km to 3 km apart which straddle the expected north-south contact between the Coomalie Dolomite and Golden Dyke Formation in this area. The results of IP/resistivity profiling surveys along these traverses are shown in Plate 10, and a description of the survey parameters is contained in Appendix 3.

Traverse 16: The IP/resistivity results on Traverse 16 exhibit large changes in resistivity which may be related to changes in overburden resistivity and thickness rather than in bedrock resistivity. The different levels of chargeability recorded to the east and west of about 1050W might indicate a contact between Coomalie Dolomite and Golden Dyke Formation rocks.

Traverse 20: Results along this traverse are characterised by a fairly uniform chargeability and moderately high but variable resistivity. The data show no evidence of a contact between rocks having dissimilar electrical properties.

Traverse 9: The results of surveys on Traverse 9 show a general increase in resistivity to the east and a relatively uniform chargeability profile. The rise in chargeability between 1100E and 1400E may indicate the presence of Golden Dyke Formation rocks. A tentative interpretation of the data suggests a contact at 1100N.

Traverse 5: The IP/resistivity results along this traverse are relatively uniform, and the data show no evidence of a contact between rocks of the Coomalie Dolomite and the Golden Dyke Formation.

Traverse 4: The IP/resistivity results on Traverse 4 are broadly similar to those observed on Traverse 5. The lower resistivities observed on Traverse 4 compared with Traverse 5 probably reflect the increasing thickness of overburden to the south in this area. A very tentative indication of the position of the contact is provided by the change in amplitude of the chargeability results at approximately 750E.

Traverse 13: The resistivity profile along Traverse 13 is similar to that observed along Traverses 5 and 4. The sharp rise in chargeability between 400W and 700W probably indicates the presence of Golden Dyke Formation rocks east of about 700W. However, the contact may lie farther to the west.

Interpretation of the Golden Dyke Formation/Coomalie Dolomite boundary in Area 3

Although sounding data and laboratory measurements suggest a large chargeability and resistivity contrast between Coomalie Dolomite and Golden Dyke Formation rocks in Area 3, electrical profiling surveys do not provide sufficient information on the electrical properties of the bedrock to permit a reliable interpretation of the contact between the two rock units. A tentative interpretation of the position of the contact is shown in Plate 9.

8. SURVEYS IN AREA 4

Area 4 is at the southern end of the Waterhouse Complex, where outcrop is very sparse. In this area, shale and greywacke of the Burrell Creek Formation appear to directly overlie the Coomalie Dolomite. As for Areas 1, 2 and 3, rock property measurements (Appendix I) show the Coomalie Dolomite to have a very high resistivity and low chargeability. No information is available directly on the physical properties of the Burrell Creek Formation, but they would be expected to have a lower resistivity and higher chargeability than Coomalie Dolomite.

Two IP/resistivity traverses (12 and 18) were made across the Coomalie Dolomite/Burrell Creek Formation contact zone in this area. Traverse 12 lies along a drill traverse comprising BMR stratigraphic drill-holes RJ44, RJ45, RJ46, RJ47, and RJ48 (Johnson & others, 1979), and has a bearing of 133°, with station 00 located at 8540300mN/716000mE (AMG). Traverse 18 has a bearing of 221° with station 00 located at 8540700mN/711700mE (AMG).

IP/resistivity profiling

The results of IP/resistivity profiles over the Coomalie Dolomite/Burrell Creek Formation contact along Traverses 12 and 18 are shown in Plate 11. Details of the IP/resistivity profile surveys are described in Appendix 3.

The results from Traverse 12 show a large change in the character of the resistivity profile north of 1600S. BMR stratigraphic drill-hole RJ48 indicates that the resistive zone to the north is due to massive crystalline dolomite. The low-resistivity, relatively high chargeability zone south of 1600S could be indicative of the Burrell Creek Formation, but no geological control is available to confirm this interpretation.

On Traverse 18 the results show a wide zone of high resistivity south of 900S and a chargeability profile which increases fairly uniformly from 1700S to 800S. The zone of high resistivity is characteristic of a rock unit such as the Coomalie Dolomite. However, the data show no evidence of a contact between lower Proterozoic rocks having dissimilar electrical properties. The low-resistivity and low-chargeability zone north of 800S is related to a suboutcrop of upper Proterozoic Depot Creek Sandstone which unconformably overlies the Lower Proterozoic units in this area. The absence of a response indicative of Burrell Creek Formation rocks might indicate that the contact is south of 1800S or is displaced by a complex structure.

Discussion: The lack of geological control, the absence of sounding data, and inadequate information on the electrical properties of the Burrell Creek Formation preclude reliable interpretation of apparent resistivity and chargeability data in Area 4. However, there is evidence of a contact between Burrell Creek Formation and Coomalie Dolomite on Traverse 12, which is characterised by a distinct change in both resistivity and chargeability. No evidence of this contact was observed in the results from Traverse 18.

9. CONCLUSIONS

The results of physical property measurements on core samples, and the interpretation of induced polarisation/resistivity soundings, have established a substantial difference between the electrical properties of the Coomalie Dolomite and the Golden Dyke Formation in the Rum Jungle area of the Northern Territory.

The use of resistivity and induced polarisation profiling surveys to map the contact between Coomalie Dolomite and Golden Dyke Formation or Burrell Creek Formation rocks at four localities around the Rum Jungle and Waterhouse Complexes proved only partially successful. The principal problems with the IP/resistivity mapping were the influence of a variably conductive overburden, the intrinsic lack of resolution of resistivity methods, and the transitional nature of the contact zone. Nonetheless, the results show that, with adequate geological and geophysical controls, IP/resistivity methods can assist in the delineation of this contact and perhaps indicate subtle changes in the lithology of rock units from area to area.

