

Preliminary Report  
of  
The Hakuhō Maru  
Cruise KH-68-3

July-August, 1968  
Northwest Pacific Ocean

Ocean Research Institute  
University of Tokyo

1968

Table of total magnetic force, and local magnetic force at every 5 min with ship position and water depth at every 10 min between 07<sup>h</sup>00<sup>m</sup>, July 19, 1968 and 08<sup>h</sup>00<sup>m</sup>, August 15, 1968 is available as Appendix.

It will be sent separately upon request.

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By  
The Members of Expedition

Edited by  
Yoshibumi Tomoda

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1. List of Scientists on board during the cruise KH-68-3

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Scientists from the Ocean Res. Inst.

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Geophysics.

Yoshio HORIBE, D. Sc., Professor of Marine Inorganic  
Chemistry.

Koji SHIGEHARA, D. Sc., Research Associate of Marine  
Inorganic Chemistry.

Ei-ichi HONZA, Research Associate of Submarine Sedimentology.

Jiro SEGAWA, Research Associate of Submarine Geophysics.

Kazuhiro KITAZAWA, Research Associate of Submarine Geophysics.

Masao INOUE, Research Associate of Submarine Sedimentology.

Kinichiro KOIZUMI, Technical official.

Minoru TANO, " "

Visiting Scientists.

From Earthquake Res. Ins., Univ. of Tokyo, Hongo, Tokyo.

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From Inst. for Nuclear Study, Univ. of Tokyo, Tanasi, Tokyo.

Teruo INOUE, Technical Assistant.

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Hiroichi HASEGAWA, D. Sc. Professor of Physics.

Akira FUJIWARA, Technical Assistant.

From Fac. of Liberal Arts, Toyama Univ., Toyama.

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From Hydrographic office, Bureau of Marine Security.

Yuzuru SUZUKI, Technical official.

Yasuhiro GANEKO, Technical official.

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Shoichi OSIMA, " " .

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Osahiro ISESAKI, Graduate Student.

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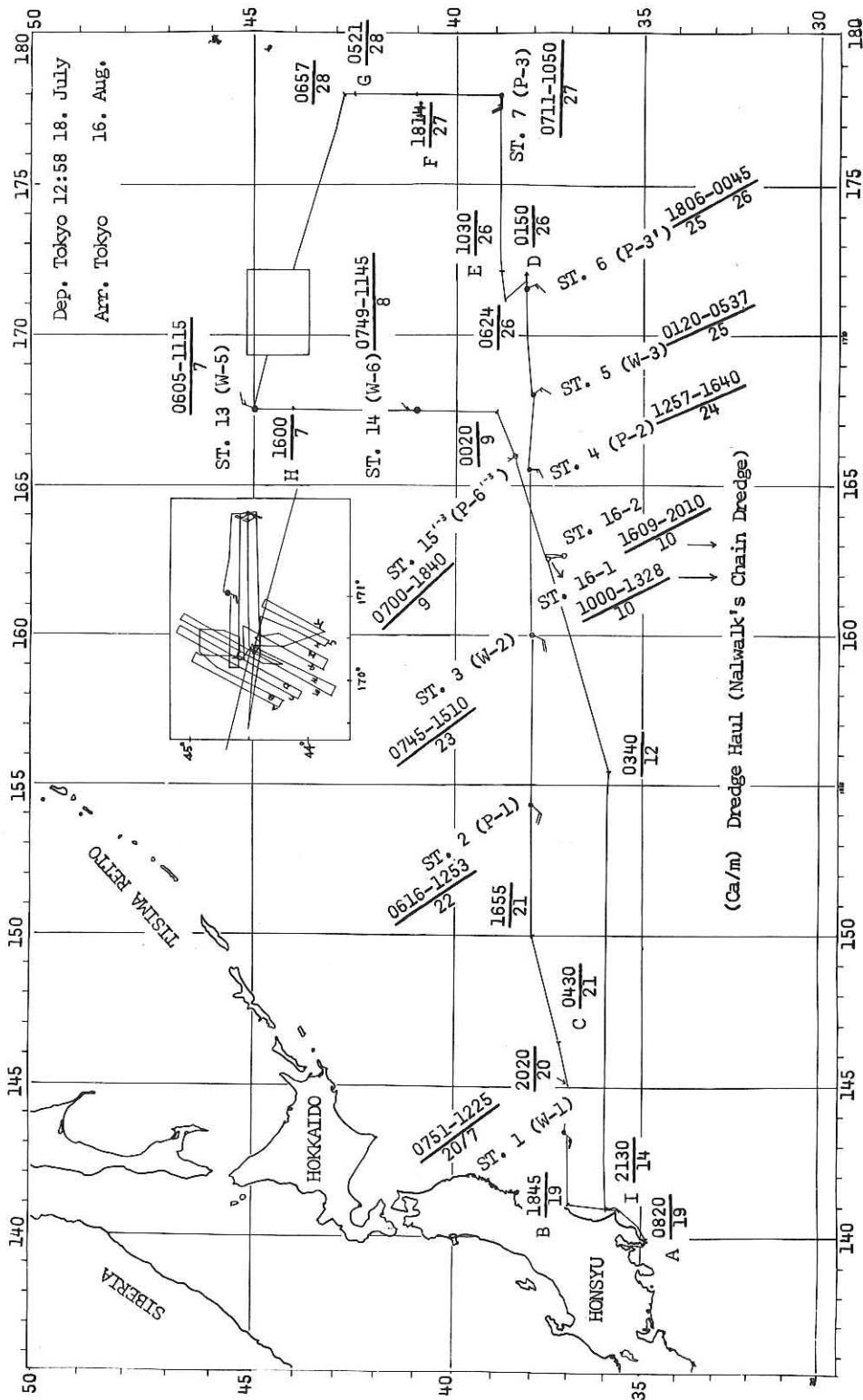
Shigeo IWAMURA, Graduate Student.

## 2. General Records of the Cruise KH-68-3.

Voyage No. KH 68 - 3

DATE	NOON POSITION		Under Way		Propelling			Oceano graphic Log			
	lat.	long.	hours	miles	hours	miles	average speed	Various Propelling Drifting			
								hours	miles	hours	miles
7.19	35-25.6N	140-47.6E	23-02	104.7	90-15	104.7	11.3				
20	37-05.3	143-31.6	24-00	187.4	13-47						
21	38-42.7	148-34.0	24-00	252.4	06-45	96.7	14.3	13-06	85.3	04-09	5.4
22	38-02.0	154-17.5	24-00	271.9	07-15	99.0	13.7	16-15	152.4	00-30	1.0
23	37-59.0	160-01.0	24-00	211.1	18-10	259.0	14.2			05-50	12.9
24	38-05.4	165-15.0	24-00	249.4	18-52	209.4	11.2			05-08	1.7
25	38-08.0	169-46.7	24-00	211.0	20-40	246.6	11.9			03-20	2.8
26	38-52.4	172-31.9	24-00	203-2	15-10	207.1	13.7			08-50	3.9
27	39-35.2	178-01.2	24-00	270.7	07-50	107.7	13.8	09-00	93.2	07-10	2.3
28	43-01.0	176-51.3	24-00	258.1	20-05	270.1	13.4			03-55	0.6
29	44-28.6	170-20.7	24-00	295.9	11-53	145.2	12.2	12-07	112.9		
30	44-12.6	170-11.2	24-00	208.3	23-40	294.8	12.4	00-20	1.1		
31	44-36.0	170-15.5	24-00	217.2				21-01	206.1	02-59	2.2
8. 1	44-36.6	170-17.2	24-00	180.2				21-15	214.1	02-45	3.1
2	44-06.3	170-35.5	24-00	162.2				18-28	176.2	05-32	4.0
3	44-27.4	170-25.0	24-00	138.5				21-07	160.2	02-53	2.0
4	44-28.3	171-58.4	24-00	98.9				24-00	138.5		
5	44-41.6	171-02.4	24-00	138.6				13-16	95.6	10-44	3.3
6	44-28.0	170-24.0	24-00	231.4				13-30	131.0	10-30	7.6
7	44-49.2	167-32.1	24-00	152.0	15-20	199.9	13.1	06-30	29.7	02-10	1.8
8	40-59.8	167-31.0	24-00	232.7	00-28	6.0	12.8	18-05	140.5	05-27	5.5
9	38-26.8	165-58.4	24-00	206.3	19-20	229.0	11.9	00-12	1.4	04-28	2.3
10	37-36.8	162-37.0	24-00	184.7	17-17	202.5	11.7			06-43	3.8
11	36-58.0	159-58.1	24-00	211.9	14-55	178.2	12.0			09-05	6.5
12	35-57.7	154-21.1	24-00	281.0	15-59	202.6	11.3	01-53	7.2	04-08	2.1
13	35-57.5	148-42.5	24-00	275.8	24-00	281.0	11.7				
14	36-01.1	142-48.4	24-00	289.4	24-00	275.8	11.5				
15	Tokyo Quarantine Anchorage		24-00	238.9	20-35	263.6	12.8	03-25	25.8		
					20-41	237.2	11.5	00-17	1.7		
TOTAL			671-02	5963.8	350-59	4116.1	11.8	213-47	1772.9	106-16	74.8

wind		Wea- ther	Baro. (In MBS)	Temperature		Remark
direc- tion	force			Air	Sea	
SSW	4	bc	11.3	24.0	20.8	18th 1258 Left Tokyo
SW	5	c	12.6	24.4	23.1	
WSW	5	c	13.5	22.6	20.7	
SW	4	0	13.8	21.6	20.1	
SSW	4	bc	17.7	22.0	20.5	
S	5	bc	25.5	22.3	21.0	
SE	3	b	29.8	22.8	22.0	
S	3	c	27.2	21.6	20.7	
W	5	f	18.0	20.8	19.3	
WNW	5	0	07.2	15.7	15.3	
NW	3	0	12.7	12.0	11.8	
NE	3	0	15.7	13.2	13.5	
NE	1	0	24.0	13.5	12.3	
ESE	4		24.7	12.8	12.3	
SW	7		07.2	16.4	13.7	
NNE	4	c	18.5	11.4	12.0	
NNW	4	0	14.7	11.0	11.2	
SSW	5	f	02.2	14.2	10.9	
WNW	6	0	98.5	13.4	13.7	
N	2	0	12.4	13.0	12.0	
N	3	0	19.8	16.9	17.6	
NW	1	bc	21.2	22.0	22.3	
	Calm	b	21.2	23.5	24.8	
S	1	bc	19.2	25.8	25.3	
S	3	bc	15.5	27.2	25.9	
WNW	3	bc	10.5	25.0	26.4	
S	3	c	14.5	26.4	26.4	
S	3	bc	13.2	28.0	27.5	0858 Arrived at Tokyo Quarantine Anchorage



W - - Water Sampling with Nansen Cast • B-C, D-E, F-G, St.9-St.12,H-I, Reflection Profiling Survey with Air gun  
P - - Mud Sampling With Piston Coring • A-I, Geomagnetic Survey with Proton Magneto Meter

