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# 29. *Report on Geomagnetic Survey in the Northwestern Pacific during JEDS-VI, JEDS-VII and JEDS-VIII Cruises.*

By Seiya UYEDA,
Earthquake Research Institute;

Takahiro SATO,
Hydrographic Department, Marine Safety Agency;

Masashi YASUI,
Japan Meteorological Agency;

Takeo YABU, Teruhiko WATANABE, Kaoru KAWADA
and Yukio HAGIWARA,

Earthquake Research Institute.

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## Summary

Geomagnetic total force was measured by a towed proton precession magnetometer in the north-western Pacific (142°E—160°E, 40°N—44°N) during the cruises of M/S "Ryofu Maru" and M/S "Takuyo" in JEDS (Japanese Expedion of Deep Seas) VI, VII (1963) and VIII (1964). Together with the data obtained in a previous cruise in JEDS IV (1961) and the data by "Spencer F. Baird" of the Scripps Institution of Oceanography during the Japanyon Expedition (1961), a magnetic total force distribution chart in the area is tentatively obtained. Subtracting the regional trend, an anomaly chart is also drawn. The charts indicate that there are anomaly lineations in the NEE—SWW direction with an amplitude of several hundred gammas. The lineations are of a width of about 30 km, and are not apparently associated with the bottom topography. Four sea mounts were surveyed somewhat closely and the anomalies associated with them mapped.

## 1. Introduction

Earthquake Research Institute (ERI) has participated in the JEDS (Japanese Expedition of Deep Seas) VI and VII cruises in 1963 and

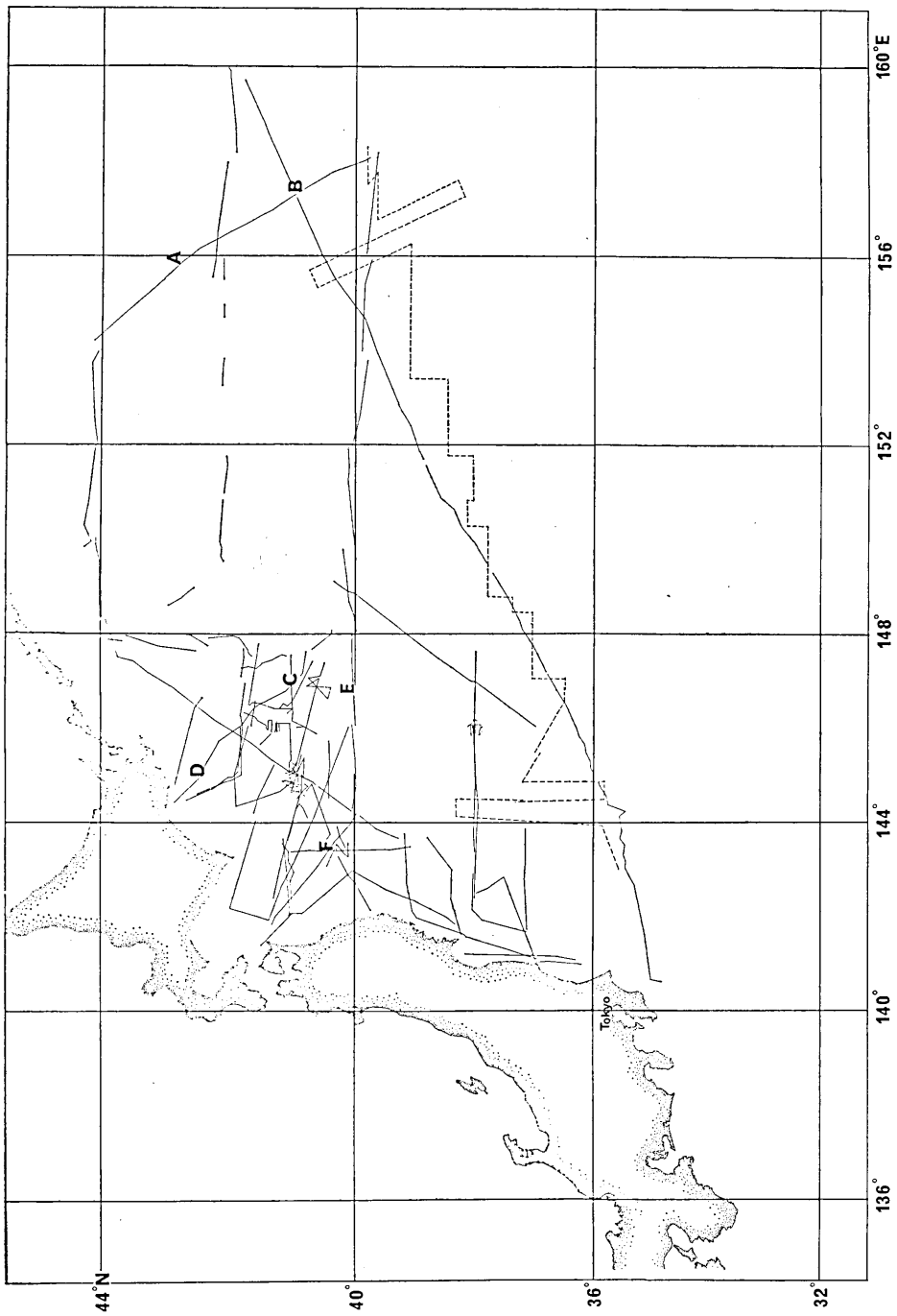


Fig. 1. Ship's tracks during JEDS IV, VI, VII and VIII cruises by "Ryofu-Maru" and "Takuyo" (Solid line) and that in Japanyon cruise (broken line) by "Spencer F. Baird".

