I-4. GRAVITY AND GEOMAGNETIC SURVEY

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Gravity measurement was carried out with the surface ship gravity meter, S–63, manufactured by La Coste and Romberg Co., and total magnetic force was measured with a marine proton magnetometer, model G 801, manufactured by Geo Metrics Co. The real time digital data of gravity and total magnetic force were transfered to NNSS, and were recorded on magnetic tapes together with navigational and bathymetric data. From this data, free air, Bouguer and magnetic anomalies were calculated with a 2100 A computer on board the ship. Free air anomalies were calculated by making latitude correction and Eötvös correction. Bouguer anomalies were computed under the assumption of a water density of 1.03 gr/cm^3 a rock density of 2.67 gr/cm^3, and without topographic correction. Magnetic anomalies were calculated by subtracting IGRF values from the measured total magnetic force. The calculated data were recorded on magnetic tapes every 5 minutes and from this data profiles of gravity and magnetic anomalies were drawn with an X–Y plotter (Fig. I–4–1). This digital data was also plotted on maps, and figure I–4–1, A–F were drawn based on these maps.

Results

The trend of free air anomaly is in a NE–SW direction, in the eastern part of the surveyed area, and in an E–W direction, in the western part following the topographic trend (Fig. I–4–2). There are three pairs of high and low anomaly zones. Each low anomaly zone exists to the south of the corresponding high anomaly zone. The southern low anomaly zone agrees with the Ryukyu Trench, the central one runs along the continental slope south of the Ryukyu Ridge, and the northern one corresponds to the Okinawa Trough.

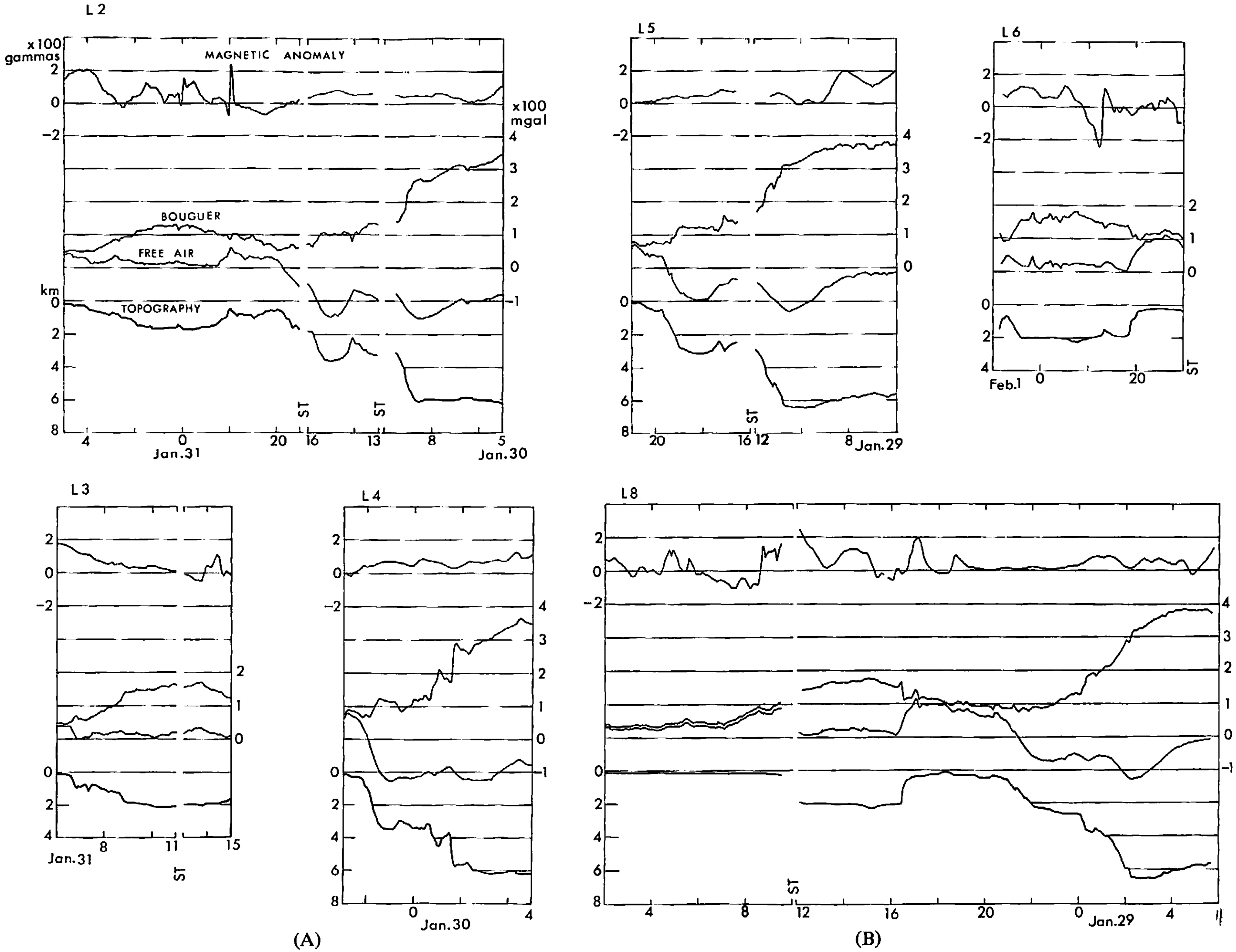
There is a high Bouguer anomaly zone along the Okinawa Trough and a low anomaly zone along the Ryukyu Ridge (Fig. I–4–3). The Philippine Basin is characterized by a high anomaly, while the Bouguer anomaly over the Tunghai Shelf is low. For convenience, we have defined high and low anomaly zones as the zones where anomaly values are greater than 160 mgals or smaller than 80 mgals, respectively, and the hatched zonal boundaries are shown in Fig. I–4–3.

