DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

GEOPHYSICAL REPORT NO. 8/53

GRAVITY AND MAGNETIC TRAVERSES IN THE FAR NORTH-WEST OF SOUTH AUSTRALIA.

by

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(Assistant Geophysicist)

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TO THE CHIEF GEOLOGIST:

Gravity and Magnetic Traverses in the Far North-West of South Australia.

Resubmitted herewith is Assistant Geophysicist, W.H. Knapman's report on this area, with additions and modifications. These are concerned only with the evaluation and presentation of the gravity results which are now presented for the first time in the form of a contour plan.

When the gravity results were computed by Knapman, it was known that the scale factor used for the Carter Gravity Meter was in error, but it had been determined accurately with respect to two standard reference stations near Adelaide. The gravity interval between these two reference stations was redetermined by Seedsman and myself in mid-1954 and as a result a new scale factor has been adopted for the Carter Meter on this survey of 0.835 gravity units per division.

Knapman also obtained a closure error of almost 200 feet in the barometric levelling between the known levels at the railway sidings at Oodnadatta and Abminga. On checking the results last year no obvious reason for this error was apparent and it was thought to be due to errors arising from taking base readings at the base camp over 100 miles from the observing stations, or possibly to inaccurate readings by the operator, who was the camp cook.

However a recheck of the values shows a surprising difference of level of apparently about 240 feet between stations a 4 and a 5 about two miles apart on the Tieyon Abminga Traverse. Such a change of level should be accompanied by a change in observed gravity of 145 gravity units if there is no change in the reduced gravity value. The observed change in gravity between a 4 and a 5 is only 13 gravity units and therefore unless there is a topographic scarp of 240 feet and in addition a sudden anomaly of over 10 milligals, there must be a discrepancy in levelling here. This may be either due to misreading the instrument or else to a sudden zero shift. To correct for this apparent discrepancy the apparent readings from a 5 to a 10 have been increased by 200 feet.

The values are based on the value of "g" at Oodnadatta airport obtained by Muckenfuss viz. 979.1021 gals. From this the value at Abminga siding is deduced as 978.9618 gals.

Narain in a survey along the North-South railway found the following values (Regional Gravity & Investigations in the Eastern and Central Commonwealth.)

Oodnadatta Railway Siding	979.0992 gals.
Abminga Railway Siding	978.9618 gals.

The closer agreement between Knapman's and Narain's values at Abminga is perhaps fortuitous. Although Narain's Oodnadatta value was taken at the railway siding and Muckenfuss' at the aerodrome, the latter is only less a mile from the former and it seems unlikely that there should be a difference of three milligals between these two stations. This discrepancy, however, has no effect on the general character of the results.

It was hoped during the middle of this year to have the levels on the traverses Oodnadatta to Lambina and Tieyon to Abminga checked by J.B.S. McCahon, who was due to carry out a gravity survey in this area on behalf of Geosurveys. For this purpose he was lent a microbarometer by the Department but unfortunately this immediately became unserviceable from an internal fault (which had been previously noticed, but had not given serious trouble). The unusually wet season prevented a return to this area by McCahon.

To put the results of this survey on a sounder basis the following additional work is desirable:-

(a) Relevelling of Oodnadatta - Lambina and Tieyon - Abminga traverses; also if possible Lambina - Tieyon on which the results are somewhat uncertain.

(b) Gravity and level ties between Oodnadatta airport and siding.

A difference of nearly 80 milligals, as found by Knapman, exists between Granite Downs and Oodnadatta. The Bouguer anomaly at Granite Downs, on recomputation, now turns out to be over 100 milligals negative. No isostatic corrections have been computed for the area. Knapman's suggestion that the anomaly may be due to a thickening of the sialic crust is accepted.

C.K.G.

SENIOR GEOPHYSICIST.

CKG:AGK
21/11/55

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DEPARTMENT OF MINES

SOUTH AUSTRALIA

GRAVITY AND MAGNETIC TRAVERSES IN THE FAR NORTH-WEST OF SOUTH AUSTRALIA

by

W. H. KNAPMAN
ASSISTANT GEOPHYSICIST

GEOPHYSICAL REPORT 8/53

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SUMMARY:

Almost six weeks were spent with the Far North West party at Granite Downs station in conducting magnetic and gravity traverses.