List of RESEARCH STATIONS during the cruise KH-68-3

St. No.	Position Lat.N Long.E	Arrival Date Time	Depart Time	Water Depth	Research & Ovservation
1	37°05' 143°31'	July20 07 <sup>h</sup> 30 <sup>m</sup>	12 <sup>h</sup> 30 <sup>m</sup>	7270 <sup>(m)</sup>	Nansen Cast
2	38°01' 154°10'	July22 06 <sup>h</sup> 15 <sup>m</sup>	12 <sup>h</sup> 57 <sup>m</sup>	5850	Piston Coring (68mm-6m Al) ---failed to sample
3	38°00' 160°00'	July23 07 <sup>h</sup> 45 <sup>m</sup>	15 <sup>h</sup> 10 <sup>m</sup>	5290	Nansen Cast
4	38°07' 165°30'	July24 12 <sup>h</sup> 57 <sup>m</sup>	16 <sup>h</sup> 40 <sup>m</sup>	5420	Piston Coring (68mm-6m Al) --266cm sampled
5	38°00' 168°01'	July25 01 <sup>h</sup> 20 <sup>m</sup>	05 <sup>h</sup> 37 <sup>m</sup>	5380	Nansen Cast
6	38°11' 171°29'	July25 18 <sup>h</sup> 00 <sup>m</sup>	July26 00 <sup>h</sup> 45 <sup>m</sup>	6010	Piston Coring (130mm-8m Stainless steel) -failed
7	39°20' 178°01'	July27 07 <sup>h</sup> 10 <sup>m</sup>	10 <sup>h</sup> 50 <sup>m</sup>	5560	Piston Coring (68mm-6m Al) --242cm sampled
8	42°37' 178°01'	July28 05 <sup>h</sup> 30 <sup>m</sup>	05 <sup>h</sup> 43 <sup>m</sup>	5830	Piston Coring Skipped due to bad weather condition.
9-1	44°28' 170°24'	July29 12 <sup>h</sup> 30 <sup>m</sup>	14 <sup>h</sup> 10 <sup>m</sup>	1262	Setting of the Ocean Bottom Seismograph.
9-2	44°26' 170°23'	July29 15 <sup>h</sup> 25 <sup>m</sup>	16 <sup>h</sup> 44 <sup>m</sup>	1293	Setting of the Bottom Current Meter.
9-3	44°29' 170°22'	July30 14 <sup>h</sup> 21 <sup>m</sup>	17 <sup>h</sup> 45 <sup>m</sup>	1215 -1200	Dredge Haul (Nalwalk's Chain Dredge)-- 2 kg rock sampled.
9-4	44°38' 170°15'	July31 10 <sup>h</sup> 10 <sup>m</sup>	12 <sup>h</sup> 20 <sup>m</sup>	1265 -1319	Dredge Haul (Stainless Pipe Dredge)--26 small rocks sampled.
9-5	44°35' 170°17'	July31 12 <sup>h</sup> 40 <sup>m</sup>	15 <sup>h</sup> 35 <sup>m</sup>	1150	Dredge Haul (Nalwalk's Chain Dredge)--many pebbles & granules sampled.
9-6	44°35' 170°20'	Aug.1 08 <sup>h</sup> 15 <sup>m</sup>	10 <sup>h</sup> 00 <sup>m</sup>	1385	Dredge Haul (Nalwalk's Chain Dredge)-- 6 rocks sampled.
9-7	44°37' 170°18'	Aug.1 10 <sup>h</sup> 21 <sup>m</sup>	13 <sup>h</sup> 00 <sup>m</sup>	1365	Dredge Haul (Nalwalk's Chain Dredge)-- 100 kg rocks sampled.

St. No.					
9-8	44°38' 170°17'	Aug.1 14 <sup>h</sup> 15 <sup>m</sup> 16 <sup>h</sup> 30 <sup>m</sup>	1195 -1232	Dredge Haul (Nalwalk's Chain Dredge)-- 50 kg rocks sampled.	
*	44°28' 170°24'	Aug.3 05 <sup>h</sup> 00 <sup>m</sup> 11 <sup>h</sup> 42 <sup>m</sup>		Recovery of the Ocean Bottom Seis- mograph-- failed due to a break of wire.	
9-9	44°30' 170°25'	Aug.3 14 <sup>h</sup> 03 <sup>m</sup> 17 <sup>h</sup> 14 <sup>m</sup>	1275 -1290	Dredge Haul (Nalwalk's Chain Dredge with speci- al devices for sea- rch of the lost seismograph)--100kg rocks sampled.	
*	44°26' 170°23'	Aug.3 17 <sup>h</sup> 14 <sup>m</sup> 20 <sup>h</sup> 40 <sup>m</sup>		Recovery of the Bottom Current Meter--recovered.	
10	44°31' 172°00'	Aug.4 05 <sup>h</sup> 20 <sup>m</sup> 20 <sup>h</sup> 40 <sup>m</sup>	5910	Nansen Cast	
11	44°27' 171°59'	Aug.4 11 <sup>h</sup> 17 <sup>m</sup> 18 <sup>h</sup> 50 <sup>m</sup>	5925	Piston Coring 1. 68mm-1'm Al-- 565 cm sampled. 2. 68mm-6m Al-- only a few cm.	
12	44°40' 171°00'	Aug.5 09 <sup>h</sup> 00 <sup>m</sup> 14 <sup>h</sup> 00 <sup>m</sup>	6370	Piston Coring (68mm-12m & 6m) failed due to sandy bottom ?	
13	44°59' 167°31'	Aug.7 06 <sup>h</sup> 05 <sup>m</sup> 11 <sup>h</sup> 15 <sup>m</sup>	5670	Nansen Cast	
14	41°00' 167°30'	Aug.8 07 <sup>h</sup> 49 <sup>m</sup> 12 <sup>h</sup> 10 <sup>m</sup>	5615	Nansen Cast	
15	38°28' 165°58'	Aug.9 07 <sup>h</sup> 00 <sup>m</sup> 18 <sup>h</sup> 40 <sup>m</sup>	5505	Piston Coring 1. 80mm-5m S.S. --459cm sampled.	
	26' 59'		5492	2. 68mm-12m Al --970cm sampled.	
	26' 59'			3. 68mm-6m Al --550 cm sampled.	
16-1	37°37' 162°37'	Aug.10 10 <sup>h</sup> 04 <sup>m</sup> 13 <sup>h</sup> 00 <sup>m</sup>	3350	Dredge Haul (Nalwalk's Chain Dredge)-- ooze and sand only.	
16-2	37°07' 162°39'	Aug.10 16 <sup>h</sup> 09 <sup>m</sup> 20 <sup>h</sup> 12 <sup>m</sup>	4400 -2900	Dredge Haul (Nalwalk's Chain Dredge)-- 23 rocks, many pumices & Mn- nodules sampled.	

### 3. Outline of Gravimetry, Magnetism and Bathymetry.

Y. Tomoda

S. Oshima

O. Isezaki

J. Segawa

Y. Ganeko

Y. Suzuki

#### Gravimetry.

Three sets of ship borne gravity meters were installed on board the ship. Among these, two sets are Model T-S-S-G (T-S-S-G 66, and T-S-S-G 61) developed at the Ocean Research Institute, and the other is Model G.S.I. developed at the Geographical Survey Institute.

Two sets of T-S-S-G's were placed in the gravity meter room of the ship and the data of each set were analyzed by different methods. In the case of Model 66, information on the precise vertical acceleration of the gravity meter was perforated on the paper tapes and the gravity value was calculated with the aid of the electronic computer Facom 270-20, installed on board the ship. On the other hand, information on the precise vertical acceleration of the gravity meter in the case of Model 61 was fed to the small electronic computer (Model P3, T.D.K.) directly connected to the gravity meter, and the results were obtained by "on-line use" of the computer. The results of these two sets of gravity meters were obtained every 10 min.

The model 66 worked perfectly and 95% of the measured result was determined within the accuracy of 1-2 mgals.

The Model 61 often had trouble with the data processing unit. The trouble did not seem to be caused by the computer itself but seemed to be caused by the interfacing device of the gravity meter and the computer.

The G.S.I. type gravity meter has no data analyzing unit on board the ship, and the final results will be obtained at Geophysical Survey Institute. The approximate value was estimated by the use of the monitoring device which calculated the mean value of acceleration, and the results, when the sea was calm enough, were compared with the results of T-S-S-G.

A computer program for analyzing the results of T-S-S-G 66 was made on board the ship. The program will be described



in the other section of this report. By the use of the program, it takes 2-3 min. to obtain a gravity value based on the vertical acceleration of 8 min observation.

The Eötvös correction was calculated by the use of the ship position given at intervals of 30 min.

The ship positions were manually perforated on the paper tapes and the calculation was also carried out by the use of the Facom 270-20.

The results of the "grid survey" on the "Suiko Seamount" were obtained and a free air gravity anomaly map was made during the cruise, although correction for the drift of the meter was not taken into consideration.

### Magnetism.

Total magnetic force was measured every 1 min by the use of the proton magnetometer.

The data were plotted manually and after smoothing out few erratic data, the average values were read at intervals of 5 min and manually perforated on the paper tapes. Local magnetic anomalies were also obtained as the differences between the measured values and the standard magnetic reference field.

In addition to the towed proton magnetometer, the Rubidium magnetometer (Varian model), and the DZ (Declination and Vertical component) magnetometer were installed at the Compass Bridge of the ship.

Vertical component caused by the magnetization of the ship at the compass bridge exceeds 15,000  $\gamma$  and the variation of the vertical component caused by the motion of the ship exceeds 300  $\gamma$ . Therefore measurement of vertical component of the earth's magnetic field was not successful in this cruise. The measurement of declination was successfully carried out throughout the cruise, and it was found that the measurement of declination anomaly on board the ship within the accuracy of 10-20' was not a difficult problem as far as the ship sailed along a fixed direction.

Magnetic profiles were made along the whole track and a

magnetic contoured map was made on the Suiko Seamount.

### Bathymetry.

Measurement of the water depth was carried out by the use of the Precise Depth Recorder. The water depth was read out every 10 min and manually punched on paper tapes together with the ship position, total magnetic force and local magnetic anomaly.

From the results of the grid survey at the Suiko Seamount, a bottom topography map was made, and large discrepancy between this and the former bathymetric data was found.

#### 4. Bottom Topography and Local Magnetic Anomaly Profiles.

Profiles of the bottom topography and the local magnetic anomaly are shown in Figs. 4-2 ~ 4-5, a position index map of these profiles is shown in Fig. 4-1.

Fig. 4-2 is a profile from Sioya ( $36^{\circ}51' \text{ N}$ ,  $141^{\circ}52' \text{ E}$ ) to ( $39^{\circ}22' \text{ N}$ ,  $178^{\circ}01' \text{ E}$ ), crossing the Japan Trench, the Northwest Pacific Rise, the Emperor Ridge and the North Hawaiian Rise.

Magnetic anomaly exceeding 500  $\gamma$  exists on the basin between the oceanic margin of the Japan Trench and the west margin of the Northwest Pacific Rise (Shatsky Rise). At the Northwest Pacific Rise, the magnetic anomaly is smaller than 200  $\gamma$  and irregular. Magnetic anomaly at the Ojin Seamount located in the Emperor Ridge is 500  $\gamma$  P-P and a negative anomaly of 400  $\gamma$  was found over the summit of the Sea mount where the water depth is 1200 m. The general Features of the profile are, as a whole, similar to the East to West profile along  $35^{\circ} \text{ N}$  (UMITAKA 1958), and the E-W profile along  $42^{\circ} \text{ N}$  (HAKUHO 1966).

Fig. 4-3-1 is the profile between ( $39^{\circ}35' \text{ N}$ ,  $178^{\circ}01' \text{ E}$ ) and ( $42^{\circ}40' \text{ N}$ ,  $178^{\circ}02' \text{ E}$ ), North to South section of the eastern part of the North Hawaiian Rise.

The bottom topography of that area is very irregular, like that of the crest of the Mid Oceanic Ridge. Although it

is said that the region is a kind of fracture zone, magnitude of magnetic anomaly is nearly 300 r everywhere and there is no isolated anomaly which is commonly found at the fracture zone.

Fig. 4-3-2 is the profile from (42°40' N, 178°02' E) to (44°59' N, 167°30' E) crossing the Suiko Seamount. On the east flank of the Seamount a deep zone (6410 m in the maximum depth) is clearly seen and further east, 120 miles from the crest of the Suiko Seamount, there is a small rise which seems to be linked to the North Hawaiian Rise. In this profile, it is worth noticing that the magnetic anomaly abruptly disappears on the eastern flank of the Suiko Seamount about 20 miles east from the crest. This feature is quite similar to that of the continental margin accompanied with a trench, and it is suggested that the basaltic layer is too deep there to reveal the observable magnetic anomaly at the surface.