JEDS VIII cruise in 1964, in cooperation with the Japan Meteorological Agency and Hydrographic Department. The ERI program was concerned with the oceanic heat flow and magnetic measurements. The present paper reports the result of the total magnetic force survey made during the above cruises in the northwestern Pacific off northeastern Honshu and Hokkaido. The JEDS VI and JEDS VIII cruises were on the M/S "Ryofu Maru" of the Japan Meteorological Agency and JEDS VII cruise was on the M/S "Takuyo" of the Hydrographic Department. The measurement of the total magnetic force was made by an automatic proton magnetometer. (Uyeda *et al.*, 1964). The area surveyed in these cruises covered mainly 40°N–44°N and 142°E–160°E. Shipborne magnetic survey in the area concerned was made previously by us in JEDS IV (Uyeda *et al.*, 1962) along the 38°N parallel and by the "Spencer F. Baird" of Scripps Institution of Oceanography (Japanyon Expedition, 1961) in the area 36°N–38°N, 144°E–150°E. The data of the latter survey was kindly given to the authors by the Scripps Institution. In the present paper, therefore, data from both surveys will be taken into account. Ship's tracks are shown in Fig. 1.

## 2. The Results of Measurement

The ship's position determined by either the Loran method or star

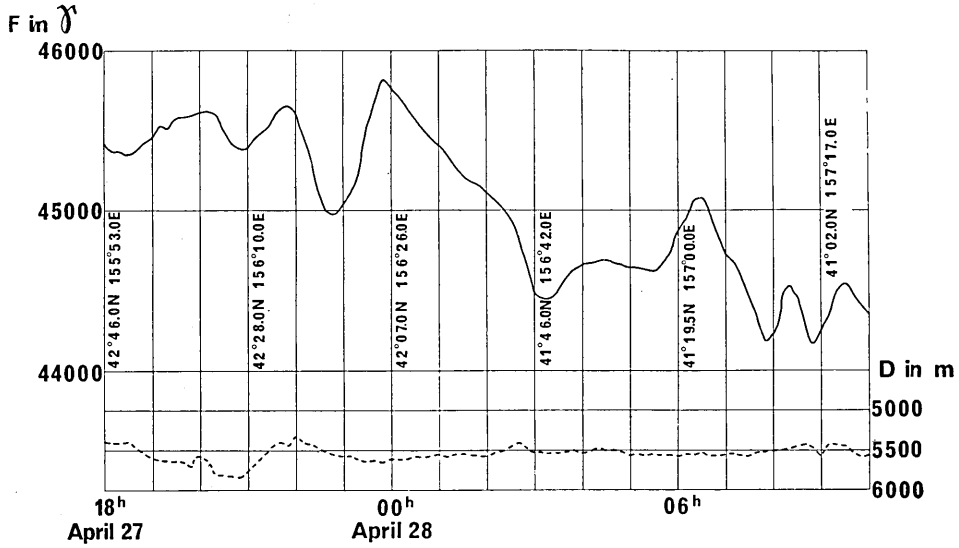


Fig. 2. Magnetic and topographic profiles along ship's track A—B in Fig. 1.

fixes, water depth, date and time, and the total magnetic force in gamma have been tabulated. Normal determination of position was made every one or two hours in JEDS VI, every half hour in JEDS VII and every three hours in JDS VIII cruises respectively. The echo depth was read every ten minutes from continuos records and corrected for sound velocity using BT records taken every two or three hours. Magnetic measurement was made every two minutes in JEDS VI, every $5/6 \times 2$ minutes in JEDS VII and every one minute in JEDS VIII. The magnetic data was printed in the precession cycle values at the time of measurement in JEDS VI and VII and converted into gamma values afterwards, while in JEDS VIII the data was printed in gamma values and recorded by an analogrecorder. A complete table and analogue plot of this data is too voluminous to be reproduced here, but is available from one of the authors (S. U).

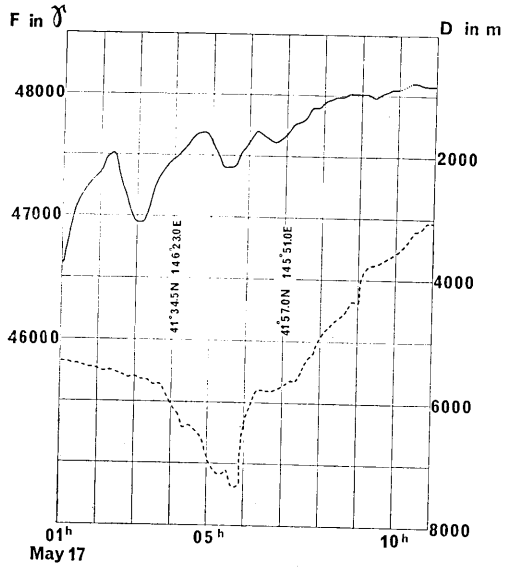


Fig. 3. Magnetic and topographic profiles along ship's track C–D in Fig. 1.

In this area, magnetic anomalies with an amplitude amounting to several hundred gammas are not uncommon, and there is no one-to-one correlation between magnetic profiles and bottom topography. Figs. 2, 3, and 4, are typical examples of the records, where the abcissa is the time which is approximately proportional to the linear distance. The magnetic features in Fig. 2, which are taken outside the Kurile Trench, are not apparently related to the bottom topography. Fig. 3 and Fig. 4 are the profiles crossing the trenches near the junction of the Kurile and Japan Trenches. In Fig. 3, a negative anomaly seems to exist just above the axis of the Kurile Trench whereas such an anomaly is absent in the case of Fig. 4 over the axis of the Japan Trench. It may be recalled that a previous crossing over the Japan Trench at 38°N parallel did not show a negative anomaly immediately on the Trench axis (Uyeda *et al.*, 1962). These facts may