Work was curtailed before sufficient results could be obtained for an accurate picture of subsurface structure. Gravity calculations have been hampered and are incomplete due to inaccurate base maps.

The magnetic work would suggest shallow bedrock between Granite Downs, De Rose Hill station and Tieyon, between De Rose Hill station and Mt. Cavanagh and between Umbiarra well and Tieyon.

The gravity work has revealed a large negative Bouger anomaly of -85 milligals at Granite Downs, and some suggestions as to bedrock configuration between Tieyon and Abminga can be made on the gravity results.

INTRODUCTION:

The geophysical survey was originally intended as a guide to bedrock structure and its relation to the younger beds of the Great Artesian basin with special reference to limits of the artesian waters. Field work was begun on May 23rd 1953 and ended on July 1st, when the survey was transferred to the Peake Denison Ranges.

Traverses were run along roads and tracks in the area between the railway line and the main Alice Springs - Adelaide roadway as far north as the S.A. - N.T. border and as far south as Oodnadatta. This area is included almost entirely in the Abminga 4 mile sheet.

PREVIOUS GEOPHYSICAL WORK:

Very little geophysical work had been done prior to this survey. A gravity traverse was made in 1951 by Narain along the commonwealth railway for the Sydney University.

A gravity station established at the Oodnadatta airport in a world wide gravity tie was used as a base for gravity measurements in the present survey.

GEOLOGY:

Granite Downs station and Tieyon station lie on the eastern edge of the Archean land mass which extends westwards as far as the W.A. - S.A. border. Around Granite Downs the Archean Complex is in the main granite gneiss intruded extensively by basic dykes. Adelaide system sediments are represented in this area and outcrops to the north and to the south of the Archean rocks.

Massive sandstones and quartzites of Ordovician age lie to the south of Granite Downs at Mt. Johns.

North of Granite Downs outcrops of Archean rocks occur discontinuously as far north as the N.T. - S.A. border. Between these outcrops lateritised sands of Tertiary age are common. Numerous outlier mesas with hard porcellanite cappings are common in this area.

Between De Rose Hill and Tieyon large areas are intruded by granites of Pre Cambrian age.

In the area ~~west~~ east of the Archean outcrop lie the beds of the Great Artesian Basin. Cretaceous shales outcrop in some areas and Tertiary mesas are common. However gibber plains of recent origin cover a major portion of the area east of the bedrock outcrop.

METHODS USED:

Traverses were run along tracks and roads in the area, using Land Rover as transport.

Magnetic readings were taken on ½ mile to 3 mile stations depending on the amount of information required, and gravity readings were taken at one mile to 3 mile intervals.

The Hilger & Watts vertical force variometer was used in the magnetic survey.

Gravity readings were read with the Carter Y Type meter on loan from the University of Adelaide. Levels were determined using micro barometers; daily variation in barometric pressure was read on a second micro barometer left at the main camp. This introduced some error in levels since at times the moving and stationary barometers were up to 150 miles apart. Levels were tied to railway lines and traverses closed at every opportunity.

No photographs were available at the time of the survey and positions of stations were determined from the Rover Speedometer. These too were tied to river crossings and road junctions as often as possible. To date accurate maps on photo scale are not available over the entire area and gravity calculations are incomplete.

RESULTS & INTERPRETATION:

The results of the magnetic and gravity surveys will be dealt with separately.

Magnetic

Magnetic traverses were run between -

a. Granite Downs - Tieyon via De Rose Hill
b. Tieyon - Granite Downs via Lambina
c. De Rose Hill station - Mt. Cavanagh station.
d. Umbiarra Well - Tieyon
e. Granite Downs - Sailors Well
f. Lambina - Oodnadatta
g. Oodnadatta - Abminga
h. Tieyon - Abminga

The rapid and irregular changes in the intensity of the vertical magnetic field as obtained on traverses between Granite Downs, De Rose Hill and Mt. Cavanagh, De Rose Hill to Tieyon and again on the Umbiarra Well - Tieyon run indicate a shallow bedrock which varies considerably in magnetic composition.