Magnetic anomaly at the eastern margin of the Seamount is about 1000 r. Although the anomaly with a wave length of 10-15 miles is superposed, the anomaly in this section is regionally negative over 50-60 miles.

On the west side of the Seamount the anomaly becomes gradually smaller.

Fig. 4-4 is the profile from (44°49' N, 167°32' E) to (38°49' N, 167°02' E), crossing the Northwest Pacific Rise at its northernmost zone.

At this section of the Northwest Pacific Rise, magnetic anomaly is 200-300 r and seems to be large compared with its southern part. The amplitude of the anomaly at the crest is almost the same with the anomaly at both north and south Basin.

Fig. 4-5 is the profile from 38°48' N, 167°02' E to 35°53' N, 140°59' E. The east part of the profile shows the section nearly parallel to the topographic trend of the rise.

The amplitude of the magnetic anomalies is 400 r P-P, at the crest, and the anomaly continues to the basin west of the rise, gradually decreasing its amplitude to 300 r. No conspicuous magnetic boundary is recognized at the west margin between the basin and the rise, in contrast to the profile in Fig. 4-2.

There are small area between  $36^{\circ}01'$  N,  $149^{\circ}34'$  E and  $35^{\circ}58'$  N,  $149^{\circ}09'$  E and its west is the anomalous zone including the basin east of Japan Trench and the Kashima Seamount 2nd.

#### 5. Measurement of declination on board the ship.

A flux-gate type magnetic compass was installed on the compass deck of the ship. The sensor consists of flux-gate magnetometer mounted on the free gymbals. The gymbal mounting is rotated by means of the servo device to keep the direction of the sensor perpendicular to the magnetic north so that the magnetic flux in the axis of the sensor is always zero.

The direction of the flux-gate sensor is transmitted to an electric signal by the use of a selsyn motor. At the same time, the direction of the gyro compass is also electrically transmitted by a selsyn motor.

The angle difference between the flux-gate magnetic compass and the gyro compass is obtained by the use of a differential selsyn motor whose inputs are electric signals from the both selsyn motors.

The out-out shaft of the differential selsyn motor is linked to the potentiometer axis so that the out-put voltage is given from the potentiometer.

In order to decrease the noise caused by the fluctuation of the direction of the ship, low pass filter with a time constant of 1 min. is connected between the potentiometer and the recorder.

The angle deviation of the magnetic compass caused by the magnetization of the ship is about  $25^{\circ}$ . The deviation is compensated by several small permanent magnets and is reduced to less than  $4^{\circ}$ , and therefore, it is possible to measure the declination anomaly directly as far as the ship sails towards a fixed direction.

An example of the measurement of declination anomaly by

the use of the instrument at Suiko Seamount is shown in Fig. 5-1, together with the local magnetic anomaly in total force.

#### 6. The results of grid Survey on the Suiko Seamount.

The ocean bottom seismometer with a radio buoy was placed at the position of ( $44^{\circ}29'$  N,  $170^{\circ}22'$  E), 1242 m water depth, and a bottom current meter is set at the position of ( $44^{\circ}26'$  N,  $170^{\circ}22'$  E), 1300 m water depth.

In order to watch these instruments for 3 days, the area of grid survey between July 29. and Aug. 03. is restricted within the area of radius of 30 miles from these instruments. After the recovering operation of these instruments, the remained area around the Suiko Seamount was surveyed.

The bathymetric, gravimetric and magnetic surveys were carried out chiefly along the same lane of the Loran A (SS3S), which seems best for receiving in this area. Distance between the adjacent tracks was selected to be 5-10 miles according to the bottom topography. The track of the ship is shown in Fig. 6-1.

#### Bathymetry.

In order to find out the best positions for sampling rocks by dredge hauling, it was required to make a bathymetric chart as soon as possible. Therefore, the chart was made neglecting the velocity correction of sound assuming that the sound velocity is 1500 m/sec.

The bathymetric chart at Suiko Seamount is shown in Fig. 6-2.

As compared with an available Bathymetric chart (chart No. 6303) and the old data used for making the chart, discrepancy in depth greater than 2000 m was found at the northern part of the Seamount. As the result of the revision the width of the area shallower than 2500 m at E. to W. section at  $44^{\circ}50'$  N is only 15 miles in contrast to the reported value of 40 miles.

According to our new bathymetric chart the Suiko Seamount

consists of two mountains, the north Suiko and the South Suiko, and these two are aligned in the direction of about  $168^{\circ}$ . The summit of the North Suiko is 1070 m in water depth although 770 m is reported in the old survey. The summit of the South Suiko is 1730 m in water depth.

The tops of the Seamounts shallower than 1500 m are flat. The flat area of both tops are nearly round, 20 miles.

Like other Seamount belonging to the Emperor Ridge, the top area is characterized by a gentle slope. One of the typical examples of the topography at the top area is shown in Fig. 6-3. The flat top area is also characterized by several small hills like pyramids. The maximum height of these pyramids from their feet is about 80 m.

#### Free Air gravity anomaly.

As the correction of the drift of the gravity meter is not yet carried out, only relative values of the free air gravity anomaly are shown along the sections A-K, and a-b, in Fig. 6-4a, 6-4b. Maximum value of the free air gravity anomaly, +338 mgals was observed at  $44^{\circ}31' \text{ N}$ ,  $170^{\circ}14' \text{ E}$  where the water depth is 1070 m.

As compared with the bottom topography along each section, it is clear that the isostatic equilibrium is imperfect. That is, the change in water depth of 5500 m corresponds to gravity difference of 320 mgals. This corresponds to about 58 mgals per 1000 m, and the apparent density of the mountain is estimated to be less than  $2.67 \text{ gr/cm}^3$ .

Comparing the free air gravity anomaly profiles to those of the bottom topography, it is remarkable that the flat tops of these Seamount are not reflected to the free air gravity anomaly at all (Fig. 6-5). Mean water depth of the flat tops is about 1400 m and their diameter is greater than 20 miles. Therefore, if the mountain is composed of rocks of the same density, the shape of the mountain should be reflected in the free air gravity anomaly without large deformation due to the potential theory.

By the dredge hauling at the top many rock samples are obtained so that the tops may possibly be covered with great number of fragments of rocks. It is not so difficult to consider that the shape of the basement of Suiko Seamount is more truly represented by that of the free air gravity anomaly.

On the south of the deep zone in the eastern flank of the Seamount water depth is about 500 m shallower and this is reflected to the difference in the free air gravity anomaly of 40 mgals.

#### Local magnetic anomaly.

Magnetic map of the Suiko Seamount is shown in Fig. 6-6. Map of local magnetic anomaly shown in Fig. 6-7. was made by subtracting the standard magnetic reference field in the region. In order to see easily the relation between the local magnetic anomaly, bottom topography, and the free air gravity anomaly, the regions where the local magnetic anomaly is greater than 500  $\gamma$  and smaller than 500  $\gamma$  are represented by hatched and dotted areas respectively and the contours of 1500 m water depth and 300 mgals free air anomaly are also shown in the same figure (Fig. 6-8).

In the case of the North Suiko Seamount, negative magnetic anomaly is found on the south of the top and the positive anomaly is on the north of the top. In the case of seamounts in the Northern Hemisphere of middle latitude, the negative anomaly should exist on the north of the top of a seamount and the positive anomaly on the south. In the case of the North Suiko, although it required further investigation such as a calculation of the magnetic anomaly caused by the body of the seamount using the Vacquier's method, it is suggested that the magnetization of the Suiko Seamount is reverse, that is, the Seamount is magnetized roughly antiparallely to the present magnetic field.

In the case of the South Suiko, this feature is not so clear as in the case of the north.

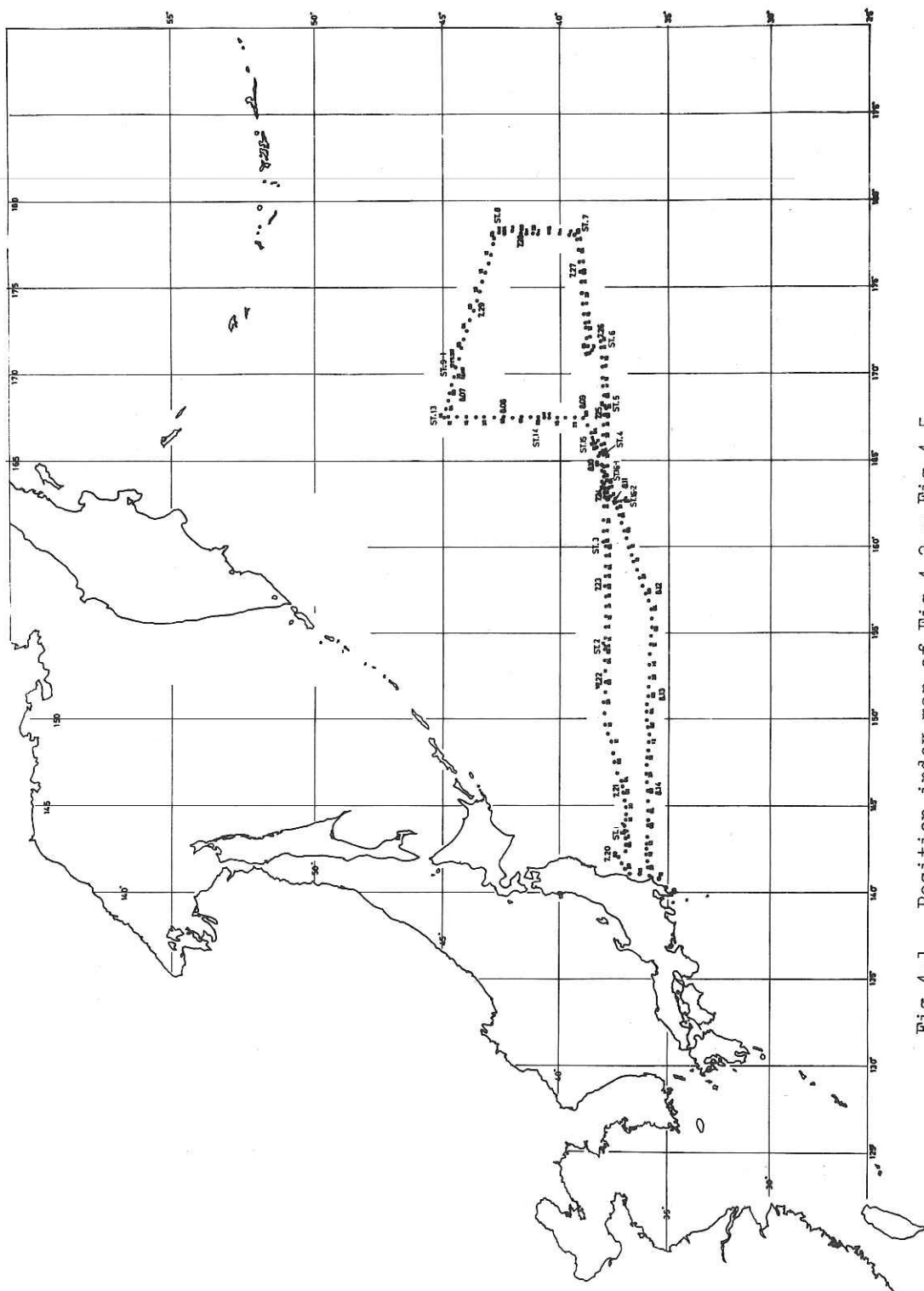


Fig.4-1 Position index map of Fig.4-2 ~ Fig.4-5





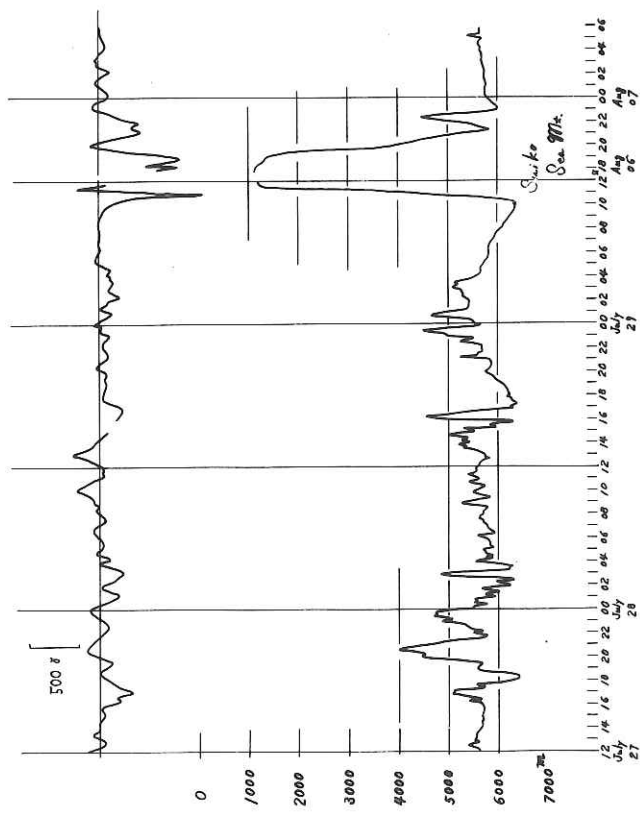


Fig. 4-3 (1,2)

