COMMONWEALTH OF AUSTRALIA

MINISTRY OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BULLETIN No. 18

GRAVITY AND MAGNETIC RECONNAISSANCE ROMA DISTRICT, QUEENSLAND

BY

J. C. DOOLEY

Issued under the Authority of The Rt. Hon. R. G. CASEY, Minister for National Development.
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ERRATA

P. 7 in "Table 1: Stratigraphic Section, Roma District", at the bottom of the first column, immediately under the word "basement", omit the word "generally".

P. 23 in "Table V: Summary of Bore Information", under the sub-heading "Metamorphic Basement". In the third line of this section in the column headed "Observed Gravity, Go", for 21.4 read 33.4. Between the fourth and fifth lines insert another line, as follows:

A.R.O. No. 15: 1330 993 4108 — 3115 18.0 45.6 27.6

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Secretary—R. G. A. JACKSON.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

H. G. RAGGATT—Director.

P. B. NYE—Deputy Director.

This Bulletin was prepared in the Geophysical Section:

J. M. RAYNER, Chief Geophysicist; R. F. THYER, Superintending Geophysicist.

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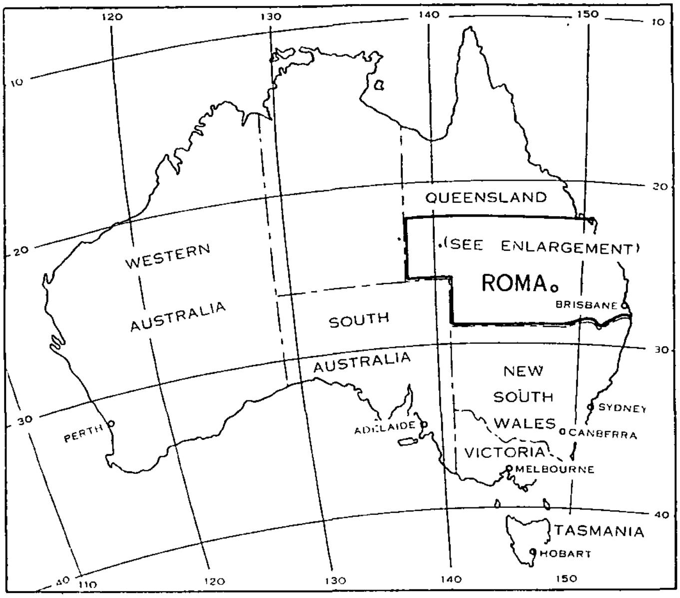

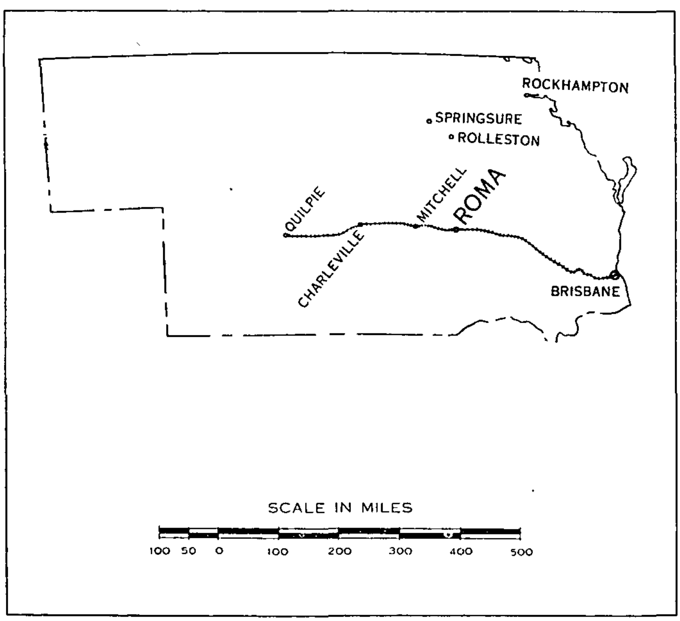

ABSTRACT

In the vicinity of Roma about 3000-4000ft. of Mesozoic sediments overlie a basement consisting of granite and metamorphic rocks. Permian rocks outcrop about 70 miles to the north of Roma.

Considerable flows of natural gas, and small quantities of oil, have been found since 1900 in many of the bores which have been drilled in the Roma area; but no major commercial supplies have been developed.

The sediments are mostly obscured by soil. Experience also suggests that pitting and shallow core drilling have limited value. It is therefore difficult, using normal geological methods, to determine geological structures in the region and to work out, except in the broadest way, the geological structure in the areas tested by drilling.

In the present survey, gravity and magnetic methods were applied in an attempt to gain some indications of basement topography, which might be related to possible oil-bearing structures. It was found that the major geophysical anomalies are not related to known basement topography, but are probably due to variations of rock-types within the basement or other causes. However, it was possible to isolate some gravity anomalies which might be related to high basement features. These anomalies are being tested by seismic methods to locate possible drilling targets.

INTRODUCTION

The geophysical survey described in this report was undertaken at the joint request of the Queensland Government and four companies, viz., Roma Blocks Oil Co. N.L., Kalimna Oil Co. N.L., Australian Oil Development Co. N.L., and Roma North Oil Co. N.L., which are associated in the search for oil in the Roma area. The companies hold an Authority to Prospect for oil (non exclusive) over an area bounded by longitudes 148°00'E and 149°30'E and latitudes 25°27'S and 26°45'S, and an exclusive Petroleum Prospecting Permit No. 677 covering 8,500 acres north of Roma. The permit boundary is shown on Plate I.

Geophysical field operations were carried out during November and December, 1947, and from June to December, 1948. A map showing the area covered is given on Plate I. Grid references to places mentioned in the report are given in Table VI.

In compiling the following summary for oil exploration in the Roma district reports by Raggatt and Crespin (1944), and Reeves (1947) have been consulted.

Natural gas was first discovered in Roma in 1900, in a Government water bore on Hospital Hill. By 1922 the Government had drilled two more bores and made several unsuccessful attempts to obtain gas for commercial use. By 1932 another twenty-five deep wells had been drilled in the Roma district in the search for gas or oil. It is doubtful whether reliable evidence of structure was found to support the selection of sites for any of these wells. Roma Oil Corporation Bore No. 1 on Hospital Hill struck light oil and wet gas. 30,000 gallons of petrol were produced from this bore between 1928 and 1932. In 1930, Roma Blocks Oil Co. No. 1 bore struck a yield of 10 gallons of light oil per day at Block 16, about 8 miles N.E. of Roma. Several of the bores near Blythdale also yielded small quantities of oil. None of the other bores drilled during this period showed any substantial quantities of oil or gas, though traces were common.

The area in the immediate vicinity of Roma is mainly soil-covered, and geological mapping does not generally give enough information to enable structures to be mapped. In order to obtain the necessary information for selecting a drill-site, some geophysical method of scout-drilling must be used. Some work of this nature has been done in the past. In 1927-29, Builders Ltd. put down 158 shallow scout bores in the vicinity of Roma. In 1928-29 Queensland Geophysical Surveys Ltd. arranged with a German firm (Piepmeyer Co.) to carry out some geophysical work as the result of suggestions made by Dr. Jensen, Chief Geologist of Roma Oil Corporation. Details of this work are not available, but it is believed that magnetic, gravity, electrical, seismic and radioactive methods of exploration were used; however, the work was confined to local testing at various places, and no useful results were obtained.

In 1933-34, Drillers Ltd., a subsidiary of Oil Search Ltd., drilled 78 shallow scout bores, as the result of which a deep well was drilled at Warooby. This gave a gas flow of 600,000 cubic feet per day, but no oil. In 1934 a well was drilled at Wallumbilla to a depth of 4968ft. without reaching basement. No oil or gas was found in it.

Oil Search Ltd. undertook a programme of regional mapping, and engaged Dr. F. Reeves as consulting geologist. He located two structures to the north of Roma where Permian rocks outcrop, on which the Hutton Creek and Arcadia bores were drilled in 1935-39. The Arcadia bore struck a flow of petroliferous gas at 1187 feet, giving 25,000 cub. ft. per day. Further gas flows were met between 2487 and 2900 feet. These gave a total flow of 3,000,000 cub. ft. per day, containing about 70 per cent. carbon dioxide. No gas or oil of any significance was found in the Hutton Creek bore.

The Roma Blocks Oil Co. drilled three more bores near Block 16 in 1938-41. Bore No. 3 gave a gas-flow of 60,000 cub. ft. per day, and it is reported that bore No. 4 intersected about 10ft. of oil sands; but no commercial production was obtained.

Since 1939, Shell Development (Queensland) Pty. Ltd. has conducted a wide-scale survey over a large area, including aerial, geological and geophysical reconnaissance. It is believed that their geophysical survey covered 192,000 square miles, with gravity stations at wide intervals, including some pendulum determinations of absolute gravity. More recently this company has been scout-drilling in an area near Rolleston, about 100 miles north of Roma, using electrical well-logging methods. The results of their investigations have not been made public.

In connection with the present survey, Mr. D. A. Pitman, consulting geologist for the four associated companies, has spent much time in gathering and correlating information about past work. Miss Irene Crespin, Commonwealth Palaeontologist, has visited Roma and collected samples for micro-palaeontological examination. The Royal Australian Air Force has photographed part of the area, to assist mapping. A geologist from the Bureau of Mineral Resources, Geology and Geophysics has started work on correlation, based on samples from bores and from surface, by determinations of heavy mineral content.

The companies have given full co-operation in conducting the survey, especially in the provision of surveyors who have carried out a large part of the necessary surveying and drafting. The help given by Mr. Pitman and his staff at all stages of the work is gratefully acknowledged.

GEOLOGY OF THE AREA

The following geological notes are based chiefly on the work of Dr. Frank Reeves, formerly consulting geologist for Oil Search Ltd.; on discussions with Mr. Pitman; and on examination of the original logs of bores where available. For a more detailed account of the geology, a recent report by Dr Frank Reeves (1947) should be consulted.. Table I shows briefly the stratigraphic section. The cross-sections on Plates 7A, B, C and D illustrate some of the more important geological features.

TABLE I: Stratigraphic Section, Roma District (Modified after Reeves)

System	Series	Thickness Feet	Description
Recent	Alluvium		Sand and gravel.
Tertiary	Volcanic Rocks		Basaltic flows; remain as capping on Mt. Bassett and Grafton Range.
Cretaceous (Lower)	Roma	0–200	Dark marine shales. Outcrop near Roma and several miles north.
Jurassic	Walloon	2500	Freshwater sandstones, sandy shales, and coal beds. Dip gently southwards. Beds are generally lenticular and correlation between bores is difficult.
Triassic	Bundamba	1000–1500	Massive coarse-grained, cliff-forming sandstones; also clay shales. Layer of coarse grit and conglomerate at base.
	Unconformity		
	Ipswich	0–1200	Moolayember shale.
	Clematis	300–400	Carnarvon sandstone. Forms high red cliffs.
	Unconformity		
Permian	Upper Bowen	1300–3200	Clay shales and coal measures.
	Middle Bowen	1200–4200	Mostly grey carbonaceous shales 300-600ft. marine sediments. 2000-3300ft. freshwater sediments. 1600ft. mixed marine and freshwater sediments.
	Lower Bowen	2600	Marine shales and coarse-grained sandstones with glacial horizons. Outcrop north of Arcadia. Andesites at base of Arcadia bore.
Basement Generally	Metamorphic Rocks	0–300	Talcose schists, tilted slates, indurated shales, and quartzites. Age unknown.
	Granite		Shows deep weathering, generally overlain by coarse granitic conglomerate. Age unknown.

Near Roma, the Ipswich Series lies directly on the basement. The Permian rocks outcrop about 70 miles to the north of Roma, and were intersected by Hutton Creek and Arcadia bores. Miss Crespin (1945) has made a palaeontological examination of samples from these two bores, which is quoted in part by Reeves (1947, pp. 1361-9).

Basement contours based on the available bore information are shown on Plate 2. A summary of the bore information is given in Table V. Those bores which struck granite basement lie in a definite N.W.-S.E. band between Roma Dome bore and Blythdale. Metamorphic rocks have been found on either side of the granite band. Lander No. 4 well on Hospital Hill penetrated over 300ft. of metamorphic rocks without striking granite. These may be Permian or earlier sediments, perhaps altered by the intrusion of the granite.

The basement shows mainly a regional rise of the order of 100 feet per mile to the north or north-west in the vicinity of Roma; but Hutton Creek and Arcadia bores show that there must be a considerable dip in basement to the north of Kayenta and Stewart's Mooga bores. Local relief of the basement surface also occurs; in two places, evidence from bores close to each other indicates fairly steep features. From R.O.C. No. 1 to R.O.C. No. 2 on Hospital Hill there is a drop of 100 feet in a distance of about 900 feet; and between A.R.O. No. 4 and A.R.O. No. 11 at Blythdale there is a drop of 260 feet in about $\frac{3}{4}$-mile.