Between Granite Downs and De Rose Hill, the area is granitic between G0 and G15 and varying magnetic field is the result. From G15 to 630, Adelaide system sediments are traversed and a more stable magnetic field is illustrated on the profile. Thereafter the near surface granitic gneiss is accompanied by an extremely irregular and variable magnetic field. Similar irregular profiles are obtained between De Rose Hill and Mt. Cavanagh (along this traverse large magnetic anomalies up to 4,500 gammas - are obtained over the basic intrusive dykes), Umbiarra Well and Tieyon and De Rose Hill and Tieyon.

The magnetic profile along the remaining magnetometer traverses generally assume a more even and flat appearance which would indicate a more deep seated bedrock than on any of the previous traverses.

These magnetometer profiles yield little in the elucidation of bedrock structure or its depth from the surface

RESULTS:

The magnetic high located ½ mile N of Lambina is encountered again 10 miles east and probably represents a dyke of higher magnetic content.

The Granite Downs Lambina magnetic profile is very flat and bedrock begins to become deeper a few miles east of Granite Downs.

The gradual decrease in vertical magnetic intensity which begins 32 miles from Oodnadatta and which persists for 30 miles obtained on the Oodnadatta - Abminga traverse could possibly indicate a deepening of bedrock.

The Oodnadatta - Lambina traverse is almost featureless indicating deep basement.

Some correlation between the magnetic and gravimetric profiles between Tieyon and Abminga is shown.

Generally increases in Bouger anomaly are accompanied by increases in vertical magnetic intensity.

GRAVIMETRIC:

Only two traverses have been computed owing to lack of accurate base maps on large scale.

Tieyon - Abminga Traverse

The persistence of high Bouger anomaly from Tieyon eastwards for 18 miles (station a9) indicate a shallow lying bedrock. East of a9 where the Bouger anomaly decreases the bedrock would seem to deepen. This eastward fall of bedrock is quite steep for some way. At station a13 the first of two increases in bouger anomaly occur; these suggest buried ridges of bedrock. The second, larger than the first extends for 8 miles east of a20. The eastward deepening of bedrock continues after the second ridge.

It is unlikely that westward extension of the artesian waters would be affected by the two buried ridges although it would be unlikely that these waters would be found west of a9 where the bedrock originally begins to deepen.

De Rose Hill Station - Granite Downs

A large negative Bouger anomaly of - 84 milligals at Granite Downs was disclosed in the gravity survey. The Bouger anomaly is +8 milligals at De Rose Hill station but becomes rapidly negative a few miles south of the De Rose Hill mesa. This rapid decrease continuous to a point where the traverse leaves the main Alice Springs - Adelaide road and swings westward.

The fall becomes less rapid and reaches a minumum at Granite Downs. The Bouger anomaly then begins to rise about 4 miles east of Granite Downs.

The explanation of such a large negative anomaly must lie in a thickening of the lighter sialic crust which

is apparently associated with the edge of the old Archean land mass.

CONCLUSIONS & RECOMMENDATIONS:

The premature termination of this survey has limited its value in determining limits of artesian water. Sufficient results have been obtained to indicate the desirability of further work in the near future.

On the production of an accurate Abminga 4 mile sheet on photo scale, the gravity computations can be completed.

The large negative anomaly at Granite Downs is an interesting phenomena, and its limits should be ascertained should time be available at a later date.