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APPENDIX I

Rock physical property measurements

Lab. No.	Drillhole No.	Area	Depth m	Geological description	Susceptibility MKS x 10^{-6}	Resistivity ohm-m	Chargeability at 50 ms mV/V
75/61	RJ3	3	42.9	Calcareous siltstone (Golden Dyke)	2.5	1530.	30
75/62	RJ4	1	24.4	Calcareous black shale (Golden Dyke)	1.7	89	480
75/63	RJ5	1	52.4	Calcareous black shale with graphite and pyrite (Golden Dyke)	0.5	87	470
75/64	RJ6	1	26.5	Grey dolomitic marble (Coomalie Dolomite)		1970	90
75/65	RJ6	1	28	Coomalie Dolomite		2900	30
75/69	RJ14	4	35.1	Coomalie Dolomite		24000	10
75/78	RJ22	3	117.7	Crystalline carbonate (Coomalie Dolomite)		34000	10
75/79	RJ23	3	16.2	Massive amphibolite (Golden Dyke)	5.0	8100	20
75/80	RJ24	3	50.6	Coomalie Dolomite		7000	10
75/81	RJ25	3	28	Black calcareous pyritic shale (Golden Dyke)	1.7	110	200
75/82	RJ27	3	32.9	Calcareous amphibolite (Golden Dyke)	6.7	14000	25
75/83	RJ28	3	54.9	Black calcareous carbonaceous pyritic shale (Golden Dyke)	0.5	1500	25
75/84	RJ29	3	47.0	Pyritic calcareous black shale (Golden Dyke)	0.5	300	260
75/96	RJ40	2	10.1	White marble (Coomalie Dolomite)		24000	10
75/97	RJ40	2	17 7	Grey dolomite (Coomalie Dolomite)		19000	10
75/98	RJ41	2	15.5	Tremolitic dolomite (Coomalie Dolomite)		3600	30
75/99	RJ42	2	18.2	Coomalie Dolomite	0.7	10000	20
75/100	RJ42	2	12.2	Coomalie Dolomite	0.5	6400	25
75/102	RJ46	4	33.5	Coomalie Dolomite		28000	10
75/103	RJ48	4	9.5	Dolomitic marble (Coomalie Dolomite)		1900	10
75/104	RJ51	4	36.0	Calcareous amphibolite (Coomalie Dolomite)	6.7	600	20

APPENDIX II

Interpretation of IP/Resistivity Soundings

Area	Site (Geology)	Layer	Resistivity (ohm-m)	Depth (m)	M (ms)	Reliability of Interpretation	Remarks
1	TR1/400s	1	332	2	2.4	Fair	
	(Plo)	2	49	21	5.6		
		3	793		4.8		
	TR2/760S	1	352	5.6	8.2	Fair	
	(Pld)	2	92	13.8	10.3		
		3	194		15.5		
2	TR11/100N	1	9.7	1.3	0.2	Poor	Bottom layer
	(Pld?)	2	0.7	2.6	0.7		poorly defined.
		3	24	4.2	16.9		
		4	6376		31.7		
3	TR4/800E	1	7570	0.3	(-5.8)	Fair	Chargeability of
	(Plo)	2	26	23	3.4		top layer is an
		3	624		11.7		unimportant para-
							meter.
	TR5/600E	1	550	3.6	6.6	Poor	Bottom layer
	(Plo?)	2	47	27	4.3		poorly defined.
		3	9393		45		
	TR5/700E	1	1079	0.4	(-16.4)	Fair	Chargeability of
	(Plo?)	2	107	3.7	6.3		top layer is an
		3	883		4.1		unimportant para-
							meter.
	TR5/850E	1	165	2.1	4.4	Poor	Bottom layer
	(contact?)	2	4.6	5.3	5.5		poorly defined.
		3	14500		25.1		
	TR5/900E	1	412	1.7	6.1	Fair	
	(Pld?)	2	4.7	4.5	5.5		
		3	2386		19.7		

APPENDIX II

Interpretation of IP/Resistivity Soundings

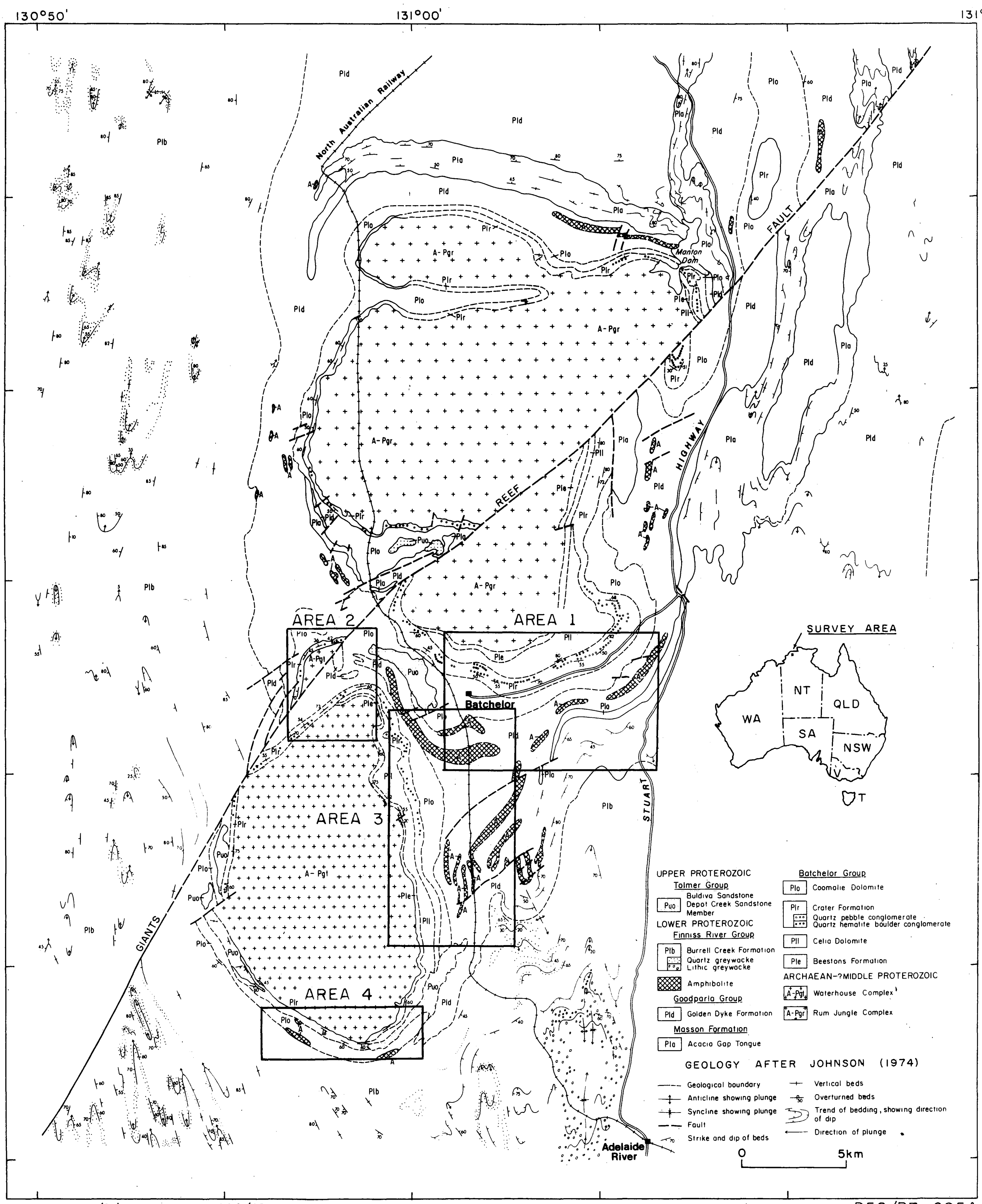
Area	Site (Geology)	Layer	Resistivity (ohm-m)	Depth (m)	M (ms)	Reliability of Interpretation	Remarks
	TR5/1100E	1	459	1.7	6.0	Poor	Bottom layer
	(Pld?)	2	12	6.4	4.5		poorly defined.
		3	79120		330		
	TR13/400W	1	2314	2.6	39.2	Poor	Bottom layer
	(Pld)	2	60	51	9.4		poorly defined.
		3	624	112	4.7		
		4	21.6		134		
	TR13/880W	1	2642	8	19.5	Poor	Bottom layer
	(Pld)	2	43	19	14.0		poorly defined.
		3	673	41	2.8		
		4	31		55.8		
	TR13/1500W	1	3097	2.2	20	Poor	Bottom layer
	(Plo)	2	555	17	9.8		poorly defined.
		3	365	32	13.0		
		4	169		11.6		