(39°35'N, 178°01'E) - (42°40'N, 178°02'E)  
 (42°40'N, 178°02'E) - (44°59'N, 167°30'E)

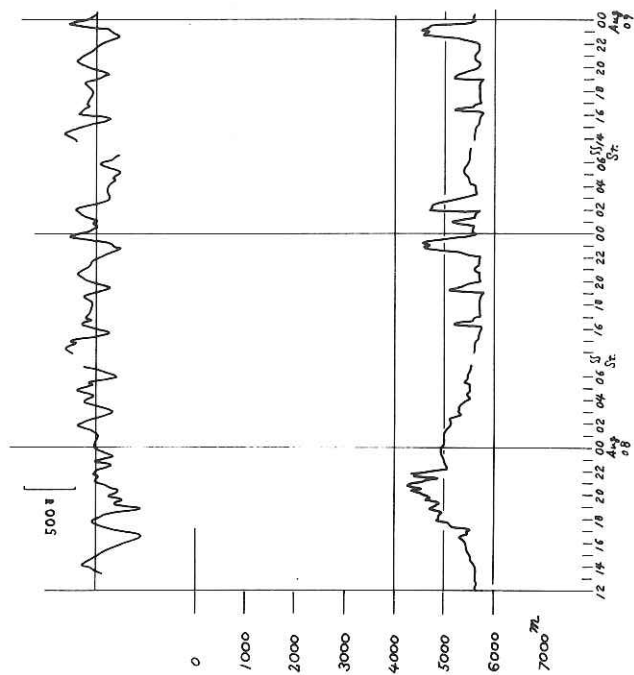


Fig. 4-4

(44°49'N, 167°32'E) - (38°49'N, 167°02'E)

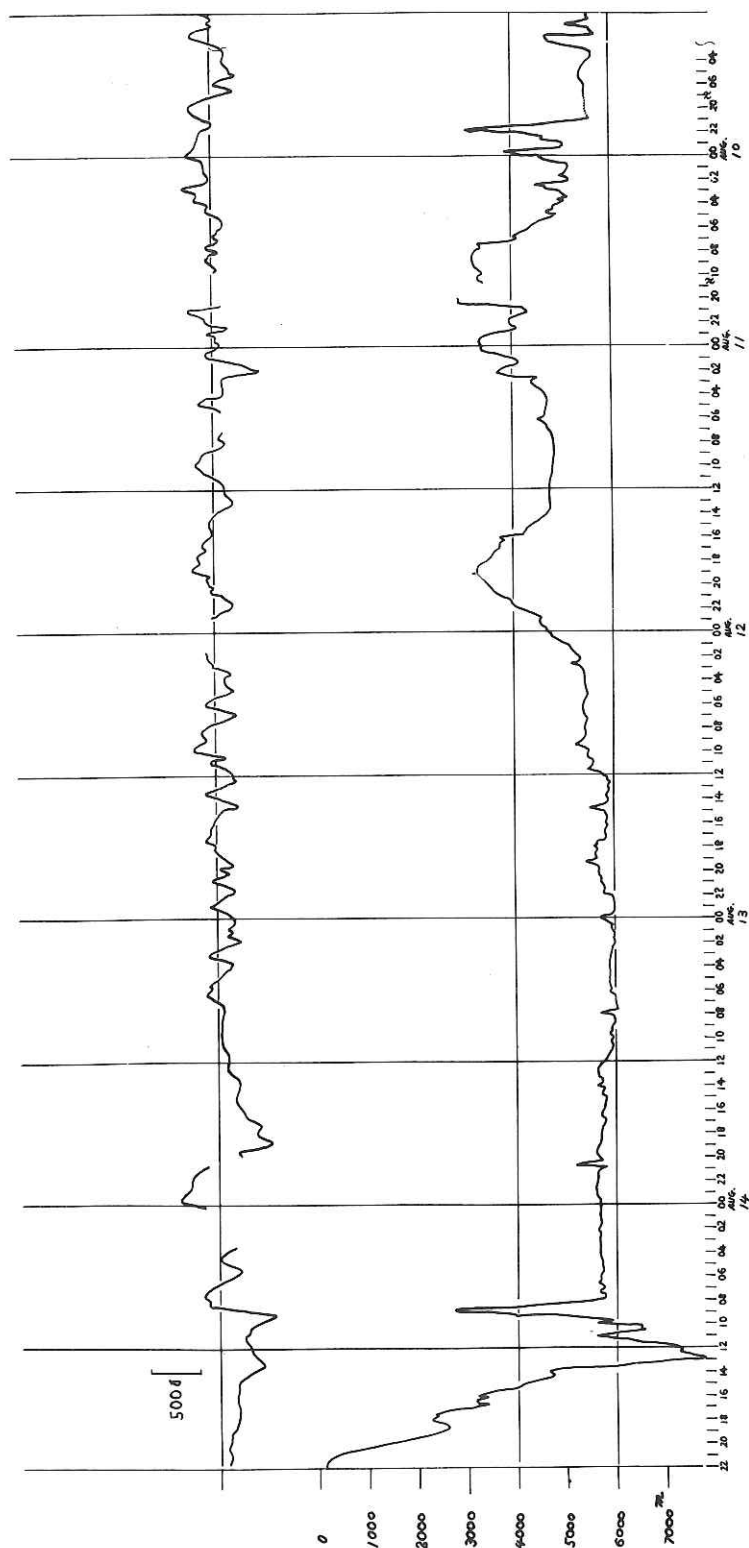


Fig. 4-5  
 (38°49'N, 167°02'E) - (35°53'N, 140°59'E)

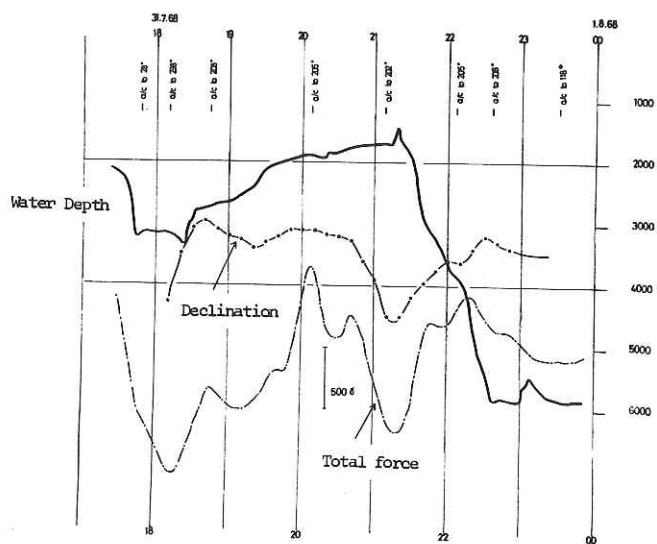


Fig.5-1  
Relation between magnetic anomaly in total force and declination

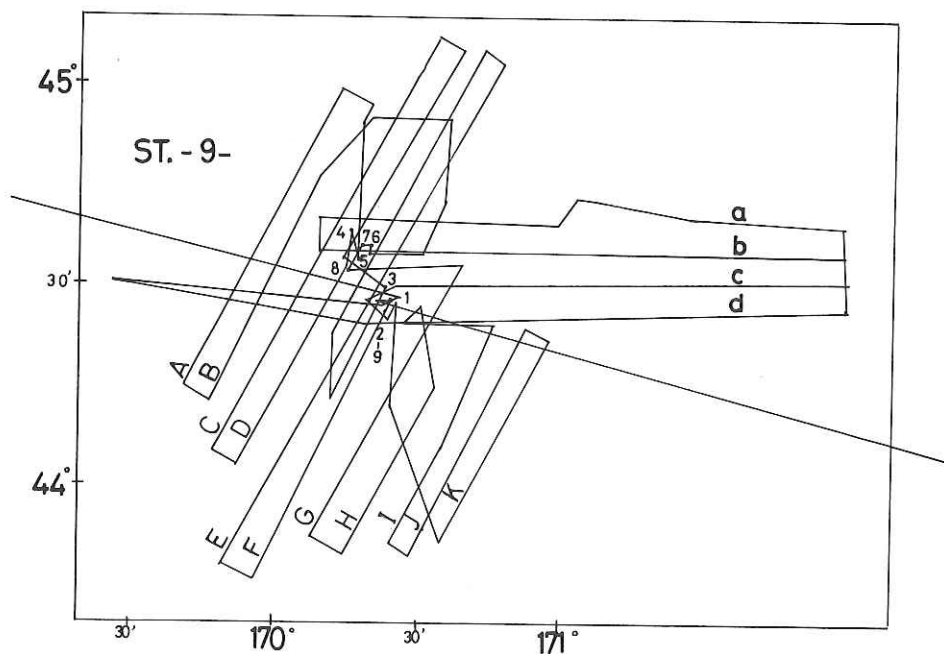


Fig.6-1 Track of grid survey on the Suiko Sea mount  
(index map of Fig.6-4)

