LYELL E.Z.. EXPLORATIONS

Queenstown

Report on

MOORE'S VALLEY GRAVITY AND MAGNETIC SURVEYS NOV./DEC. 1959

I.V. SEFTON

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To: Mr. G.F. Hudspeth.

Gravity and Magnetic Surveys in Moore's Valley, 1959

Below is a summary of I.V. Sefton's report, a copy of which is attached. The summary is divided into two parts: how the observed gravity results are corrected and a discussion of the results. In the latter section where I have added my comments they are underlined.

1. General Procedure

The value of the force of gravity at a latitude of 40° can be taken as 980 gals or cm/sec/sec. The one thousandth part of a gal, the milligal, is commonly used in gravity prospecting consequently one milligal is approximately equal to one millionth part of the normal force of gravity of the earth. The gravitymeter measures the relative component of this force of gravity, that is the variations from a chosen base station, and readings are taken direct to 0.1 milligal with a vernier adjustment to 0.01 mgal. These readings are raw or observed gravity values which have to be corrected as follows:

A. Instrument Drift and Time Variation

All readings are relative to the main base station at 00/12N which was given the arbitrary observed gravity value of 0.00 mgal. Subsidiary base stations were connected to 00/12N and the instrument was checked in to one of these points every 2 or 3 hours whilst making observations.

B. Latitude Correction

The force of gravity has a minimum value at the equator and a maximum at the poles. The latitude of 00/12N in Moore's Valley was taken by Sefton as 42°43'S which gives a latitude correction of 1.303 mgals/mile. This correction, which is approximately 0.1mgal/400 feet is added to the gravity values to the north of the base station and subtracted from those to the south.

C. Elevation Corrections

Two corrections are necessary:

(a) "Free Air" Correction

This correction is 0.09406 mgals per foot difference in elevation between the base station and point of observation. It is added to points higher than the base and subtracted from those which are lower.

(b) Bouguer Correction

The correction for the effect of the mass of material between the station and datum is 0.0127d mgals/foot difference in elevation where "d" equals the density of the material in this slab. It is subtracted from points higher than the base and added to those which are lower, this is in the opposite sense to the "free air" correction.

The density of the slab of material between the point of observation and datum can rarely be directly determined. Consequently, Sefton has used the following standard procedure. The observed gravity readings are corrected for drift, latitude and elevation ("free air" correction). The resultant values in section will reflect the topography along the traverse line and differing observed values of "d" are used in the Bouguer correction until this correlation is at a minimum. If the value of "d" used is too small, it will still reflect the topography; if it is too large it will image a reversal in the topography.

In the area covered by the programme of March, 1959 which was south of 44N, J.B. Boniwell found that a density of 1.87 gave least correlation with the surface topography and he reduced the gravity results using this figure. In the recently completed programme, Sefton extended the observations north of here to the northern boundary fault at 176N, and slightly beyond. When the same density of 1.87 was applied to these results, Sefton found obvious correlations between reduced gravity and topography indicating that this figure was too low for the northern area. He found that a density of 2.28 was generally appropriate and all results have been reduced using this figure. However, on line 156N between the baseline and 25E a density value of 2.55 had to be assumed to remove the topographical effects.

Sefton emphasises the importance of using the correct figure in this correction since the effect of changing "d" (in 0.0127d) by 0.1

is to produce a change in the reduced gravity value of 0.13 mgal for each 100 feet difference in elevation between the base station and observation point. Consequently an error of this nature could cause a spurious anomaly if the value of the density taken is too low, or smooth out a true residual effect if the value is too high.

D. Terrain Correction

Terrain corrections, which are always positive, are applied to allow for the effect of the attraction of a nearby mass of rock on the gravitymeter. The effect of minor topographic irregularities is small and can usually be neglected but at the north end of Moore's Valley on the slope from the Valley to Thirkell Hill this correction is apparently necessary. Strictly each station should be considered to be at the centre of a circle and corrections made from a contoured height plan of the zone. The process if tedious and slow and Sefton has used a two dimensional correction which assumes that the topographical profile of the line surveyed extends unaltered for a great distance on either side of the line. However, this approximation does not yield accurate corrections at the ends of traverses where the terrain beyond these ends is not known. Sefton remarks that the magnitude of the terrain corrections which he has calculated by this method vary up to 1.6 mgal.

Summary

Sefton concludes that owing to these difficulties in reduction of the observed gravity values there could be a combined error between two consecutive stations of 0.1 mgal to 0.5 mgal, the former in the less rugged and open country as on line 76N and the latter in the converse type of country such as line 10W and 19E. He agrees with Boniwell (report G96) that the estimated limit of detection is 0.2 mgal.

2. Results

A. Correlation with Induced Polarisation Zones

(a) There are no residual gravity anomalies over the I.P. zones. The limit of detectability has been given by both Boniwell and Sefton as 0.2 mgal residual anomaly. Boniwell (in report G96) expresses this in terms of a range of possible sulphide bodies as below:

Conditions Depth cover of 300 ft., country rock density of 2.70 gms./cc, bodies at least 400 ft. in strike length, dipping 70° west and to extend at least 1000 ft. down the dip.

Body 400 ft. wide total sulphide content less than 5%.
200 ft. 10%.
100 ft. 20%.

The depth of cover is now known to be at least 400 ft., since the force of gravity falls off as the square of the distance the surface effect of a sulphide body at 300 ft. would be proportional to $\frac{1}{9}$, and at 400 ft. proportional to $\frac{1}{16}$. This will have the obvious effect of increasing the size of a sulphide body (which would not be detectable at a depth of 400 ft. as follows - with the same conditions as Boniwell assumed (except the depth of cover):

Body 400 ft. wide total sulphide content less than 9%.
200 ft. 18%.
100 ft. 36%.

(b) There is a consistent magnetic correlation with the I.P. zones. The anomalies are weak and Sefton suggests that they could be due to feeble pyrrhotite mineralisation. Equally as well they could be due to a basic rock such as a quartz gabbro or diorite.

B. Southern Area

(a) Southern Boundary Fault

The table below gives the position of this fault as determined by magnetic, gravimetric and I.P. data.

	Magnetic	Gravity	I.P.
Baseline	Not detected	20 south	24 south
10E	17 south	15 to 20S	23S
20E	27S	Not detected	22S

A step-like gravity anomaly occurring at 30E/10S correlates well with the fault which is assumed to be associated with I.P. anomaly "C" at this point.

(b) The broad features of the magnetic results are consistent with the aeromagnetic picture. On line 12N the ground results show a gradual increase in magnetic intensity from east to west, from approximately zero gammas at 4W to 50E, to 125 gammas from 4W to 40W (plan R12).

This feature is consistent with the position of the fault associated with anomaly "A" on its western side as shown by the I.P. work and discussed in report GP30. This magnetic gradient shows that the basement to the west of this fault has a higher magnetic susceptibility than that to the east. The other fault which the I.P. work located in this area, at 12N/10E, is not apparent in the magnetic work thus implying that the material on either side has about the same magnetic susceptibility.

C. Northern Area

(a) The table below gives the position of the northern boundary fault as determined by gravity and I.P., the magnetometer was not used in this area.

	Gravity	I.P.
Line 19E	180N	176N

(b) Variations in the density figure used in the Bouguer Correction

(i) Line 156N/B.L. to 156N/25E

Using the system of trial and error which has already been outlined in the first half of this summary, Sefton found that the best density value for the Bouguer correction which gave best correlation with the topography was 2.55. This is obviously a high figure for unconsolidated sands and gravels and actually equals the density of the Owen Conglomerate in the area. Consequently the best interpretation is to assume that at no great depth beneath gravel and sand cover on line 156N is a ridge of solid rock, in other words the basement comes very close to the surface in this area. Since the density value of 2.25 proved suitable on line 19E it would appear that the basement drops away again before being up-faulted to the surface some 2000 feet to to the north of line 156N. This picture is supported by the apparent resistivity values which sho w a resistivity high on line 156N/B.L. to 156N/25E.

(ii) General Northern Area

South of about 76N Boniwell found that a density figure of 1.87 was suitable for the Bouguer correction. This figure is also in general agreement from what would be expected as a density for the sands and gravel. Sefton found that north of 76N he had to use a figure of 2.28 which would be in the upper range of density value for these sediments. A suggestion is that this difference could be attributed to a variation in the type of sediment between the northern and southern halves of the Valley, that to the north containing a far higher percentage of clay.

D. Regional Gradient

The figures below give the position of the major changes in the gradient of the reduced gravity values along the baseline and 19E from 40S to 195N:

Position	
B.L./35N	
B.L./90N	
B.L/136N	Minimum value, values increase to north and south from this point.
19E/175N	Associated with northern boundary fault.
19E/186N	On outcrop of Owen Conglomerate at north edge of Valley.

At B.L./40S the curve has a value of plus 12.5 mgals, a minimum of minus 5.3 mgals at B.L./136N, and a maximum to the south of plus 1.1 mgals at 19E/186N. The position of the southern boundary fault on the baseline is at 24 South. Sefton does not comment upon the significance of these changes.

