DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS

Record 1974/62

THE FOLLOW-UP OF AN AIRBORNE GAMMA-RAY SPECTROMETER SURVEY IN THE RUM JUNGLE AREA, NORTHERN TERRITORY

by

P.W.B. Bullock

Record 1974/62

THE FOLLOW-UP OF AN AIRBORNE GAMMA-RAY SPECTROMETER SURVEY IN THE RUM JUNGLE AREA, NORTHERN TERRITORY

by

P.W.B. Bullock

CONTENTS

Illustrations

Figures

Plates

SUMMARY

In 1969 the Bureau of Mineral Resources carried out an airborne gamma-ray spectrometer survey in Rum Jungle area, Northern Territory, to evaluate the usefulness of the spectrometer method for uranium exploration. As a check on the results of the survey, a number of anomalies were investigated on the ground using a McPhar TV-5 four-channel threshold spectrometer, and samples from the anomalies were analysed for uranium and thorium on a 256-channel gamma-ray spectrometer in the laboratory.

It was shown that the airborne survey results located uranium and thorium anomalies, and detected point sources of radioactivity as well as broad sources. In general, agreement between airborne, ground, and laboratory results was good.

1. INTRODUCTION

The Bureau of Mineral Resources (BMR) made a test airborne gamma-ray spectrometer survey in 1969 in the Rum Jungle area of the Northern Territory to evaluate the usefulness of the spectrometer method compared with total-count scintillation methods (Beattie, 1971). To test the accuracy of the airborne survey results, ground follow-up work was carried out by the Darwin Uranium Group of the BMR in 1970, 1972 and 1973. Anomalies were located on the ground with the aid of aerial photographs and grids laid out with compass and tape as shown in Plate 2.

Four channels of data were recorded in the airborne survey. The total gamma-radiation count between 1.0 and 3.0 MeV was recorded by channel 1. Channels 2, 3, and 4 were centred on the 1.46, 1.76 and 2.62 MeV gamma-ray peaks of potassium 40, bismuth 214, and thallium 208, respectively. The last two are daughter elements of uranium 238 and thorium 232, respectively. The energy ranges of channels 2, 3, and 4 were 1.3 to 1.6 MeV, 1.6 to 1.9 MeV and 2.4 to 2.8 Mev. A time-constant of 2 seconds was used.

The follow-up work was made with a McPhar TV-5 portable four-channel threshold spectrometer; the thresholds were 0.20, 1.30, 1.63, and 2.50 MeV. In 1970 the readings were made with a TV-5 hired from McPhar Geophysics; the results were unsatisfactory owing to instrumental problems and the readings were repeated during 1972 and 1973 using a TV-5 purchased by BMR.

Samples collected from the anomalies were examined with a 256-channel gamma-ray spectrometer in the Darwin Uranium Group laboratory. Selected anomalies were drilled with auger or rotary percussion drills.

Stripping errors and counting errors

The count-rates with backgrounds removed in channels 1, 2, and 3 are referred to as C1, C2, and C3 respectively. The net count-rates owing to the potassium, uranium, and thorium decay series in channels 1, 2, and 3 are referred to as C1K, C2U, and C3Th respectively and are obtained by a stripping technique defined by the following equations:

$$
\begin{aligned}
C3Th &= C3 \\
C2U &= C2 - 3.5\ C3Th \\
C1K &= C1 - 1.95\ C2U - 4.75\ C3Th
\end{aligned}
$$

If the gross count-rates in channels 1, 2, and 3 are S1, S2, and S3 and are counted for a time ts and the background count-rates are B1, B2, and B3 and are counted for a time tb, then, assuming Poisson distributions, the standard deviations (SD) of C1, C2, and C3 are:

$$SD_{C1} = \left(\frac{S1}{ts} + \frac{B1}{tb}\right)^{\frac{1}{2}}$$

$$SD_{C2} = \left(\frac{S2}{ts} + \frac{B2}{tb}\right)^{\frac{1}{2}}$$

and $$SD_{C3} = \left(\frac{S3}{ts} + \frac{B3}{tb}\right)^{\frac{1}{2}}$$

The standard deviations of C3Th, C2U and C1K are:

$$SD_{C3Th} = SD_{C3}$$

$$SD_{C2U} = (SD^2_{C2} + 3.5^2\ SD^2_{C3Th})^{\frac{1}{2}}$$

$$= (SD^2_{C2} + 12.25\ SD^2_{C3})^{\frac{1}{2}}$$

and $$SD_{C1K} = (SD^2_{C1} + 1.95^2 SD^2_{C2U} + 4.75^2\ SD^2_{C3Th})^{\frac{1}{2}}$$

$$= (SD^2_{C1} + 3.8\ SD^2_{C2} + 69.1\ SD^2_{C3})^{\frac{1}{2}}$$

The standard deviations of the net uranium and thorium count-rates are shown graphically in Figure 1 for values of C3Th from 0 to 250 counts per minute (cpm) and for values of C2U of 0, 100, 200, 300 and 400 cpm for a scaler counting time of one minute. The background count-rates B2/tb and B3/tb are taken as 46 and 38 cpm respectively. The derivation of these figures is described later; the standard deviations of B2/tb and B3/tb are ignored in Figure 1. It can be seen that when both uranium and thorium are present, the greater the amount of thorium the more difficult it is to detect or measure a given level of uranium. Thus the uranium results are not reliable in the presence of thorium anomalies, and potassium would not be detectable in the presence of either uranium or thorium. The statistics can be improved by increased counting times; the maximum scaler counting time of the TV-5 is 5 minutes and this would improve the results only slightly.

It is apparent that the principal use of the TV-5 is the determination of whether radiation is due to the thorium series and, if it is not, whether radiation is due to the uranium series. Detection of the uranium series in the presence of the thorium series is unreliable except for large uranium to thorium ratios.

Background measurements

Background count-rates were measured over water at Stokes Hill Wharf, Darwin. Eight measurements were made with five minute counting times giving 46 and 38 cpm in channels 2 and 3 respectively. The standard deviations of the background count-rates are of the order of 1 cpm and have been ignored in the calculations of the standard deviations of net uranium and thorium count-rates.

Laboratory analysis

Using a 256-channel gamma-ray spectrometer, crushed 100-g samples from the anomalies were analysed in the laboratory. The method of analysis employed is described by Mero (1960). Uranium decay series 'equilibrium factors' were determined using Mero's method by taking the ratio of the counts registered in channels centred on 0.19 MeV and 0.24 MeV; this gives an approximate measure of the equilibrium of the U238 series providing thorium (gamma emitter at 0.24 MeV) is absent. Equilibrium factors between 1.0 and 1.3 indicate uranium ore in equilibrium, factors below 1.0 indicate a radium-rich ore, and factors between 1.3 and 3.0 a 'transition-type' ore. Channels centred on 0.24 MeV register counts owing to the U238 series radium group and channels centred on 0.19 MeV register counts owing to both U235 and to the U238 series radium group. The count owing to U235 is proportional to the U238 content of the sample because the U235/U238 ratio found in nature is almost always constant. Thus Mero's ratio serves as an approximate measure of the state of equilibrium between U238 and Ra226. Mero attributed the U235 peak at 0.18 MeV to Th230 of the U238 series, but the gamma emission of Th230 is negligible and the peak that he measures is due to U235.

The ratio of uranium to thorium in the samples was estimated by Mero's method of taking the ratio of counts in channels centred on 0.24 MeV (Pb 212 of the thorium decay series) and 0.35 MeV (Pb 214 of the uranium decay series). Reference is then made to a graph of this ratio against uranium/thorium ratios established experimentally by Mero. Equilibrium of both the uranium and thorium series must be assumed in this method.

Assays of equivalent U_3O_8 or ThO_2 were made by comparing the spectra of the samples with the spectra of uranium and thorium standards of the same weight. Equilibrium is again assumed to exist.

The results of the analyses of the samples from the anomalies are shown in Table 1. The results are each based on one sample which may not be representative of the anomaly from which it is taken.

Comparison with the airborne survey results

The gross count-rates registered by the airborne survey in channels 3 (uranium) and 4 (thorium) over each anomaly examined on the ground are shown in contoured form with the corresponding net TV-5 profiles to facilitate comparison between results. Laboratory gamma-ray analysis of a sample from each anomaly is shown in Table 1.

The airborne results for channel 3 have not been stripped of the thorium series contribution. Beattie (1971, p. 6) gives a stripping ratio of 1:1 for channels 4:3. Beattie's interpretation of the uranium results is included in the locality map (Plate 1) of this Record. Plate 1 also shows the geology based on the BMR 1:63 360 Rum Jungle Special Sheet.

A prominent feature of the airborne results which has to be considered when comparing the airborne and TV-5 results is the broad high over most of the Rum Jungle Complex owing to radioactivity from the thorium series.

2. GEOLOGY

The Rum Jungle area consists essentially of Lower Proterozoic granitic rocks which form the Rum Jungle Complex, and the surrounding low-grade metasediments. The Rum Jungle Complex occupies the core of the domed metasediments (Beattie, 1971; Rhodes, 1965). The constitution of the metasediments is shown in Plate 1. The Waterhouse Complex crops out in the south-western corner of the airborne survey area and is considered to be similar to the Rum Jungle Complex.

3. METHODS

The TV-5 spectrometer

The TV-5 is a portable spectrometer with four channels 0, 1, 2, and 3 which accept all gamma-ray energies greater than specific threshold levels of 0.20, 1.30, 1.63, and 2.50 MeV respectively. The thresholds are fixed relative to each other and can be brought into correct position by use of a thorium source and calibration controls. Channel 3 accepts counts from the thorium 232 decay series only, channel 2 accepts counts from the uranium 238 and thorium 232 decay series, channel 1 accepts counts from potassium 40 as well as the uranium and thorium decay series, and channel 0 is a total-count channel.

The count-rate in counts per minute (cpm) can be obtained for each channel on a ratemeter; alternatively a scaler can be used to store the counts in channels 1, 2, and 3 for times of 1, 2, or 5 minutes. In the work described in this Record, the scaler was used and was generally set to count for one minute.

Field procedure

A scaler counting time of one minute was used. The probe was held waist-high and the observer walked from one station to the next (100 ft) and then waited for the count to be completed. A test over Anomaly 17 showed that this method gave results compatible with those obtained by making a count at each station with the probe placed on the ground. However the method was almost twice as quick and had the advantage of smoothing out the effect of inhomogeneously distributed surface radio-activity. It was also considered that the method was more realistic for making a comparison with an airborne survey using a moving detector.

TV-5 results

A test of repeatability over a thorium anomaly (Anomaly 17) was satisfactory, but repeatability over weak uranium anomalies showed that it is not really justifiable to show the results as profiles. Nevertheless for the sake of consistency all the results are shown as profiles. The errors associated with these profiles may be estimated using the information presented in Figure 1.

It is useful to establish a quantitative method of determining whether an anomaly is statistically significant. Count-rates can be considered anomalous if they rise by three times the standard deviation of the general level of radioactivity. Approximate thorium and uranium count-rates appropriate to non-anomalous localities were found by using the airborne data to select areas for ground survey where neither thorium nor uranium was evident. A straight line mean was subsequently drawn through the relevant TV-5 profile obtained from ground survey. In this way, approximate values of 25 cpm for thorium and 70 cpm for uranium were established as the average, background, non-anomalous net readings applicable to the TV-5 instrument in the Rum Jungle area.

In the absence of equilibrium data, uranium and thorium count-rates cannot be related directly to the concentrations of parent uranium and thorium; however according to the TV-5 hand-book, the ratio of the net uranium count-rate to the net thorium count-rate in a sample containing equal uranium and thorium in equilibrium is 25:7.

4. DISCUSSION OF RESULTS

Anomaly 10 (Plate 2)

This anomaly occurs almost wholly in the leucocratic granite unit of the Rum Jungle Complex except for the eastern portion which extends into the large feldspar granite unit. The units are described by Rhodes (1965). Contacts are sharp and interfingered.

7

The airborne results show that both uranium and thorium anomalies are present.

The TV-5 results show net thorium count-rates above the average background for the Rum Jungle area as a whole but typical of thorium count-rates for the Rum Jungle Complex. The uranium count-rates are anomalous over the outcrop on each traverse.

The laboratory spectrometer analysis showed that the radioactivity in the sample selected was caused by both thorium and uranium.

Agreement of results is reasonable.

Anomaly 12 (Plate 3)

The northern half of this anomaly lies in the granite gneiss unit and the southern half in the leucocratic granite unit (Rhodes, 1965). The boundary is uncertain owing to lack of definite contacts.

The airborne survey results show peaks in both uranium and thorium channels; the airborne interpretation (Plate 1) shows no uranium anomaly.

The TV-5 results show anomalous thorium count-rates. The net uranium count-rates are not considered anomalous compared with the average background in the Rum Jungle area and considering the counting errors caused by the presence of thorium.

The laboratory spectrometer analysis indicated that the radioactivity is due to thorium.

Agreement of the results is considered good.

Anomaly 14 (Plate 4)

This anomaly is in the leucocratic granite unit north of the inferred boundary with the large feldspar granite unit (Rhodes, 1965).

The airborne interpretation shows only a thorium anomaly.

The TV-5 profiles show a thorium level which is above the thorium background level. The profiles are interpreted as showing a poorly defined thorium anomaly. The uranium profile is not anomalous.

The laboratory spectrometer analysis detected thorium.

The results are consistent; however the anomaly is too weak to be shown satisfactorily by the TV-5 results.

Anomaly 16 (Plate 5)

This anomaly lies solely in the leucocratic granite unit of the Rum Jungle Complex between the large feldspar granite unit to the south and the granite gneiss unit to the north. Contacts between the units are sharp (Rhodes, 1965).

A percussion-drill hole was located near ON, OW as shown in Plate 5. The radiometric and geological logs are presented in Plate 11; the radioactivity measured with a Widco Portalogga gamma-ray probe, does not increase with depth below the zone of surface enrichment, which extends to about 50 ft below ground level.

The airborne results show a broad thorium anomaly. The TV-5 results also indicate a broad anomalous zone owing to thorium, Traverse 1 having peaks near OE and 23E which appear to correlate with the airborne contours. The uranium channel results are affected by the presence of thorium and are not considered anomalous. This interpretation results from a determination of a standard deviation of 50 cpm for the uranium count-rate between stations 1E and 5E, thereby indicating that the highest uranium count-rates recorded involve an increase of only twice standard deviation. Stripping corrections made for thorium account for the apparent negative uranium count-rates on parts of Traverse 2; the standard deviation of C2U is about 50 cpm for C2U=0 and C3Th=150 cpm.

The laboratory spectrometer results showed radioactivity owing to thorium.

Agreement of results is considered to be good.

Anomaly 17 (Plate 6)

Anomalies over the thorium-bearing conglomerate beds of the Crater Formation were investigated.

The airborne and TV-5 results show anomalous thorium response as expected. The uranium count-rate is not significant. The laboratory spectrometer results confirmed that the radioactivity is due to thorium.

Agreement between results is good.

Anomaly 29A (Plate 7)

The anomaly lies in the Coomalie Dolomite and is in the Rum Jungle Laterites area. Anomalous radioactivity is associated with two ironstone caps which overlie talc and chlorite schist. Detailed radiometric contours of the area presented by Douglas (1962) show two anomalies (maximum 0.3 mR/h) sharply defined against an average background of 0.015 mR/h. Ruxton & Shields (1963) mention assays of up to 0.15% U_3O_8 in hand specimens.