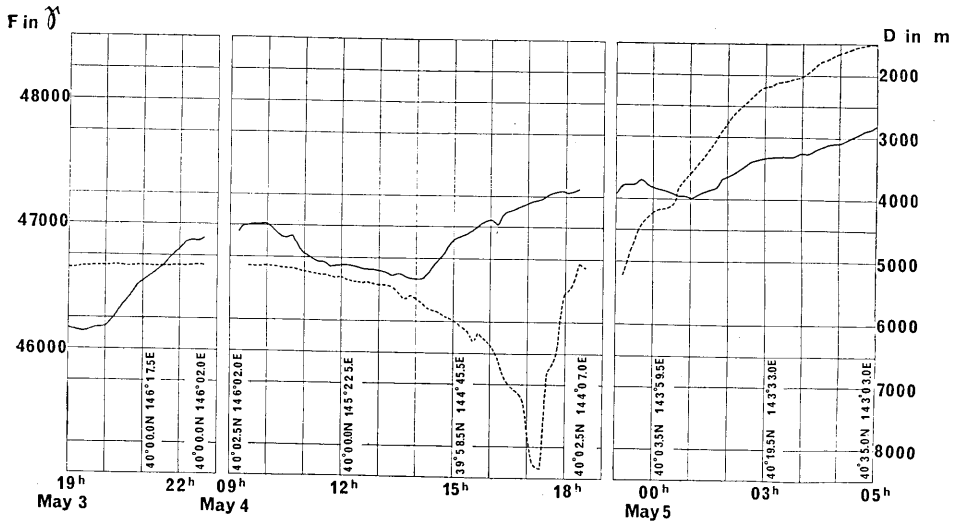


Fig. 4. Magnetic and topographic profiles along ship's track E-F in Fig. 1.

be related to the orientation of the trenches with respect to the geomagnetic field.

The distribution of the total geomagnetic force as measured has been mapped as shown in Fig. 5, where the contour line intervals are 200 $\gamma$. In this figure, no allowance for temporal variations has been taken into account. In this area, the regional total force distribution trends are characterized by the NEE–SWW isodynamic lines (See for instance U. S. Hydrographic Office Chart No. 1703), and the observed distribution seems to conform this. In Fig. 5, the area not covered by the present survey has been tentatively contoured by dotted lines. Superposed on the regional trends, there appears to be local anomalies, or Hope's crustal macranomalies (Hope, 1964), amounting to 4–500 gammas in magnitude, which are of the shape of linearly extended bands about 30 km wide. The trend of these lineations are observed to be also in NEE–SWW directions. They were found in the area 40°N–42°N, 144°E–148°E by the present authors and in the area 36°N–38°N, 144°E–150°E by the Scripps Expedition "Japanyon". A bathymetic chart of a part of the area has been made by H. Kagami and others (unpublished). This chart is reproduced in Fig. 6 with the permission of the authors. Apparently, the anomaly bands are roughly parallel to the Kurile Trench. This means at the same time that the anomaly bands are oblique to the Japan Trench. The agreement of the direction

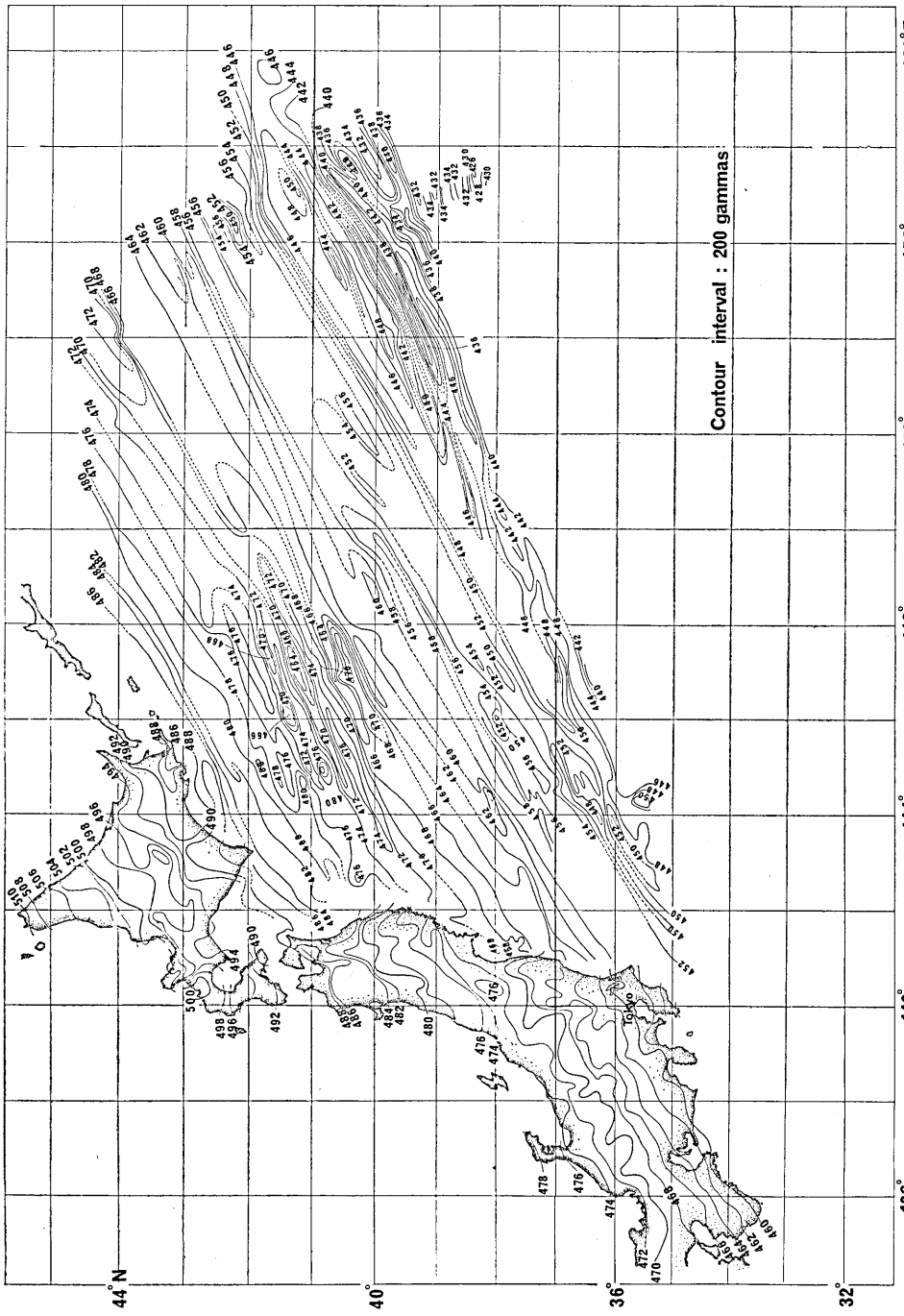


Fig. 5. Isodynamic Map in the Northwestern Pacific. Data on land was supplied by Dr. M. Tazima, Geographical Survey Institute.

