

1972/28

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF
NATIONAL DEVELOPMENT
**BUREAU OF MINERAL
RESOURCES, GEOLOGY
AND GEOPHYSICS**



Record 1972/28



**ORMOND RIVER AREA (KAKAKAKA PROSPECT)
GEOPHYSICAL SURVEY, PAPUA 1970**

by

P.J. Gillespie and P.C. Pollard

The information contained in this report has been obtained by the Department of National Development as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology & Geophysics.

**BMR
Record
1972/28
c.4**

Record 1972/28

**ORMOND RIVER AREA (KAKAKAKA PROSPECT)
GEOPHYSICAL SURVEY, PAPUA 1970**

by

P.J. Gillespie and P.C. Pollard

CONTENTS

	<u>Page</u>
SUMMARY	
1. INTRODUCTION	1
2. GEOLOGY AND GEOCHEMISTRY	1
3. METHODS	2
4. RADIOMETRIC RESULTS	2
5. SELF-POTENTIAL RESULTS	2
6. ELECTROMAGNETIC RESULTS	3
7. MAGNETIC RESULTS	4
8. INDUCED POLARIZATION RESULTS	5
9. CONCLUSIONS	6
10. REFERENCES	7

ILLUSTRATIONS

- Plate 1. Locality map, traverse plan, and geochemical anomalies.
- Plate 2. Contours of self-potential and vertical magnetic intensity.
- Plate 3. Contours of Turam reduced ratio and VLF filtered values.
- Plate 4. Magnetic, Turam and VLF results - Traverses 400 E , 440 E.
- Plate 5. Magnetic, Turam, VLF, IP and drilling results - Traverses 320 E, 640 E.
- Plate 6. Magnetic, Turam, VLF, IP, and drilling results - Traverse 520 E.
- Plate 7. Magnetic, Turam, VLF, IP, and drilling results - Traverse 1 040 E.

SUMMARY

A geophysical survey using magnetic, electromagnetic (VIF and Turam), S-P, IP, and radiometric methods was made at the Kakakaka prospect in the Ormond River area over geochemical anomalies located by A.O.G. Minerals Pty Ltd. The survey was made to test geophysical exploration methods in the area. Electromagnetic and IP methods were found to be the most suitable. S-P and radiometric results showed no significant anomalies, and the magnetic results were complicated by irregular anomalies arising from the underlying basic igneous rocks.

The main conductivity anomalies were associated with near-surface or outcropping ironstone. Some small anomalies not directly attributable to the ironstone were located.

1. INTRODUCTION

A geophysical survey was made by the Bureau of Mineral Resources (BMR) at the Kakakaka prospect in the Ormond River area, Papua. The prospect is within Authority to Prospect PA34 held by A.O.G. Minerals Pty Ltd. The locality is shown in Plate 1. Access to the prospect, which is in the rugged foothills of the Owen Stanley Ranges, was by four-wheel-drive vehicle from Port Moresby. The road from Port Moresby was negotiable only in dry weather.

The geophysical party consisted of J.E.F. Gardner (Party Leader) and P.C. Pollard and P.J. Gillespie (geophysicists). The survey took place between 9 July and 15 August 1970. The traverses were cleared, surveyed, and pegged by Territory Electronic Surveys Pty Ltd, Port Moresby, under contract to A.O.G. Minerals Pty Ltd.

The purpose of the survey was to determine the suitability of various metalliferous geophysical methods in the local environment.

2. GEOLOGY AND GEOCHEMISTRY

The geology of the area has been described by Berkman, (1969, 1970) and the following remarks are based on his reports. The geology is similar to that of the Astrolabe Mineral Field as described by Yates & de Ferranti (1967).

The Kakakaka prospect lies on the contact between Sadowa Gabbro and a Tertiary argillite series. The Sadowa Gabbro is a group of basaltic and doleritic intrusives with some gabbroic phases. The argillite is highly sheared and forms a roof pendant in the Sadowa Gabbro. In the prospect, the outcrop is a ridge of hematitic rock (ironstone) with occasional traces of malachite in the joints and fractures of the ironstone. An indication of the size and distribution of the ironstone bodies is given by the approximate limit of ironstone outcrop and float shown in Plate 1.

The important copper mineralization of the Astrolabe region occurs in the shale and siltstone of the Port Moresby Beds, also a Tertiary argillite series, the major ore minerals being deposited by colloidal precipitation. Tuffs are reported as being commonly present in the sedimentary sequences adjacent to the orebodies (Yates & de Ferranti, 1967). The geological setting of the sulphides at Kakakaka is similar to that of the sulphides in the Astrolabe Mineral Field, where the sulphides are in shale and siltstone beds close to a contact with dolerite. A petrological examination of the Kakakaka diamond-drill cores indicates that the copper mineralization here is also of chemical-sedimentary origin and ultrabasic tuffs are also present in the drill holes. Drilling results are shown in Plates 5, 6, and 7.

Detailed geological mapping, costeaning, and geochemical exploration carried out in 1969 by A.O.G. Minerals Pty Ltd established the presence of three zones of anomalous copper values associated with hematitic ironstone outcrop trending east and dipping south. The results of the geochemical auger sampling are shown in Plate 1.

The geophysical survey was planned to cover the areas of anomalous copper values.

3. METHODS

The geophysical grid (Plate 1) consisted of 27 traverses 300 m long, and 4 traverses 1 000 m long. The traverses were 40 m apart and were pegged at 20-m intervals. The 1 000-m traverses were situated over the four proposed diamond-drill sites so that induced polarization (IP) surveys could be made over the drilling targets.