APPENDIX III

Description of Profiling Arrays

Area	Traverse	Array	Current spacing (m)	Potential spacing (m)
1	1	Various	see Plate 4	
	2	Gradient	1500	40
	3	"	1500	40
	7	"	1000	40
	8	"	1200	40
	17 (1)	"	1000	40
	17 (2)	"	1000	40
	10	"	1500	40
	19	"	1500	40
	21	"	1500	40
	22	"	1000	40
	23	"	1000	40
2	14 (1)	"	1200	40
	14 (2)	"	1200	40
	11	Schlumberger	200	20
3	16	Gradient	1800	60
	20	"	1500	40
	9	"	2000	40
	5	"	1500	40
	4	"	1300	40
	13	Schlumberger	400	10
4	12	Gradient	1500	40
	18	"	1500	40

92



Based on D52/A/145 Record 1980/48

D52/B7-695A

Plate I Location of 1974 Electrical Geophysical Surveys, Rum Jungle area

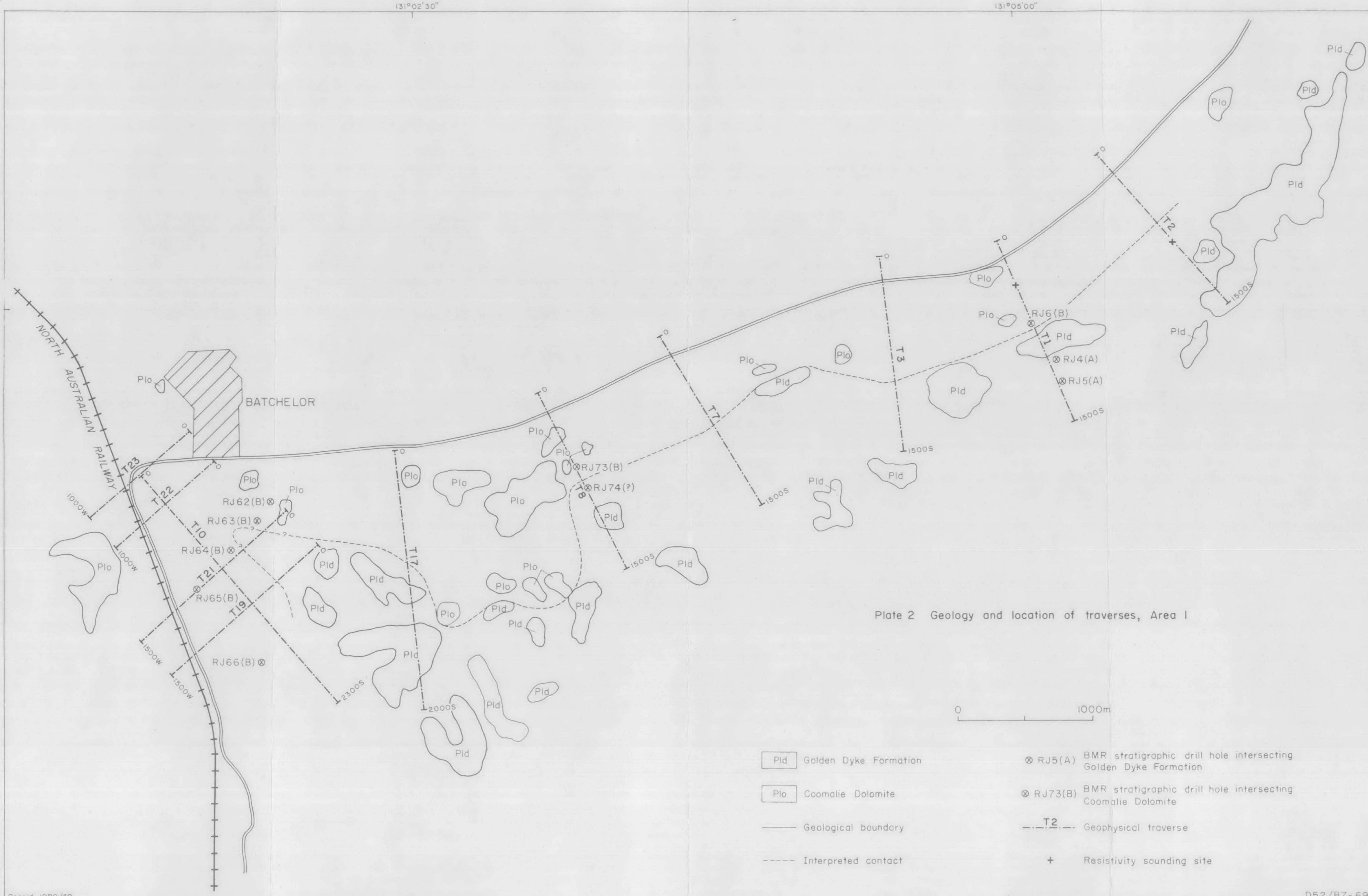
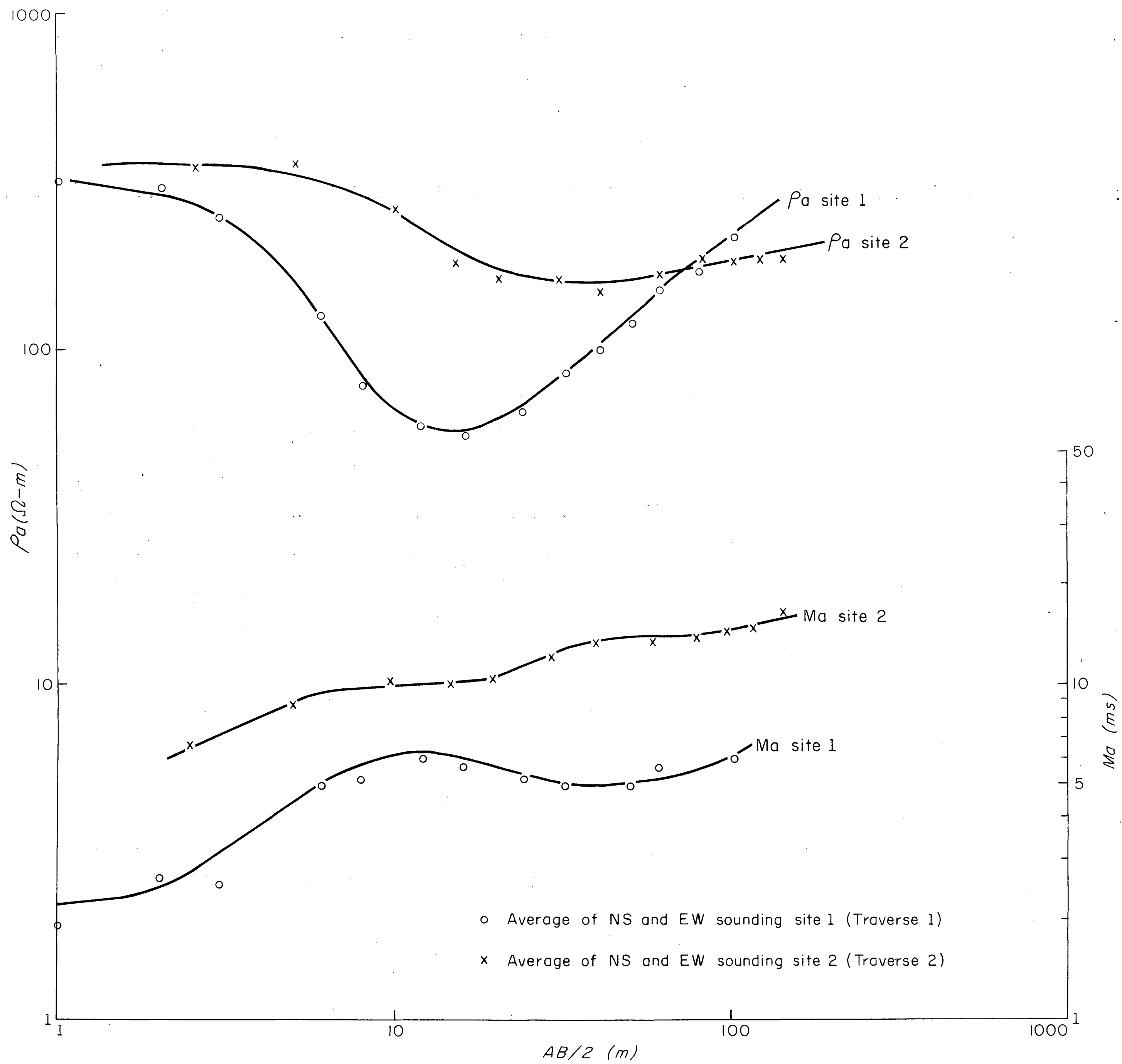


