II–4. GRAVITY SURVEY

By Fumitoshi Murakami

Gravity measurement was carried out by using a surface ship gravity meter, an Air Sea Gravity Meter of La Coste and Romberg Co. The real time digital data of gravity were transfered to NNSS, and were recorded on magnetic tapes together with navigational, bathymetric and total magnetic force data. From this data free air, Bouguer and magnetic anomalies were calculated with a 2100 A computer of Yokogawa Hewllet Packard Electric Co. on board the ship.

Free air anomalies were calculated by making latitude and Eötvös corrections. For calculation of the latitude correction, the International Gravity Formula was applied. Bouguer anomalies were calculated under the assumption of a water density of 1.03 g/cm^3, a rock density of 2.67 g/cm^3, and without topographic correction. The calculated data were recorded on magnetic tape every 5 minutes. The correlation to the gravity value on land was made at Funabashi (35°40.8′N, 139°59.3′E), where the gravity value is 979,802.7 milligal. At Funabashi the gravity meter reading was 10678.5 milligal on the departure day (July 16) and 10679.1 milligal on the returning day (August 22). The drift of the gravity meter was 0.47 milligal/month.

Results

A contour map of free air anomalies in the Ryukyu arc system was drawn from the gravity data of the GH 75–5 Cruise, GH 75–1 Cruise (rf. I–4) and the GH 74–7 cruise (MIZUNO ed., 1975) and is shown in Fig. II–4–1. There are three high anomaly zones (GH 1, GH 2 and GH 3) and three low anomaly zones (GL 1, GL 2 and GL 3) running parallel to the trend of the Ryukyu arc system (Fig. II–4–2). The low anomaly zone GL 1 is situated over the Ryukyu Trench, and extends northward to combine with the low anomaly zone of the Nankai Trough. The low anomaly zone GL 2 is situated over the continental slope, and its northward extension terminates to the east of southern Kyushu. The high anomaly zone GH 2 corresponds to the Ryukyu Ridge. Fig. II–4–3 illustrates gravity anomalies and magnetic anomalies and topographic profiles, the line numbers of which corresponds to the line numbers in Fig. II–1–3.

1) Tunghai Shelf and Okinawa Trough

There is the rise of 10 milligal in the free air and Bouguer anomalies in the marginal area of the Tunghai Shelf (profile of L 29). An acoustic basement high is observed on the seismic reflection profile (Fig. II–6–2, C), and the 10 milligal rise seems to correspond with this basement high.

In the Okinawa trough, the Bouguer anomaly is larger than those over the Ryukyu ridge and Tunghai shelf, and the Bouguer anomaly is almost constant in the Tunghai shelf area. This indicates that under the Okinawa trough the crust thickness is probably thin and that under the shelf it is almost constant.

