COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1968 / 89

Mount Hardy Geophysical Survey,

Northern Territory 1967

by

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SUMMARY

In October and November 1967, a detailed geophysical survey, using self-potential and Turam methods, was carried out over mining lease 367H in the Mount Hardy area of the Northern Territory to try to trace copper ore zones beneath the scree cover.

The self-potential work is considered to be invalid, because of contact difficulties. The Turam work gave only minor anomalies and it is probable that these are related to shear zones and not to mineralisation, which is mostly secondary carbonates. No further investigations of the area are proposed.

1. INTRODUCTION

The Yuendumu Native Settlement, about 180 miles north-west of Alice Springs, houses about 900 natives. About 20 miles west of Yuendumu, near Mount Hardy, mining lease 367H was pegged to provide work for some of the native population. The area contains low-grade secondary copper mineralisation, and a proposal to provide a leaching plant at Yuendumu to treat this and low-grade ores from other areas is under consideration.

The Mines Branch, Northern Territory Administration, undertook a programme of diamond-drilling to investigate the ore reserves at depth within the lease. Only sparse copper mineralisation was located, and the Bureau of Mineral Resources was requested to carry out a geophysical survey to attempt to trace ore zones beneath the scree cover.

The survey was carried out in October and November 1967, over a grid laid down by the Resident Geological Section, Alice Springs. The geophysical party consisted of one geophysicist, one geophysical assistant, and one field-hand. Labourers for digging and watering self-potential stations were supplied by the Yuendumu Native Settlement.

2. GEOLOGY

Reference should be made to Grainger (in preparation) for a detailed geological description of the area.

Briefly, the rocks in the general area form part of the Arunta Complex, which consists of gneisses and schists of various compositions intruded by the Mount Doreen and Yuendumu granites. In the survey area, the rock type is confined to a spotted gneiss with bands of chloritic schist intruded by two generations of quartz and pegmatite veins. The foliation dips steeply (60° to 80°) to the NNW except at the eastern end of the area where the dip is near-vertical and the strike is due east. This has been interpreted as indicating a north-plunging anticlinal structure.

The younger series of quartz and pegmatite veins are barren and non-conformable with the foliation. The older veins tend to be conformable and contain patchy mineralisation of copper carbonates, with minor residual chalcopyrite and pyrite at depth. Surface enrichment appears to have taken place, probably owing to ground water circulation. No secondary enrichment zone has been located although chalcocite is present throughout the oxidised zone.

Diamond-drilling carried out by the Mines Branch has shown that the grade of mineralisation decreases with depth. To date about 750 tons of handpicked ore has been mined and stockpiled. The present estimated ore reserves are 12,000 tons of 3 to 4% copper (Grainger, in preparation).

3. GEOPHYSICAL METHODS AND RESULTS

The geophysical programme was designed principally to delineate shear zones within the area. Because the major mineralisation consists of secondary copper carbonates, it was not expected to detect the ore zones directly. However, it was hoped that the self-potential method would detect the residual pyrite and chalcopyrite known to exist in minor amounts at depth.

A grid of 17 traverses 100 ft apart was pegged at 25-ft intervals, with the origin of the grid at the datum peg of the lease (Plate 1).

Turam method

The Turam electromagnetic method has been adequately described by many authors (e.g. Parasnis, 1966) and a detailed description will not be given here. Readings were taken at 25-ft intervals along all traverses using ABEM 2S equipment, with a coil spacing of 100 ft, and frequencies of 220 and 660 c/s. A vertical primary field was supplied by a 4000 ft by 2000 ft horizontal loop laid out to the south-east, with the ends equidistant from the area and the front edge of the loop 200 ft from the baseline.

The mineralisation in this area consists of secondary copper carbonates which have a similar conductivity to that of the host rock. It was not expected that the mineralisation would be directly detected by the Turam method, but it was hoped that the mineralisation would be associated with shear zones which would be detected.

The anomalies were all very small, variations being most prominent in the profiles of phase angle (and to a lesser extent in the ratio profiles) at 660 c/s. Selected Turam profiles are shown in Plate 3.

Self-potential method

Self-potential (S-P) readings were taken at 25-ft intervals along all traverses. The base pot was kept at the same point on the grid for all readings, a cable along the baseline providing the necessary link to each traverse.

