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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1966/119

HODDLES CREEK
GEOPHYSICAL SURVEY,

VICTORIA 1965

by

R.J. SMITH

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ILLUSTRATIONS

Note. This Record supersedes Record No. 1965/152.

SUMMARY

A short geophysical test survey was made at Hoddles Creek, Victoria, during April and May 1965. Self-potential, magnetic, electromagnetic (E. M. Gun and Turam), and induced polarisation methods were used in an attempt to detect and trace possible extensions of the gold-stibnite lode worked in the Gem and Surprise Gully mines.

No significant anomalies were detected over the known mineralisation but strong electromagnetic and induced polarisation anomalies were detected approximately in line with the lode. One hole has been drilled, as recommended, to test the geophysical anomalies but it located only pyrite, apparently in sufficient quantity to cause the anomalies.

1. INTRODUCTION

At the request of Messrs. L. & K. McRae of the Gem Mine (also known as the Coronation Mine), Hoddles Creek, Victoria, the Bureau of Mineral Resources (BMR) conducted a geophysical test survey at the mine during April and May 1965 using several geophysical methods. The mine is situated beside Hoddles Creek about 2½ miles from the main Melbourne to Warburton road and is easily accessible. The surrounding country is mainly gently undulating, open farmland with some patches of heavy undergrowth and deep gullies along the creek. The geophysical party consisted of R. J. Smith (party leader), A. Howland-Rose and B. Farrow (geophysicists), and J. Dymond and N. Ashmore (field-hands). The survey took place between 20th April and 21st May using self-potential, magnetic, electromagnetic, and induced polarisation (IP) methods. The clearing, surveying and pegging of the traverses was conducted by L. & K. McRae and they provided an extra field-hand for the geophysical party on several occasions.

The mine is on a gold-antimony lode, and the aim of the survey was to locate extensions of the lode and recommend drilling targets. If sufficient ore reserves could be located, it was planned to reopen the mine. The project was regarded as a test survey because the BMR had not previously detected this type of lode with geophysical methods; several methods were used in order to examine the feasibility of further surveys of this type.

2. GEOLOGY

The geology of the area has been described by Thomas (1950) and Whiting (1955) and the following remarks are based on their reports.

The country rock is Silurian siltstone and sandstone, dipping approximately 55° west and striking approximately north. The Silurian rocks are intersected by a decomposed feldspar porphyry dyke dipping 80° south and striking 60° east of north. The dyke has been intruded by a gold-bearing quartz-stibnite lode, from 6 inches to 2 feet wide, which follows the hanging-wall of the dyke and which has various offshoots along the bedding planes of the Silurian rocks and in the dyke itself. The dyke has been displaced a few feet to either side in several places along its length, presumably along bedding plane slips.

The lode has been worked in the Gem Mine at two levels (88 feet and 148 feet), following the dyke for several hundred feet (see Plate 1) and following spurs almost perpendicular to the main lode for short distances. The lode extends about 120 feet north-east of the shaft on the upper level and the full length of the drive (approximately 150 feet) on the lower level. The total mineable width was up to five feet including stibnite veins in the dyke itself and in the Silurian country rock. As well as gold and stibnite, the lode contains some pyrite, but its concentration is not known.

West of Hoddles Creek, the lode has been worked by the Surprise Gully shaft and the mineralisation appears to be continuing to the south-west. The Pioneer shaft, nearly 700 feet south-east of the Gem Mine was mining a similar lode, which apparently was striking north, although records are contradictoryon this point. The upper level of the Gem Mine was continued 200 feet past the end of the mineralisation in the hope that an enriched zone could be found near the intersection with the Pioneer lode. This intersection has not been reached and further work in this direction is not envisaged.

South-west of the Gem and Surprise Gully shafts is an area that had been worked extensively for alluvial gold (see Plate 1). Many shafts and trenches were still in existence but, almost without exception, they were full of water.

The geophysical survey was planned to cover the area surrounding the Gem and Pioneer shafts in order to try to detect the two lodes and possibly their intersection, and also to look for possible extensions of the Gem lode south-west of the Surprise Gully shaft.

