RB 41/105

DEPARTMENT OF MINES

GEOLOGICAL SURVEY OF SOUTH AUSTRALIA

MAGNETIC ANOMALIES ON YORKE'S PENINSULA.

1 BALGOWAN and WEETULTA AREAS

December 1952 - January 1953

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GEOPHYSICAL REPORT 2/53

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Introduction

One of the magnetic anomalies noticed in the aerial magnetic survey of the Maitland Military Sheet has now been investigated. in some detail. A preliminary ground reconnaissance disclosed the presence of two large magnetic anomalies in the vicinity of Balgowan which could possibly be interpreted as a pair of Synclinal magnetic beds pitching in a WSW and ENE directions respectively. The highest readings on one of the arms of the most southerly anomaly were so large that it appeared probable that the magnetic source causing this disturbance lies very close to the surface. A more detailed survey, using both gravity and magnetic techniques has now been conducted by C. Kerr Grant and University vacation Student, K. Lokan, in order to define its position as accurately as possible and to obtain the greatest possible information concerning its probable interpretation.

Previous Investigations.

In 1952 an aerial magnetometer survey was conducted by the Commonwealth Bureau of Mineral Resources Geology and Geophysics over the area of the Wallaroo, Moonta, and Maitland 1 inch to 1 mile Military Sheets.

The aeromagnetic maps of this area have not yet been published but the locations of several very large magnetic anomalies were obtained from preliminary data and a reconnaissance made of two areas, one near Balgowan and another near Weetulta. The Balgowan results are described in an interin report "Preliminary Survey of Magnetic Anomalies, Maitland Military Sheet" by D. McPharlin.

AREA Investigated

The detailed investigation covered the southermost of the two adjacent anomalies near Balgowan located by McPharlin. A few more magnetic observations have been made over the northerly anomaly here/.

Fig. 1 shows that the locality of this work. Further reconnaissance work has been carried out in the Weetulta area .

Some basic dykes on Yorke's Peninsula, one near Ardrossan and another series running along the coast north of Port Victoria, were also investigated.

Geology and Topography

The area is overlain entirely with recent to tertiary soil and travertine cover rising gently from the sea to the centre of the peninsula. Cambrian series outcrop near Maitland and Moonta, and also on Point Pearce, but there are no outcrops on the coast near Balgowan. Pre-Cambrian has been found ar a shallow depth in bores near Maitland and granitic bedrock has been found in bores at Maitland. South of Balgowan the coast is flanked by sand dimes, and north of it a cliff about 100ft high exposes tertiary Strata along the coast. There is no geological evidence or borehole data on the the depth of bedrock, but presumably it is relatively shallow over the whole area.

Methods Used.

For the detailed survey near Balgowan a grid was surveyed consisting of five traverses 500 feet apart, on which stations were pegged 100 feet apart, observations of vertical magnetic intensity were taken at these stations with a Watts variometer, and gravity determinations made along three traverses with a Carter Y type gravity meter on loan from the University of Adelaide. Reconnaissance magnetic observations in other areas were made at positions located by means of air photos, except over the basic dykes where a single traverse was pegged and run over each.

Results and Interpretation

In the area covered by the detailed survey it is seen that the anomaly falls along two nearby parallel zones running in approximately E.N.E. direction (Fig. 2). The Northern anomalies are much sharper than the Southern anomalies, which is partially accounted for by the fact that they appear to be beds dipping to the south which would be more highly magnetised in the earths magnetic field than beds almost perpendicular to its direction. Attempts to evaluate the dip and depth of the beds by the elementary method described previously are not very accurate owing to the sharpness of the maximum on the profile and a slightly more accurate estimation of the dip of the beds has been found by computation of the theoretical vertical magnetic intensity of

dipping beds by a method described in Jakosky's Exploration Geophysics. The results obtained by this method give a dip of 41^{0} for the southerly dip f the bed and are shown in Fig. 3. The agreement of the theoretical curves with the observed shape of the anomalies makes it quite unlikely that any other interpretation than a synclinal one is possible for the stata causing the anomalies. This syncline appears to be pitching downwards towards the east, from the earlier reconnaissance. observations.

The magnetic values decrease in intensity both to the east and the west of the main anomaly which consists of a ridge of high magnetic values with two peaks near the B and D traverses respectively. The falling off in values to the ease may be partially due to increasing cover, as the ground riser in this direction; in the west it is possible that the basement becpmes deeper as the coast is approached. There is geological and geophysical evidence for a major fault or fault system forming the eastern margin of Spencer's Gulf. If circumstances warrant further pursuit of these investigations, it is considered that much more light could be thrown upon the general structure of this region by extension of there observations. The areomagnetic maps should be of some assistance for this.

