IV. GRAVITY SURVEY IN THE GH78-1 AREA

Takemi Ishihara

Gravity measurement was conducted throughout the cruise using LaCoste and Romberg sea gravimeter S-63. We had two kinds of trouble in the gravity measurement in this cruise: One problem is concerned with the meter drift and the other is concerned with noise in gravity measurement.

With regard to the former problem, readings of the sea gravimeter at ports are shown in Table IV-1. In this table the meter zero, which is calculated by subtracting the gravity reading multiplied by the scale factor (0.9992 for S-63) from the absolute value at a port, means the absolute gravity value in milligals for gravity reading 0 and the change of the meter zero indicates the gravity meter drift (NETTLETON, 1976). Due to 4-months long heating off after August 12 the meter zero decreased greatly, but after heating up on December 21, it increased rapidly and approached its normal value again.

Table IV-1 Gravity readings at ports

Port	Absolute Gravity Value*	Date	Gravity Reading	Meter Zero
Funabashi	979789.38	Aug. 12, 1977	10686.7	969111.5
		Dec. 21	10749.4	969048.6
		Dec. 29	10736.7	969061.3
		Jan. 7, 1978	10723.1	969074.9
Majuro	(978308.1)**	Jan. 15	9231.1	(969084.4)
		Jan. 18	9228.8	(969086.7)
Suva	978624.57***	Feb. 9	9513.3	969118.9
Funabashi	979789.38	Mar. 7	10692.5	969105.4

* Absolute gravity value in milligals at mean sea level tied to IGSN 71.
** Calculated from the gravity reading in Majuro during GH77-1 cruise.
*** Tied to the gravity station in the office of the Mineral Resources Department of Fiji (Absolute value 978614.70 mgal).

In order to clarify still more the cause of this anomalous meter drift, the meter zero since 1975 is shown in Fig. IV-1. It is obvious that almost all of the meter zero values after cruises are near the smooth curve, which is shown by the dashed line, while those before cruises tend to lie below the curve and this effect is very remarkable in the case of GH77-1 and GH78-1 cruises, before which heating off is very long. Since GH78-2 cruise the gravimeter has been always heated and the phenomenon of the anomalous drift disappeared. These facts clearly show that heating off the gravimeter caused the anomalous drift. Taking account of the rapid recovery of the meter zero before the cruise, we simplified the drift rate for the calculation of gravity values in this cruise to

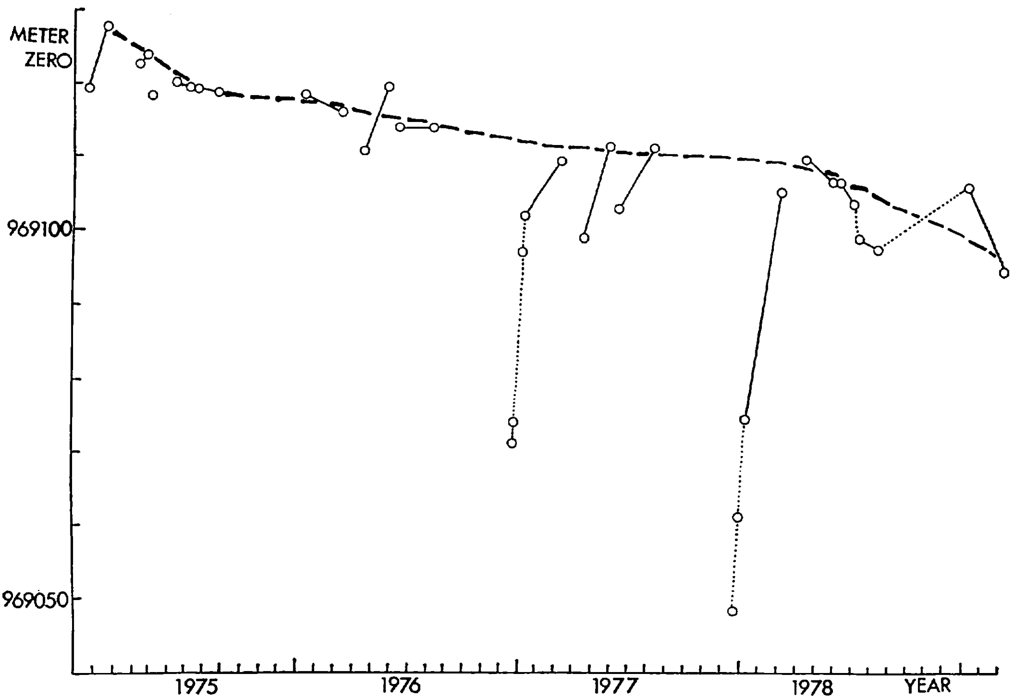

Fig. IV-1 The meter zero for LaCoste and Romberg sea gravimeter S-63 since 1975.

be 3 mgals/day from January 7 to January 15 and to be 0 mgal/day from January 18 to March 7.