There is maximum Bouguer anomaly of 160 milligal in the SW part of the Okinawa

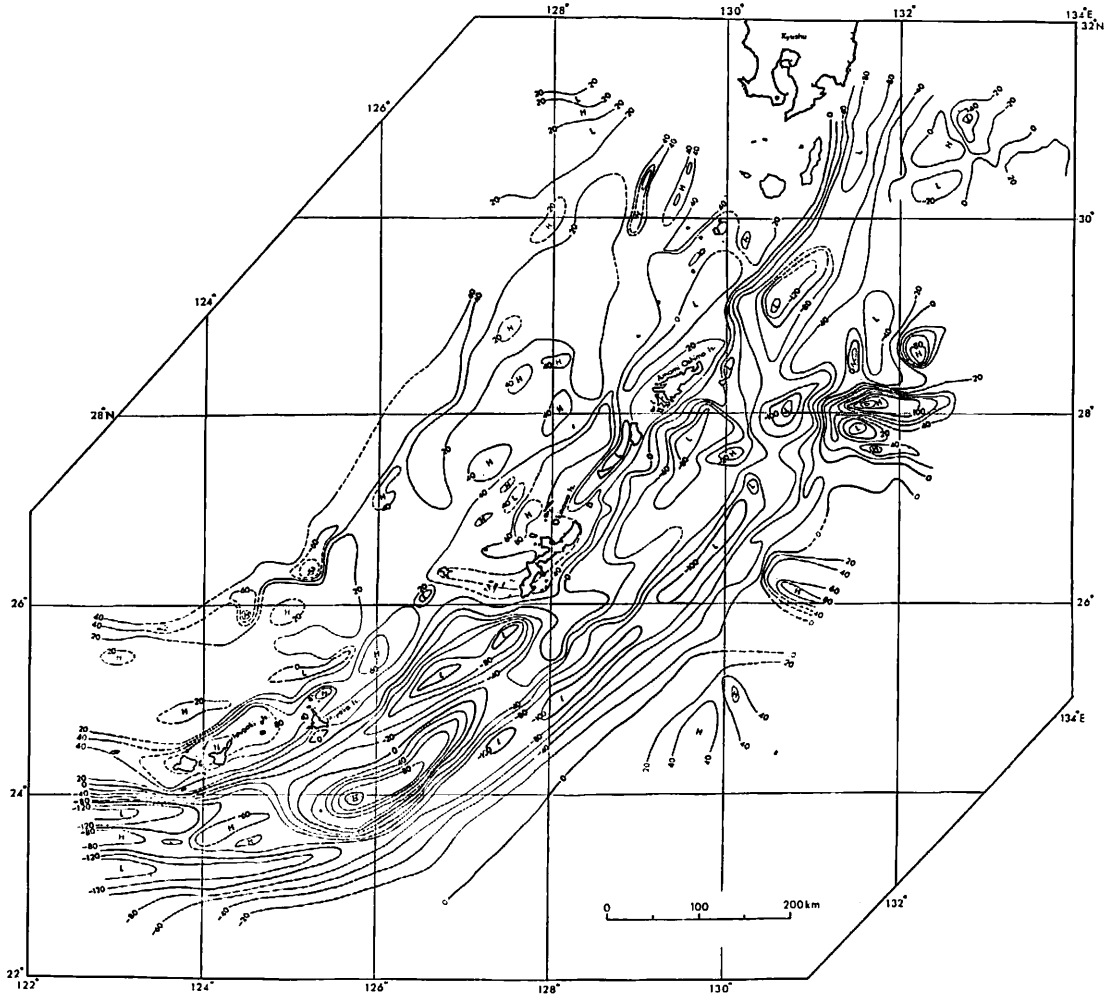


Fig. II–4–1 Contour map of free air anomalies. Contour interval is 20 milligal.