3. General

The results of this and other geophysical and geological work will be compiled into a single report.

Chief Geologist, L.E.E.

GP29

22nd February, x60

Report on

MOORE'S VALLEY

Gravity & Magnetic Surveys - November/December, 1959

by

I. V. Sefton

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Introduction

This report covers gravity and ground magnetic surveys carried out in Moore's Valley during 1959. The results of this work are discussed with reference to earlier geophysical work, which is outlined below.

Ground work carried out by McPhar Geophysics Ltd. consisted of AFMAG and induced polarisation-resistivity surveys. A single AFMAG indication near 00/11N was used as a guide to the location of the I.P. survey, which revealed the existence of three anomalous zones shown on plan No. 26/13. An extension of this survey is in progress.

A ground magnetic survey was conducted by the Bureau of Mineral Resources over an area located to the north of that covered by the I.P. survey. This work revealed the existence of minor anomaly character (see plan No. R8/3).

An electromagnetic test survey of the AFMAG indication, using a vertical loop apparatus, produced no significant results (see plan No. Q22, sheet 10). All these results have been discussed in detail in various reports.

Geology and Nature of the Problem

The known geology of the area is shown on plan No. S15/13a.

The area of interest in Moore's Valley is considered to lie within a rift valley defined by two boundary faults, the Thirkell fault on the north and the Hazell fault on the south. The valley is covered by unconsolidated Cainozoic sediments.

Shear zones running northwards from the Thirkell fault and southwards from the Hazell Fault have been correlated with the Lyell Shear. The shear zone is presumed to continue through Moore's Valley, obscured by the Cainozoic cover.

The geophysical problem, in general, falls into two parts:

(a) to locate the position of the Lyell Shear in Moore's Valley,

(b) to discover any significant mineralisation associated with the shear.

The I.P. survey in the southern part of Moore's Valley has already been successful in locating anomalous zones which could be due to sulphide mineralisation.

Gravity work was designed to seek confirmation of I.P. anomalies and also to discover any anomaly character which might be interpreted in terms of the broad geology of the area.

Outline of Operations

1. Gravity

The gravity observations were made by the writer during March-april and November, 1959. J.B. Boniwell directed the field-work performed during March-April and carried out the reductions for that work. The results are contained in report G96.

Final reduction of the gravity results, including a revision of the earlier work, has been carried out in the office at Killara.

The gravity readings were taken with Worden gravity meter No. 38 at a nominal station spacing of 100 feet.

Owing to the rugged nature of the terrain, involving danger to the instrument, and also owing to the absence of a solid ground surface in many places, a number of gravity stations had to be omitted.

Those stations actually read are represented by points on the reduced gravity profiles. The extent of the gravity survey is shown on plan No. 26/4 . Altogether about 900 gravity stations were read.

The main base station was located at 00/12N and was assigned the arbitrary observed gravity value of 0.00 mgal. Subsidiary base-stations were connected to 00/12N by means of 3-2 or 2-1 ties.

In reading the observed gravity values at other stations repeat readings at base-stations and other intermediate points were taken at least every 2 or 3 hours during the day.

On 7th April, the gravity meter was knocked over, but its subsequent behaviour, after the reading range had been reset, appeared to be normal.

Station positions and reduced levels for the first part of the gravity work were determined by stadia survey carried out by P.C. Towndrow. Reduced levels for the remainder of the gravity work were determined by dumpy-level survey carried out by T.N. Burrell. Levels were not closed, except on the base line.

Observed gravity differences were corrected for instrument drift, estimated from the repeated readings at base stations and intermediate points. A latitude correction of 1.303 milligal/mile, increasing in the direction of true north has been applied to all observations. This correction is appropriate for a latitude of 42°43'S. 00/12N was chosen as the datum point for the correction, and the direction of true north was taken as 4°E of the map grid north.

Elevation corrections were applied assuming a mean density of near-surface material of 2.28 gm. cm^{-3}, instead of the value 1.87 gm. cm^{-3} chosen by Boniwell. 100 feet was subtracted from the R.L. values supplied before computing this correction.

Terrain corrections, based on a two-dimensional approximation, have been applied in some places. Elevation and terrain corrections are discussed below.

Since the completion of the initial survey, a mistake of 7 ft. in the R.L. values, between stations 10E/16N and 10E/20N has been found by check survey. The appropriate correction has been applied to all stations between 10E/20N and 10E/12N, taking the R.L. value at 10E/20N as that originally given, viz. 168.3 ft.

However, it is apparent that there are other mistakes in the same locality. Since it is neither practicable nor desirable to deduce from the gravity results what these mistakes are, their effects remain in the reduced gravity results at several places on traverses 10E, 15E, 12N and 16N.

The preparation of the gravity contour plan required some smoothing of the profiles to reduce the effects of mistakes and errors. The smoothing is shown as a dotted line on the profiles. Since terrain corrections could not be applied to all results, it was not possible to incorporate the effects of this correction in the contour picture.

The gravity results are presented as profiles on plan S17, 18 & 19 and as contours on plan S12/4 & S14/4. Traverses G12 and G14, which were read in March, are not incorporated in these results, but appear as profiles, based on the original reduction procedure, on plan No. S10, sheet 4.

The effect of using different values of the assumed near surface density in the reductions for various profiles is shown on plan S16 and the results are discussed below.

2. Magnetic

A magnetic survey of an area embracing the known zones of I.P. anomaly, and adjacent to the area covered by the B.M.R. magnetic survey, was carried out by T.N. Burrell during December, 1959.

The instrument used was a Watts vertical force variometer No. 62878 with a scale value of 32.2 gamma/scale division determined at St. Ives, N.S.W. on 25.10.59. This scale value was checked by the writer immediately before the start of the survey, and was found to be satisfactory.

The main base station for the survey was located at 00/12N and was assigned a value of -10 gamma, in accordance with the result obtained by the B.M.R. party. Subsidiary base-stations, where needed, were connected to the main base station by means of a series of 1-1 and 2-2 ties.

Copies of the field records were sent to this office for reduction and plotting.

It is apparent from the records that the variometer reading is affected strongly by temperature. Although a rigorous treatment of this effect was impossible, an attempt to remove it was made by adjusting the shape of the diurnal variation curve. No claim is made that this treatment is complete.

Whenever possible, reduced values were adjusted to agree with those obtained by the B.M.R. at stations common to both surveys. A mis-close of one scale division (32 gamma) in the new results at 10E/20N could not be removed by any reasonable procedure and has been left in the results.

No magnetic latitude correction has been applied.

Since the results are not suitable for the preparation of contours, they are presented as profiles only on plan R12 .

Quality of the Gravity Results

Assessment of the significance of anomaly features of a type to be expected from mineralisation occurrences should be preceded by some consideration of the probable errors to be expected in the results, and of other limiting factors.

Errors in the reduced gravity values arise from errors in observed gravity and reduced levels. The other limiting factors present are:

(a) uncertainties in the density of near-surface material, giving rise to uncertainties in the elevation corrections;

(b) effects due to steep terrain, which, in general cannot be calculated from the information available;

(c) uncertainties arising from the anomaly character due to broad geological features.

Errors in individual observed gravity values arise from errors in reading and uncertainties in the estimation of the instrument drift. However, if we consider observed gravity values at two consecutive stations, the error in the difference between the two values will be derived mainly from the errors in readings.

In most of the earlier gravity work, the maximum error in this difference is not likely to be less than 0.1 mgal, and may be as high as 0.2 to 0.3 mgal in cases involving instrument set-up on unsteady ground.

Errors in the difference between the levels of two consecutive gravity meter positions could be of the order of 2 ft. in cases where the gravity meter set-up may not correspond to the point levelled.

This leads to a combined maximum error in the difference in reduced gravity values between two consecutive stations of between 0.2 and 0.5 mgal, depending on the circumstances. In other words, errors of 0.2 mgal may be common and an occasional error as high as 0.5 mgal would not be surprising.

From these considerations alone, the estimated limit of detection of 0.2 mgal suggested by Boniwell in report G96 would seem to be of the right order.

In some of the later results, obtained over less rugged and more open country (e.g. traverse 76N), a reasonable estimate of the maximum error in the gravity difference between two consecutive stations may be of order 0.1 mgal.

It should be noted that the errors discussed above are not considered to be mistakes, but are in the nature of randomly distributed errors in observation.

Another important factor is the effect of elevation changes and steep terrain. Normally, in areas where the terrain is not steep and the density of near-surface material is known with a fair degree of confidence, it is possible to remove the effects of elevation changes from the gravity results in a satisfactory manner.

In Moore's Valley we have no independent information concerning the near-surface density, so that the value used for the gravity elevation correction was obtained largely by trial and error. Boniwell has suggested a value of 1.87 $gm.cm^{-3}$ for the near-surface density and has reduced the initial gravity results using this figure.