Methods used were self-potential (S-P), radiometric, magnetic, electromagnetic (VLF and TURAM), and IP. Readings were taken at all assessible points on the surveyed grid. The southern ends of traverses 800 E to 1 080 E were on a cliff face with slopes of greater than 35° and readings on these were not attempted. Traverses 0 to 440 E were limited at either one end or both ends by the Ormond River.

4. RADIOMETRIC RESULTS

Readings were taken using an AAEC portable ratemeter Type 239 coupled to a scintillometer detector. The results showed that the general level of radioactivity was very low. No significant anomalies were detected.

5. SELF-POTENTIAL RESULTS

All accessible stations were read using a Sharpe VP6 voltmeter. The contoured results (Plate 2) show no anomalies of interest. There is a gradual decrease in potential of about 60 mV from west to east across the grid.

6. ELECTROMAGNETIC RESULTS

VLF readings with North West Cape (NWC) as the transmitter (22.3 kHz) were taken using a Ronka EM16 instrument, and Turam readings (660 Hz) were taken using ABEM Turam 2S equipment.

Because of the meandering of the Ormond River, the steep topography, and dense undergrowth it was impracticable to use a loop for the Turam primary field and as an alternative a grounded cable placed along 420 N was used. Turam reduction tables were produced by modifying computer program TURAMBUK (Williams, 1969) so that only the field due to a line segment of current was considered.

Contours of Turam reduced ratio are shown in Plate 3. Profiles showing the major VLF and Turam anomalies are given in Plates 4 to 7 together with results from other methods.

The VLF results were filtered using the method described by Fraser (1969) and contours of the filtered values are shown in Plate 3. The filtering process uses a difference operator which transforms the points of inflexion into peaks. The difference operator also attenuates features of very small or large wavelength, and thus the contours of the filtered results indicate the conductor pattern with a reduced interference from noise and topographical effects.

Good correspondence between the Turam reduced ratio maxima and VLF inflexion points is evident from both the profiles and the contour plans, with two exceptions. The major exception is the Turam anomaly centred near 300 N on 640 E which has no corresponding VLF anomaly (Plate 5). This may be due to a source lying below the limit of depth penetration of the VLF method. From IP results (section 8) the apparent resistivity of the near-surface region is of the order of 100 ohm-m. This would imply a skin depth of about 35 m for electromagnetic waves of vertical incidence. A second exception is the large VLF anomaly which extends from 140 N to 170 N across traverses 600 E and 640 E. This has associated with it only a small Turam reduced-ratio anomaly centred at 170 N on 640 E. The anomaly is more noticeable on the profile (Plate 5) than on the contour plan since the major portion of the anomaly lies below the 1.0 level.

The VLF filtered results show three main positive features. One trends westerly along the main ridge from 560 E to 0 and coincides with the region of hematitic outcrop and geochemical anomaly. Another trends westerly from 760 E to 360 E and corresponds to the axis of the spur. The third positive feature (which could not be completely delineated because of the risk involved in attempting readings on the cliff face) corresponds to the ridge above the river and extends westerly from 1 080 E to 840 E. The axes of the ridges are shown on the contour plan. These axes also mark the line of the ironstone body. That the VLF anomalies are not solely a result of topography, but have a significant contribution from a conductivity anomaly, is demonstrated by the correspondence between the general trends of the VLF anomalies and the topographically independent Turam anomalies. This is indicated on the profiles (Plates 4, 5, 7) and the contour plans (Plate 3). Calculations indicate that the most severe topographic displacement of the Turam staffs relative to each other and to the primary field cable produced only an error of the order of two percent in the reduced ratios. Thus the Turam results indicate the areas of anomalous conductivity without significant topographic interference.

Two features of interest are the small highs in VLF filtered values across traverses 400 E and 440 E and across traverses 120 E and 200 E. Both are associated with well defined Turam anomalies.

The Turam reduced ratio anomalies are all weak - the largest is of the order of 1.2. The main Turam anomalies are at 240 N on 1 040 E, 80 N on 440 E, 180 N and 280 N on 1 200 E, and 280 N on 640 E. This last anomaly was not completely defined because of the proximity of the primary cable and because the anomaly extended out of the surveyed grid.

Most of the electromagnetic anomalies appear to be a result of the near-surface or outcropping ironstone body - the dispersion of a large hematite and smaller magnetite content in the body is responsible for the anomalous conductivity.

7. MAGNETIC RESULTS

Readings of vertical magnetic intensity were taken at all accessible stations using a McPhar M700 fluxgate magnetometer. The reading accuracy of the instrument was about 10 gammas.

All the magnetic profiles show irregular short-wavelength (approximately 60 m) anomalies with an amplitude of several hundred gammas. In addition occasional sharp anomalies of much larger amplitude such as the one at 240 N on 520 E (Plate 6), were observed.

A magnetic intensity contour map is shown in Plate 2. The contours were drawn at 500-gamma intervals. This value was chosen so that the contour interval was greater than the amplitude of the short-wavelength anomalies. These anomalies are attributed to the presence of weakly magnetic dolerite underlying the roof pendant.

The sharp anomalies of several thousand gammas are due to magnetite in the outcropping ironstone. Specimens collected from the outcrop on 520 E had a high magnetite content and gave a crushed volume susceptibility of $41\,000 \times 10^{-6}$ cgs units using a Sharpe SM4 susceptibility meter.

Apart from the abrupt anomalies associated with the outcropping ironstone no other anomalies were discernible above the noise level produced by the underlying dolerite.