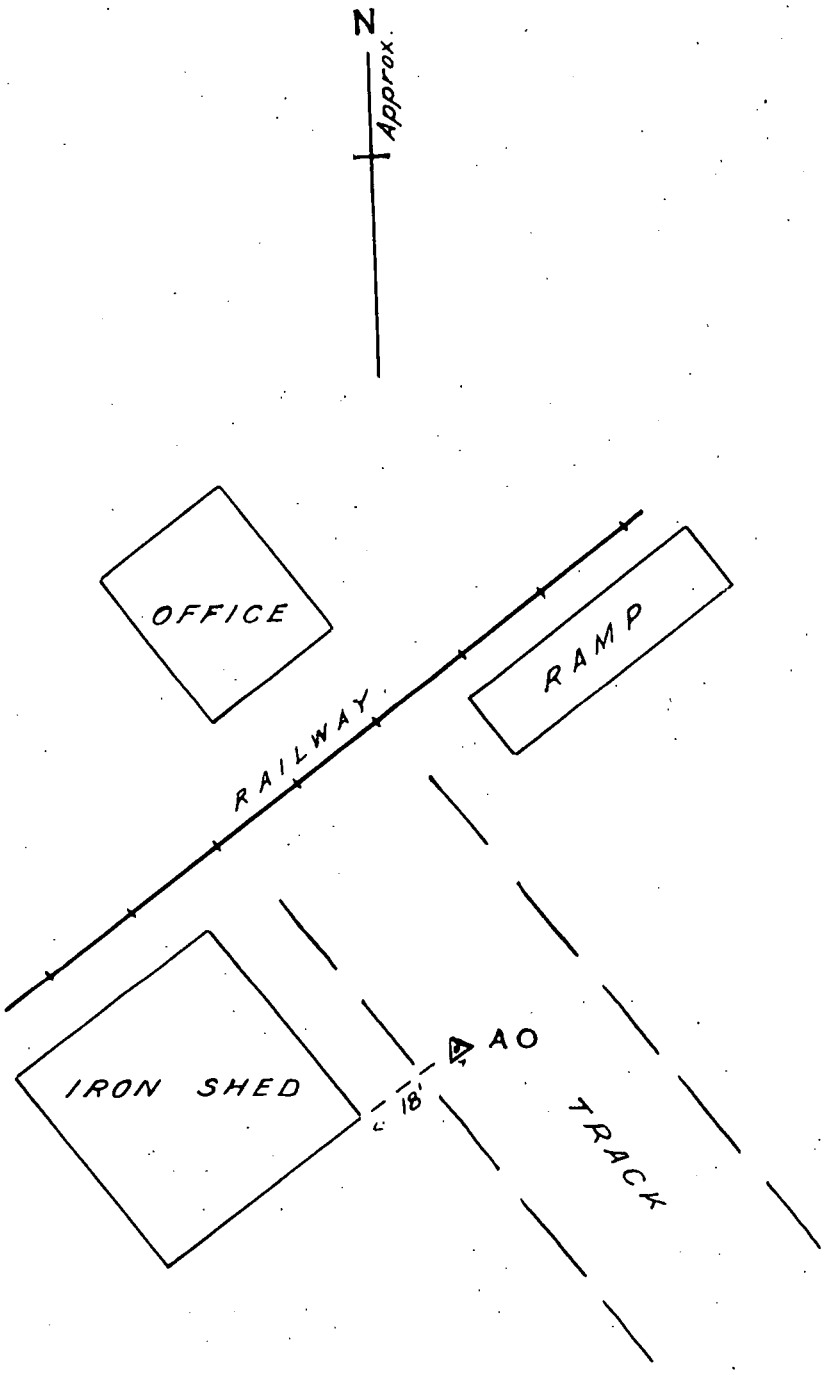
The Abminga - Tieyon gravity traverse shows the value of the survey in tracing the edge of the artesian basin, and the necessity of a continuation of the work begun.