Considerable difficulty was experienced in obtaining a sufficiently low contact resistance, and several methods of watering the holes were tried without real success. Readings could almost always be obtained, but often the repeatability was poor. The most reliable method consisted of putting one gallon of water in each hole on two consecutive days (in the late afternoon) and on the third day about a third of a pint of water per hole one to two hours before taking a reading. This method still gave erratic readings but seemed the best obtainable. The large quantity of water required had to be carted from Yuendumu. At the end of the experiments on watering, heavy rain fell over a period of several days, and the whole area was read with S-P in the two days following. The profiles are relatively smooth, and repeatability was good except for erratic readings over bare rock outcrop. However, the validity of the results is suspect; the heavy rain provided a thin conducting sheet over the ground surface, which gave a good path between the two pots, but provided no contact with the potential distribution at depth. It is suggested that it is pointless attempting self-potential work in this type of area, except after a prolonged wet season.

Discussion of results

Selected profiles of self-potential and Turam results are shown in Plate 3. No attempt has been made to interpret the S-P results for reasons given above.

No anomalies worthy of further investigation were detected by the Turam method. There are seven main anomalous zones within the area (see Plate 2). These are labelled A to G for discussion purposes. All anomalies appear to be due to current concentrations at a depth of about 100 ft. Zones B, C, and D are due to southerly-dipping current sheets, and zones A, E, F, and G are due to vertical or north-dipping sheets. Anomalies E and F are only the southern-most tips of anomalies, which were not traced to their maximum values because they extend off the lease. They would perhaps warrant further attention if the lease is ever extended northward. Anomaly B correlates well with a south-dipping shear zone postulated by Grainger (in preparation) and intersected in DDH3 and DDH6. The shear zone was not associated with mineralisation.

It must be emphasised that the anomalies are all extremely weak, and are not considered worthy of further investigation. However, if the plain surrounding the mine is to be drilled on a wildcat basis, then anomalies A, C, and G could be investigated by drill holes as indicated:

Drill hole	Target	Collar position	Depression	Bearing	Length
DDH8	50E/180N	50E/220N	70°	South	150 ft
DDH9	600E/570N	600E/530N	70°	North	150 ft
DDH10	1500E/320N	1500E/360N	70°	South	150 ft

Target depth in all cases 100 ft

An important point is indicated by the Turam results in this area. The Turam loop was laid out to the south, because it was anticipated that the shear zones would be dipping north. However, it is obvious from the results that some conductors dip to the south, i.e. towards the cable. There is always the danger that these bodies could in fact be near the critical angle, at which point the anomaly will disappear (no Turam anomaly is produced by a conductor which is tangential to the Turam field). Thus the weak 'reverse' anomalies could in fact be due to relatively strong conductors dipping almost tangentially to the Turam field. The simplest method of checking this is to energise a loop on the opposite side of the area. However, owing to inclement weather, there was not sufficient time in the geophysical programme for the new loop to be laid in and read. It is proposed that this should become standard practice in all Turam surveys in the future.

4. CONCLUSION

The self-potential method is not suited to this area except after a prolonged wet season. The Turam method succeeded in delineating several conductors but the anomalies are so weak that no further investigation is recommended.

5. REFERENCES

GRAINGER, D.		The geology of the Mount Hardy district. Bur. Min. Resour. Aust. Rec. (in preparation).
PARASNIS, D.S.	1966	Methods in geochemistry and geophysics. In MINING GEOPHYSICS. Amsterdam, Elsevier.