The reduced Bonguer Gravity values are shown contoured in Fig 4. These indicate a minor trough in the northern part of the area. of detailed survey succeeded by a sharp increase in gravity over the area of the maximum magnetic anomaly, no corresponding drop in gravity anomalies is found to the south, but a slight ridge occurs somewhat to the south oftthe supposed southern limb of the syncline. This suggests tentatively that this southern limb may be the crest of an anticline; it could possibly also be explained by a very flat dip on the southern limb.

Using the dips computed from the magnetic data, a theoretical gravity porfile has been drawn 2 and is shoen compared with the observed profile in Fig. 5. The thickness of the bed causing the anomaly is underdeterminated to a large extent as very similar profiles are obtained by increasing the thickness of the bed and decreasing its density excess over the surrounding bedrock, so that the product of thickness times density excess remains constant.

A thickness of 100 feet and density excess of 0.7 appears to give the best fit.

5 From the magnetic data the bed thickness is also indeterminate, only the product of thickness times magnetic ausceptibility being found. The maximum horizontal extent of the anomaly however should not be greater than twice the computed depth of the anomaly since the observed maximum is not flat-topped. This gives a maximum horizontal extent of approximately 350 feet or thickness of 250 feet. The product of thickness times magnetic suspeptibility of 0.4 for a thickness of 100feet. The susceptibility of magnetic ore ranges from 0.5 to 1.2. The variation in the suspectibility of magnetite grains has been investigated by Schlichter, who gives a curve correlating suspectibility with the percentage of void im crushed samples. For a suspectibility of 0.4 50% void is deducted. As the density of magnetite is about 5.0 this would appear to indicate that the magnetic bed if only 100 feet wide might contain over 50% by weight of magnetite. Similar considerations apply to the consideration of densities of the anomalies. body. Without more definite information on the normal bedrock in this area speculations on the precise nature of these anomalies cannot be reliable.

Contours of vertical magnetic intensity found in the Weetult area are shown in fig. 6. The magnetic intensities here are somewhat less than in the Balgowan area rising to a maximum of 8000 gammas, this may be due merely to increased cover over the basement. No obvious structure is discernible from the contours.

The traverses taken over the basic dyke about five miles south west of Ardrossan, and ober the series of magnetic dykes running along the coast near Port Victoria are shown in Figs. 7,8. There is no appreciable anomaly over the first dyke which is apprantly non magnetic, and an anomaly of approximatley 100 gammas only over the second. The Balgowan and Weetulta anomalies are far too large to be caused by any rocks of similar character to those comprosing these basic dykes.

A site for an exploratory diamond drill hole to test the largest anomalie found has been selected and is marked on Figs 1 and 2. At an angle of depression of 45° this should intersect the top of the anomalies bed at approximately 200 feet down the hole.

Conclusions

The extremely high values obtained in those anomalies which equal

Intensities recorded in the Middleback Ranges lead to the following deductions:

1. The anomaly must be caused by a bed containing a large percentage Of magnetite., possibly approximately 50%.

2. The tertiary cover in this area must be extrenely thin and probably does not exceed 150 feet.

3. The anomaly may result from a thin bed of high grade magnetite, or more probably from a somewhat thicker ned of correspondingly lower grade, The exact thickness is indeterminate from geophysical observation but should not exceed 200 feet.

In addition the traverses observed across the anomaly define its position to within about 50ft, the magnetic and gravity traverses observed agreeing within the accuracy of the observations for the expressions of a ayncline of the form shown hence this interpretation is considered extremely likely.

Economically the anomalies may be of interest in two ways, first it is possible that the anomalies bed itself is sufficiently rich in iron to be considered an ore bed, or, secondly, they may result from a magnetit quartzite or magnetite achist which may, as in the Middleback Ranges have pockets of ore associated with it, in the troughs of synclines. Whether or not these anomales indicate deposits of economic value at least a portion of Yorke's Peninsula should be now considered as apoten ential iron ore area. Geologically these results give a means of interpretation of the conformation of the basement of Yorke Peninsula beneath its territory cover and throw considerable additional light on the basic structure of this region. It is therefore suggested that this occurence merits further attention both by drilling, and, provided the drilling results are encouraging, by further geophysical exploration of other anomalies both in the area covered by aerial survey and in the rest of the peninsula south of the Maitland sheet.

A site for exploratory drilling has been selected. No further action is recommended in respect of the other magnetic anomalies discovered until the main Balgowan anomaly has been tested.