Magnetite is reported to be associated with the copper deposits of the Astrolabe Mineral Field and is considered to have been introduced by metasomatic solutions related to the Sadowa Gabbro (Pontifex, 1965). It is thus theoretically possible that magnetic anomalies could be used to locate the copper orebodies. However, in practice the presence of magnetite in the basic igneous rocks produces an irregular background reading which tends to obscure any anomaly associated with a copper orebody.

8. INDUCED POLARIZATION RESULTS

Using McPhar frequency-domain IP equipment, IP readings were taken at 5 and 0.3 Hz with a dipole-dipole electrode configuration and 40-m dipoles. IP results on the long traverses 520 E and 1 040 E are shown in Plates 6 and 7. The IP survey on traverse 320 E (Plate 5) was limited by the presence of the Ormond River.

There is a weak IP anomaly at 220 N on 1 040 E with apparent resistivities of 130 ohm-m and frequency effects of 6 percent. Well defined Turam and VLF anomalies at 240 N appear to be associated with a near-surface expression of this anomaly. Two other near-surface resistivity lows with associated frequency effects of 5 and 3.5 percent occur at 300 N and 380 N; however, these have no associated VLF anomalies.

Another weak IP anomaly is centred at about 140 N on traverse 520 E. This has a resistivity of 70 ohm-m and a frequency effect of 6 percent. The diamond-drill hole KA5, which intersected 76 mm of massive sulphides at 24.2 m, passes over the top of the source of this anomaly. The VLF and magnetic results show strong anomalies further north over the ironstone outcrop at 240 N, but only minor effects that might be associated with the IP anomaly.

Also on this traverse is a resistivity anomaly, with slight increase in frequency effect, at about 480 N.

Because of the presence of the Ormond River insufficient data were obtained on 320 E to allow comparison with the drilling results; however, no IP anomalies are evident.

9. CONCLUSIONS

Almost all the conductivity anomalies are associated with the near-surface or outcropping ironstone. The anomalous conductivity would result from the dispersion of hematite and magnetite in the ironstone. The ironstone also contains manganese oxides, which can be conductive. The only significant anomalies which are not directly attributable to the ironstone are:

- (1) The well defined Turam and VLF anomalies at 240 N on 1 040 E which lie outside the area of ironstone outcrop and float. A weak frequency effect IP anomaly appears to be associated with these electromagnetic anomalies.
- (2) The deep IP anomaly at 140 N on 520 E. This has little, if any, expression in the electromagnetic or magnetic results.
- (3) The near-surface resistivity anomaly at 480 N on 520 E.
- (4) The Turam and VLF anomalies that extend from 60 N to 80 N across traverses 400 E and 440 E.

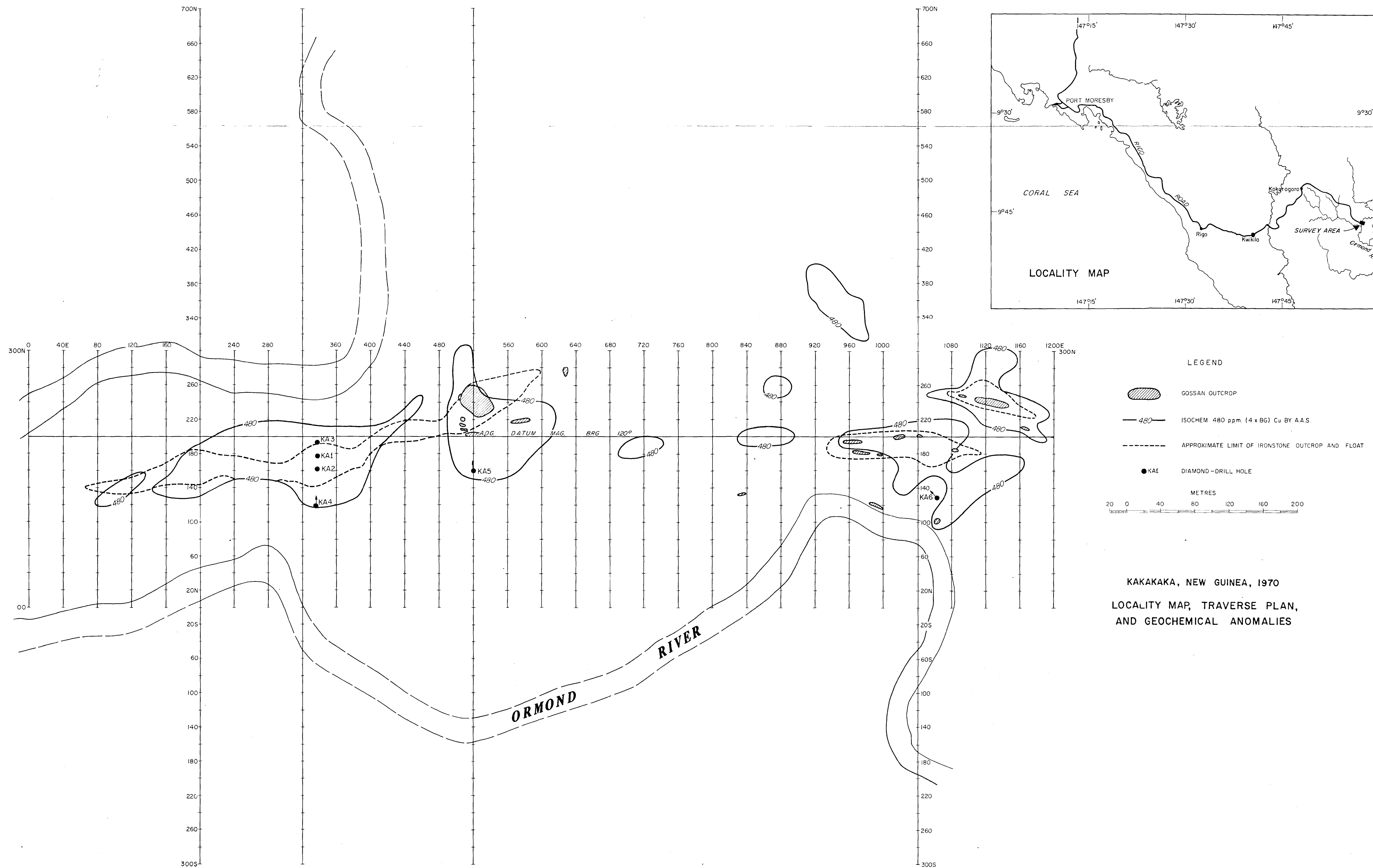
Of the methods used, the electromagnetic and IP methods seem most suitable for exploration. The electromagnetic methods were responsive to the conductive ironstone. There was good agreement between the Turam and VLF results and the results of both methods were not seriously affected by the steep topography.

