Geophysical Test Surveys at Moonta, S.A.

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GEOPHYSICAL TEST SURVEYS AT MOONTA, SOUTH AUSTRALIA.

I. INTRODUCTION

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The following notes accompany a plan of one of the areas tested at Moonta, namely, an area embracing sections of Elder's Main lode and Elder's West lode between Warmington's and Taylor's shafts. The test surveys on which the plan and notes are based were made in March, 1942.

The plan shows the results of a potential gradient survey in the form of a potential gradient contour plan. Places occupied by high potential gradient values are places where the resistivities are greater than the average for the area, while places of low gradient values correspond to resistivities below this average.

The potential gradients are determined by passing an alternating current through the ground and mapping the potential distribution on the surface.

The plan is intended to illustrate in a general way the nature of the potential gradient results of all the tests in the Moonta-Kadina area and it should not be accepted as a basis for assessing the value of the tests as a whole.

A great number of tests were made embracing the use of potential gradient, electromagnetic, magnetic and self-potential methods, and the nature of the results varied considerably. Correlation between geophysical results and known geology was good in many cases, but indifferent in others. It will be appreciated therefore, that a decision to carry out routine surveys can only be based on a critical examination of the results as a whole.

II. GEOLOGY AND NATURE OF THE GEOPHYSICAL PROBLEM

The rock in which Elder's Main lode and Elder's West lode occur is a felspar porphyry which has been weathered to a considerable depth. Its outcrop, and the outcrop of the lodes are obscured by a covering of clay, travertine limestone and soil.

The lodes occur in fissures or shears in the porphyry and are pegmatitic in character. They strike roughly N.E.-S.W. and dip at about 60 degrees to the N.W. Within 60-70 ft. of the surface the lodes are oxidized and leached of their copper content. In the oxidized zone the lode filling comprises quartz, kaolin, limonite and minor amounts of oxidized copper minerals. The potential gradient effects herein described are believed to be largely due to material within the oxidized zone, the primary zone having been extensively mined.

In addition to the shears carrying the lodes, there is a fault (called Taylor fault) traversing the area. Taylor fault has approximately the strike of the Main lode shear but dips at a flatter angle, viz. 45 degrees, to the N.W. Its projected outcrop position is 100-150 ft. to the S.E. of the Main lode outcrop. It has not been intersected in the upper workings of the mine so that the outcrop position as shown on the plan is only approximate.

In order to fully appreciate the nature of the geophysical results it is necessary to briefly outline the physical character of the lode shears and Taylor fault.

i. Main lode shear - shows little smashing of the wall rocks but the wall rocks and the material contained therein have been altered by the action of the vein-forming solutions. This alteration has resulted in the wall rocks becoming more friable than the unaltered porphyry - a change which might reasonably be associated with an increase in electrical conductivity.

The copper minerals occur in shoots along the Main lode shear. Between the shoots the Main lode shear is generally a weakly developed feature in which minor amounts of crushed material and lode filling occur.

Thus, from a geophysical point of view, one would expect strong reactions from the Main lode shear over the ore shoots and poor reactions elsewhere on the shear. Applying this to the area under discussion one might, on the basis of the stope plan shown in Dr. Jack's report, classify that section of Elder's Main lode between traverses 100E. and 200W. layout C, as one over which poor reactions are to be expected while that section between traverses 200W, layout C, and 170 W, layout B, might be classified as one over which stronger reactions might be expected.

ii. West lode shear - is a typical fault which has been filled with crushed material. The wall rock alteration is usually more extensive than in the Main lode shears. The West lode shear has a composite character and consists of a number of parallel fractures. As a result of this the West lode has taken a selective route, not necessarily collinear. The upper limit of the West lode ore body is 240 ft. from the surface but Dr. Jack states in his report that the 'track' of the lode persists towards the surface. It is difficult to determine from published descriptions of the lodes what physical character this lode 'track' has. In one or two places where it has been described it appears to consist of a few inches of crushed material containing a little quartz and copper sulphide. If this description applies generally to the West lode shear near the surface in the area tested, no appreciable geophysical reaction could be expected from it.

iii. Taylor fault - intersects Elder's Main lode at a depth of from 600 ft. to 1000 ft. in the area tested. At this depth the fault contains from 1 ft. to 2 ft. of crushed material which is not mineralized. If it has a similar character near the surface a measurable geophysical effect might be expected from it.