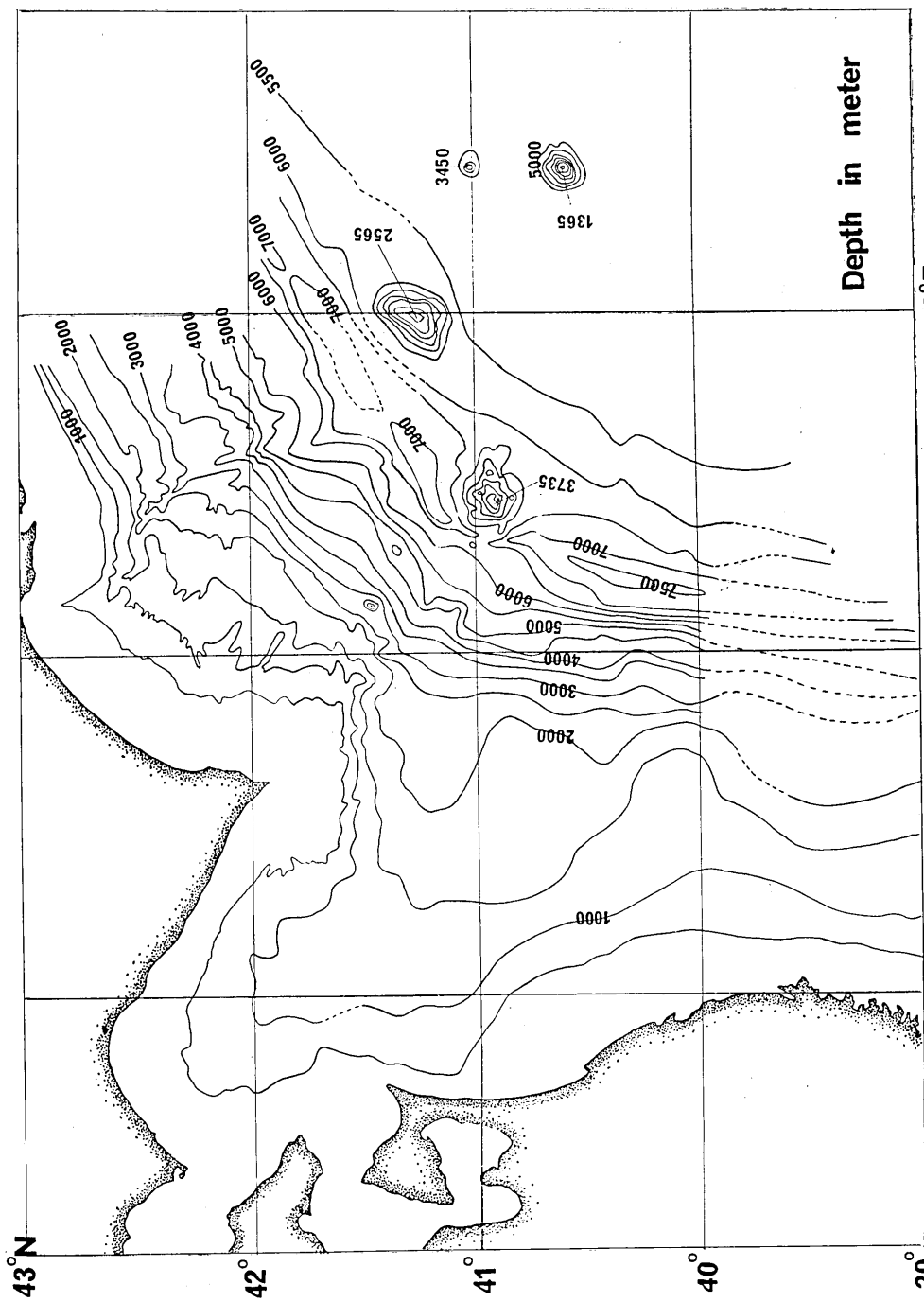


Fig. 6. Bathymetric chart of a part of the area studied. (after H. Kagami, T. Sato, K. Oshide, J. Ishii, R. Tuti, H. Mii, Y. Koizumi, H. Shiozawa and M. Nogami)