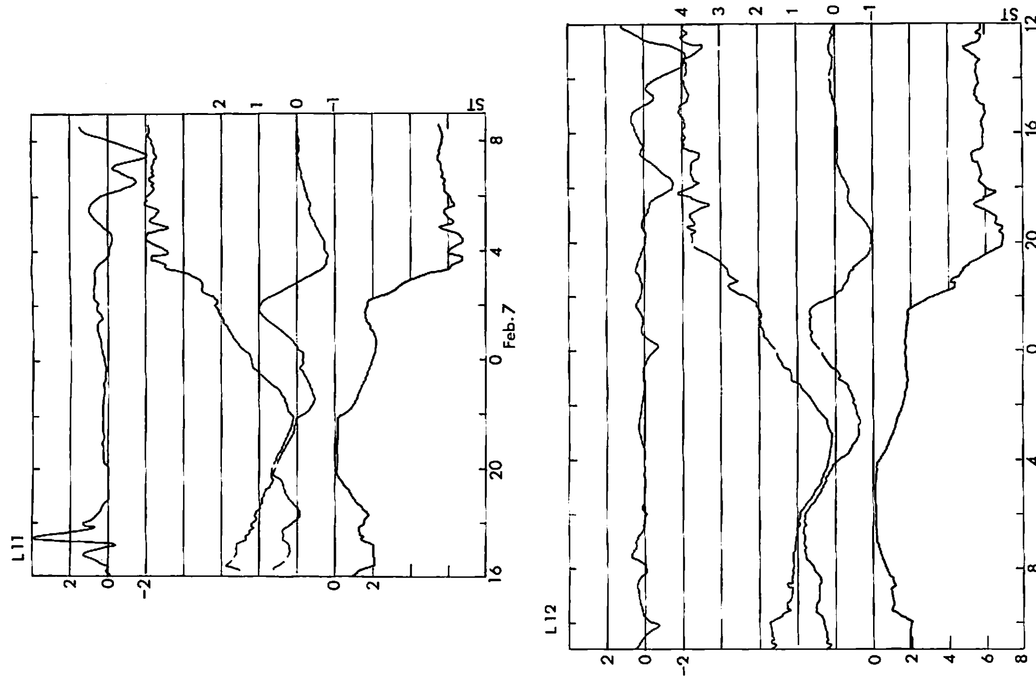
There is a magnetically quiet zone along the Ryukyu Ridge. In the north of this zone anomalies with rather short wavelength and large amplitude exist, and in the south-anomalies with longer wavelength and smaller amplitude are present.