W. KNAPMAN
ASSISTANT GEOPHYSICIST.

WK:BK
8/2/54

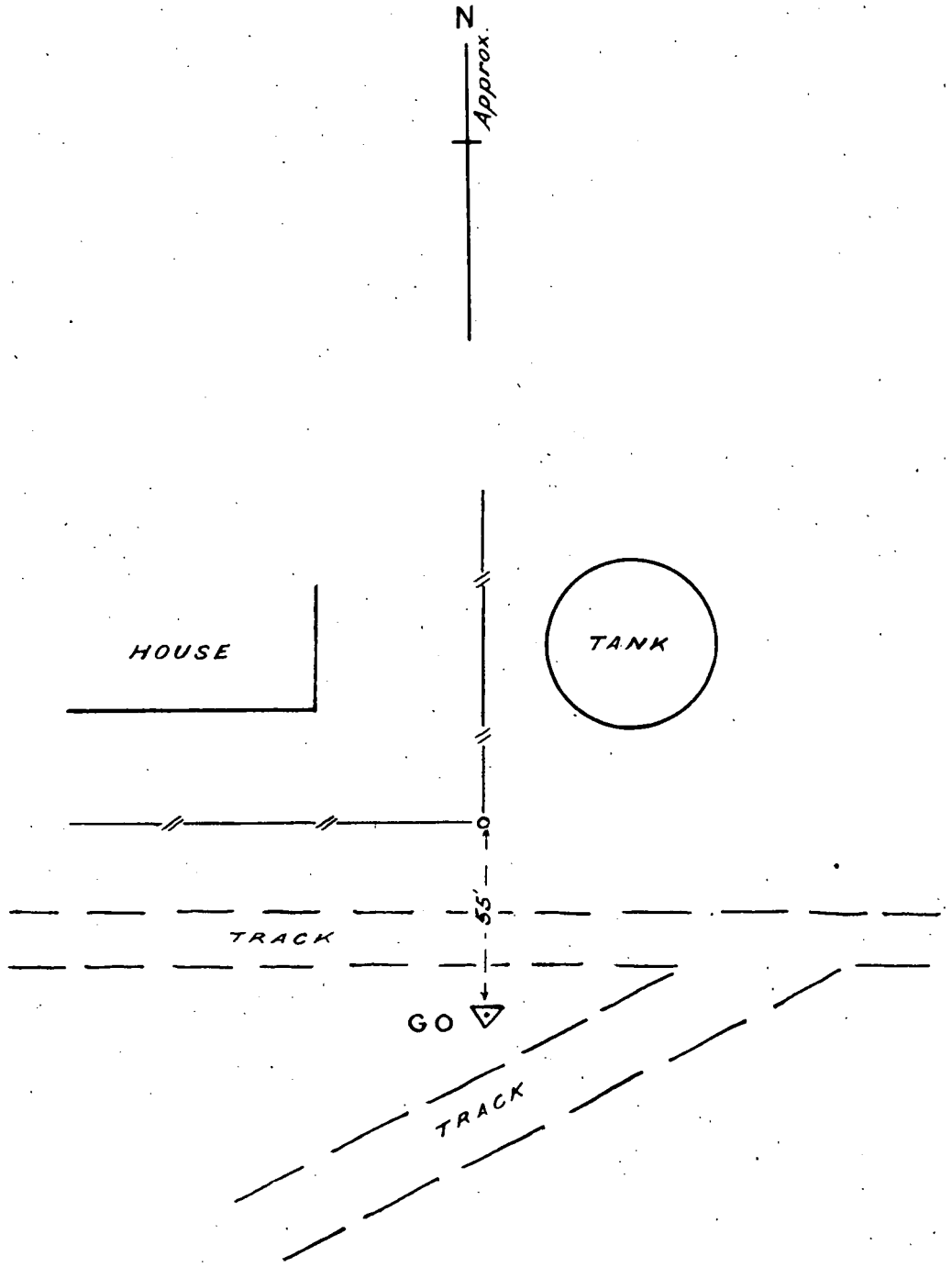
Associated Drawings.

54-47	Locality Plan
54-45	Vertical Magnetic Profiles (a) to (g)
54-43	Gravity Traverses Tieyon - Abminga De Rose Hill - Granite Downs
S 817	Gravity Base Station, Abminga
S 818	Gravity Base Station, Granite Downs H.S.
S 819	Gravity Base Station, Tieyon H.S.
55-372	Tentative Bouguer Anomalies N.W. of Oodnadatta.