The S-P and radiometric profiles showed no significant anomalies.

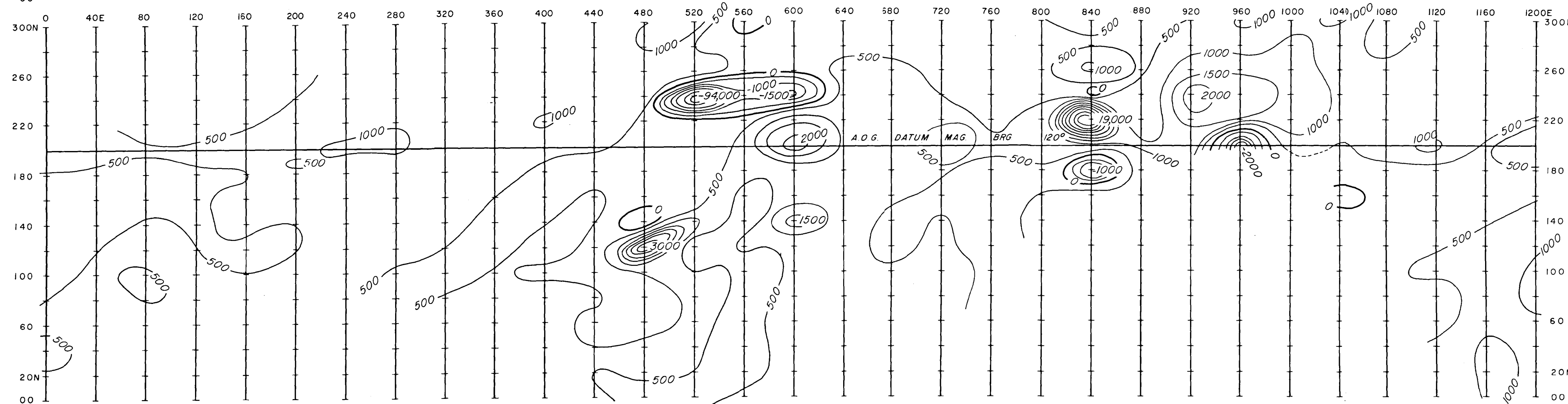
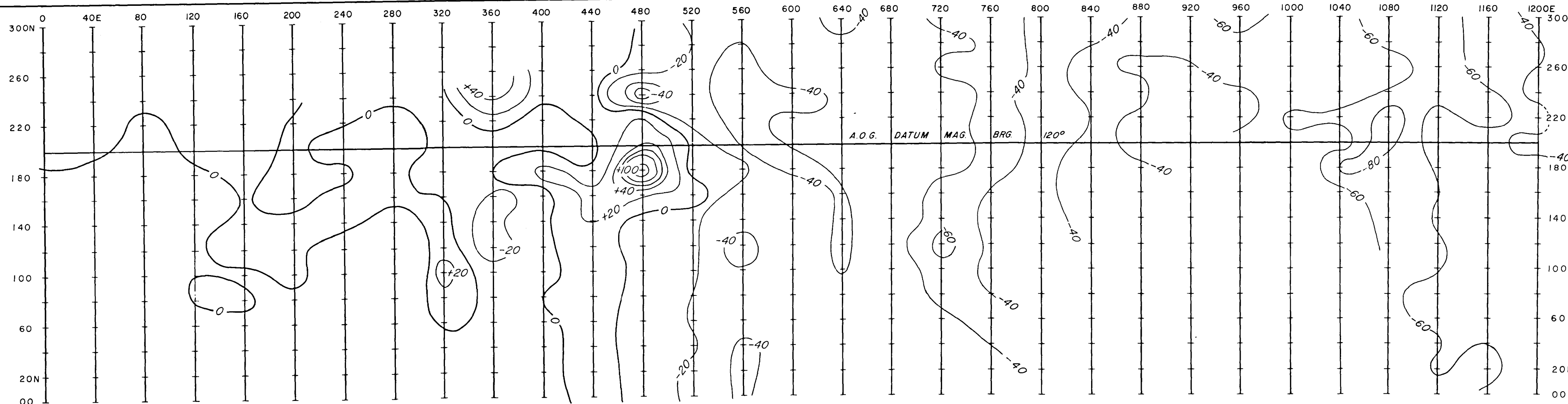
Magnetic intensity readings would seem unsuitable for exploration in the region because of the high noise level caused by the underlying basic igneous rocks. This noise masks any anomalies which may be associated with a copper-magnetite orebody.