However, when the same corrections were applied to the later results, very obvious correlations between reduced gravity and elevation became apparent.(see e.g. traverse 76N on plan S16). A detailed study of the results on traverse 76N and other selected localities showed that an assumed value of 2.3 $gm.cm^{-3}$ for the near-surface density would be more appropriate.

For convenience in calculation, the figure 2.28 $gm.cm^{-3}$ was chosen and all the results have now been reduced using this figure. It should be noted that, while this value gives satisfactory results for particular localities, it does not mean that it is appropriate for all parts of the Moore's Valley area. However, there does not appear to be any strong evidence to suggest that the density of the Cainozoic cover varies significantly from one part of the valley to another. On the other hand, it is pointed out that a density of 2.28 $gm.cm^{-3}$ for unconsolidated Cainozoic sediments appears to be suspiciously high.

To illustrate the problems involved, it is pointed out that the effect of changing the value of the assumed near-surface density by 0.1 $gm.cm^{-3}$ is to produce a change in reduced gravity of 0.13 mgal for each 100 ft. of change in elevation, disregarding terrain correction.

Terrain corrections are much more difficult to estimate.

Corrections have been worked out for selected parts of the survey, on the assumption that the topography is two-dimensional, i.e. that the topographic profile, taken in the direction of the traverse concerned, extends unaltered for a great distance on either side of the traverse. The method of calculation was based on a line-integral method given by Hubbert

(Geophysics XIII, 215-225, 1948).

Even when this two dimensional treatment may be regarded as valid it does not yield accurate corrections near the ends of the traverses, since the form of the terrain beyond these ends is not known.

Further uncertainties in terrain corrections arise from the uncertainty in the assumed near-surface density. However, since the magnitude of the terrain effect is directly proportional to this density, the uncertainties from this source are not likely to be important for corrections less than 0.5 mgal.

Terrain corrections are always positive, so that where these approximate corrections have been applied, the corrected gravity profile appears above the uncorrected one.

Note that the magnitude of those corrections which have been applied varies from 0 to 1.6 mgal.

These considerations lead to the conclusion that one may expect to find, in those rugged parts of Moore's Valley where the terrain effect cannot be reliably estimated, a considerable amount of spurious anomaly whose magnitude may often be as high as one milligal.

The effect of the remaining limiting factor, anomaly character due to broad geological features, is difficult to assess, because it removal involves either a personal judgement by the interpreter, or a mathematical procedure which exaggerates those errors already present.

Such a feature is present in the Moore's Valley results in the form of a strong east-west gradient which must tend to obscure any significant minor anomaly character in the area of interest.

With all these considerations in mind, a number of anomaly features have been selected for discussion. Any feature not discussed in the following section is not considered to be significant.

Discussion of Results

It may be noted at the outset that the gravity results show no significant correlation with the I.P. anomalies discovered during the 1958-59 season.

The ground magnetic results display minor anomaly character throughout, with only vague correlation from traverse to traverse. However, where such correlation can be recognised, the strike of the minor anomaly features is usually approximately true north. Furthermore, magnetic anomaly features of small magnitude occur at the position of the I.P. anomaly zone A on traverses 5W, 00 and 5E, and at the position of zones B and C on traverse 15E.

The broad features of the magnetic results seem to be consistent with the aeromagnetic picture, as one would expect. The aeromagnetic survey revealed two total intensity anomalies, one of magnitude about 110 gamma, situated about 30 chains north of principal point 34, and one of about 30 gamma magnitude, situated about 45 chains south of principal point 33. The first of these anomalies is reflected in the ground results by a general westward increase in vertical intensity on traverses 12N to 76N. The second anomaly is not so clearly defined on the ground.

In the ground magnetic results over the area of the I.P. survey, it is worth noting the change in character of the magnetic profiles between the eastern and the western traverses. In particular, notice the marked irregularities on traverse 10W, especially between 10W/35S and 10W/40S. This change in character may be associated with a change in the rock type present at very shallow depth.

Other individual features in the magnetic results are discussed below in connection with the gravity and resistivity results.

The most prominent feature in the gravity results is the broad east-west gradient displayed on the gravity contour plan. This feature does not appear to be related to the known geology in the immediate vicinity of Moore's Valley. However, the trend of the contour lines does appear to be in sympathy with the regional geological strike and with the strike of the zone of magnetic anomaly to the west of Moore's Valley, as defined by the aeromagnetic survey.

From the very limited evidence available, it would appear that the strike of the gravity contours in the vicinity of the Thirkell fault could swing into sympathy with the strike of the fault itself (see plan S14/4).

A study of the gravity results on traverses 19E and 156N indicates that there may be no single near-surface density value which is suitable for elevation and terrain corrections throughout the whole length of these traverses. Reduced gravity profiles obtained using values of 2.28 $gmcm^{-3}$ and 2.55 $gm.cm^{-3}$ are shown separately on plan No. S16 . The figure 2.55 $gm.cm^{-3}$ was obtained from the average density of a collection of specimens of Owen Conglomerate.

The writer's impression is that while a value of 2.55 $gm.cm^{-3}$ might be appropriate for traverse 156N from 00 to 25E, it does not appear to be suitable for the adjacent part of traverse 19E, from 156N to 175N. The choice of 2.55 $gm. cm^{-3}$ for the reductions on the hilly part of traverse 156N, between 00 and 25E, implies that the true density of near-surface material in this part is likely to be higher than that to be expected from unconsolidated Cainozoic sediments.

On the northern half of traverse 19E, there is gravity anomaly character consistent with the existence of a contact type anomaly, arising from within the older rocks, and centred at about 180N. However, this character is superimposed on a broader anomaly feature which complicates the actual form of the presumed local anomaly.

Gravity results on traverses across the position of the Hazell fault (as shown on plan No. 26, sheet 1) display no features attributable to a fault structure at the position shown. There is, however, considerable irregularity in the reduced gravity results on traverse 10E, but the true picture is almost certainly obscured by terrain effects, which may be as much as 1.5 mgal in the vicinity of 10E/35S. Hence, no significance should be attached to any gravity features on line 10E between 10E/25S and 10E/40S.

A step-like gravity anomaly occurs between 10E/15S and 10E/20S. Similar features also occur at about 30E/10S and 00/20S. However, the latter is associated with a misclose in observed gravity values at the position 00/20S. It should be noted that the features on traverses 10E and 00 occur in the vicinity of a sudden southward increase in apparent resistivity values.

Two magnetic features of interest also occur in this locality. A marked southward decrease in vertical intensity occurs at 10E/17S in the same place as the gravity and resistivity features. A similar magnetic feature at 20E/27S does not correlate with any well defined anomaly feature.

These magnetic features are of a type which might be related to a contact between two rock types, with the more magnetic one lying to the north.

Although the gravity feature between 10E/15S and 10E/20S could represent a contact type anomaly, it could also represent a small positive anomaly centred in the vicinity of 10E/15S.

A comparison of geophysical results on traverse 10E is shown on plan R13 and the location of the magnetic and resistivity features discussed is marked on the gravity contour plan (plan S12/4).

Changes in gravity gradient between 5E/1S and 5E/12S and between 40E/5S and 40E/30S could be related to terrain effects. Much of the irregularity in reduced gravity values on traverse 10W is almost certainly due to terrain effects and errors in observed gravity values, particularly at points south of 10W/00.

The gravity contour plan displays one feature which is not obvious in the profiles. A sharp kink in the gravity contours occurs on traverse 15E. Features such as this are usually regarded with some suspicion since they often occur through some cumulative mistake in levels or observed gravity values. No such mistakes are obvious in these results but any significance attached to this feature should be regarded with caution.

On the other hand, the trend of the gravity contours in the vicinity of 15E/20S could be in sympathy with a postulated trend in magnetic results.

Another feature worthy of note is the sudden decrease in the magnitude of the broad gravity gradient at the position 00/32N. Although this feature means little by itself, the apparent resistivity results show some lateral variation in the electrical properties of the ground in the same locality.

Attention is drawn to the gravity anomaly character between 20N/5W and 20N/15W, disregarding the point 20N/11W which appears to be a mistake. Reduced gravity profiles for two different assumed near-surface density values are shown in plan S16 . In the absence of independent geophysical results on this traverse, no significance can be suggested for this feature.

Although no comparable gravity feature occurs on traverse 16N, a similar feature does occur on traverse 12N between 12N/10W and 12N/14W. There is also a westward increase in apparent resistivity values in this locality.

Conclusions and Recommendations

The gravity surveys have failed to reveal any anomaly character attributable to the source of the known I.P. anomalies. The gravity results appear to be significant only in terms of the broad geology of the area, although their precise significance is obscure.

The magnetic results show weak positive anomaly at the position of some of the I.P. indications. It is possible that this magnetic anomaly character arises from weak pyrrhotite mineralisation.

The ground magnetic survey also revealed one feature which could be due to a magnetic contact at about 10E/17S. Further investigation of this feature would require a detailed magnetic survey. The coverage for such a survey should be decided after a study of the results of the current I.P.-resistivity programme.