27/4/53

C. Kerr Grant
SENIOR GEOPHYSICIST

S.A. DEPT. OF MINES

BALGOWAN AREA
H[D] KILKERRAN
MAGNETIC SURVEY

Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from Original from C. Kerr Grant.

Approved	Passed
Director of Mines	

Drn.
Trd. T.P.
Ckd. R.R.
Exd.

Scale 10 CHAINS TO 1 INCH

53-76

Gh1

Date 27.3.53

Fig. 1.

S. A. G. DEPT. OF MINES.

BALGOWAN AREA MAGNETIC SURVEY

LOCALITY PLAN

Approved		SCALE 20 Chn. to 1inch
Director of Mines.	Drawn K Traced Checked / Passed Chief Draughtsman	53·19 Ghl
		DATE 16 · 1 · 53

Associated Drawings	Drg. No.	No.	Authority	Date	Amendment	Req. No.	D.M.

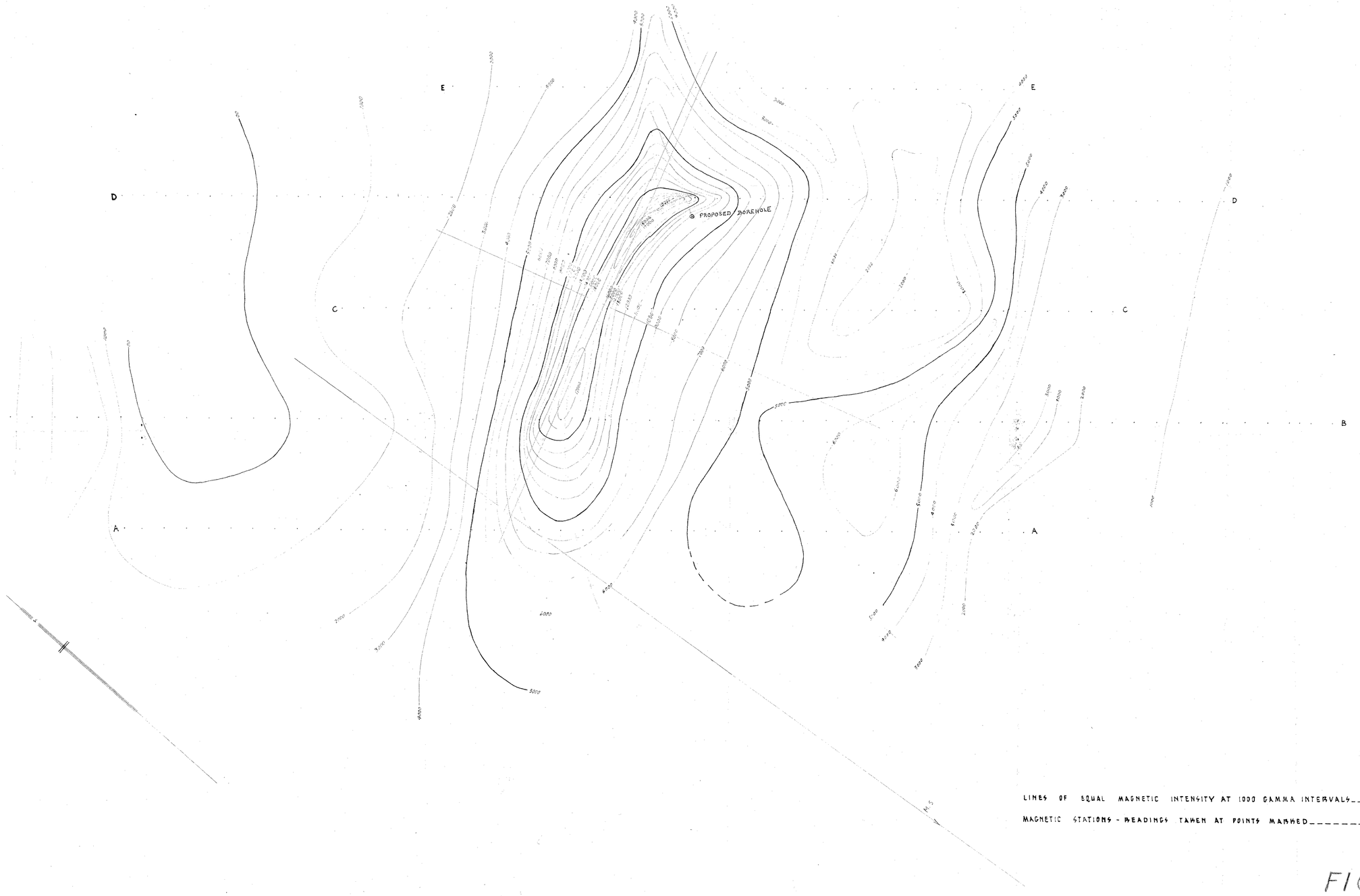


FIG. 2

S.A. DEPT. OF MINES

BALGOWAN AREA

PLAN SHOWING

LINES OF EQUAL VERTICAL INTENSITY

Scale 200 FT. TO 1 IN.

