COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1972/67

HAYES CREEK/GROVE HILL AREA GEOPHYSICAL TESTS, NORTHERN TERRITORY, 1971

by

P.W.B. Bullock

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<u>CONTENTS</u>

<u>ILLUSTRATIONS</u>

SUMMARY

Geophysical tests were made by the Darwin Uranium Group of the Bureau of Mineral Resources over two prospects between Hayes Creek and Grove Hill to select geophysical methods suitable for following up geochemical anomalies. Electromagnetic (Slingram and Turam) and self-potential methods were used.

Slingram and self-potential methods did not indicate anomalies over the Jar copper prospect, where geochemical anomalies are probably related to surface staining. At Heatleys prospect, Slingram was found to be unsatisfactory. The self-potential method revealed an anomaly extending for more than 1200 m. Turam profiles showed large ratio and phase anomalies. Subsequent drilling by Central Pacific Minerals encountered near-surface carbonaceous shales with minor pyrite below 30 m, and the shales are considered to be the source of the anomalies.

1. INTRODUCTION

The work described in this Record was done by the Darwin Uranium Group of the Bureau of Mineral Resources (BMR) to select geophysical methods suitable for following-up geochemical anomalies in Authorities to Prospect 1959 and 2269 held by Central Pacific Minerals. The areas where the work was done are the Jar copper prospect and Heatleys prospect, both roughly between Hayes Creek and Grove Hill (Pl. 1). The work comprised a number of test traverses, and was not intented to constitute a detailed survey of the areas. Geological information was supplied by Central Pacific Minerals through B. Pietsch (Geologist).

The field work was done in one week in June and another week in July, 1971, by P. Bullock (Geophysicist) and N. Ashmore (Technical Assistant) with the assistance in June of J. Gardener (Geophysicist). Help was given by B. Pietsch (Central Pacific Minerals), who also provided two field hands.

Readings were taken on geochemical grids pegged and levelled by Central Pacific Minerals. Self-potential and electromagnetic (Slingram and Turam) methods were used at Heatleys prospect and self-potential and Slingram methods at the Jar copper prospect.

2. GEOLOGY

The Jar copper prospect (Pl. 2) is on an alluvial plain, underlain by Lower Proterozoic rocks of the Burrell Creek Formation, where Central Pacific Minerals had obtained anomalous geochemical copper values over areas of weathered ironstained siltstone, shale, and quartz fragments. Old workings occur within the prospect.

Heatleys prospect (Pl. 3) is in Lower Proterozoic rocks of the Golden Dyke Formation. The area of geochemical ancmalies over which the geophysical readings were made consists of steeply dipping shale beds which strike along the side of a steep ridge and which lie between amphibolite masses.

Lines 4, 5, 6, and 8 shown in Plate 3 are lines along which drilling was done by Central Pacific Minerals after the geophysical work described here was completed. The drilling was done with an Airtrak drill on inclined holes up to 50 m deep. The drilling revealed shales with up to 5 percent disseminated pyrite at depth. Two basic intrusive bodies were found within the shales. The drilling results on lines 4, 5, 6, and 8 are summarized in Plate 3.

3. METHODS

The Slingram electromagnetic method was used with a 61 m (200 ft) separation between horizontal receiving and transmitting coils.

The frequency used was 1760 Hz. Readings were taken 30 m (100 ft) apart.

In the Turam electromagnetic method, the primary field was transmitted from a 500 m straight grounded cable normal to the traverses; the cable position is shown in Plate 3. The topography was too rugged to lay out a rectangular loop. Readings were taken at 15 m (50 ft) spacings with a 15 m separation between the horizontal receiving coils. In places a separation of 7.6 m (25 ft) was necessary to obtain readings on scale. Frequencies of 220 and 660 Hz were used.

Self-potential traverses were read with a Sharpe VP-6 instrument. Stations were read at 15 m (50 ft) intervals relative to a fixed base station.

4. RESULTS

Jar Copper Prospect

The results of the Slingram and self-potential work are shown in Plate 4. No anomalies were obtained over the anomalous copper values. The copper is probably associated with surface material only.

Heatleys Prospect

The Slingram method was tried over traverses at 84N, 96N, and 112N, but the results were unsatisfactory owing to rugged topography which caused inaccuracies in pegging and levelling. The Slingram results are not shown.

The self-potential method was tried over areas where high geochemical anomalies had been found in the shales, and large negative self-potential anomalies were recorded (Pl. 5). Further self-potential work over areas with lower geochemical values (traverses 84N and 128N) indicated that the anomalies persist for over 1200 m and are probably associated with the shales themselves rather than with the geochemically anomalous zones within the shales. Similar self-potential anomalies have been found in black shales in the Golden Dyke Formation in the Rum Jungle area (Duckworth, 1968; Gardener, 1968). Plate 5 also shows topographic profiles for traverses 84N, 96N, and 112N and geology along traverse 96N; this geology is projected from the drilling results on drill-lines 4 and 5.

