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GEOPHYSICAL SURVEYS AT SHUTTLETON AND CANBELEGO NEW SOUTH WALES 1947-1950

by

W.D. KEATING AND J. DALY.

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FOREWORD.

The geophysical surveys described in this report were carried out between 1947 and 1950 as part of an investigation for copper deposits in western New South Wales.

The work was done in cooperation with mining companies to whom the results were conveyed in a preliminary form adequate for their immediate purpose.

Although the results obtained were not promising it is considered desirable to record them in this report.

CONTENTS.

ILLUSTRATIONS.

ABSTRACT.

In the course of an extensive program of geological and geophysical investigations carried out in central New South Wales by the Bureau in conjunction with various mining companies, surveys using magnetic and self-potential methods were performed over areas at Shuttleton, Wirlong and the Mount Boppy Copper and Canbelego Copper workings near Canbelego. At Shuttleton, magnetic and self-potential anomalies were obtained which indicate the presence of an extensive zone of mineralisation. This zone has been tested by one drill hole, which intersected pyritic material, containing no metal of commercial value. At the Mount Boppy Copper mine, magnetic anomalies were obtained indicating the presence of two small mineralised bodies, possibly similar in nature and dimensions to the body already opened by the old workings. In other areas, no anomalies were obtained.

1. INTRODUCTION.

In conjunction with an exploration program carried out by Zinc Corporation Ltd. and North Broken Hill Ltd., the Bureau performed an extensive program of geophysical surveys in the copper belt of western New South Wales, from 1947 to 1950. The main known orebodies occur in a triangular area with corners at Cobar, Girilambone and Mt. Hope, and have all been covered by geophysical survey. Results of the following surveys have been published.

Cobar district.

A large area embracing all the known mines, has been covered, partly by the Bureau, and partly by Zinc Corporation Ltd. No final report on the Bureau's work has been prepared, but the results of all the work are discussed by Thomson (1950). This report also contains details of drilling carried out on anomalies by Zinc Corporation Ltd.

Budgery, Budgerygar and Girilambone. Barlow (1950).

Mt. Hope and Comet. Doyle (1951).

Nymagee. Oldham (1959).

The present report deals with the remainder of the work, comprising surveys at Shuttleton, and Wirlong, and the Mt. Boppy Copper and Canbelego Copper mine areas, near Canbelego. These surveys were carried out by W. D. Keating, W. H. Oldham and M. G. Allen.

2. GENERAL GEOLOGY.

The geological information available varies greatly over the area mentioned above. The Cobar field has had a great deal of attention. The most recent publication, in which references to earlier work are given, is by Thomson (1953). The Shuttleton and Canbelego areas have had less attention. Brief reference to the geology is made in later sections of this report.

It cannot be assumed that the criteria derived from studies at Cobar can be applied to the areas in question in this report. However, the whole of the copper mining area of central New South Wales has the feature in common, that geological mapping is extremely difficult, for the following reasons.

(a) Outcrop is very poor, and by far the larger part of the area is soil covered.

(b) The important rock types have no very distinctive features. They consist of quartzites, sandstones and shales, with intermediate types.

For these reasons, geological mapping cannot be expected to provide targets for exploration, except where mine openings give facilities for the extremely detailed mapping necessary to elucidate structure in such featureless rocks.

3 METHODS USED.

The basis for the application of geophysical methods is the fact that the orebodies sought are sulphide bodies, containing some pyrrhotite and/or magnetite. It may be expected that they will cause magnetic anomalies, and in favourable situations, self potential anomalies. This has been confirmed by tests over the main deposits, which are described in the reports referred to above. The testing performed by Zinc Corporation Ltd. has shown that the presence of pyrrhotite mineralisation is not necessarily associated with copper in mineable grade. It may be expected, therefore, that any copper orebody of significant size will be associated with a magnetic anomaly, and in certain cases, a self potential anomaly, but that some, and probably the great majority, of the anomalies discovered will be due to mineralised bodies containing pyrrhotite, without copper mineralisation of economic value.

The magnetic and self potential methods only were used on the surveys.