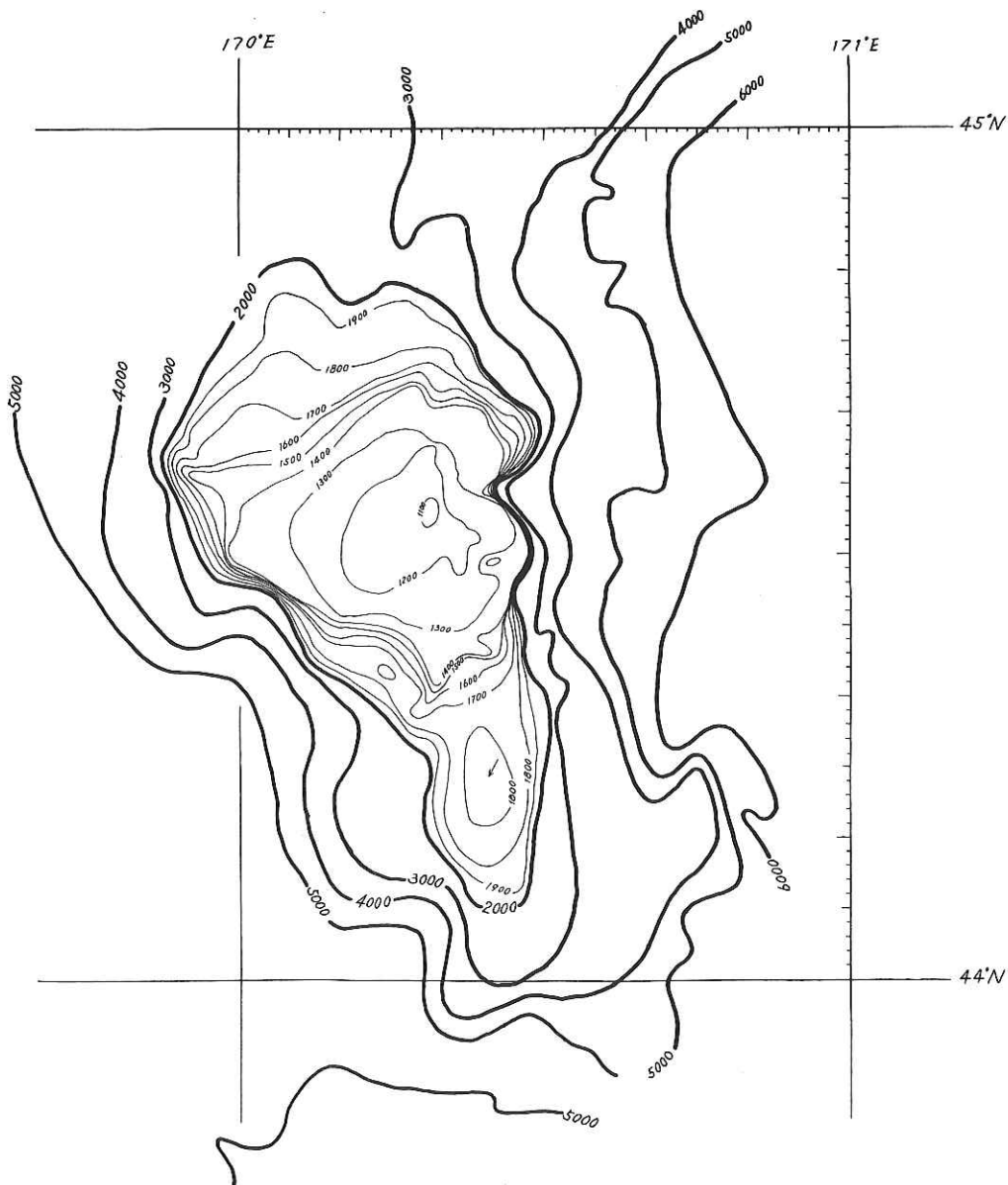


Fig.6-2  
Bathymetric map of Suiko Sea mount

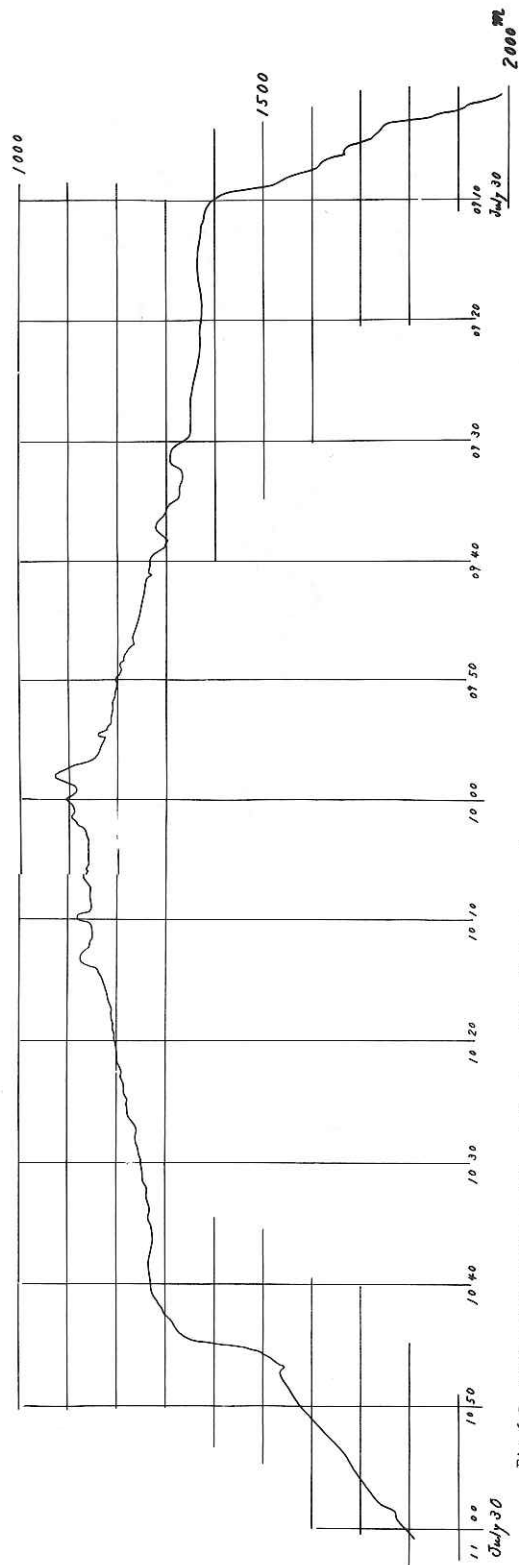
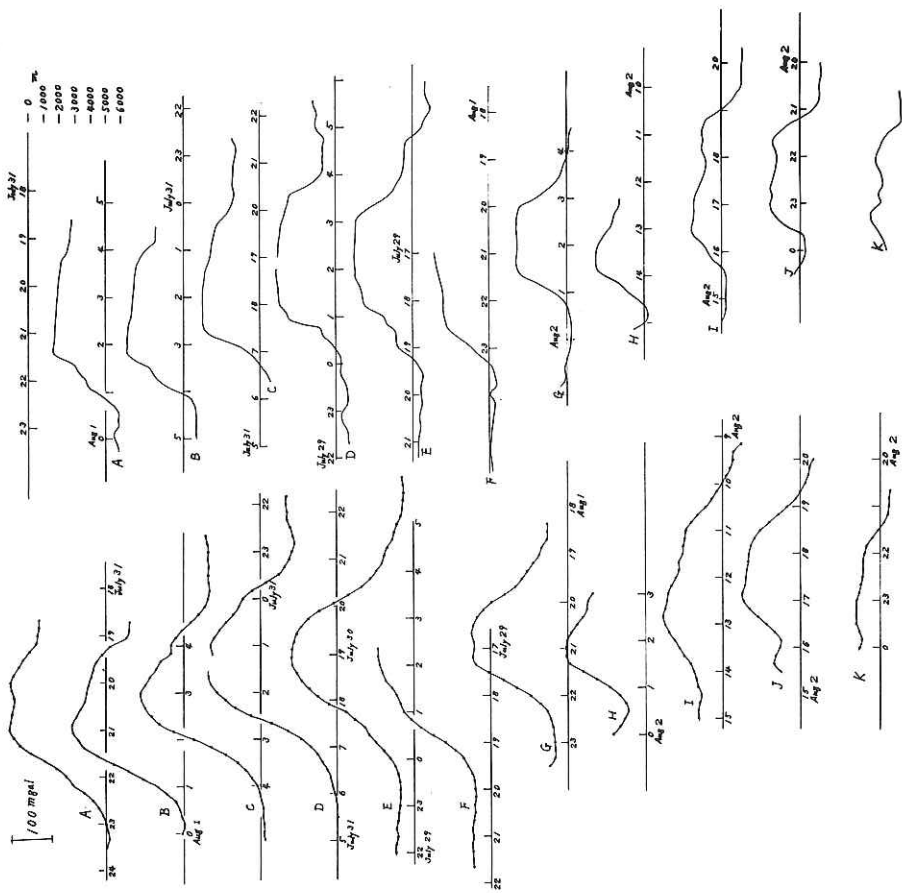


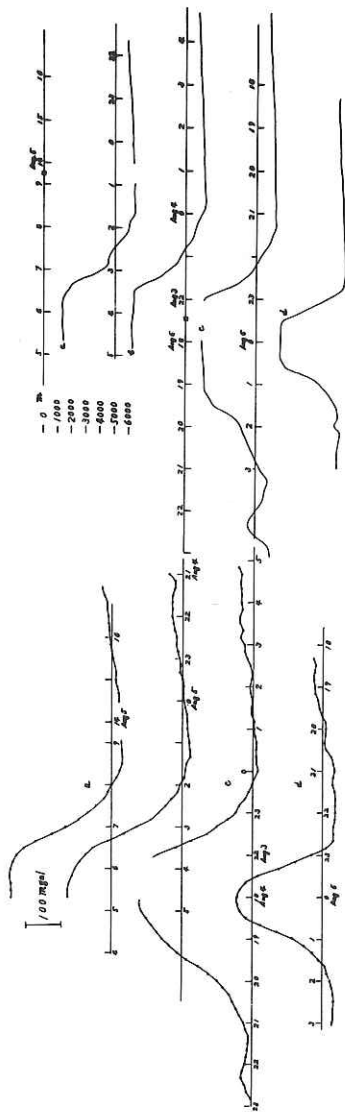
Fig.6-3 Bottom topography profile at the top of the Suiko Sea mount



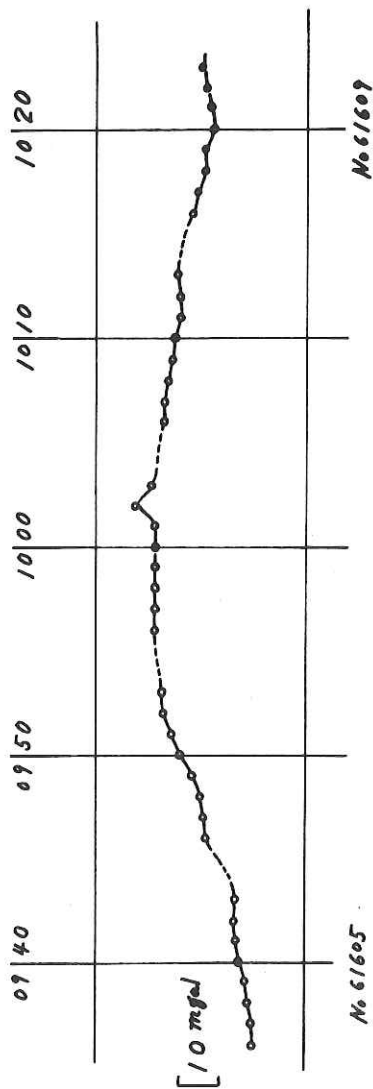
Free air gravity anomaly

Bottom topography

Fig. 6-4a Free air gravity anomaly and bottom topography along the profiles A-K in Fig. 6-1



Free air gravity anomaly  
Bottom topography  
Fig. 6-4b Free air gravity anomaly and bottom topography along the profiles a-d in Fig. 6-1



Free Air Gravity Anomaly at the top of the Suiko Seamount.  
No. 61605  
No. 61609