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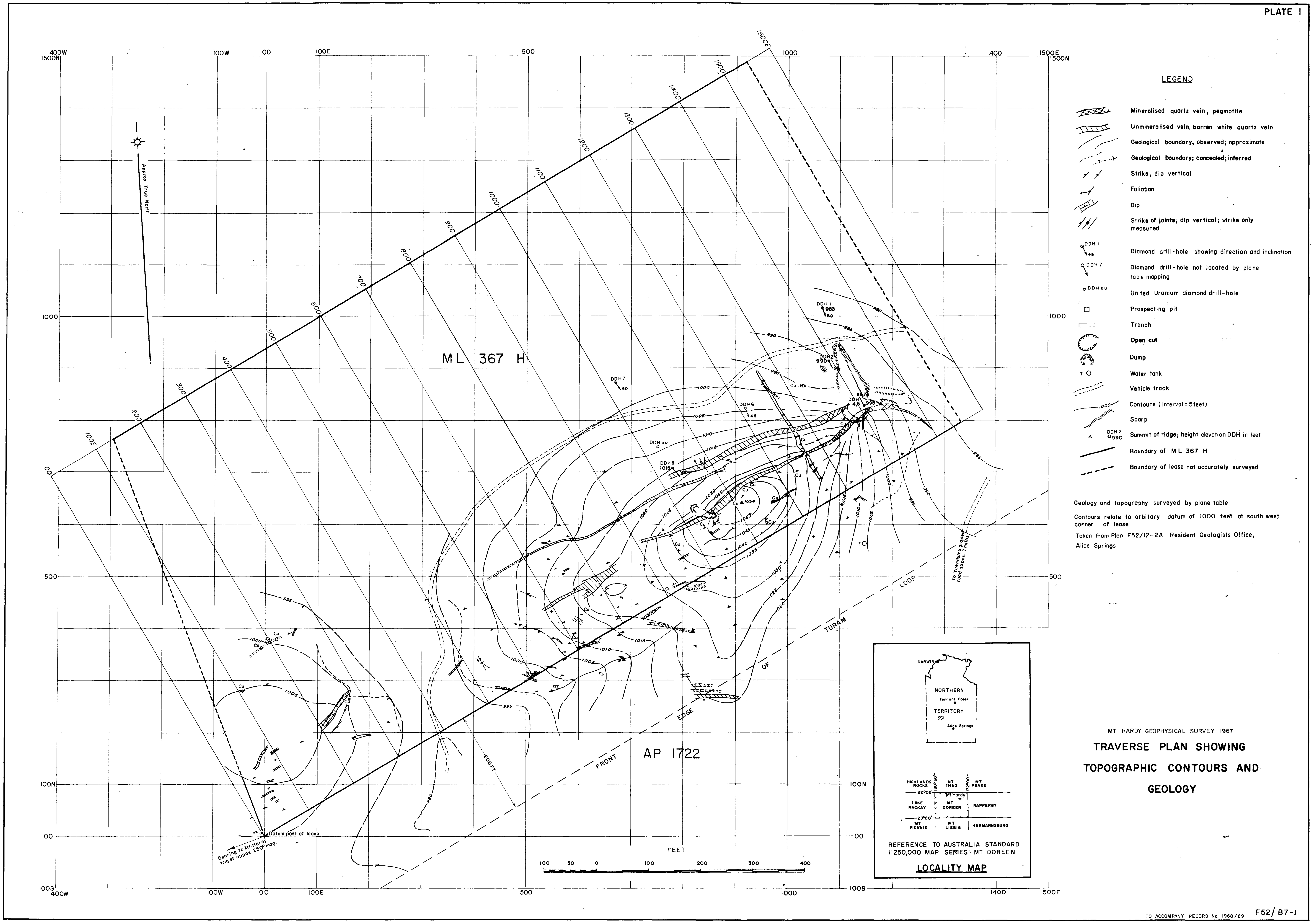
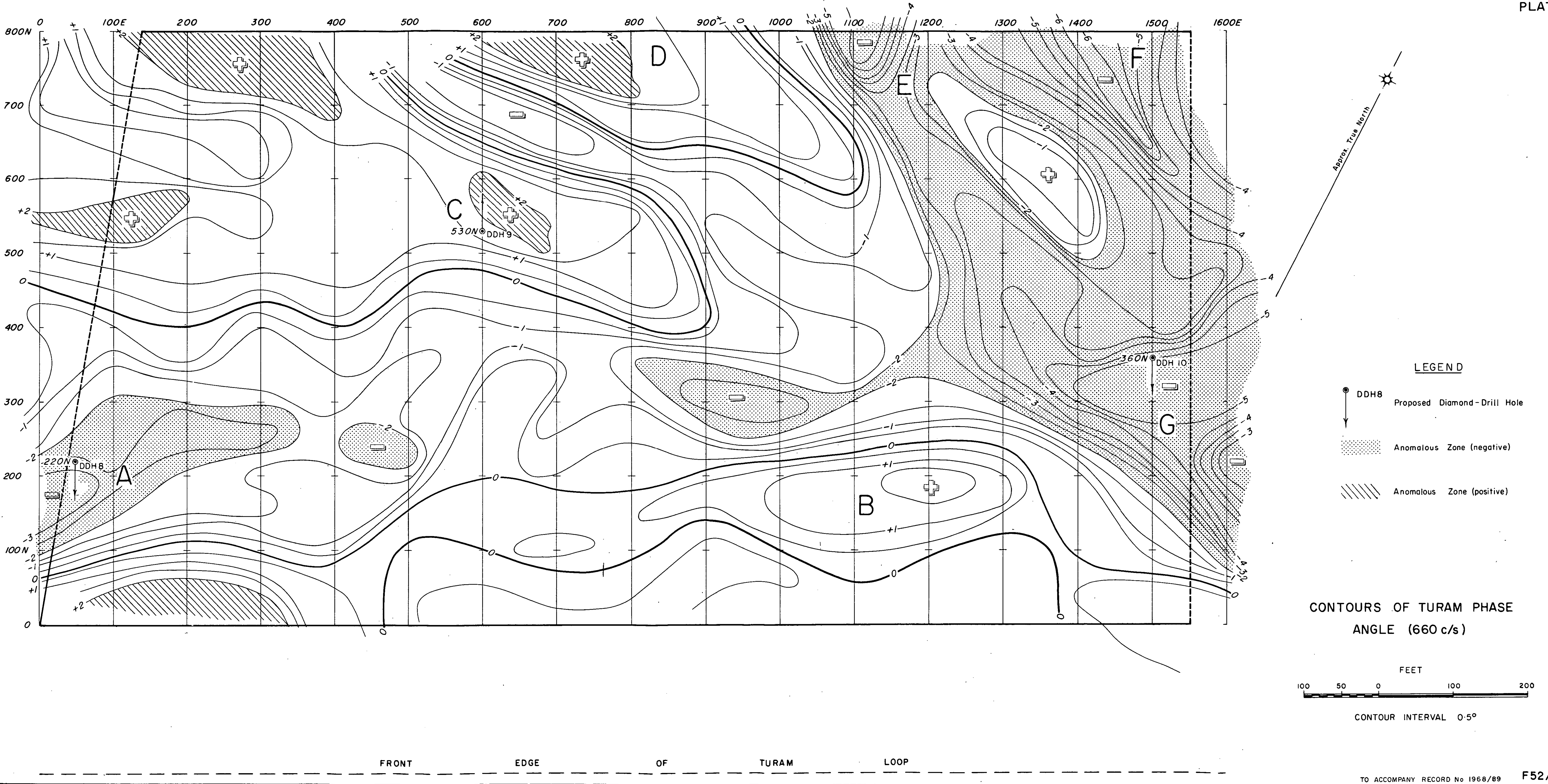