The evidence from many of the bores is rather indefinite, as in many cases drillers' logs only are available; cores have been lost; and much of the drilling was done by percussion methods. Thus in some cases it is doubtful whether the basement found in a bore was granite or metamorphic rock, or whether basement was reached at all. The interpretation of the logs shown in Table V differs from that of Dr. Reeves in some details.

To the north of Roma the Permian sediments show folding with dips up to 40°. Reeves has mapped four anticlines—the Serocold, Consuelo, Woolsack and Arcadia, in the Permian. These persist for 12 or 15 miles southwards into the Triassic sediments, in which the folding is less intense. He also mapped the Hutton-Eurombah Creek anticline in the Triassic. The folding probably occurred chiefly in the late Permian and early Triassic epochs. It persisted later in the western part of the area; in the most westerly structure mapped, the Serocold anticline, the Bundamba Sandstone (the lowest stage of the Upper Triassic) is folded with dips up to about 13°. The Jurassic sediments have no keybeds suitable for mapping detailed structures; their general southerly tilt is apparent, but there is no evidence of major folding having occurred in them.

In the vicinity of Roma, oil and gas occur mainly in the conglomerate immediately overlying granite basement (as at Blythdale and Block 16), or in coarse-grained sandstone and grit at the base of the Bundamba Sandstone (as in the Hospital Hill bores). The Jurassic and Triassic rocks penetrated by the bores near Roma consist of fresh water sediments and do not appear to contain suitable source beds for oil. The Permian sediments to the north are generally considered to be the probable source beds; even there, the known thickness of marine sediments is not very great. Nothing is known of the sub-surface geology to the south of Roma, and it is possible that source beds may exist there. In any case, it is evident that the oil which has been found in the bores near Roma must have migrated a considerable distance.

The most promising conditions for an oil-trap would seem to be either a suitable high feature in granite bedrock with the overlying conglomerate, and an impervious layer of shale acting as a caprock; or a closed structure at the base of the Bundamba Sandstone, forming an inverted bowl in the grit bed. The Middle Triassic being mostly dense shales, may form a suitable caprock for the first type of structure; it is unlikely, however, that this formation would contain suitable porous reservoir rocks. The second type of structure may be due to compaction folding of the Bundamba Series, which would occur over a high feature in the Middle Triassic surface. As there is an unconformity between the Upper and Middle Triassic, it is probable that the Middle Triassic surface suffered some erosion before the Upper Triassic sediments were deposited. A high feature in this surface might be composed of Middle Triassic rocks. On the other hand, an outcrop of basement rocks might have protruded through the Middle Triassic sediments because an insufficient thickness of sediment was deposited; or a hill of basement rocks may have been exposed by the erosion of the Middle Triassic sediments. Thus it is possible that a compaction fold in the Bundamba Series may be directly associated with a high basement feature.

As mentioned above, the Bundamba Sandstone is folded in parts of the area. This folding may have affected the Bundamba Series near Roma slightly, although Reeves shows no unconformity between it and the Jurassic sediments, which do not show any marked folding. If the Cretaceous, Jurassic and Upper Triassic Series are conformable, then a structure in the Bundamba Series would be reflected at the surface and could be located by surface geology or shallow scout-drilling. As there is an unconformity between the Upper and Middle Triassic, the first type of structure mentioned may not be reflected at the surface.

Further north, where there are substantial thicknesses of Permian rocks, a structure may occur in these rocks. If they are the source beds, there should be a greater chance of finding suitable accumulations of oil in them.

Warcoby bore is supposed to have been drilled in a minor structure with a 30ft. closure, mapped in the surface beds by shallow scout-drilling; but there is some doubt whether even this surface structure exists. Dr. Reeves' mapping of the Hutton dome, based on marker beds in the Bundamba Series, showed an anticline plunging gently to the south for about 20 miles. While there is every reason to believe that this anticline and the dome itself reflect even steeper folds in the Permian rocks beneath, it is not certain that the highest structural point in the Permian would correspond with that of the Bundamba Series. Thus there is room to doubt whether any of the bores near Roma, except Arcadia (which was mapped in out-cropping Permian sediments), have been drilled on suitable structures; and the Roma field, although it is nearly half a century since gas was discovered, cannot yet be said to be adequately tested.

GEOPHYSICAL METHODS APPLICABLE

In considering methods of exploration to be adopted, the possible oil structures may be divided roughly into three classes—firstly, those which are associated with a corresponding condition in the surface or near-surface beds; secondly, those which are associated with a high feature in the basement rocks; and, thirdly, those which occur in the intermediate sediments and are not reflected at the surface or the basement. So far, surface mapping and shallow scout-drilling have failed to indicate structures, at least in the southern part of the area; although scout-drilling with electrical or radioactive well-logging methods may be more successful. The question then arises which geophysical methods would be suitable for locating structures of the second and third classes.

The seismic reflection method is undoubtedly the most direct approach to the problem. In this method, an explosion at a shallow depth causes elastic waves to pass through the earth. Some of these waves are reflected from suitable layers immediately beneath the explosion point, and are picked up by sensitive detectors or geophones at the surface. The time taken by the waves to be reflected and to return to the surface is measured accurately, and the depth of the reflecting layers can be calculated. Thus, if suitable reflecting layers are found, the configuration of the beds can be determined. Thus, structures of any class can be located, provided reflections are found from layers in the same series of sediments. The seismic method is rather expensive, however, and is usually preceded by a cheaper means of reconnaissance, such as the gravity and magnetic methods. If either of these methods suggests the existence of a structure, or a suitable area for more intensive exploration, tests would normally be made with the seismic method on a more local scale before selecting a site for drilling.

When the present work was started at Roma the Bureau had reflection seismic equipment on order, but had not yet taken delivery of it. This has since arrived from America. In the meanwhile field work was carried out by gravity and magnetic methods. Generally these methods as used in an area such as Roma are expected to detect anomalies caused by basement effects. They are thus particularly applicable for locating structures associated with high features in the basement rocks.

Table II, compounded from values given by Heiland (1940), gives typical densities and magnetic susceptibilities for various types of rock similar to those found near Roma. It will be seen that the igneous and metamorphic rocks are generally likely to be denser and more magnetic than the sedimentary rocks, although there may be exceptions. Thus, in the ideal case, where the basement rocks are nearer to the surface, a rise in both gravity and magnetic readings may be expected.

TABLE II: Relative Densities and Magnetic Susceptibility of Typical Rocks

Class.	Type of Rock.	Relative Density.	Magnetic Susceptibility.
Igneous	Granite	2.56–2.74	8–3580 x 10^{-6}
Metamorphic	Slate	2.7 –2.85	61–3000 x 10^{-6}
	Quartzitic Slate	2.63–2.91	—
	Schists	2.39–2.87	115 x 10^{-6}
Sedimentary	Sandstone	2.25–2.72	5–17 x 10^{-6}
	Shale	1.98–2.57	44–54 x 10^{-6}

However, variations in rock type within the basement can cause gravity and magnetic anomalies which are not related to basement topography. At Roma the basement consists of granite in some places and various types of metamorphic rock, usually highly tilted, at others, and may therefore be fairly complex. Anomalies other than those due to variations in the depth to basement may be expected. Regional anomalies on a broad scale are commonly found, due to the proximity of mountain ranges with associated isostatic anomalies, or other deep-seated causes. However, gravity and magnetic methods are more likely to detect structures which are associated with basement highs; although an increase in density of the sediments towards the centre of a high zone caused by folding may cause a small gravity anomaly.

DESCRIPTION OF FIELD WORK

A Western Geophysical Gravity Meter was used for the gravity work. This consists fundamentally of an almost unstable system of springs supporting a gold mass. Slight changes in gravitational attraction cause changes in the weight of the gold mass and corresponding deflections in the spring system. It is capable of measuring changes in gravity of about .03 milligal (1 gal=1 cm./sec.^{2}); i.e., about 1 part in 30 million of the total gravity. Only differences in gravity between stations can be measured. The gravity meter is connected continuously during field operations to a battery, which maintains the spring system at a constant temperature. The gravity meter is transported by car where possible, the car being fitted with a special carrier to protect the meter from shocks. A tripod is fitted in the car so that it can be lowered to the ground through the floor of the car, and the instrument can be set up and read without being removed from the car.

The magnetic work was done with a Watts Vertical Force Variometer. This consists of a magnetic needle balance which rests on quartz knife edges. It measures variations in the vertical component of the earth's magnetic field, caused by the presence of magnetic material under the earth's surface. It is much smaller and lighter than the gravity meter, and needs no elaborate thermal control.

Readings were taken at about 730 stations with both gravity meter and magnetometer. Locations of the stations are shown on Plate I. The usual procedure was for both instruments to be transported in the same car. While the gravity meter operator was setting up and taking a reading, another operator would set up and read the magnetometer at a station about 120ft. away. This distance was found to be outside the zone of magnetic disturbance caused by the car. Readings were taken with both instruments at three or four stations, then these readings were repeated before reading new stations, so that corrections could be applied for drift in the readings of the instruments. The stations were generally spaced from about half a mile to a mile and a-half apart.

The work can be divided roughly into two parts—a more intensive survey in the area surrounding Roma-Mt. Bassett-Blythdale where most of the deep bores were drilled; and exploratory work consisting of traverses along the road and rail to Injune, thence north along the Carnarvon Highway to Baffle Creek, westwards along the road to Muckadilla and Mitchell, eastwards to Wallumbilla and Yuleba, along the main roads southwards to the boundary of the permit areas, and in the north-east to the vicinity of A.R.O. No. 7 bore and Stewart's Mooga bore. Twenty-six bores which are supposed to have reached basement were located and readings were taken at them, and also at about ten other deep bores.

A considerable amount of surveying had to be done in connection with the work. Apart from the obvious need for locating the stations, it was necessary to determine the height of the stations within a few inches in order to reduce the gravity readings. In the more rugged parts of the area, contours were required for some distance around the stations, as a terrain correction had to be calculated to apply to the gravity results. Advantage was taken of existing land, rail and main road surveys where possible. The positions of stations were referred to the military grid system, on which all the results were plotted.

As the instruments were transported by car, traverses were laid out along roads where possible. However, it was often necessary to work in areas where there were not made roads, and travelling was often slow over rough and hilly country through scrubby timber. In some places a clearing party had to go ahead of the geophysical party.

Some density tests were made at Roma on cores from R.B.O. bores Nos. 2, 3 and 4. Further tests were made at Brisbane on cores from various bores, which were stored at the Mines Department. Cores from Hutton Creek, Arcadia and Warooby bores, which are stored at Canberra, were also tested.

DISCUSSION OF THE GRAVITY RESULTS

The readings taken in the field were corrected for drift and misclosure errors, then converted to milligals and corrected for elevation, latitude and terrain effects. The density of the sediments adopted for use in calculating the elevation and terrain corrections was determined by a statistical method, which depends on the gravity readings at groups of three collinear stations with a non-linear height distribution. The density finally adopted was 2.18. (This refers to the near-surface sediments only.) The reduced results are shown in the form of a contour plan (Plate 3). Profiles along the sections A, B, C and D are shown on Plate 7, together with geological sections and the magnetic profiles.

The main feature of the gravity pattern is the persistent low zone which strikes N.W.-S.E. from about Alicker to the area north-east of Mt. Bassett. On comparing the gravity contour plan with the basement contours (Plate 2) it is apparent that there is no direct correlation between the two patterns. Nor has it been possible to postulate a uniform regional correction which, if applied to the gravity readings, would enable them to be correlated with the known depths to basement of bores. (By a uniform correction is meant a correction which increases steadily in the same direction throughout the area.)

In the ideal case of a basin with sedimentary rocks of uniform density d_s resting on a basement of uniform density d_b, the gravity contours measured at the surface do not necessarily correspond accurately with the basement contours. If the gravity anomaly is taken as zero at a point on a basement outcrop at a comparatively large distance from the sedimentary basin, then the anomaly at a point on the basin where the depth to basement is h, is $2 \pi k (d_s - d_b) h$ (k is the gravitational constant), or $.01285 (d_s - d_b) h$ milligals, when h is in feet. Strictly speaking, this formula applies only when the basement is horizontal for some distance around the point under consideration; however, in cases where the slope of the basement surface is not great, and no abrupt changes occur, it gives a good approximation to the actual anomaly. Thus, the gravity contours in such a case have a direct linear relation to the basement elevation.