As part of the follow-up work, two rotary-percussion-drill holes (R48, R49) were drilled to 140 ft and 110 ft respectively near the outcrop. Radiometric and geological logs are shown in Plate 12. The radioactivity appears to be associated with the ironstone in R48, and falls off when this gives way to talc at about 30 ft. In R49 radioactivity is greatest between 30 and 45 feet, but does not increase with depth. The down-hole radioactivity is near surface and is probably related to the surface radioactivity in the ironstone.

The airborne results indicate a uranium anomaly and show clearly the two point sources, although resolution is broader than from the ground.

The TV-5 results show strong uranium anomalies over the outcrops. The channel 0 count-rate was off-scale on the highest range. An anomalous thorium count-rate appears over the main outcrop (Traverse 2/0), probably caused by a small calibration error.

The laboratory spectrometer analysis indicated uranium in equilibrium according to Mero's method.

Agreement of the results is good as would be expected over such a strong anomaly.

<u>Anomaly 36</u> (Plate 8)

This anomaly is in the Batchelor Laterites area within the Coomalie Dolomite. A number of diamond-drill holes made in the area by TEP intersected ferruginized breccia and sandstone overlying limestone. The anomaly was investigated by Rowston (1962) who concluded after shallow drilling that the anomaly was purely a surface feature restricted to laterite.

The airborne results show a uranium anomaly with peaks superimposed on a plateau.

The TV-5 results also show an anomalous uranium plateau response in contrast to a low thorium background. Several peaks are evident; however, the grid did not completely cover the anomalous region.

The laboratory spectrometer analysis indicated uranium in equilibrium.

Agreement of the results is considered to be good.

Anomalies 38A, B, C (Plates 9)

These anomalies occur in the Golden Dyke Formation in an area covered mostly by soil and laterite. Anomaly 38C was investigated by Alle (1953) and Rosenhain (1953), and is known as the Waterhouse No. 4 Prospect. These anomalies are also included in the Gould Area survey by Shatwell & Duckworth (1966) who measured surface radioactivity and carried out auger probing but did not encounter radioactivity that increased with depth.

Auger drilling was also carried out in 1970 and the results are shown in Plate 9 together with the TV-5 profiles. Radioactivity was found to increase with depth in two holes drilled to 20 and 32 feet on 38A.

The airborne results show minor anomalies in the uranium and thorium channels.

The TV-5 profiles show weak irregular uranium and thorium anomalies.

The laboratory spectrometer analysis showed uranium and the presence of some thorium, confirming the airborne results.

Anomaly 40A (Plate 10)

This anomaly lies in the Crater Formation north of the main road to Batchelor. All that could be found was a small amount of lateritic material beside an old army track. The anomaly is probably associated with the material used to make the road and appears to be due solely to uranium.

The airborne results show a low-order uranium anomaly.

The TV-5 results show a weak uranium anomaly at one station only (0,0).

The laboratory spectrometer analysis indicated uranium. Agreement of the results is good. The source, which proved difficult to locate, is localized.

Anomaly 42A (Plate 10)

No outcrop was found, and surface fragments of slate and ironstone were assumed to be residual. The anomaly is probably in the Golden Dyke Formation, and lies adjacent to a road running along the eastern side of the Coomalie airstrip. The surface material has been bulldozed, and this disturbance may have exposed material which is radioactove. Difficulty was encountered in finding a sample strong enough for quantitative laboratory analysis, and the sample finally selected consisted of gravel which almost certainly was not a true representative sample.

The airborne results show a uranium anomaly, and the TV-5 results also indicate uranium.

The laboratory spectrometer analysis indicated thorium as well as uranium. The low equilibrium factor reflects the presence of thorium.

Anomaly 43 (Plate 10)

This anomaly is in the Golden Dyke Formation. It is near a World War 2 camp site about 200 feet from an ironstone outcrop which itself is not above background radioactivity.

The airborne results show a minor uranium anomaly.

The TV-5 results show no anomaly.

The laboratory analysis of a leached lateritic soil sample indicated weak readioactivity owing to uranium and thorium.

5. CONCLUSIONS

The degree to which the airborne results have been verified is limited. This is due to the statistical reliability of the TV-5 results, and the laboratory analyses being based on one sample collected from each anomaly. However, the general agreement of results is considered to be good and suggests that the airborne spectrometer is a reliable, efficient method of exploration for uranium and thorium anomalies (the potassium-channel results have not been tested).

The airborne spectrometer detected point sources such as Anomaly 29A, as well as broader sources such as Anomaly 16. A number of the broad, weak airborne anomalies were difficult to locate on the ground in areas of variable radioactivity.

None of the anomalies is considered to require further investigation. Radioactivity was found to increase with depth in two auger holes on Anomaly 38A; however, the results of a more extensive auger drilling program in the area are described by Shatwell & Duckworth (1966) who consider that the radioactivity in the area of Anomaly 38A is not significant.

The counting efficiency of the TV-5 at one minute scaler-times is considered to be too low to obtain meaningful profiles over weak uranium anomalies where thorium is present. It is possible that a differential system using channels centred on 1.46, 1.76, and 2.62 MeV would overcome the problem by reducing the stripping factors. A larger detector could also increase the counting efficiency.

6. REFERENCES

ALLE, A.F., 1953 - Preliminary geophysical report on the Waterhouse uranium prospect No. 4, Northern Territory. Bur. Miner. Resour. Aust. Rec. 1953/128 (unpubl.).

BEATTIE, R.D., 1971 - Airborne gamma-ray spectrometer survey, Northern Territory, 1969. Bur. Miner. Resour. Aust. Rec. 1971/85 (unpubl.).

DOUGLAS, A., 1962 - Flynns area geophysical survey near Rum Jungle, Northern Territory, 1961. Bur. Miner. Resour. Aust. Rec. 1962/122 (unpubl.).

MERO, J.L., 1960 - Uses of the gamma-ray spectrometer in mineral exploration. Geophysics, 25(5), 1054-76.

RHODES, J.M., 1965 - The geological relationships of the Rum Jungle Complex, Northern Territory. Bur. Miner. Resour. Aust. Rep. 89.

ROSENHAIN, P.B., 1953 - Geological report on Waterhouse uranium prospect No. 4, Northern Territory. Bur. Miner. Resour. Aust. Rec. 1953/127 (unpubl.).

ROWSTON, D.L., 1962 - Batchelor Laterites area geophysical survey, Northern Territory, 1961. Bur. Miner. Resour. Aust. Rec. 1962/103 (unpubl.).

RUXTON, B.P., & SHIELDS, J.W., 1963 - Geochemical and radiometric survey, Rum Jungle, Northern Territory, 1961. Bur. Miner. Resour. Aust. Rec. 1963/49 (unpubl.).

SHATWELL, D.O., & DUCKWORTH, K., 1966 - Gould area geochemical and geophysical surveys, Rum Jungle area, Northern Territory 1965. Bur. Miner. Resour. Aust. Rec. 1966/154 (unpubl.).

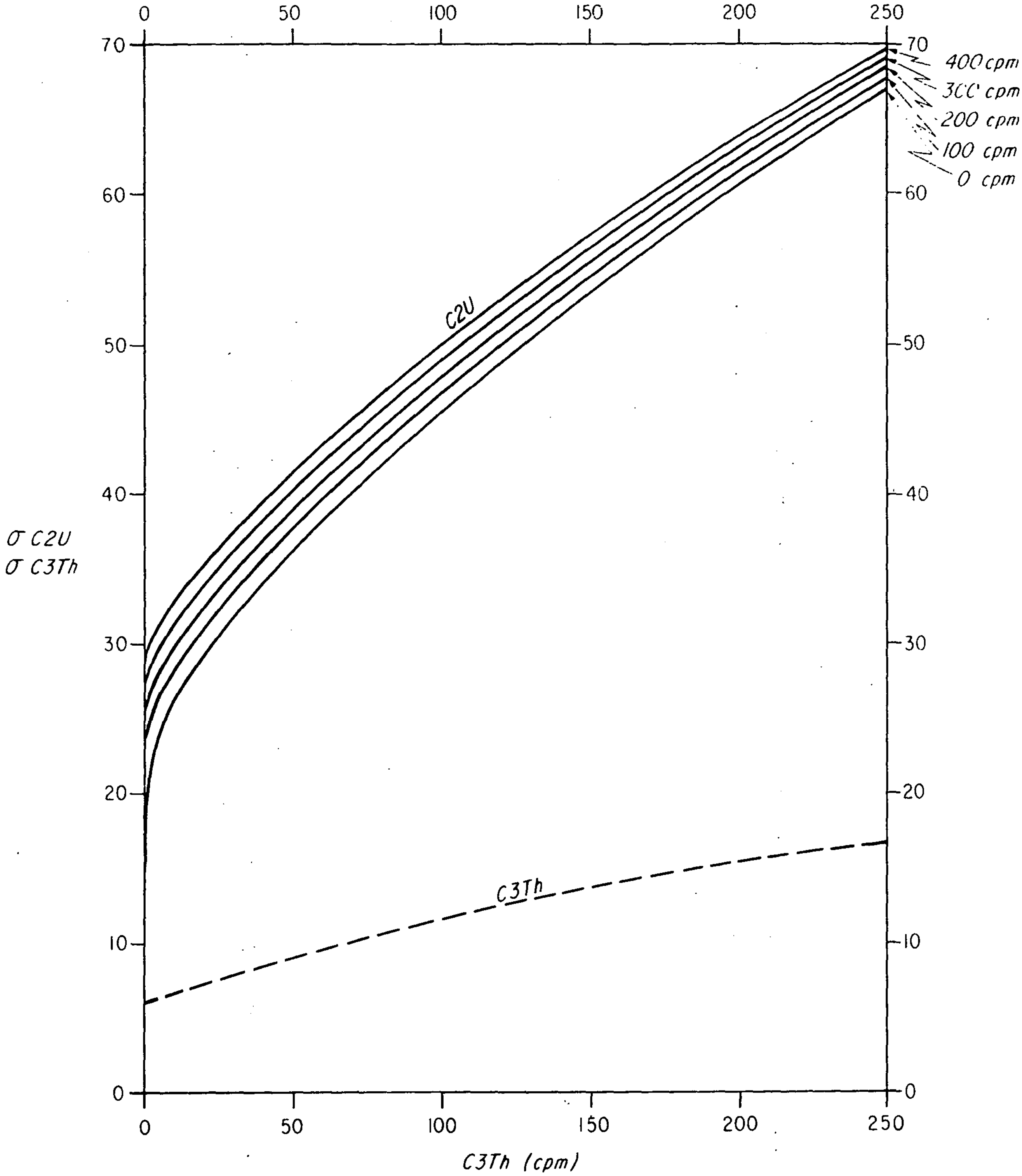
TABLE 1

LABORATORY GAMMA-RAY SPECTROMETER RESULTS

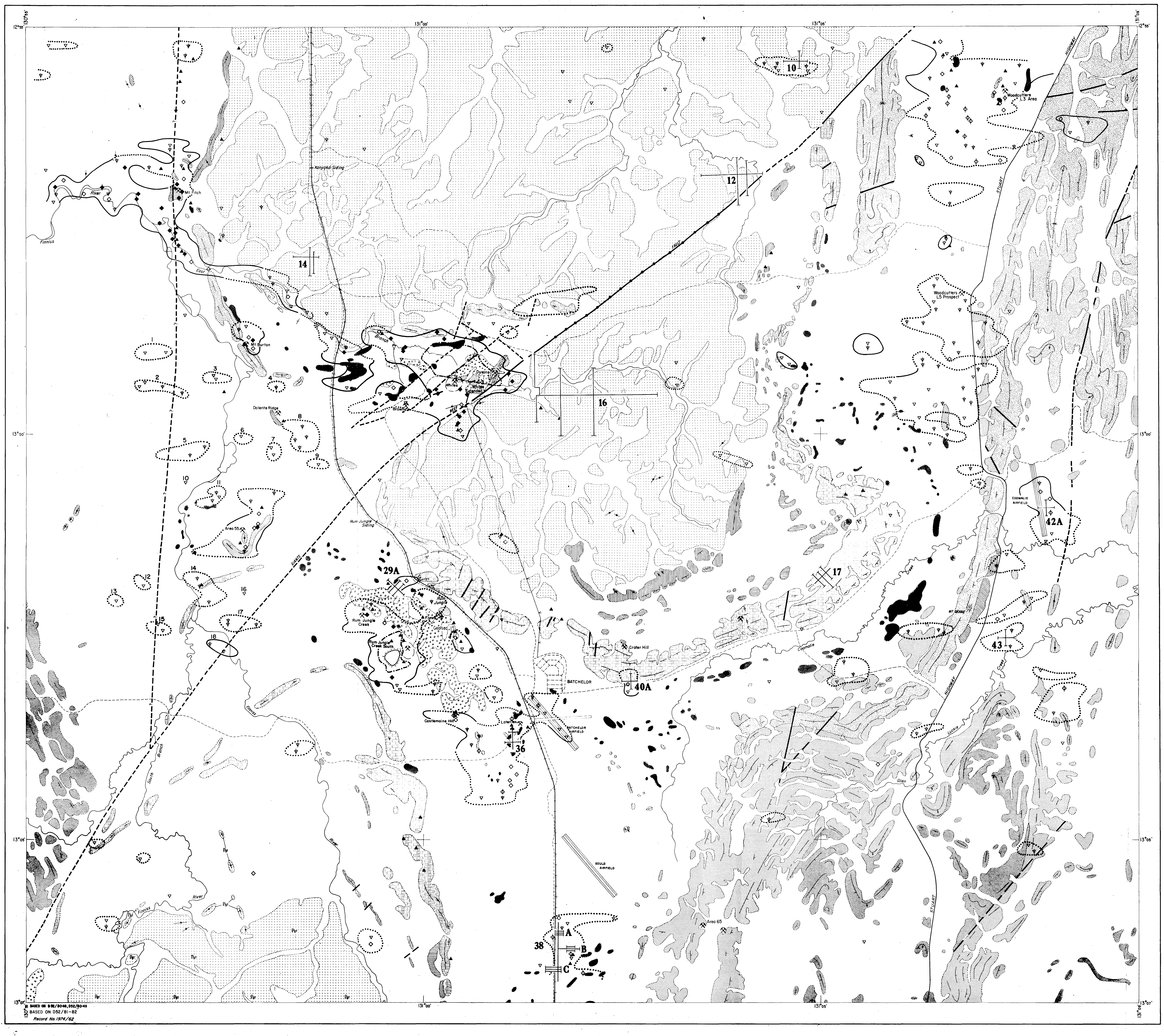
Anomaly	Uranium equilibrium factor	$\frac{eU_3O_8}{eThO_2}$	$eU_3)_8$ ($eThO_2$) %
10	N.A.	0.15	(0.006)
12	N.A.	0.03	(0.002)
14	N.A.	0.10	(0.011)
16	N.A.	$<$ 0.01	(0.021)
17	N.A.	$<$ 0.01	(0.42)
29A	1.25	$>$10.	0.078
36	1.23	$>$10.	0.012
38A	1.07	$>$10.	0.006
38B	0.97	5.	0.008
38C	1.23	10.	0.13
40A	1.03	$>$10.	0.007
42A	0.63	0.5	0.003
43	0.76	1.5	0.004

N.A.: not applicable

Fig. 1



TV-5 NET URANIUM AND THORIUM COUNT-RATES FOR A SCALER COUNTING TIME OF 1 MINUTE THEORETICAL COUNTING ERRORS



GEOLOGICAL LEGEND

QUATERNARY

Alluvium

UPPER PROTEROZOIC

TOLMER GROUP
BULDIVA SANDSTONE
DEPOT CREEK SANDSTONE MEMBER

Quartz sandstone, with lenses of haematite-rich breccia and lenses of quartz pebble conglomerate

LOWER PROTEROZOIC

RUM JUNGLE COMPLEX

Schist, gneiss, diorite, granite, pegmatite etc.

