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XIII. GRAVITY AND MAGNETIC ANOMALIES IN THE PENRHYN BASIN, SOUTH PACIFIC (GH83-3 AREA)

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Geological Setting

The Penrhyn Basin lies adjacent to the eastern margin of the Manihiki Plateau (Fig. XIII-1). The Manihiki Plateau is one of the mid-plate swells in the Pacific, and was dated as 123±1.5 Ma by the ^{40}Ar-^{39}Ar method (Mahoney *et al.*, 1993). Magnetic lineation has not yet been found in the Penrhyn Basin (Golovchenko *et al.*, 1981). On the other hand, magnetic lineations of north-south direction produced by the Cenozoic seafloor spreading at the East Pacific Rise are recognized in basins to the east of the Penrhyn Basin (e.g. Mayes *et al.*, 1990). It is thus considered that the Penrhyn Basin belongs to the Cretaceous Magnetic Quiet Zone (83-124 Ma; Harland *et al.*, 1990). Tectonic reconstruction by Joseph *et al.* (1993) suggests that the Penrhyn Basin was formed by NNW-SSE spreading of Pacific-Farallon plates after reorganization of the spreading system at M0 time (124 Ma).

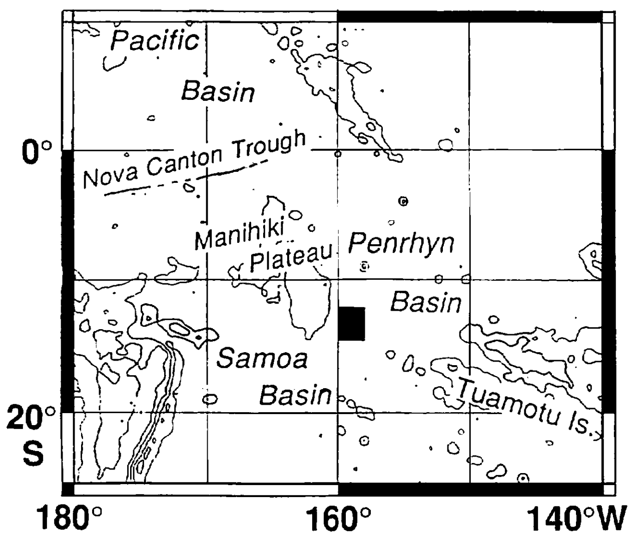

Fig. XIII-1 Location of the study area (GH83-3 area).

Keywords: gravity, magnetic anomaly, Cretaceous Magnetic Quiet Zone, Manihiki Plateau, Hakurei-Maru, Penrhyn Basin

The general topographic feature of the western part of the Penrhyn Basin (Fig. XIII-1) has not yet been well documented because of insufficient survey tracks. Our bathymetric data (Okuda *et al.*, Chapter II of this volume) resulted in a better topographic map of the detailed survey area in the GH83-3 area (Fig. XIII-2). Water depths of the basin floors range in general from 5200 to 5300 m, but a conspicuous trough and ridge system runs to NNW-SSE directions. Maximum depth of the trough exceeds 6000 m. The similar strike of the trough-ridge system to that of the Pacific-Farallon spreading suggests its paleo-rift origin.