4 SHUTTLETON AREA.

General.

The Shuttleton mines are about 50 miles south of Cobar, and 18 miles west-south-west of Nymagee. The deposits have been mined on a small scale between 1900 and 1920, for a production of about 2,800 tons of copper metal. Two main shafts have been sunk, the Crowl Creek shaft to 730 feet, and the South Shuttleton shaft to 470 feet. Only the upper levels of the shafts are now accessible. Water level stands at 300 feet in the Crowl Creek shaft, and 360 feet in the South Shuttleton workings. The geophysical survey was performed in connection with an exploration campaign carried out by North Broken Hill Ltd.

Geology.

The area was mapped geologically by Dr. A. H. Voisey on behalf of North Broken Hill Ltd., and the following brief notes are based on his unpublished report to the Company.

The principal structural feature is a shear zone of considerable width, occupied by a finely sheared igneous rock. East of the shear, the rocks consist of the Cobar series of alternating bands of slates and quartzites. The rocks west of the shear are quartzites, which are considered to be younger than the Cobar series. The two known ore bodies occur east of the shear, close to its intersection with small transverse faults. The rocks dip steeply to the east.

Results.

The self potential results are shown as contours on Plate 2, and the magnetic results on Plate 3.

The magnetic contours show an elongated anomaly of very low intensity, with an axis roughly parallel to the shear, and about 400 to 500 feet east of it. There is evidence of a similar anomaly at the northern end of the surveyed area, which

has not been completely covered by the survey. The main anomaly could be caused by a tabular mass of weakly magnetic material with a steep easterly dip, the top of which is about 500 feet from the surface.

A more or less continuous zone of self potential anomaly extends over the whole of the surveyed area. The axis of the anomaly is roughly parallel to the shear, and about 200-300 feet east of it, until the Crowl Creek shaft is reached. Here, the plan shows the axis as swinging to the west, and proceeding on the west of the shear to the northern end of the area. However, there is no evidence for the shape of the contours between traverses 186 and 190, and it is possible that the anomaly north of traverse 190 is quite distinct from the main anomaly south of traverse 186. The axis of the anomaly passes close to the shafts, and is almost certainly related to the worked ore bodies. However, there is no minimum associated with the lode at either main shaft. It is certain that only a small proportion of the primary copper ore has been mined, but there is evidence that the water level has risen about 50 feet in each shaft, so that it is possible that all sulphide ore is now below waterlevel, and thus not subject to oxidation.

The profile on traverse 170 is consistent with a tabular body dipping to the east at 70°, with its top at a depth of about 150-200 feet below surface.

It has been noted that the general shape of the self potential contours corresponds closely with the topographic contours of the ridge on which the shafts are situated. It is known that earth potentials may be affected by topographic features, and in some cases, large self potential anomalies have been observed which are attributed solely to topographic effects. It is considered that the main part of the Shuttleton anomaly may be attributed to sulphide mineralisation for the following reasons:

(a) Tests made over other hills around Shuttleton showed no self potential anomalies.

(b) Self potential anomalies have been observed at Cobar and Nymagee. Although these anomalies are located on high ground, there is no close correspondence of self potential with topographic contours.

(c) If self potential anomalies are associated with sulphide mineralisation in the Cobar district, it is to be expected that tests over known orebodies will show a positive correlation between self potential anomalies and hills. Owing to the small amount of rock exposure, only those orebodies which outcropped on hills have been discovered.

The cause of the anomaly north of traverse 190 is not known. Because of its narrow width, and its position to the west of the shear, it cannot be attributed to sulphide mineralisation with any confidence.

Testing.

As the results of the survey indicated the possibility of extensive mineralisation in the untested area

between the two main shafts, it was suggested to North Broken Hill Ltd. that testing was desirable (Richardson, 1949). One hole was drilled to test the self potential anomaly, the position of which is shown on Plates 2 and 3.