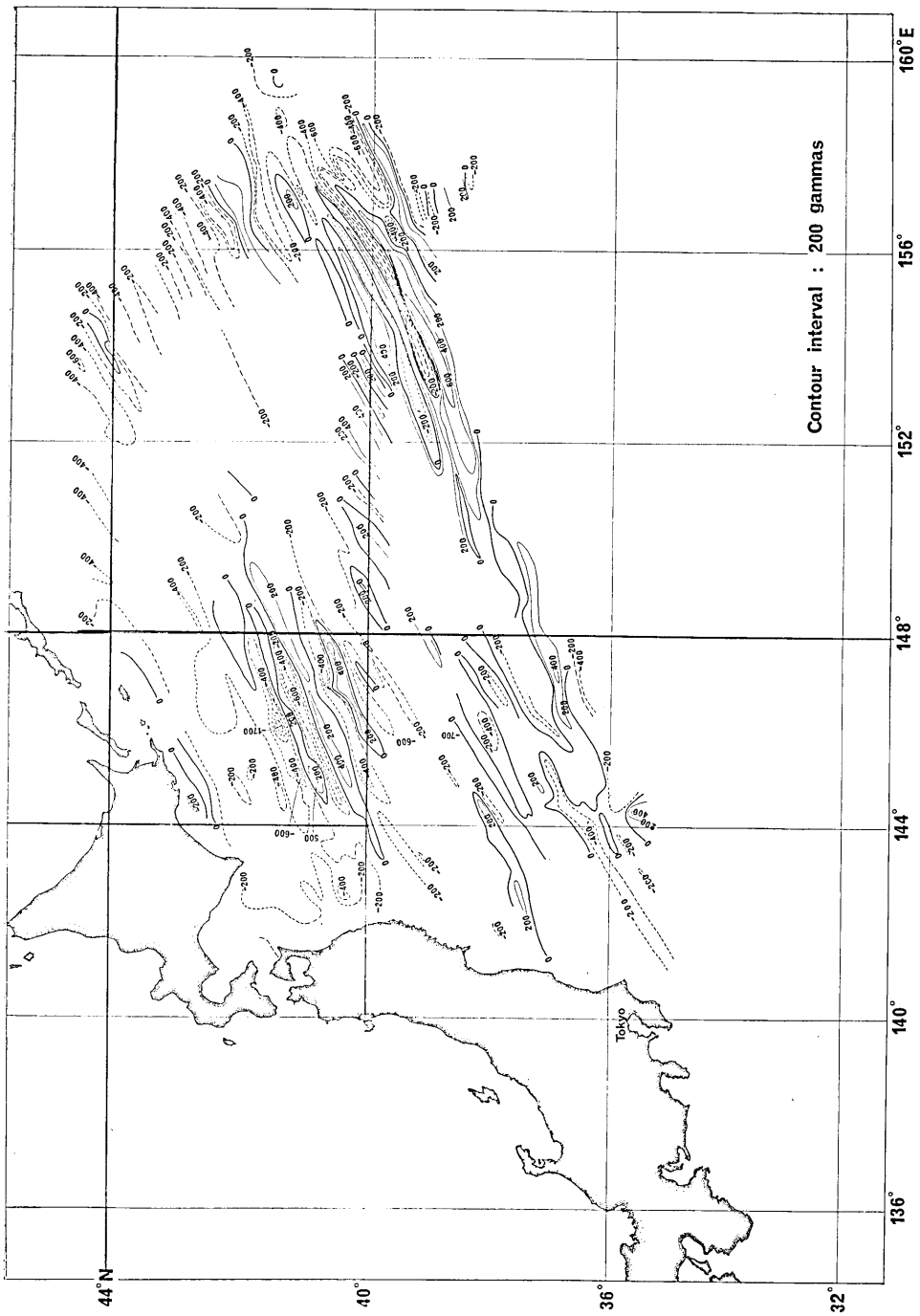


Fig. 7. Total magnetic force anomaly chart.

of these bands with that of the regional trend which is likely at the core origin may be a coincidence and the trend of the bands be related to the crustal or subcrustal structures and their development at the northwestern Pacific basin. The area extensively surveyed by Russian scientists is northeast of the area covered here with some overlapping (O. N. Solov'yev and A. G. Gainanov, 1963).

An anomaly chart of the area should be mapped by subtracting the regional trend from the observed distribution. To do this, the regional trend should be determined from the observations by such a method as described by Bullard *et al.* (1962). But the area studied here being still rather small and the data still largely to be accumulated, it was considered that such a work should await further survey. In the present work, the regional distribution for the year 1945 was taken from the U. S. Hydrographic Office Chart No. 1703 and subtracted graphically from the observations, and then, to make the distributions more or less even around zero, 300 gammas were added to all the difference values. This, though crudely, corresponds to taking care of the secular variation in the area. The charts of anomalies thus constructed are shown in Fig. 7. In this figure, the linear anomaly bands show up more clearly. The general appearance of the anomalies is quite similar to that of lineations reported in the eastern part of the Pacific by Mason and Raff (Mason, 1958, Raff and Mason, 1961). As regards the origin of these remarkable magnetic anomalies, computations based on models have been put forward by Mason and others showing that the magnetic body causing the anomalies must be embedded quite near to the surface of the ocean bottom (Mason, 1958). These interpretations will apply to the present cases. To investigate the nature of these buried magnetic bodies beyond the scope of mere potential theory, present knowlege of the ocean bottom, particularly in the area concerned in the present study, seems to be still too meagre, unless one has recourse to highly speculative ideas. Interpretative as well as data-accumulating work should be continued.

The pattern of the anomaly distribution is complicated by the existence of sea mounts. In the area investigated four sea mounts with strong magnetic anomalies have been found. These are the Sea Mount "Ryofu" at about 38°N, 146°E, "CblcoeB" at about 41°N, 145°E, unnamed ones at about 41°20′N, 146°E and at 40°40′N 146°50′E. Sea Mount "Ryofu" was surveyed in JEDS IV, the local anomaly associated with it being reported previously (Uyeda *et al.*, 1962). Bathymetry of

the Sea mount "CblcoeB" was studied on the Russian Expedition by "Vitiaz", Zamonsky *et al.* (1961). Sea mount "CblcoeB" and one at 41°30'N, 146°E are located on the southern slope of the Kurile Trench and amidst a geomagnetic lineation. The bathymetric and magnetic maps of the four sea mounts are as shown in Figs. 8 a. b., 9 a. b., 10 a. b. and 11 a. b. Bottom topography data was supplied through personal communication from the same source as in the case of Fig. 6. The magnetic maps show the anomaly values obtained by the same method as in the case of Fig. 7. As can be obseved from these figures, the magnetization of these sea mounts are considered to be roughly normal, and the intensity of magnetization very large. There will be little doubt that the basic body of the mounts are volcanic. It seems, from the dredge work made near the top of the Sea Mount "CblcoeB", that the age of the limestone of this Sea Mount is Cretaceous (H. Kagami, personal communication). Possible use of these sea mounts for palaeomagnetic purposes will be explored elsewhere.