It may be worth noting that the ground magnetic, I.P. and resistivity results suggest the existence of a general strike in a direction approximately due north, in the area between the I.P. zone C and traverse 76N. This strike appears to match the strike of the broad gravity anomaly which, however, may be considerably more deep-seated in origin.

There is some evidence in the existing results to suggest that resistivity surveys may be suitable for locating broad geological contrasts to a depth of a few hundred feet.

I.V. SEFTON
for L.A. RICHARDSON & ASSOCIATES

APPENDIX

Recommendations concerning the conduct of geophysical field work

The following recommendations are based particularly on the writer's experience in the Moore's Valley area, and are offered here so that the problems involved may be appreciated by those planning any future work of the same kind under Tasmanian conditions.

Wherever gravity work is to be used in the search for minerals, it is desirable to strive for extreme accuracy in the results, since the anomalies being sought are, in general, of small magnitude. Certain errors are unavoidable, but it is essential to keep errors entirely in the gravity observations themselves, wherever possible. This means that errors from other sources should, ideally, be kept an order of magnitude lower than those which are unavoidable in the gravity observations.

The following requirements apply particularly to gravity surveys, but the general principles involved can be adopted for all geophysical work.

(a) Traverses should be straight and parallel to one another, wherever possible.

(b) Slope corrections should be applies to chainages when pegging in hilly country, so that the position of each station is known to within the accuracy of plotting at the chosen scale.

(c) Care should be taken to ensure that, where two traverses intersect, any errors in chainages or direction should be noted and adjusted before proceeding with further pegging.

(d) Levels, where required for gravity work, should be taken at specified locations, preferably on top of a dumpy peg. R.L. values are required with an accuracy of ±0.1 ft., or better, at each station.

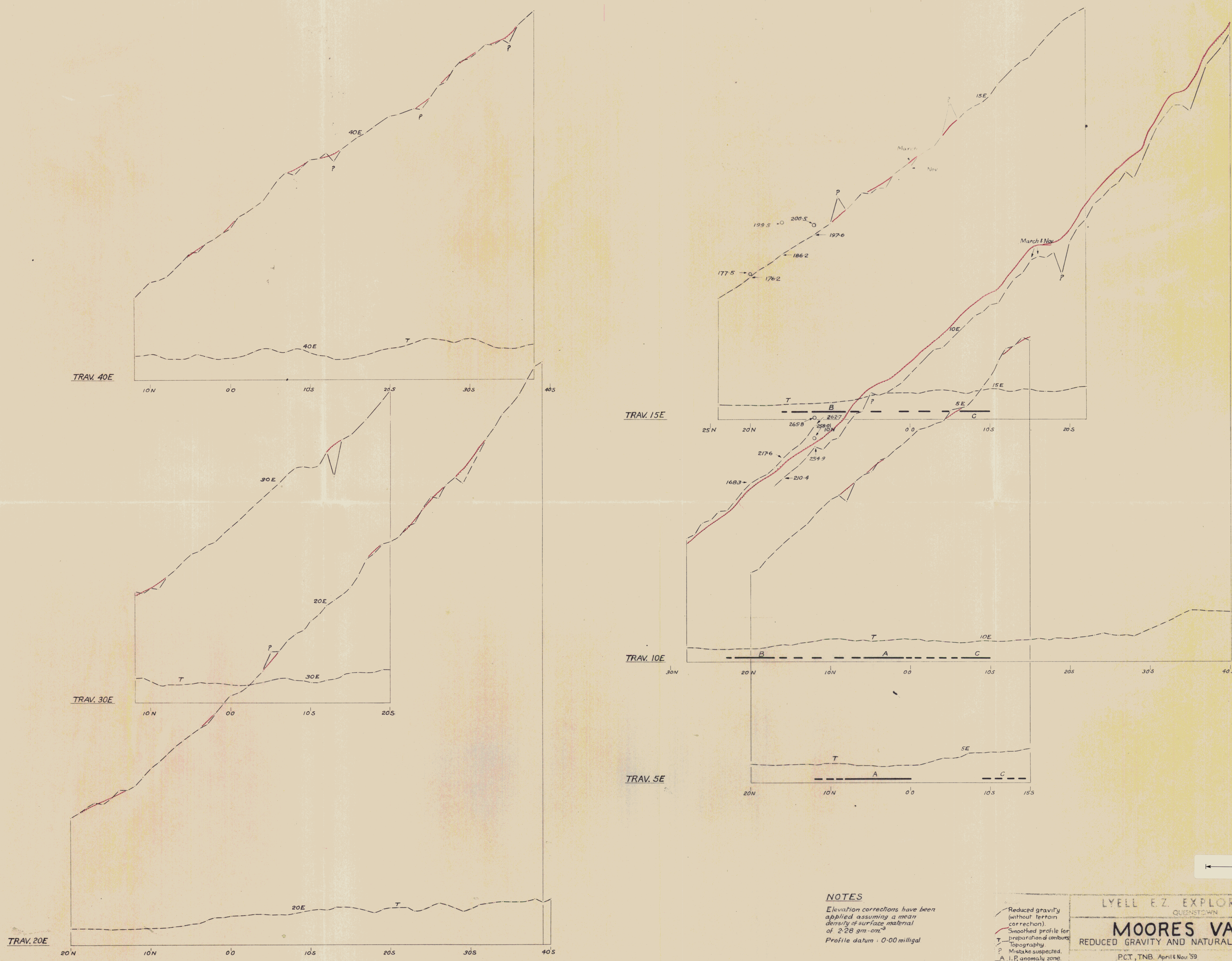
(e) Level surveys should always be closed and the results of the survey, showing miscloses, should be given to the geophysicist conducting the gravity survey.

(f) In forest or scrub country, gravity stations should be cleared for a radius of at least 18", to provide a hard ground surface for the gravity meter and operator.

(g) Gravity surveys in areas of high relief should be avoided wherever possible, since accurate correction for gravity terrain effects generally required very detailed topographic surveying.

(h) Gravity stations should be spaced at 50 ft. intervals or less.

I.V. SEFTON
For L.A. RICHARDSON & ASSOCIATES



NOTES

Elevation corrections have been applied assuming a mean density of surface material of 2·28 gm.-cm.$^{-3}$

Profile datum : 0·00 milligal

- Reduced gravity (without terrain correction).
- Smoothed profile for preparation of contours.
- T — Topography.
- ? Mistake suspected.
- A I.P. anomaly zone.
- 262·7 R.L. in feet used for reductions.