The hole was continued to a depth of 707½ feet. The greater part of the core showed pyrite mineralisation, but only traces of copper as chalcopyrite were present. It is considered that this mineralisation is sufficient to account for the self potential anomaly. The core up to 580 feet was logged magnetically using a variometer. It was non-magnetic, except for a magnetic section between 470 and 535 feet, carrying finely divided pyrrhotite. This may be the north end of the body causing the magnetic anomaly. However, the drill hole is far distant from the centre of the magnetic anomaly and it would be expected that the main bulk of the body would be at greater depth.

Conclusions.

The results show that a substantially continuous zone of sulphide mineralisation occurs in the area between the South Shuttleton and Crowl Creek shafts. It appears that copper minerals occur in this zone in short shoots. The zone could well contain other shoots than those previously mined. However, as it appears that the geophysical results are not likely to be of value in distinguishing between copper and other sulphide mineralisation, the only way of prospecting for any other ore shoots which may exist would be to test the mineralized zone systematically along its length, by drilling.

5 WIRLONG AREA.

A brief magnetic survey was conducted over the Wirlong area, some miles east of Shuttleton. Very little geological information is available about this area, which contains several shafts, but from which production has been small. Plate 4 shows a plan of the area and profiles of vertical magnetic intensity. The results show nothing of significance.

6 CANBELEGO AREA.

General.

The township of Canbelego is about 3 miles south of Boppy Mountain railway station, on the Cobar line. It is located at the site of the Mt. Boppy mine, which was for many years a major gold producer. In addition to this, a considerable number of gold and copper prospects has been tested. None has been mined on a large scale, and from most, the production was insignificant. In connection with their prospecting campaign in the district, North Broken Hill Ltd. selected two groups, the Mount Boppy Copper group and the Canbelego Copper group, which appeared to offer the best prospects. Geophysical surveys were performed by the Bureau over an area surrounding these groups.

Geology.

The main source of geological information on the Canbelego area is Andrews (1913).

The area contains two main rock types

(1) the Canbelego series, of slates, sandstones, schists, and quartzites. These are closely folded, and contain the mineralised areas of the district

(2) quartz felspar porphyry. Evidence is not sufficient to decide whether this is or is not of intrusive origin.

The Mount Boppy Copper lode occurs in the sedimentary rocks close to the contact with the porphyry, which in this area dips steeply to the west. The lode consists of quartz veins and stringers, carrying copper minerals. Its dip is almost vertical. It can be traced for a considerable length, and is marked by a strong gossan outcrop. Previous workings and general distribution of rock types are shown on Plate 5.

The Canbelego Copper lode occurs in sedimentary rocks. It consists of quartz veins and stringers in a crush zone, and is apparently remote from igneous rocks, although a dyke, possibly of norite, lies parallel to the lode a few chains to the east. The dip of the lode is almost vertical. Plate 6 shows the distribution of old workings.

7. RESULTS.

(a) Mount Boppy Copper Area.

The results of the magnetic survey are shown on Plate 5. They show the following features -

(i) A zone of strongly disturbed magnetic conditions over the gossan outcrops. This is due to iron minerals in the outcrops.

(ii) A zone of weak anomalies in the western portion of the layout. The cause of these is uncertain, but is very shallow seated.

(iii) Three well defined anomalies, which may be due to mineralised bodies of the type sought. One of these is situated at the Old Burra shaft, and is presumably due to the body encountered in mining operations. The other two occur in untested ground at the southern end of the layout. Rough calculations suggest that the anomaly at the Old Burra shaft may be due to a pipe-like body, centred at a depth of 125 feet. The two southern anomalies could be caused by slightly larger bodies, centred at a depth of about 200 feet.

The self potential survey showed no anomalies, except for a series of weak features about 700 feet east of the base line. The cause of these is unknown, but they are not of the type generally associated with sulphide orebodies.

It may be mentioned that the "gossan" outcrops frequently found in this area, are not a reliable indication of the presence of sulphide mineralisation at depth, but are commonly surface features of a lateritic nature. A great deal of effort has been expended in the Canbelego area in sinking shafts on strong "gossan" outcrops, which have passed into undisturbed sediments at shallow depth.

(b) Canbelego Copper Area.

Neither magnetic nor self potential surveys showed any features of significance.