Measurements

Gravity measurements were carried out by a LaCoste-Romberg air-sea gravimeter

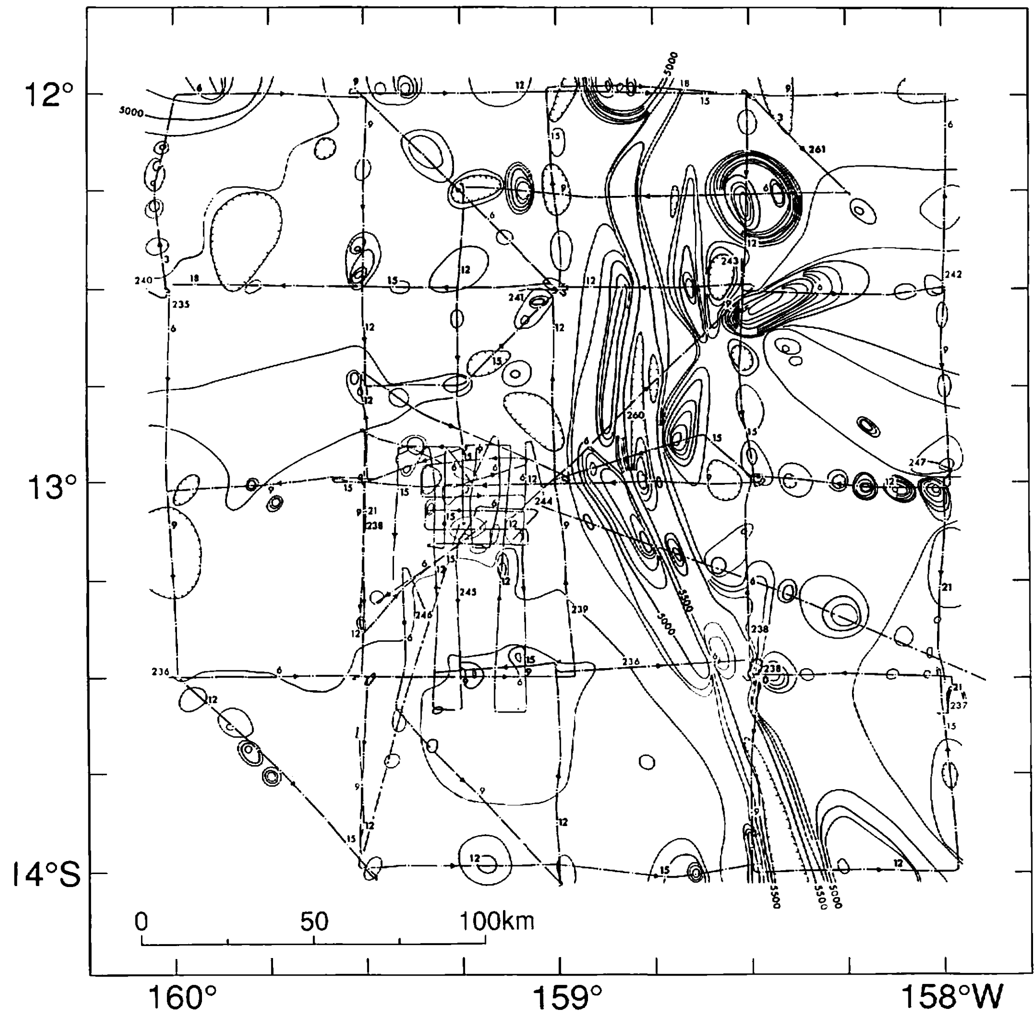

Fig. XIII-2 Topography of the GH83-3 area and ship's tracks of gravity measurement. Bathymetric contours are at 100m intervals.

model S-63. The gravity sensor is mounted on a gyro-stabilized platform. The gravimeter has an analog computer to calculate cross-coupling corrections. An analog low-pass filter was applied to the raw outputs from the sensor in order to suppress noises due to ship's vertical movement. The junction to the IGSN 71 system was made at Funabashi Port on the Tokyo Bay. The IAG 1967 gravity formula was used for latitude correction. A linear drift of the gravimeter was assumed between ports.

Magnetic total force was measured using a proton precession magnetometer (Geo-Metrics G801) towed about 250 m behind the vessel. Residual total magnetic intensity field, that is, magnetic anomaly, was obtained by subtracting the 1985 version of the IGRF (International Geomagnetic Reference Field) (IAGA Division I Working Group 1, 1985) from the observed data. Diurnal correction was not applied.

The shipboard geophysical data were logged on magnetic tapes every 30 seconds, and finally edited as a series of records on every five minutes. The records include ship's position, speed, magnetics, gravity, and water depth. Only NNSS-satellite fixes were available for navigation during the Cruise GH83-3. The Eötvös correction for gravity anomaly, which is a function of ship's heading and velocity, is expected to have an accuracy of about 5 mgal.

