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ELECTROMAGNETIC SURVEYS IN THE MOONTA-WALLAROO COPPERFIELD

APPRAISAL OF PREVIOUS WORK

by

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ELECTROMAGNETIC SURVEYS IN THE MOONTA-WALLAROO COPPERFIELD.

Geophysical surveys in this area have been carried out at various times using magnetic, gravitational, radioactive and various types of electrical surveys. The earliest geophysical work was carried out by the Imperial Geophysical Experimental Survey in 1929, when magnetic, electrical equipotential line and high frequency resistivity methods were tried and found unsatisfactory on account of the screening effects of saline ground water. In 1942, Thyer, on behalf of the Mineral Resources Survey Branch, carried out further work using the potential gradient, electromagnetic, self potential and magnetic methods. Of these methods the electromagnetic appeared to give quite promising results, the self potential and potential gradient methods were discarded as useless in this area, and information precise enough to be used to define drilling targets does not appear to be obtainable from the magnetic results, although correlation in a general way with structure is evident.

The results obtained by the Imperial Geophysical Experimental Survey are published in -

"Principles and Practice of Geophysical Prospecting" Broughton Edge and Laby., Cambridge University Press 1931; and Thyer's work is contained in Report No. 1943/19 of the Mineral Resources Branch, Department of Supply and Shipping. An abridged version of Thyer's report is contained in Mining Review 77, pp. 41-48, which leaves out all details of the field electromagnetic results obtained.

Extensive further geophysical work on the area was carried out in 1947-8 under the auspices of the Zinc Corporation, including a magnetic survey of a large area called Benedict's Square, a reconnaissance Magnetic Survey along roads, and a number of constant electrode separation resistivity traverses using the Wenner system mostly at 30 feet and 300 feet spacing. Three of these resistivity traverse lines A, B and 2 cover the eastern portion of /Thyer's layouts on his Elders-East Moonta

layout, running along portions of Thyer's lines 100S and 300S (layout C) and 500S (layout B) respectively. The results obtained on these traverses qualitatively confirm Thyer's positioning of conductors in this region, but seem to be less specific. A considerable amount of geochemical work was also carried out by V.P. Sokoloff (Mining Review 88, pp. 32-71). Confirmatory results were obtained over known lodes and one relatively large anomaly was drilled resulting in the discovery of a low grade lode. None of this work, however, was in the areas covered by Thyer's electromagnetic surveys. W.H. Knapman (Geophysical Report 3/52, D.M. 1105/51) carried out in 1951-2 a radioactive survey of an extensive area nearly identical with that covered by the Zinc Corporation, using jeep-mounted scintillation equipment. This was unsuccessful in indicating further possible copper bearing lodes, but led indirectly to the location of another felspar porphyry intrusion in the vicinity of Sections 513 and 514, Hd. of Wallaroo. K.R. Seedsman discussed the use of magnetic anomalies to provide indications of shearing on a scale likely to provide structures for ore body emplacement. (Geophysical Report 5/53, D.M. 1114/51). A summary of the Zinc Corporation's geophysical work to September 1948, was written by W.G. Fenner (Geophysical Report 6/48, DM 264/49)

It has been suggested that insufficient follow up work has been carried out on Thyer's electromagnetic anomalies and that further testing of his results is desirable either immediately or else after comparison with geochemical work in the same area.

Thyer's work was carried out in two main regions; one near East Moonta where three "layouts" called Hogg's, Beddome's and Elders-East Moonta were measured; and the other in the vicinity of Kadina where the Kurilla and Devon layouts were measured. In the first area numerous electromagnetic anomalies were found and almost all the known lodes were found to give indications of the order of 10-40 electromagnetic units (microgauss ~~grams~~ per ampere of primary current). In the second main region the electromagnetic anomalies were somewhat smaller ranging from 5-20 electromagnetic units, and in addition a magnetic survey

was carried out over a large part of this area in the vicinity of the Devon lode.