8. CONCLUSION & RECOMMENDATIONS.

The magnetic survey suggests the possible presence of two untested orebodies in the Mount Boppy Copper area. These lie in a favourable position with reference to the known position of the lode. However, they are due to relatively small bodies, of size comparable with the orebody explored from the Old Burra shaft. If the discovery of such orebodies would be of interest, the anomalies could be tested by drill holes located as follows:

DDH 1, collar 125.8/52.8
bearing in direction of traverse to west
depression 50°
length 300 feet.

DDH 2, collar 118/53.13
bearing in direction of traverse to west
depression 50°
length 300 feet.

However, the results do not suggest the presence of ore bodies of major dimensions.

Results on the Canbelego Copper area do not suggest any targets for further exploration.

9 REFERENCES.

ANDREWS, E.C., 1913 - Cobar Copper and Gold Field Pt. II. The Canbelego, Budgery and Budgerygar Mines, N.S.W. Mines Dept. Min. Resour. 18.

BARLOW, A.J., 1950 - Geophysical Surveys at Hermidale and Girilambone, N.S.W. B.M.R.G.G. Records 1950/25.

DOYLE, H., 1951 - Geophysical Surveys at Mt. Hope, New South Wales. B.M.R.G.G. Records 1951/12

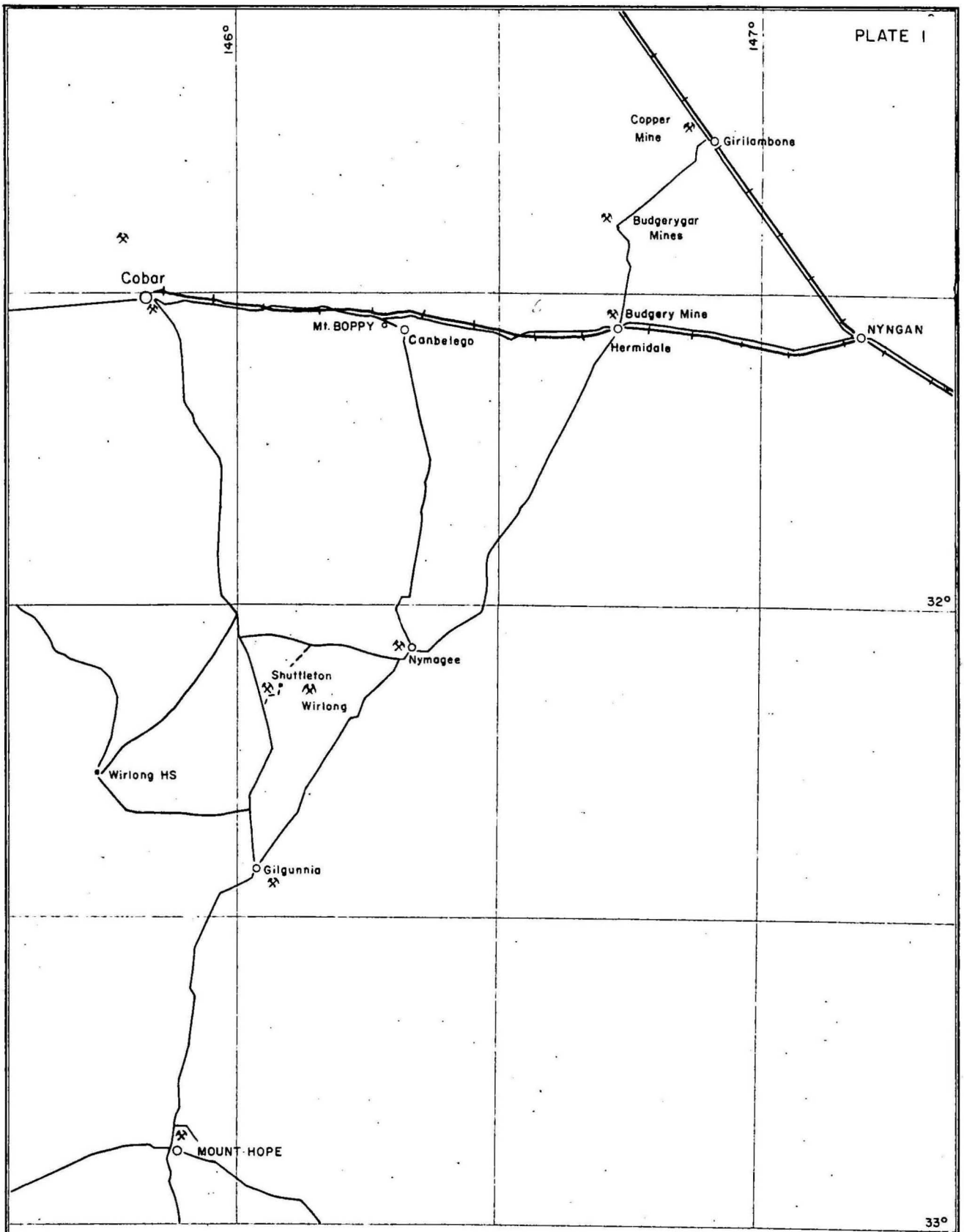
OLDHAM, H., 1959 - Geophysical Survey of Nymagee Copper Field, New South Wales. B.M.R.G.G. Records 1959/1.