LYELL E.Z. EXPLORATIONS
QUEENSTOWN

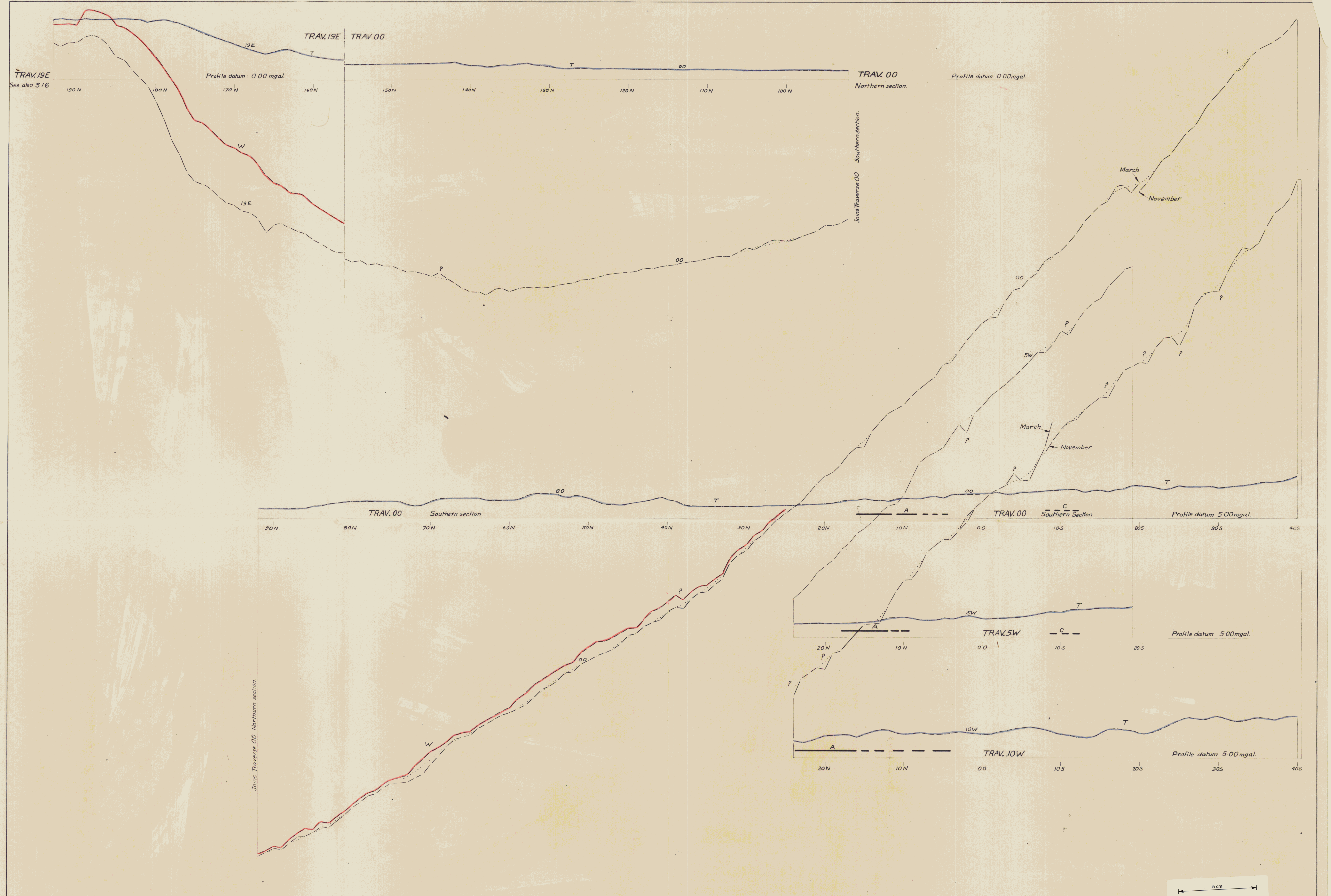
60-327

MOORES VALLEY

REDUCED GRAVITY AND NATURAL SURFACE PROFILES

P.C.T., T.N.B.	April & Nov. '59	500 ft. to 1 inch	S17 4
I.M.S.	Nov. '59	1·0 mgal. to 1 inch.	
I.M.S.	Jan. '60		Checked by: P. Rudd(?) June 2, '60
B.H., T.H.P.	May '60		2383

321022



NOTES

Elevation and terrain corrections have been applied assuming a mean density of near surface material of 2·28 gm. cm.$^{-3}$
Terrain corrections are based on a two-dimensional approximation (see text).

- Reduced gravity without terrain correction.
- W Reduced gravity with terrain correction.
- Smoothed and adjusted profile for preparation of contours.
- T Topography.
- A Zone of I.P. Anomaly
- ? Mistake suspected.
- R.L. ? Cumulative mistake in R.L. suspected.

LYELL E.Z. EXPLORATIO[N]S
QUEENSTOWN

MOORES VALLEY

REDUCED GRAVITY AND NATURAL SURFACE PROFILES

60-327

P.C.T. T.N.B. April & Nov. '59

I. M. S.	Mar.-Ap., Nov '59	500 ft. to 1 inch
I. M. S.	Jan. '60	1·00 mgal to 1 inch
B.H., T.H.P.	May '60	

S18 4

P. Radola
June 2, '60

2384

321023

NOTES:

Elevation and terrain corrections are based on an assumed near surface density of $2{\cdot}28\ gm.\text{-}cm.^{-3}$

Terrain corrections are based on a two dimensional approximation.

References (contd)

RL ? — Cumulative mistake in R.L. suspected.

- Reduced gravity without terrain correction.
- W — Reduced gravity with terrain corrn.
- ········ Smoothed and adjusted profile for preparation of contours.
- T — Topography.
- A — Zone of I.P. Anomaly.
- 262·7 — RL in ft. used for reductions.
- ? — Mistake suspected.

5 cm

LYELL E.Z. EXPLORATIONS
QUEENSTOWN

MOORES VALLEY

REDUCED GRAVITY AND NATURAL SURFACE PROFILES

Survey	P.C.T. T.N.B.	April & Nov. '59	Scale 500 ft. to 1 inch; 1·00 mgal to 1 inch.
Geology			
Geophysics	I.M.S.	Mar-Ap., Nov. '59	
Geochemistry			
Drawn	I.M.S.	Jan. '60	
Traced	B.H., T.H.P.	May '60	

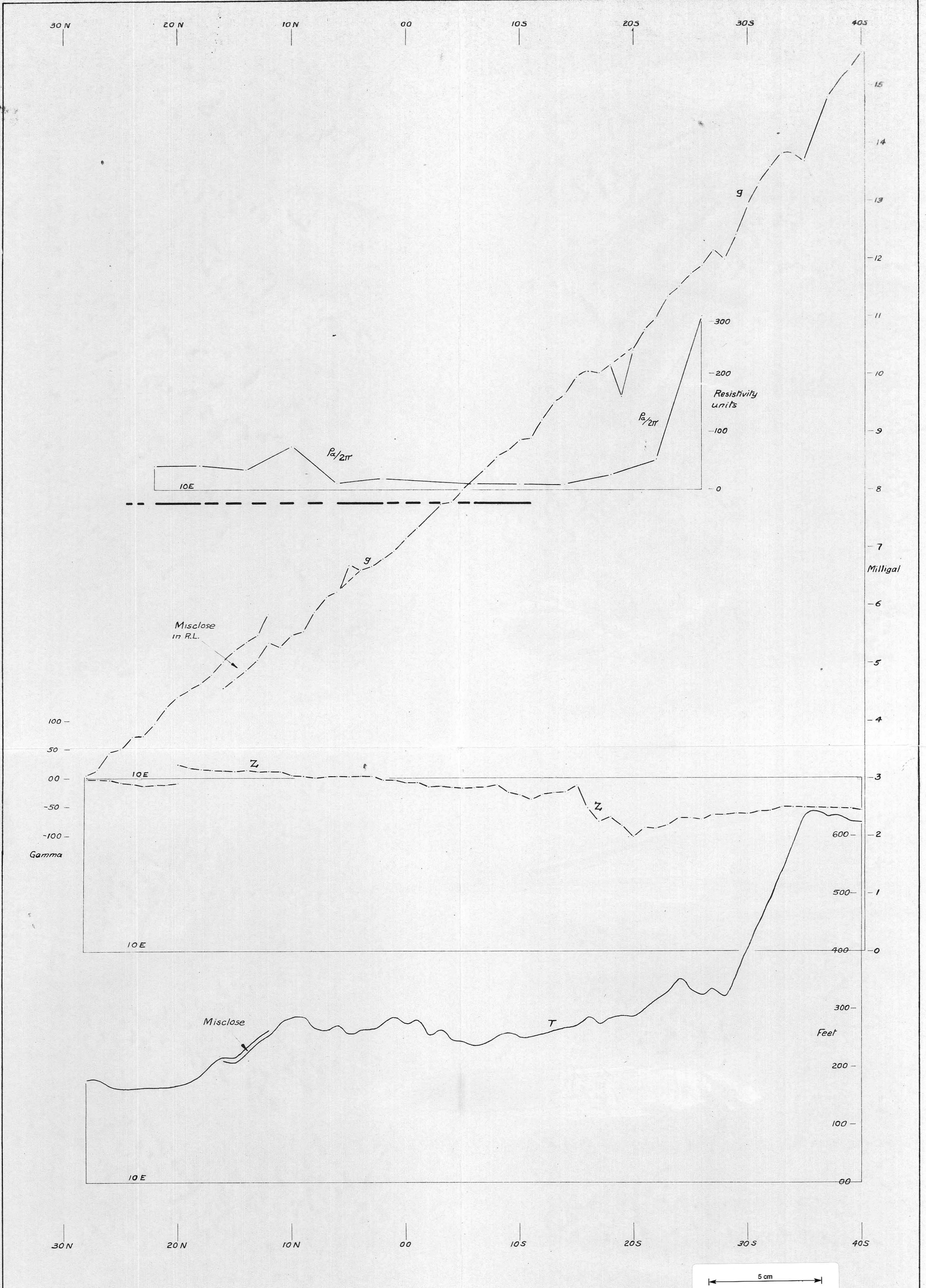
860-327

S 19 Sheet No. 4

Checked by P. Rodda
Date June 2, '60

2385

321024



Legend:
- g Reduced gravity.
- $P_a/2\pi$ Apparent resistivity profile 400ft × 400ft electrode spread.
- Z Vertical magnetic intensity.
- — — - Zone of induced polarisation anomaly.
- T Topography, vertical exaggeration:×5.