The Turam method was tried over traverses 92N, 96N, and 100N and the profiles as shown in Plate 6 reveal a very strong off-scale anomaly over the shale horizon. Subsequent drilling by Central Pacific Minerals in this region intersected near-surface carbonaceous shales with minor pyrite below 30 m (Pl. 5).

The Turam anomalies are of very large amplitude but are narrow, and the cause is considered to be highly conductive shales just below the surface. However, other factors can contribute to the amplitude of an anomaly. When a grounded cable is used and suitable geological conditions exist, galvanic effects can cause enhancement, mainly of the in-phase response; the presence of material of high permeability (for example, magnetite) can cause an increase in amplitude of the secondary field but not the phase (Parasnis, 1962, p.113). Magnetic susceptibility is not considered to have contributed to the anomaly because the drilling did not reveal material of high enough permeability; moreover, a magnetic anomaly found by Central Pacific Minerals over traverse 96N was a very broad anomaly of less than 500 gammas, which cannot be associated with the sharp features of the Turam anomaly of very shallow origin.

5. CONCLUSIONS

Slingram and self-potential are probably satisfactory methods over the Jar copper prospect although no anomalies were detected.

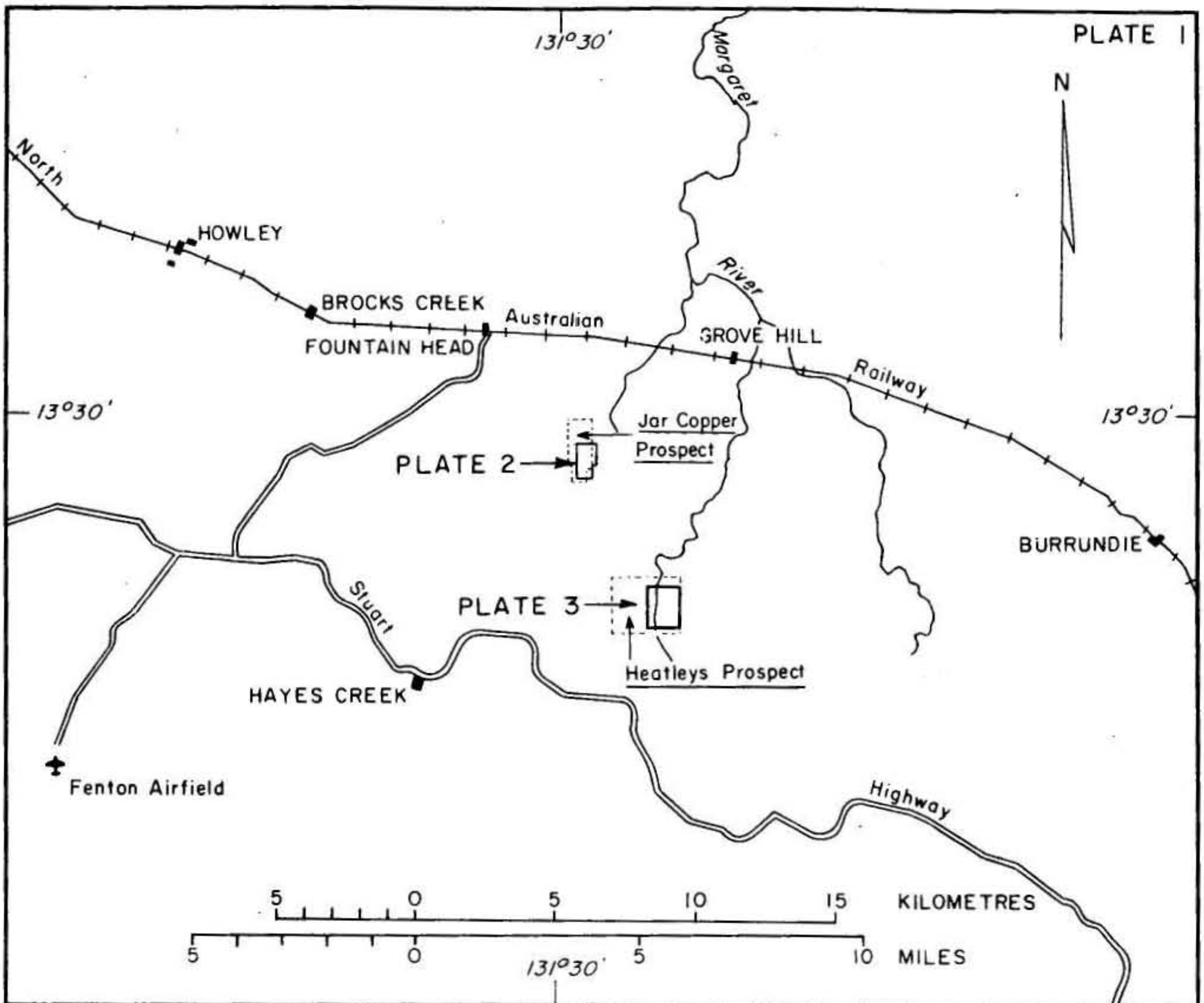
Slingram is not a suitable method over the rugged terrain of Heatleys prospect, where the signal-to-noise ratio was low. Turam and self-potential methods appear to be satisfactory to the extent to which they were tried out, that is in delineating near-surface shales.