3. METHODS AND INSTRUMENTS

The geophysical grid (see Plate 1) consisted, initially, of eleven traverses, 100 feet apart, perpendicular to the strike of the Gem-Surprise Gully lode. The traverses were approximately 1000 feet long, pegged every 25 feet, with the Gem Mine near the centre of the grid. The traverses were extended far enough to the south to pass the Pioneer shaft in the hope that the Pioneer lode could be detected also. The strike of the Pioneer lode was not known definitely as some reports stated that it was north-south, others east-west. In order to test the lode in either direction, two cross-traverses were added at 250S and 400S. When an anomaly was detected west of the Gem Mine, several additional traverses were added at 350W, 450W, 550W, and 600W to study it in more detail.

Self-potential

The self-potential method should detect the presence of sulphide ore bodies or graphite undergoing oxidation. If such an orebody projects above and below the water table, electrochemical action often produces recognisable negative potential anomalies on the surface (Parasnis, 1962, Ch. 4). It was considered possible that the quartz-stibnite lode at Hoddles Creek might produce such an anomaly, which could be used to trace the mineralisation.

Self-potential measurements were made over the whole grid using a Cambridge PH meter (No. L225879) and two BMR self-potential meters (RL 807B No. 1 and RL 807B No. 2). The only recognisable anomalies were found tobe over corroded water pipes. No anomaly could be recognised over the known position of the dyke and no significant new anomalies were found. As most and possibly all of the lode was below the water table, oxidation would be very limited and the absence of a self-potential anomaly was not unexpected. No self-potential results are shown in this report.

Magnetic

Magnetic measurements detect disturbances in the Earth's magnetic field and many basic igneous minerals produce recognisable magnetic anomalies (Parasnis, 1962, Ch. 2). Although the feldspar porphyry dyke at Hoddles Creek was unlikely to exhibit magnetic properties, it was considered remotely possible that it might and it was, therefore, worth testing.

Magnetic measurements were made over most of the grid, using an ABEM variometer (No. 4503). The presence of fences, water pipes, buildings, and heavy machinery around the mine caused many strong disturbances in the magnetic field. If there was any magnetic anomaly over the dyke, it was masked by these disturbances, and no significant anomalies were discovered. The magnetic results did not help to locate the lode and they are not illustrated in this report.

Electromagnetic

Electromagnetic measurements detect the presence of buried electrical conductors such as water-filled shears, graphitic shales, and metallic sulphides. An alternating primary electromagnetic field is set up by the instrument and eddy currents are induced in any conductors within its range. These eddy currents distort the primary field, which is mapped by search coils, and the distortions indicate the nature and position of the conductor. The depth penetration of the electromagnetic method depends on coil separation, frequency (lower frequencies give greater depth penetration), and the actual method of measurements (Parasnis, 1962, Ch. 5). At Hoddles Creek, both the electromagnetic Gun (E.M. Gun) and Turam methods were used over the quartz-stibnite lode; the two methods detect the same phenomena but differ in sensitivity and depth penetration. Although stibnite is not a good conductor, it was hoped that sufficient pyrite was associated with the Gem lode to cause an electromagnetic anomaly.

Initially, most of the area was covered with the E.M. Gun equipment (ABEM No. 82), using the high frequency (1760 c/s) and a separation between the transmitting and receiving coils of 150 feet. Some interference was experienced near the power lines that cross the grid, but this did not seriously affect the measurements. Some anomalies were observed on the eastern traverses (200E, 300E, 400E, and 500E), but these could all be accounted for by nearby sheds, fences, etc. Traverses 100E and 100W were omitted because of the many fences, sheds, and heavy machinery nearby. The western traverses were relatively free of surface disturbances and several of these traverses exhibited small anomalies in the imaginary component. As tests with the IP method gave interesting results over these anomalies, the additional traverses 350W, 450W, 550W, and 600W were pegged and surveyed with the E.M. Gun and IP equipment. The E.M. Gun was used as a quick reconnaissance tool to guide the positioning of the subsequent IP work.