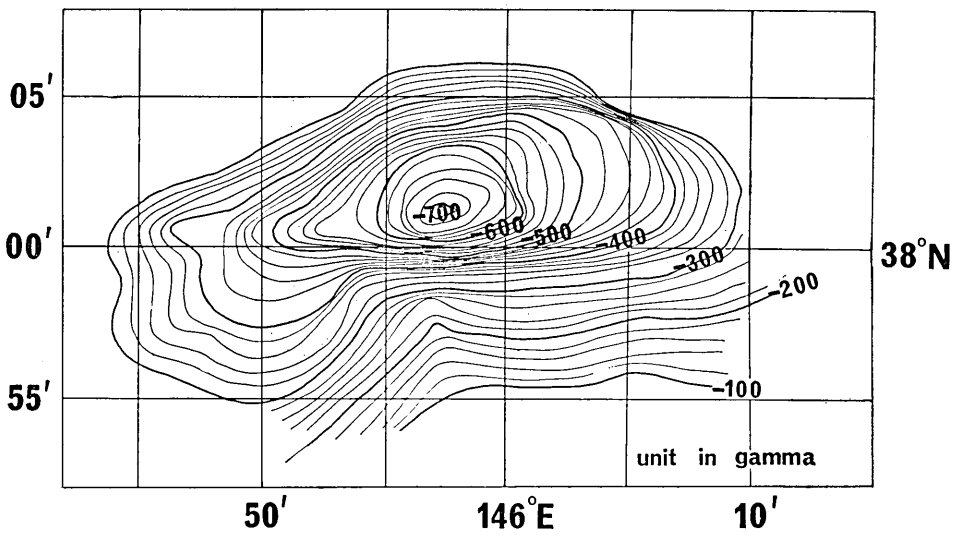


Fig. 8, a. Total magnetic force anomaly on Sea Mount "Ryofu". (Uyeda *et al.*, 1962)

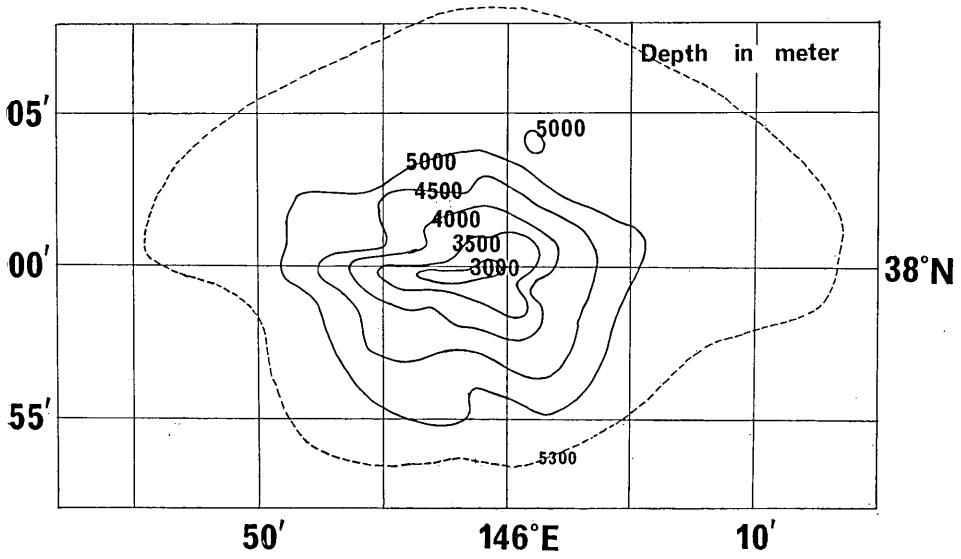


Fig. 8, b. Bottom topography of Sea Mount "Ryofu". (after Nasu and Sato, 1962)

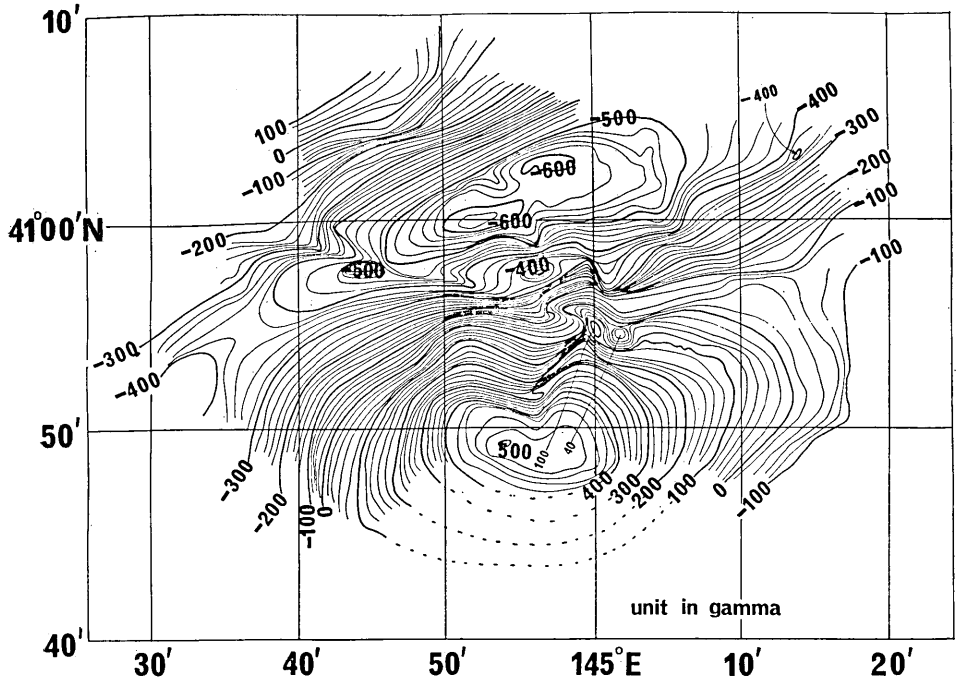


Fig. 9, a. Total magnetic force anomaly on Sea Mount "CblcoeB".