WATERHOUSE COMPLEX

Pgt Porphyitic granite, and adamellite

Basic intrusives

FINNISS RIVER GROUP
BURRELL CREEK FORMATION

Siltstone, greywacke siltstone, greywacke, quartz greywacke

GOODPARLA GROUP
GOLDEN DYKE FORMATION

Quartz siltstone and carbonaceous siltstone, in places pyritic

MASSON FORMATION
ACACIA GAP TONGUE

Quartz greywacke, quartz sandstone, pyritic and silicified in places; pyritic, carbonaceous siltstone, siltstone

BATCHELOR GROUP
COOMALIE DOLOMITE

Silicified and metamorphosed dolomite

CRATER FORMATION

Quartz greywacke, greywacke, arkose, fine and pebble conglomerate, siltstone

CELIA DOLOMITE

Algal dolomite, in places silicified and metamorphosed, silicified dolomitic breccia, tremolite schist

BEESTONS FORMATION

Arkose, greywacke, siltstone, conglomerate, arkosic conglomerate, white friable quartz sandstone

Geological boundary
Dip and strike of strata
Trend lines
Established synclinal trough - position accurate
Established synclinal trough - concealed; position approximate
Plunge of syncline
Plunge of anticline
Established fault - position accurate
Established fault - position approximate
Established fault - concealed
Probable fault
Quartz vein
Quartz-tourmaline vein
Fossil locality

GEOLOGY AFTER RUM JUNGLE DISTRICT
SPECIAL SHEET, 1:63,360, 1960 EDITION

TOPOGRAPHICAL LEGEND

Highway
Road or track
River or creek
Railway with station and siding
Mine or prospect
Open cut
Dump
Transmission line
Dam

GEOPHYSICAL LEGEND

POINT SOURCE "URANIUM" ANOMALIES
- 1st Order (> 8 s.d. above mean geological background noise)
- 2nd Order (4·5 – 8 s.d. " " " " ")
- 3rd Order (< 4·5 s.d. " " " " ")

Anomaly peak not well defined

BROAD SOURCE "URANIUM" ANOMALIES
- Anomaly boundary well defined
- Anomaly boundary not well defined

Channel 3 trace offscale (> 100 counts/second)

Radiometric anomalies after Livingstone 1959

43 Grid surveyed by TV5

LOCATION OF FOLLOW – UP GROUND SURVEYS WITH RESPECT TO URANIUM CHANNEL ANOMALIES DETECTED BY DETAILED AIRBORNE GAMMA-RAY SPECTROMETER SURVEY, RUM JUNGLE NT 1969.

GEOPHYSICAL INTERPRETATION

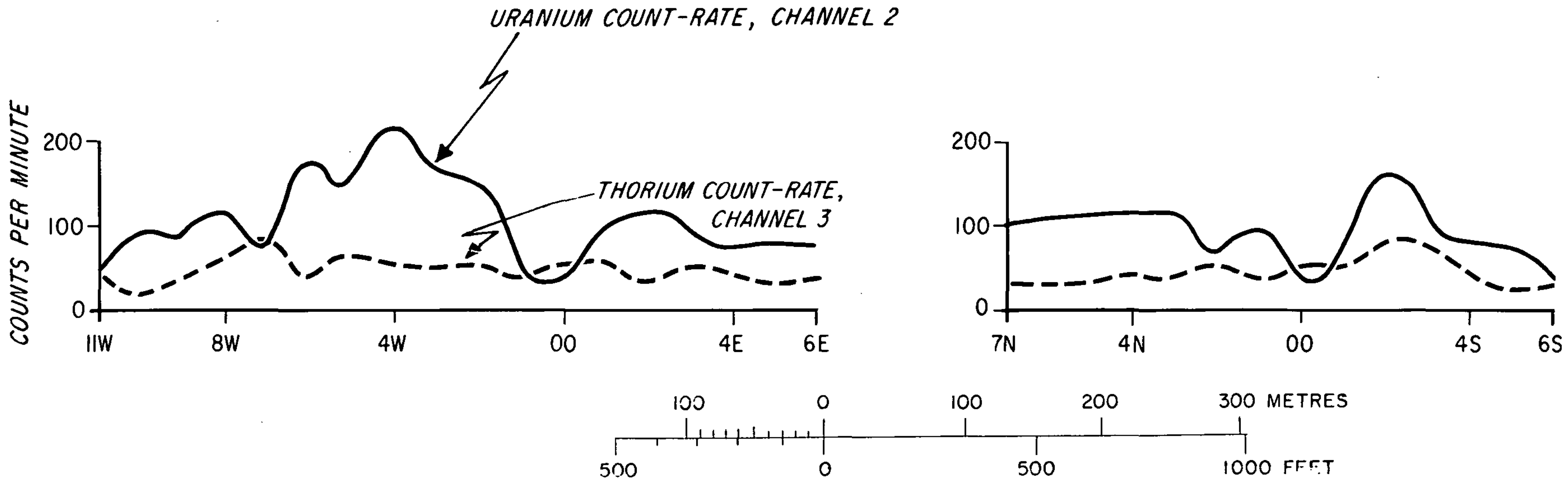
CHANNEL 3 - "URANIUM"