The Turam equipment (ABEM 2S) was not available throughout most of the survey and was only used for one day's field work over the most interesting traverses (300W, 350W, 400W, 450W, 500W, and 600W). A grounded cable was laid along 600S and extended from 500E to approximately 2000W. The central parts of the traverses were surveyed using a 50-ft coil separation and two frequencies (220 c/s and 660 c/s).

The results obtained using both the E.M. Gun and Turam equipment on traverses 00, 300W, 350W, 400W, 450W, 500W, 550W, and 600W are illustrated as profiles in Plates 2, 3, and 4. Turam ratio contours (660 c/s) over the whole area surveyed are shown in Plate 5, which includes Turam ratio and phase profiles (660 c/s) and a cross-section along the line of the proposed borehole.

<u>Induced polarisation</u>

The IP method measures both resistivity and frequency effect and these are combined to give a metal factor. The resistivity measurements indicate zones of low resistivity due to water or numerous other possible causes, but frequency effect measurements are more specific and detect mainly electronic conductors (e.g. metallic sulphides, graphite, magnetite, etc.). Some clay minerals can also produce frequency effects but these are comparatively rare (Madden & Cantwell, 1963, pers. comm.).

Tests were made with the IP equipment in the hope that it would detect the sulphides (pyrite and stibnite) present in the lode and eliminate any electromagnetic anomalies caused by mineralised water.

The Geoscience Incorporated IP equipment was used initially on traverse 300W using aluminium-foil electrodes and a dipole-dipole array. The traverse was surveyed from 300S to 300N using 25-ft dipoles and eight dipole separations (n = 2 to n = 9). The dipole-dipole array is illustrated in Plate 2. Measurements were made using frequencies of 10 c/s and 0.3 c/s. The results were inconclusive as the reciprocity was poor, but there appeared to be a low resistivity anomaly near the suspected position of the lode and it was decided to continue using the method on some other traverses.

After further tests, it was found that better contacts could be obtained using iron spikes as electrodes and the results showed better reciprocity. Traverse 00 was surveyed completely with the IP method, but only small anomalies were observed, which could not be correlated with the known position of the lode. The work on traverse 300W was repeated and about 400 feet of IP surveying was completed on each of traverses 350W, 400W, 450W, 500W, 550W, and 600W. Some interesting anomalies were encountered, mainly on traverses 350W, 400W, and 450W. These are discussed in the next section and are illustrated in Plate 3. The IP and electromagnetic results on the other traverses are illustrated in Plates 2 and 4.

4. RESULTS AND INTERPRETATION

The first results of interest were the E.M. Gun anomalies on traverses 200W, 400W, and 500W; similar anomalies were later observed on traverses 350W, 450W, 550W, and 600W. The anomalies, which were recognisable only in the imaginary component, were centred slightly south of the line of the Gem-Surprise Gully lode. The anomalies appeared strongest in traverses 400W and 500W and had almost disappeared by traverse 600W. A closer examination of the E.M. Gun results on traverse 00 revealed a possible similar anomaly near the known position of the lode, but a strong disturbance in the electromagnetic field - probably due to a fence or water pipe - obscured most of the interesting section.

The anomalies in the imaginary component of the E.M. Gun measurements indicated the presence of a conductor extending westward from the Gem-Surprise Gully lode. This could have been an extension of the lode or it could equally well have been a water-filled shear, possibly associated with the dyke and not necessarily mineralised.

The IP work showed significant anomalies on traverses 300W, 350W, 400W, 450W, 500W, 550W, and 600W but not on traverse 00. The anomalies coincided with the position of the E.M. Gun anomalies; they were strongest on traverse 400W but were still quite pronounced on traverse 600W. Both resistivity and frequency effect anomalies were observed, supporting the evidence of a conductor. The frequency effect anomaly was particularly significant as it could only be caused by an electronic conductor; this would include the sulphide minerals (e.g. pyrite and stibnite) but would exclude a water-filled shear. It seemed unlikely that the stibnite in the Gem-Surprise Gully lode could be a sufficiently good conductor to cause these observed anomalies, but pyrite associated with it - if present in sufficient quantitues - could account for the observed resistivities and frequency effects.

