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VII. MAGNETIC AND GRAVITY ANOMALIES OF THE OFFSHORE TOKAI REGION

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Data processing

Magnetic and gravity field measurements were conducted during the GH97 cruise. Data from a proton precession magnetometer and a marine gravimeter were transferred to a GPS-based navigation system, and digitally recorded on magnetic tapes in this

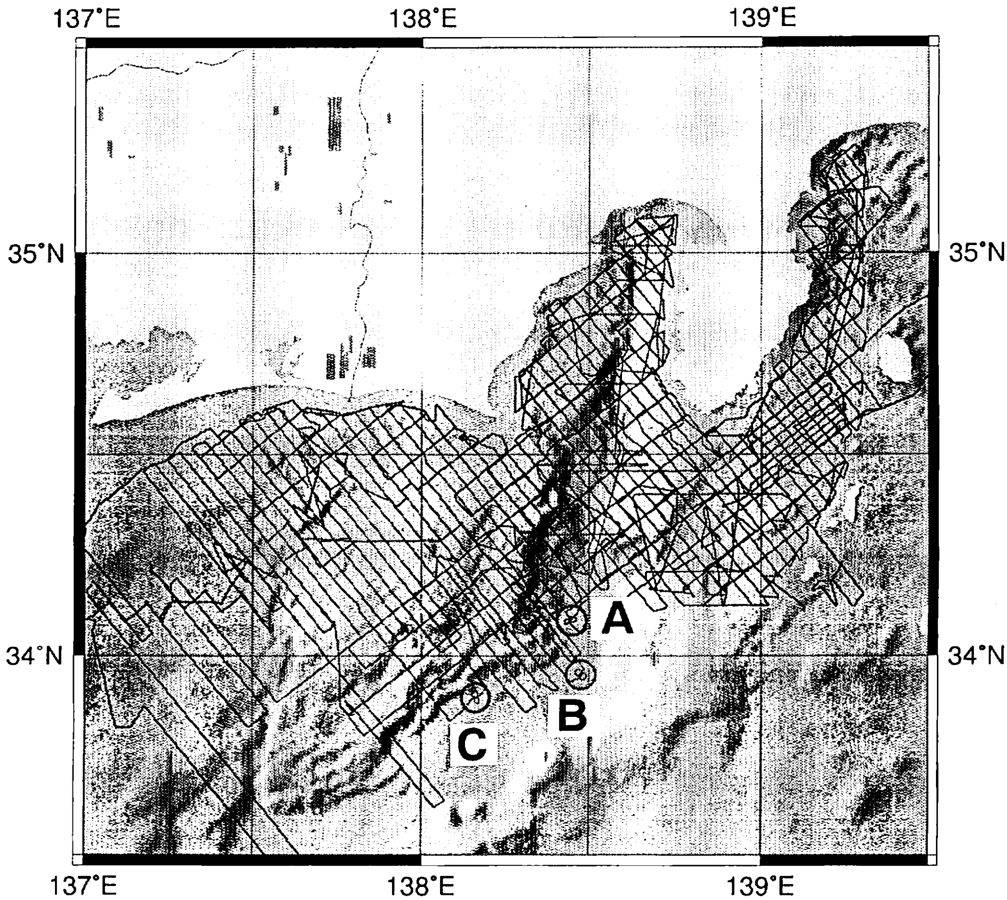

Fig. VII-1 Tracks during GH97 cruise, where onboard three-component magnetometer data were obtained. Locations of figure-8 calibration are also shown. Seafloor topography is expressed by an image with illumination from NW.

Keywords: magnetic anomalies, gravity anomalies, offshore Tokai region

system. These data tapes were read by an HP-UX workstation and onboard data processing was carried out on this computer. Data from a three-component magnetometer were transferred to a SUN Sparc 10 UNIX computer via the LAN for data processing.

The total magnetic field was measured using a Geometrics G866 proton precession magnetometer, that was towed about 200 m astern the ship's tail in order to avoid the magnetic effect of the vessel. Six digits of digital data with a resolution up to 0.1 nT can be obtained at 10 s interval from the magnetometer, but the actual accuracy was probably about 1 nT or worse due to a high noise level during the cruise. Magnetic anomaly values were obtained by subtracting IGRF95 values, which can be calculated using geographic co-ordinates and date (year, month and day) information, from the observed total field values. No correction was made for the diurnal magnetic variation.