10. REFERENCES

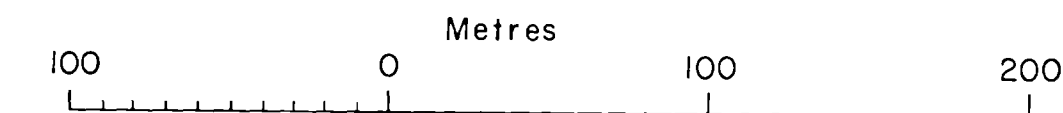
- BERKMAN, D.A., 1969, 1970 - Reports on exploration progress in PA34 (Papua). A.O.G. Minerals Pty Ltd.
- FRASER, D.C., 1969 - Contouring of VLF-EM data. Geophysics, 34(6), p.958-967.
- PONTIFEX, I.R., 1965 - Mineralogical investigation of ore specimens from the Astrolabe Mineral Field, Papua. Bur. Miner. Resour. Aust. Rec. 1965/132 (unpubl.)
- WILLIAMS, J.P., 1969 - Computer programs for Turam ratios and data reductions. Bur. Miner. Resour. Aust. Rec. 1969/49 (unpubl.)
- YATES, K.R., & DE FERRANTI, R.Z., 1967 - Geology and mineral deposits of Port Moresby/Kemp Welch area, Papua. Bur. Miner. Resour. Aust. Rep. 105.