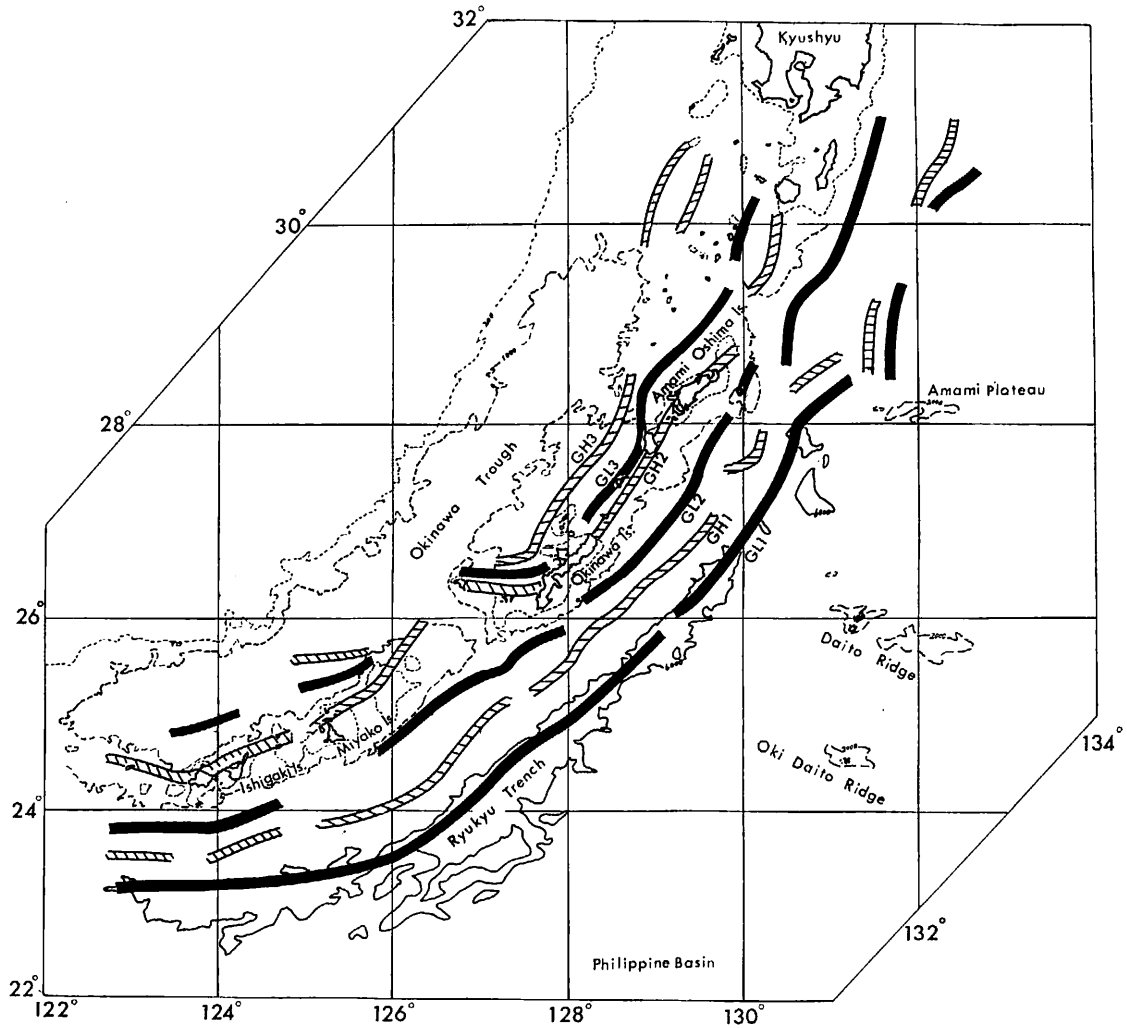