(1) Ryukyu Trench and Philippine Basin

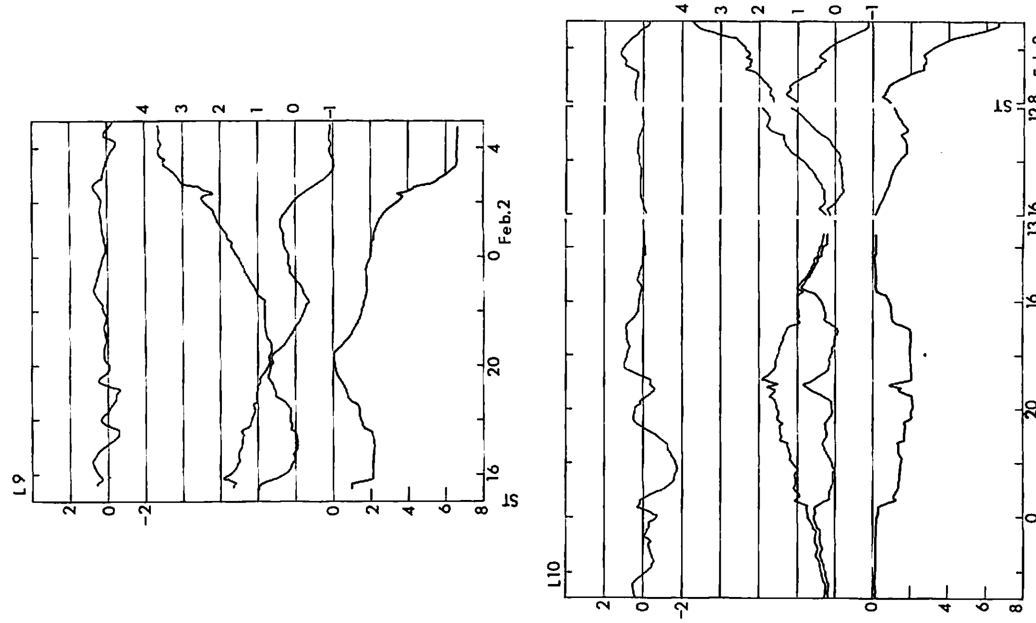
In the Philippine Basin, free air anomalies are almost equal to 0 mgal and Bouguer anomalies reach 400 mgal (Fig. I–4–4). These values suggest that the Philippine Basin has a typical oceanic crust, and water masses are isostatically compensated. Along each of the surveyed lines the minimum of the southern low zone of free air anomaly almost agrees with the deepest part of the Ryukyu Trench. Along the Ryukyu Trench, however, the free air anomaly is smaller than -140 mgal, but in the deepest part of the trench

Fig. I-4-1 Profiles of free air and Bouguer anomaly, magnetic anomaly and topography along the ship's tracks in Fig. I-1-2. Day and time in JST and station number of sampling are shown in the horizontal axis.

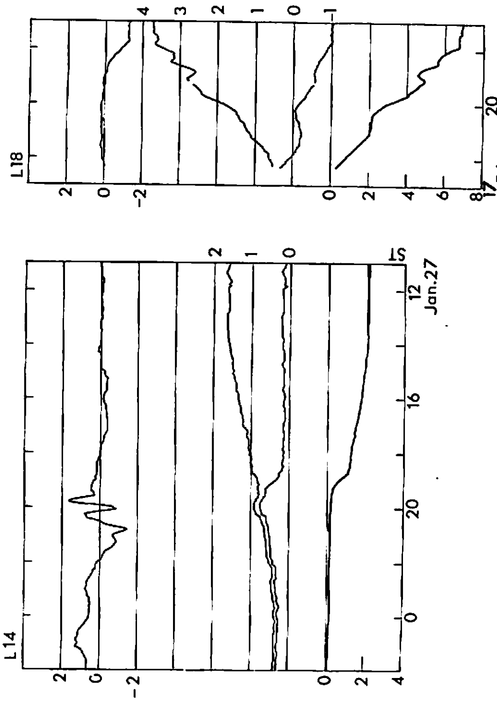




(D)