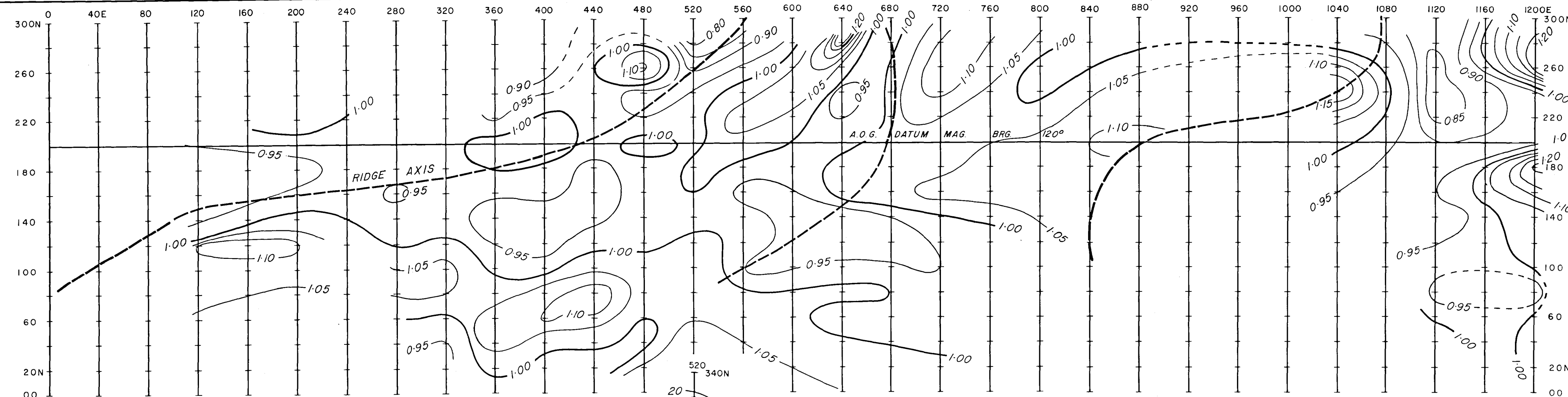


KAKAKAKA, NEW GUINEA, 1970
LOCALITY MAP, TRAVERSE PLAN,
AND GEOCHEMICAL ANOMALIES

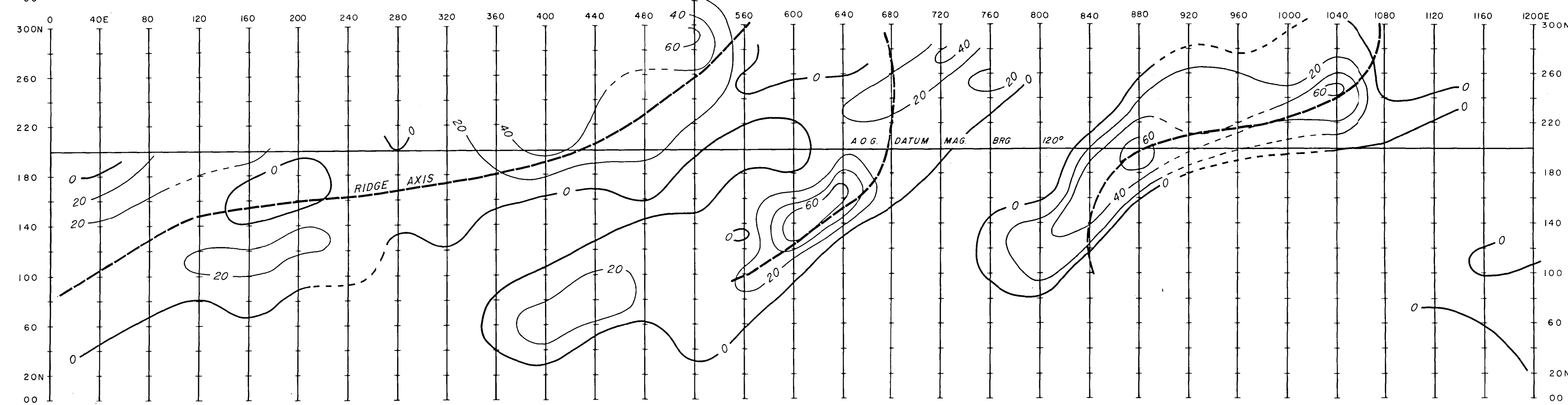


CONTOURS OF SELF-POTENTIAL
AND VERTICAL MAGNETIC INTENSITY