Plate 2 Geology and location of traverses, Area 1

Record 1980/48

D52/B7-696



Record 1980/48

D52/B7-697A

Plate 3 Resistivity soundings, Area 1

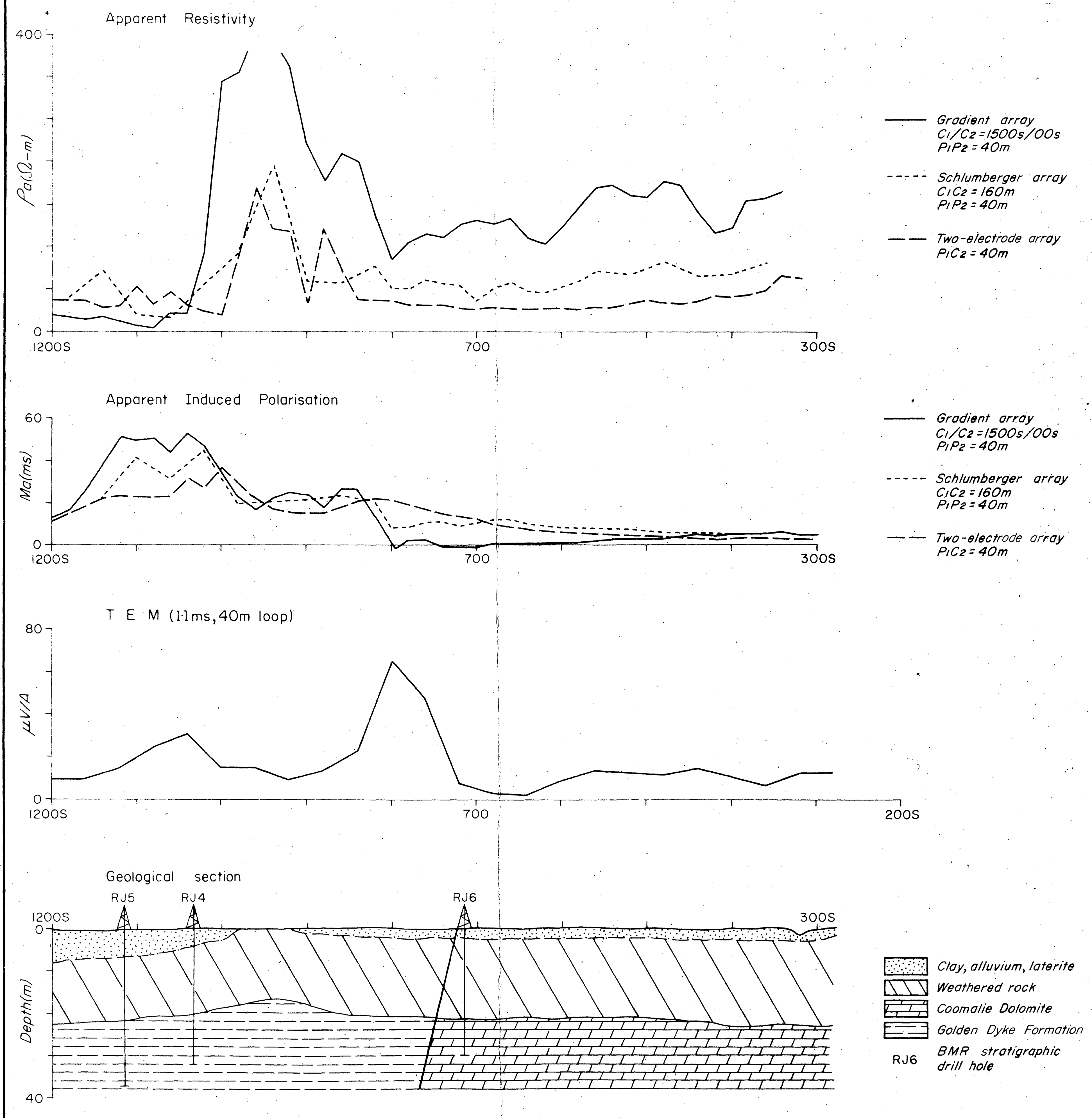


Plate 4 Comparison of IP/Resistivity and TEM results Traverse I Area I

Record 1980/48