MILES

KILOMETRES

D52/B7-607

TV-5 RADIOMETRIC PROFILES

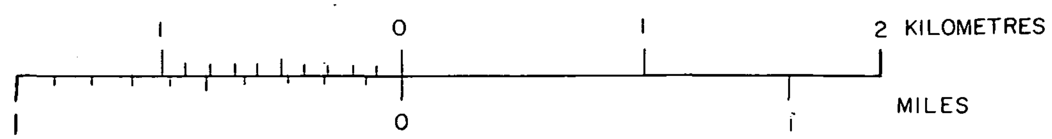


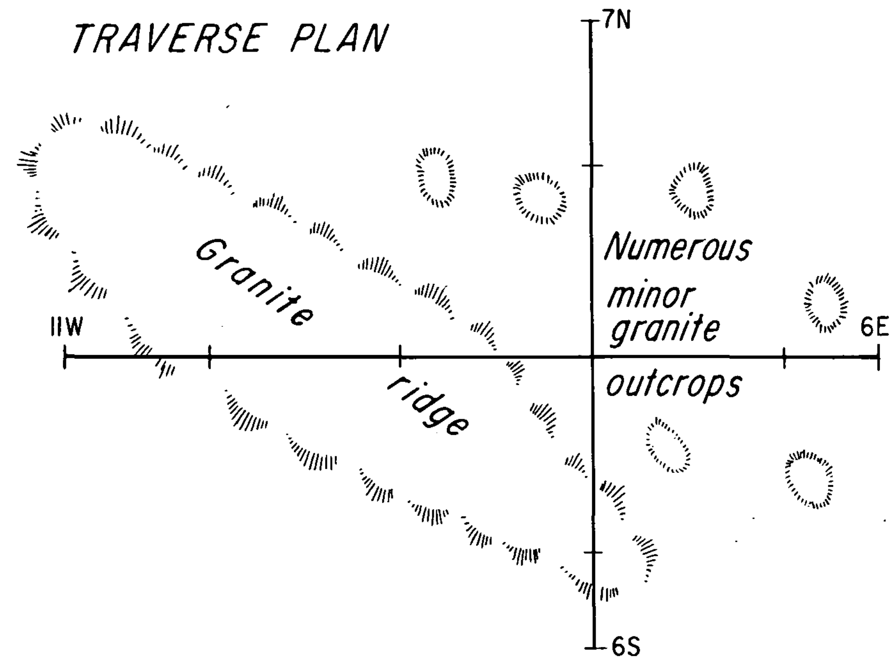
AIRBORNE RESULTS

CHANNEL 3 (URANIUM) CONTOURS

CHANNEL 4 (THORIUM) CONTOURS

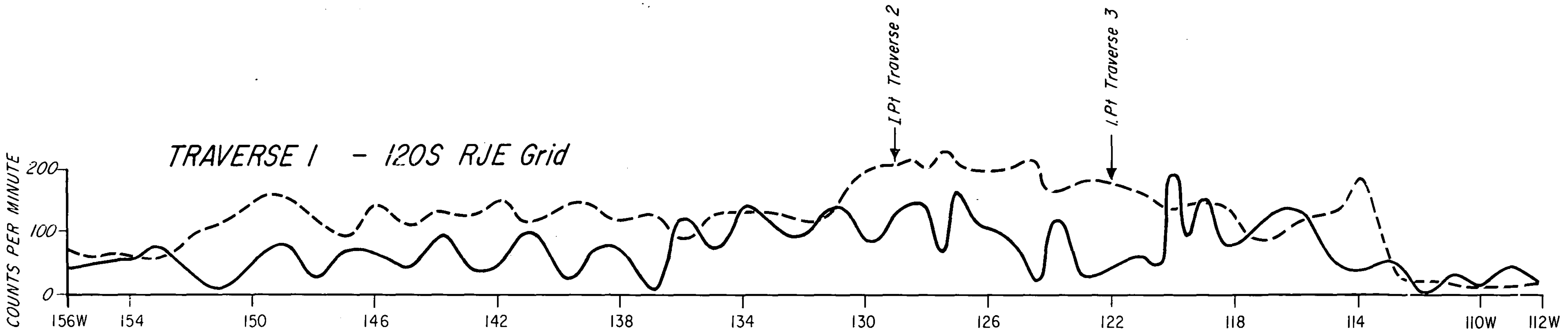
Contour interval = 5 cps

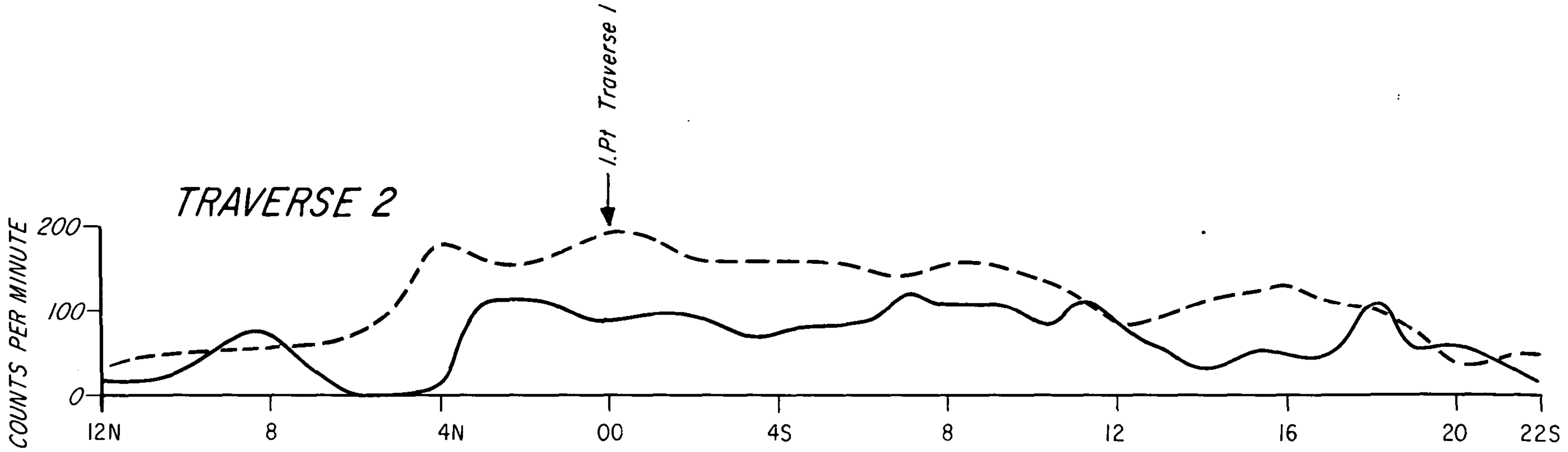


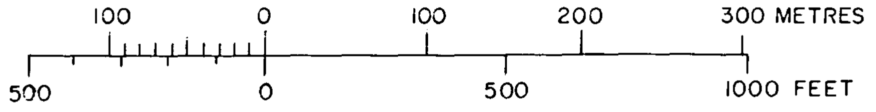


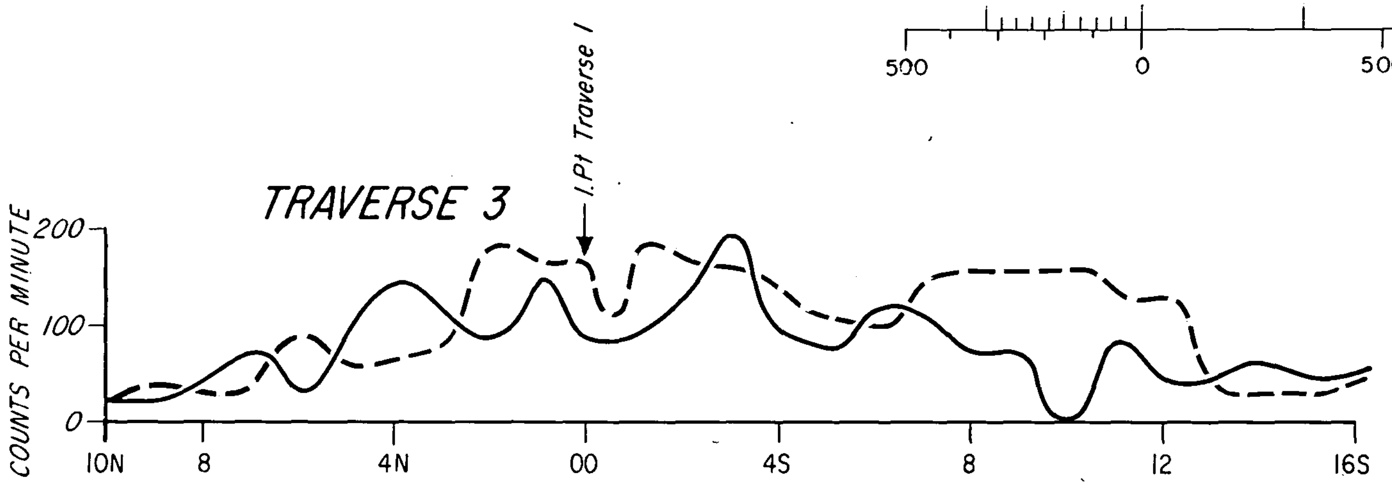
ANOMALY 10

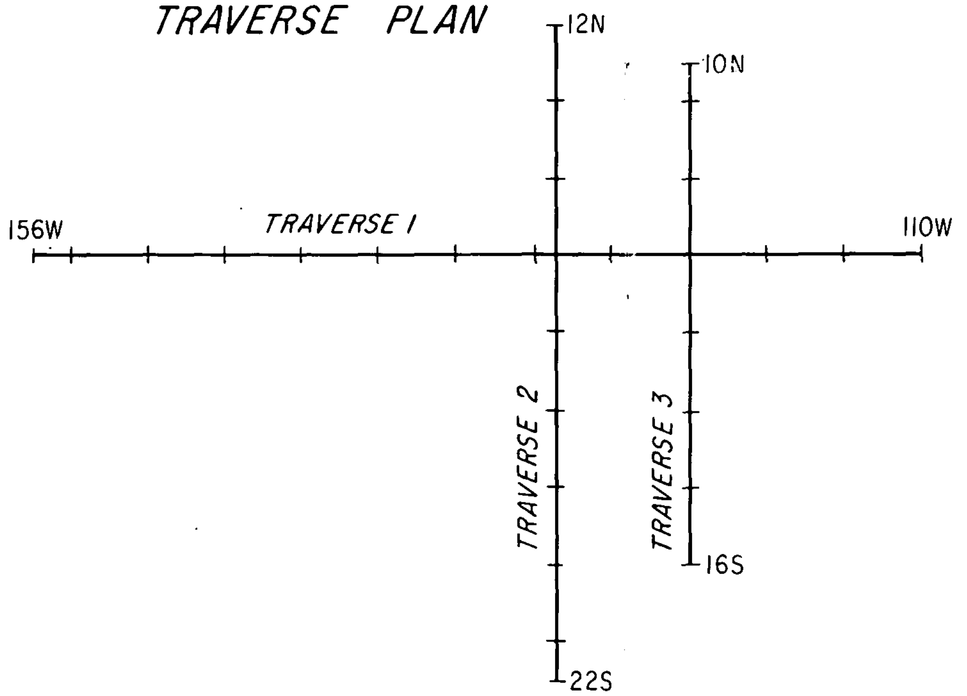
TV-5 RADIOMETRIC PROFILES



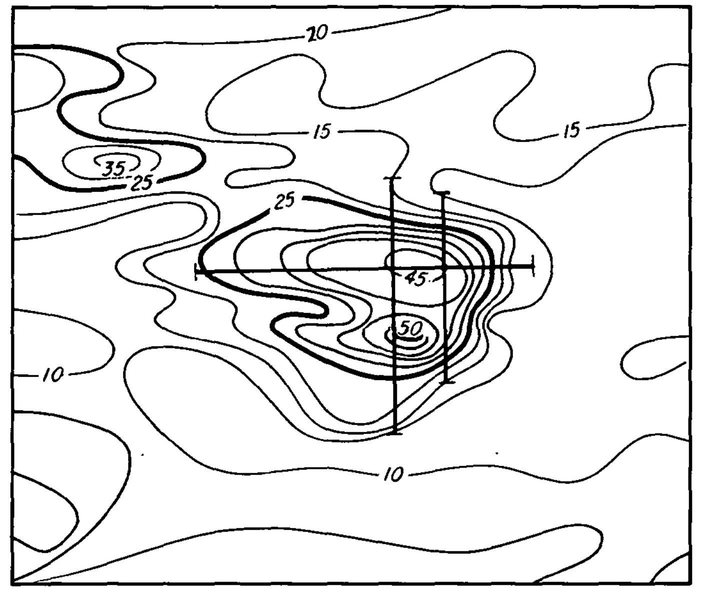




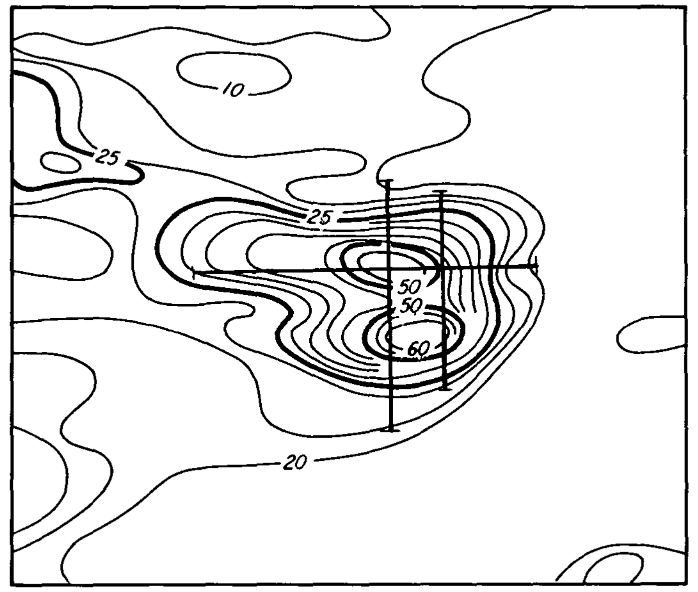




AIRBORNE RESULTS

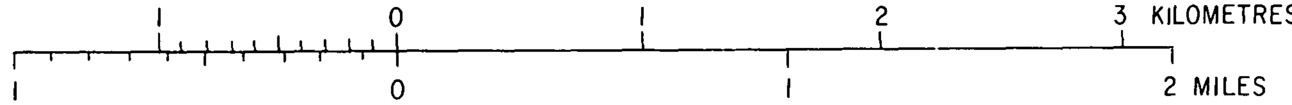


Channel 3 (Uranium) contours



Channel 4 (Thorium) contours

Contour interval = 5 cps



LEGEND

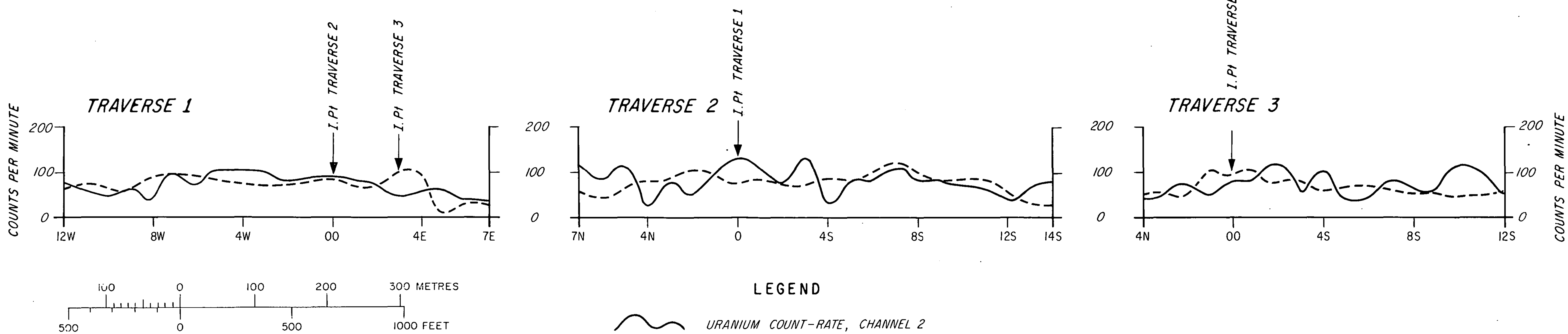

URANIUM COUNT-RATE, CHANNEL 2


THORIUM COUNT-RATE, CHANNEL 3

ANOMALY 12

Record No.1974/62

TV-5 RADIOMETRIC PROFILES

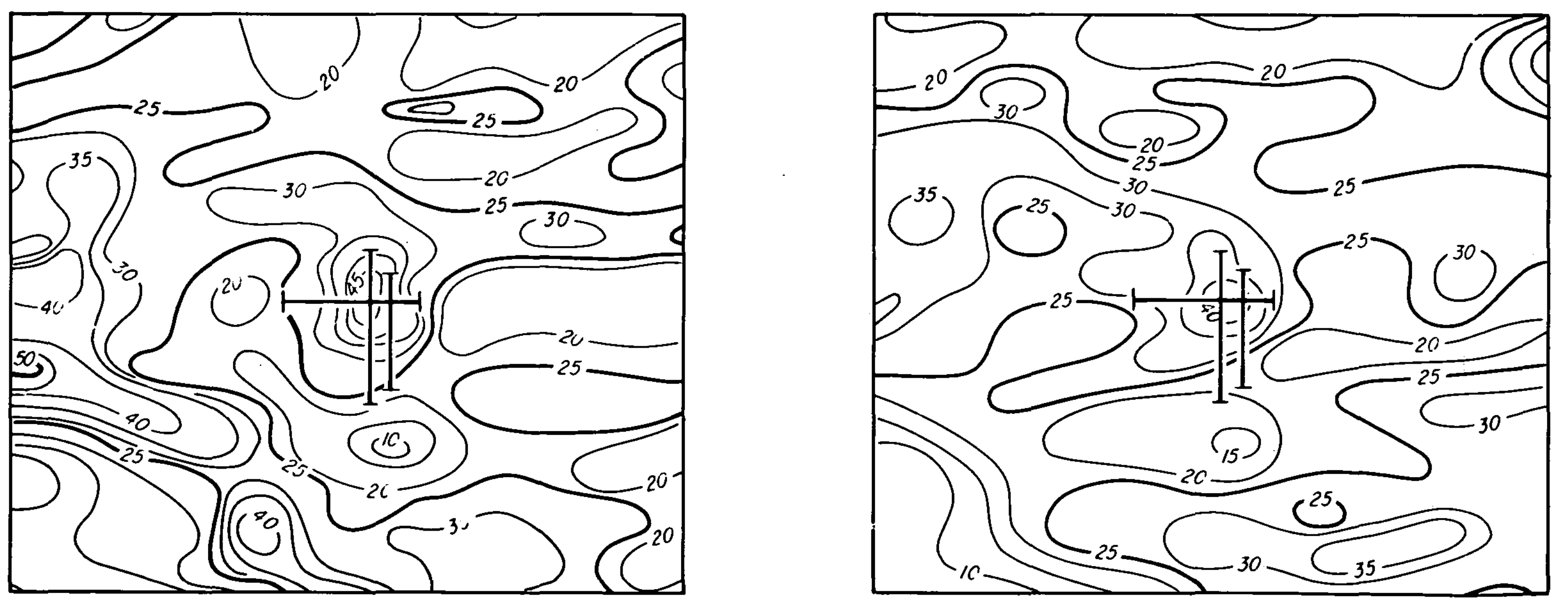


LEGEND

URANIUM COUNT-RATE, CHANNEL 2

THORIUM COUNT-RATE, CHANNEL 3

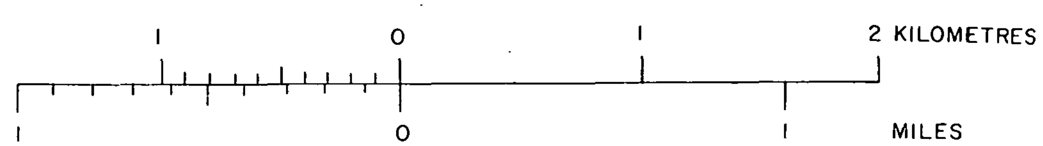
AIRBORNE RESULTS

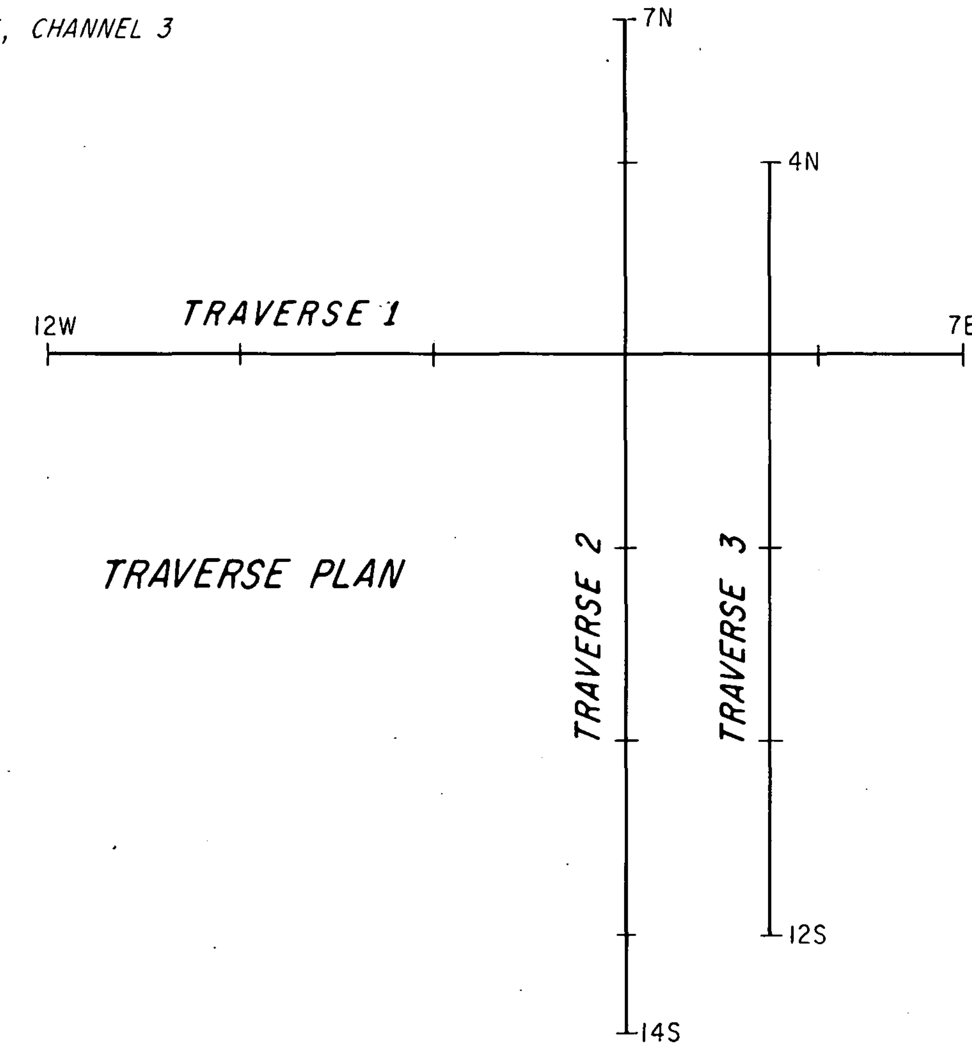


Channel 3 (Uranium) contours.