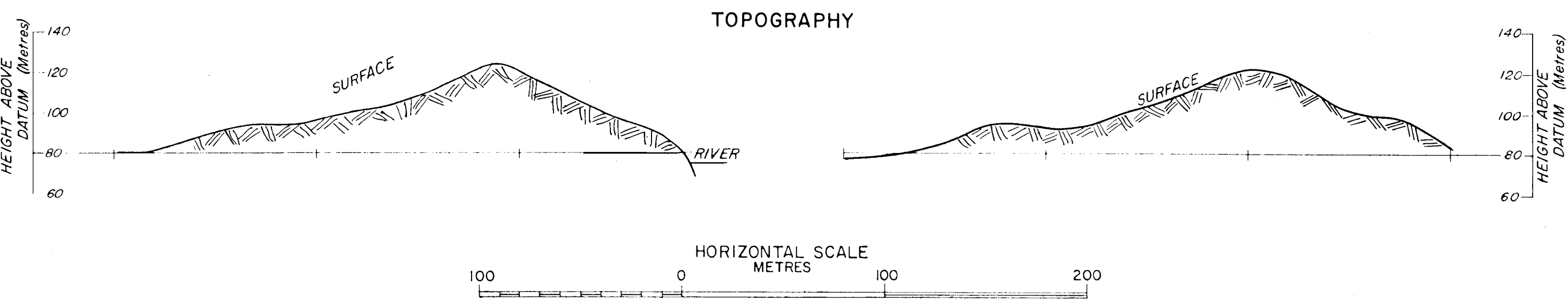
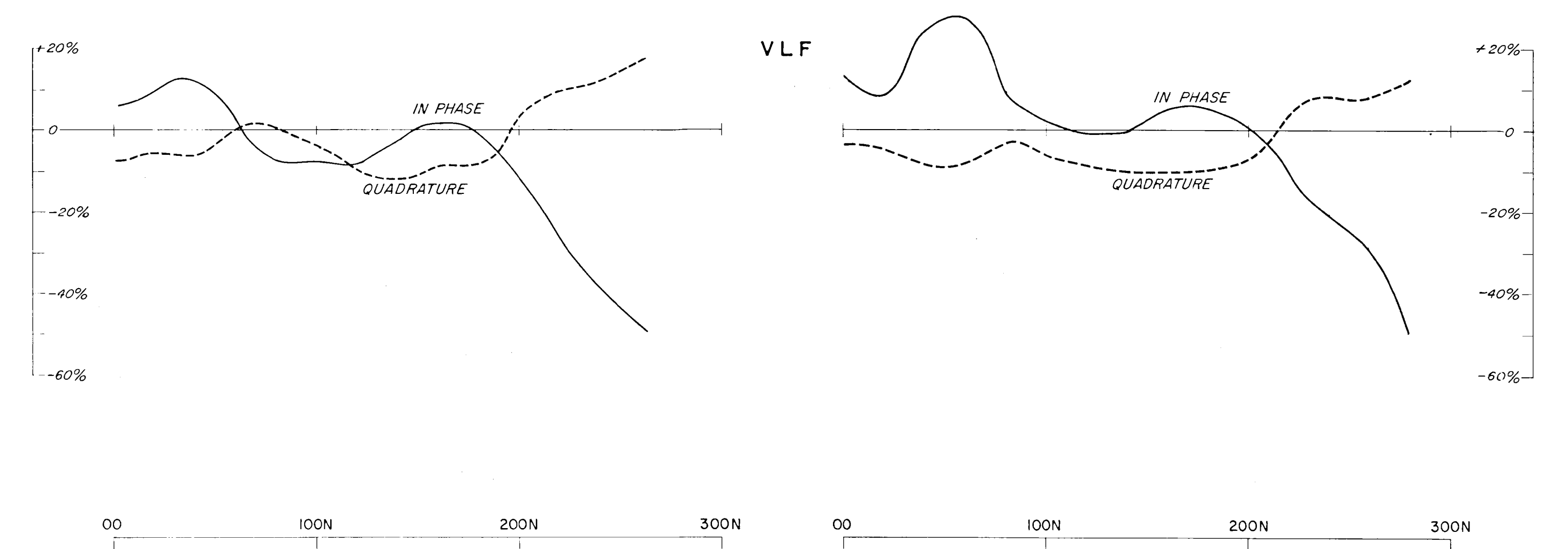
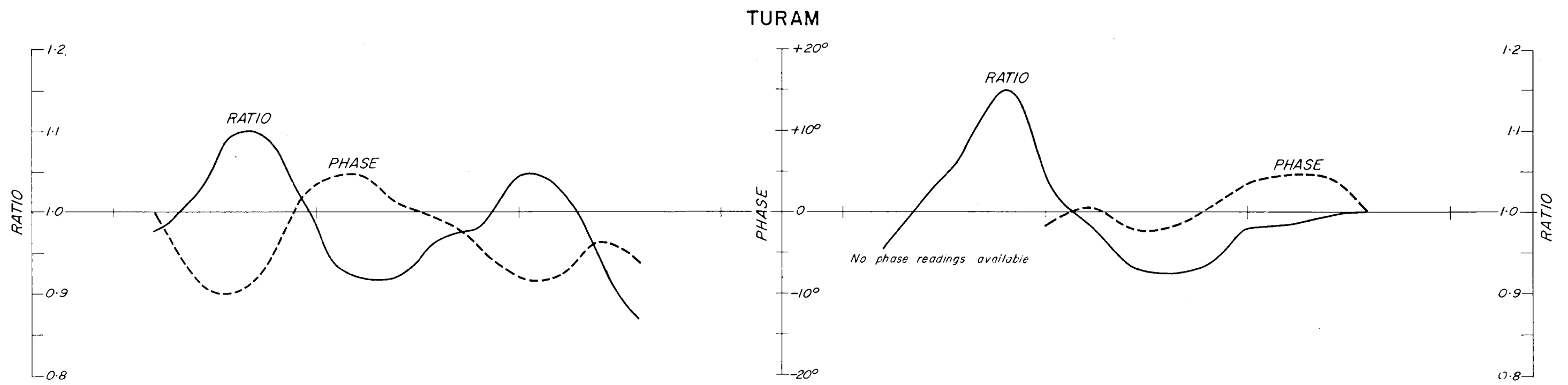
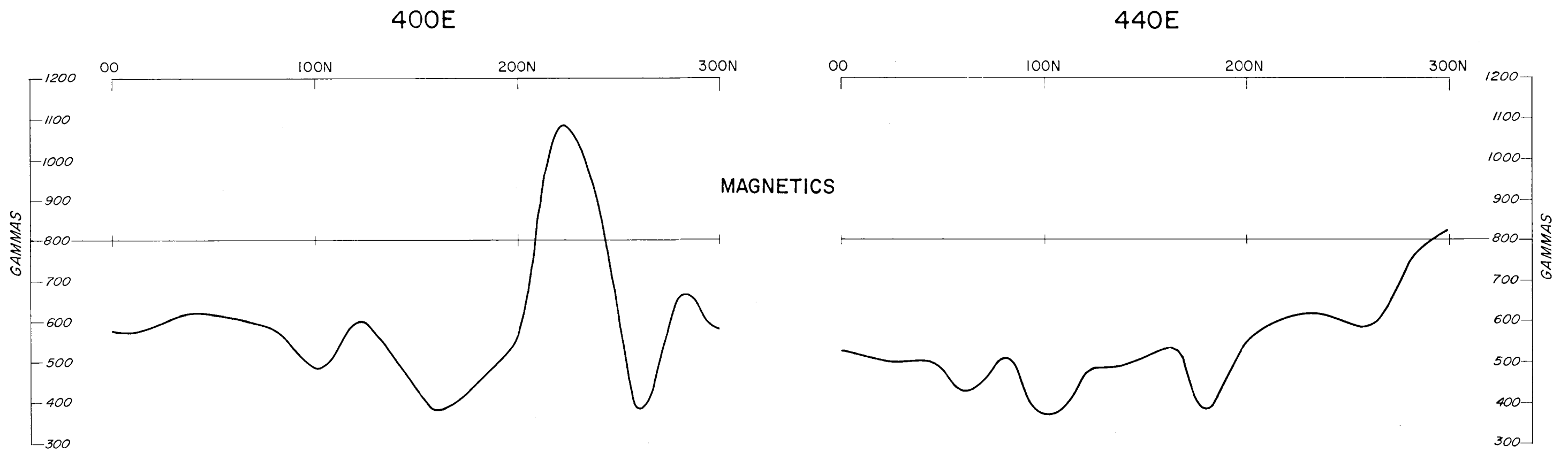
TURAM REDUCED RATIO
(Contour interval 0.05)