53·40
Ghl

Date 25 – 2 – 53

ALTERNATIVE INTERPRETATION OF VERTICAL MAGNETIC INTENSITY ON LINE c.d.

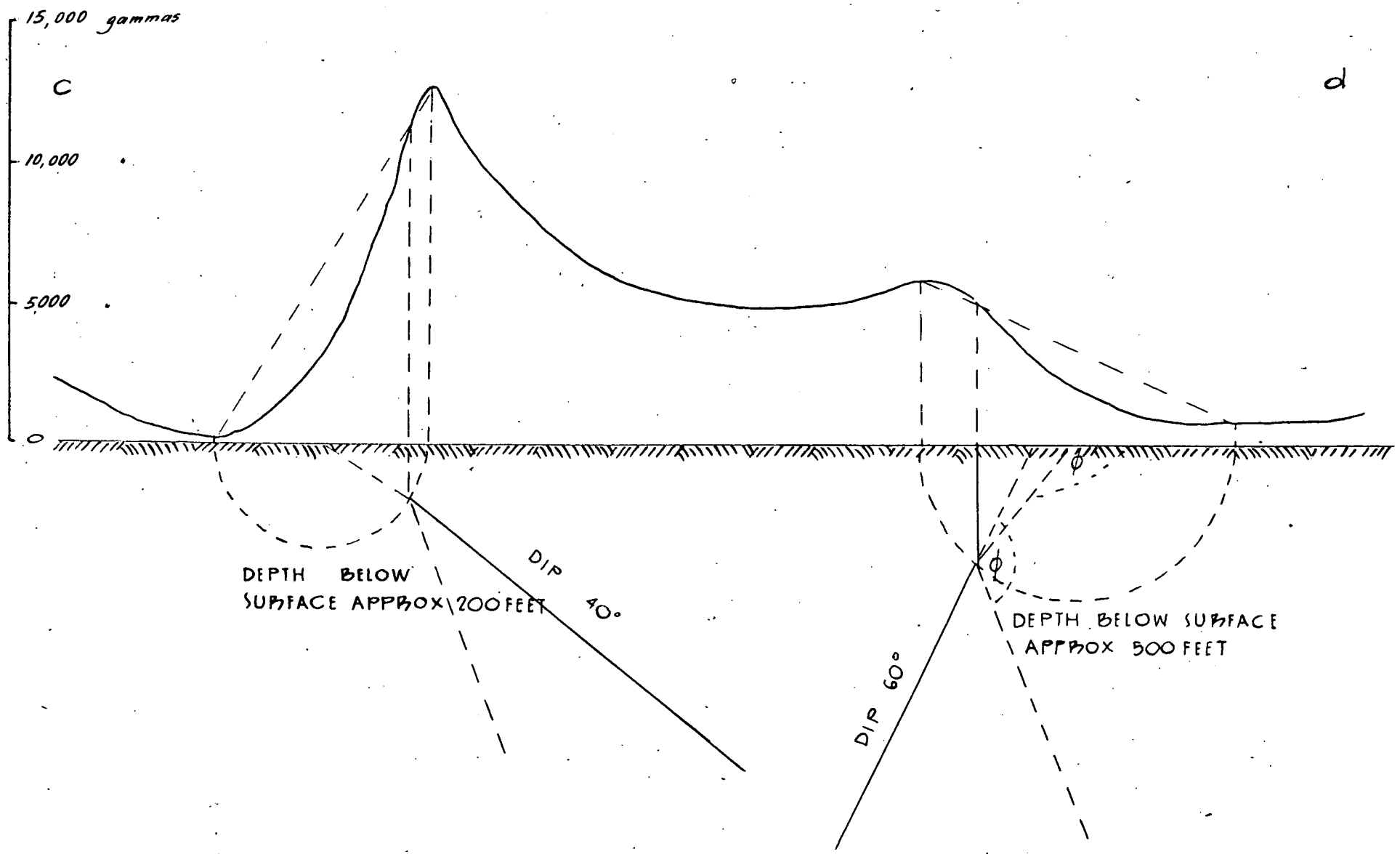


Fig. 3.

S.A. DEPARTMENT OF MINES

BALGOWAN AREA (MAGNETIC SURVEY)

Approved

Passed

Drn.