Any abrupt or local change in the surface of this ideal basement gives rise to a corresponding local effect in the gravity values measured at the surface. However, the gravity effect in such a case does not follow exactly the changes in basement elevation. The effect is spread over a greater area than the actual basement irregularity, in a way which depends on the depth of the feature below the surface, and on its shape; as the depth becomes greater so the area of spreading becomes greater; also the maximum value of the anomaly becomes smaller.

TABLE III: Results of Density Tests on Bore-cores.

Bores near Roma.		N	Average density.	P	R
Sediments depth .	0–1000ft.	18	2.16	75%	1.97 to 2.36
,, ,, .	1000–2000ft.	24	2.21	75	2.09 to 2.37
,, ,, .	2000–3000ft.	60	2.28	75	2.10 to 2.47
,, ,, .	3000–4000ft.	258	2.41	75	2.23 to 2.52
				95	2.10 to 2.64
,, ,, .	4000–5000ft.	18	2.40	75	2.18 to 2.54
Metamorphic rocks		13	2.64	100	2.57 to 2.72
Granite (unweathered)		10	2.55	100	2.50 to 2.59
Hutton Creek Bore:					
Sediments depth .	4000–4350ft.	11	2.59	75	2.54 to 2.66
,, ,, .	4350–4700ft.	10	2.70	75	2.62 to 2.82

Arcadia Bore:

Sediments depth .	4000–5000ft.	11	2.75	75	2.50 to 3.04
" " .	5000–6000ft.	12	2.63	75	2.54 to 2.66

N=number of specimens tested.

P=percentage of specimens tested whose density lies in the range **R.**

The results of the density tests on the bore-cores are summarised in Table III. To make a proper estimate of the average density of any part of the sedimentary section, a density should be assigned to each type of rock. From the log of a bore, the total thickness of each of the different rock-types in the section should be obtained. A mean of the densities for the different rock-types should then be calculated, the density of each type being weighted according to its thickness. It has not been possible to do this, firstly, because the rock-types commonly grade into one another; and, secondly, because specimens with the same description have widely different densities. The average densities given in Table III are simply the average of all the specimens tested in the various depth ranges. They should give a fairly good approximation to the true average densities. Table III also gives the range of densities which includes most of the specimens (percentage quoted) tested in each depth range.

The density tests show that the densities of the sediments near Roma increase with depth from about 2.15 at the surface to about 2.4 below 3,000 feet. The overall average density of the sediments is about 2.25. Granite (2.55) has a density higher than the average of the deepest sediments, although some sedimentary specimens tested have a higher density than the granite. The metamorphic rocks are denser than the granite, as are also the Permian rocks intersected by Hutton Creek and Arcadia bores below 4,000 feet. Some specimens of the latter have densities as high as 3.0.

Although the density of the sediments is not uniform, those near Roma are on the average lighter than the basement rocks. One would expect, therefore, a general correlation between the gravity values and the depth to basement at the known bores, especially as the general trend of the basement surface appears to be more or less uniform over fairly large areas, and not very steep. Local departures from an exact correlation would, however, be expected owing to local features in the basement. It has been found, however, that there is no such general relation, and the main feature of the gravity pattern must therefore be due to other causes.

It will be observed that the low gravity zone trending N.W.-S.E. corresponds approximately with the area in which granite has been found in the bores. Variation in basement density is therefore a probable cause for the gravity differences. Support for this hypothesis is given by the density tests on the drill cores, which show that a change in basement rock from granite to metamorphics could cause an increase in gravity at the surface. There are difficulties in accepting this as the only cause of the anomaly, as some of the granite occurrences are found well into the region of the high gravity gradient on the south-west side of the low zone —notably in the bores at Warooby and Blythdale. If it is assumed that metamorphic rocks of density 2.65 rest on a sloping surface of granite of density 2.55, a thickness of about 15,000 feet of metamorphic rocks in the vicinity of Roma and southwards, and about 6,000 feet in the region of Stewart's Mooga bore would be required to account for the observed gravity value. However, in distant regions where it is exposed the basement is very complex, and the major features of the gravity pattern are probably due to the deep-seated causes within the basement. The low gravity zone could be caused by a feature centred at a depth of as much as 15,000 feet.

Another outstanding feature of the gravity pattern is the rise in values of about 30 milligals from near Gunnewin, where basement is known to lie at a shallow depth, to the vicinity of Hutton Creek bore, which penetrated over 4,500 feet of sediments, mainly Permian. To explain this in terms of a variation in the thickness of sediments overlying the basement rocks, one would need to postulate an increase of about 9,000 feet of Permian or earlier sediments with a density of 0.2 higher than the granite. The density tests on cores from Hutton Creek and Arcadia bores show that the increase in thickness of the Permian sediments to the north could account for at least part of this anomaly. A much greater thickness of Permian or earlier sediments than is at present known would be required to explain the anomaly.

It is apparent that deep-seated variations in the basement complex are the cause of major features in the gravity contour pattern, and these are unlikely to be related to possible oil-bearing structures. From the density tests on the bore cores, however, and from general consideration, it would still be expected that changes in elevation of the basement surface would produce gravity effects, even though these may be much smaller than the deep-seated effects; and that local features of basement topography would cause comparatively local disturbances of the regional contour pattern. It is not clear from the density tests whether the increase in density with depth is a general increase due to compaction, or whether the sediments of different eras can be assigned different average densities which increase with age.

If the former is true, the density contrast between the basement and the sediments should be based on the density of the sediments immediately overlying the basement, i.e., about 2.4. If the latter is true, then folding in the earlier sediments should produce gravity anomalies at the surface. If the folding is associated with corresponding basement features, the anomalies due to the basement features would be increased. It is also possible that folding in the sediments independent of basement features could cause anomalies. In the following discussion, for the sake of simplicity, the assumption has been made that the sedimentary section has uniform average density. The anomalies are interpreted as if they were associated with basement topography combined with more deep-seated causes. Possible modifications of this interpretation should be borne in mind.

In order to isolate anomalies which may be associated with the basement elevation it is necessary to eliminate the major, deep-seated, gravity effects. It is difficult to do this in areas where there are few or no bores giving the depth to the basement; however, in the Roma-Blythdale-Mt. Bassett area, where many basement depths are known, some success may be expected.

Two methods were used for eliminating the regional effect. In the first one, assuming a density of 2.25 for the sediments and 2.55 for the (granite) basement, the anomaly expected from the sediments of the various bores was calculated from the formula $2 \pi k (d_s - d_b) h$. These values are listed in Table IV as "calculated anomaly (Gc.)". The difference between the calculated and observed gravity values at the bores (Go-Gc, Table V) then gives the "regional" effect at the bores, or the effect due to causes other than basement topography. This regional effect was plotted at the bores for a part of the area—that part enclosed by a rectangle in Plate 3, and shown enlarged to double scale in Plates 4A and 4B. A contour plan was drawn to fit these calculated values, ignoring local discrepancies between bores close together. As far as possible the contours were made to follow the general trends of the contour plan of observed gravity, local irregularities being smoothed out (Plate 4A). Profiles of observed gravity were drawn along several cross-sections as a guide in drawing this contour plan. From this smoothed contour plan a value of the regional effect was read for each station. The regional effect was subtracted from the observed gravity value at the station, the remainders were plotted, and a contour plan was drawn from them (Plate 4B).

The contour plan of Plate 4B shows a "ridge" of high values, trending through pegs 1226, 689, 570, 41 and 316, nosing to the south in conformity with the general southerly basement dip. Along this "ridge" there are two definite high closures, centred near pegs 41 and 570 respectively. These two anomalies, with closures of 0.4 and 0.5 milligals respectively, could correspond to basement highs.

The chief disadvantage of the foregoing method for eliminating the regional effect is that it involves a certain amount of more or less arbitrary personal judgment. While considerable care was taken in drawing the regional pattern, it must be remembered that the anomalies removed are much greater than those remaining in the final plan. Relatively small changes in drawing the regional pattern may produce important changes in the residual pattern.

The second method reduces the personal element although there is still room for variation in the residual pattern obtained. The method is fundamentally that described by W. Raymond Griffin (1949). The regional effect at a station is defined as the average value of gravity around a circle centred at the station. This is subtracted from the actual value of gravity at the station, leaving a value of residual gravity. From the values of residual gravity thus determined at a number of stations a contour plan is drawn. The value of the regional effect at a station, according to this definition, depends on the radius of the circle used for determining it. With a small radius, the residual pattern includes chiefly very local anomalies; the broader effects are treated as regional effects, and are eliminated. As the radius is increased a greater part of the more widespread anomalies is included in the residual pattern, as well as the local anomalies. With a suitable choice of radius, the regional effects are largely eliminated, and the residual pattern consists chiefly of such local anomalies as are of interest in structural mapping. However, there is considerable latitude in the choice of the radius. Moreover, for any chosen radius, there is a certain amount of overlapping, in so far as the regional effects contribute something to the residual pattern; and, on the other hand, the local anomalies are not fully revealed in the residual pattern being somewhat reduced. The chief advantage of this method over the one already described is that the results are treated on a uniform and definite basis, and may be compared if necessary with results from other areas treated on the same basis.

As it stands, Griffin's method takes no account of the control data from bore information. It eliminates anomalies due to regional basement trend as well as other regional effects. For the present work the method was modified to make the resulting contour pattern fit in with the bore data. Anomalies were calculated at the bores where depths to basement are known (Gc, Table V). These anomalies were plotted on a plan showing the position of the bores, and a smoothed contour plan was drawn through them. This contour plan represents approximately the gravity anomaly to be expected from the known regional trend of the basement. Next a value of residual gravity was determined for each station in the area from the contours of observed gravity, Plate 3, by Griffin's method as described in the previous paragraph. A regional basement anomaly for the station was determined from the smoothed contour plan and was added to the residual gravity for the station. These combined gravity values were plotted at the stations, and a contour plan was drawn from them. Thus, the anomaly expected from the known regional trend of the basement was added to the local gravity effects which may be due to local basement topography. The resulting contour pattern should approximately represent the complete anomaly due to basement topography.

The radius chosen at first in determining the residual gravity was two miles. The regional effect was taken as the average of the gravity values at eight points equally spaced around the circle. In calculating the control data a density contrast of 0.3 was assumed as before. The residual pattern so obtained is shown in Plate 5A. The pattern is very similar to that of Plate 4B. The two most significant closures are in much the same position, but the closures are .55 and .25 milligals respectively.

To illustrate the difference caused by changing the radius used in the second method, the process was repeated, using a circle of 4 miles radius for determining the regional effect; otherwise the procedure was the same. The residual pattern is plotted on

Plate 5B. The character of the anomalies has changed somewhat, most features being rather steeper than before. Further contour maps were prepared assuming different density contrasts between the sediments and the basement. These maps were based on the residual values obtained using the circle of 2-mile radius. As before, values were added to them to make them correspond roughly with the general basement trend; but these values are increased or decreased in proportion so as to correspond with a density contrast of 0.4 (Plate 5C) or 0.2 (Plate 5D), instead of 0.3. These plans illustrate further ambiguities in the interpretations owing to the doubt about the actual densities.

Comparison of the residual plans (Plates 4B, 5A, B, C and D) shows that the two high anomalies, centred near pegs 41 and 570 respectively, are found on all these plans, though they vary considerably in shape, areal extent, amount of closure, and relative height. There is also a suggestion of a closure to the north of pegs 70-71; however, this is indefinite, owing to the lack of stations in this area. Of the two most significant features, the closure on the northern one varies from 0.1 to 0.5 milligals and on the southern one from 0.4 to 0.75 milligals.

Considering the possible variations in the details of the anomalies, calculations to determine what basement feature would give the best fit to these anomalies are not warranted. Even where the gravity contours are definitely related to basement topography a variety of features can generally be found which would give a good approximation to any given gravity anomaly. The following calculations are therefore intended to give only a rough idea of the sort of feature that might be the cause of these anomalies, and are not to be regarded as a strict interpretation of the results.

It is possible to make an approximate estimate of the maximum depth to the centre of gravity of a feature from a study of a cross-section of its gravity anomaly. (Nettleton, 1940.) By this method estimates of maximum depths for these features are of the order of 6000 to 9000 feet. These maximum estimates assume that the feature is very abrupt, or else spherical (or cylindrical) in shape. A more widespread feature could produce the same anomaly if it were nearer to the surface. As the basement is about 4000 feet below the surface in this area, these gravity anomalies are compatible with high features at or above the basement, as it is naturally expected that such features would give rise to more widespread anomalies than the features used for estimating the maximum depth. The effects of some theoretical features were calculated using the densities assumed above, and are listed in Table IV. The features were assumed to be hills in the form of cones or truncated cones resting on an otherwise flat basement at 4000 feet depth. The dimensions of the features are given in Table IV with the anomalies as calculated for hills composed of granite (density contrast = 0.3) or metamorphic rocks (density contrast = 0.4). Maximum anomalies are given immediately above the centres of the features.