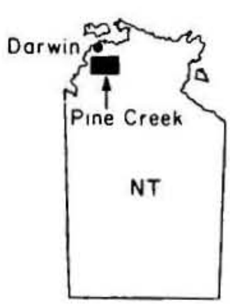
6. REFERENCES

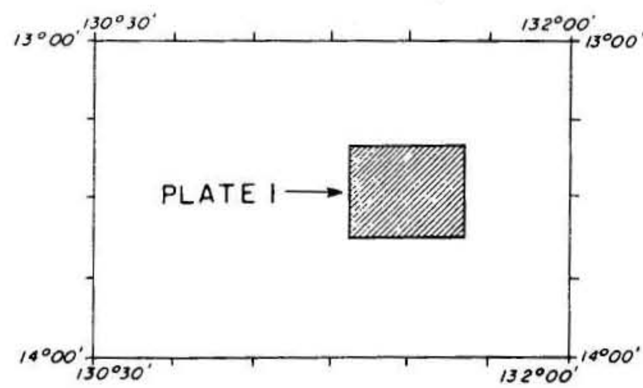
DUCKWORTH, K., 1968 - Mount Minza area experimental geophysical surveys, Northern Territory, 1966 and 1967. Bur. Miner. Resour. Aust. Rec. 1968/107 (unpubl.).

GARDENER, J.E.F., 1968 - Rum Jungle East (Area 44 Extended, Coomalie Gap West, and Woodcutters areas) geophysical surveys, Northern Territory, 1967. Ibid. 1968/104 (unpubl.).

PARASNIS, D.S., 1962 - PRINCIPLES OF APPLIED GEOPHYSICS. London, Methuen and Co. Ltd.