PLATE I
LEGEND
Mineralised quartz vein, pegmatite
Unmineralised vein, barren white quartz vein
Geological boundary, observed; approximate
Geological boundary; concealed; inferred
Strike, dip vertical
Foliation
Dip
Strike of joints; dip vertical; strike only measured
Diamond drill-hole showing direction and inclination
Diamond drill-hole not located by plane table mapping
United Uranium diamond drill-hole
Prospecting pit
Trench
Open cut
Dump
Water tank
Vehicle track
Contours (Interval = 5 feet)
Scarp
Summit of ridge; height elevation DDH in feet
Boundary of M L 367 H
Boundary of lease not accurately surveyed
Geology and topography surveyed by plane table
Contours relate to arbitary datum of 1000 feet at south-west corner of lease
Taken from Plan F52/12-2A Resident Geologists Office, Alice Springs
ML 367 H
AP 1722
FRONT EDGE OF TURAM LOOP
To Yuendumu graded road approx. 7 miles
Datum post of lease
Bearing to Mt Hardy trig st. approx. 250° mag.
Approx True North
FEET
100 50 0 100 200 300 400
LOCALITY MAP
DARWIN
NORTHERN TERRITORY
Tennant Creek
Alice Springs
HIGHLANDS ROCKS
MT THEO
MT PEAKE
Mt Hardy
LAKE MACKAY
MT DOREEN
NAPPERBY
MT RENNIE
MT LIEBIG
HERMANNSBURG
REFERENCE TO AUSTRALIA STANDARD 1:250,000 MAP SERIES: MT DOREEN
MT HARDY GEOPHYSICAL SURVEY 1967
TRAVERSE PLAN SHOWING TOPOGRAPHIC CONTOURS AND GEOLOGY
TO ACCOMPANY RECORD No. 1968/89
F52/ B7-1