RICHARDSON, L.A., 1949 - Shuttleton Geophysical Survey. First Progress Report. B.M.R.G.G. Records 1949/73.

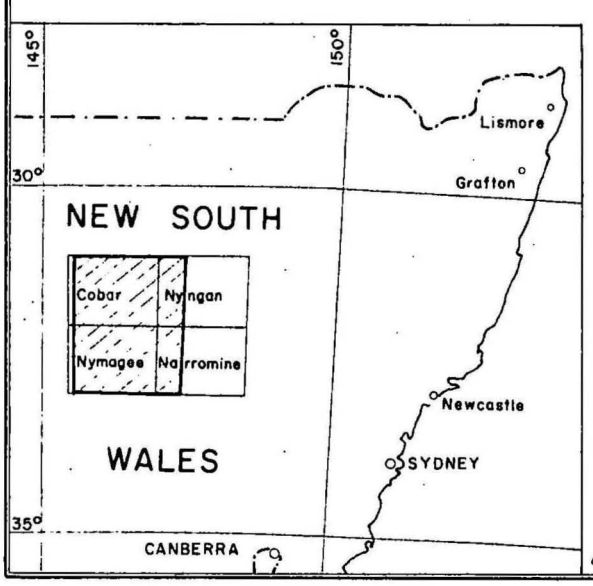
THOMSON, B.P., 1950 - Cobar Exploration 1947-49. Report to Zinc Corporation Ltd.

THOMSON, B.P., 1953 - Geology & Ore Occurrence in the Cobar district. Geology of Australian Ore Deposits p.863-897.

PLATE 1



REFERENCE TO AUSTR. 4 MILE MILITARY MAP SERIES



GEOPHYSICAL SURVEYS AT SHUTTLETON AND CANBELEGO, N.S.W.

LOCALITY MAP

SCALE IN MILES

10 0 10 20 30

(AFTER 1:1,000,000 I.C.A.O CHARTS BOURKE AND CANBERRA)