TABLE IV

Calculated anomalies of conical and truncated conical features. Lower surface at depth 4000 feet.

Base diameter.	Upper diameter.	Height.	Calculated anomalies. Granite.	Metamorphics.
7000ft.	3000ft.	800ft.	.54 mg.	.72 mg.
6000ft.	3000ft.	500ft.	.28 mg.	.38 mg.
3000ft.	0ft.	500ft.	.14 mg.	.18 mg.
3000ft.	0ft.	200ft.	.05 mg.	.07 mg.

Thus, if the two most significant closures are to be explained in terms of basement topography, it is evident that they would represent substantial features several hundreds of feet in height. It is possible, though, that these anomalies are associated with comparatively local changes of rock-type near the surface of the basement. It is also possible that the anomalies are associated with high features in the sediments, either in conjunction with or independently of basement highs.

It would require very careful field work to detect anomalies of the order of 0.1 milligal even if there were no other disturbing anomalies. With the strong regional effect which is present near Roma one could not be at all certain of their existence, as additional errors may be introduced in isolating them. Thus, Table IV shows that features may be large enough to be important from the point of view of forming possible oil-bearing structures and yet may give rise to gravity anomalies too small to be detected at the surface.

Outside the area for which the residual plans were drawn the gravity contours show many features, including several high zones. For example, there is a "ridge" between pegs 724 and 1317, and another from peg 1206 to 858; some one-sided high features of fairly local disturbances, as near pegs 910 and 1516; and a high closure to the south of Roma in the area between pegs 598 and 673. There is not enough information from bores in these areas to enable a regional pattern to be drawn in the same way as was done for the Roma area; also the intensity of the gravity stations is not great enough. It is difficult to decide to what extent these anomalies should be incorporated in the regional pattern.

DISCUSSION OF THE MAGNETIC RESULTS

The variometer readings taken in the field were corrected for temperature, drift and misclosure errors, and converted to gammas. A further correction was applied for normal regional variation, based on the absolute observations at stations covering a wide area around Roma. This correction was assumed uniform throughout the area and equal to 17.3 gammas per mile at a true bearing of 9°20', the correction increasing to the north. (I).

(I) An observation was made at the absolute magnetic station at Roma, for which the vertical component of the earth's field is known. - Thus, the observed values in the survey can be reduced to absolute values. This is of no particular importance for the interpretation of the results; however, the information is recorded as it may be of value in relating this survey to future work. A value of 44740 gammas must be added to the results of the present survey to convert them to absolute values. Note that this must be applied to the results uncorrected for regional variation. The results plotted on Plate 4 include the regional correction, which has been taken as zero at peg 25 (R.O.C. No. 1 bore, co-ordinates 157840E and 1697910N, zone 8), and at 17.3 gammas per mile of the distance from this point as projected on to a line through the point at a true bearing of 9°20'; the sign of the correction being positive to the north and negative to the south.

The reduced results are plotted as a contour plan on Plate 6. Profiles along the sections A, B, C and D are shown on Plate 7, together with the gravity profiles and geological sections.

Many of the considerations used in discussing the interpretation of the gravity results may be expected to apply to the magnetic results, at least qualitatively. Thus, a general relation may be expected to hold between basement elevation and magnetic contours where slopes in the basement surface are small, or in considering trends which persist over large areas; but it is not likely that they will be directly proportional to one another. Further, anomalies due to local features of basement topography are spread over a greater area than the feature; the extent of the spreading being greater the deeper the feature, and the maximum anomaly correspondingly smaller. As the earth's magnetic field is not vertical, but dips at about 56° in the Roma area, the magnetic anomalies may be displaced slightly to the north of the feature causing them. As with gravity anomalies, changes in the material forming the basement may be associated with changes in magnetic properties which will cause magnetic anomalies.

The reduced values from which the magnetic contour plan is drawn show local and erratic effects in many places. Such effects are for the most part confined to an anomalous value at one station only, or else at stations near towns or old bore sites, and are presumably due to near surface effects such as iron pipes, scrap iron, or local deposits of magnetic material in the soil. Further local irregularities are associated with the basalt on Mt. Bassett. Plate 6 shows a smoothed contour plan superimposed on the actual contours, and eliminating these local effects.

There is no obvious correspondence between the magnetic contours and the basement contours on Plate 2. The magnetic contours in the region of the major gravity low feature are parallel with the strike of that feature; however, they do not come to a minimum, but continue to dip to the north-east. To the south of Roma the magnetic contours rise more rapidly to the south-west. In the area around pegs 1308-623-630 an outcrop of dark-reddish ferruginous rock was noticed. Specimens of this rock tested in the field gave small deflections of the variometer. In the area near pegs 595-606-679 alluvial deposits occur, and would obscure this rock if it persists there.

To the east of Blythdale there is a low contour closure with values rising further to the east past Wallumbilla. A "ridge" of high values noses westwards from the area north of Wallumbilla towards Mt. Bassett. Here the magnetic and gravity contours show a similar pattern, but the magnetic high corresponds to a gravity low. Further north a single traverse shows an anomaly of about 300 gammas centred at peg 1539. This may be associated with the basalt which caps the Grafton Range. (The traverse crosses the Range at peg 1536.) The readings taken show a regular rise to the maximum from each side; but it is possible that closer spaced readings would reveal more irregular values.

In the northern part of the area the most prominent feature is a high zone with a maximum at peg 1038, about 4 miles north of Hutton Creek bore. An outcrop of dark-reddish rock was noticed in this vicinity also. This may have been the bed of ferruginous sandstone which Dr. Reeves used as a marker in mapping the Hutton Creek Dome.

Thus some of the features of the magnetic pattern seem to be related to ferruginous outcrops. They show no relation to known basement topography, and very little if any relation to the gravity pattern. For the most part the pattern is too regular (after eliminating the near surface effects) to suggest the existence of comparatively local anomalies which could be isolated by methods similar to those used for gravity results. The only features which may be related to possible oil-bearing structures are the high values around peg 1539 and the "ridge" from north of Wallumbilla towards Mt. Bassett. However, in the absence of any corroborative evidence, no reliance can be placed on such an interpretation.

No magnetic anomalies or disturbances of the contours are associated with the gravity high closures on Plates 4 and 5, which are possibly due to high basement features. As there is no evidence that magnetic effects are associated with basement topography in any part of the area, this fact neither detracts from nor adds to the probability of the gravity anomalies being due to basement features.

CONCLUSIONS AND RECOMMENDATIONS

Summarising the conclusions drawn from the geophysical work to date it is found that the major gravity and magnetic anomalies are not associated with basement topography. There is, nevertheless, a reason to believe that features of basement topography, and possibly features in the deeper sediments, should make some contribution to the gravity effect. Calculation of the contribution due to basement elevation at known points has enabled an approximate elimination of the anomalies due to more deep-seated causes in a part of the area, and a gravity pattern has been isolated which may be due to features in the sediments, either directly or indirectly through their association with basement topography. This pattern shows at least two high features which may be associated with structures favourable for oil accumulation. The possibility of oil accumulation in these features is enhanced by the fact that they are situated in an area in which showings of oil and considerable quantities of gas have been found in several bores, although it is doubtful whether a suitable structure in that area has yet been tested.

However, it is recommended that seismic testing be carried out before a drilling site is chosen. The interpretation of the gravity anomalies has been necessarily approximate, and it is not altogether certain that they are due to high features in the sediments or in the basement surface. Even granted this, it would be difficult to select the best site for drilling on gravity evidence alone. Moreover, if the reflection seismic method is found to be applicable, it will give direct evidence of structure in the sediments. It may also reveal features too small to be detected by the gravity method. The two gravity highs near pegs 570 and 41 would be suitable targets for beginning the seismic survey. Their proximity to bores would enable tests to be made at points where conditions are known in order to assist the interpretation of the results. They are in areas where the terrain is reasonably flat, and are easily accessible from Roma. Some of the area is covered by light timber, and clearing and track-making would be necessary in places. If the seismic work shows that structure is associated with these two anomalies, possibly some of the high features mentioned which are outside the area for which the smoothing process was applied should be tested by seismic methods. If the results of the seismic work are inconclusive, i.e., suitable reflections cannot be obtained, the only way to test these anomalies would be by deep scout-drilling, possibly with electrical or radioactive logging. On the other hand, if seismic work gives positive evidence that there is no structure associated with the anomalies, it may be necessary to make a wide-scale reconnaissance survey by the refraction or reflection seismic method.

From the work done so far it is apparent that neither the gravity nor the magnetic method is of any use for following regional trends in the basement topography. The gravity method may have further application for finding residual local anomalies, which could be tested further by seismic methods, or, possibly, by drilling. However, no further gravity exploration is recommended until the anomalies already discovered have been tested.

Some of the magnetic anomalies seem to be associated with outcrops of ferruginous rocks. It is possible that these rocks may form marker beds suitable for mapping structure in the near surface sediments, and that further application of the magnetic method may be useful in tracing these beds in places where they are soil-covered. Some geological investigations would be necessary before the possible value of this could be assessed. Other magnetic anomalies of unknown cause may be due to such beds in the sediments. At present no useful interpretation of the magnetic results can be made.

Another suggested application for the seismic method is in the Hutton Creek area. Reflections may be obtained which would give directly the structure in the Permian sediments. As mentioned above, the site of Oil Search Ltd.'s bore on this structure was selected on the basis of mapping the Bundamba (Upper Triassic) Series, which is not completely conformable to the Permian. Thus, seismic work may enable a more suitable site to be chosen.

Melbourne, June, 1950.

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TABLE V: SUMMARY OF BORE INFORMATION

Bore.	Peg No.	Surface Elevation.	Depth to basement.	Basement Elevation.	Calculated anomaly Gc (+ 30 mg.)	Observed Gravity Go	Go - Gc
Granite Basement:—							
A.R.O. No. 1 ..	1115	1235ft.	2414ft.	-1179ft.	25.5 mg.	30.4 mg.	4.9 mg.
A.R.O. No. 3 ..	1219	1141	3209	-2068	22.0	27.4	5.4
A.R.O. No. 4 ..	86	1019	3865	-2846	19.0	36.3	17.3
A.R.O. No. 8 ..	89	1038	3880	-2842	19.0	36.1	17.1
A R.O. No. 11 ..	84A	976	4129	-3153	17.9	36.8	18.8
A.R.O. No. 14 ..	1501	1151	3535	-2384	20.9	31.8	11.0
Warooby	49	1044	3764	-2720	19.5	37 8	18.3
Lander No. 3 ..	1210	1363	2659	-1296	25.0	25.5	0.5
R.B.O. No. 1 ..	3	1067	3536	-2469	20 5	32.8	12.3
R.B.O. No 2 ..	74A	1604	4026	-2422	20.7	31.5	10.8
R B.O. No. 3 ..	10A	1167	3628	-2461	20.5	33.0	12.5
R.B.O. No. 4 ..	6A	1094	3611	-2517	20.3	33.3	13.0
Roma Dome ..	1117	1397	2198	- 801	26.9	27.2	0.3
Roma Orallo ..	1119	1162	2835	-1673	23.4	32.0	18.6
Metamorphic Basement:—							
A.R.O. No. 2 ..	1220	1258ft.	2773ft.	-1515ft.	24.2 mg.	33.2 mg.	9.0 mg.
A.R.O. No. 6 ..	1118	1334	2258	- 924	26.4	35.0	8.6
A.R.O. No. 7 ..	1500	1361	3586	-2225	21.4	21 4	12.0
A.R.O. No. 9 ..	409	1547	2050	- 503	28.1	33.5	5.4
Q.R.O. No. 1 ..	1221	1226	2828	-1602	23.8	34.0	10.2
Mooga	1414	1298	3220	-1922	22.6	36.2	13.6
Lander No. 4 ..	30	1022	3850	-2828	19.1	44.4	25.3
R.O.C. No. 1 ..	25	1040	3855	-2815	19.2	44.0	24.8
R.O.C. No. 2 ..	24	1051	3950	-2899	18.8	44.1	25.3
Muckadilla ..	735	1171	3758	-2587	20 0	46 0	26.0
Mitchell	770	1107	2995	-1888	22.7	42.7	20.0
Did not reach Basement:—			Total Depth.				
Govt. No. 2 ..	27	1030	3710	-2680-	19.7-	43.9	24.2 +
Govt. No. 3 ..	X	1027	3713	-2686-	19.6-	44.1	24.5 +
Govt. No. 4 ..	31	1033	3709	-2676-	19.7-	44.0	24.3 +
R.O.C. No. 3 ..	28	1018	3732	-2714-	19.5-	44.0	24 5 +
R.O.C. No. 4 ..	90	1016	3839	-2823-	19.1-	36.4	17.3 +
A.R.O. No. 5 ..	88	1014	3834	-2820-	19.1-	36.2	17.1 +
A.R.O. No. 12 ..	1227	1165	3070	-1905-	22.7-	36.7	14.0 +
A.R.O. No. 13 ..	—	982 ?	2705	-1723- ?	23.4- ?		
A.R.O. No. 19 ..	1800	1042	4968	-3926-	14.9-	25.9	11.0 +
Hutton Creek ..	1032	1509	4688	-3179-	12.2-	57.5	45.3 +
Lander No. 2 ..	—	—	2625				

ABBREVIATIONS USED:—

A.R.O. Australian Roma Oil Corporation Ltd.
R.B.O. Roma Blocks Oil Co., N.L.
Q.R.O. Queensland Roma Oil Co.
R.O.C. Roma Oil Corporation.