The Turam work on traverses 300W, 350W, 400W, 450W, 500W, and 600W helped to position the anomaly more accurately. Significant anomalies were observed on all traverses except 600W, the strongest anomaly being observed on traverse 400W. Depth calculations on traverse 400W yielded a depth to the centre of the current concentration of 80 feet below the grid position 39S/400W; this current concentration was selected as the primary drilling target. The current concentration should be within the conductor but the calculations give no indication of the extent of the conductor. Similar calculations on traverses 350W and 450W confirmed the depth calculations, and the positions of the anomalies on the three traverses (350W, 400W, and 450W) were collinear.

The only traverses that crossed known mineralisation were 100E, 00, and 100W. Traverses 100E and 100W were not surveyed with the electromagnetic or IP methods because of the many buildings, fences, and other obstacles nearby. No significant anomalies were observed on traverse 00, which was surveyed with both E.M. Gun and IP methods, but there was a suggestion of a weak anomaly in the results from both methods.

The position and strike of the anomalies on the western traverses suggested that they were caused by an extension of the Gem-Surprise Gully lode displaced slightly to the south, but their magnitude indicated that their source differed from the lode either in composition or size. Either an increase in the pyrite content or a widening of the mineralised zone would cause a more pronounced anomaly, but this could only be resolved by drilling.

5. CONCLUSIONS AND RECOMMENDATIONS

A significant anomaly was located west of the Gem-Surprise Gully lode. There was strong evidence for the existence of an electronic conductor that could have been an extension of the Gem-Surprise Gully lode displaced slightly to the south; the following drill hole was recommended to test it:

Drill hole No.	Target	Collar	Depression	Magnetic bearing	Length
DDH1	400W/39S depth 80 ft	382W/83S	60°	312°	120 ft

This drill hole was intended to show the cause of the anomaly and, if economic mineralisation was detected, further drilling targets to test its extent could be recommended on the basis of the geophysical results.

The hole was drilled, as recommended, by the Victorian Mines Department and the drilling has been described by Bell (pers. comm.). Neither the Gem-Surprise Gully lode nor a continuation of the feldspar porphyry dyke was intersected by the drill hole but several thin bands of fine-grained, concretionary pyrite were intersected and these are probably the cause of the IP anomalies. The steeply dipping shear zone containing pyrite and probably mineralised water is a likely source of the Turam and E.M. Gun anomalies.

These drilling results do not discount the possiblity of a continuation of the Gem-Surprise Gully lode, as the test hole did not cross the line of the dyke. As the dyke, and its associated mineralisation, are not necessarily accompanied by geophysical anomalies they could extend in line with the previous workings and remain undetected.

The test hole apparently located the source of the geophysical anomalies. The survey was not successful in tracing the Gem-Surprise Gully lode and no further drilling targets can be recommended from the geophysical results.