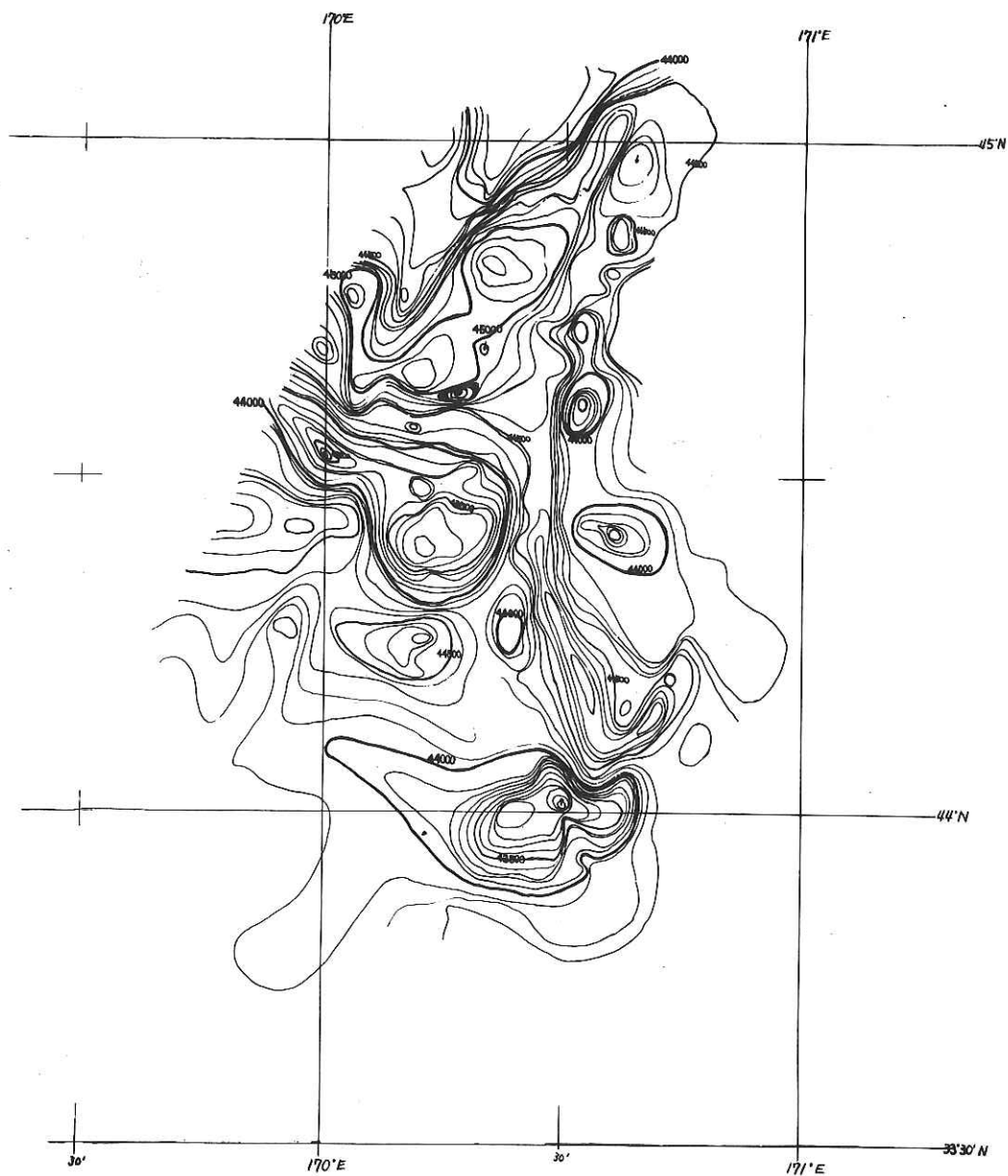


Fig.6-6  
Magnetic map on the Suiko Sea mount (unit  $r$ )

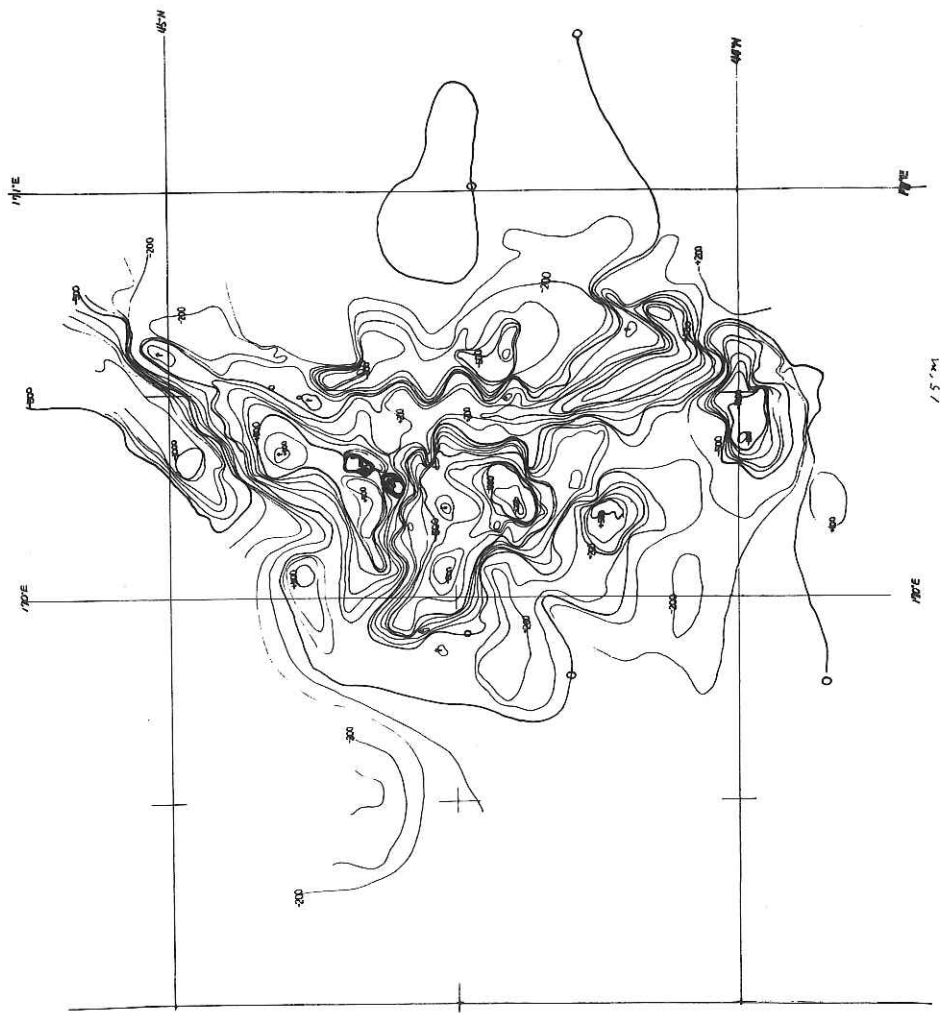
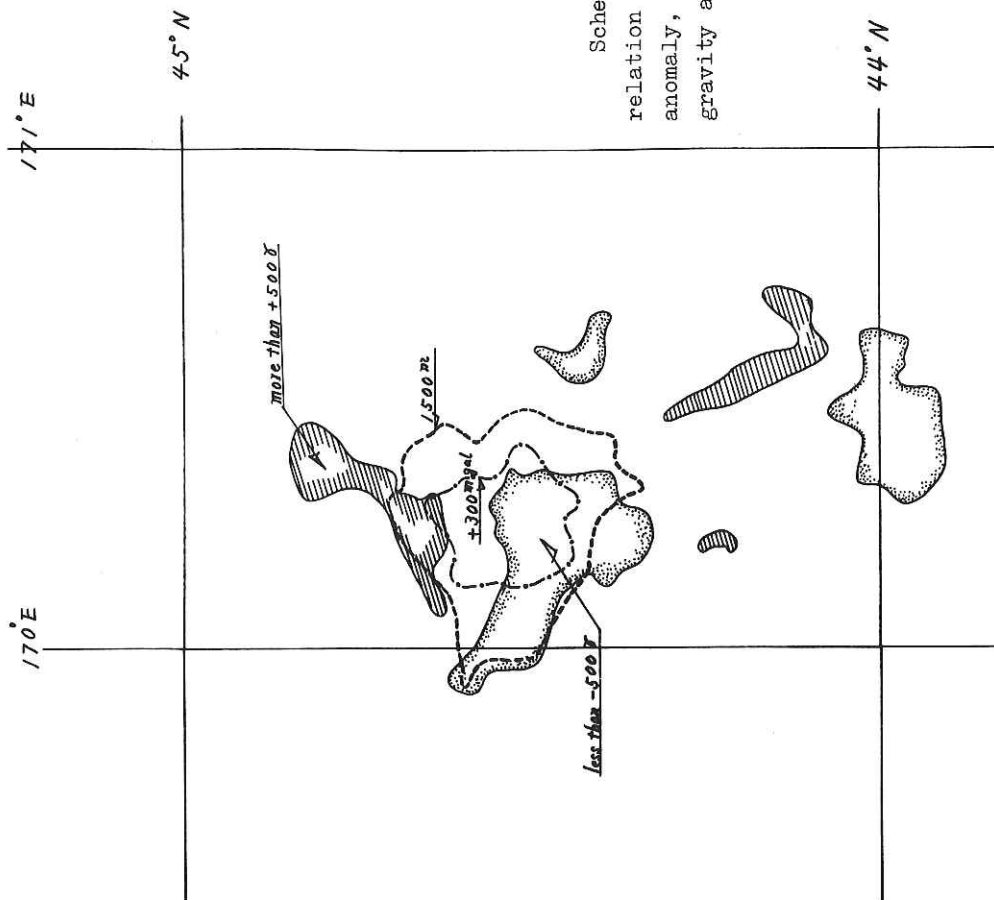


Fig. 6-7  
Local magnetic anomaly in total force at the Suiko Sea mount (unit  $r$ )



Schematic view of the relation between the local magnetic anomaly, water depth and free air gravity anomaly.

FIG. 6-8

- This table can be referred to the appendix.
8. Gravity Data Processing

T. Igarashi

The data punched out of T.S.S.G. are a series of binary coded values of the period of the gravity pendulum, which is sampled at about 0.5 sec. interval continuously during 9.5 min. with 0.5 min. space feed. Among the 8-bit holes of the punched tape 6 bits are used for the binary coding and the rest remain unpunched, except for the 8th bit hole (sign bit) which is punched at every 3 lines and which signifies the line of the most significant bit array. The sign bit line followed by another 2 less significant lines composes a single number which is proportional to the period of the gravity pendulum. A set of gravity data consists of more than 800 such numbers and the continuous 795 numbers are used in the present computer program for evaluating a single gravity value. The data No. of each gravity value is punched on the tape at the space feed interval.

$$G_1^i = K_1 \cdot \frac{\sum_j W_j / T_{i+j}}{\sum_j W_j T_{i+j}} \quad \text{in gal.}$$

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ship may be decreased as small as 1/100000.

The second order correction  $\Delta g_i$  is approximately proportional to the dispersion of the vertical acceleration  $(\tilde{a}^2)_i$  which is expressed as

$$(\tilde{a}^2)_i = K_2 \frac{\sum_{Wi}^i \left[ \left( \frac{1}{T_{i+j}} \right) - \left( \frac{1}{\bar{T}} \right)^2 \right]^2}{\sum_{Wi}} \quad \text{in (gal)}^2$$

and  $\Delta g_i = K_3 \cdot (\tilde{a}^2)_i$  in gal

where  $K_2$ ,  $\bar{T}$ ,  $K_3$  are the constant of proportion ( $K_2 = (K_1)^2$ ), a simple average of  $T_i$ , and the second order co-efficient.

The gravity value  $g_2^i$  corrected for the 2nd order effect is expressed as

$$g_2^i = g_1^j + \Delta g_i$$

or as a representative value in 10 min. the average with respect to (i) is used

$$g_2 = \overline{g_2^i} = \overline{g_1^i} + \overline{\Delta g_i}$$

The flow chart of the computing program to obtain  $g_1^i$ ,  $\Delta g_2$ ,  $g_2$  is shown in Fig.8.

Other corrections which must be applied to the  $g_2$  in order to obtain a true gravity are the Eötvös correction and Bouguer correction. The Eötvös correction is introduced from the East-to-West component of the velocity of the ship, or from the longitude difference in a definite interval. That is

$$\Delta g_E = A \cdot \delta L \cdot \cos^2 \phi \quad \text{in gal}$$

where  $A$ ,  $\delta L$  and  $\phi$  are the constant of proportion, the longitude difference and the latitude.

The Bouguer correction is expressed by use of the water depth as

$$\Delta g_B = B \cdot D$$

$B$  and  $D$  are the constant of proportion and the water depth. '  $B$  ' is usually selected as 69 mgal/1000 m. The two corrections cannot be calculated until the ship's position and the water depth are measured. At the present case these measurement cannot be made simultaneously with the gravity measurement. So, another program for the correction and the gravity value tabulation is prepared for Facom 270-20.