TABLE VI: GRID REFERENCES IN TEXT

In these grid references the first three figures refer to east co-ordinates and the last three to north co-ordinates, in units of 1000 yards. Thus for peg 41, the complete co-ordinates are **166**480 E, I **697**260 N. The grid reference is 166697. (The initial figure in the N co-ordinate is omitted.) The area covers portions of zone 7 and zone 8 on the military transverse mercator projection for Australia, with the boundary at longitude 148°30'E. Unless otherwise specified, places in the list are in zone 8, east of this longitude.

References to Places:

Name.	References.
Alicker	127748-
Baffle Creek	148819-
Blythdale	177697
Grafton Range	180728
Gunnewin	132769
Hospital Hill	158698-
Injune	133786
Mitchell	615709 (zone 7)
Mt. Bassett	169709
Muckadilla	660696 (zone 7)
P.P.P. No. 677	162706
Roma	159698
Wallumbilla	202697
Warooby	171697
Yuleba	224694

References to Bores:

Name.	Reference
Arcadia	153852
A.R.O. No. 4	178698
A.R.O. No. 6	664749 (zone 7)
A.R.O. No. 7	176730
A.R.O. No. 11	178697
Block 16	164709
Hutton Creek	148804
Kayenta	667770 (zone 7)
R.B.O. No 1	164709
R.B.O. No. 2	169709
R.B.O. No. 3	165708
R.B.O. No. 4	163708
Roma Dome	673751 (zone 7)
R.O.C. No. 1	158698
R.O.C. No. 2	158698
Stewarts Mooga	174737
Wallumbilla	202697
Warooby Bore	171699

References to Survey Pegs:

Peg Numbers.	References.	Peg Numbers.	References
25	158698	565	169704
41	166697	570	163704
70	168711	595	164682
71	169711	598	164679
316	174694	606	167677
623	153688	1038	148812
630	153681	1206	142743
673	171680	1226	152712
679	173678	1308	147689
689	160708	1317	134687
724	136697	1516	183721
858	129754	1536	180728
910	190697	1539	173729

PLATE

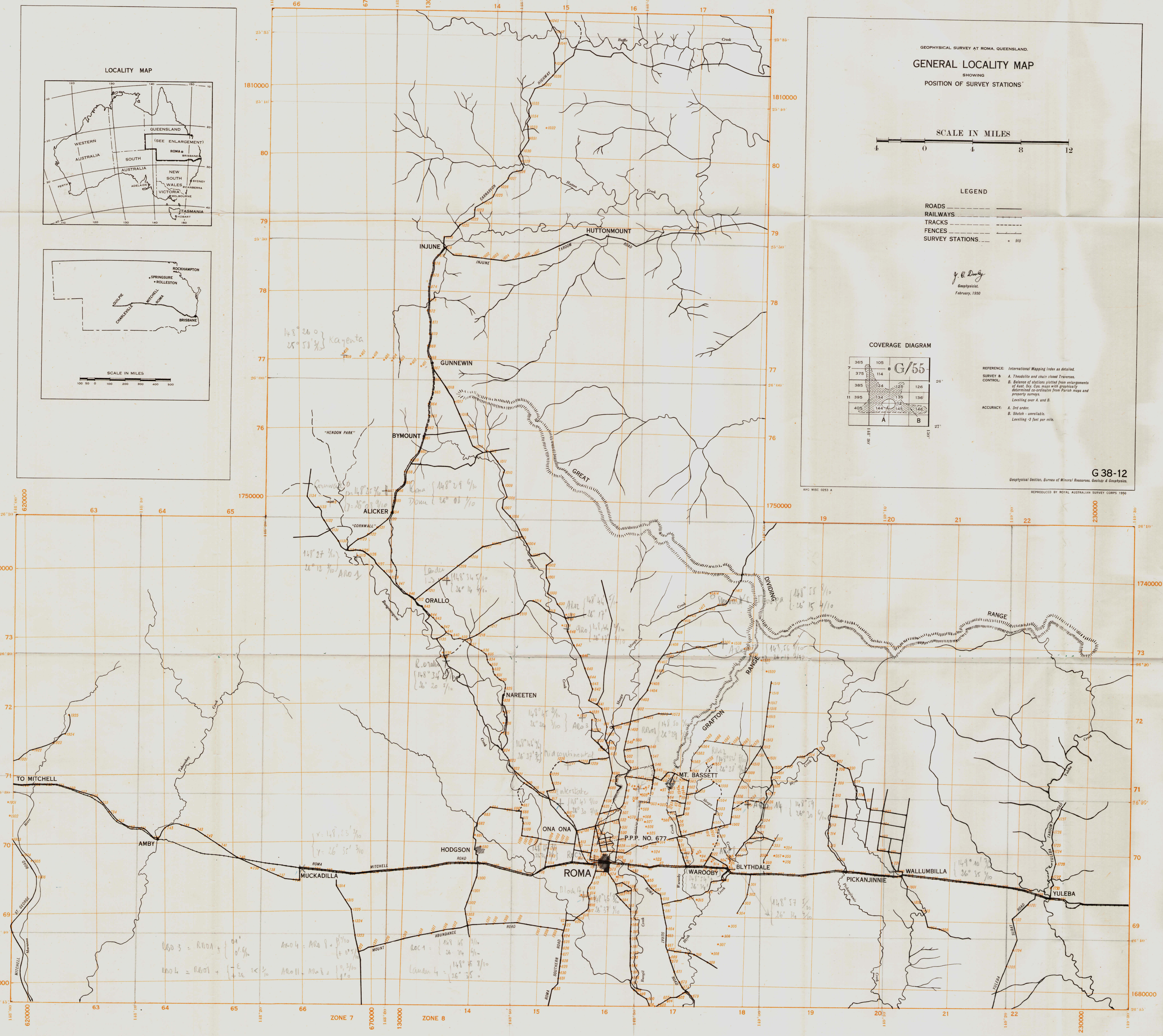
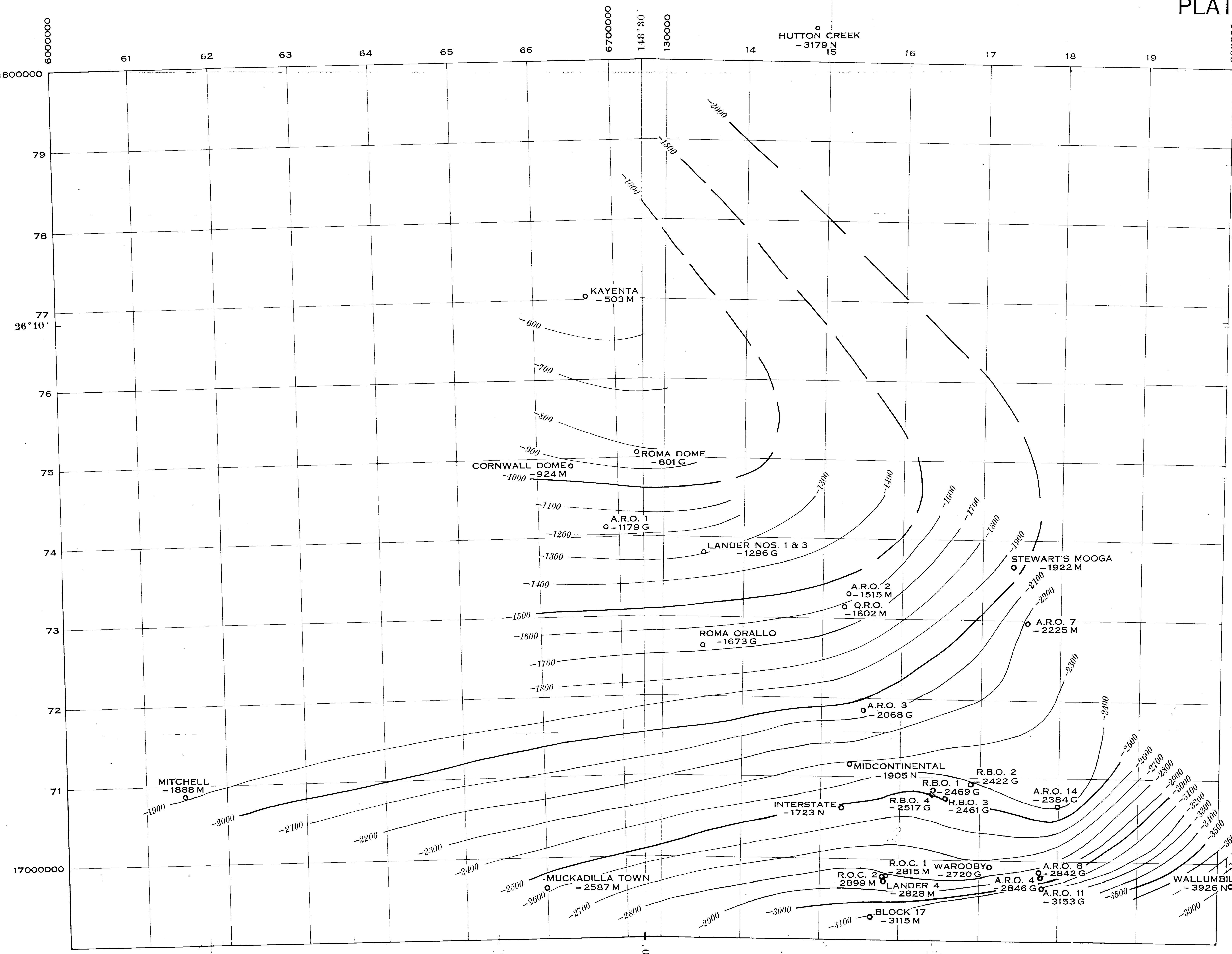

GEOPHYSICAL SURVEY AT ROMA, QUEENSLAND.
GENERAL LOCALITY MAP
SHOWING
POSITION OF SURVEY STATIONS
SCALE IN MILES
4 0 4 8 12
LEGEND
ROADS
RAILWAYS
TRACKS
FENCES
SURVEY STATIONS
Geophysicist.
February, 1950
COVERAGE DIAGRAM
G/55
REFERENCE: International Mapping Index as detailed.
SURVEY & CONTROL: A. Theodolite and chain closed Traverses.
B. Balance of stations plotted from enlargements of Aust. Svy. Cps. maps with graphically determined co-ordinates from Parish maps and property surveys.
Levelling over A. and B.
ACCURACY: A. 3rd order.
B. Sketch - unreliable.
Levelling ·3 feet per mile.
G 38-12
Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics.
REPRODUCED BY ROYAL AUSTRALIAN SURVEY CORPS 1950
LOCALITY MAP
WESTERN AUSTRALIA
SOUTH AUSTRALIA
QUEENSLAND
(SEE ENLARGEMENT)
ROMA
BRISBANE
NEW SOUTH WALES
SYDNEY
CANBERRA
VICTORIA
MELBOURNE
ADELAIDE
PERTH
TASMANIA
HOBART
ROCKHAMPTON
SPRINGSURE
ROLLESTON
QUILPIE
CHARLEVILLE
MITCHELL
SCALE IN MILES
INJUNE
HUTTONMOUNT
GUNNEWIN
BYMOUNT
"HENDON PARK"
ALICKER
"CORNWALL"
ORALLO
NAREETEN
GREAT DIVIDING RANGE
GRAFTON RANGE
MT. BASSETT
ONA ONA
P.P.P. NO. 677
HODGSON
ROMA
WAROOBY
BLYTHDALE
PICKANJINNIE
WALLUMBILLA
YULEBA
TO MITCHELL
AMBY
MUCKADILLA
ROMA MITCHELL ROAD
MOUNT ABUNDANCE ROAD
SOUTHERN ROAD
ST GEORGE
ZONE 7
ZONE 8
1810000
1750000
1740000
1680000
620000
670000
130000
230000

PLATE 2



LEGEND

Contour Interval 100 Feet

Figures at Bore indicate basement elevation in feet (datum, Sea Level)

M - *Metamorphic Rock*

G - *Granite*

N - *No basement reached, elevation at bottom of bore given.*

o *Bore*

J. C. Dooley

Geophysicist.