REFERENCE TO AUSTRALIA 1:250,000 MAP SERIES: PINE CREEK

LOCALITY MAP

HEATLEYS AND JAR PROSPECTS

To accompany Record No. 1972/67

D52/B7-587A

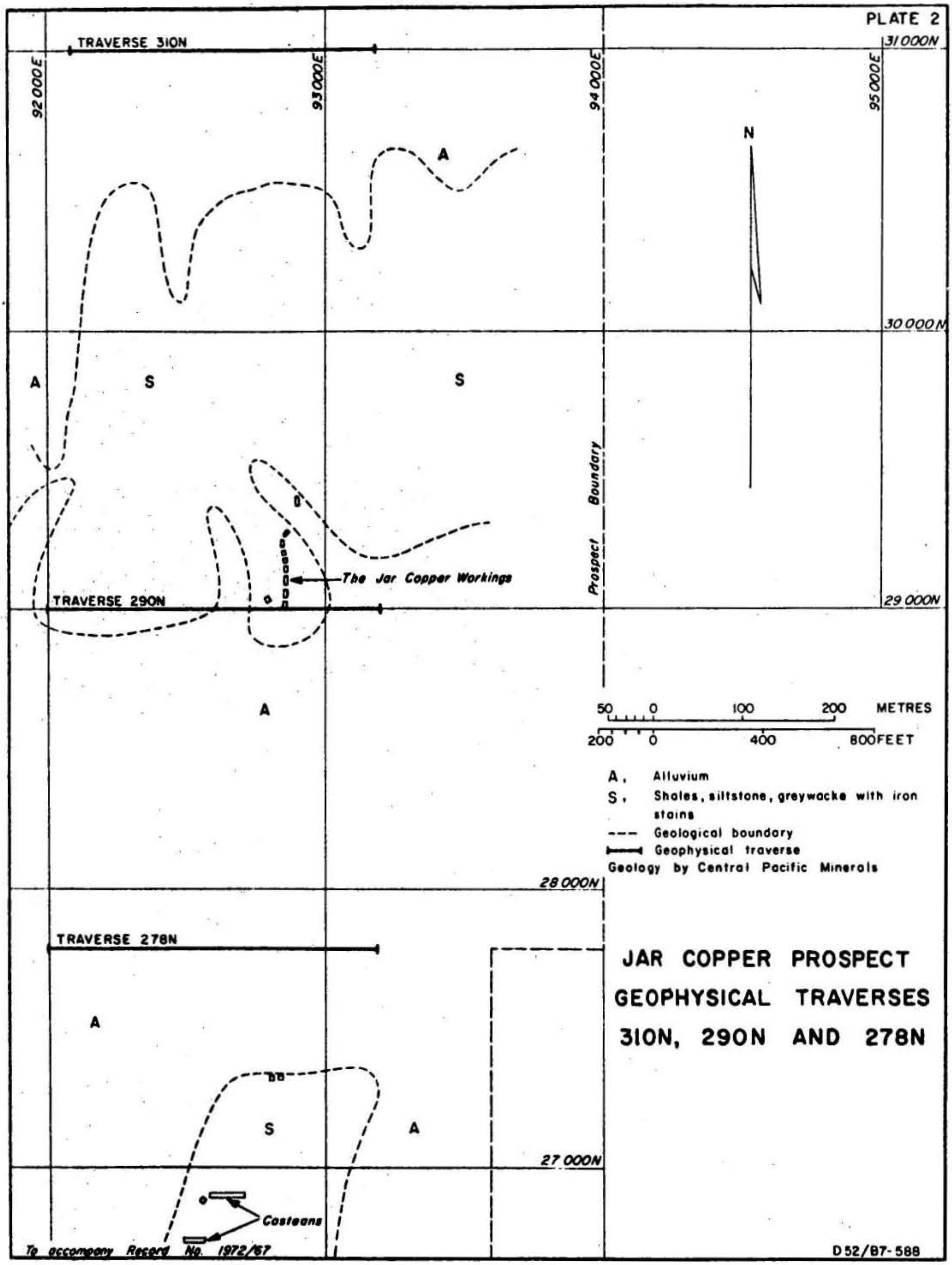
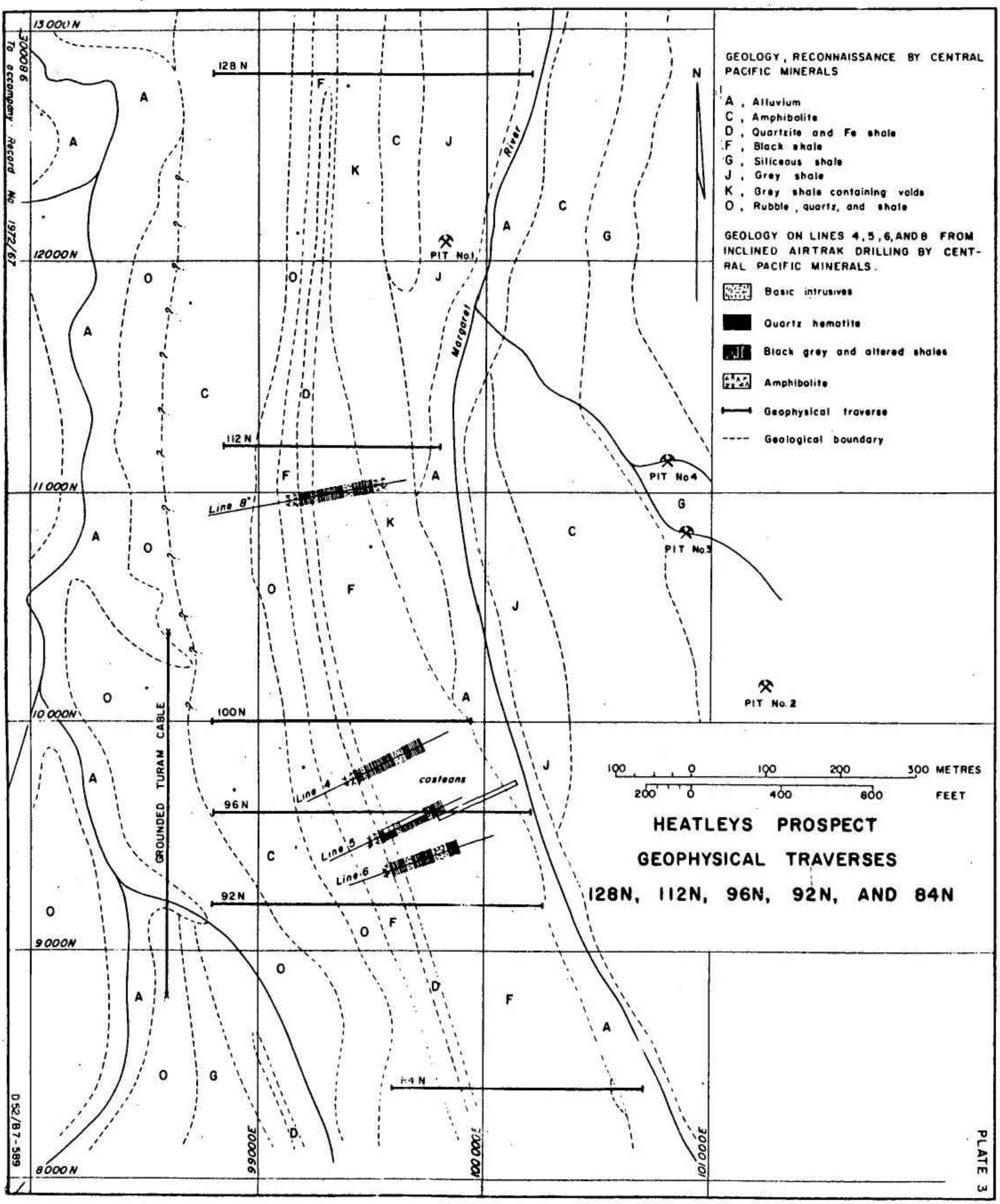
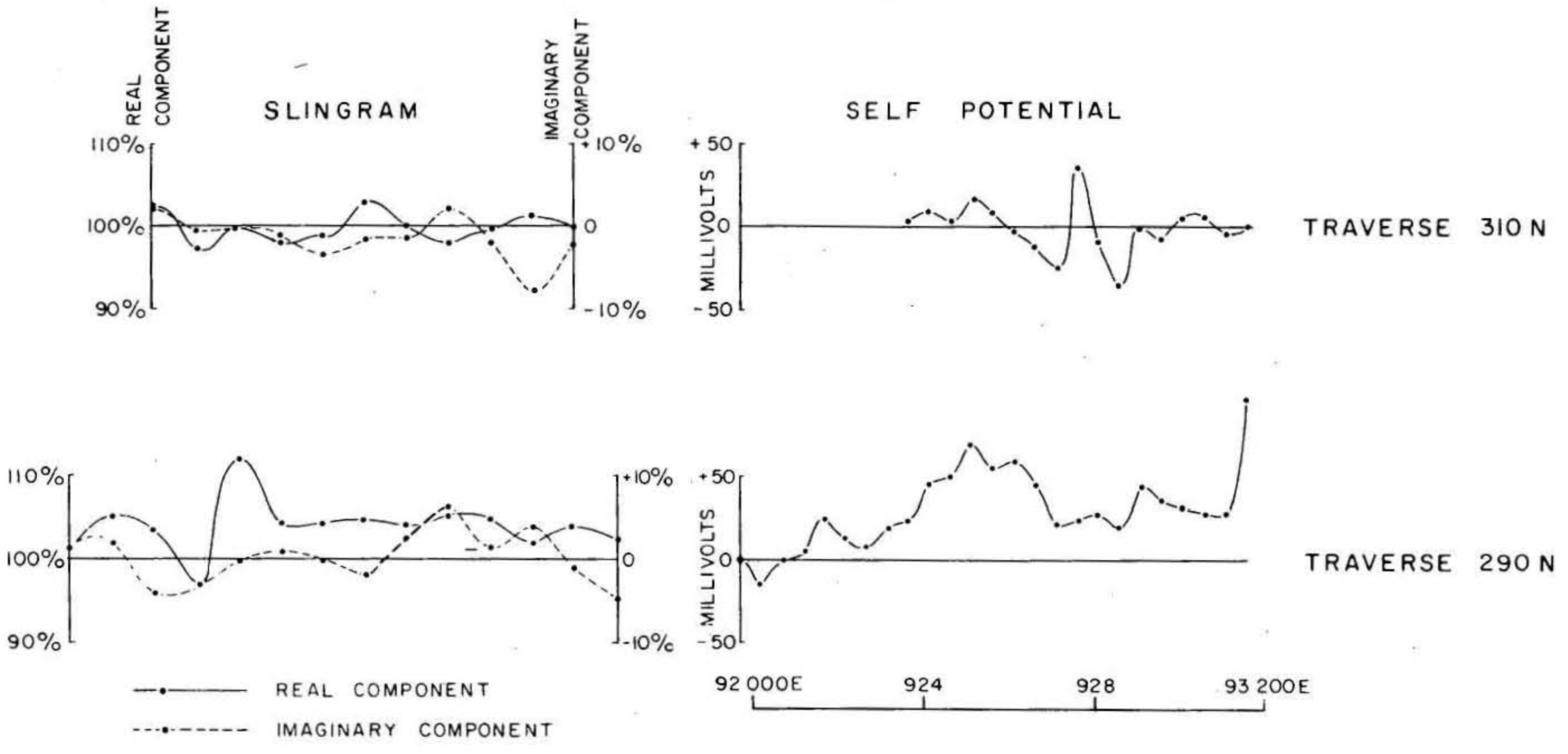
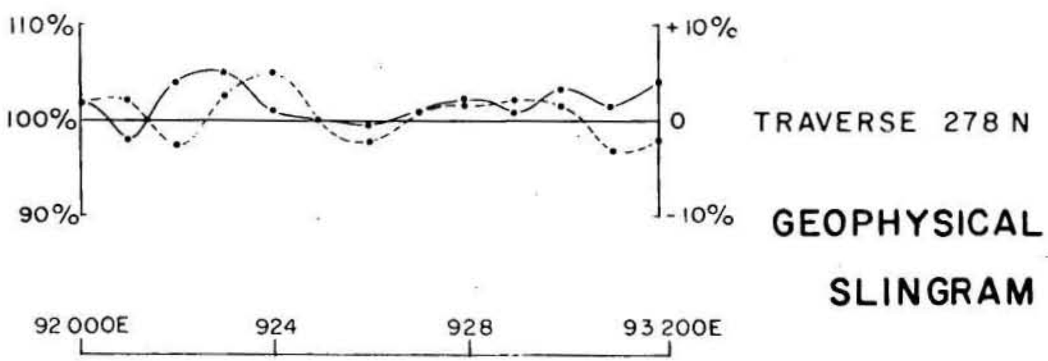