Here, we want to state several characteristics of the

gravity analysis programing by use of Facom 270-20.

The computer Facom 270-20 is characterized particularly by interruption process, Input Output command system (IOC System), Block Read, Three Index Registers, 200/400 character PTR Read Speed Change, etc.. By the aid of the interruption process computation can be made simultaneously with, for example, the tape read. When the tape is running at the speed of 400 CH/min., about 2.5 msec. time is shared for computation between the read of a character and that of the following one. Therefore, in the case of the program indicated at Fig. 8, 1) Interruption Process 2) Data error check 3) Synthesis of 3 characters are carried out when the tape is running.

The present Facom 270-20 is not yet equipped with the hardware of the Floating Point Calculation, and the subroutine for the Floating Point Calculation is prepared instead of it. The memory resistors are 16 K of 16 bit-core memories with the aid of the magnetic drum. There are two ways of using the memory; one is to use 2 memories at once as a continuous 32 bit-memory, the other to use 4 memories at once. The former is called a single precision method, and the later double precision method. The precision of computation is, originally,  $10^{-7}$  at the single, and the  $10^{-14}$  at the double precision method. But, perhaps, due to the subroutine of the Floating Point calculation, the actual precision is lowered as,  $10^{-4}$  at single, and  $10^{-8}$  at double. This will be improved by installing the hardware for floating calculation.

The time consumed by the calculation of a gravity value is, in double precision method, about 2.5 min.; 8 sec. for reading the tape, 110 sec. for calculation and 30 sec. for type-writing.

Table 8-1 is the actual program written in Facom 270-20 programing words FASP for the T.S.S.G gravity analysis.

# T.S.S.G Gravity Data Analysis Flow Chart

(Facom 270-20/30)

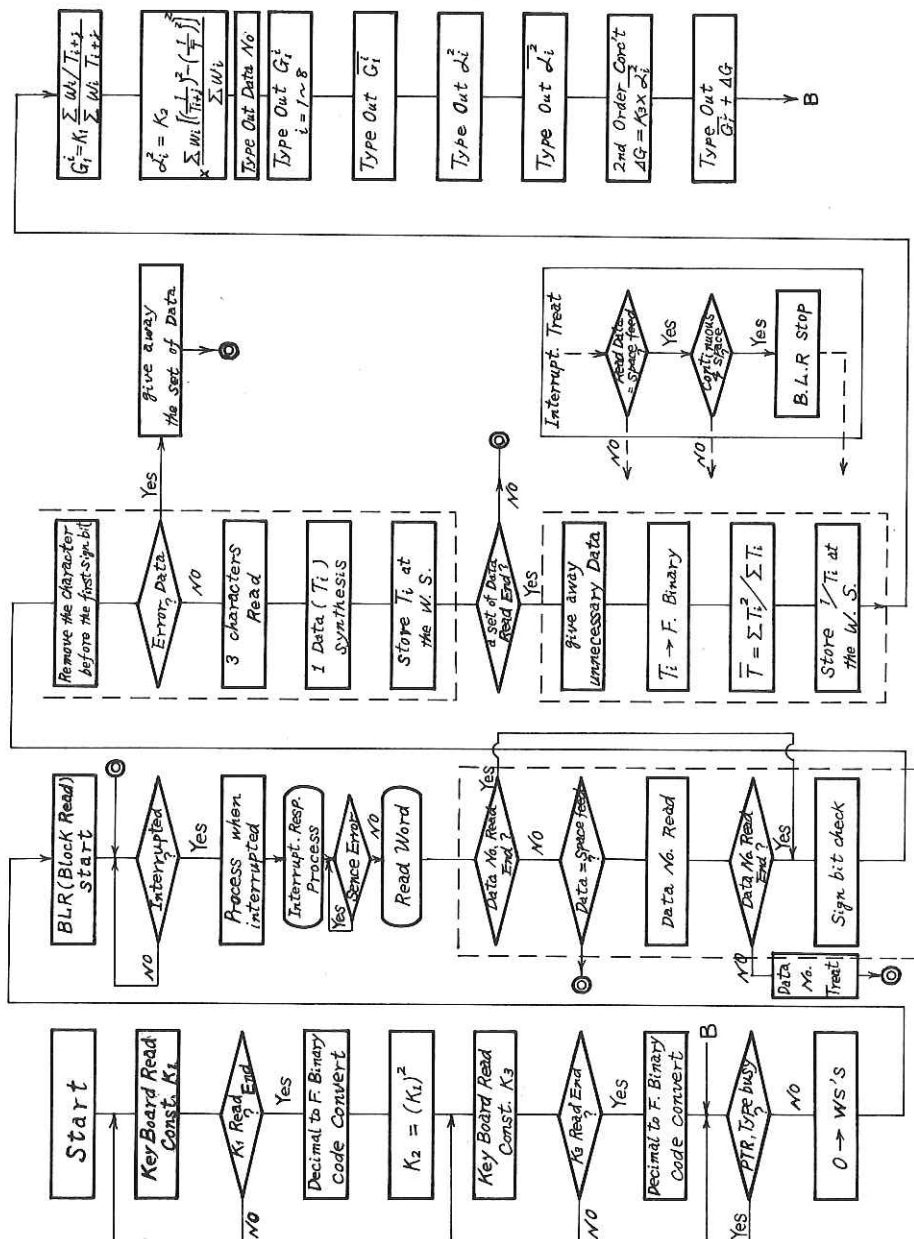


Fig. 8

Table 8-1

T.S.S.G. gravity data analysis program written by FASP.

YJOB		
YFASP		
	EXTN,	CTRFW,CTPFW@
	QUAD	@
DATA1;	DA,	3200@
DATA2;	DA,	3200@
	LX.L,	*3,0@
	CALL,	OPNK@
	B.R,	*@
KERB;	CALL,	GETK@
	B.R,	*@
	ST.L,	*3,EARE@
	EOR.R,	KER@
	AX.S,	*3,1@
	B.L,	KERB,Z@
	CALL,	FDBCD@
	DN,	EARE@
	DN,	0@
	FSTW,	K1@
	FLW,	K1@
	FMW,	K1@
	FST,	K2@
	LX.S,	*3,0@
KEY;	CALL,	GETK@
	B.R,	*@
	ST.L,	*3,EARE@
	EOR.R,	KER@
	AX.S,	*3,1@
	B.L,	KEY,Z@
	CALL,	CLSK@
	CALL,	FDBCS@
	DN,	EARE@
	DN,	0@
	STD.L,	K3@
	B.L,	START@
EARE;	BSS,	15@
	QUAD	@
K1;	BSS,	4@
K2;	BSS,	2@
K3;	BSS,	2@
KER;	DN,	#2C@
	EVEN	@
BLR;	DN,	#2901,0@
RAW;	DN,	#6900,RDATA@
RCON;	DN,	#C980,0@
RSENCE;	DN,	#A900,#4@
	QUAD	@
DONE;	EFLD,	1@
ANSW1;	BSS,	4@



SNSW2;	BSS,	4@
ANSW3;	BSS,	4@
TISG;	BSS,	4@
TPSG;	BSS,	4@
ONE;	DN,	1@
SCH;	DN,	#5@
CHD;	BSS,	1@
KINSA;	BSS,	1@
TEST1;	DN,	#5A@
SENCE;	XIO.L,	RSENCE,#10@
	XIO.L,	RAW,#10@
	EOR.L,	SCH@
	B.L,	JPPP,Z@
	A.R,	ONE@
	ST.R,	KINSA@
	B.L,	#130@
JAPP;	XIO.L,	RCON,#10@
	B.R,	SENCE@
ADDR1;	DN,	RDATA@
SADDR;	DN,	SENCE@
RDATA;	BSS,	4@
	EVEN	@
F1;	B.L,	AO@
F2;	AX.L,	*3,1@
F3;	B.L,	GG@
F4;	B.L,	GGG@
F5;	L.L,	RDATA@
F6;	B.L,	G@
ZQP;	DN,	#A900,0@
S3;	DN,	#A600,0@
NOND;	DN,	SENCE5@
NON;	DN,	O@
SENCE5;	XIO.L,	RSENCE,#10@
	XIO.L,	RAW,#10@
	EOR.L,	SCH@
	B.L,	SE1,Z@
	L.L,	RDATA+3@
	B.L,	SE2,Z@
	L.L,	NON@
	A.L,	ONE@
	ST.L,	NON@
	EOR.L,	D4@
	B.L,	SE3,Z@
	ST.L,	NON@
	XIO.L,	RCON,#10@
	L.L,	SADDR@
	ST.L,	#15B@
SE2;	SL.S,	16@
	ST.R,	NON@
SE3;	B.L,	#130@
SE1;	B.R,	*@
START;	XIO.L,	S3,#10@
	B.L,	START,Z@
CE;	XIO.L,	ZQP,#10@
	B.L,	CE,Z@

	XIO.L,	BLR,#10@
	L.R,	SADDR@
	ST.L,	#15B@
A10;	SLD.S,	32@
	ST.R,	RDATA@
	STD.R,	TISG@
	STD.R,	TISG+2@
	STD.R,	TPSG@
	STD.R,	TPSG+2@
	LX.L,	*3,0@
	ST.L,	KOSU@
	LD.L,	F5@
	STD.R,	A2@
A0;	SLD.S,	32@
	ST.R,	KINSA@
	LD.R,	F1@
	STD.R,	SUTERU@
	LX.L,	*1,-3180@
A8;	LX.S,	*2,-3@
	L.L,	ADDR1@
	ST.L,	RAW+1@
A1;	L.L,	KINSA@
	EOR.R,	ONE@
	B.L,	A1,Z@
	ST.R,	KINSA@
	L.R,	RDATA@
	B.L,	A2,Z@
	B.R,	AO@
	EVEN@	
A2;	L.L,	DRATA@
	ST.L,	*3,NO@
	EOR.L,	TEST1@
	AX.S,	*3,1@
	B.L,	A1,Z@
	L.D,	F6@
	STD.L,	A2@
	LX.S,	*3,-2@
	B.R,	A1@
G;	SR.S,	7@
	B.L,	A3,Z@
	EVEN@	
SUTERU;	B.L,	AO@
A3;	LD.R,	F3@
	STD.R,	SUTERU@
	B.R,	GGG@
GG;	SL.S,	16@
	ST.L,	KINSA@
AZQ;	L.L,	KINSA@
	EOR.L,	ONE@
	B.L,	AZQ,Z@
	L.L,	RDATA@
	B.L,	GGGG,Z@
	L.L,	NON@
	A.L,	ONE@
	ST.L,	NON@

	EOR.L,	D4@
	B.L,	GG,Z@
	ST.L,	NON@
	B.L,	A10@
GGGG;	SL.S,	16@
	ST.L,	NON@
	B.L,	GG@
	B.L,	A10@
GGG;	L.L,	RAW+1@
	A.L,	ONE@
	ST.L,	RAW+1@
	AX.S,	*2,1@
	B.R,	A1@
	LX.S,	*2,1@
A6;	L.L,	*2,RDATA+1@
	SRAD.S,	6@
	AX.S,	*2,-1@
	B.R,	A7@
	B.R,	A6@
A7;	L.L,	RDATA@
	SL.S,	9@
	SR.S,	9@
	SRAD.S,	4@
	STD.L,	*1,DATA1+3182@
	AX.L,	*1,4@
	B.R,	A8@
	SR.S,	16@
	ST.L,	KINSA@
	L.L,	NOND@
	ST.L,	#15B@
	LX.L,	*1,-3180@
CVT;	FLW,	FWZERO@
	LD.L,	*1,DATA1+3182@
	CALL,	FXFL@
	DN,	31@
	FSTW,	DATA1+3180,1@
	LD.L,	*1,DATA1+3180@
	FA,	TISG@
	STD.L,	TISG@
	LD.L,	*1,DATA1+3180@
	FM,	DATA1+3180,1@
	FA,	TPSG@
	STD.L,	TPSG@
	FLW,	DONE@
	FDW,	DATA1+3180,1@
	FSTW,	DATA2+3180,1@
	AX.L,	*1,4@
	B.R,	CVT@
	LD.L,	TISG@
	FD,	TPSG@
	STD.L,	ANSW1@
	FM,	ANSW1@
	STD.L,	ANSW1@
	B.L,	JMP8@
	QUAD	@