D52/B7-698

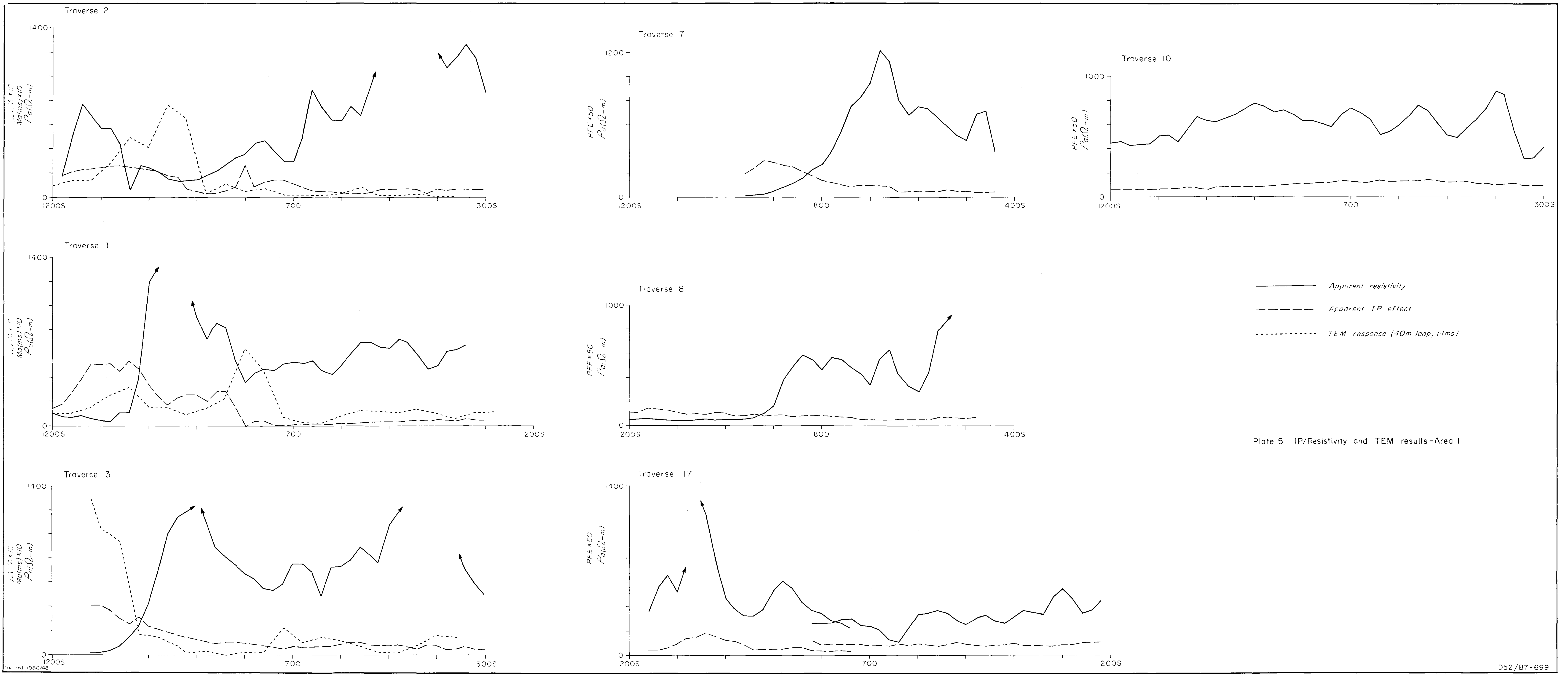


Plate 5 IP/Resistivity and TEM results-Area I

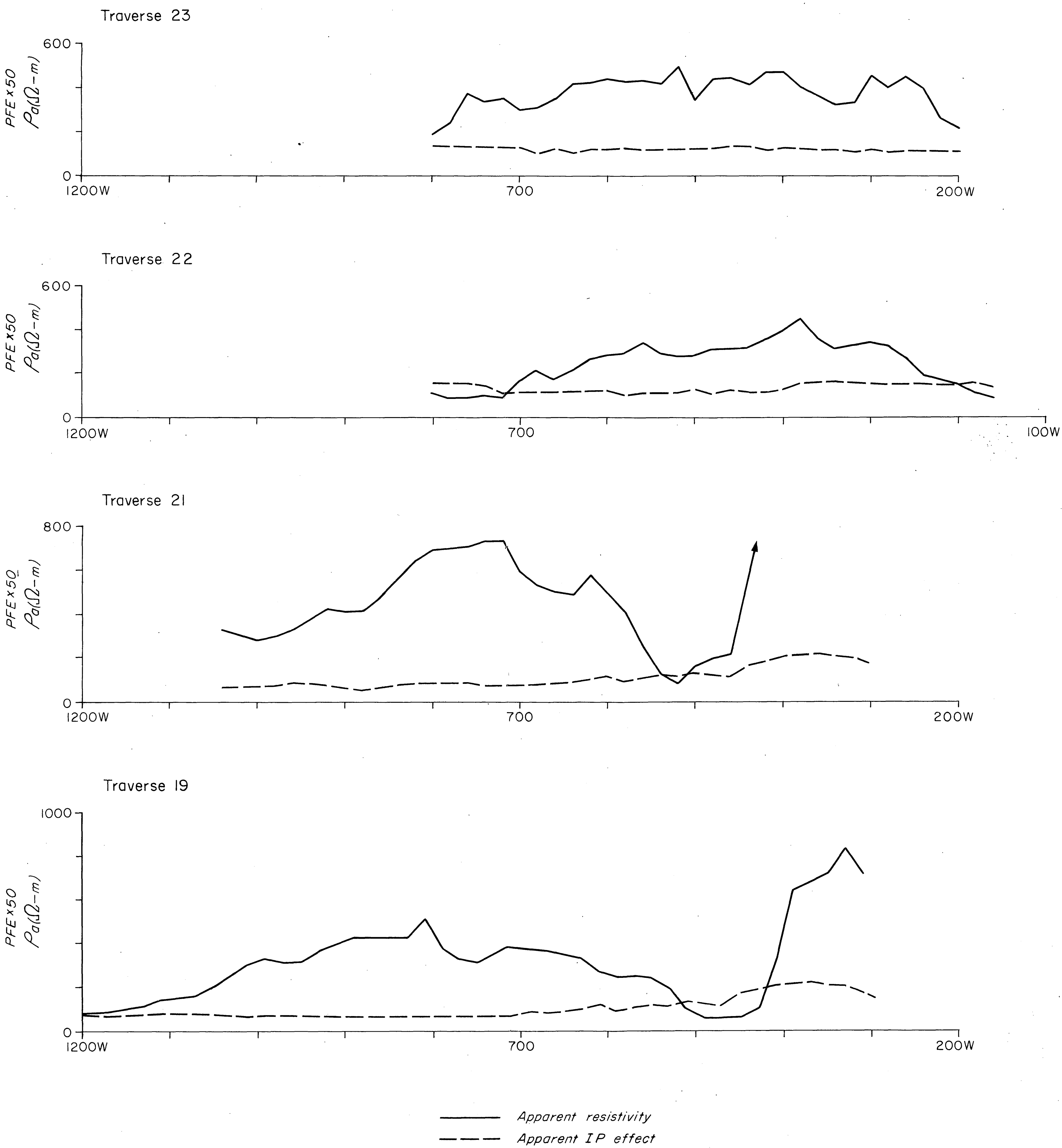
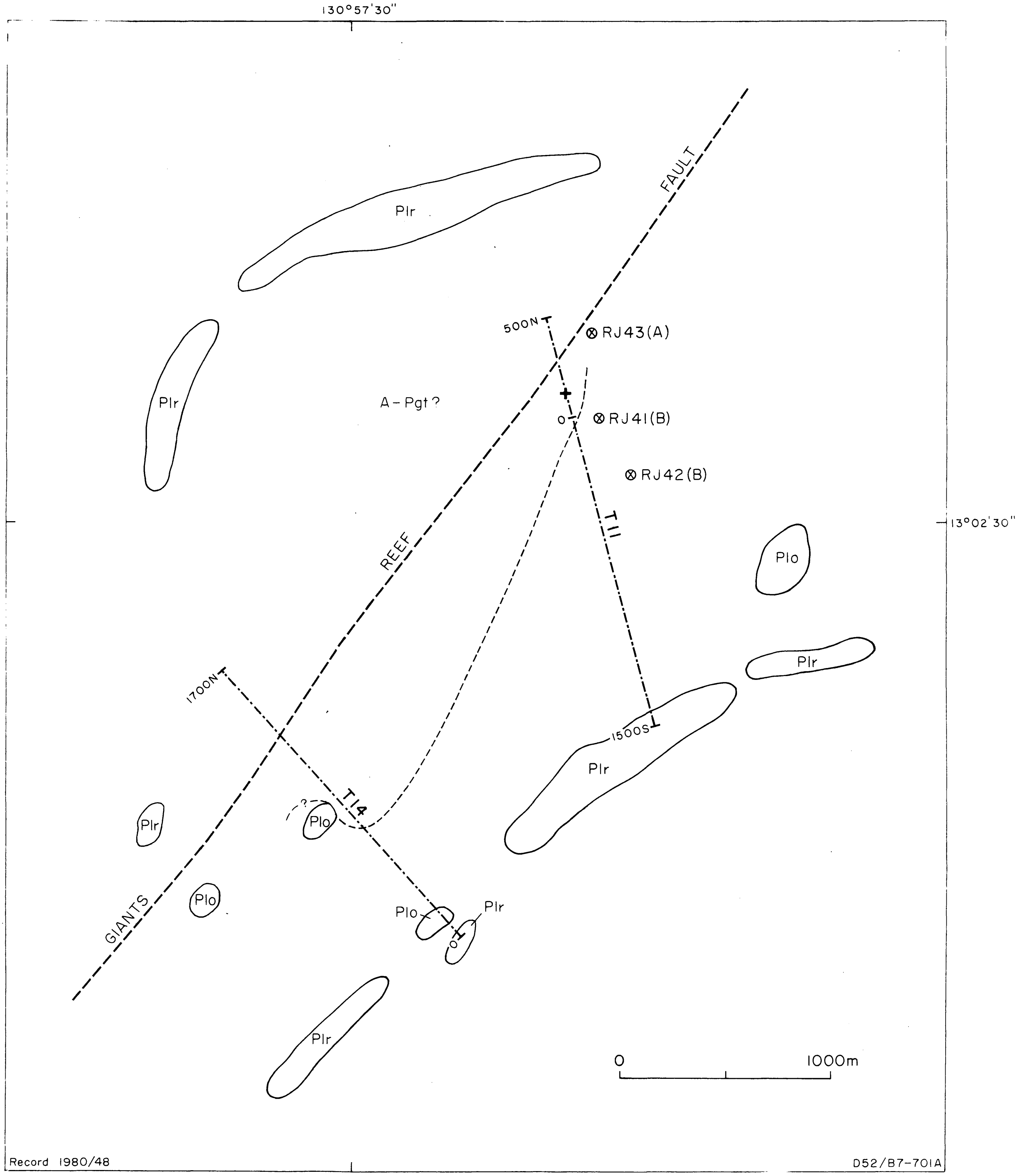


Plate 6 IP/Resistivity results, Area 1

Record 1980/48

D52/B7-700



Plo	Coomalie Dolomite	⊗ RJ43(A)	BMR stratigraphic drill hole intersecting Golden Dyke Formation
Plr	Crater Formation	⊗ RJ41(B)	BMR stratigraphic drill hole intersecting Coomalie Dolomite
——	Geological boundary	_._T14_._	Geophysical traverse
-----	Interpreted contact	+	Resistivity sounding site