6. REFERENCES

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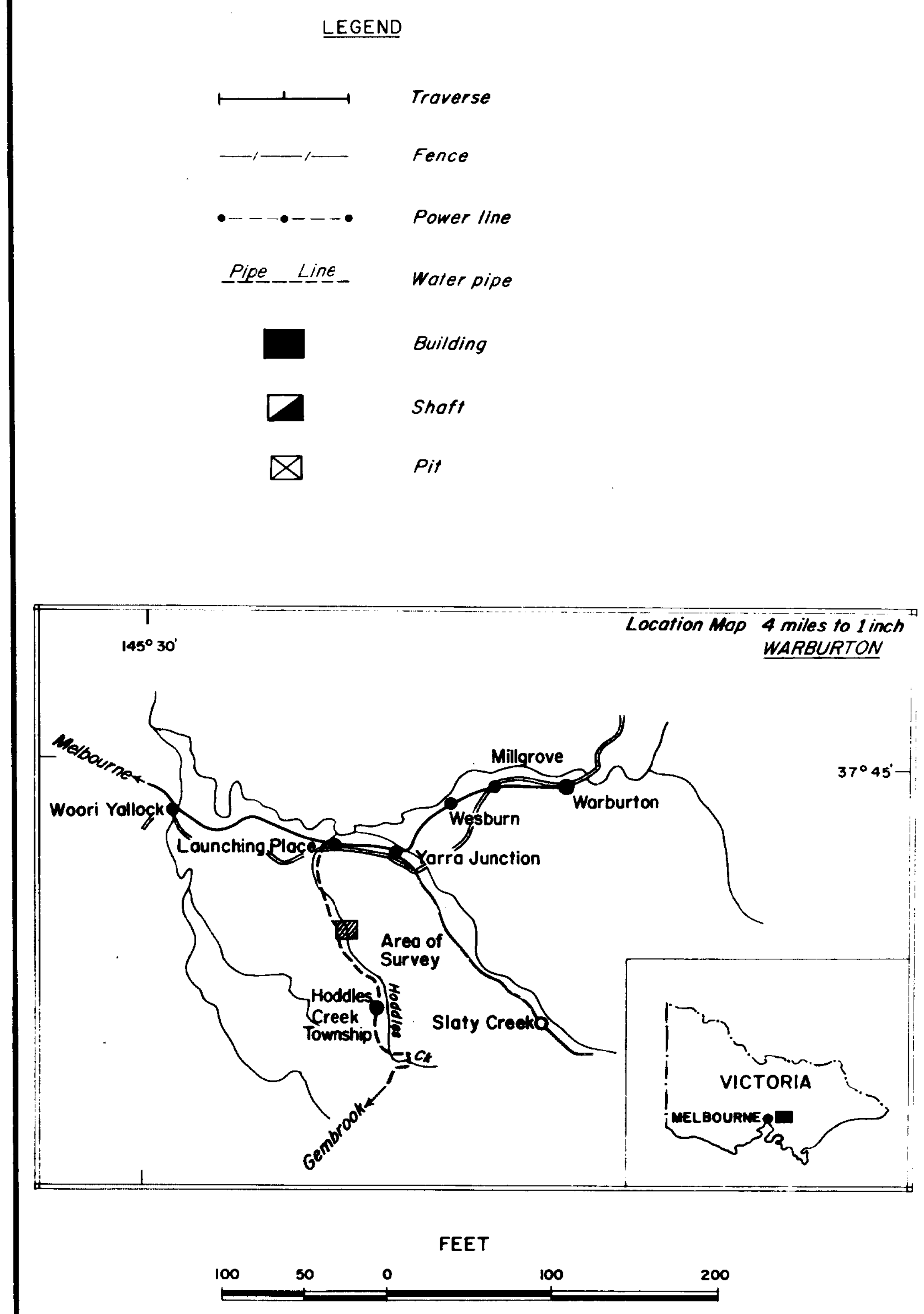
THOMAS, D. E. — 1950 — The Gem prospecting syndicate, Hoddle's Creek. Mining and Geological Journal, Vol.4 No. 1.

WHITING, R. G. — 1955 — Report on Gem Mine, Launching Place. Victorian Government Department of Mines (unpublished report).