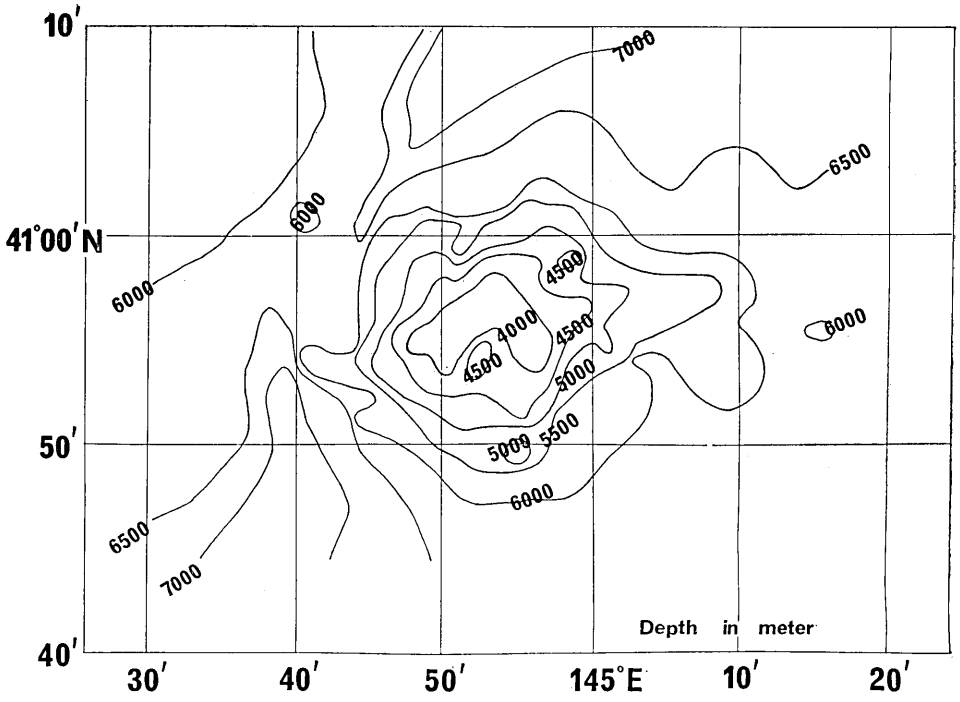


Fig. 9, b. Bottom topography of Sea Mount "CblcoeB".
(after H. Kagami *et al.*, Private communication)

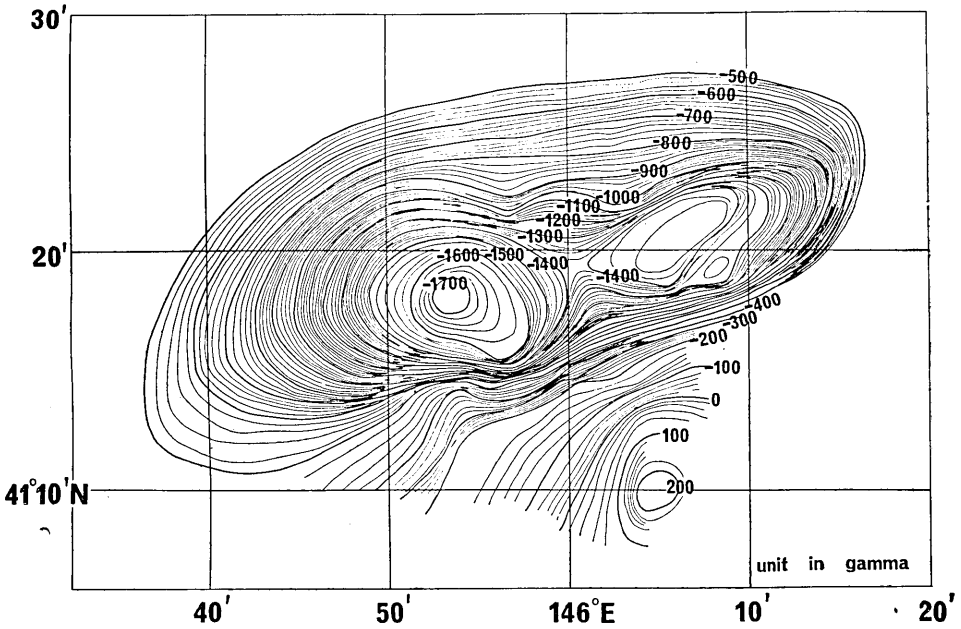


Fig. 10, a. Total magnetic force anomoly on Sea Mount at 41°20′N, 146°E.

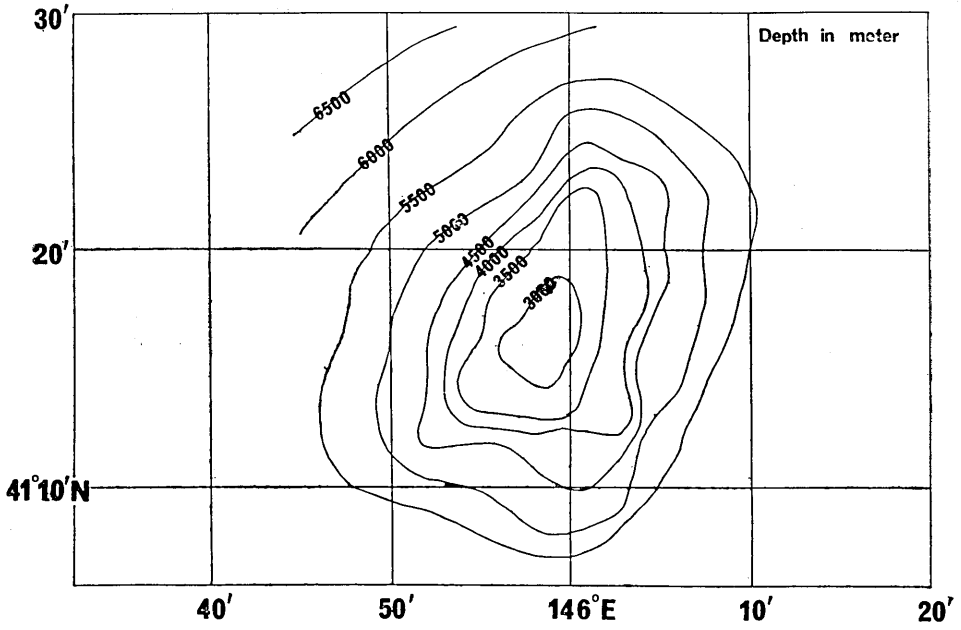


Fig. 10, b. Bottom topography of Sea Mount at 41°20′N, 146°E.
(after H. Kagami *et al.*, Private communication)