The latter is the problem of noise with the period of 4–6 minutes and this noise seemed to become high when the ship heaved heavily. A typical chart record is shown in Fig. IV-2. It is apparent from this figure that the gravity reading GR is highly correlated with the total correction TC. GR is the sum of TC and 3-minutes average of the spring tension ST, while TC is the sum of the total cross coupling CC and the average beam velocity BV:

$$GR = TC + \overline{ST},$$

$$TC = CC + BV.$$

CC does not have such a large amplitude oscillation as TC does, so we reach a conclusion that BV causes the noise in TC, which means also the noise in GR. In fact after the cruise this noise turned out to be due to the optical block which detects the beam position. In order to decrease the noise we applied the following simple filter to the average beam velocity and calculated corrected gravity values:

$$\overline{BV}(t) = \sum_i f_i BV_i / \sum_i f_i.$$

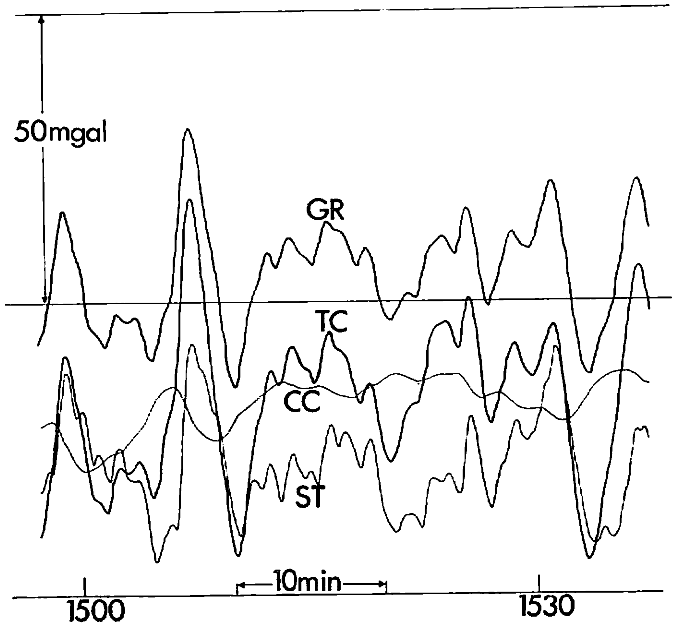

Fig. IV-2 A chart record section from data on January 22, 1978. GR, gravity reading; TC, total correction; CC, total cross coupling; ST, spring tension.

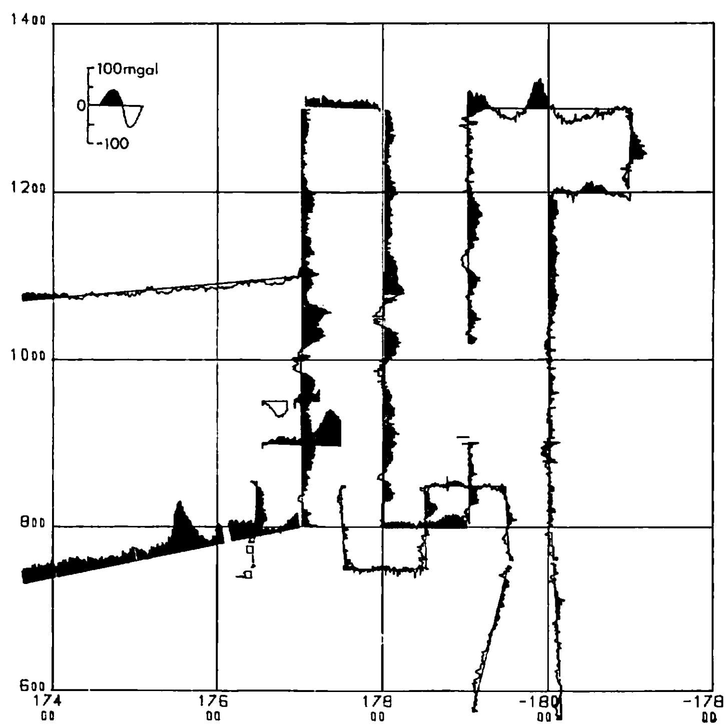

Fig. IV-3 Free air anomaly profiles in the survey area.

where $f_i = \sin[\pi(t_i - t)/T]/[(t_i - t)/T], \quad -T < t_i - t < T,$

$= 0, \qquad t_i - t < -T \text{ or } t_i - t > T,$

and T = 10 min.

The error of gravity values probably decreased to be the order of 10 mgals through this procedure.

Result

Free air anomaly profiles are shown in Fig. IV-3. Free air anomalies southeast of the survey area are very flat and almost 0 mgal, while in the mountainous region southwest of the survey area they have an amplitude up to 100 mgal peak to peak and are highly correlated with the bathymetry. The seamount which is located about at 13°N, 180° is accompanied by a remarkable negative free air anomaly region around it.

Although anomaly values are generally positive in the earlier part of the cruise (in the western part of the survey area), this is due to the misestimate of the gravimeter drift. If we adopt the meter zero value on January 18 in Majuro in Table IV-1 and recalculate the gravity anomalies, the average of anomaly values in the earlier part will become close to 0.

Reference

NETTLETON, L. L. (1976) *Gravity and Magnetics in Oil Prospecting.* McGraw-Hill Book Company, New York.