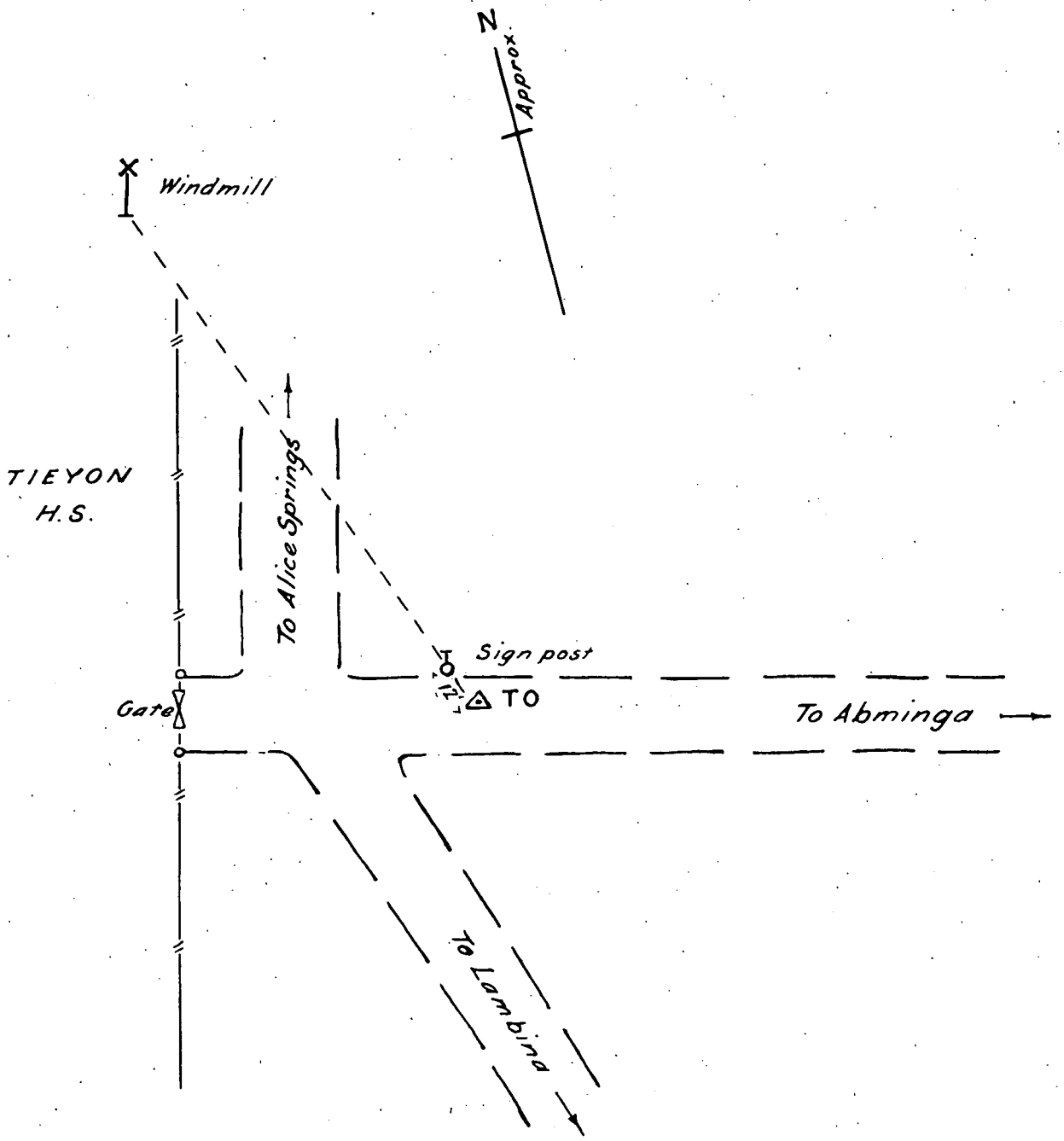
S. A. DEPT. OF MINES

Approx.	Pur.	Drn. W.H.K. R.R.	GRAVITY BASE STATION AO ABMINGA SIDING		S 817 Ba
Drawing	C.D	Exc.			2.9.53