(C)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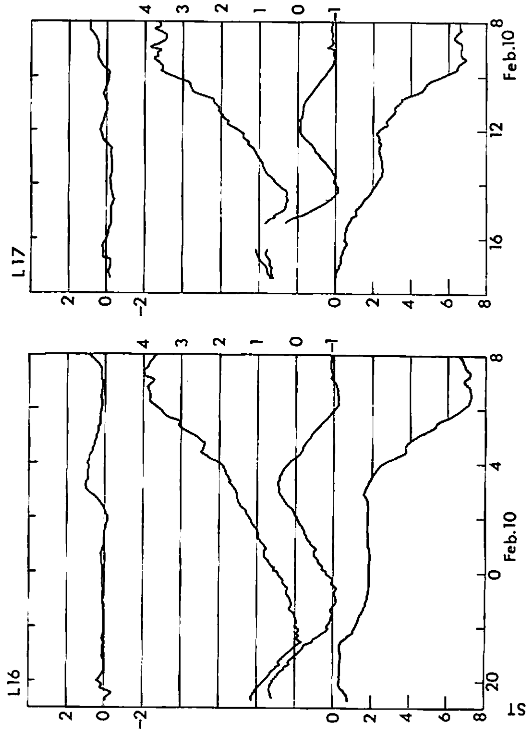
Feb.10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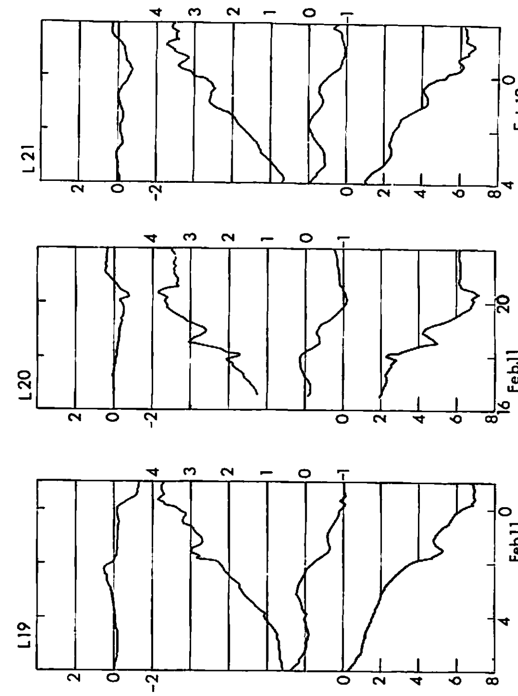
(E)


L19
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L20
Feb.11
ST
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Feb.12

(F)

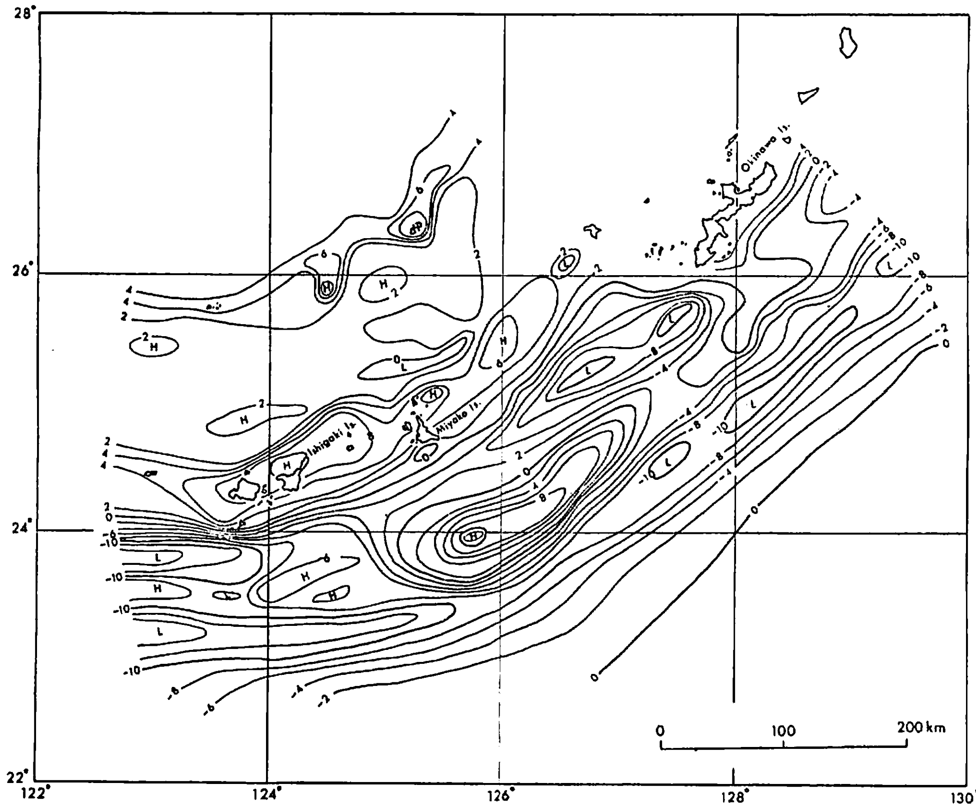

Fig. I-4-2 Contour map of free air anomaly. Unit is ×10 milligal and contour interval is 20 milligal.

developed in the east, the free air anomalies have values ranging from −80 to −100 mgal.