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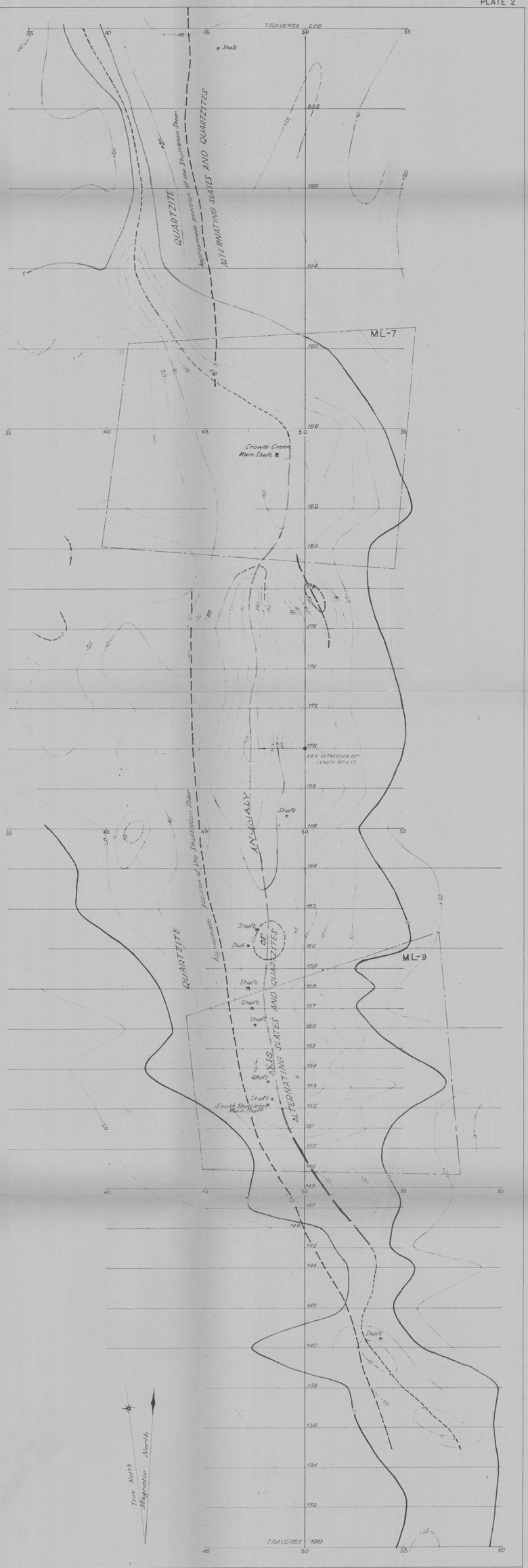
TO ACCOMPANY RECORDS 1959, No 152



Geophysicist
5-5-49

SCALE

0 200 400 600 800 FEET

Contour Interval - 20 Millivolts.

SHUTTLETON GEOPHYSICAL SURVEY

GEOLOGICAL FEATURES AND SELF POTENTIAL CONTOURS

G52-5

Geophysical Branch, Bureau of Mineral Resources Geology and Geophysics.

TO ACCOMPANY RECORDS 1949, No 102

Hugh S. Allen
Geophysicist
6-5-49.

Scale
200 100 0 200 400 600 FEET

Contour Interval - 10 Gammas.

SHUTTLETON GEOPHYSICAL SURVEY

PLAN SHOWING
MAGNETIC VERTICAL FORCE CONTOURS

G52- 3

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PLATE 4

Hugh Oldham

Geophysicist

2 · 5 · 49

0 100 200 400 600 800 1000 feet

0 100 200 300 400 500 gammas

Geophysical Survey of

WIRLONG COPPER FIELD

Nymagee District, N.S.W.

Plate showing layout of Traverses, position of shafts and Magnetic Vertical Force Profiles.