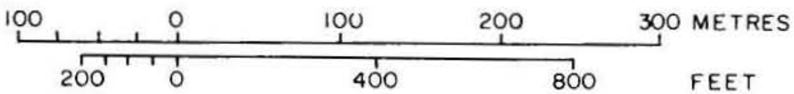
PLATE 2
TRAVERSE 310N
TRAVERSE 290N
TRAVERSE 278N
92 000E
93 000E
94 000E
95 000E
31 000N
30 000N
29 000N
28 000N
27 000N
N
A
S
The Jar Copper Workings
Prospect Boundary
Costeans
50 0 100 200 METRES
200 0 400 800FEET
A, Alluvium
S, Shales, siltstone, greywacke with iron stains
Geological boundary
Geophysical traverse
Geology by Central Pacific Minerals
JAR COPPER PROSPECT
GEOPHYSICAL TRAVERSES
310N, 290N AND 278N
To accompany Record No. 1972/67
D52/B7-588


GEOLOGY, RECONNAISSANCE BY CENTRAL PACIFIC MINERALS
A , Alluvium
C , Amphibolite
D , Quartzite and Fe shale
F , Black shale
G , Siliceous shale
J , Grey shale
K , Grey shale containing voids
O , Rubble , quartz, and shale
GEOLOGY ON LINES 4, 5, 6, AND 8 FROM INCLINED AIRTRAK DRILLING BY CENTRAL PACIFIC MINERALS.
Basic intrusives
Quartz hematite
Black grey and altered shales
Amphibolite
Geophysical traverse
Geological boundary
N
100 0 100 200 300 METRES
200 0 400 800 FEET
HEATLEYS PROSPECT
GEOPHYSICAL TRAVERSES
128N, 112N, 96N, 92N, AND 84N
13000N
12000N
11000N
10000N
9000N
8000N
99000E
100000E
101000E
128 N
112 N
100N
96 N
92N
84 N
Line 8
Line 4
Line 5
Line 6
costeans
GROUNDED TURAM CABLE
Margaret River
PIT No.1
PIT No.2
PIT No.3
PIT No.4
To accompany Record No 1972/67
D52/B7-589
PLATE 3