Channel 4 (Thorium) contours

Contour interval = 5 cps





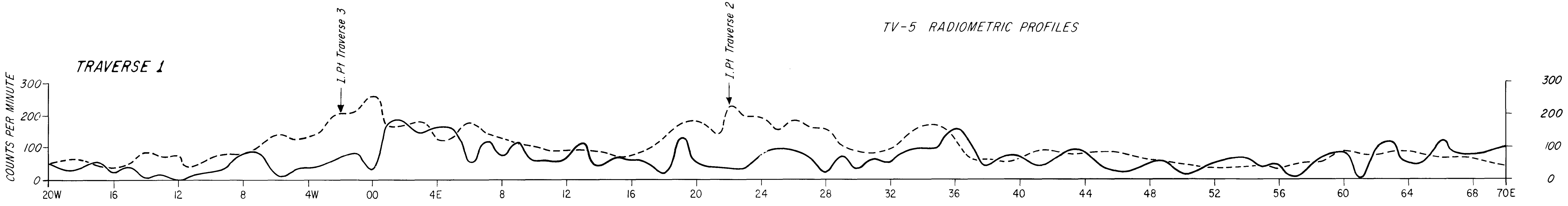
TRAVERSE PLAN

ANOMALY 14

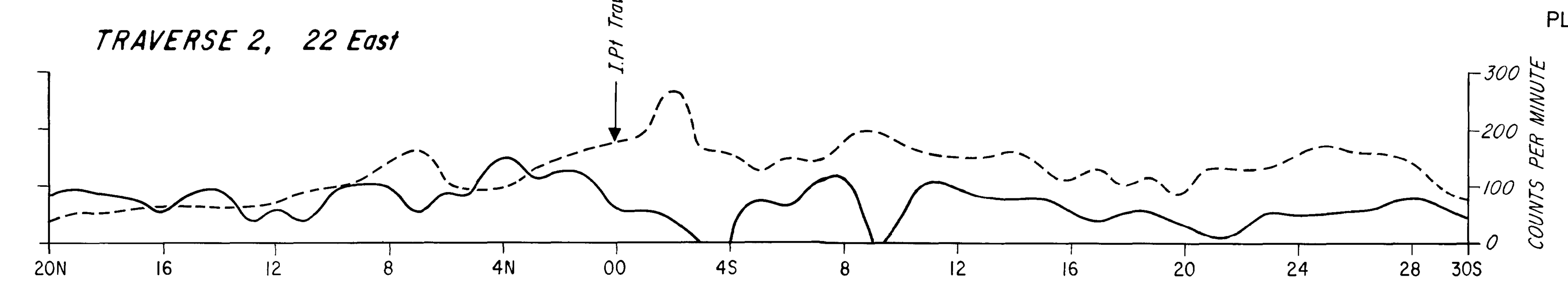
PLATE 5

TV-5 RADIOMETRIC PROFILES

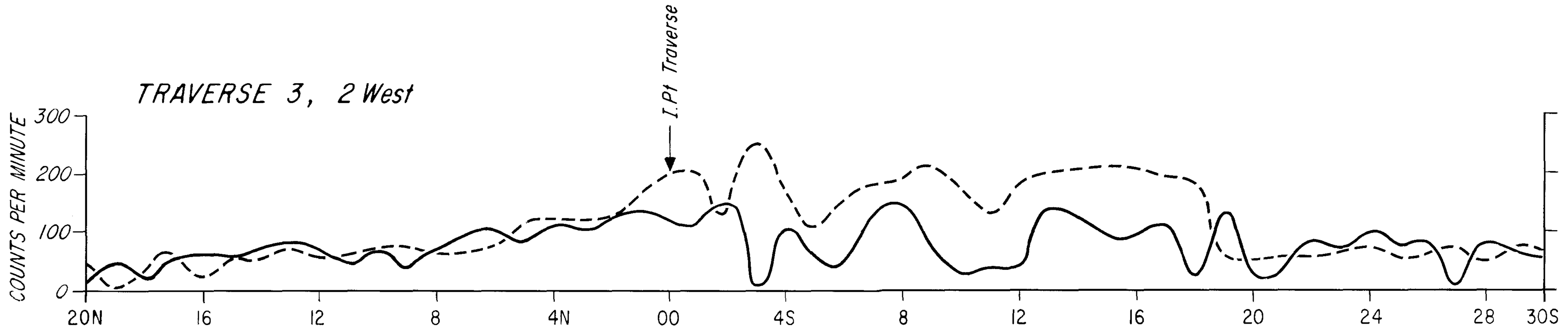
TRAVERSE 1



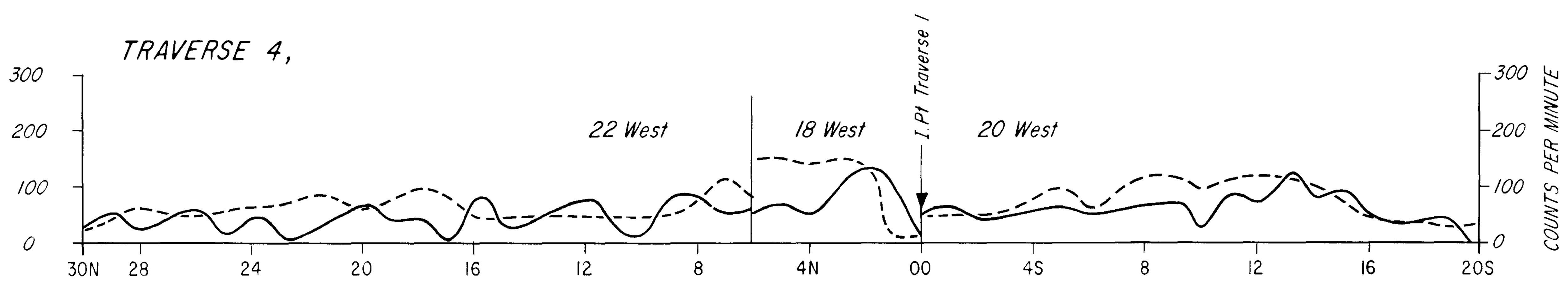
TRAVERSE 2, 22 East



TRAVERSE 3, 2 West

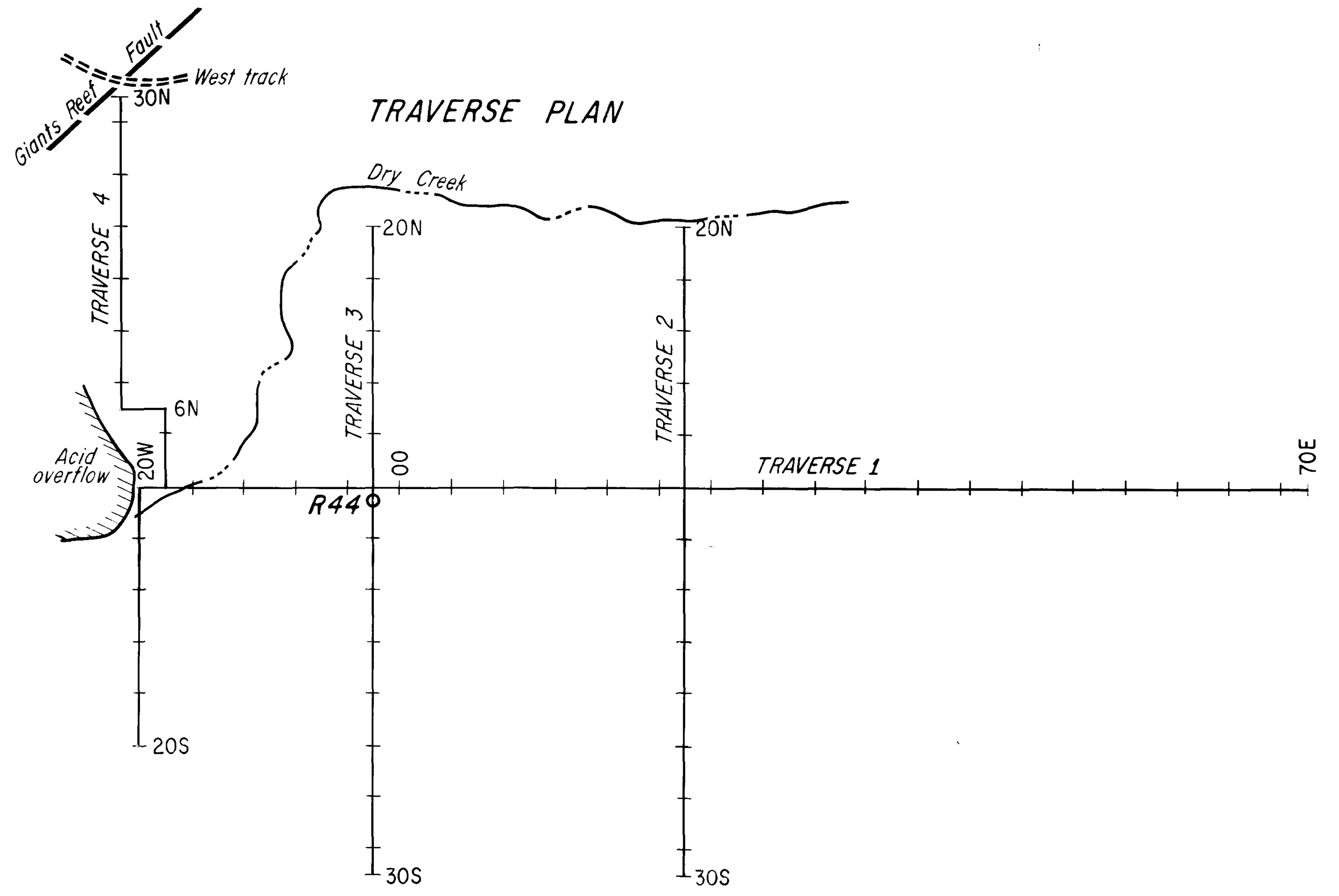


TRAVERSE 4,

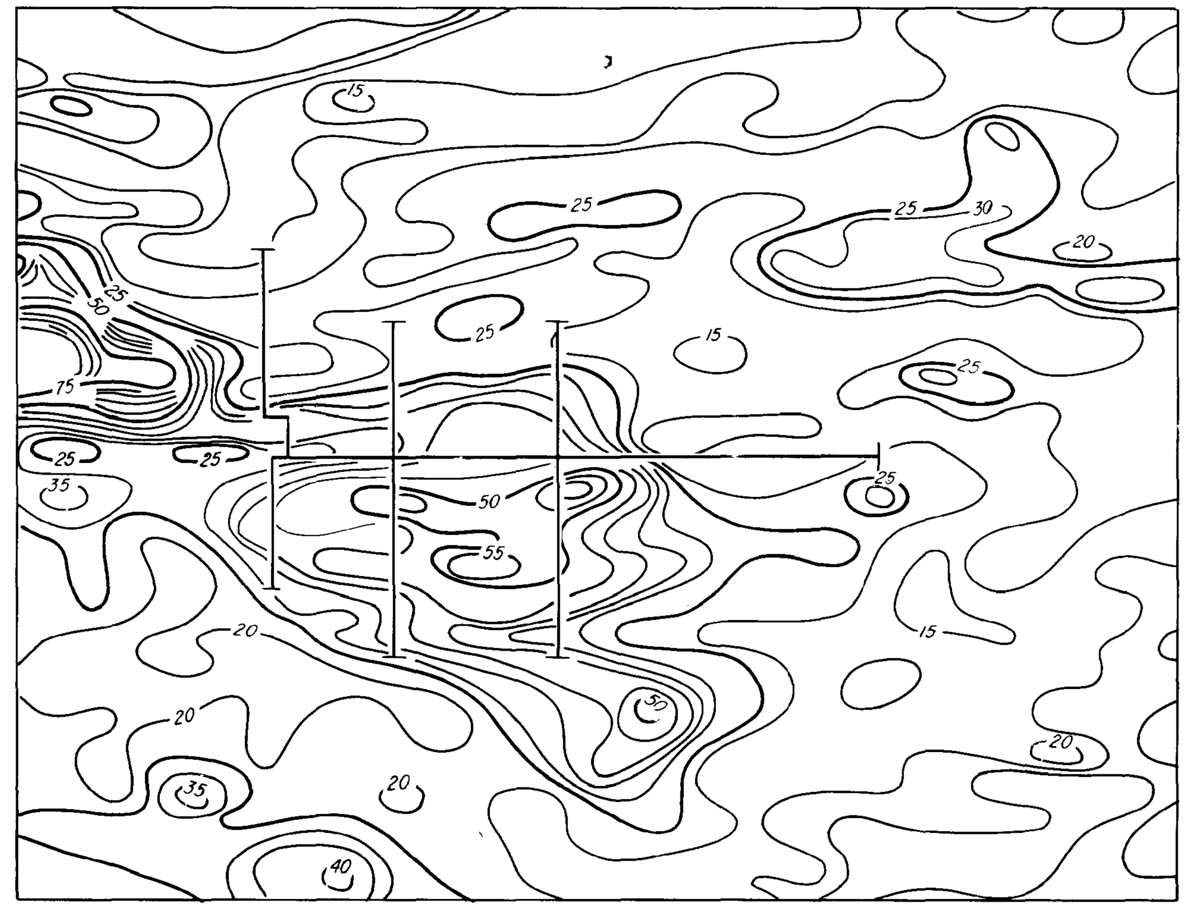


100 0 100 200 300 400 METRES
500 0 500 1000 1500 FEET

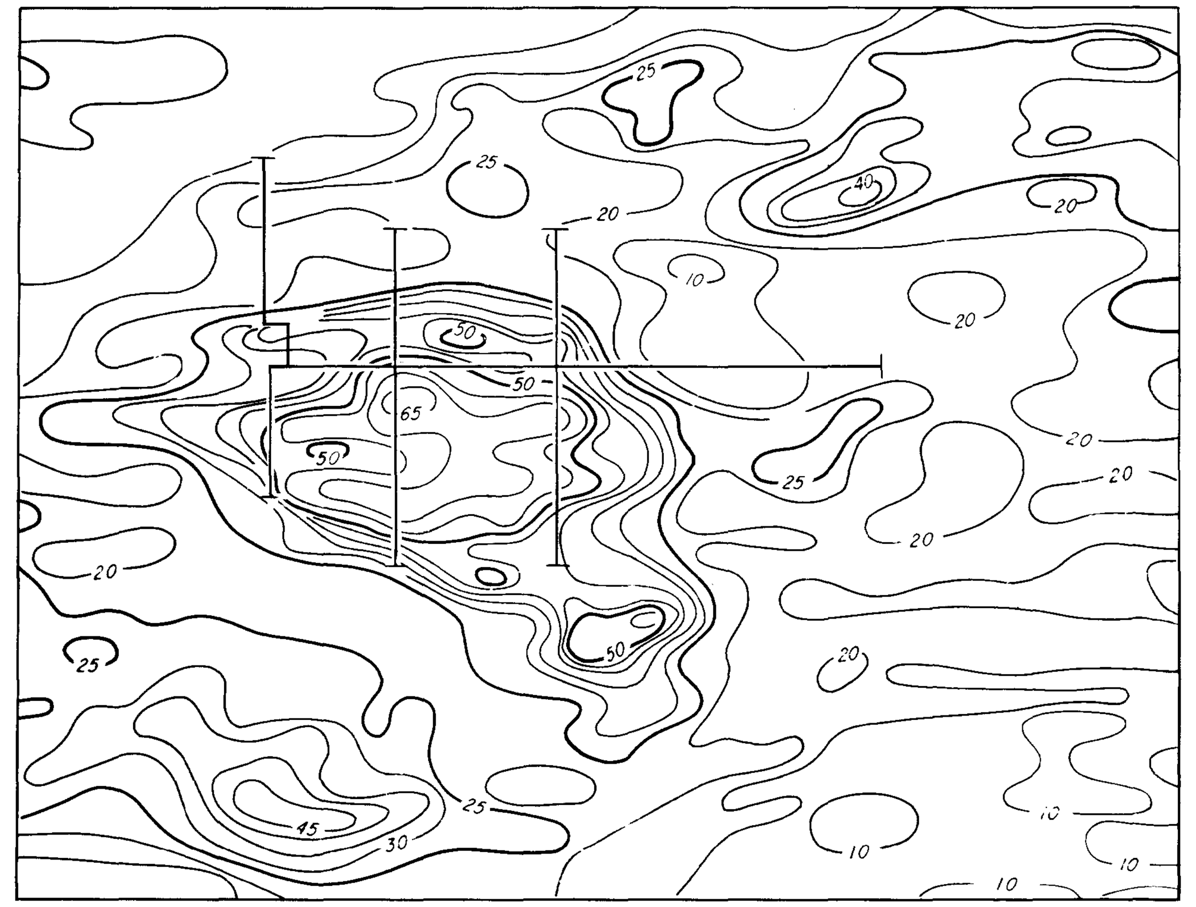
TRAVERSE PLAN



AIRBORNE RESULTS



Channel 3 (Uranium) contours Interval = 5 cps



Channel 4 (Thorium) contours Interval = 5 cps