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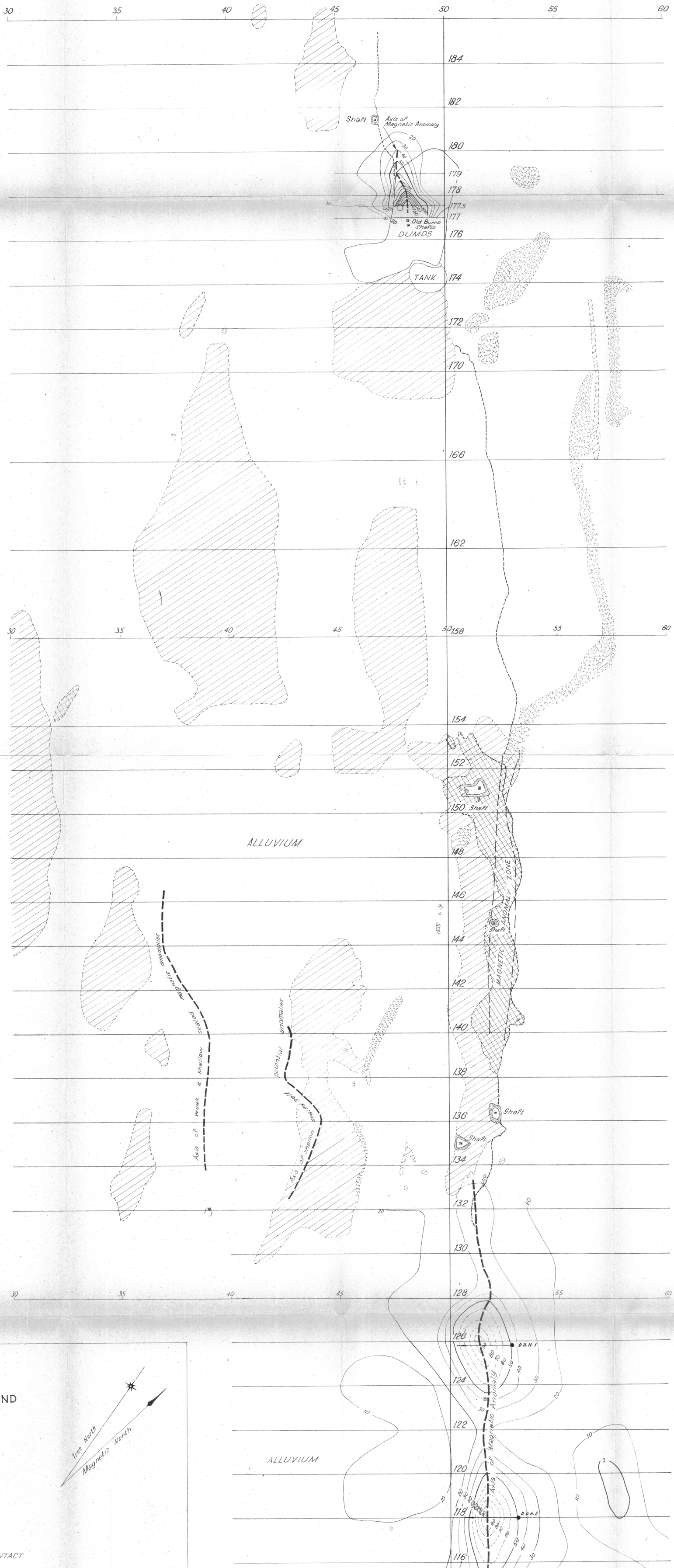
G 57-3

TO ACCOMPANY RECORDS 1959, No. 152



LEGEND

- SEDIMENTS
- PORPHYRY
- GOSSAN
- RHYOLITE
- PORPHYRY CONTACT
- ANOMALY AXIS
- BOUNDARY OF INTENSE MAGNETIC ANOMALIES DUE TO GOSSAN.
- MAGNETIC VERTICAL FORCE CONTOURS

True North

Magnetic North

Traverse pegging, geology and location of mine workings by Nth Broken Hill Ltd.

D.D.H. Recommended drill hole

SCALE

200 0 200 400 600 Feet

W. D. Keating.
Geophysicist

GEOPHYSICAL SURVEY AT CANBELEGO N.S.W

MOUNT BOPPY COPPER MINE AREA

PLAN SHOWING POSITIONS OF SURVEY TRAVERSES, GEOPHYSICAL AND GEOLOGICAL FEATURES AND OLD MINE WORKINGS.

Geophysical Branch, Bureau of Mineral Resources Geology & Geophysics.

G 67 - 1

TO ACCOMPANY RECORDS 1959, No. 152

PLATE 6

SCALE

200 0 200 400 600 800 FEET

W. D. Kerby.
Geophysicist

GEOPHYSICAL SURVEY AT CANBELEGO N.S.W.

CANBELEGO COPPER MINE AREA

PLAN SHOWING POSITIONS OF SURVEY TRAVERSES AND OLD MINE WORKINGS

Traverse pegging and location of surface features by North Broken Hill Ltd

G67-5

Geophysical Branch, Bureau of Mineral Resources Geology & Geophysics