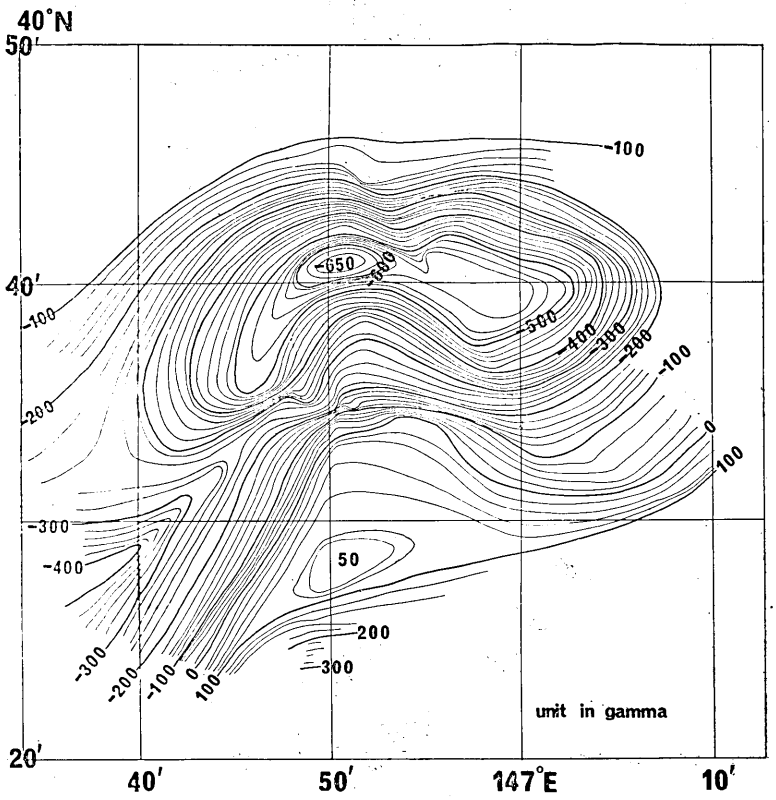


Fig. 11, a. Total magnetic force anomaly on Sea Mount at 40°40′N, 146°50′E.

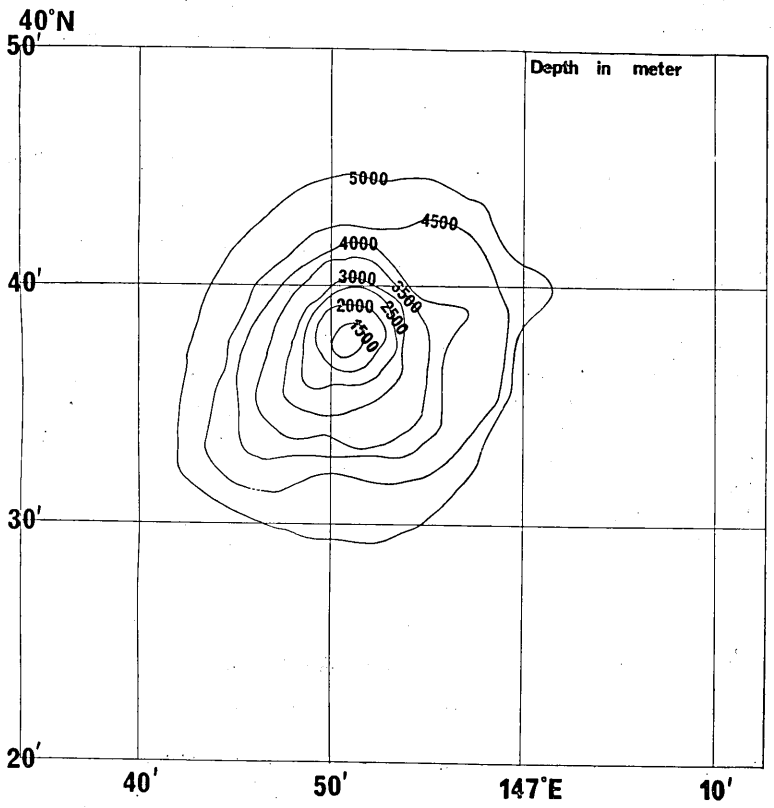


Fig. 11, b. Bottom topography of Sea Mount at 40°40'E, 146°50'E (after H. Kagami *et al.*, Private communication).

## Aknowledgments

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US-Japan Cooperative Science Program. Thanks are due to Mrs. Y. Tomoda and Miss T. Tanaka for drawing the charts and diagrams.

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## 29. 第六次，第七次，第八次深海観測航海における北西太平洋海域の地磁気測量結果

地震研究所 上田誠也
海上保安庁水路部 佐藤任弘
気象庁 安井正
地震研究所 簸武夫
地震研究所 渡部暉彦
地震研究所 川田薫
地震研究所 萩原幸男

表記航海において，気象庁観測船“凌風丸”，および水路部観測船“拓洋”に便乗し，プロトン磁力計によつて地磁気全磁力の測量を行なつた．海域は主として，142°E—160°E, 40°N—44°N であり，従来の結果，および，Scripps 海洋研究所観測船“Baird”号による結果をまとめて，全磁力分布図を得た．また，地域全体の分布を観測値からさし引くことによって，局地異常図もつくられた．

この海域には，北東東—南西西向きの地域的分布があるが，局地異常もほぼこれに平行し，帯状に分布している．異常帯は幅約 30km，異常強度数百ガンマのもので，太平洋東部海域において，Mason らの見出したものと軌を一にするごとくである．また，観測航海中には4個の海山での測深，磁気測量も行なわれた．海山は千数百ガンマに達する異常をもたらすものもあり，その分布図が作られた．

今後，測線をより密にして，より精度の高い磁気図をつくることがのぞまれる．