III. RESULTS OF THE POTENTIAL GRADIENT SURVEY

1. Layout B. Two pronounced conductive zones cross the layout. The most southerly of these is a wide zone containing two minima. Elder's Main and East lodes (the latter being an off-shoot of the former) pass through this conductive zone but there is no obvious correlation between the conductive minima and the lodes.

Two cross features, one having the strike of the West lode shear, and the other a N.E.-S.W. strike are known to cross the Main lode near Taylor's shaft. Their plan positions are not known for certain but it is believed that one or both of these features may have influenced the results.

/ R.Lockhart Jack, B.E., F.G.S. Geology of the Moonta and Wallaroo Mining district - Geological survey of S.A. Bulletin No.6, 1917.

The strong conductive indication which crosses the layout between 450 N. and 475 N. is too far to the northwest to permit a correlation between it and the West lode shear. It is a strong feature and its strike resembles that of the Main lode shear. It may possibly represent a northerly continuation of Bennett's lode which has this strike and, where known, lies approximately 650 ft. to the west of Elder's Main lode.

The projected outcrop position of the West lode shear crosses the layout at approximately 300 N. but it is not known for certain whether this feature actually reaches the surface. There is no indication near 300 N. which could be correlated with the West lode shear.

No indication was obtained over the assumed outcrop of Taylor fault.

2. Layout C. A zone of low resistivity values crosses the layout between 0 and 100 S. It embraces two lines of minima (shown by the closed contours) the most northerly of which coincides roughly with the outcrop of Elder's Main lode. The coincidence is best on the southwestern edge of the layout and there is little doubt that the line of minima is due to the main lode shear. It will be observed that the indication is most intense on traverses 200 W, 250 W, and 300 W. Geological evidence suggests that the shearing is more intense over this section of the layout than elsewhere on the layout so that a correlation is possible between degree of shearing and intensity of indication.

The second line of minima passes through, and is most intense on, 90S/200W, 95S/100W, and 70S/50E. In plan position it is midway between the assumed outcrop of Taylor fault and the outcrop of Elder's Main lode. It may be due to an offshoot of Elder's Main lode (c.f. Elder's East lode on layout B) or to a parallel shear of the Main lode type. On the other hand the position of Taylor fault at the surface is uncertain and the indication may possibly be due to this feature.

A weak conductive indication crossing traverse 0 at 150N. and traverse 50E. at 165N. coincides roughly with the projected position of the West lode shear. Elsewhere along the course of this shear resistivity values are high and on traverse 200W. the projected position coincides with a resistivity maximum. As stated earlier in the discussion of the physical characteristics of the shears, there is reason for believing that the West lode shear near the surface comprises a few inches of crushed material containing quartz and copper sulphides so that the absence of a definite electrical effect over the feature is not surprising.

Other conductive indications on the layout are in areas of unknown geology. With the exception of the wide zone along the southeastern edge of the layout, these conductive indications are discontinuous in strike and no attempt will be made to interpret them in terms of geological structures.

It is believed that the low resistivity values on the southeastern edge of the layout are due in part to the nearness of the power electrodes and that a repetition under more favourable electrode conditions might remove part if not all of the effect. It will be appreciated, therefore, that an interpretation of this effect in terms of geology is not justified.

IV. CONCLUSIONS

The foregoing descriptions should serve to indicate in a general way the nature of the potential gradient results at Moonta.

It will be appreciated that the coincidence between geophysical results and known geology is by no means perfect. An examination of the results from other test areas, however, supports the view that some sections of the lode shears are electrically conductive and can be traced by electrical methods.

In addition to the generally favourable results obtained with the potential gradient method, the self-potential and electromagnetic methods gave encouraging results in tests over other areas.

It should be clearly understood that the geophysical methods would be primarily directed towards the disclosure of the structures with which the ore-bodies are associated. Providing these structures can be located by the methods, the selection of places favourable to the occurrence of ore-shoots would be governed largely by the geological interpretation of these structures. The term largely is used advisedly because at least one of the methods, namely the self-potential method, might give direct indications of the presence of the sulphide minerals which occur in the lodes, and hence locate the lodes directly.

In view of the excellent chances which appear to exist for the occurrence of hitherto undiscovered ore bodies and the difficulties associated with their discovery by other means, it is believed that a routine geophysical survey of the Moonta-Kadina copper area is justified.

Because the lodes occur in a homogeneous rock (felspar porphyry) at Moonta whereas at Kadina the country rock has a variable habit, it is suggested that a survey be carried out in the first instance at Moonta and that the results of this be thoroughly tested before extensive surveys of the Kadina and surrounding areas be undertaken.