February, 1950

SCALE IN MILES

0 2 4 8 12 16 20 24

GEOPHYSICAL SURVEY AT ROMA, QUEENSLAND.

PLAN SHOWING

BASEMENT CONTOURS

G 38-13

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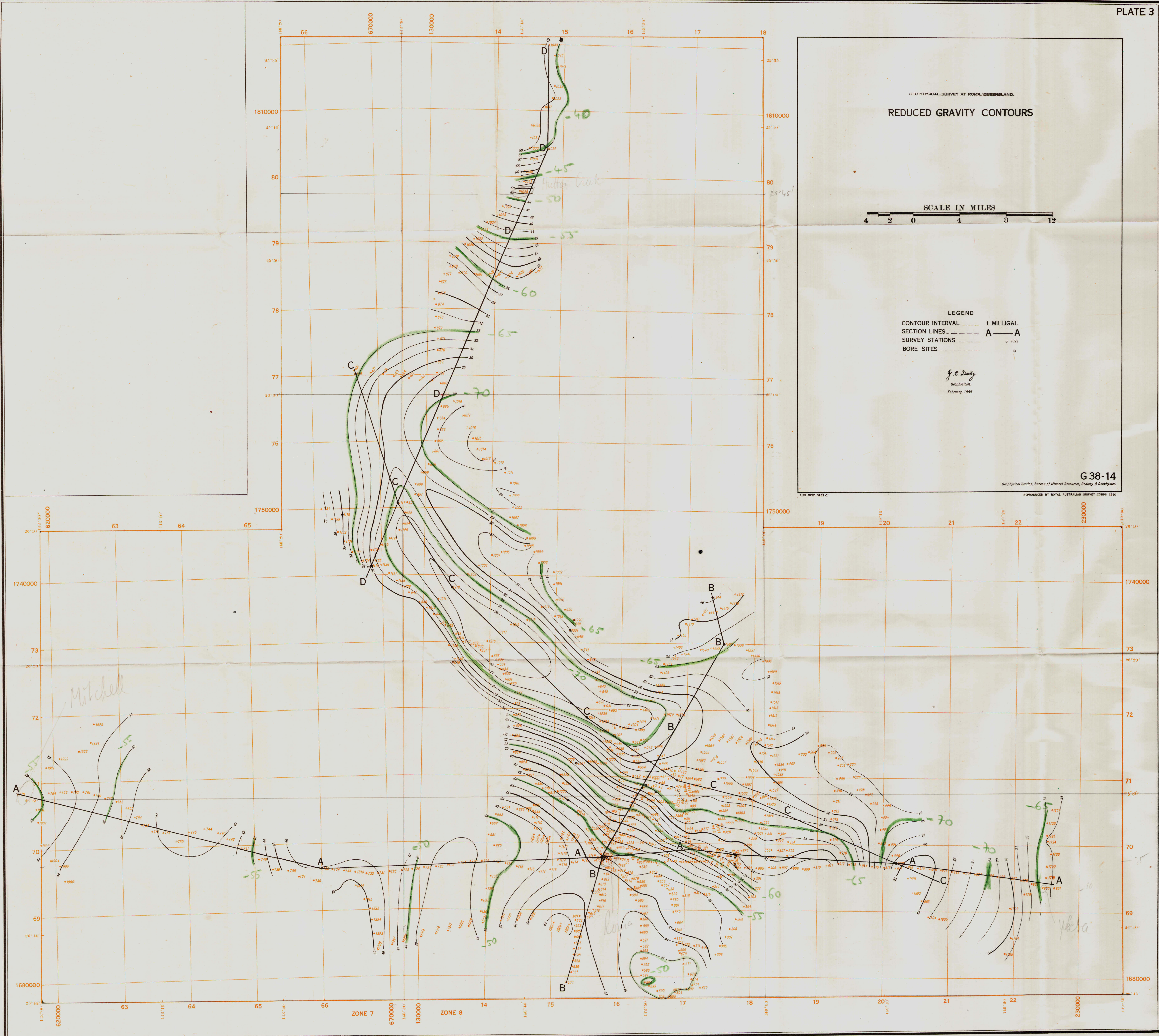
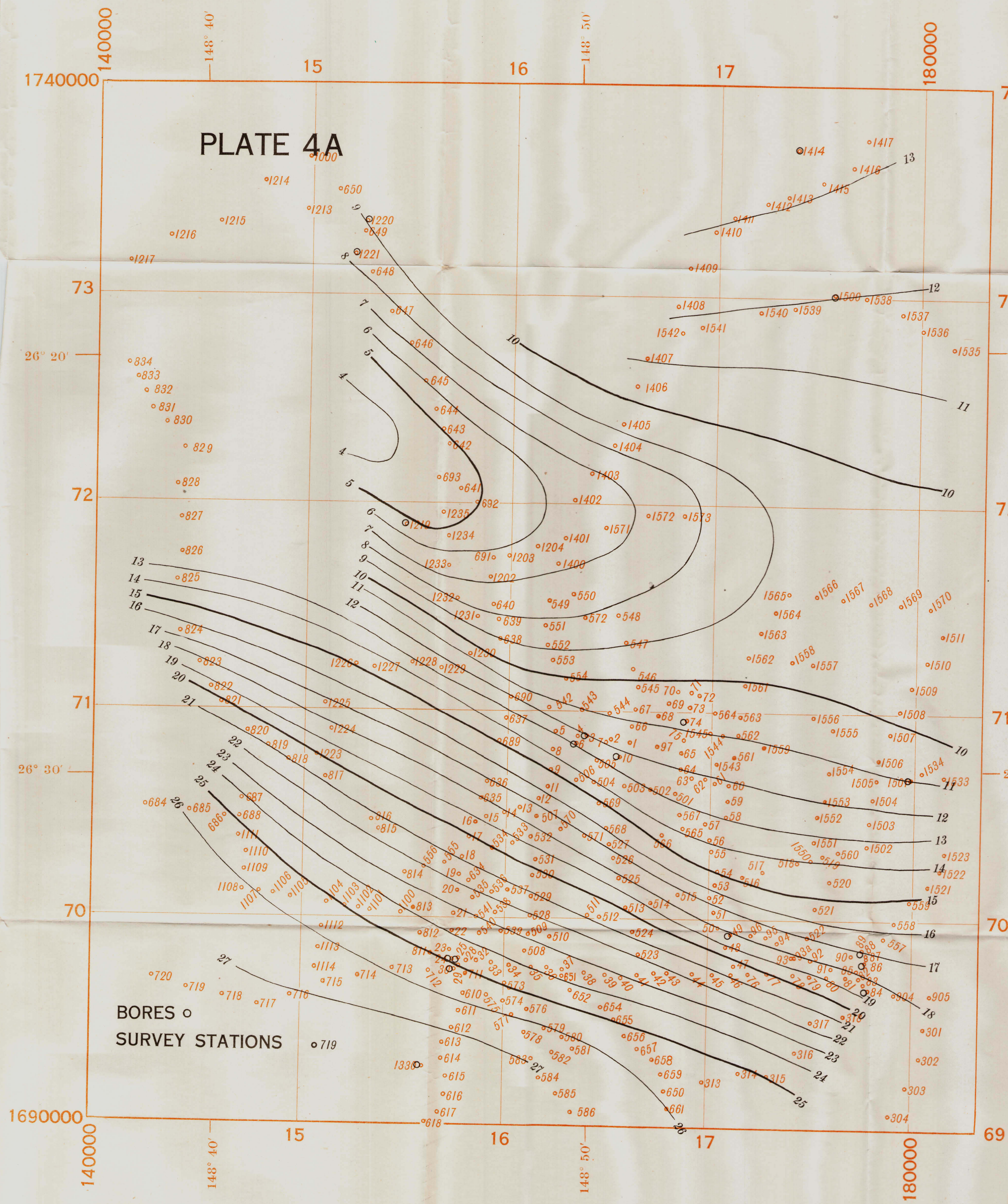
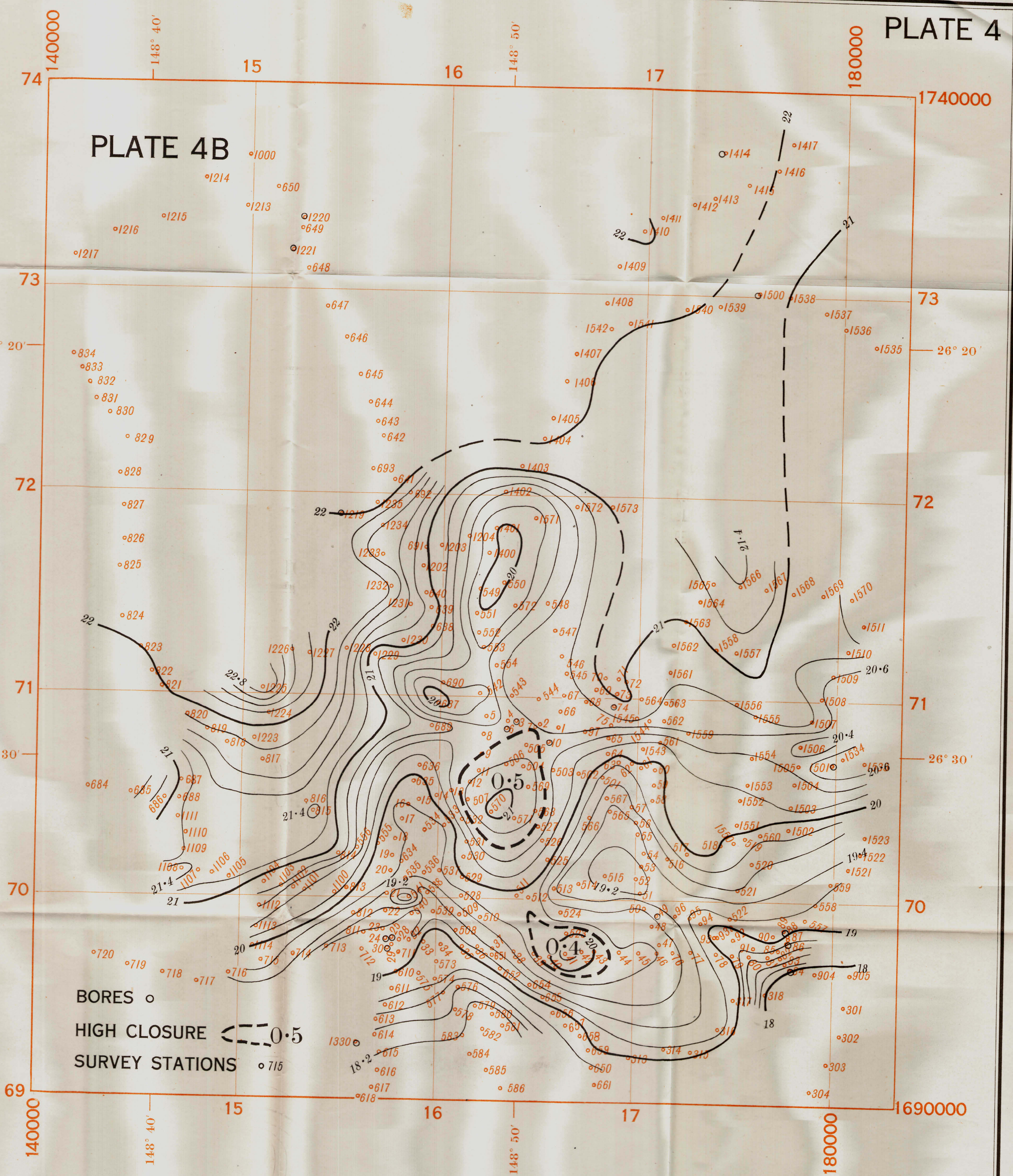
PLATE 3



GEOPHYSICAL SURVEY AT ROMA. QUEENSLAND.
REDUCED GRAVITY CONTOURS
SCALE IN MILES
4 2 0 4 8 12
LEGEND
CONTOUR INTERVAL 1 MILLIGAL
SECTION LINES A——A
SURVEY STATIONS 1022
BORE SITES
J. C. Dooley
Geophysicist.
February, 1950
G 38-14
Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics.
AHQ MISC 0253 C
REPRODUCED BY ROYAL AUSTRALIAN SURVEY CORPS 1950
ZONE 7
ZONE 8
Hutton Creek
Mitchell
Roma
Yeeba

PLATE 4





GEOPHYSICAL SURVEY AT ROMA, QUEENSLAND.