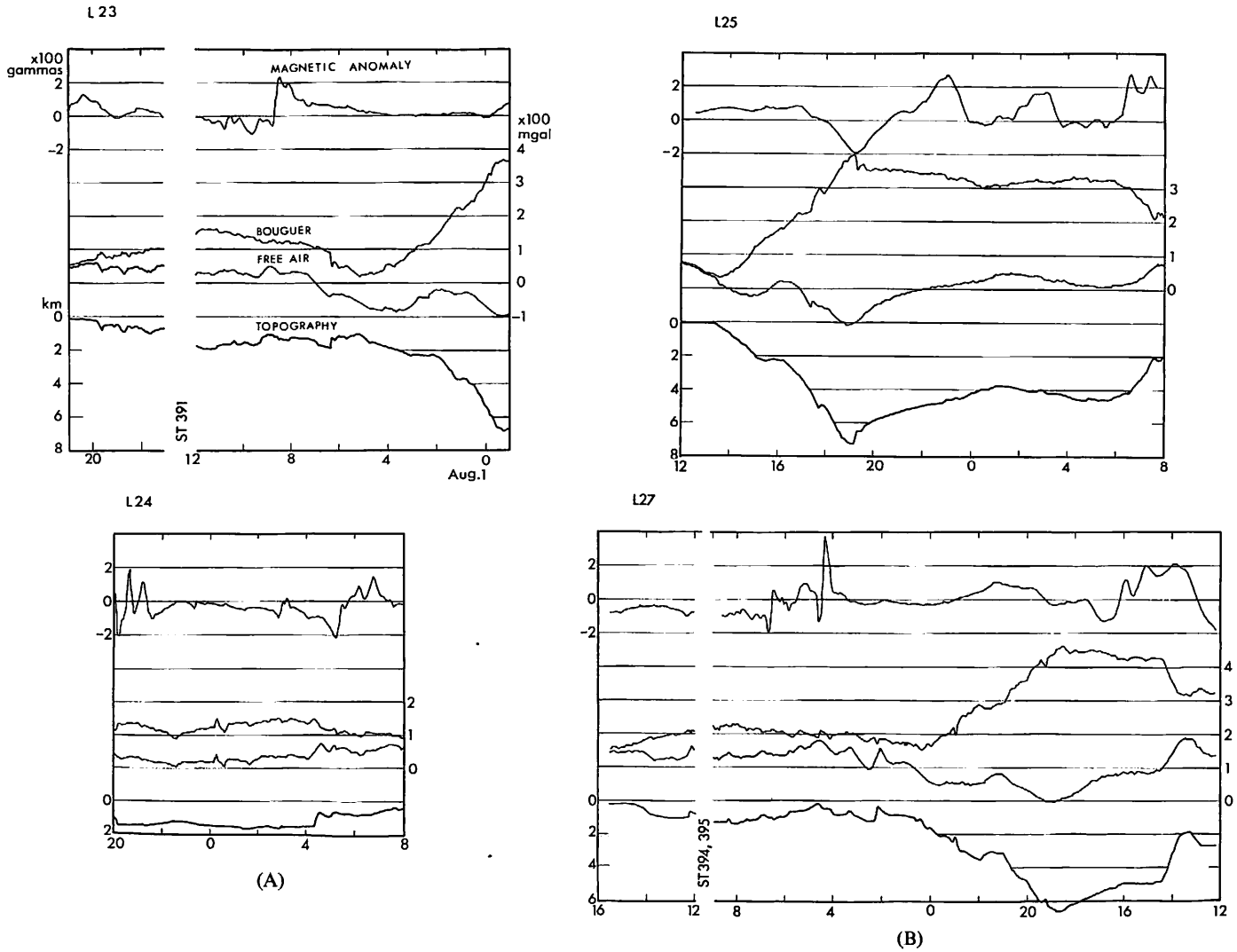
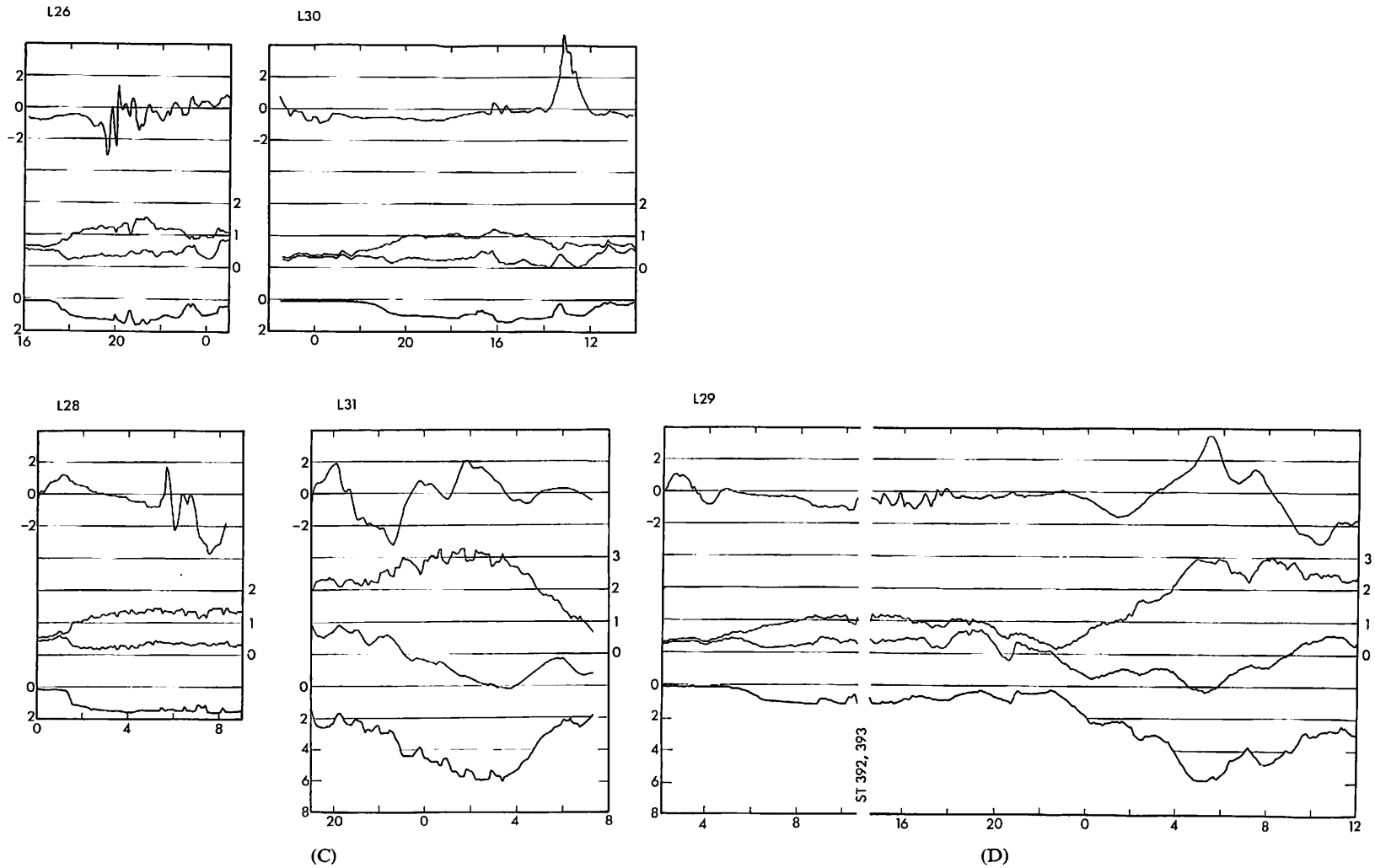