To accompany Record No. 1972/67







JAR PROSPECT

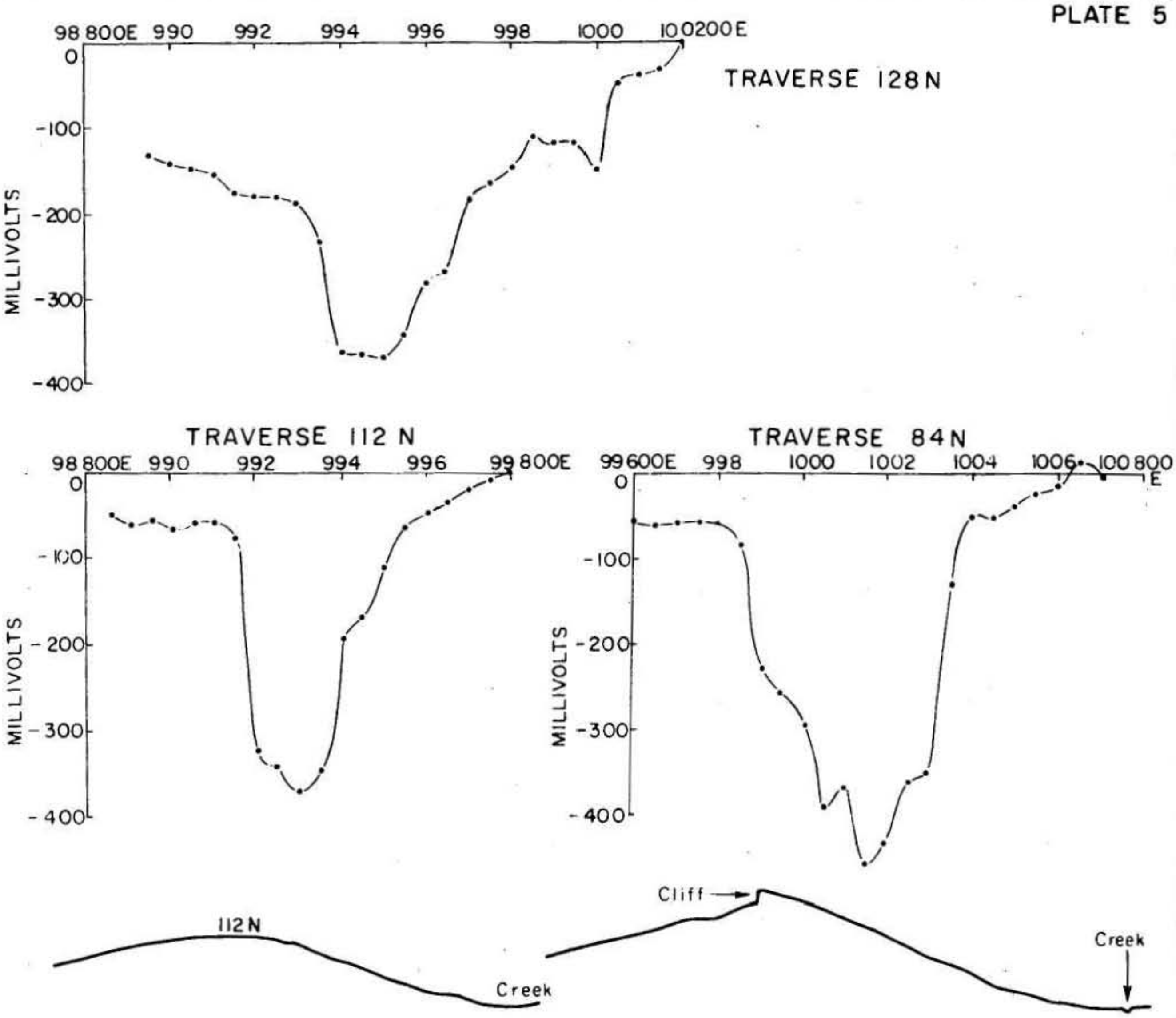
GEOPHYSICAL TRAVERSES 310N, 290N AND 278N