GRAVITY REGIONAL PATTERN

BASED ON CALCULATED REGIONAL EFFECTS AT BORES AND ON SMOOTHING OF OBSERVED GRAVITY PATTERN

CONTOUR INTERVAL 1 MILLIGAL

SCALE IN MILES

0 2 4 8 12 16

J. C. Dooley

Geophysicist.

February, 1950

GEOPHYSICAL SURVEY AT ROMA, QUEENSLAND.

GRAVITY RESIDUAL PATTERN

DEDUCED FROM OBSERVED VALUES AND REGIONAL PATTERN ASSUMING DENSITY CONTRAST 0·3

CONTOUR INTERVAL 0·2 MILLIGAL

G 38-15

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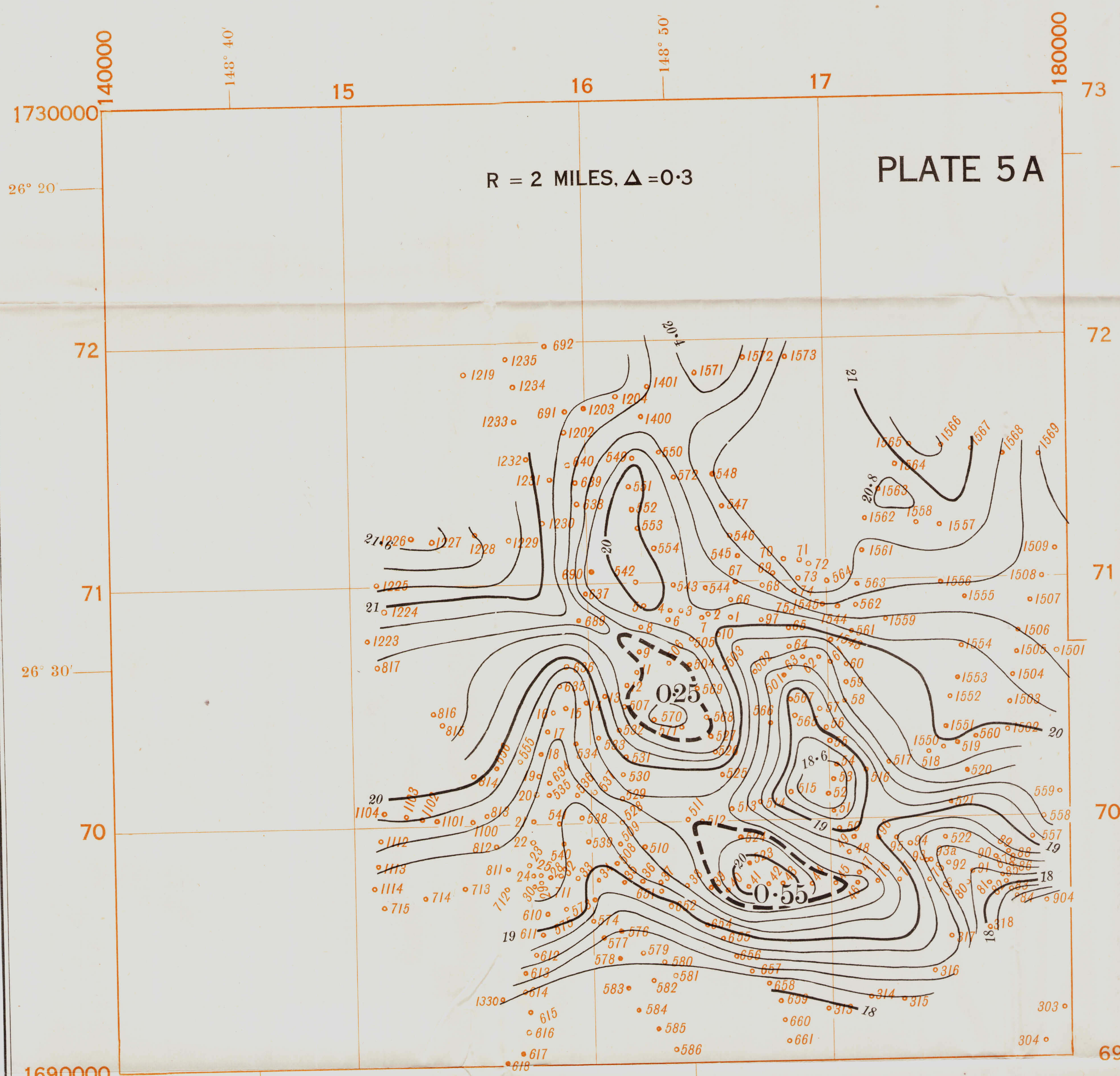
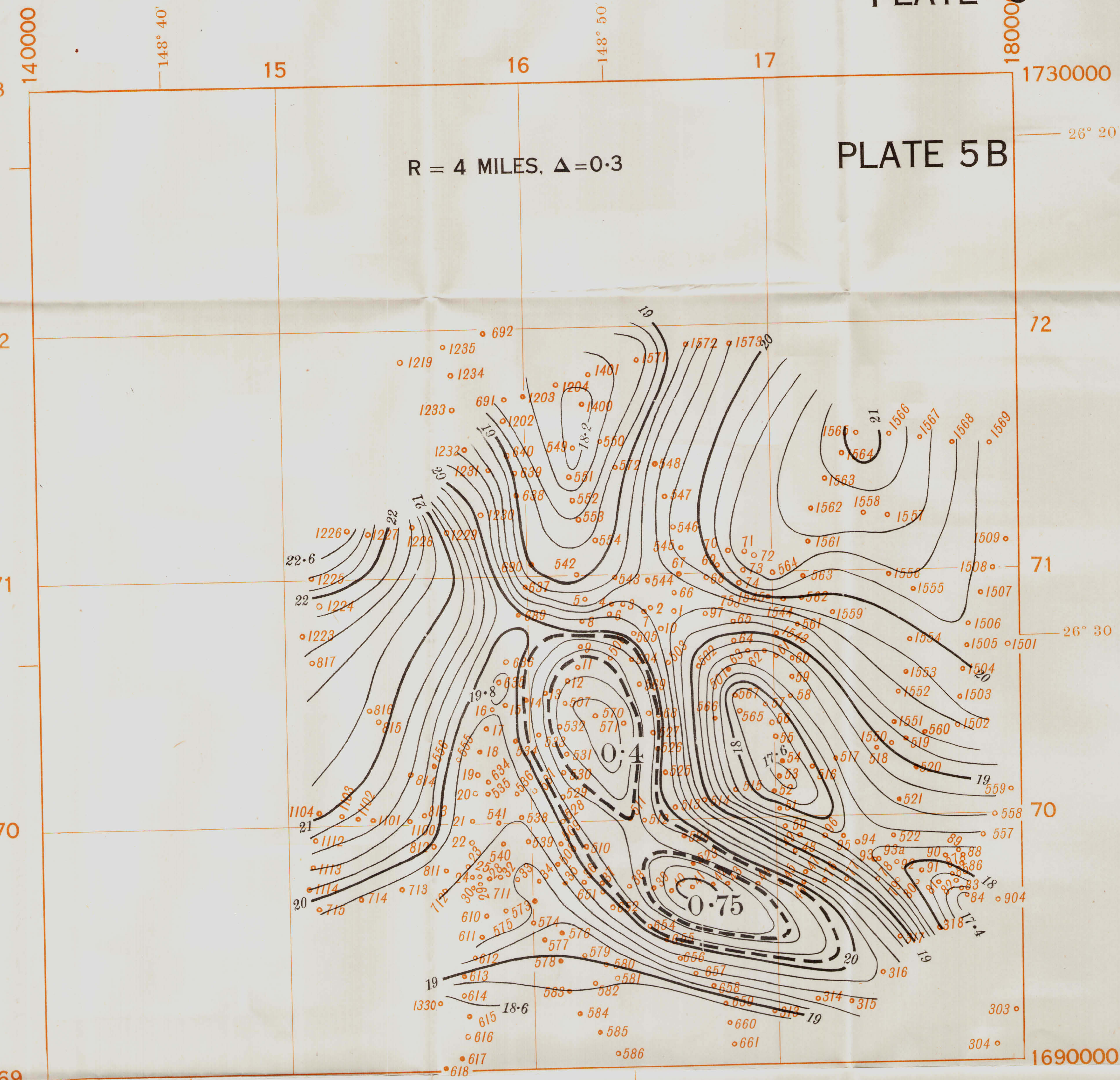
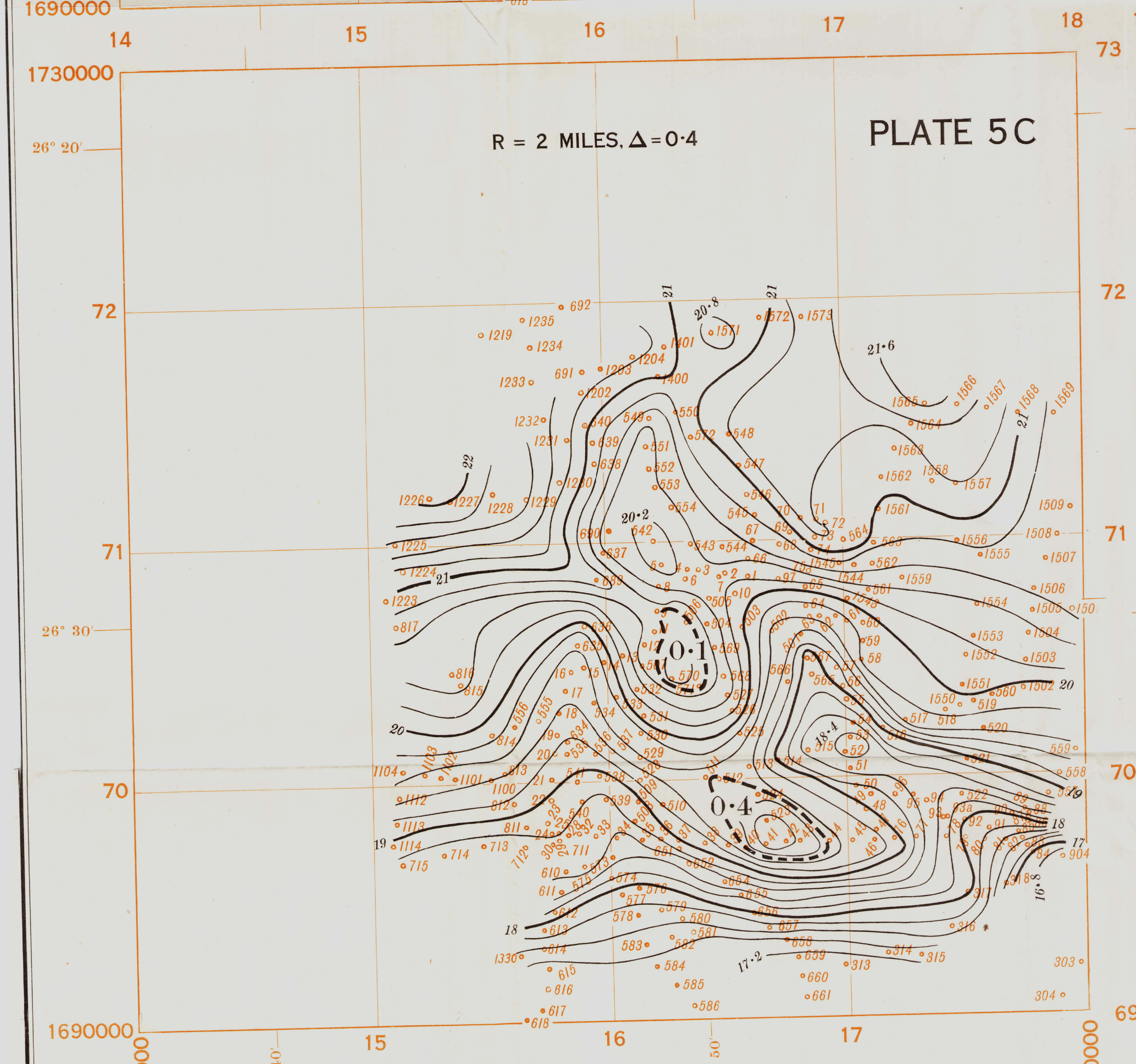
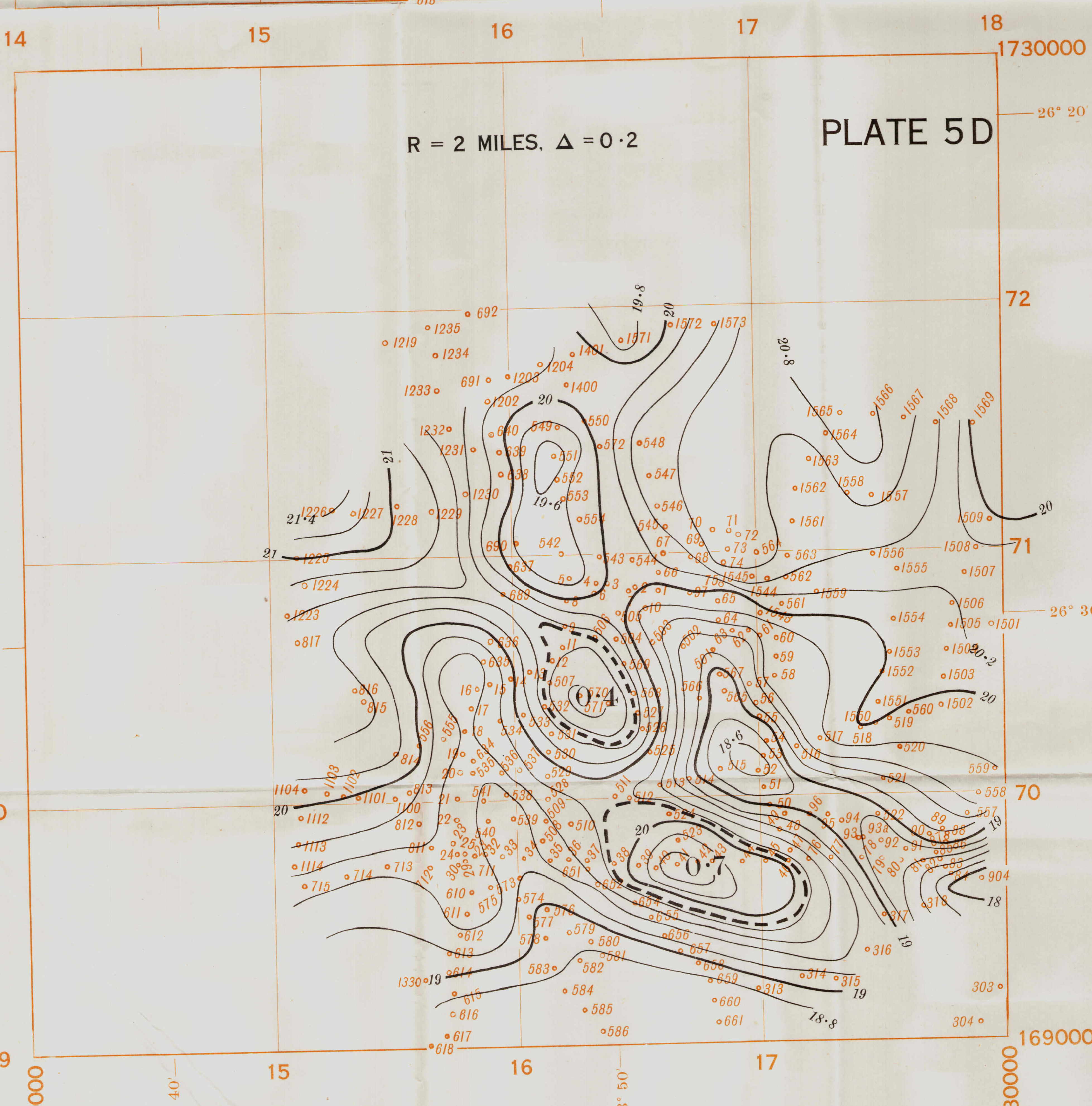
Printed by Royal Australian Survey Corps, 1950