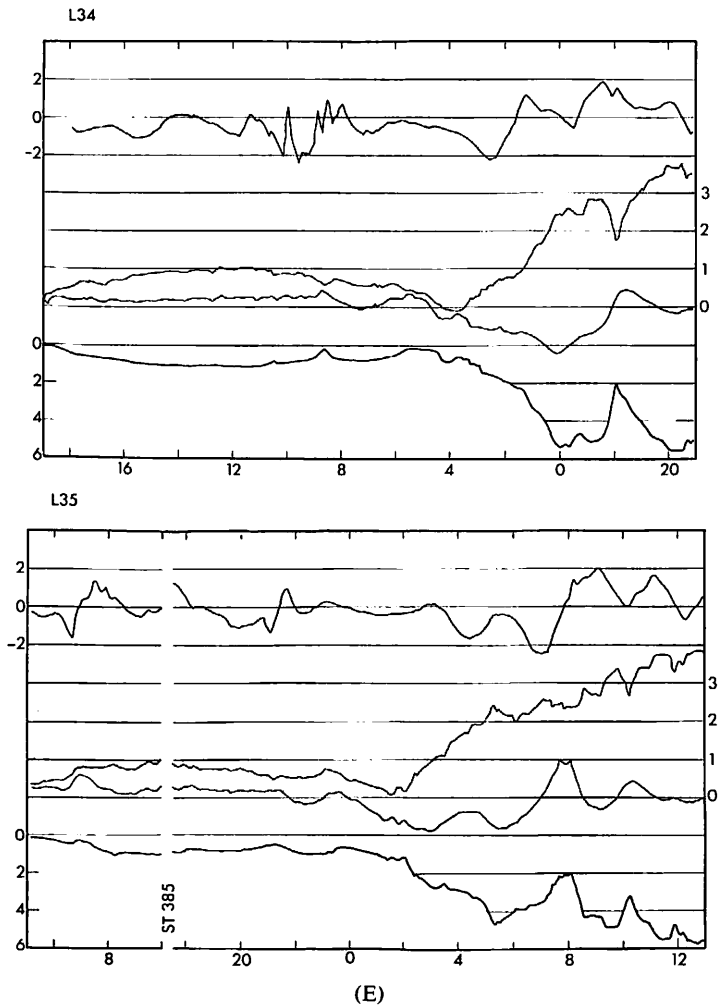