The three-component magnetic field was also measured using an SFG 1211 onboard fluxgate magnetometer manufactured by Tierra Tecnica Co. (Fig. VII-1). The original three-component magnetic data, which were measured in a co-ordinate system fixed to the ship, were digitally collected at 1/8 s interval together with pitch and roll information measured by an inclinometer and heading information obtained from the ship's gyrocompass. One-second data were made by averaging the original 8 Hz data, and used for later processing. In order to correct the ship's magnetic effect, the magnetometer requires that the ship rotate to make a figure-8. These calibrations were made at three locations as shown in Fig. VII-1. We used all the one-second data obtained during the three calibration periods, and calculated coefficients for correction of the ship's magnetic effect (Table VII-1). One-second values were corrected making use of these coefficients, transformed to a co-ordinate system fixed to Earth: X (north), Y (east) and Z (down). Then, one-minute values were obtained by averaging the corrected and transformed one-second values.

The gravity field was measured using a LaCoste & Romberg straight-line marine gravimeter SL-2 on a stabilized platform. Digital data were collected at a 10 s interval. Drift correction and conversion from gravimeter readings to absolute gravity values were made using readings at Funabashi port. The Eötvös correction was applied using easterly speed and latitude information. Free-air anomaly values were obtained subtracting IAG 1967 reference field formula, which is a function of latitude, from the obtained absolute gravity values. The gravimeter showed a large negative drift (about -1 mGal/day during GH94 cruise in 1994) just after a service of its sensor unit in 1993. The drift gradually decreased, and it finally became positive (+ 0.056 mGal /day) in GH97 cruise as before the service in 1993. Fig. VII-2 shows tracks, where gravity data were obtained. Accurate gravity data were not available near the start and

Table VII-1 Calibration coefficients for the three-component magnetometer onboard Hakurei-maru during GH97 cruise.

B(1,1)= 1.00190	B(1,2)= 0.02175	B(1,3)=-0.07616	Hph=-2907.1
B(2,1)=-0.01978	B(2,2)= 1.35547	B(2,3)= 0.03821	Hps= 4695.8
B(3,1)=-0.06107	B(3,2)= 0.05719	B(3,3)= 1.00846	Hpv=-2705.3

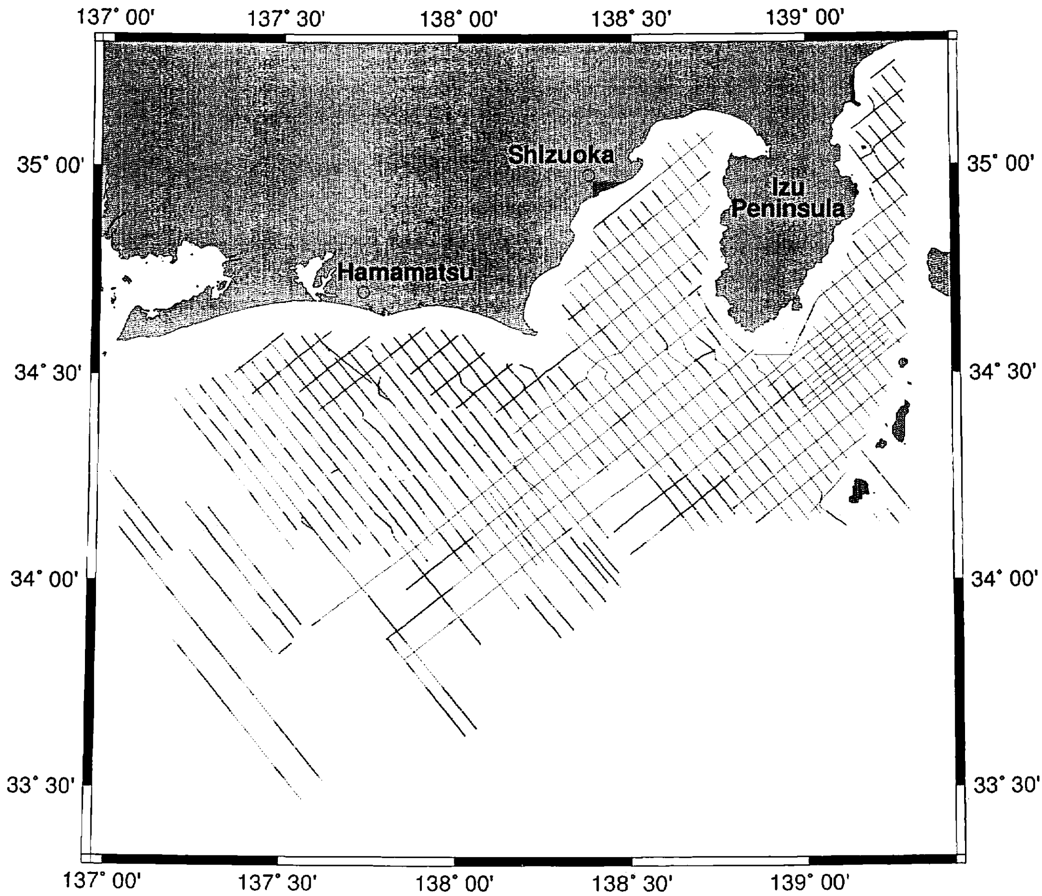

Fig. VII-2 Track lines during TH97 cruise, where gravity data were collected.