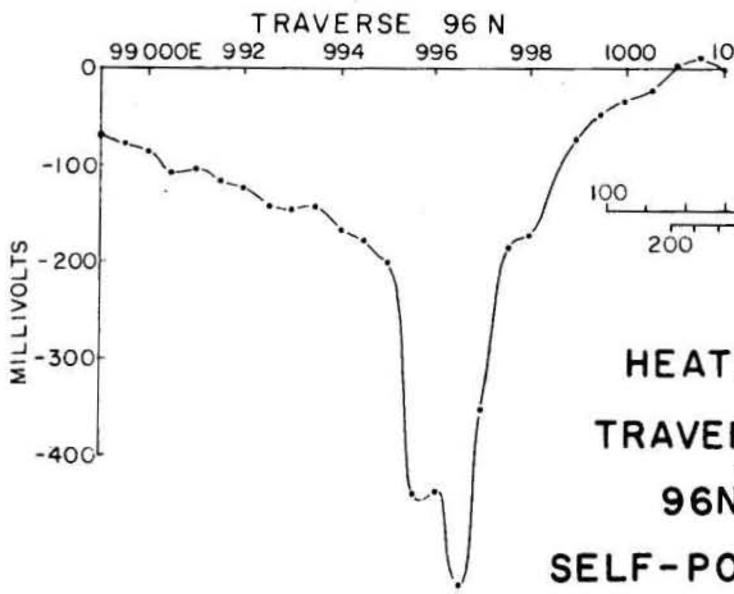
SLINGRAM AND SELF-POTENTIAL PROFILES

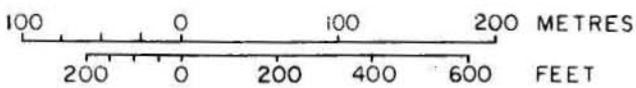
PLATE 4

D52/B7-590A

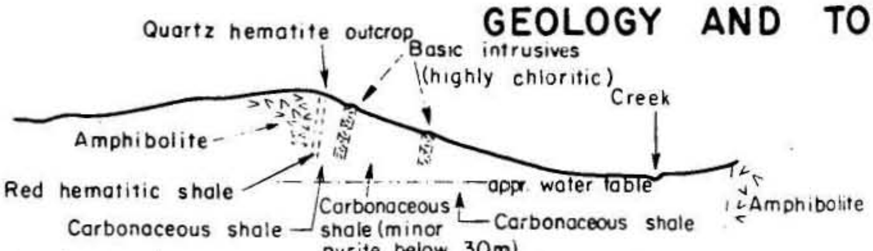
PLATE 5







HEATLEYS PROSPECT
TRAVERSES 128N, 112N, 96N, AND 84N
SELF-POTENTIAL PROFILES GEOLOGY AND TOPOGRAPHY



To accompany Record No. 1972/67

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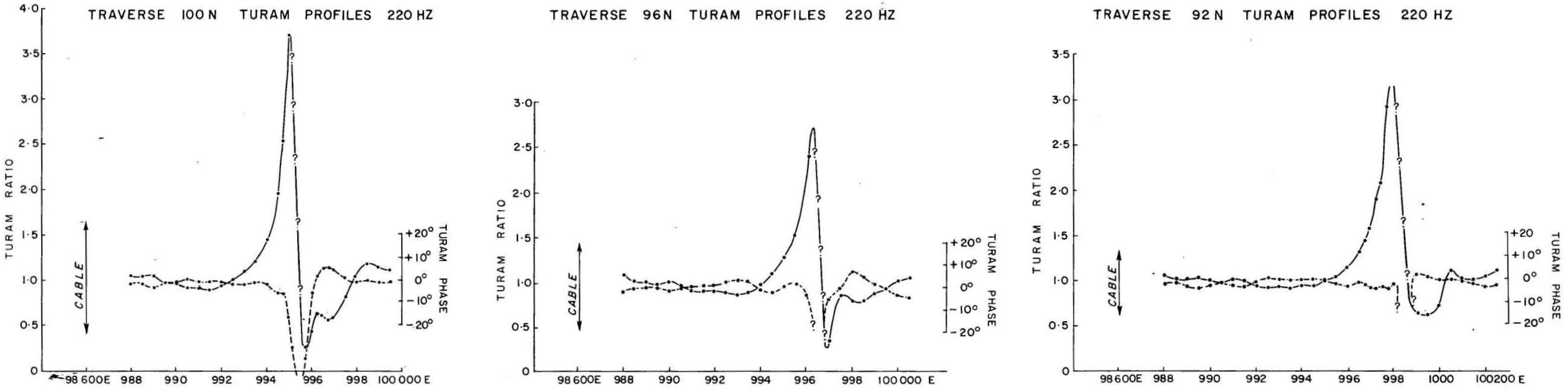

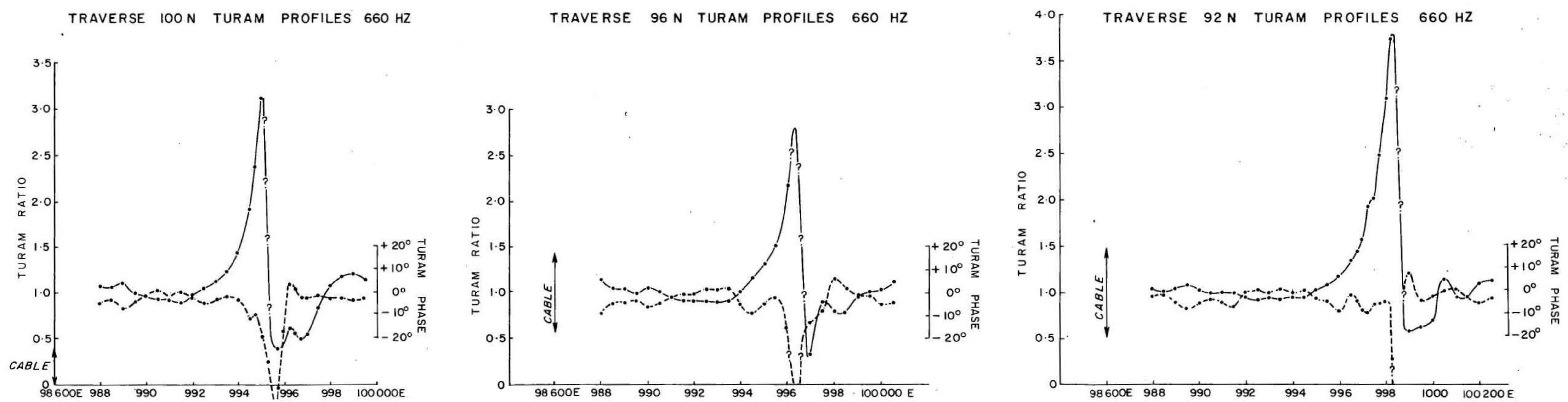

HEATLEYS PROSPECT
TRAVERSES 100N, 96N, AND 92N
TURAM PROFILES 220 AND 660Hz

To accompany Record No. 1972/67

D52/B7-592