LYELL E.Z. EXPLORATIONS
QUEENSTOWN

MOORES VALLEY

COMPARISON OF GEOPHYSICAL RESULTS ON TRAVERSE 10E

60-327

			Scale
	I.M.S.	Jan.'60	Horizontal: 500ft to linch. Vertical: 1·00 milligal to 1 inch. 100 resistivity units to 1 inch. 100γ to 1inch. 100ft to 1inch
	B.H., T.H.P.	May '60	

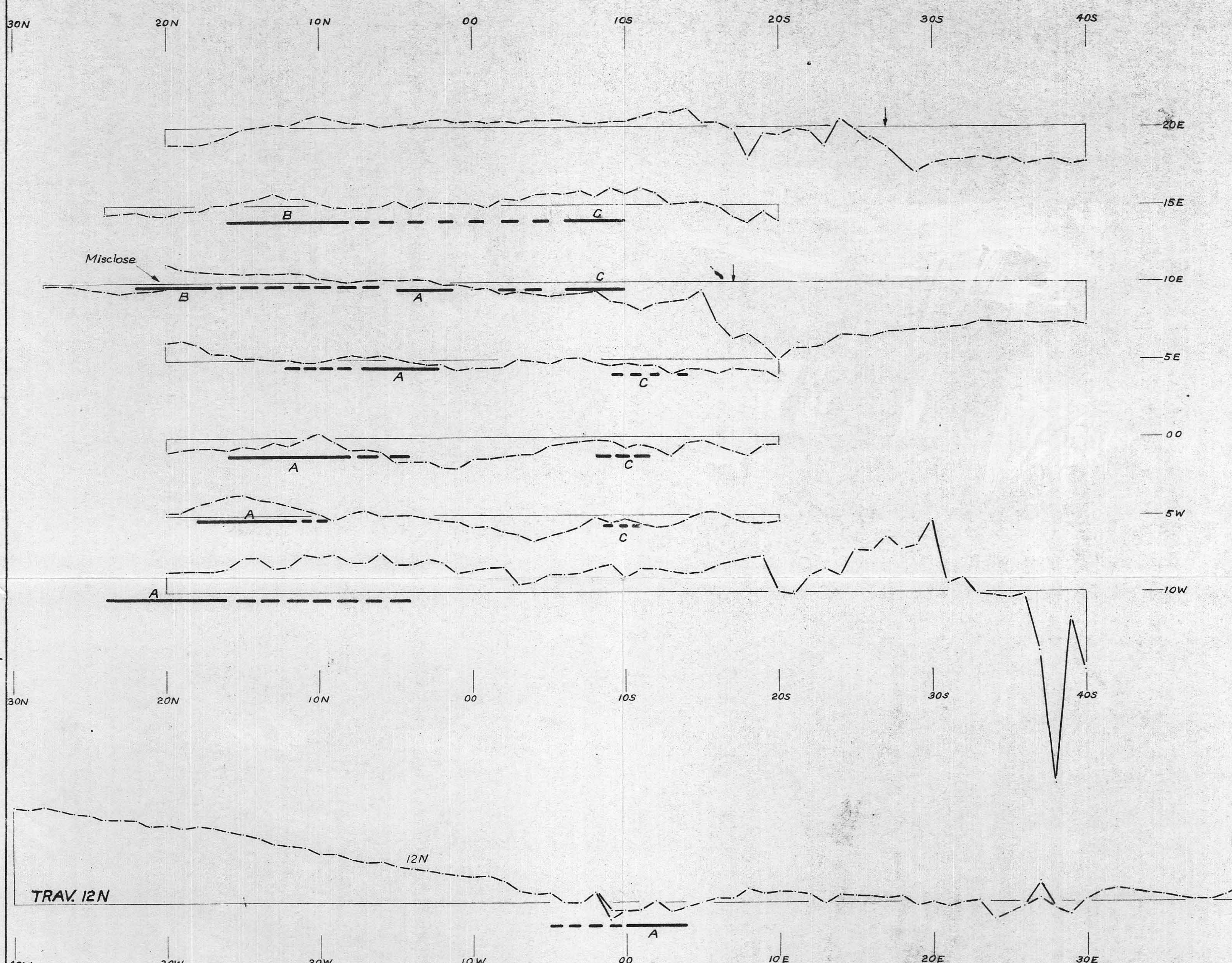
R13

Sheet No.

Checked by: P. Rodda
Date: June 2, '60

2386

321025



5 cm

References

A - - I.P. Anomalies.

↓ Anomaly feature marked on gravity contour plan.

Watts No. 62878

LYELL E.Z. EXPLORATIONS

QUEENSTOWN

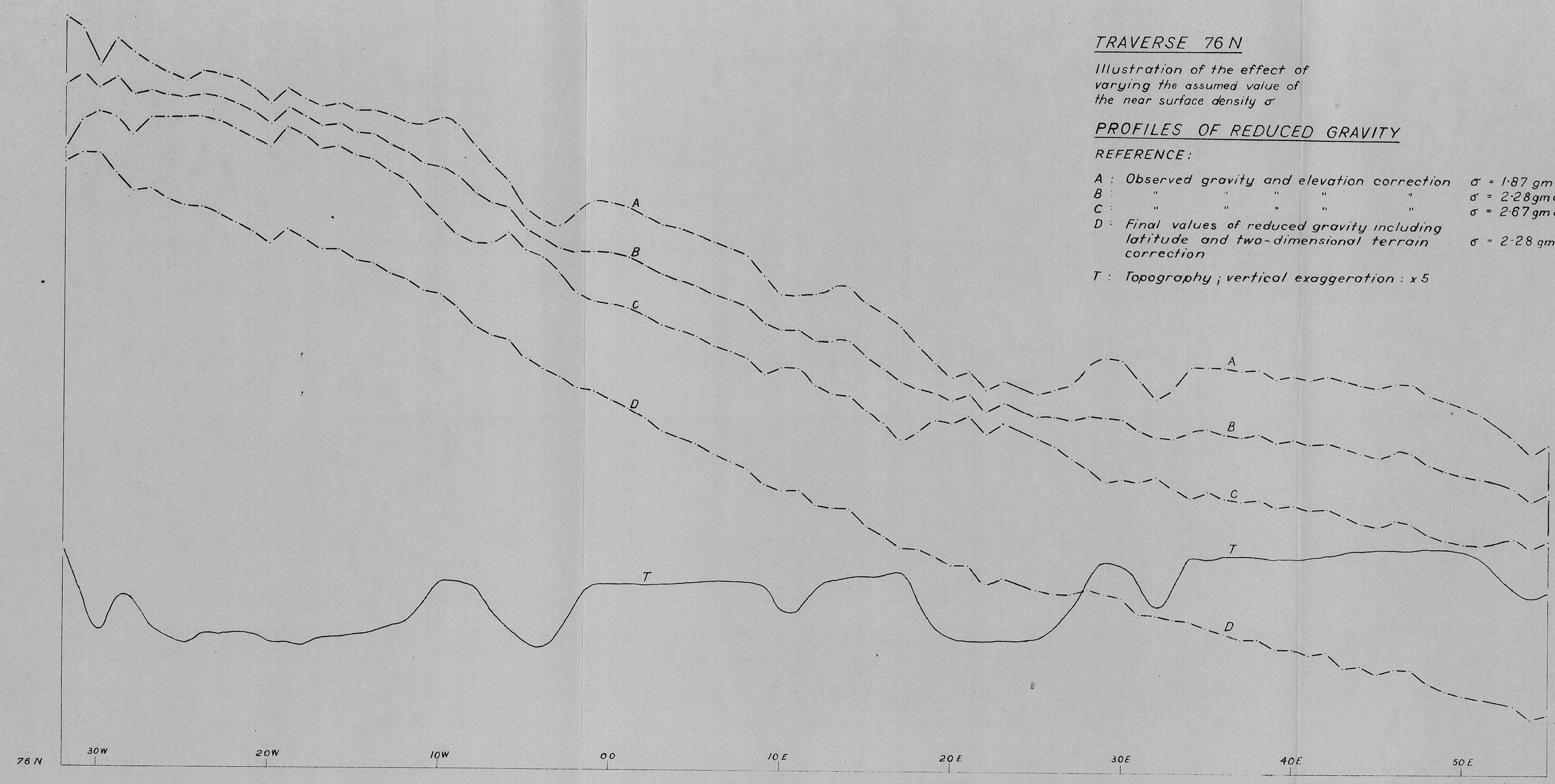
60-327

MOORES VALLEY

PROFILES OF GEOMAGNETIC VERTICAL INTENSITY

Survey	T.N.B.	Dec. '59	Scale		
Geology			Plan: 500 ft to 1 inch. Profile: 100 γ to 1 inch	R12	Sheet No. 3a
Geophysics					
Geochemistry					
	I.M.S.	Dec. '59		Checked by: I. Rodda	2387
	B.H., T.H.P.	May '60		Date: June 2, '60	