VLF FILTERED DATA
(Contour interval 20)

CONTOURS OF TURAM REDUCED RATIO
AND VLF FILTERED DATA

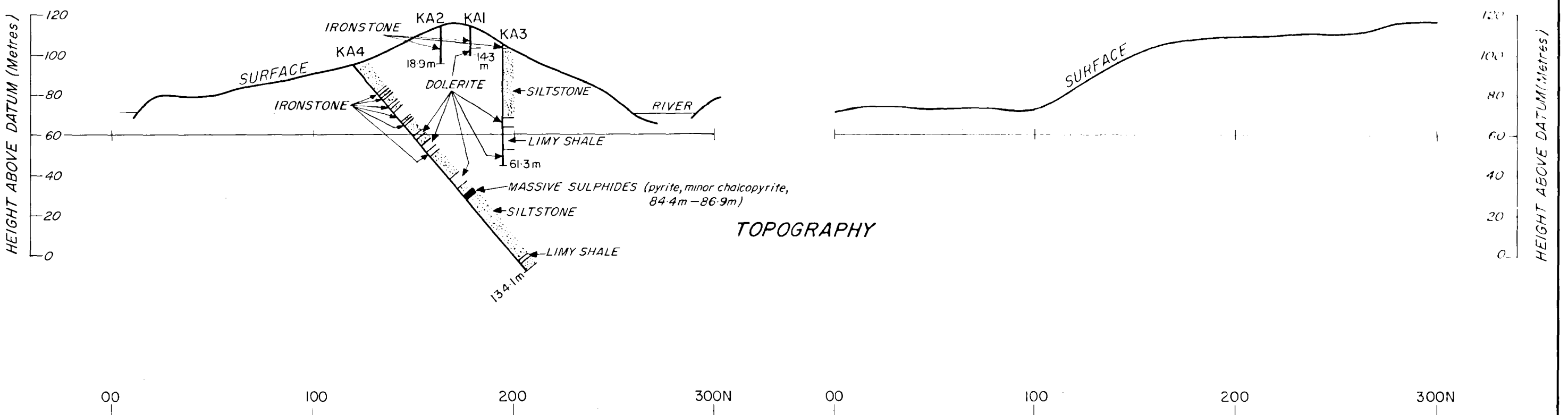
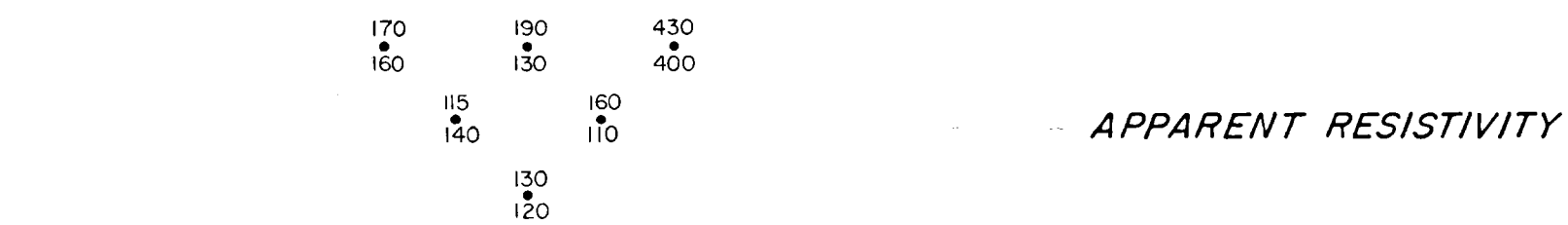
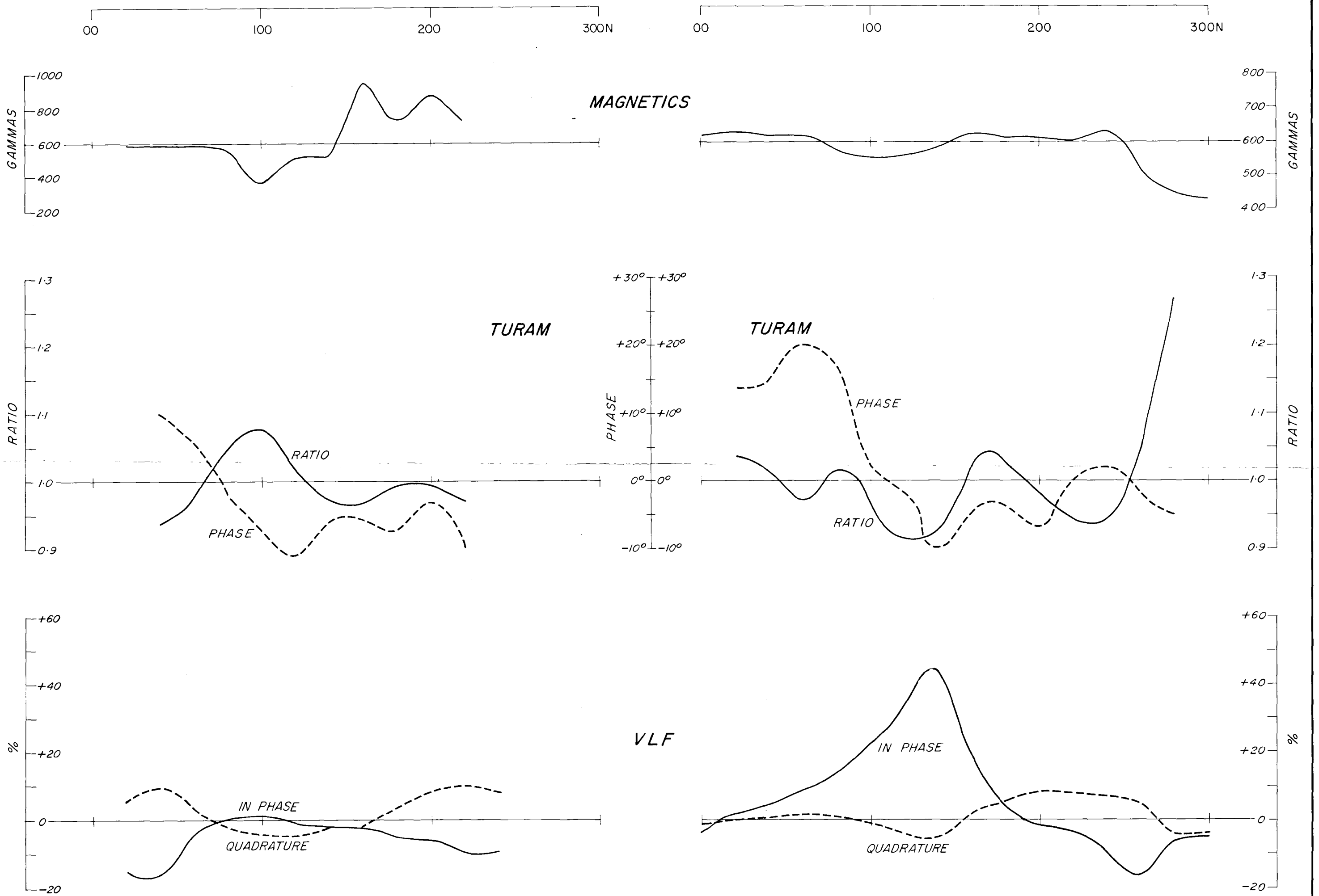




TRAVERSES 400E AND 440E
MAGNETIC TURAM, VLF,
AND DRILLING RESULTS

320E

640E



TRAVERSES 320E AND 640E
MAGNETIC TURAM, VLF, IP,
AND DRILLING RESULTS