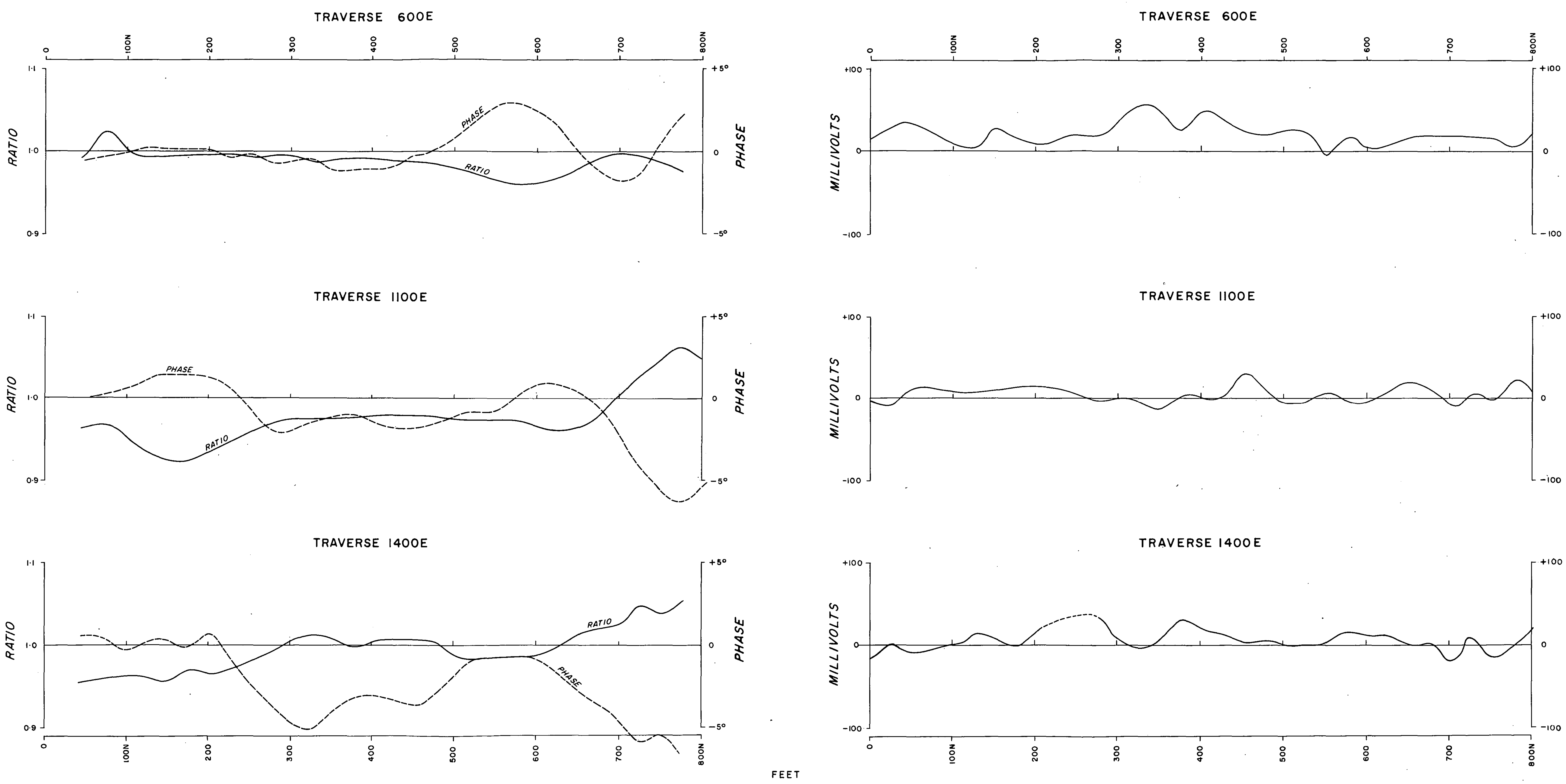


CONTOURS OF TURAM PHASE ANGLE (660 c/s)

PLATE 3

SELECTED TURAM PROFILES 660c/s

SELECTED SELF - POTENTIAL PROFILES



FEET

100 50 0 100 200

(Vertical scales as shown)

SELECTED TURAM AND SELF-POTENTIAL PROFILES

TO ACCOMPANY RECORD No. 1968/89 F52/B7-4

MT HARDY SURVEY N.T. 1967