321026



TRAVERSE 76 N

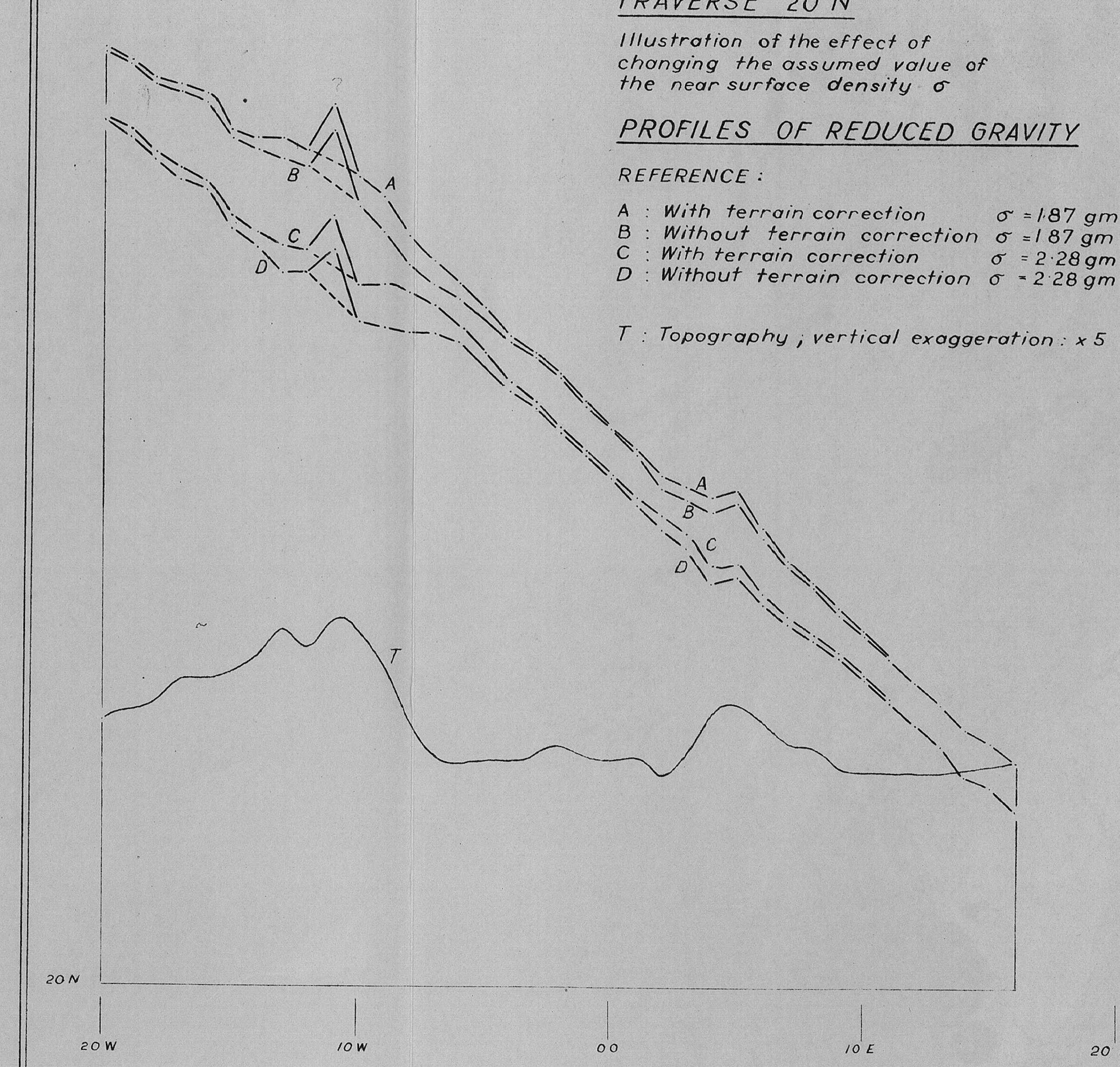
Illustration of the effect of varying the assumed value of the near surface density σ

PROFILES OF REDUCED GRAVITY

REFERENCE:

A : Observed gravity and elevation correction $\sigma = 1{\cdot}87$ gm cm^{-3} Datum : -9·00 mgal
B : " " " " " $\sigma = 2{\cdot}28$ gm cm^{-3} Datum : -9·00 mgal
C : " " " " " $\sigma = 2{\cdot}87$ gm cm^{-3} Datum : -9·00 mgal
D : Final values of reduced gravity including latitude and two-dimensional terrain correction $\sigma = 2{\cdot}28$ gm cm^{-3} Datum : -6·00 mgal

T : Topography ; vertical exaggeration : x 5



TRAVERSE 20 N

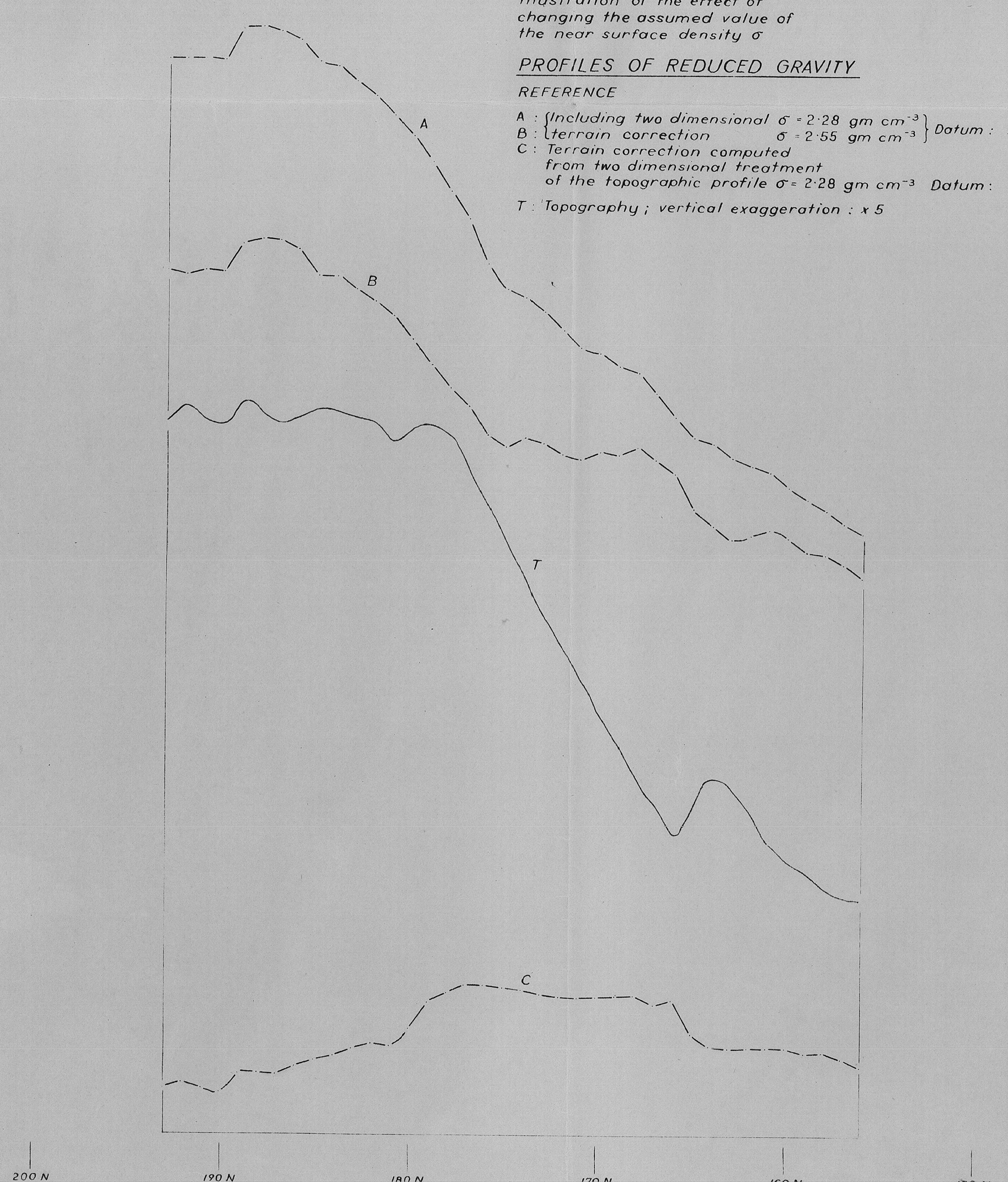
Illustration of the effect of changing the assumed value of the near surface density σ

PROFILES OF REDUCED GRAVITY

REFERENCE :

A : With terrain correction $\sigma = 1{\cdot}87$ gm cm^{-3}
B : Without terrain correction $\sigma = 1{\cdot}87$ gm cm^{-3}
C : With terrain correction $\sigma = 2{\cdot}28$ gm cm^{-3}
D : Without terrain correction $\sigma = 2{\cdot}28$ gm cm^{-3}
} Datum : 2·00 mgal