1 0 1 2 3 KILOMETRES
1 0 1 2 MILES

LEGEND

Uranium count-rate, channel 2
Thorium count-rate, channel 3
R44 ○ Drill hole

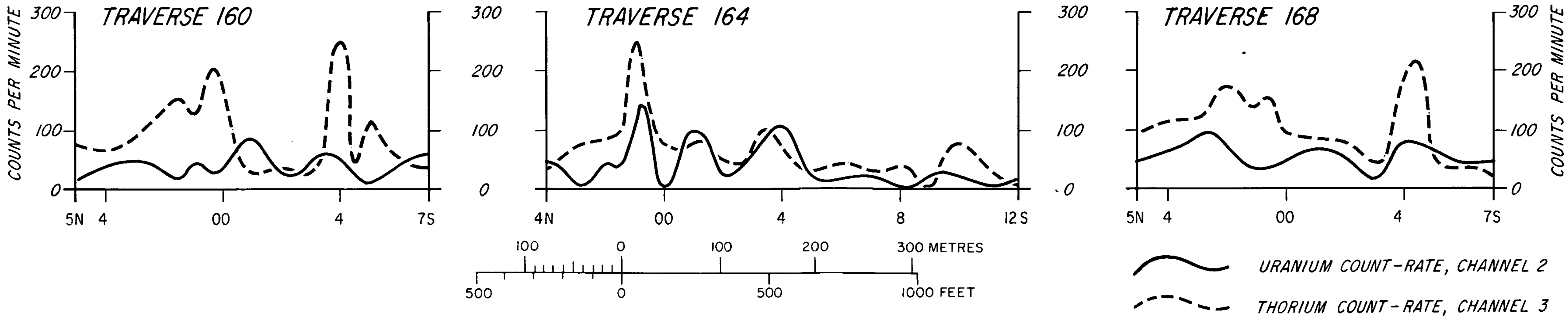
ANOMALY 16

D52/B7-611

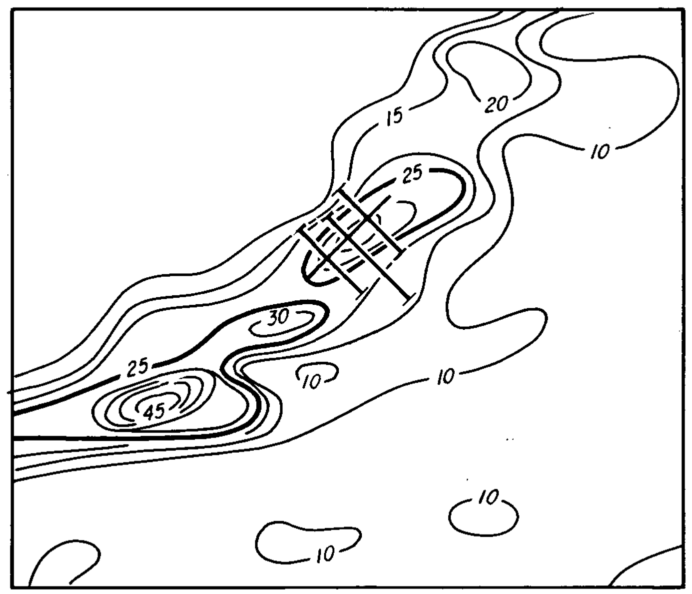
Record No. 1974/62

PLATE 6

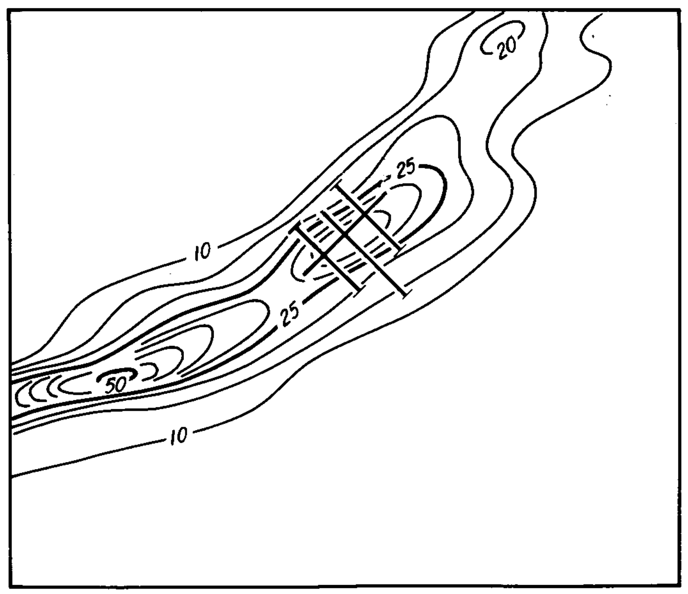
TV-5 RADIOMETRIC PROFILES



AIRBORNE RESULTS



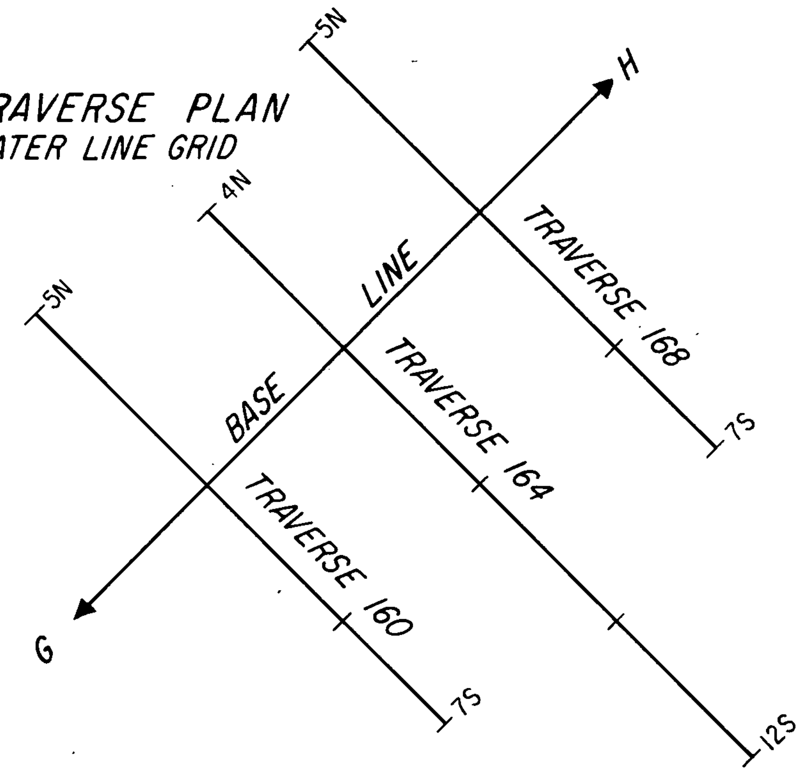
Channel 3 (Uranium) contours



Channel 4 (Thorium) contours

Contour interval = 5 cps

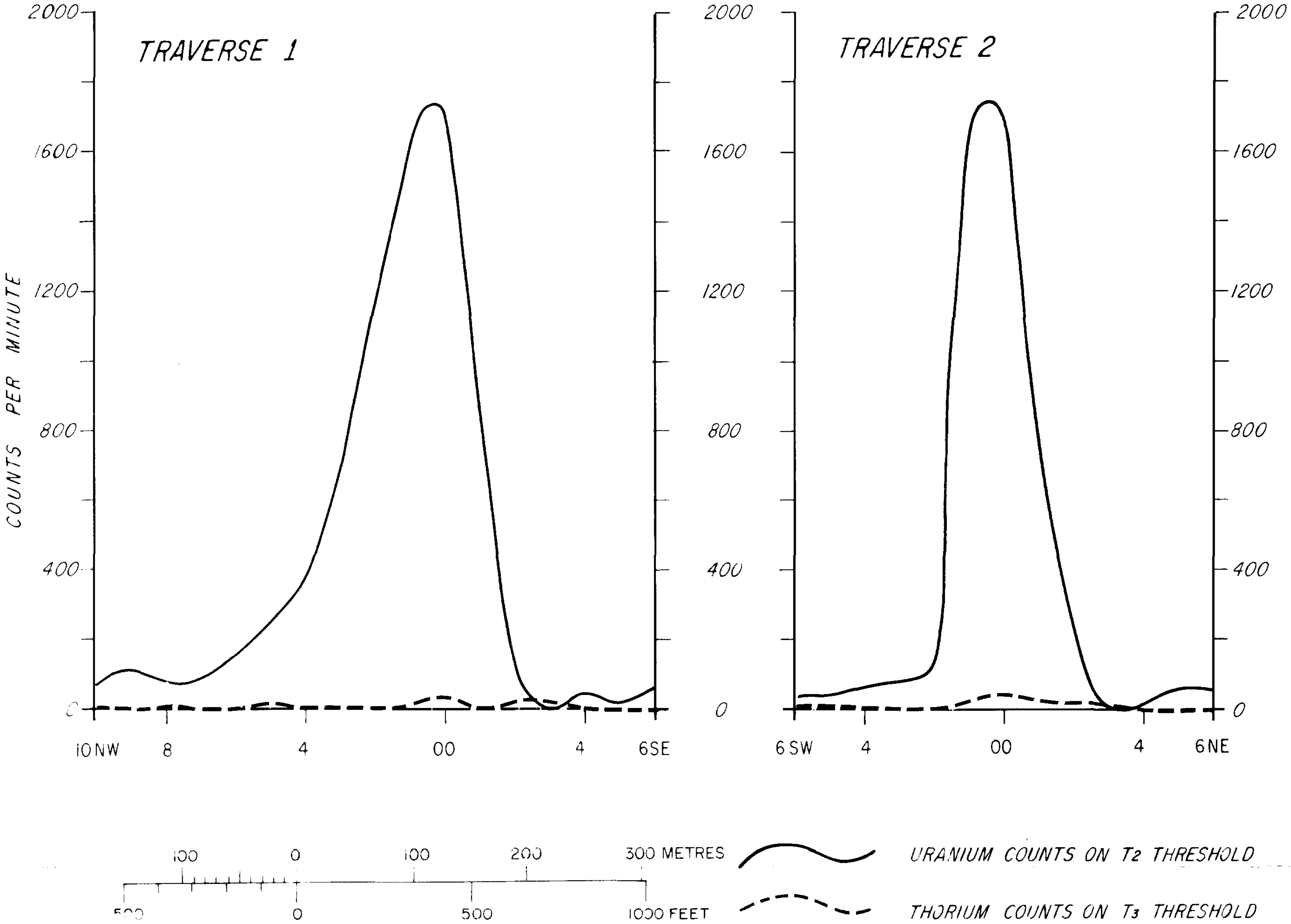
TRAVERSE PLAN
CRATER LINE GRID



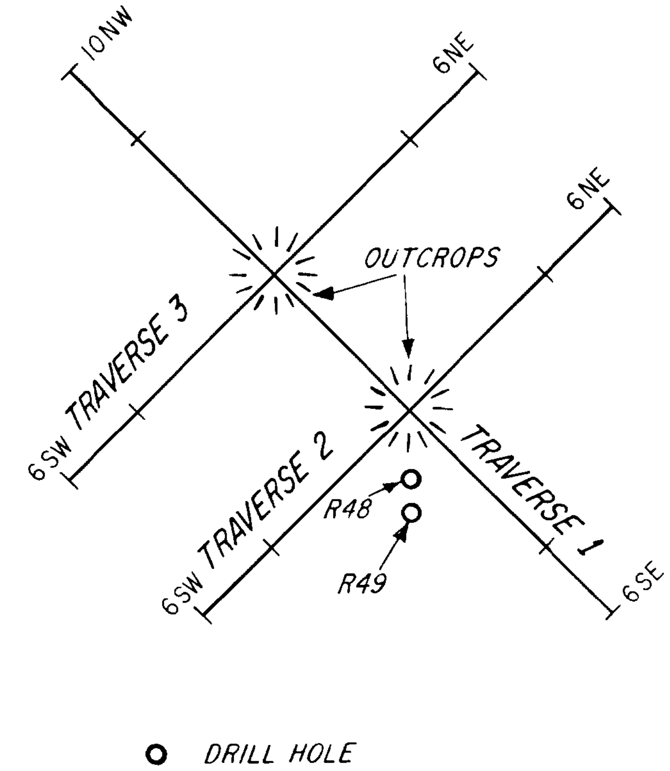
ANOMALY 17

PLATE 7

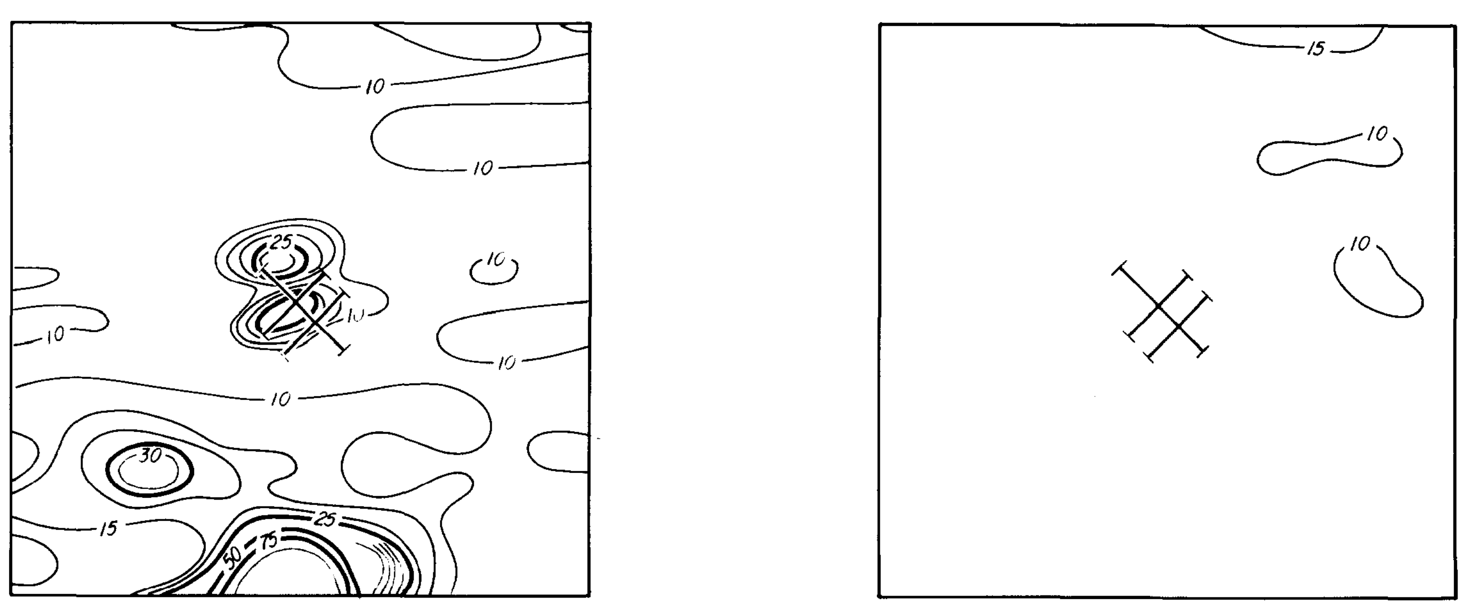