Plate 7 Geology and location of traverses — Area 2

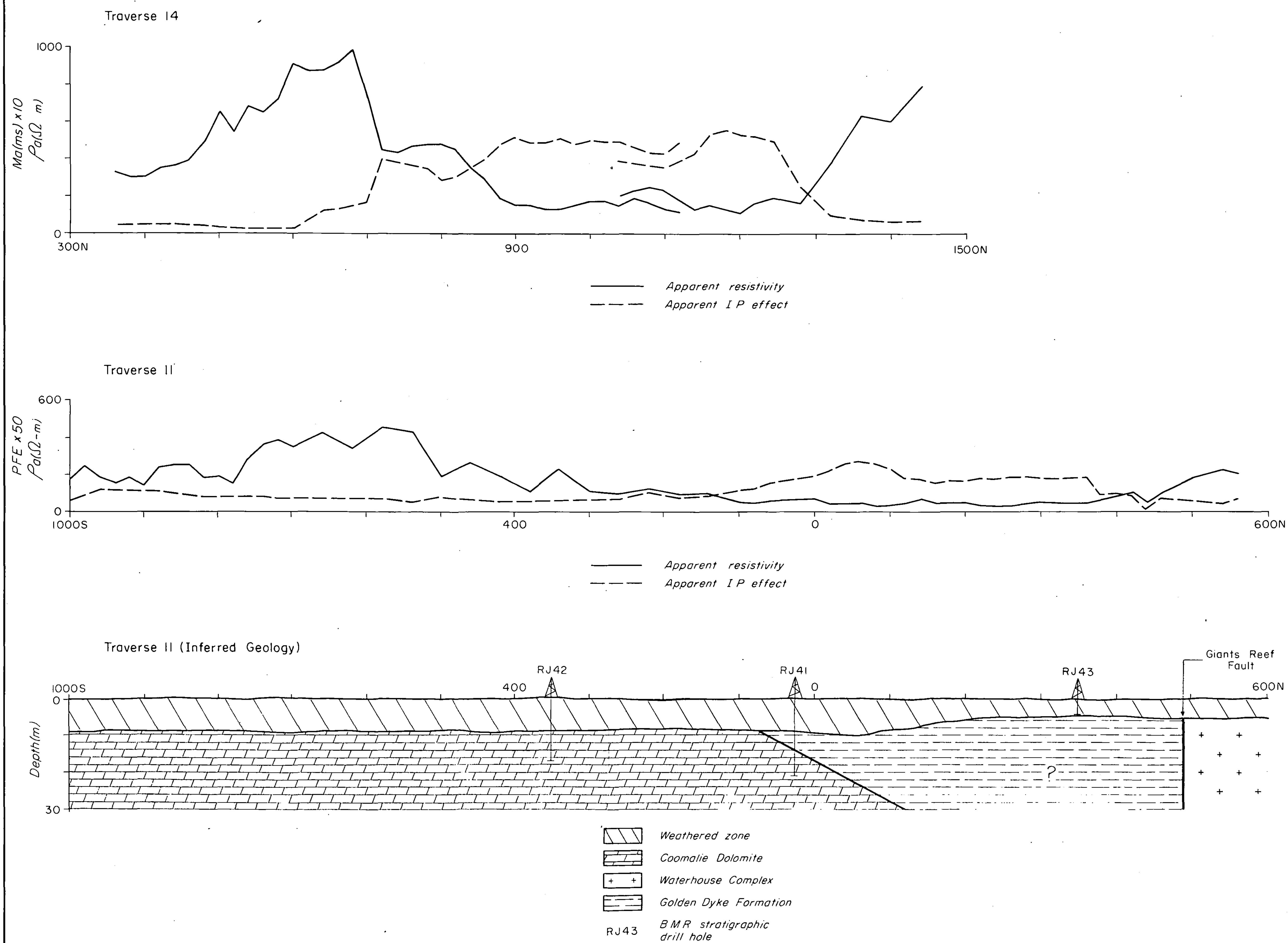
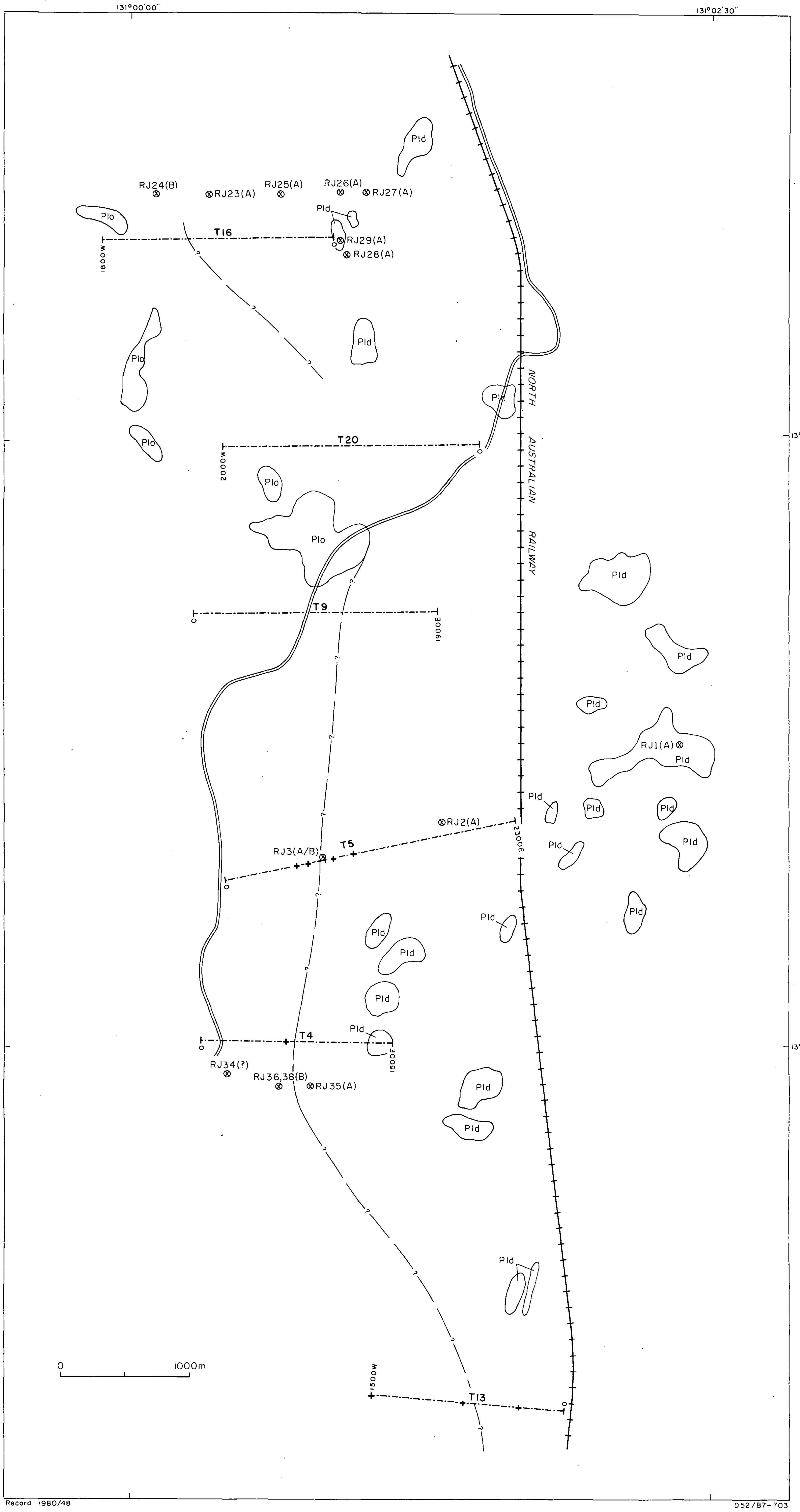


Plate 8 IP/Resistivity results, Area 2

Record 1980/48

D52/B7-702



Record 1980/48

D52/B7-703

Plo	Coomalie Dolomite
Pld	Golden Dyke Formation
——	Geological boundary
-----	Interpreted contact
⊗ RJ35(A)	BMR stratigraphic drill hole intersecting Golden Dyke Formation
⊗ RJ24(B)	BMR stratigraphic drill hole intersecting Coomalie Dolomite
T5	Geophysical traverse
+	Resistivity sounding site