Magnetic anomalies in this area do not have a large amplitude (100), and the characteristic wavelength is rather longer (100 km).

(2) Ryukyu Ridge and Continental Slope

The central high anomaly zone passes through Ishigaki Island and north off Miyako Island with anomalies ranging from +80 to +100 mgals. There is another high anomaly zone just adjacent to the trench. There is a maximum anomaly of larger than +100 mgal southwest of Miyako Island in the eastern part of this zone. Free air anomalies, however, are negative, ranging from −80 to −60 mgal in the western part. In the low anomaly zone between the two high anomaly zones, there is a minimum of less than −140 mgal in the western part but SE of Miyako Island, the free air anomalies have values from −20 to 0 mgal. These facts suggest that upward movement is predominant SE of Miyako Island, while downward movement is predominant in the west.

The northern boundary of the low Bouguer anomaly zone passes north off Miyako Island and south off Ishigaki Island. The southern boundary exists in the continental slope area, but east of Miyako Island this zone is wide with a minimum value of less than

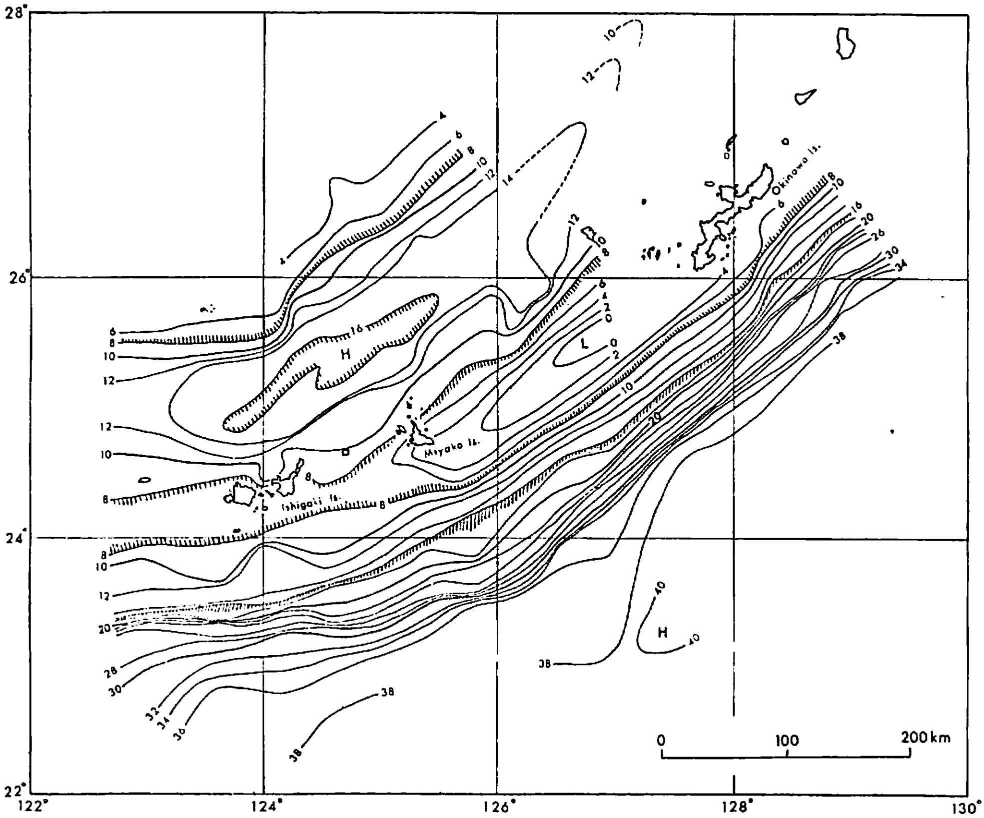

Fig. 1-4-3 Contour map of Bouguer anomaly. Unit is ×10 milligal and contour interval is 20 milligal.

0 mgal. This low Bouguer anomaly zone becomes narrower to the west, as anomaly values become greater.