Results

A free-air gravity anomaly contour map is shown in Figure XIII-3. The interval of survey lines is about 15 mile except in the detailed survey area (Fig. XIII-2). The

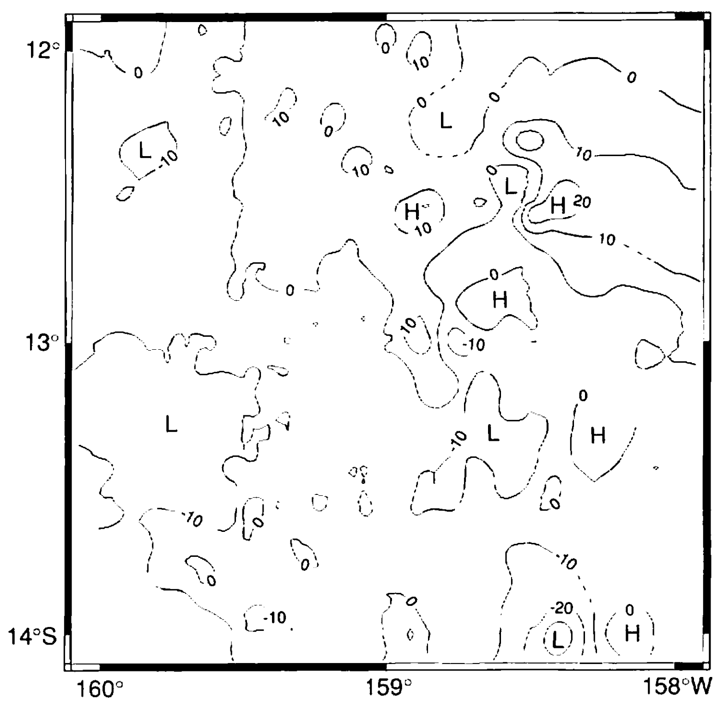

Fig. XIII-3 A contour map of free-air gravity anomalies. Contour interval is 10 mgal.

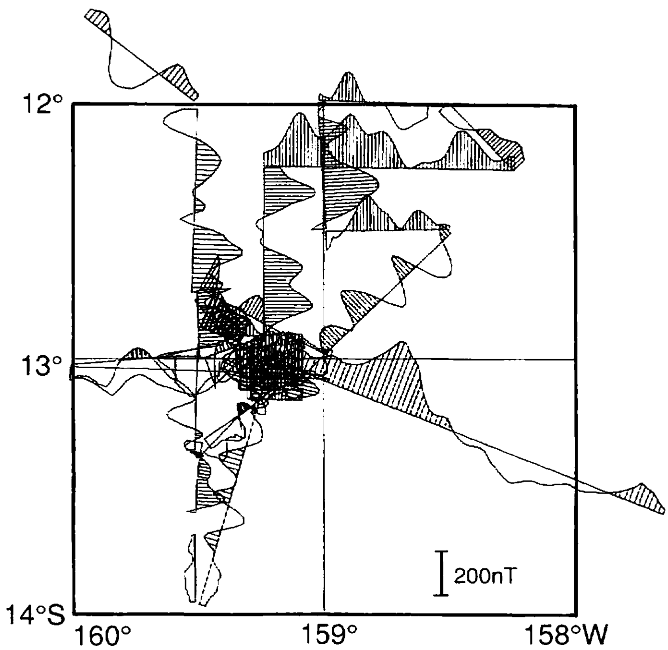

Fig. XIII-4 Magnetic anomaly profiles along survey lines. Positive anomalies are shaded.

trough and ridge system accompanies free-air anomalies of about ±20 mgals. Anomalies of other areas are within the range of ±10 mgals. The anomalies have a tendency of northward slight increase, although the water depth does not change. This suggests that the lithosphere in the northern part of the survey area would be slightly apart from isostacy, and it is dynamically supported.

Magnetic anomaly profiles along survey lines are presented in Figure XIII-4. We could not obtain geomagnetic data during the first leg of the cruise. because of malfunction of a magnetometer. Unfortunately, survey lines normal to the NNW striking trough and ridge system, which would be the expected spreading direction of the Penrhyn Basin, are not available. Thus we could not define general magnetic lineations of seafloor-spreading origin, but no such lineations can be recognized. Amplitude of the anomaly is relatively small throughout the area, usually less than ± 300 nT, and the wavelength of variation appears to be short. These features are consistent to the previous idea that the Penrhyn Basin belongs to the Cretaceous Magnetic Quiet Zone.

Results of the geomagnetic measurements in the Western and Central Pacific underway from the GH83-3 area were reported by Nakanishi *et al.* (1992).

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