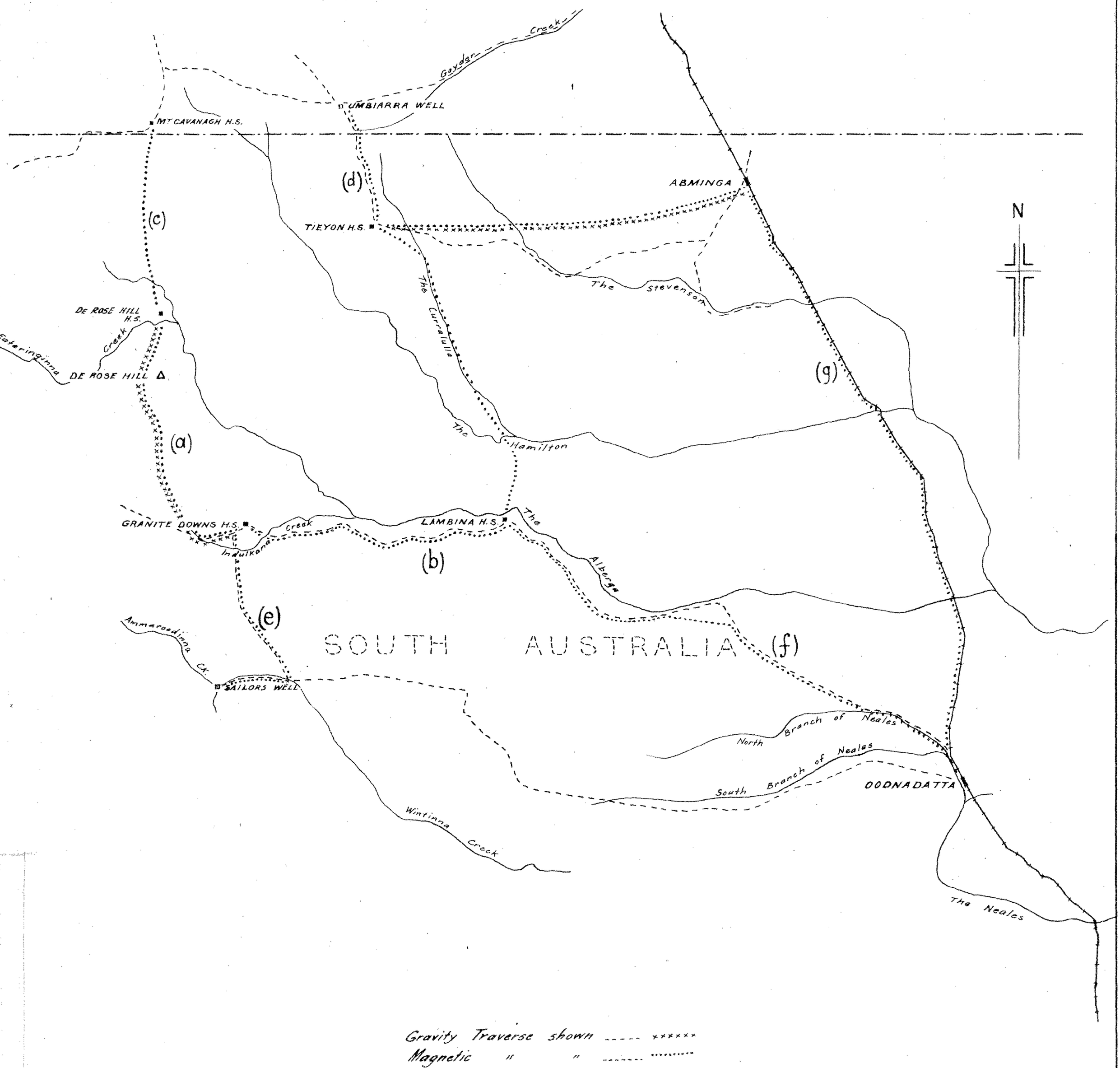
S. A. DEPT. OF MINES

		Drn. W.H.K. R.R.	GRAVITY BASE STATION GO GRANITE DOWNS H.S.		S 818 Ba Dt. 2.9.53



S. A. DEPT. OF MINES

Asst. Dir.	Passed	Drn. W.H.K.	GRAVITY BASE STATION TO TIEYON H.S.	Dft. M.	S 819 Ba
Director	C.D.	Trd. R.R. Ckd. Exd.			Date 2.9.53



Gravity Traverse shown ----- ××××××
Magnetic " " ------- ·····

To accompany report by W.H. Knapman.
Asst. Geophysicist.