PLATE 5









LEGEND

SURVEY STATIONS ∘ 1304

CONTOUR INTERVAL ·2 MILLIGALS

HIGH CLOSURE (0·5)

SCALE IN MILES

0 2 4 8 12 16

J. C. Dooley
Geophysicist.

February, 1950

GEOPHYSICAL SURVEY AT ROMA, QUEENSLAND.

GRAVITY RESIDUAL PATTERNS

BASED ON REGIONAL EFFECTS CALCULATED AS AVERAGE VALUE ON A CIRCLE AROUND THE STATION WITH RADIUS = R, COMBINED WITH REGIONAL BASEMENT TREND CALCULATED FROM BORE DATA ASSUMING DENSITY CONTRAST Δ

Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics.

G 38-16

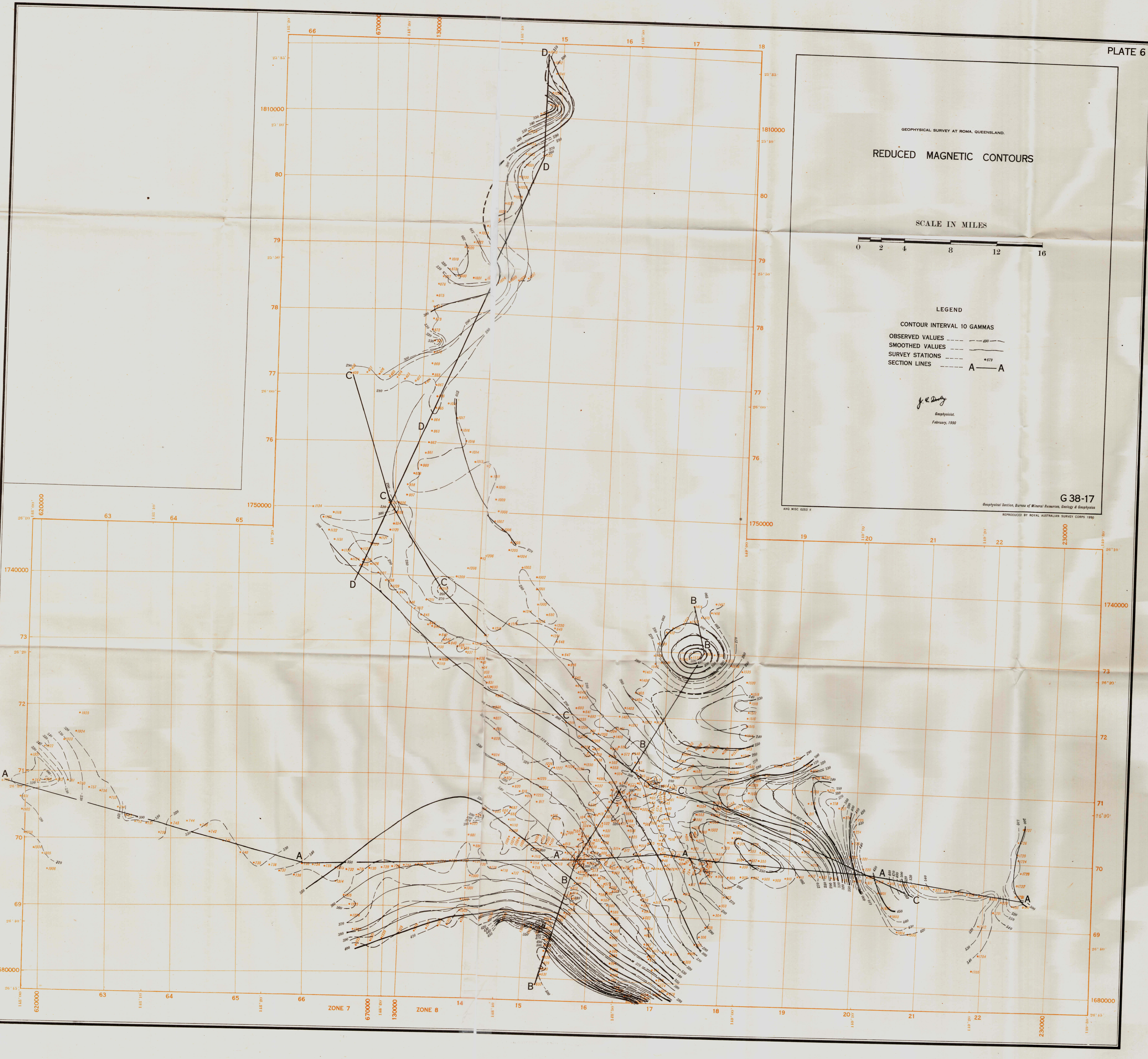
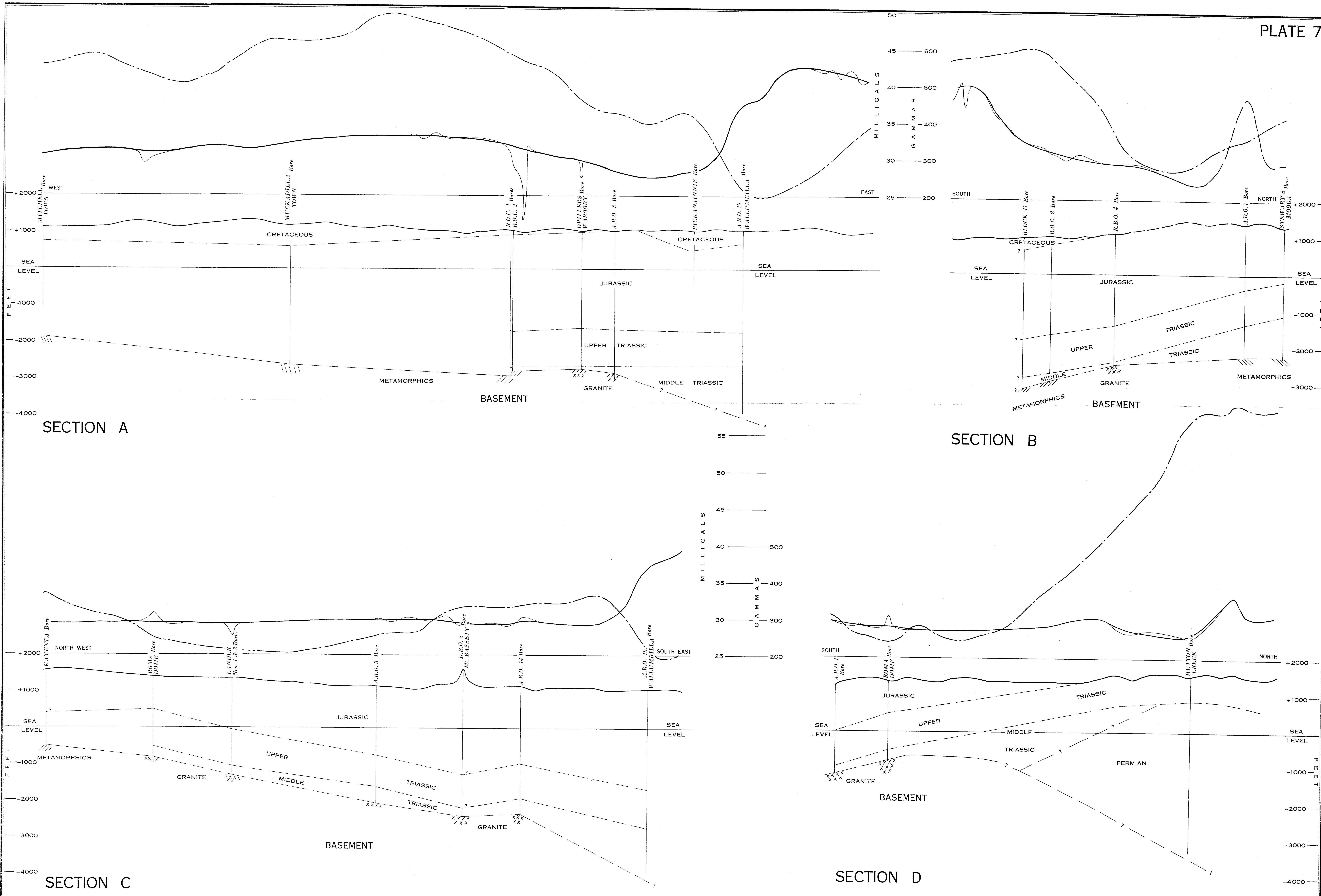


PLATE 6
GEOPHYSICAL SURVEY AT ROMA, QUEENSLAND.
REDUCED MAGNETIC CONTOURS
SCALE IN MILES
0 2 4 8 12 16
LEGEND
CONTOUR INTERVAL 10 GAMMAS
OBSERVED VALUES ---- 490
SMOOTHED VALUES ---
SURVEY STATIONS ---- 679
SECTION LINES ----- A—A
Geophysicist.
February, 1950
G 38-17
Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics
AHQ MISC 0253 F
REPRODUCED BY ROYAL AUSTRALIAN SURVEY CORPS 1950
ZONE 7
ZONE 8



LEGEND

Gravity Profiles
Observed Magnetic Profiles
Smoothed Magnetic Profiles

For positions of Section Lines see Plates 3 and 6

SCALE IN MILES

0 2 4 8 12 16 20 24

J. C. Dooley
Geophysicist.
February, 1950

GEOPHYSICAL SURVEY AT ROMA, QUEENSLAND.

GEOLOGICAL CROSS SECTIONS WITH GRAVITY AND MAGNETIC PROFILES

G 38-18

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