PLATE 1



THE GEM MINE
HODDLES CREEK
1965

TRAVERSES AND LOCATION MAP

TO ACCOMPANY RECORD No. 1966/119

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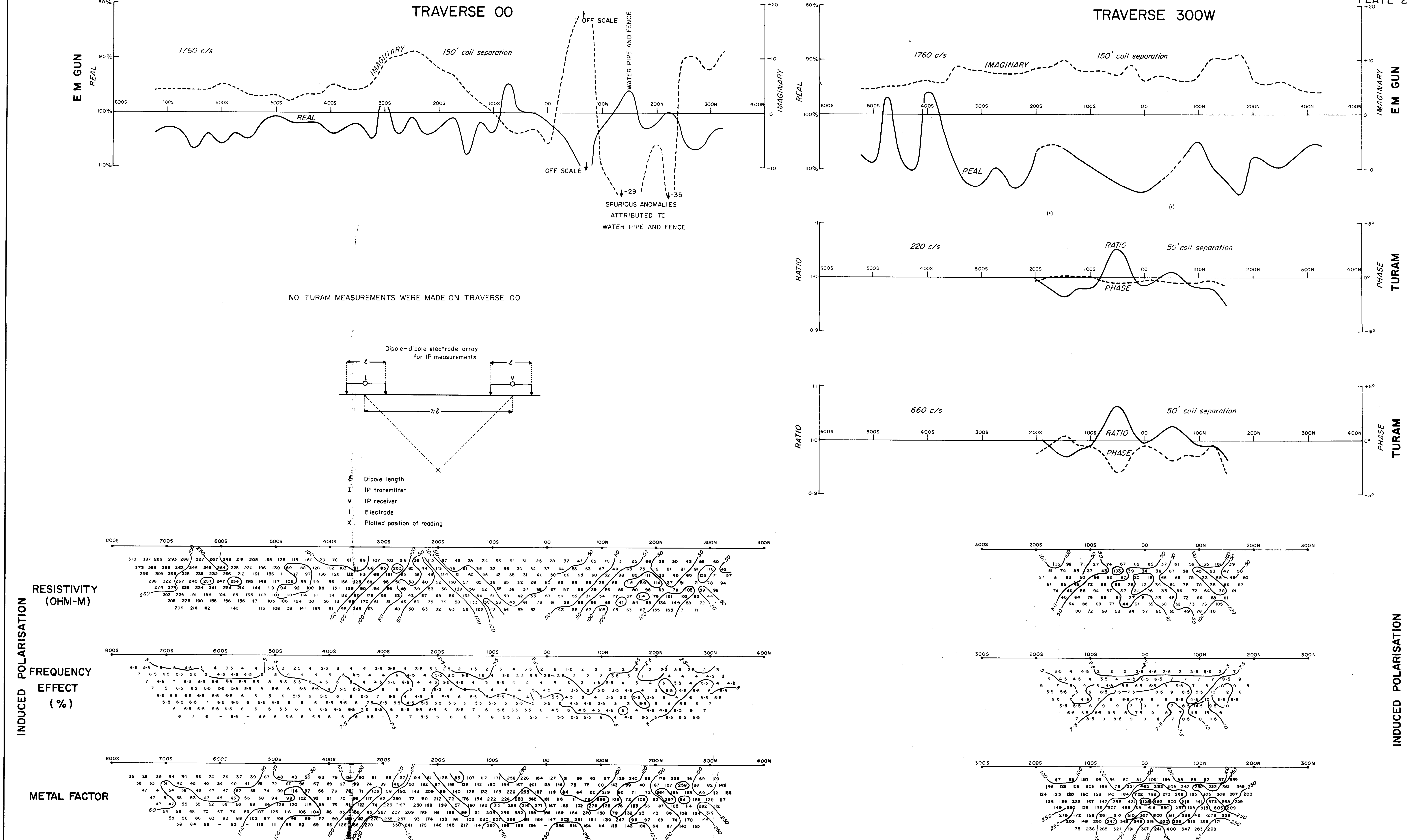
PLATE 2