Beddome's layout, the first area tested, was also covered with potential ratio and self potential traverses, but the results obtained were discarded as evidently due to many causes other than subsurface lodes. In general the indications over known lodes were found to be displaced about 30 feet horizontally in a down dip direction from the outcrop or projected outcrop of the lode. In only two localities were the electromagnetic indications not found corresponding to known lodes, and in one of these the electromagnetic results were badly disturbed by the presence of buried water mains.

As a result of this work Thyer recommended a number of diamond drill holes to test the anomalies viz:

(a) at one site near the faults on Beddome's lode

(b) at nineteen sites in the Elder's-East Moonta layout, divided into four groups - A, B, C, D.; of which two holes in each group were suggested for initial testing.

(c) at four sites in the Kurilla area

(d) at two sites near the Devon lode to test magnetic anomalies.

No testing was recommended in the Hogg's and Buchan's lode area as the only indications obtained corresponded to known lodes and these were represented for the whole of their length.

These recomm-endations were subsequently reconsidered by S. B. Dickinson, (Mining Review 77, p. 50) who modified them ~~only~~ to the extent of substituting ~~in the Kurilla area a fifth~~ only the initial sites ~~originally included~~ recommended by Thyer, ~~but later withdrawn in place of one of those recommended by him~~.

The drilling actually carried out was as follows:-

(a) At East Moonta geophysical sites Nos. 1, 5, 9, and 15, one in each of Thyer's Groups, of which site No. 9 was abandoned at 126'4" due to broken casing and bad ground. The first site drilled (No. 15) entered a micaceous schist at 66 feet, from which it was

surmised that the geophysical indications were due to a change from felspar porphyry to mica schist.

(b) At Kurilla geophysical sites Nos. 2 and ~~5 6 7~~ 4.

(c) On the Devon magnetic anomalies both sites recommended by Thyer.

A summary of the results of the drilling to test Thyer's electromagnetic anomalies is given in the accompanying Table.

The anomaly found by Thyer near Beddome's lode has, as far as can be ascertained, not been tested.

Although a barren lode and various shears and fracture zones were encountered in these holes no indication of any lodes approaching economic value were obtained. After the above drilling had been completed, on the recommendation of E. Broadhurst a drilling programme was initiated "with a view to locating an entirely new zone of copper mineralization, the presence of which is anticipated from broad geological reasoning." This was described as "a policy of bold prospecting for drilling for entirely new mines without geophysical surveys, conditions for which at Moonta, appear to be extremely unfavourable."

Broadhurst recommended 6 diamond drill sites in a line between Hogg's lode and Warmington shaft, of which four Nos. E1, E2, E3 and E4 were actually drilled, but some were drilled much deeper than the 400 feet recommended by Broadhurst. These also failed to intersect any worthwhile lodes. All subsequent drilling in the Moonta - Wallaroo - Kadina triangle has been to test other geophysical anomalies or lode extensions and has not been in the area covered by Thyer's electromagnetic surveys.

Prior to the geophysical surveys, however, in 1927-9, ten bores were sunk near the southern end of Eders lode and the northern extension of Milnes lode to test the extensions of Milnes and Elders lode. All except three of these bores come within the southern boundary of Thyer's Elders - East Moonta layout but they are in the southwest corner of his area, where there are both strong electromagnetic indications and known lode shears. Most of these diamond drill holes encountered lode formations, but

they cannot be considered to be of much assistance in assessing the usefulness of the electromagnetic indications. In No.10 of these a minor electromagnetic anamaly is confirmed by 3 ft. ins. of quartz struck at 140 ft.

The drill holes put down on the magnetic anomalies failed to intersect any lodes or shears; as has been found in all subsequent drill holes put down to test magnetic anomalies, except that in a few instances minor shears have been located. A portion of the eastern part of Thyer's layouts were covered by shallow boreholes to bedrock in the course of the resistivity traverses conducted over it, some of the tests being made with the electrodes at bedrock level.