Plate 9 Geology and location of traverses – Area 3

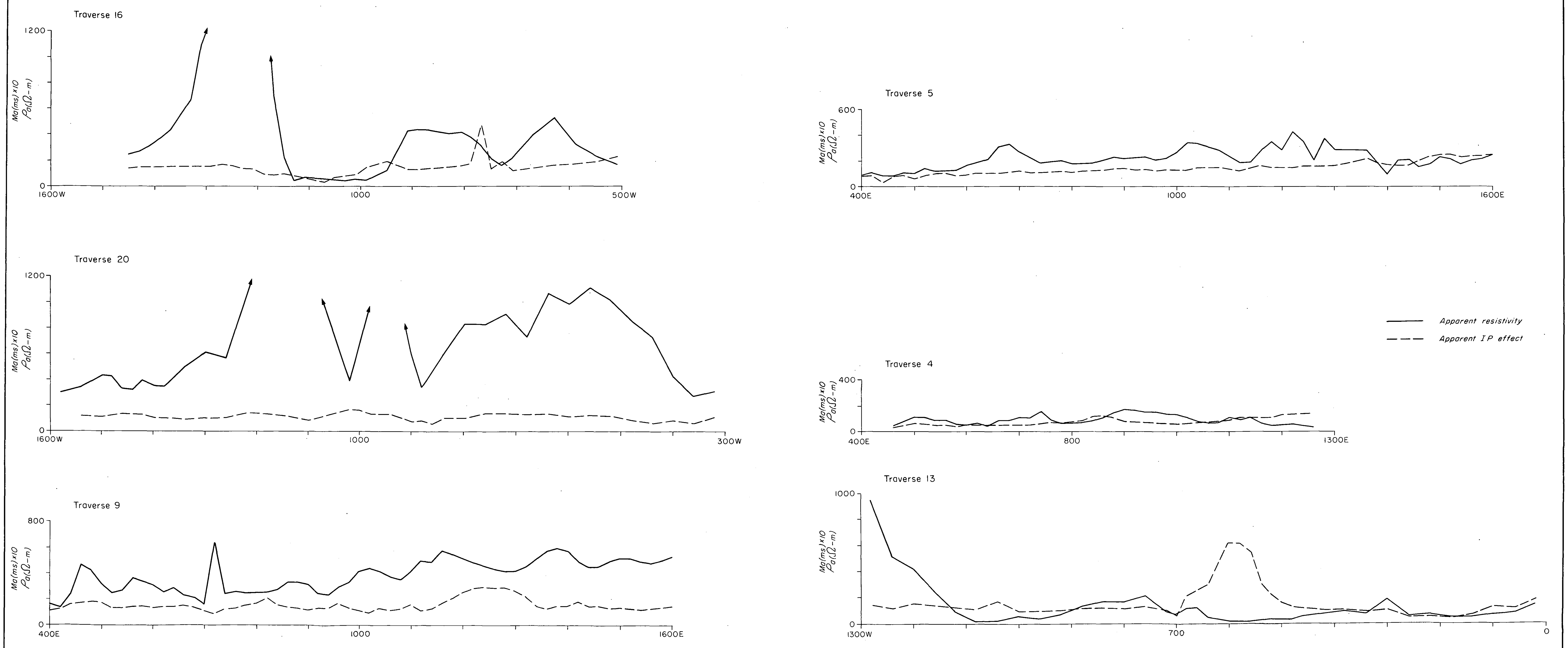


Plate 10 IP/Resistivity results, Area 3

Record 1980/48

D52/B7-704

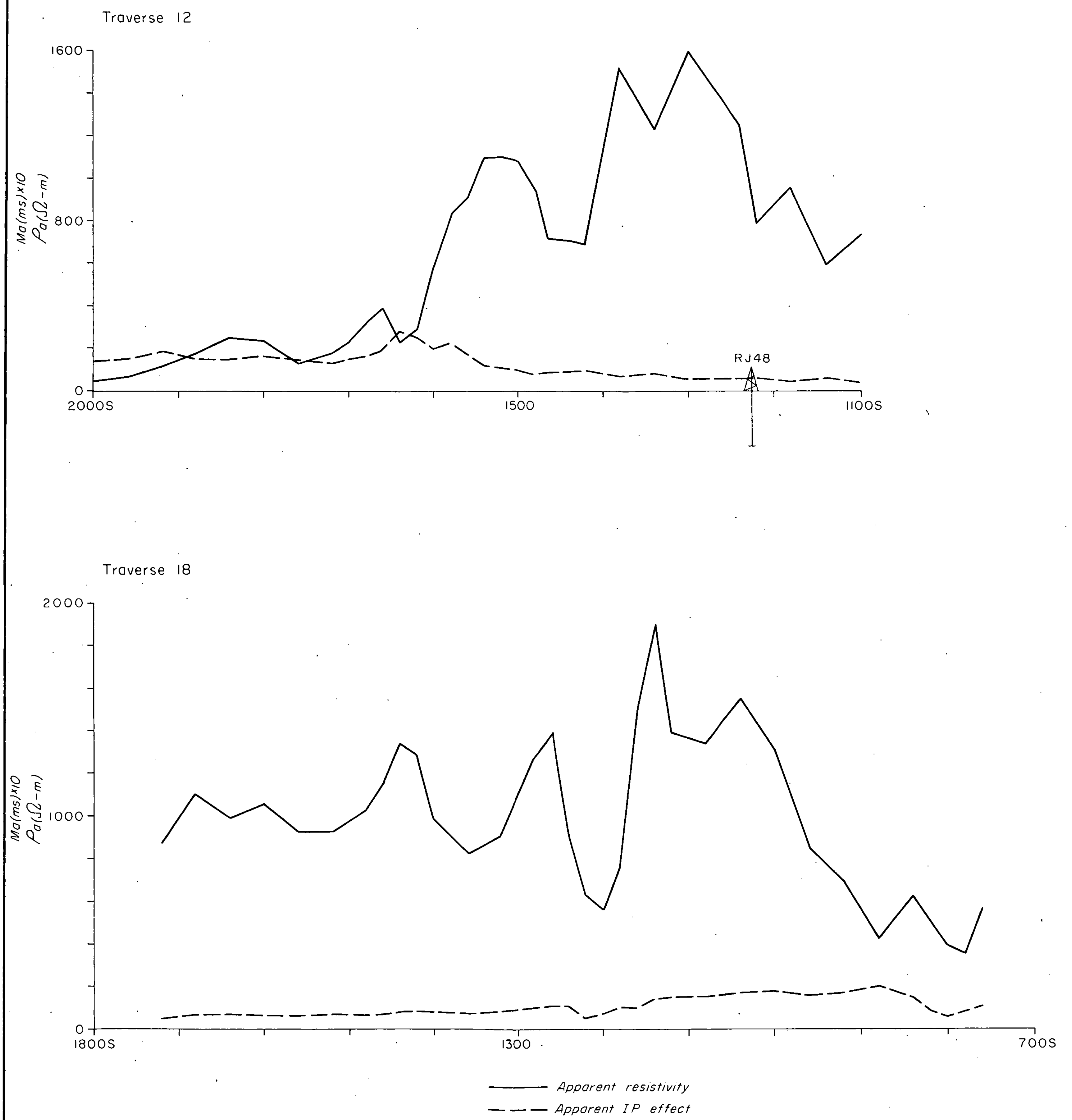


Plate 11 IP/Resistivity results, Area 4