TRAVERSES 00 AND 300W

ELECTROMAGNETIC AND INDUCED POLARISATION PROFILES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

J55/B7-8

TO ACCOMPANY RECORD No. 1966/119

PLATE 3

TRAVERSES 350W, 400W & 450W

ELECTROMAGNETIC AND INDUCED POLARISATION PROFILES

TO ACCOMPANY RECORD No. 1966/119

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

J55/B7-5

PLATE 4

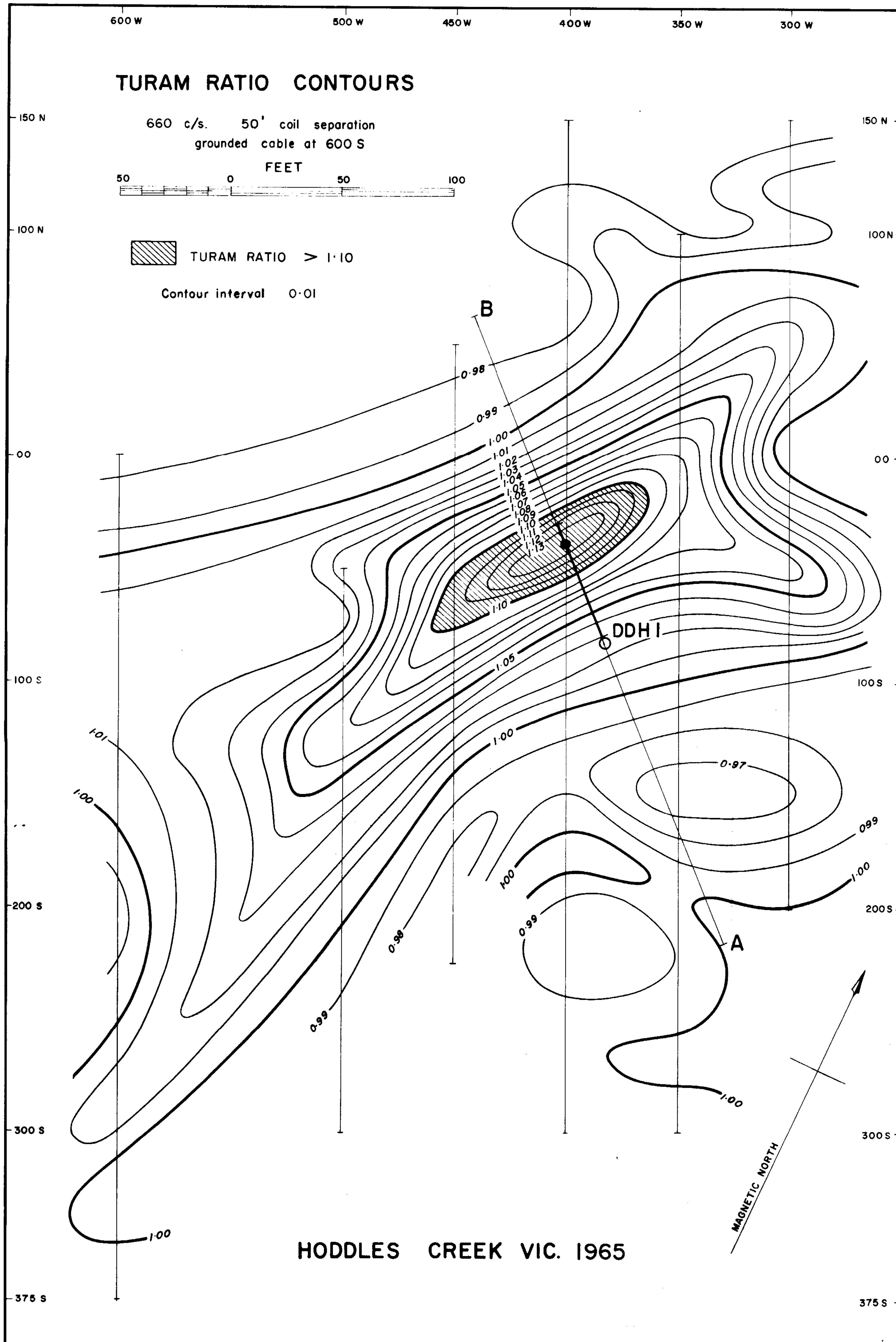
TRAVERSES 500W, 550W AND 600W

ELECTROMAGNETIC AND INDUCED POLARISATION PROFILES

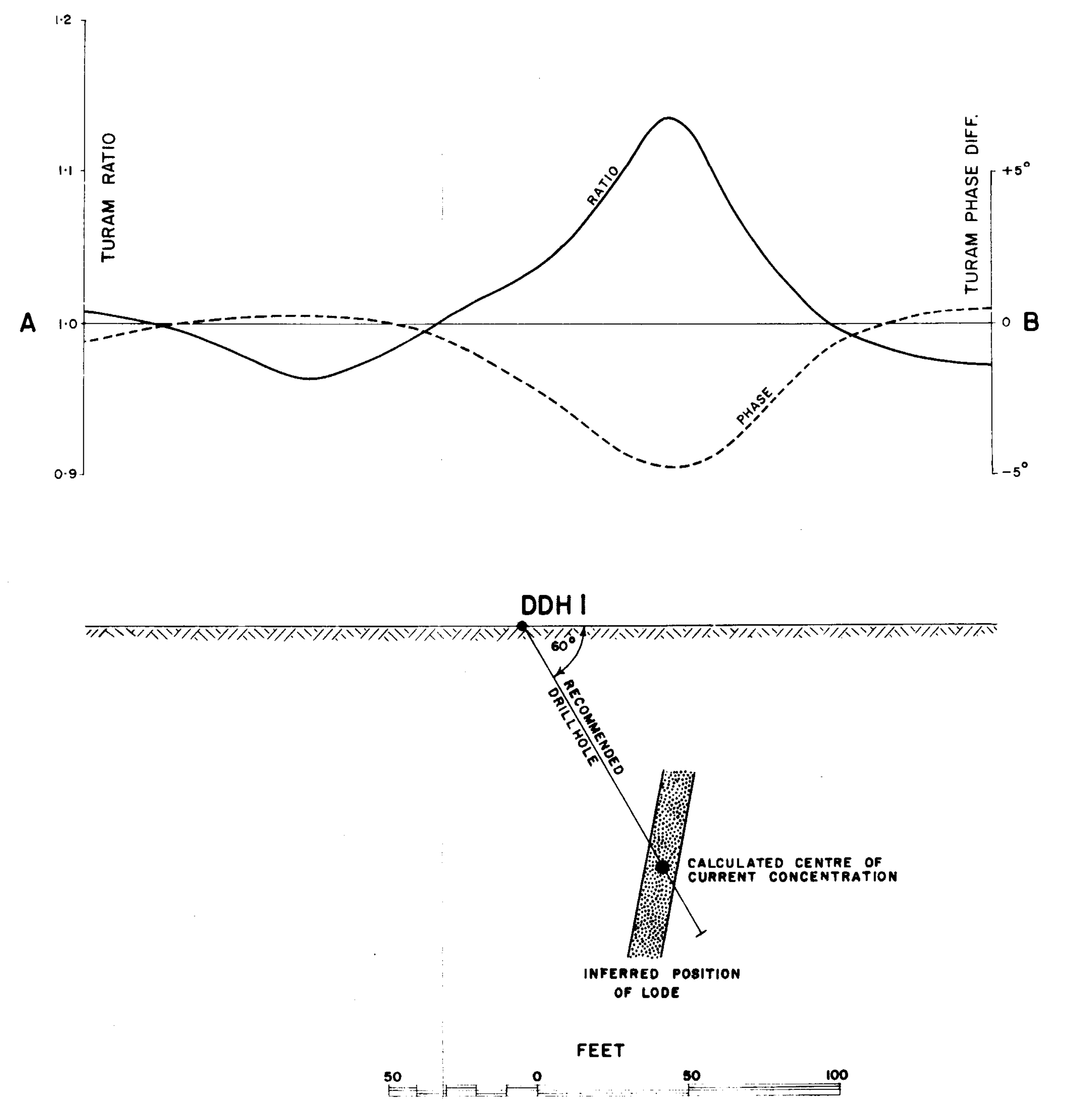
TO ACCOMPANY RECORD No. 1966/119

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS J55/B7-7

PLATE 5



TURAM RATIO CONTOURS
660 c/s. 50' coil separation
grounded cable at 600 S
FEET
50
0
50
100
TURAM RATIO > 1·10
Contour interval 0·01
600 W
500 W
450 W
400 W
350 W
300 W
150 N
100 N
00
100 S
200 S
300 S
375 S
B
A
DDH 1
0·98
0·99
1·00
1·01
1·02
1·03
1·04
1·05
1·06
1·07
1·08
1·09
1·10
1·11
1·12
1·13
0·97
MAGNETIC NORTH
HODDLES CREEK VIC. 1965



TURAM PROFILE AND CROSS-SECTION ALONG LINE A-B
TURAM RATIO
TURAM PHASE DIFF.
1·2
1·1
1·0
0·9
+5°
0
-5°
A
B
RATIO
PHASE
DDH 1
60°
RECOMMENDED DRILL HOLE
CALCULATED CENTRE OF CURRENT CONCENTRATION
INFERRED POSITION OF LODE
FEET
50
0
50
100