Tcd.

Ckd.

Exd.

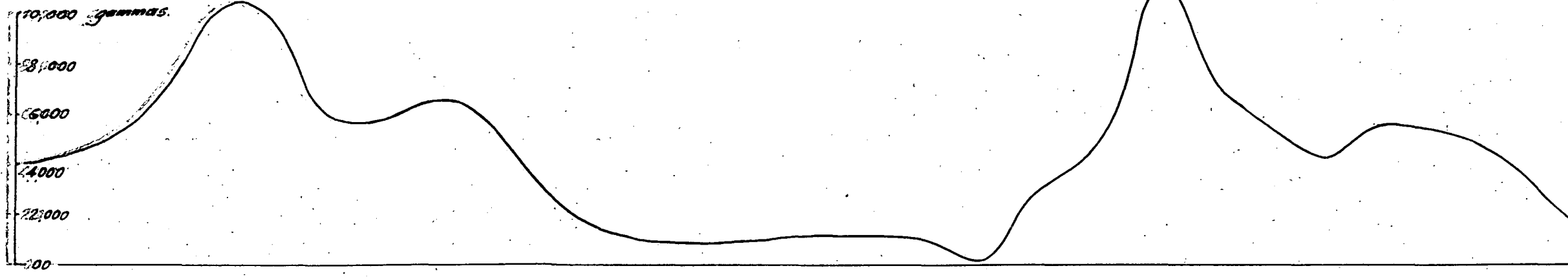
c.d

Scale 10 Chns. to 1in.

S 770

Gh1

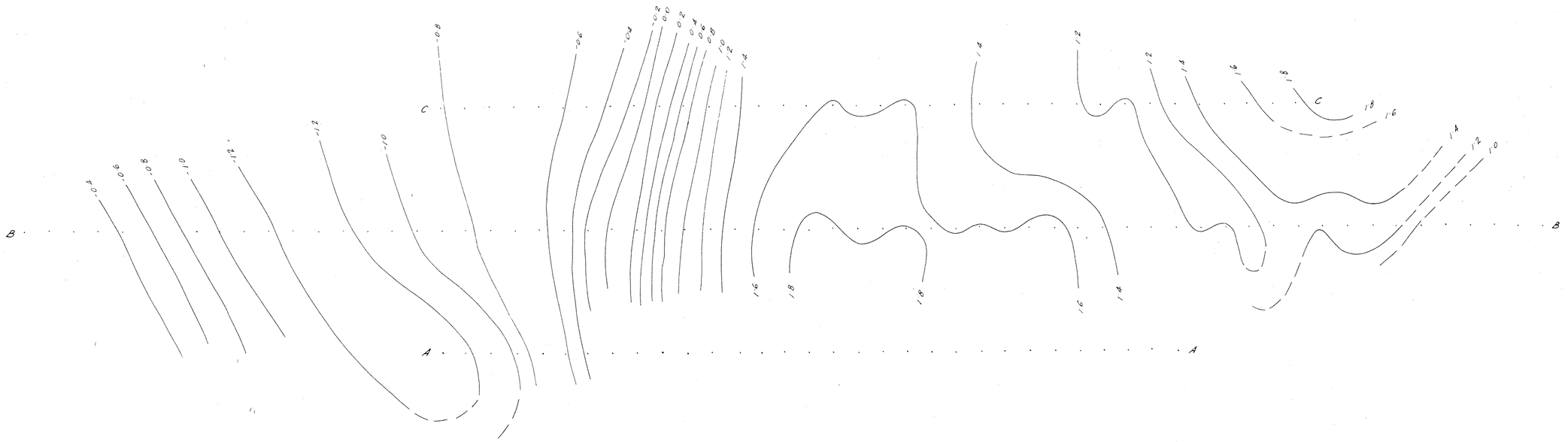
17.4.55



PROFILE a-b

Scale :- 10 Chains to 1 inch

S. A. DEPT. OF	MINES
BALGOWAN AREA PROFILE a-b.	S 775 Ghl
	24. 4. 53



GRAVITY CONTOURS AT 0·2 MILLIGAL INTERVALS ______ ·14

POINTS OF TESTING ______________________________ .

FIG. 4.

S.A. DEPT. OF MINES

BALGOWAN AREA

BOUGUER GRAVITY ANOMALIES

Associated Drawing	No.	No.	Amendment	Exd.	Date	Reg. No. D.M. Compiled from	Approved	Passed	Drn. Trd. J. McC Chd. Exd.	Scale 200 ft to 1 inch 53-95 GH 1 Date 24-4-53
							Director of Mines	C.O.		