S. A. DEPT. OF MINES

GEOPHYSICAL TRAVERSES
NORTH WEST OF OODNADATTA
LOCALITY PLAN

Scale of Plans: 14 M/s. to 1 in. Approx

R.R. 54-47

994·2+81

26·2·'54

GRANITE DOWNS - DE ROSE HILL H.S.

Magnetic intensity in gammas

+800 +400 00 -400 -800 -1200

DE ROSE HILL H.S.

G0 G1 (Camp) G7 G15 G20 G30 G37

4 Miles to 1 inch

a

DE ROSE HILL H.S. - TIEYON

Magnetic intensity in gammas

+800 +400 00 -400 -800 -1200

DE ROSE HILL H.S.

TIEYON STATION

G51 70 80

4 Miles to 1 inch

TIEYON - LAMBINA

Magnetic intensity in gammas

+400 0 -400 -800 -1200

TIEYON

HAMILTON CREEK

LAMBINA

T0 110 G120

4 Miles to 1 inch

b

LAMBINA - GRANITE DOWNS

GRANITE DOWNS

G14E

DE ROSE HILL H.S. - Mt CAVANAGH

Magnetic intensity in gammas

+400 00 -400 -800 -1200 -1600

DE ROSE HILL H.S.

Mt CAVANAGH

G57 G20

4 MILES TO 1 INCH

c

UMBIARRA WELL - TIEYON

Magnetic intensity in gammas

+800 +400 00 -400 -800 -1200

UMBIARRA WELL

TIEYON

4 MILES TO 1 INCH

d

GRANITE DOWNS - SAILORS WELL

Magnetic intensity in gammas

+800 +400 00 -400

SAILORS WELL

G0 3.3 7 11 15 19 23 27

4 Miles to 1 inch

e

LAMBINA - OODNADATTA

Magnetic intensity in gammas

800 400 00 -400

LAMBINA

OODNADATTA

G14G 0.10 0.20 0.30 0.40 0.50

4 MILES to 1 inch.

f

OODNADATTA - ABMINGA (along railway)

Magnetic intensity in gammas

800 400 00 -800

Line traverse LAMBINA - OODNADATTA

OODNADATTA

B50 B10 B11 13 15 17 19 21 23 25 27 29 31 B33 35 37 39 41 43 45 47 49 51 A0

SCALE 4 Miles to 1 inch.

g

To accompany report by W. Knapman, Assist. Geophysicist

S.A. DEPARTMENT OF MINES

N·W OF OODNADATTA

VERTICAL MAGNETIC PROFILES

Req. No.
D.M.
Compiled from

Associated Drawing No. | No. Amendment Exd. Date

Approved Passed

Director of Mines

Drn.
Tcd.
Ckd.
Exd.

Scale –

54·45

Bd

Date 25·2·54

DE ROSE HILL STATION - GRANITE DOWNS GRAVITY PROFILE

Granite Downs

Camp

De Rose Hill

Milligals

Miles to 1 inch.

TIEYON - ABMINGA PROFILES

Magnetometer Traverse
Profile of vertical Magnetic Intensity

Gravity Traverse
Profile of Bouguer Anomaly

Vertical Magnetic Intensity

Milligals

To accompany report by W. H. Knapman

S. A. DEPT. OF MINES

GRAVITY TRAVERSES
Tieyon to Abminga and
De Rose Hill Station to Granite Downs

Approved	Date	Drawn	Date	Traced	Checked	Scale
		W.H.K.	18-2-54	MBL	R.R.	54-43

TIEYON M.S.

ABMINGA

ILBUNGA

PEDIRKA

LAMBINA H.S.

MT. SARAH

ALBERGA

ODDNADATTA

Granite

Note :- Contour Interval 2 Milligals.

To accompany report by W.H. Knapman.

S.A. DEPT. OF MINES

TENTATIVE BOUGUER ANOMALIES
NORTH WEST OF OODNADATTA

Associated Drawing	No.	No.	Amendment	Exd.	Date

Reg. No.
D.M.
Compiled from

Approved — Director of Mines

Passed — C.D.

Drn.
Tcd. R.G.C.
Ckd. A.K.
Exd.

Scale 1" = 3½ Miles approx.

55-372

Date 29-11-65

Bar'd.