end points of each line, because the stabilized platform cannot be maintained horizontal when the ship changes her course. These data were excluded from further data processing. The accuracy of the gravity measurements can be estimated from the distribution of the cross-over differences. Fig. VII-3 below shows a histogram of the cross-over differences with a standard deviation of 2.78 mGal for total of 301 cross-over points. The standard deviation decreases to 1.55 mGal by applying a constant bias to each of cross-over track lines (Fig. VII-3 above). The data set after this adjustment with a constant bias to each line was used to make a gridded data file.

A 0.5' x 0.5' gridded data file was created for each of magnetic and gravity anomalies. We made a magnetic and a free-air gravity anomaly contour map at 50 nT and 5 mGal intervals, respectively, using these gridded data files.

Results

The offshore Tokai region can be divided into three parts on the basis of magnetic characteristics: east of Izu Peninsula, Suruga Bay and Enshu-nada Sea (Fig. VII-4). The area east of Izu Peninsula, which has a rugged topography with many small

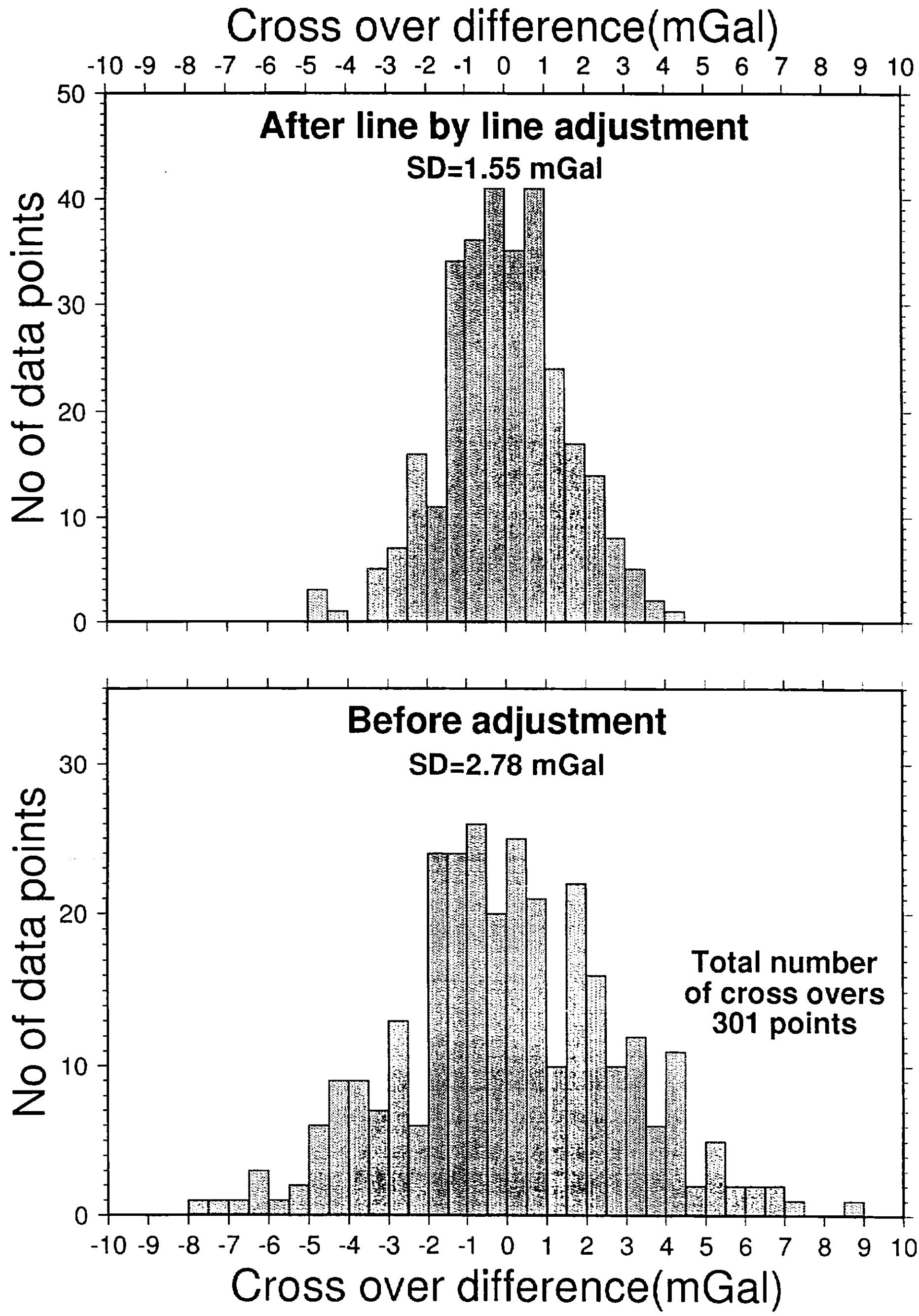

Fig. VII-3 Histograms of cross-over differences of free-air gravity anomalies. Below is for data without adjustment. Above is for data after adjustment by giving a constant bias to each track line to minimize the cross-over differences.

knolls, is magnetically characterized by short wavelength (of several km) and large amplitude anomalies (hundreds of nT). Magnetic anomalies in the Suruga Bay, including its southward extension, have a characteristic wavelength of 10 to 20 km and an amplitude of 100 to 200 nT. The amplitude of the anomalies decreases to less than 100 nT with a longer wavelength in Enshu-nada Sea. Volcanic rocks, which are probably sources of magnetic anomalies, almost crop out east of Izu Peninsula. It is inferred that the depth of the source rocks increases toward west, and that thick sedimentary rocks cover the seafloor of Enshu-nada Sea.

Free-air anomalies reflect long-wavelength component of the seafloor topography (Fig. VII-5). The observed anomalies generally show a NE-SW trend, which probably reflects a structual trend perpendicular to the direction of subduction of the Philippine Sea Plate. Free-air anomalies have two minimums in the Suruga Trough: the northern one of about -55 mGal and the southern one of about -65 mGal. Another minimum of about -70 mGal occurs further south in the Nankai Trough. Just east of the Suruga Trough, the Izu Spur, which extends SSW-ward from Cape Irozaki of Izu Peninsula, is associated with a NNE-trending positive anomaly belt with a maximum up to 70 mGal. Two NE-trending belts of high positive anomalies occur further southeastward: one, which passes through Toshima Island, Takase and Hyotanse