If we define here a magnetically quiet zone as the zone where absolute values of anomalies do not exceed 50, this zone approximately corresponds to low Bouguer anomaly zone, and also becomes narrower to the west, although the southern boundary of this zone is difficult to define. This suggests that thick non-magnetic sediment is widely distributed to the east of Miyako Island, but is thin in a restricted area of distribution in the west.

(3) Okinawa Trough and Tunghai Shelf

There is a high free air anomaly zone over the shelf slope of the Okinawa Trough with values ranging from +80 mgal to +100 mgal. The free air anomaly is minimum in the Okinawa Trough area, is nowhere less than 0 mgal. A high anomaly zone with a maximum value of more than +160 mgal corresponds to this trough. This indicates that the crustal thickness beneath the Okinawa Trough is small although greater than that beneath the Philippine Basin. This conclusion does not conflict with the possibility that new oceanic crust is being created in this area.

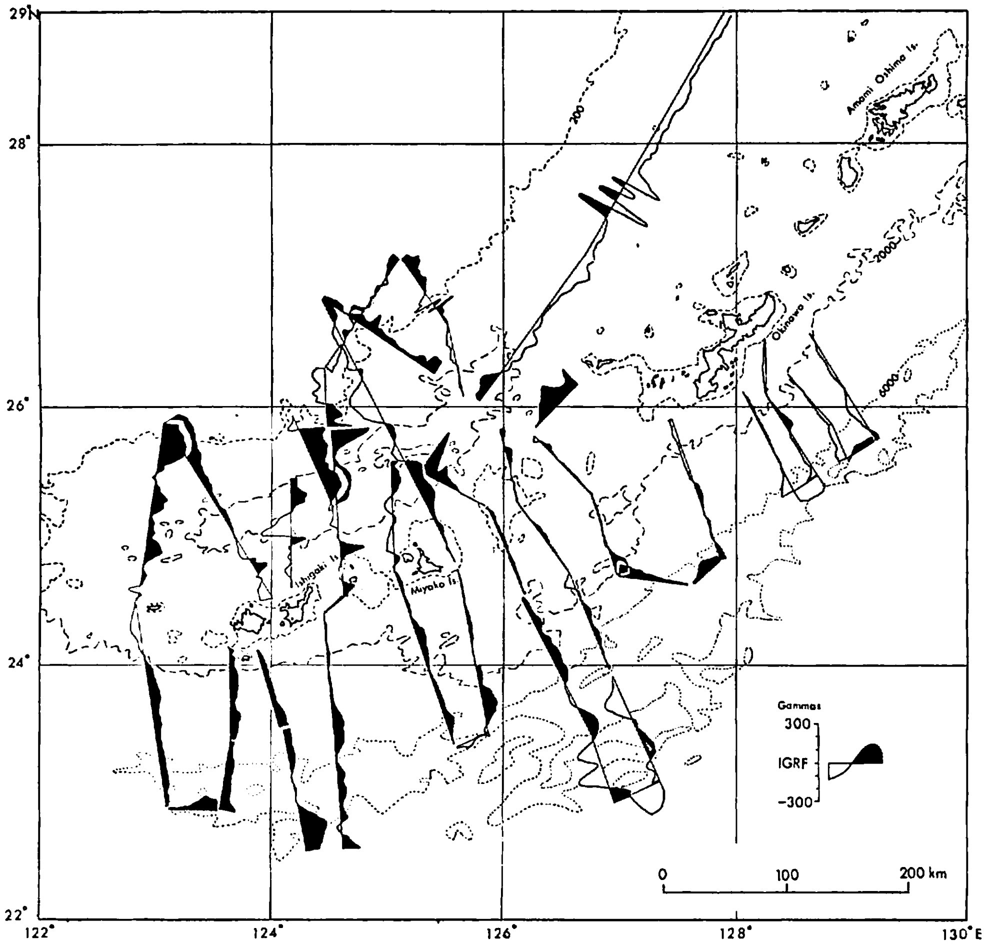

Fig. I-4-4 Magnetic anomaly profiles along the ship's tracks.

Throughout this area, magnetic anomalies have rather large amplitudes (200–300) and short characteristic wavelengths (20–50 km), though there are no surveyed lines deep enough into the Tunghai Shelf. Bouguer anomalies are low, from +20 to +40 mgal, over the marginal area of the Tunghai shelf. Therefore, the gravity basement of the Tunghai Shelf is deep, although the magnetic basement seems to be shallower.