T : Topography ; vertical exaggeration : x 5



TRAVERSE 19 E

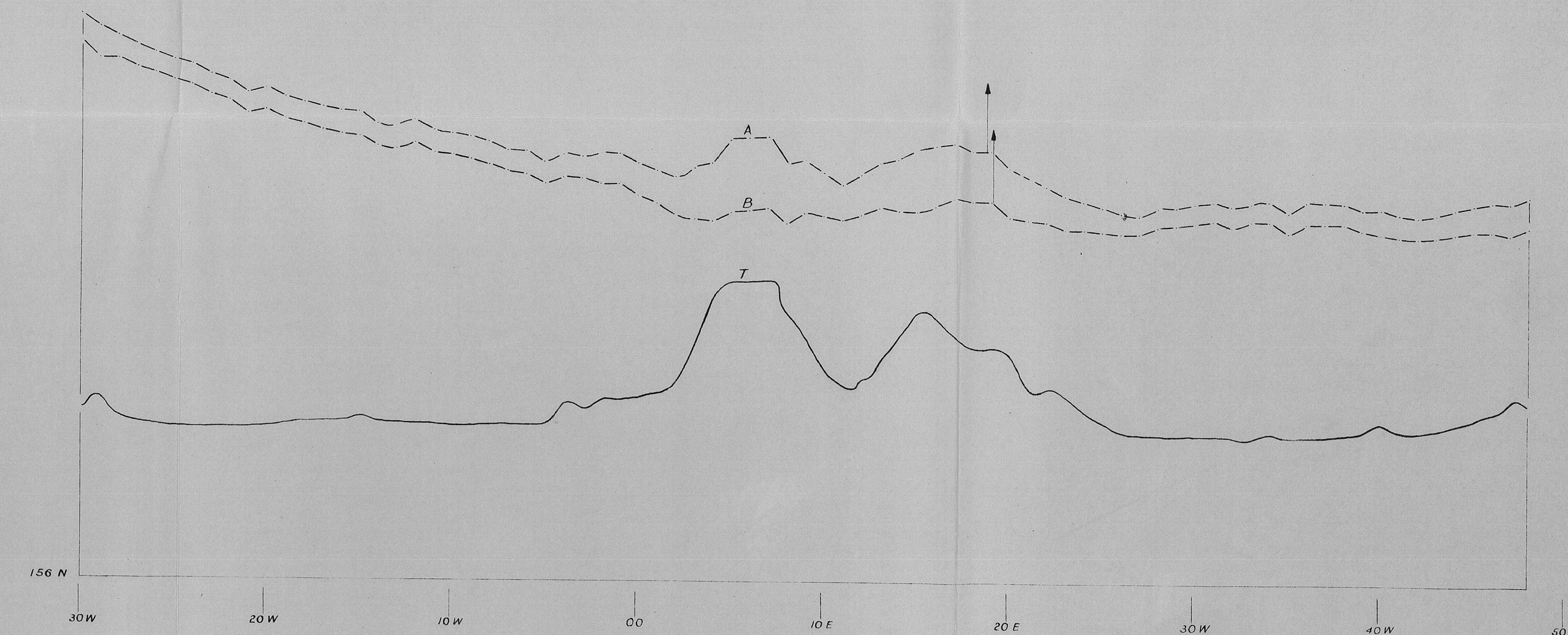
Illustration of the effect of changing the assumed value of the near surface density σ

PROFILES OF REDUCED GRAVITY

REFERENCE

A : {Including two dimensional $\sigma = 2{\cdot}28$ gm cm^{-3}
B : {terrain correction $\sigma = 2{\cdot}55$ gm cm^{-3} } Datum : 10·00 mgal
C : Terrain correction computed from two dimensional treatment of the topographic profile $\sigma = 2{\cdot}28$ gm cm^{-3} Datum : 0.00 mgal

T : Topography ; vertical exaggeration : x 5



TRAVERSE 156 N

Illustration of the effect of changing the assumed value of the near surface density σ

PROFILES OF REDUCED GRAVITY

REFERENCE

A : {Without terrain $\sigma = 2{\cdot}28$ gm cm^{-3}
B : {correction $\sigma = 2{\cdot}55$ gm cm^{-3} } Datum 9·00 mgal

↑ Terrain correction deduced from the two dimensional treatment of the topographic profile 19 E

T : Topography , vertical exaggeration : x 5

MOORES VALLEY

PROFILES OF REDUCED GRAVITY
FOR DIFFERENT VALUES OF ASSUMED NEAR SURFACE DENSITY

5 cm

SCALE

Horizontal : 500 ft to 1 inch
Vertical : 100 ft. to 1 inch
1·00 mgal to 1 inch

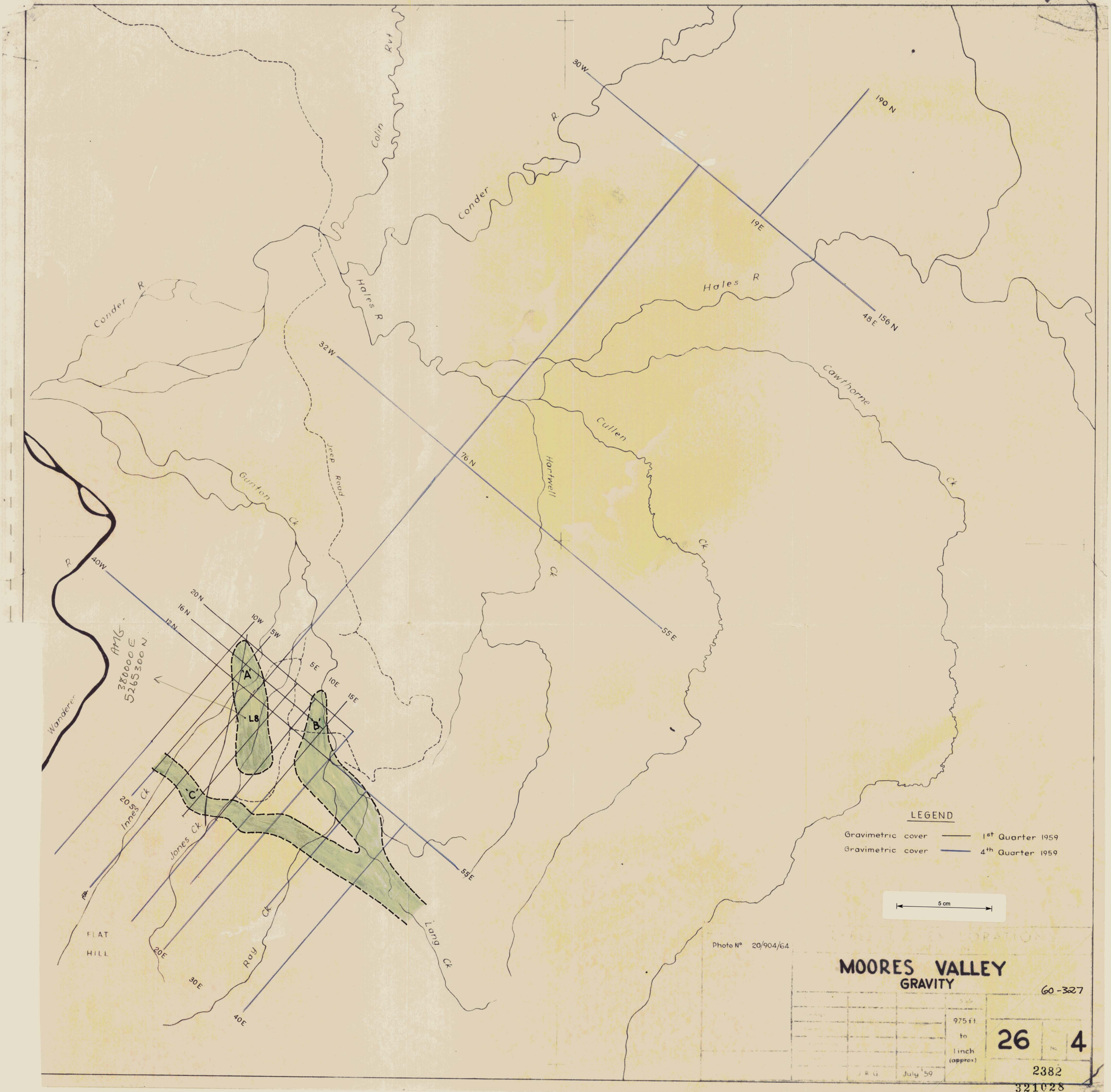
Survey	P.C.T.	Date:	April '59
	T.N.B.	"	Nov '59
Geophysics	I.M.S.	"	March/Nov.'59
Drawn	I.M.S.	"	Jan. '60
Traced	D.S., B.H.	"	April '60

P. Radda
June 2, '60

60-327

2388 S 16

321027


MOORES VALLEY
GRAVITY
LEGEND
Gravimetric cover 1st Quarter 1959
Gravimetric cover 4th Quarter 1959
5 cm
Photo Nº 20/904/64
60-327
975 ft to 1 inch (approx)
26
4
J.R.G.
July '59
2382
321028
Conder R
Colin Rvt
Hales R
Cawthorne Ck
Cullen Ck
Hartwell Ck
Gunton Ck
Jeep Road
Wanderer R
Innes Ck
Jones Ck
Ray Ck
Lang Ck
FLAT HILL
AMG
380000 E
5265300 N
'A'
'B'
'C'
L8
30W
190 N
19E
156 N
48 E
32W
76 N
55E
40W
20 N
16 N
12 N
10W
5W
5E
10E
15E
20 S
20E
30E
40E
55E