Fig. II–4–2 Schematic diagram of the trend of high and low anomaly zone in free air anomaly shown in Figure II–4–1. Hatched lines show high anomaly zone and black lines show low anomaly zone.

Fig. II–4–3 Profiles of free air and Bouguer anomaly, magnetic anomaly and topography along the ship's tracks shown in Figure II–1–1. Day and time in JST and station number of sampling are shown by the horizontal axis.




L26
L30
L28
L31
L29
ST 392, 393
(C)
(D)



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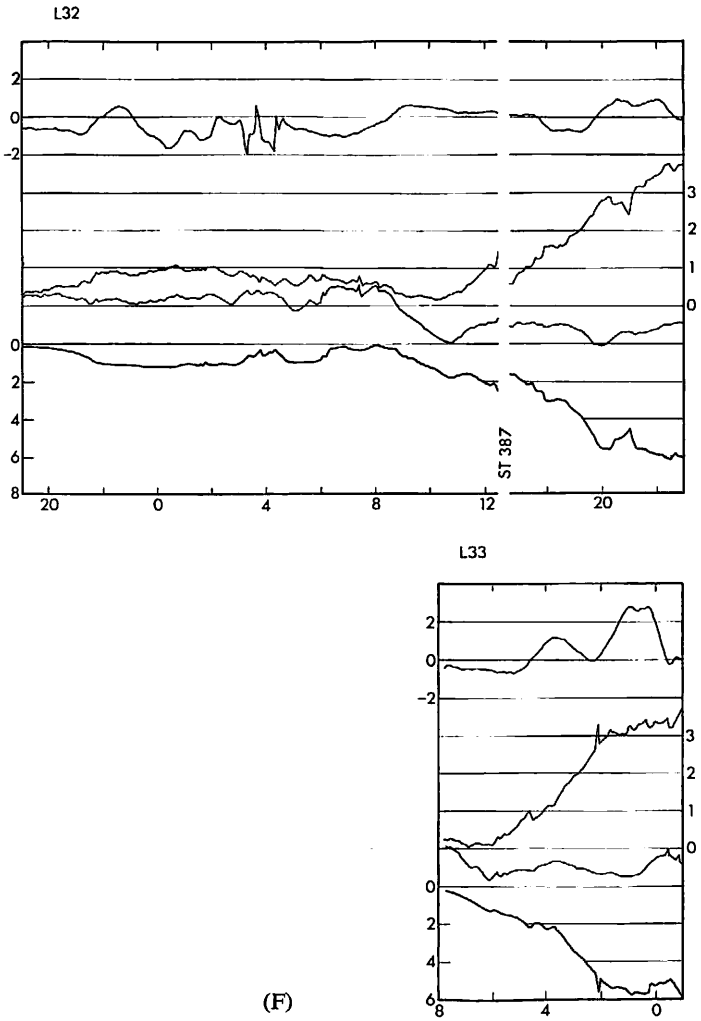

