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1. INTRODUCTION

During the period 6.6.83 to 10.6.83 resistivity surveys were conducted at Neutral Junction and Pine Hill Stations by staff of the Water Division, Northern Territory Department of Transport and Works.

In this time 8 line-kilometres of two electrode resistivity profiling, 2 line-kilometres of pole-dipole resistivity profiling and 3 vertical electrical soundings (VES) were completed by a crew of 1 geophysicist and 3 field assistants.

This work was done to assist the Division's Hydrogeology Section in the siting of water bores as part of its rural advisory service.
2. GEOLOGY OF THE AREA

2.1 Neutral Junction

The survey area lies on the western side of the Stuart Highway approximately 15 km S.W. of the Crawford Range and is covered by the Barrow Creek 1:250 000 geological series map. In this area archean gneisses and schists have been intruded by proterozoic granites. Associated with the intrusions shear zones have developed and been infilled with pegmatite.

2.2 Pine Hill

This area is covered by the Reynolds Range 1:100 000 map. 3 to 4 kilometres north of the station homestead, at the base of the southern margin of the Anmatjira Range, proterozoic gneisses and schists have been faulted against felsic granulite. The faulting has been regional in extent but in the area of interest its exact position is unknown.
3. SURVEY OBJECTIVES

3.1 Neutral Junction

The resistivity survey was designed to firstly investigate the subsurface electrical conditions near to, and to the south of bore RN 13629. This hole had been sited to intersect a suspected shear zone but had yielded only a small (0.1 L/s) supply of very good quality water. On the basis of resistivity measurements it was hoped to either more accurately position a new bore within the fracture zone, or site another along strike in an area of more favourable recharge.

The problem, in geoelectrical terms, translates into searching for a probably conductive anomaly that could be caused by a subvertically dipping body extensive in both strike direction and depth.

3.2 Pine Hill

The aim of the resistivity survey was to accurately locate the regional fault which might act as a collector of run off from the Anmatjira Range. Further it was hoped that some areas (crush zones) more favourable to the entrapment of groundwater might be detected.

A simple fault between differing rock types would be expected to manifest itself as two blocks of differing resistivity while a crush zone would presumably add a conductive anomaly to this picture.
4. INSTRUMENTATION

The resistivity instrumentation used is fully documented in Geophysical Report 82/1. Briefly, it consisted of a 300 W DC/DC converter employed as a transmitter while a high impedance digital voltmeter was used as a receiver.
5. FIELD TECHNIQUES

5.1 Neutral Junction

5.1.1 Surveying:

Both traverses were marked out using tape and compass. Traverse 1 was situated to begin near RN 13629 as shown in figure 1 and was orientated north-south. Traverse 2 was placed 2.5 km to the east also north-south and was intended to coincide with the supposed location of the vein near its midpoint.

5.1.2 Profiling:

The pole-dipole array was used on both traverses and the two electrode array on traverse 1 only. Details of array geometries, plotting point and profiling direction are given in figure 1. On all traverses the remote electrodes were emplaced 1000 m from the beginning, roughly at right angles to traverse direction. For the two electrode profiling, where 2 remote electrodes were needed, their mutual separation was 2000 m.

The array geometries used were chosen to enable subsurface investigation to be as deep as possible while retaining both lateral resolution and good received signal strength. No VES were felt necessary initially since observation in the area revealed that the surface cover was very thin.

5.1.3 Sounding:

One schlumberger VES was carried out on traverse 2 in the position indicated in figure 1. The half current separation (AB/2) was expanded to 215 m while the half-potential electrode separation (MN/2) was moved from 3 m to 10 m with one intermediate step. AB/MN was kept > 5. The frequency of sampling was 6 points/decade.

5.2 Pine Hill

5.2.1 Surveying:

All three traverses were marked out using tape and compass and all were orientated north-south. Traverse 3 is approximately 3.5 km north of the Pine Hill Homestead and .5 km west. Traverse 1 is 1.5 km west along the fault line and traverse 2 is in turn a further .5 km west from there.

5.2.2 Sounding:

VES PH-1 and RH-2 were done at the origin of each of traverses 1 and 2 as a check on subsurface resistivities and as a guide to array geometries. Observation frequency was 6 points/decade.
5.2.3 Profiling:

The two electrode array was used throughout the survey. Details of interelectrode distances, plotting point and profiling direction are given in figure 6. The remote electrodes were emplaced 1000 m at right angles to the traverse direction, with the mutual separation being 2000 m.
6. RESULTS

6.1 Neutral Junction

6.1.1 Profiling:

The results of the resistivity profiling are shown in figure 1. With reference to traverse 1, the most obvious feature is a general increase in apparent resistivity with increasing station number. The feature most pertinent to this investigation is the low at station 300. A possible interpretation is a conductive dyke-like body positioned as shown in figure 2(a). The theoretical curves for this and all succeeding models have been computed on the basis of infinite extent in both strike and depth. The correspondence between observed and theoretical data would be closer if the background trend was removed from the observed data.

A conductive body of similar dimensions and position may also be inferred from the two electrode results (figure 2(b)) but with less confidence because of the low amplitude of the anomaly and the strong background trend.

The need for caution in interpreting these results is underlined by figure 2(c). Here, the pole-dipole data from traverse 2 is well matched to the anomaly due to a resistive body yet the anomalies of traverse 1 and 2 are not very different.

6.1.2 Sounding:

The VES presented in figure 3 was done primarily as a check on the values chosen for the array dimensions. For the completeness the interpretation shown is offered with this note. The sharply rising terminal branch exceeds the maximum theoretical gradient and is probably caused by the relatively shallow basements being other than flat lying.

6.2 Pine Hill

6.2.1 Sounding:

The results of the two VES are given in figures 4 and 5. Because of the lack of generally available interpretation procedures for this array, the models given have been arrived at by a trial and error computer based curve matching procedure. The fits obtained are not good but serve to indicate the generally thin surficial cover. Although relatively small a spacings (≈ 10 m) could be used to reflect bedrock resistivities, much larger dimensions (50 m & 100 m) were chosen in the hope that any indications might lead to deeper more reliable supplies.
6.2.2 Profiling:

The most immediately obvious feature of all the profiles is the generally increasing measured resistivity observed as the foot of the Amatjira Range is approached; i.e. with increasing station number.

The position of the fault on traverses 1 and 2 has been marked beneath those profiles in figure 6. These have been deduced after comparison with theoretical curves. The fault zone beneath traverse 2 seems to have more width than that of traverse 1.

No fault position has been given for traverse 3. Here there is very little resistivity contrast over the length of the line. This is probably due to the materials separated by the fault being very similar; i.e. gneiss and granulite compared to schist and granulite on traverses 1 and 2.
a. Detail from Traverse 1 (Pole-dipole)

b. Detail from Traverse 1 (Two electrode $a = 150 \text{m}$)

c. Detail from Traverse 2 (Pole-dipole)
SCHLUMBERGER ELECTRICAL SONDING

AREA: CENTRAL JUNCTION

DESIGNATION: MJ-1

FIELD DATA... O X

MODEL CURVE...

INTERPRETATION

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FIG. 4

THREE ELECTRODE ELECTRICAL Sounding

AREA: FINE HILL STATION

DESIGNATION: FH-1

FIELD DATA... O

MODEL CURVE... ---

INTERPRETATION

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4-SPACING (METRES) →

1000 = \( \frac{AB}{2} \)
2-electrode Electrical Sounding

Area: High Hill Station

Designation: PH-2

Field Data... 0

Model Curve...

Interpretation

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![Diagram with measurement details](image_url)