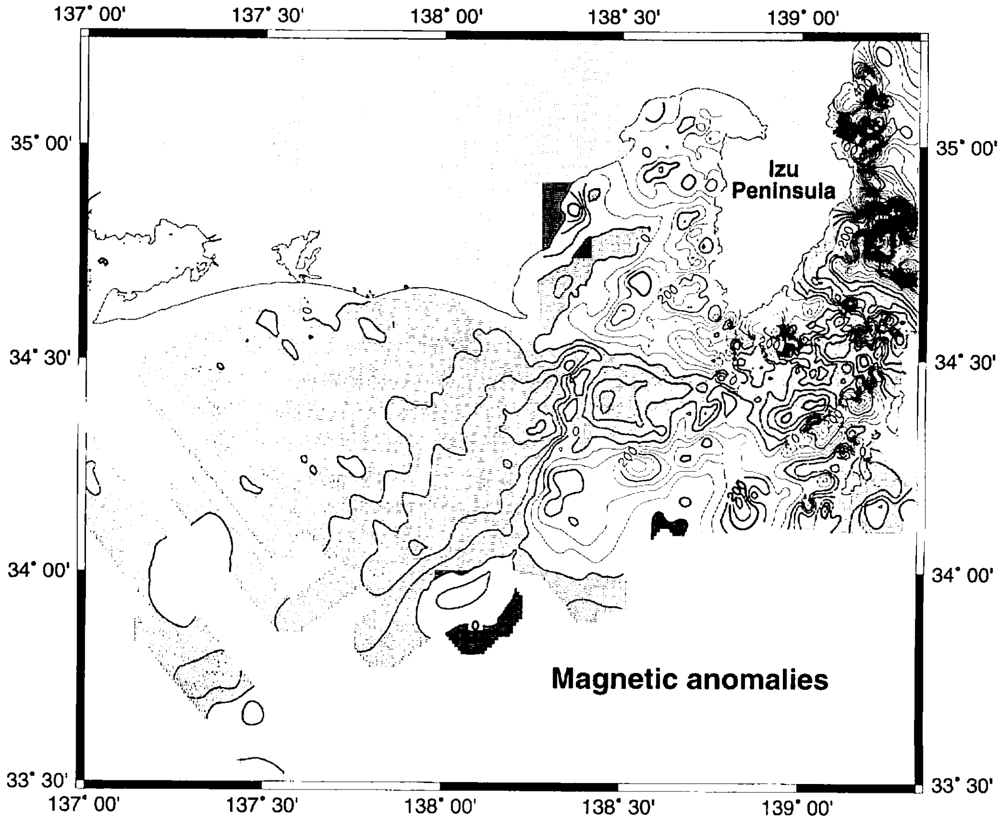

Fig. VII-4 Magnetic anomaly map of GH97 area. Contour interval is 50 nT. Negative anomalies are shown in dark grey.

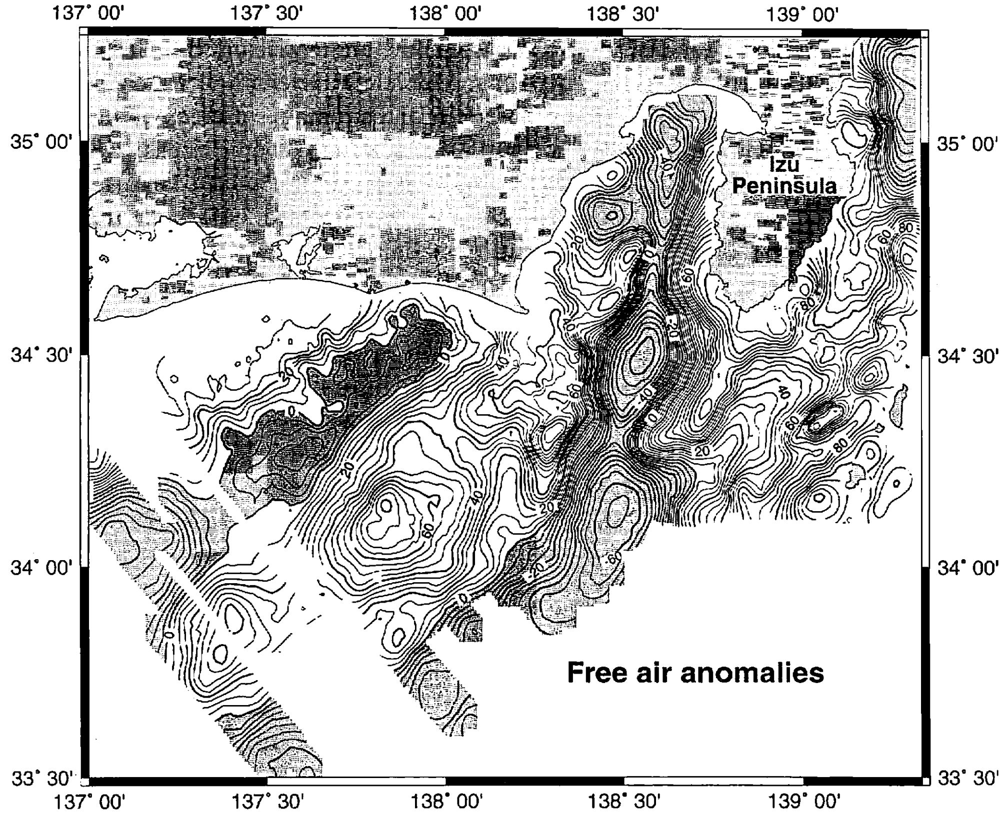

Fig. VII-5 Free-air gravity anomaly map of GH97 area. Contour interval is 5 mGal. Negative anomalies are shown in dark grey.

shallows, and the other, which passes through Niijima and Kozushima Islands and Zenisu. Both belts have maximum anomalies of about 120 mGal. To the northwest of the Suruga and Nankai Troughs, a broad positive anomaly belt extends southwestward from Cape Omaezaki, and covers the Daiichi, Daini and Daisan-Tenryu Knolls and Daiichi and Daini-Atsumi Knolls in Enshu-nada Sea. Daini-Tenryu Knoll is associated with a maximum anomaly of about 80 mGal. A prominent maximum of almost 90 mGal occurs not in the Omaezaki Spur just off Cape Omaezaki, but further offshore near Kanesunose just west of the Nankai Trough. The gravity gradient is very steep east of Kanesunose. The Enshu Trough, to the west of the broad positive anomaly belt in Enshu-nada Sea, is associated with a negative anomaly belt that has an amplitude of -10 to -20 mGal. The negative anomaly belt continues southwestward to the Kumano Trough. The amplitude of the negative anomalies becomes larger southwestward.