TV-5 RADIOMETRIC PROFILES



TRAVERSE PLAN



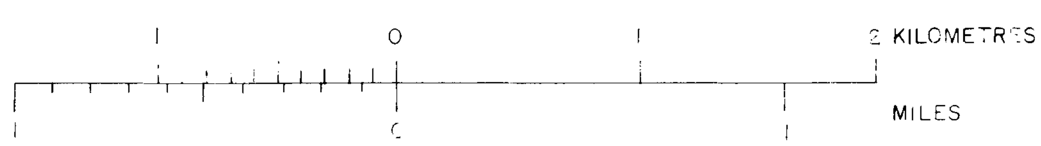
AIRBORNE RESULTS



Channel 3 (Uranium) contours

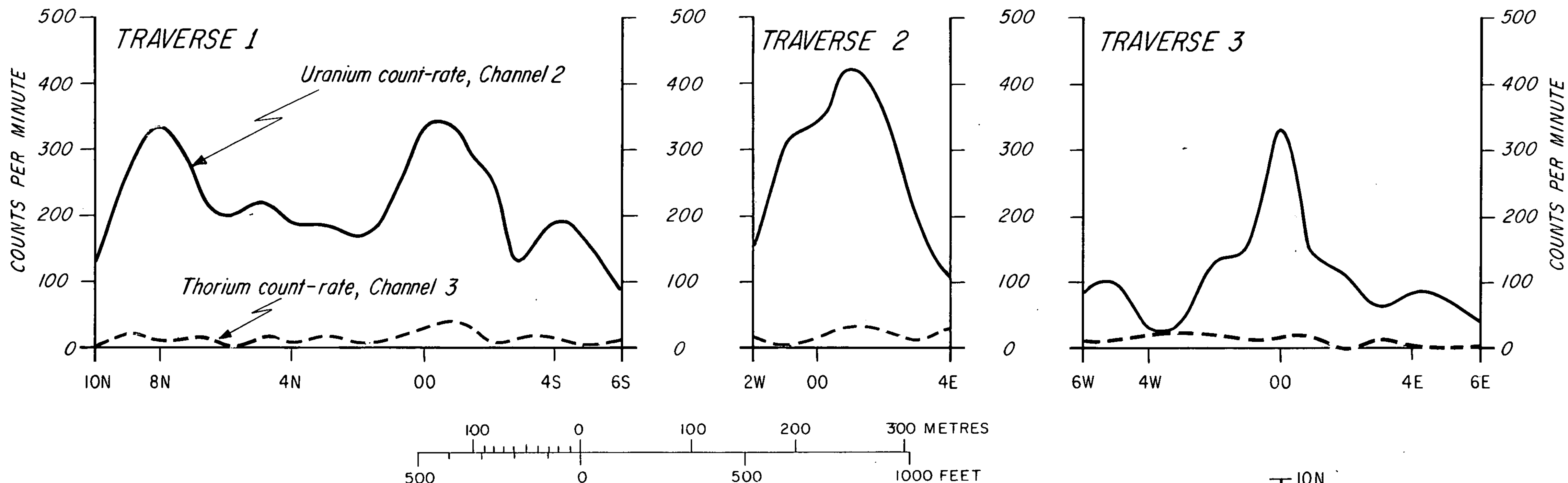
Channel 4 (Thorium) contours

Contour interval = 5cps

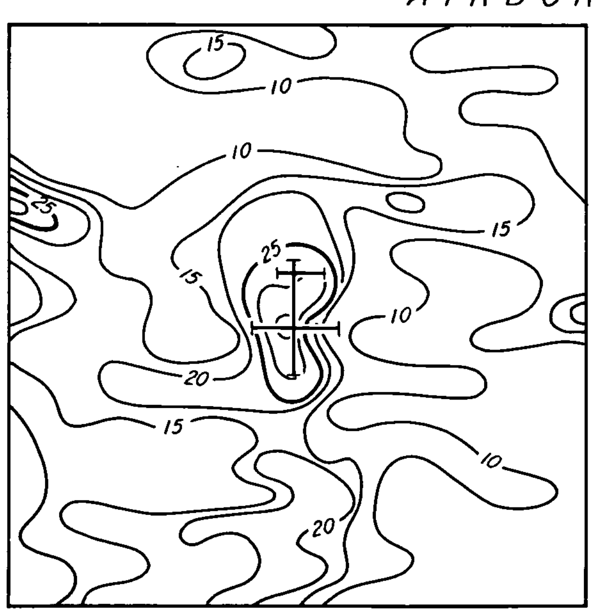


ANOMALY 29A

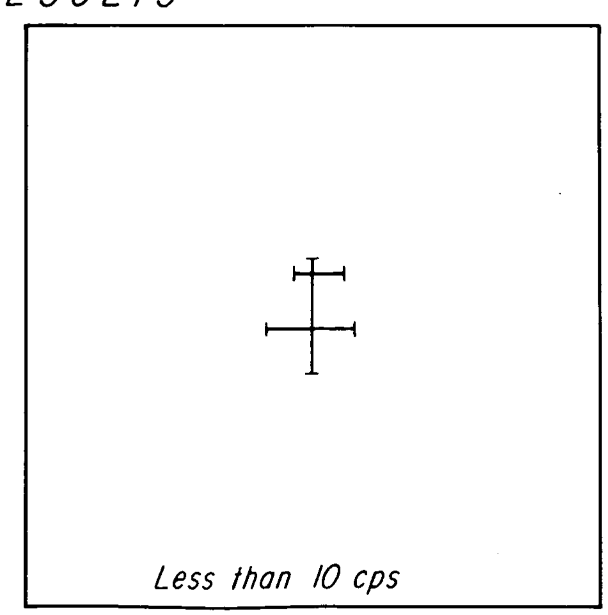
TV-5 RADIOMETRIC PROFILES



AIRBORNE RESULTS

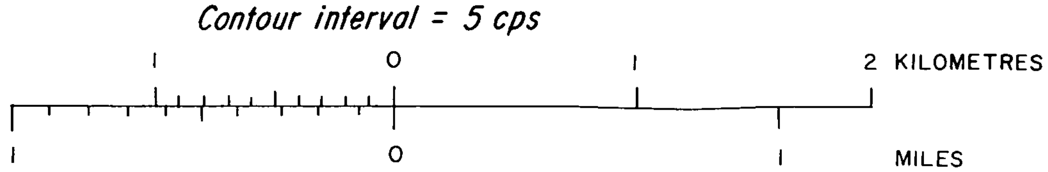


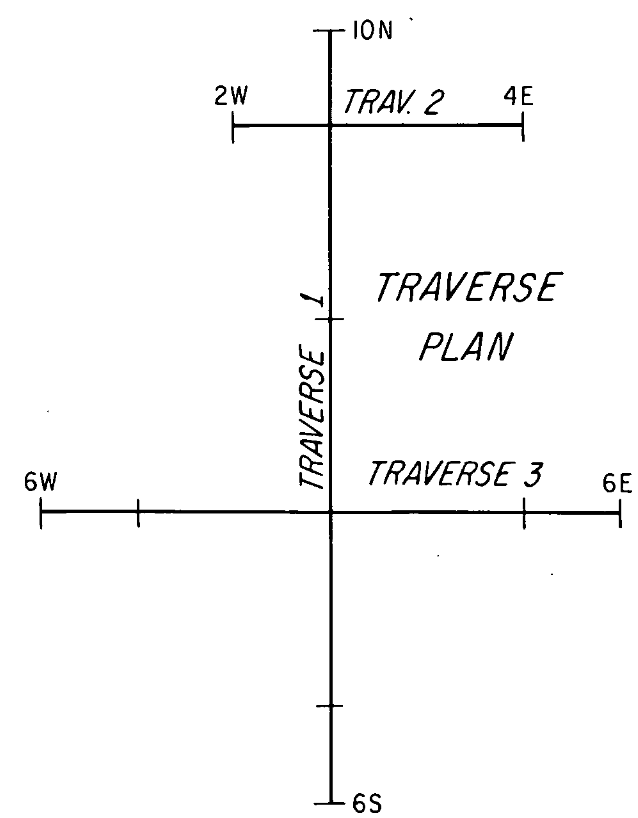
Channel 3 (Uranium) contours



Channel 4 (Thorium) contours

Contour interval = 5 cps

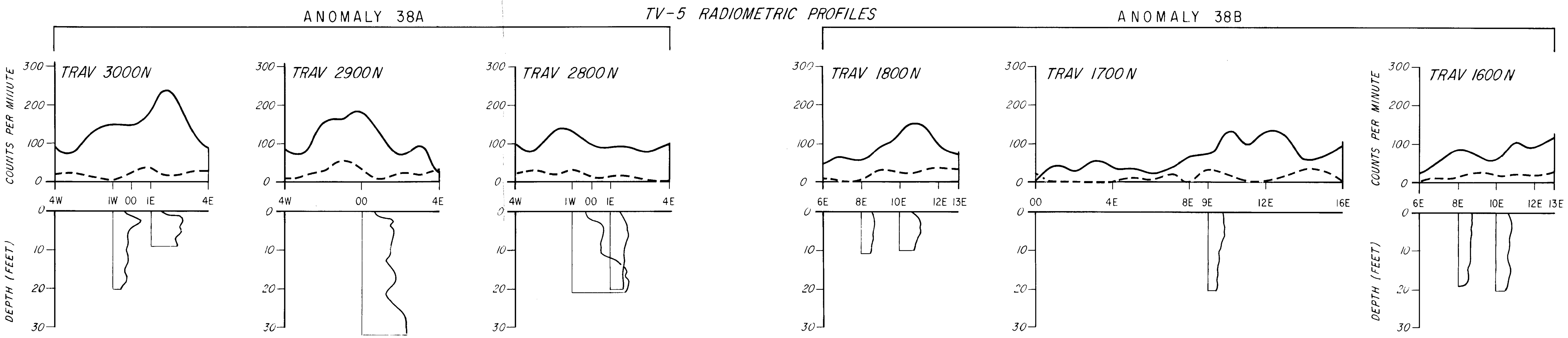


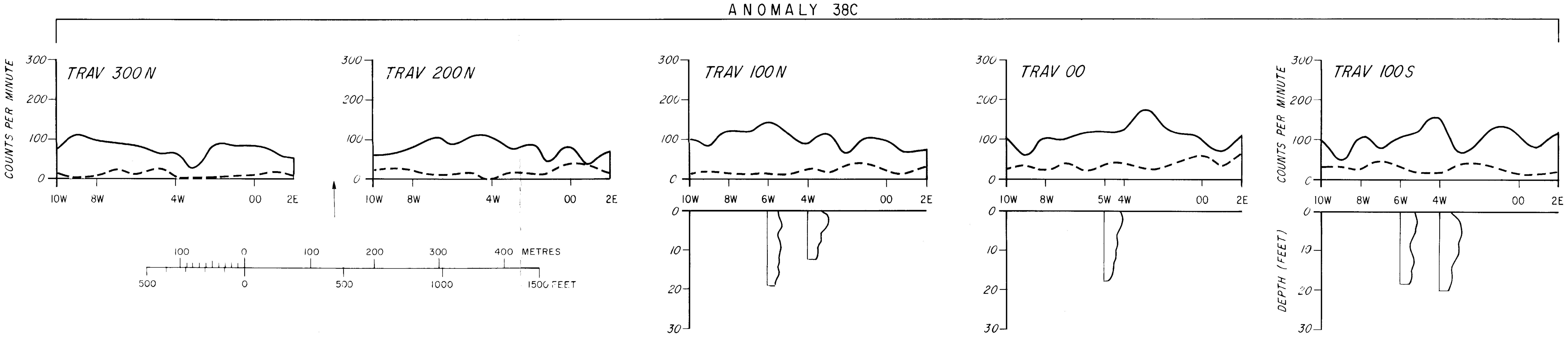


ANOMALY 36

PLATE 9