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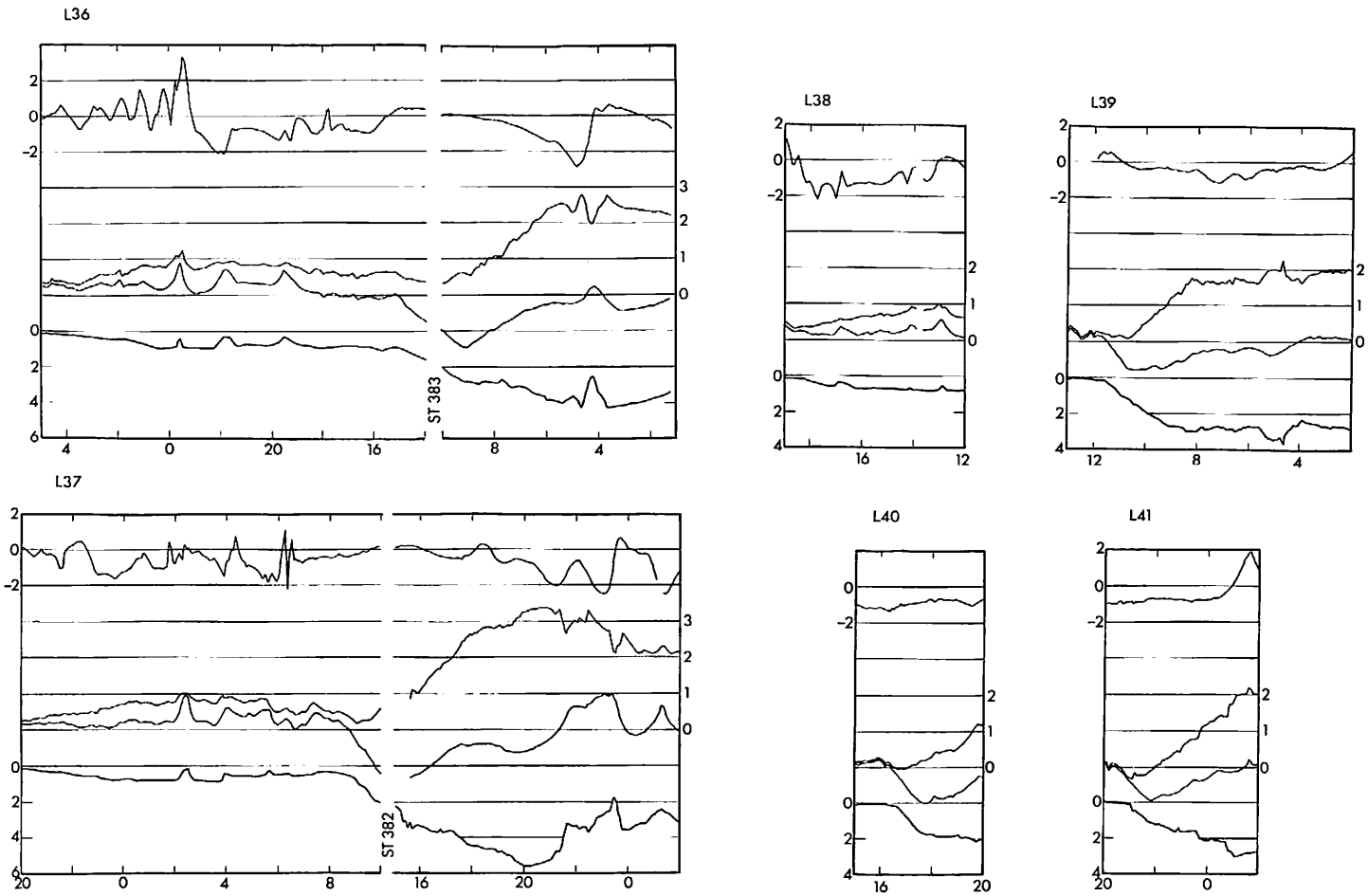

(G) (H)

Trough, and it decreases to the NE (rf. I–4). The Bouguer anomaly over the Okinawa Trough is about 150 milligal on the profile of L 24, however, on the profile of L 37 it is about 80 milligal, and the anomaly variation is about 70 milligal. This fact suggests that the structure which gives the long wavelength variation in the gravity anomalies deeps to the NE of the Okinawa trough.

2) Ryukyu Ridge, Continental Slope and Trench Slope

In the Ryukyu Ridge area, free air anomalies have values ranging from 20 to 60 milligal, therefore, they are rather low. In the vicinity of Okinawa Island, the Ryukyu Ridge is composed of two ridges, where the free air anomaly of the western half of the two ridges is higher than that of the eastern half.

The Bouguer anomaly gradually decreases towards the Ryukyu Ridge. However, it increases near the boundary between the Ryukyu Ridge and the continental slope. The abrupt increase in the Bouguer anomaly over the arc-trench gap indicates a gradual change from continental to oceanic crust.

On the Continental slope, there is minimum free air anomaly zone, which has the value of -140 milligal on profile L 37, and -100 milligal on profile L 32. This minimum free air anomaly zone seems to correspond to the sediment filled trough (with a seismic velocity of 3.3 km/sec) recorded by LUDWIG and others (1973). There is free air anomaly high over the trench slope break where the inclination of the arc-trench gap changes. According to the seismic refraction data of MURAUCHI and others (1968), there is a ridge composed of continental crust with a seismic velocity ranging from 2.8 km/sec to 3.0 km/sec in this region, and the free air anomaly high corresponds to this ridge.

3) Ryukyu Trench and the outer region beyond the trench

Along the Ryukyu Trench, the minimum free air anomaly almost agrees with a deepest part of the trench (profiles L 23 to L 35). On the bordering Amami Plateau, the characteristics of the gravity anomalies differ between the northern part and the southern part. The free air anomaly ranges from -100 to -120 milligal on profile L 23 and L 34, while it is from -20 to -50 milligal on profiles L 36 and L 41.

In the northern basin of the Daito Ridge, the Bouguer anomaly is about 380 milligal, and this value corresponds to that of typical oceanic crust material.

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