Numerous underground drill holes were put down in Hogg's and Buchans mines to test the lode when these mines were operating and about six underground holes were drilled on Beddome's lode. These, of course, gave no indication of the presence or otherwise of adjacent lodes.

This is believed to be all the drilling carried out in the areas covered by Thyer's electromagnetic Surveys.

Although the drill holes put down to test the electromagnetic anomalies discovered no new lodes of economic value East Moonta No. 2 reached a fracture zone presumably containing electrically conductive saline waters at the position indicated by the anomaly and East Moonta No. 1 indicates a change of rock type from porphyry to mica schist at approximately the position expected from the electromagnetic anomaly. This was considered at the time "reasonably conclusive" that the whole of Thyer's "Group D" of electromagnetic indications was due to a change of rock type. No suggestions were made however, as to why these indications should have an echelon pattern. In the two Kurilla boreholes the second reached an incipient lode formation at about the depth to be expected from the first of the electrical anomalies and traces of pyrite and chalcopyrite in the positions corresponding to the second.

These minor indications, although economically not

significant appear to have been ignored in previous assessment of this work. It should be pointed out that this electrical method attempts to locate electrical conductors, and therefore an incipient lode or fractured zone filled with saline groundwater may give almost as strong an indication as a well defined lode. Confirmatory testing by other methods is, therefore, most desirable, and conversely it is by no means evident that uneconomic values on one portion of an electromagnetic indication necessarily indicate an absence of lode formation along the whole length of the electromagnetic anomaly, especially since many of the known lodes in the Wallaroo and Moonta mines are lenticular.

The results obtained by using all methods of prospecting in the Moonta-Wallaroo copperfield have been disappointing and considering the results of every method tried - including pure geology, testing of magnetic anomalies, and geochemical work, it would appear that geochemical investigations are the most favourable and that Thyer's electromagnetic work has not been sufficiently tested as it was abandoned after only five economically unsuccessful test holes.

On account of the vast amount of unsuccessful drilling already undertaken in this field it is not suggested that further drilling be carried out on these electromagnetic anomalies, but that if possible the indications be tested by another method, preferably geochemical; any anomalies confirmed by subsequent work should then merit testing by drilling. It might be advantageous, too, to trace along Thyer's conductors, if and when they are confirmed, in order to find, not only lode shears, but also if possible their widest expression.

There may be some difficulty in finding areas sufficiently free from contamination from old mine dumps and refuse from buildings etc. to enable tests to be carried out, and it is

suggested that the practicability of geochemical tests over the area of Thyer's anomalies be referred to the Senior Geochemist.

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TABLE I.

DIAMOND DRILLING ON ELECTROMAGNETIC ANOMALIES

Mines Dept. Bore No.	Geophysic. Site No.	Depth (ft.)	Angle of Depression	Bearing °(M)	Remarks	Year
East Moonta 1	15	175'3"	50°	100° 15'	47' - 52' Quartz lode, No Cu Trace Au 66' Mica Schist, changing to micaceous sandstone	1944
East Moonta 2	9	350'	50°	115° 45'	116'6" - 120'6" Quartz-tourmaline vein and brecciation; no Cu 307'8" - 310'1" fractures with traces of chalcopyrite	1944
East Moonta 3	5	126'4"	50°	112°	abandoned on account of bad ground and casing breaking	1944
East Moonta 4	1	225'	50°	100° 15'	218'6" - 219'0" fracture zone.	1944
Kurilla 6	2	339'6"	45°	170° approx.	Few traces of chalcopyrite below 240 ft. No defined lode.	1942
Kurilla 7	34	554'3"	45°	185° approx.	Fractured quartz-mica schist 213' - 213'5" and 350' - 369'3". Traces of pyrite and chalcopyrite from 268'6" - 291'4" Lodes at 518'1" - 518'7" 532'1" - 532'4" 536'5" - 536'9".	1943