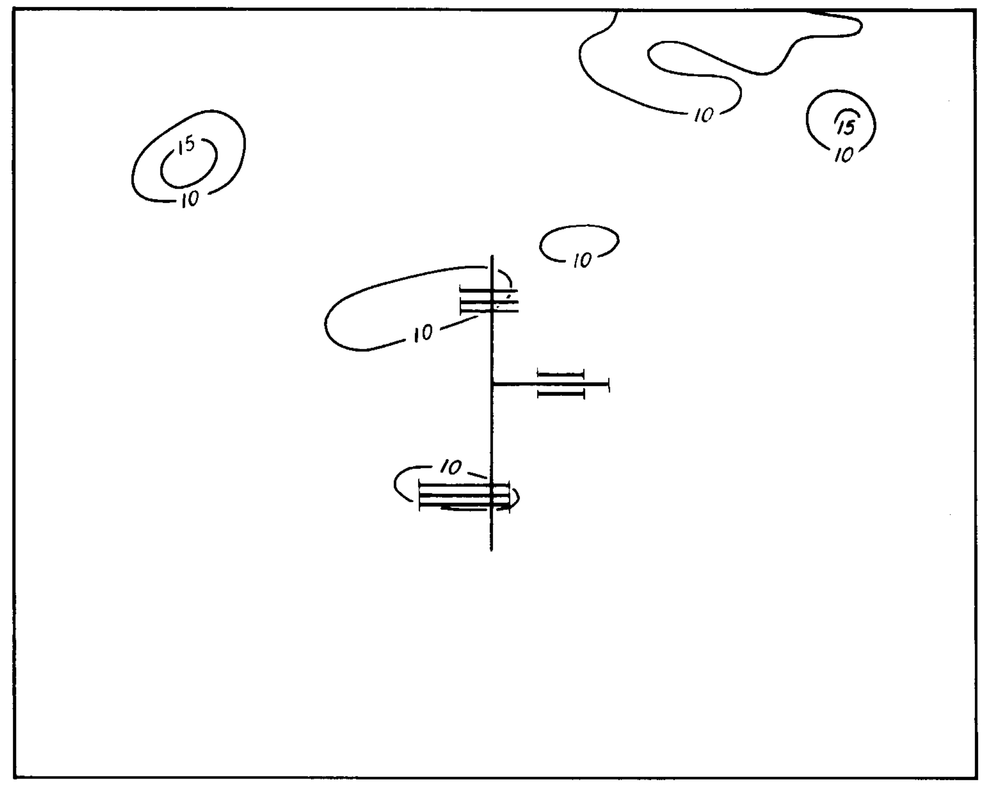
TV-5 RADIOMETRIC PROFILES





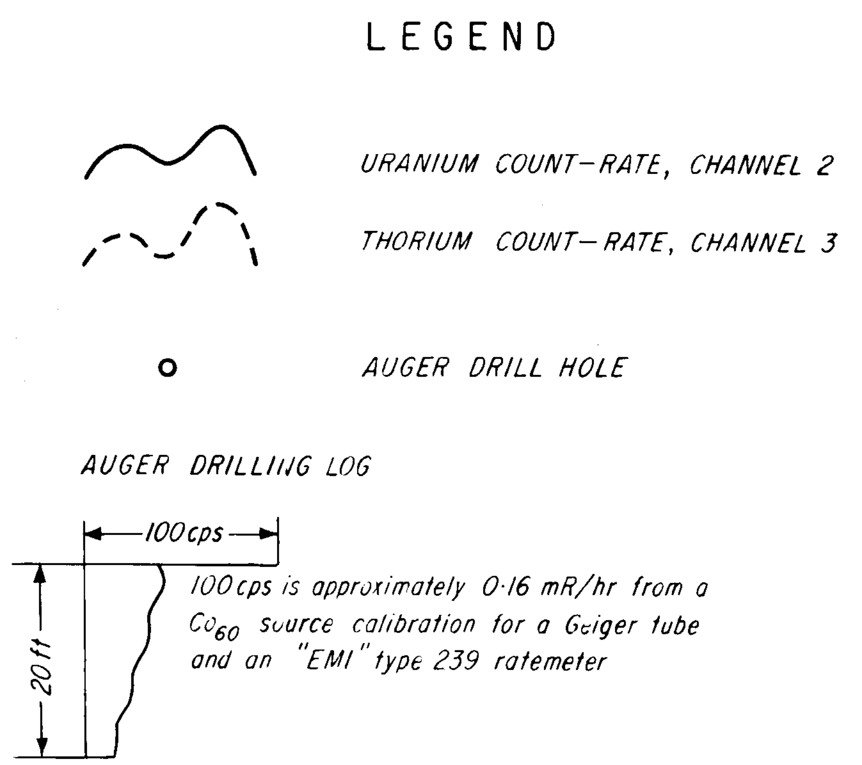
AIRBORNE RESULTS

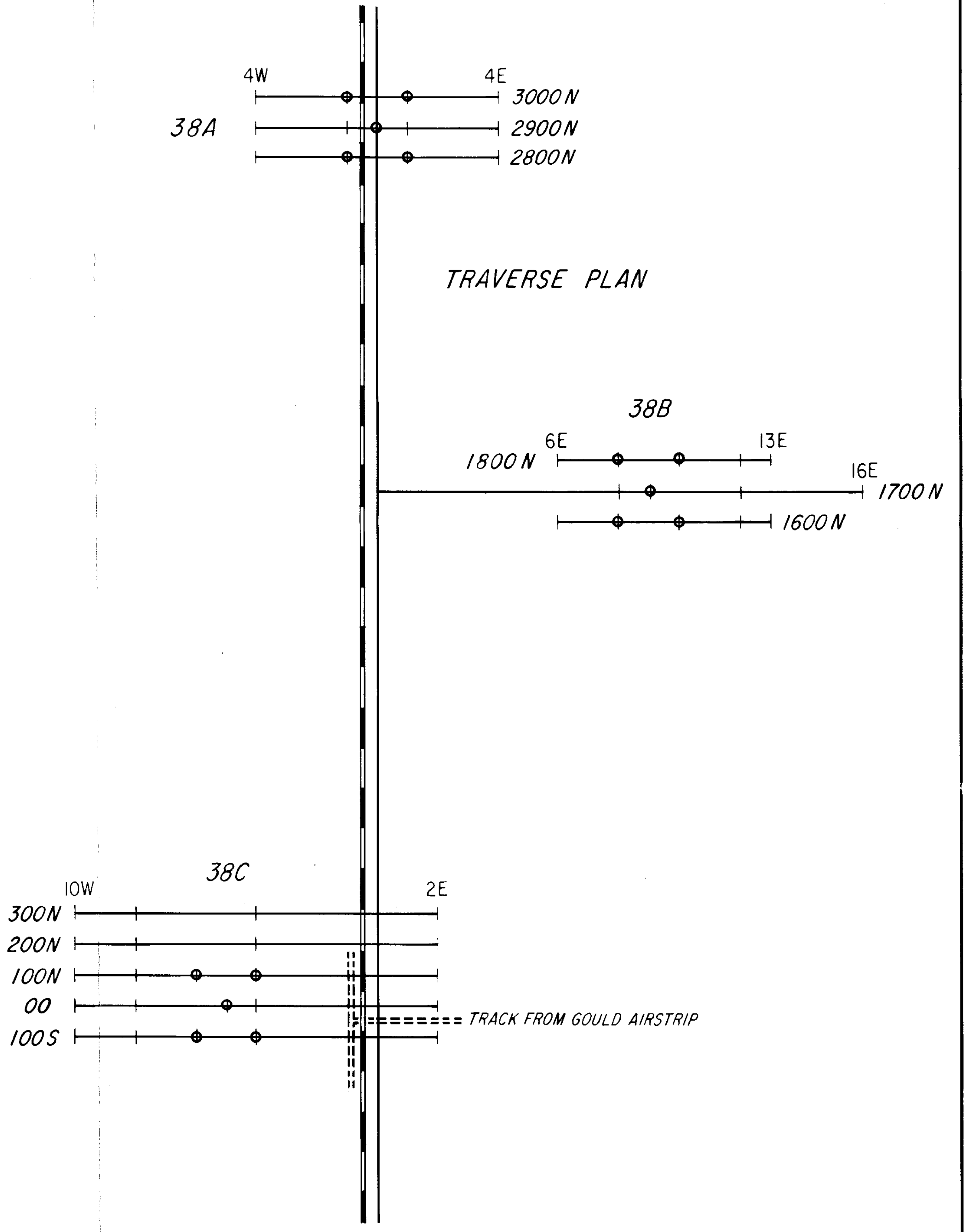
CHANNEL 3 (URANIUM) CONTOURS



CHANNEL 4 (THORIUM) CONTOURS

CONTOUR INTERVAL = 5cps





Record No. 1974/62

D52/B7-615

PLATE 10

TV-5 RADIOMETRIC PROFILES

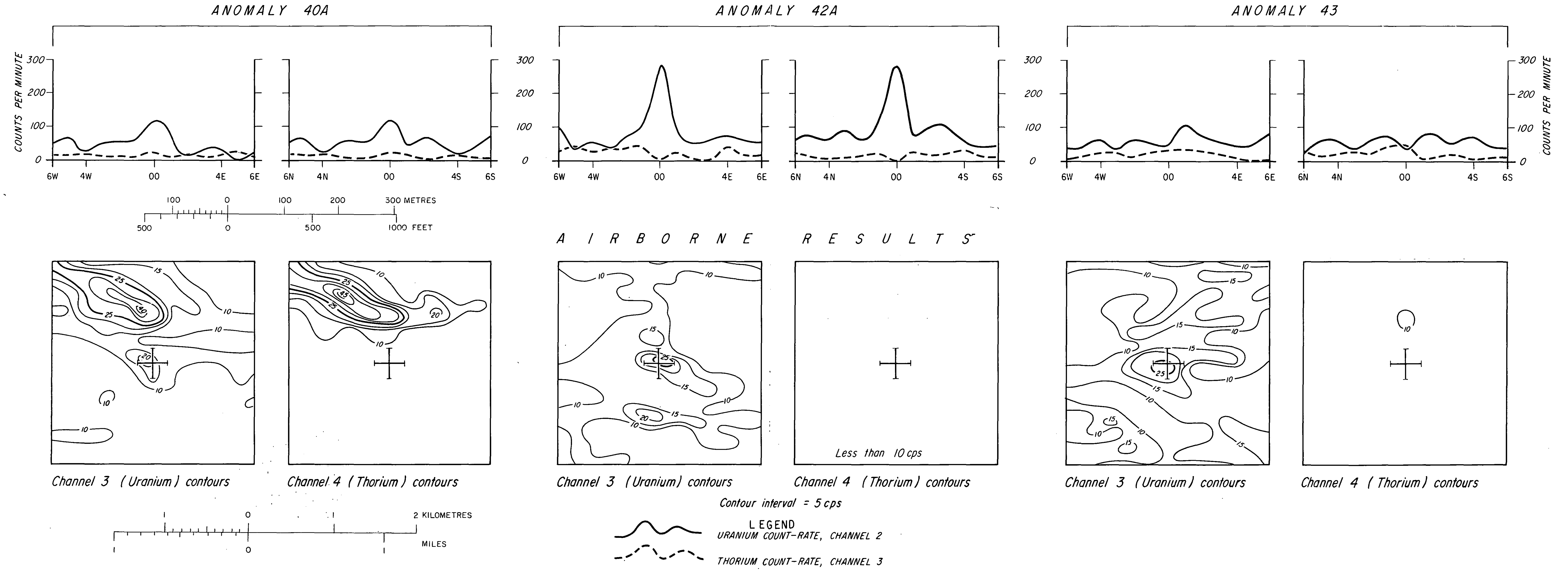
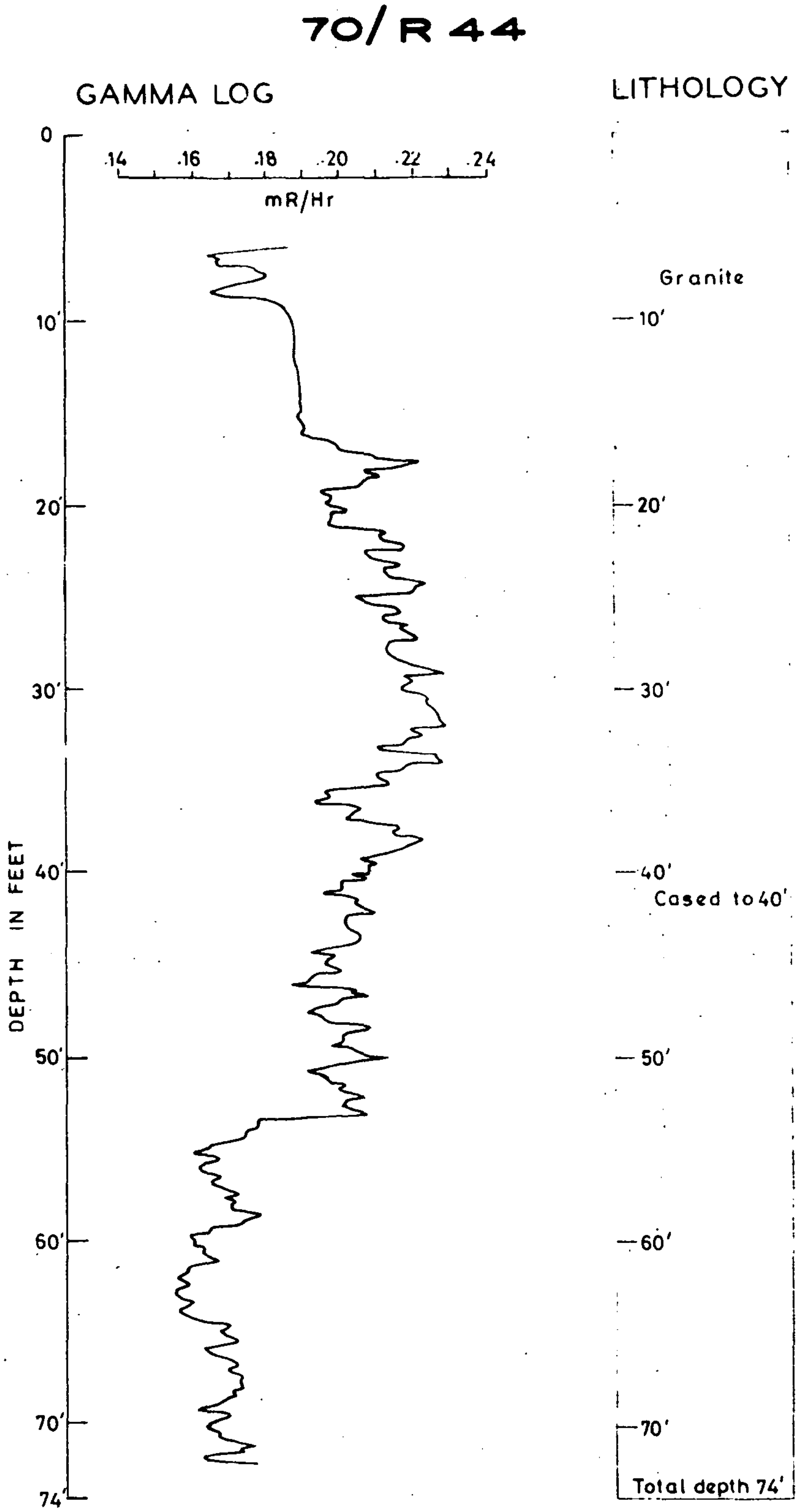


PLATE 11



DRILLING RESULTS

ANOMALY 16

R.P.D. 70/R44

RUM JUNGLE DISTRICT N.T.

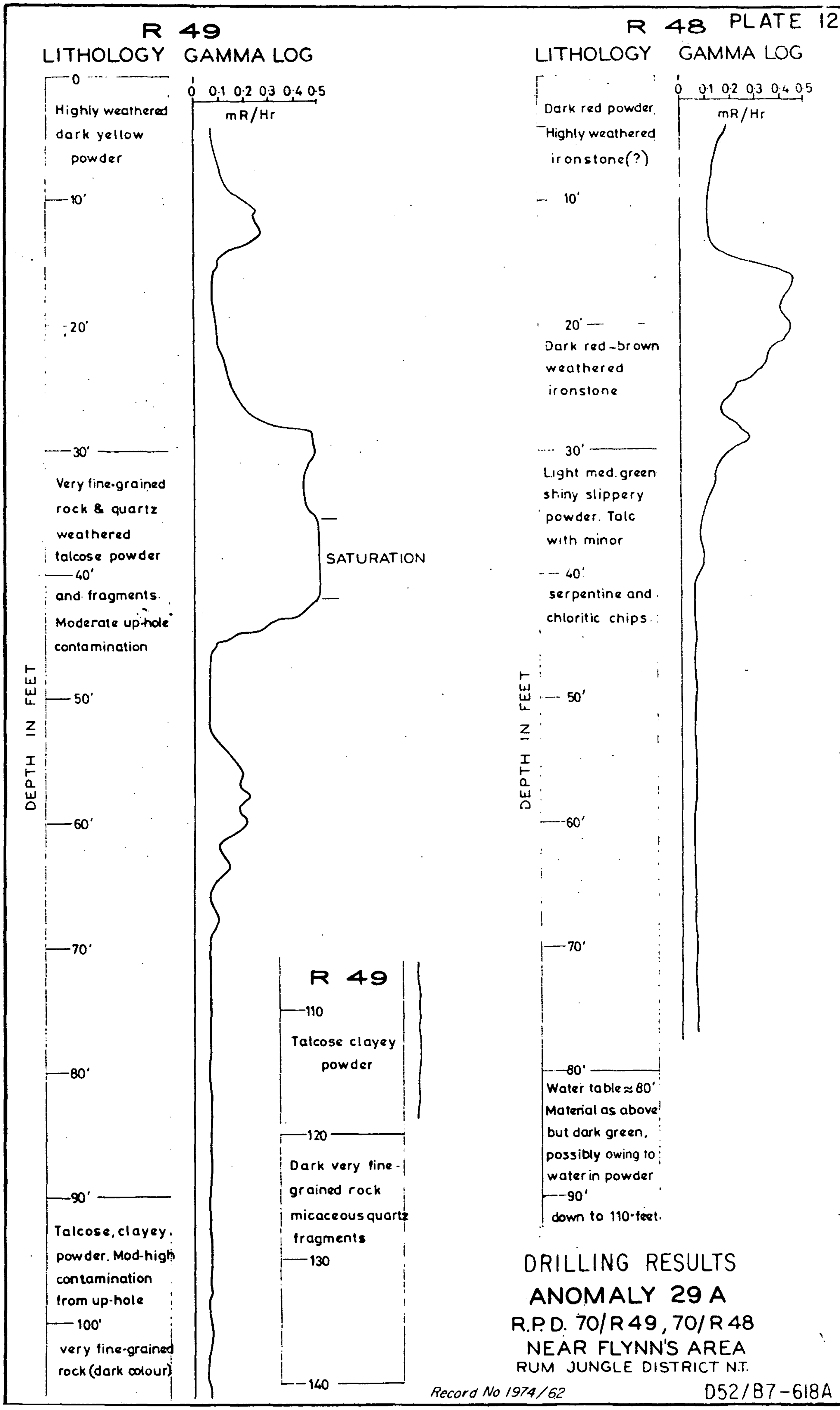


PLATE 12

DRILLING RESULTS
ANOMALY 29 A
R.P.D. 70/R49, 70/R48
NEAR FLYNN'S AREA
RUM JUNGLE DISTRICT N.T.

Record No 1974/62

D52/B7-618A