CANBERRA, A.C.T.
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(R.F. Thyer)
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GEOPHYSICAL TEST TRAVERSES
— MOONTA MINES —
TAYLOR SHAFT SECTION
ELDER MAIN LODE

0 60 120 240 FT.

REFERENCE

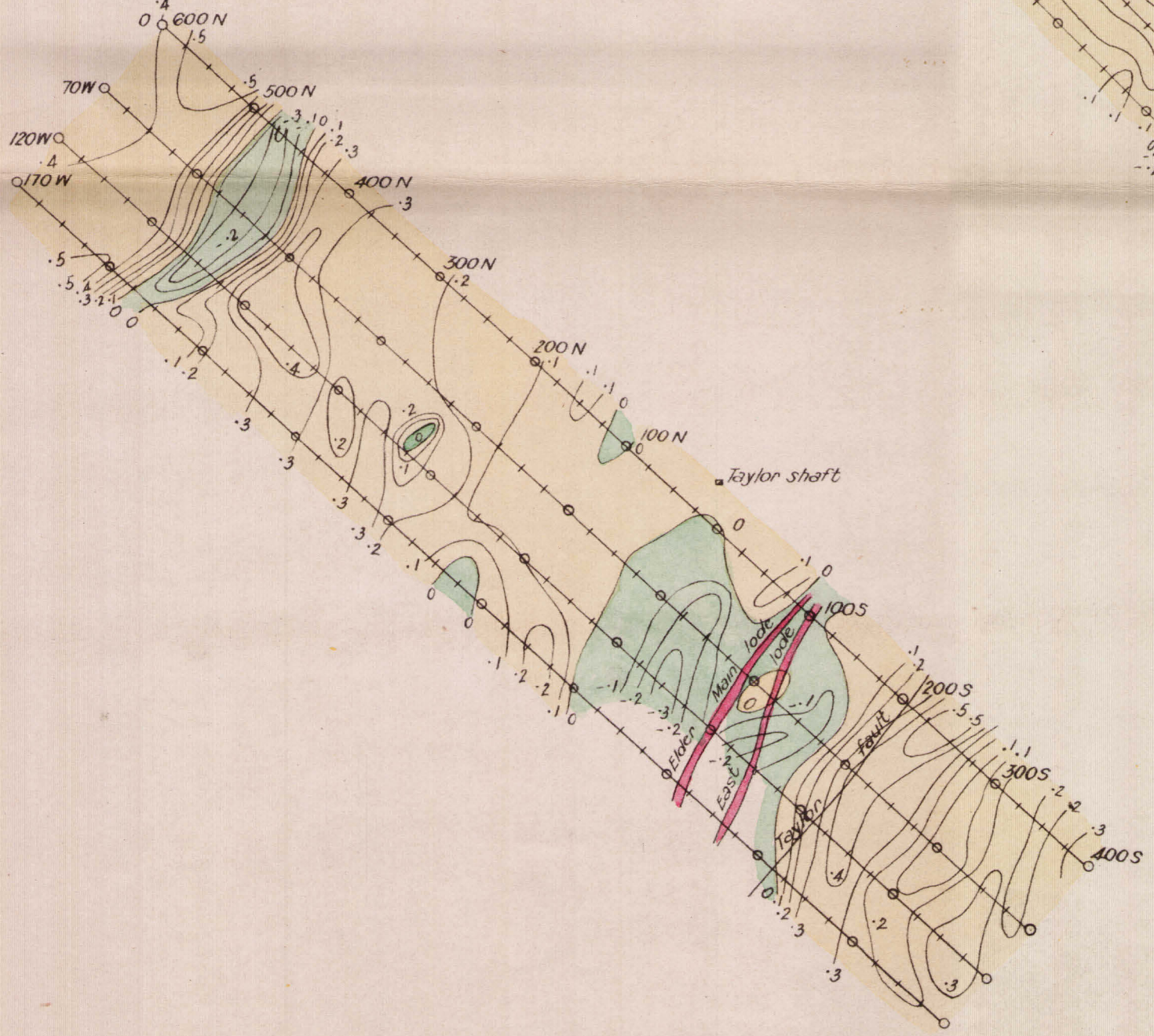
LOGARITHM OF POTENTIAL GRADIENTS

0 - 0·5

0 - -·4

LODES SHOWN

LAYOUT B



LAYOUT C