KOTAI;	BSS,	36@
KOTAI2;	BSS,	36@
OHK2;	BSS,	4@
ONETH;	BSS,	4@
WI;	EFLD,	2956877@
INDEX3;	DN,	888@
KOSU;	DN,	0@
JMP8;	LX.S,	*1,-8@
	LX.L,	*2,0@
JMP9;	LX.L,	*3,0@
	L.L,	D4@
	ST.L,	KKK+1@
	LD.L,	DDO@
	STD.L,	AAAA@
	SLD.S,	32@
	STD.L,	ONETH@
	STD.L,	ONETH+2@
	STD.L,	ANSW2@
	STD.L,	ANSW2+2@
	STD.L,	ANSW3@
	STD.L,	ANSW3+2@
	STD.L,	OHK2@
JMP10;	STD.L,	OHK2+2@
	FLW,	DATA1,2@
	FMW,	OMEGA,3@
	FAW,	OHK2@
	FSTW,	OHK2@
	FLW,	DATA2,2@
	FMW,	OMEGA,3@
	FAW,	ONETH@
	FSTW,	ONETH@
	LD.L,	*2,DATA2@
	FM,	DATA2,2@
	FS,	ANSW1@
	STD.L,	ANSW2@
	FM,	ANSW2@
	FM,	OMEGA,3@
	FA,	ANSW3@
	STD.L,	ANSW3@
	AX.L,	*2,4@
	L.L,	#3@
	S.L,	INDEX3@
	EVEN	@
	B.L,	KKK,Z@
	L.L,	MINAS2@
	ST.L,	KKK+1@
	LD.L,	DDO@
	STD.L,	AAAA@
KKK;	AX.L,	*3,2@
	B.R,	AAAA@
	B.R,	JMP10@
M3;	B.L,	JMPA@
	EVEN	@
BBB;	B.L,	KKK,Z@
DDO;	B.L,	M3@

DDO;	B.L,	JMP10@
AAAA;	B.L,	JMP10@
CQ;	DN,	KOTAI@
UUU;	DN,	KOTAI2@
D2,	DN,	2@
MINAS2;	DN,	-4@
D4;	DN,	4@
JMPA;	L.L,	KOSU@
	A.L,	CQ@
	ST.R,	MDQ@
	FLW,	ONETH@
	FDW,	OHK2@
	CALL,	FLOATX@
	VFD,	6/0,2/0,1/0,7/1@
MDQ;	DN,	0@
	L.L,	KOSU@
	A.L,	UUU@
	ST.L,	SSS+1@
	LD.L,	ANSW3@
	FD,	WI@
SSS;	STD.L,	UUU@
	L.L,	KOSU@
	A.L,	D4@
	ST.L,	KOSU@
	AX.L,	*2,-1580@
	DN,	#F800@
	AX,L,	*1,1@
	B.R,	JMPQ@
	B.L,	OUTPUT@
JMPQ;	B.L,	JMP9@
	QUAD	@
OMEGA;	EFLD,	1,3,6,10,15,21,
		28,36,45,55,66,78,91,105,120,136,153
		171,190,210,231,253,276,300,325,351,
		378,406,435,
		465,496,528,561,595,630,666,703,741,
		780,820,861,903,946,990,1035,1081,
		1128,1176,1225,1275,1326,1378,1431,
		1485,1540,1596,1653,
		1711,1770,1830,1890,1953,2016,2080,
		2145,2211,2278,2346,2415,2485,2556,
		2628,2701,2775,2850,2926,3003,3081,
		3160,3240,3321,3403,
		3486,3570,3655,3741,3828,3916,4005,
		4095,4186,4278,4371,4465,4560,4656,
		4753,4851,4950,5050,5150,5250,5350,
		5450,5550,5650,5750,
		5850,5950,6050,6150,6250,6350,6450,
		6550,6650,6750,6850,6950,7050,7150,
		7250,7350,7450,7550,7650,7750,7850,
		7950,8050,8150,8250,
		8350,8450,8550,8650,8750,8850,8950,
		9050,9150,9250,9350,9450,9550,9650,
		9750,9850,9950,10050,10149,10247,
		10344,10440,10535,10629,

10722,10814,10905,10995,11084,11172,  
 11259,11345,11430,11514,11597,11679,  
 11760,11840,11919,11997,12074,12150,  
 12225,12299,12372,  
 12444,12515,12585,12654,12722,12789,  
 12855,12920,12984,13047,13109,13170,  
 13230,13289,13347,13404,13460,13515,  
 13569,13622,13674,13725,  
 13775,13823,13869,13913,13955,13995,  
 14033,14069,14103,14135,14165,14193,  
 14219,14243,14265,14285,14303,14319,  
 14333,14345,14355,  
 14363,14369,14373@

NAME;	INTC, N O .@
NO;	BSS, 6@
OUTARE;	BSS, 21@
CRLF;	INTC,
@	
BLCH;	BSS, 1@
	EOR,R, DAT1@
	B.L, PP,Z@
	L.R, DAT6 9@
	B.R, PPP@
PP;	EOR.R, DAT1@
PPP;	CALL, PUTT@
	B.R, *@
	B.I, BLCH@
CH30;	DN, #30@
OUTPUT:	CALL, OPNT@
	DN, CTPFW@
	B.R, *@
	BB.L, LF@
	LX.S, *1,-3@
Z4;	L.L, *1,NAME+3@
	BB.L, BLCH@
	AX.S, *1,1@
	B.R, Z4@
	LX.S, *1,0@
Z3;	L.L, *1,NO@
	EOR,L, TEST1@
	B.L, Z1,Z@
	B.R, Z2@
Z1;	L.L, *1,NO@
	SL.S, 12@
	SR.S, 12@
	EOR.R, CH30@
	BB.L, BLCH@
	AX.S, *1,1@
	B.R, Z3@
Z2;	BB.L, LF@
	LX.S, *1,-8@
	LX.S, *2,1@
Z7;	LX.S, *3,-2@
	L.R, CRLF@

Z5;	BB.L,	BLCH@
	AX.S,	*3,1@
	B.R,	Z5@
	L.L,	#2@
	EOR.R,	CH30@
	BB.L,	BLCH@
	AX.S,	*2,1@
	LX.S,	*3,-7@
	L.R,	CRLF@
Z6;	BB.L,	BLCH@
	AX.S,	*3,1@
	B.R,	Z6@
	AX.S,	*1,1@
	B.R,	Z7@
	BB.L,	LF@
	B.R,	I1@
	QUAD	@
TOTAL1;	BSS,	4@
FWZERO;	EFLD,	0@
DATA8;	EFLD,	8@
DAT69;	DN,	#6C@
DAT1;	DN,	#31@
BDC;	BSS,	1@
	CALL,	FBDCD@
	DN,	OUTARE@
	DN,	0@
	B.I.	BDC@
I1;	SLD.S,	32@
	STD.L,	KOTAI+32@
	STD.L,	KOTAI+34@
	STD.L,	KOTAI2+32@
	STD.L,	KOTAI2+34@
	LX.S,	*1,-32@
I2;	FLW,	KOTAI+32,1@
	FAW,	KOTAI+32@
	FSTW,	KOTAI+32@
	LD.L,	*1,KOTAI2+32@
	FA,	KOTAI2+32@
	STD.L,	KOTAI2+32@
	AX.S,	*1,4@
	B.R,	I2@
	FLW,	KOTAI+32@
	FDW,	DATA8@
	FSTW,	KOTAI+32@
	LD.L,	KOTAI2+32@
	FD,	DATA8@
	STD.L,	KOTAI2+32@
	LX.S,	*1,-36@
I7;	FLW,	K1@
	FMW,	KOTAI+36,1@
	BB.L,	BDC@
	LX.S,	*2,-7@
I4;	L.L,	*2,OUTARE+7@
	BB.L,	BLCH@
	AX.S,	*2,1@

	B.R,	I4@
	BB.L,	SPECE@
	B.R,	I5@
SPECE;	BSS,	1@
	LX.S,	*3,-3@
	L.L,	CRLF@
I6;	BB.L,	BLCH@
	AX.S,	*3,1@
	B.R,	I6@
	B.I,	SPECE@
SPECE2;	BSS,	1@
	LX.S,	*2,-2@
I9;	L.L,	CRLF@
	BB.L,	BLCH@
	AX.S,	*2,1@
	B.R,	I9@
	B.I,	SPECE2@
I5;	AX.S,	*1,4@
	B.R,	I7@
	BB.L,	LF@
	LX.S,	*1,-36@
W1;	FLW,	FWZERO@
	LD.L,	K2@
	FM,	KOTAI2+36,1@
	BB.L,	BDC@
	LX.S,	*2,-5@
W2;	L.L,	*2,OUTARE+5@
	BB.L,	BLCH@
	AX.S,	*2,1@
	B.R,	W2@
	LX.S,	*2,-3@
I8;	L.L,	*2,OUTARE+21@
	BB.L,	BLCH@
	AX.S,	*2,1@
	B.R,	I8@
	BB.L,	SPECE2@
	AX.S,	*1,4@
	B.R,	W1@
	FLW,	K1@
	FMW,	KOTAI+32@
	FSTW,	KOTAI+32@
	FLW,	FWZERO@
	LD.L,	K2@
	FM,	KOTAI2+32@
	FM,	K3@
	FA,	KOTAI+32@
	BB.L,	BDC@
	LX.S,	*1,-7@
W3;	L.L,	*1,OUTARE+7@
	BB.L,	BLCH@
	AX.S,	*1,1@
	B.R,	W3@
	BB.L,	LF@
	BB.L,	LF@
	CALL,	CLST@



	B.L,	START@
CF1;	DN,	60@
CF2;	DN,	0@
Lf;	BSS,	1@
	L.L,	CRLF+4@
	BB.L,	BLCH@
	L.R,	CF2@
	A.L,	ONE@
	ST.R,	CF2@
	S.R,	CH1@
	B.L,	FEED1,Z@
	LX.S,	*3,-6@
	ST.R,	CF2@
FEED2;	L.L,	CRLF+4@
	BB.L,	BLCH@
	AX.S,	*3,1@
	B.R,	FEED2@
FEED1;	B.I,	LF@
ERROR;	HLT.S,	@
	B.L,	=END@
	END	@
¥PRBL	SPRG	N-GRAVI
¥STOP		

## 9. G.S.I. Type Surface Ship Gravity Meter

Takao SETO

Object: Gravity survey in the north-western Pacific region and comparison with the T.S.S.G. gravity meter.

Name of instrument:

G.S.I. type surface ship gravity meter.

Type of instrument:

Measuring the total gravity with three vibrating strings including the effect of horizontal acceleration due to the ship's movement which is recorded by a horizontal accelerometer independently.

Records:

Magnetic tape; Frequencies of the three strings with standard frequency.

15 min. record for one position,  
60-120 min. intervals, 300 stations  
(60 reels).

Summation of the three frequencies of 540 sec. on  
analogue

recorder;            Every 1 min. whole term.

Integrated values of square of the horizontal  
acceleration;

Every 15 min., whole term.

Some notes about the stability of the horizontal  
gyroscope.

#### Observing conditions:

The gravity meter was set up in the bow side corner of  
No.7 research room which was close enough to the pit-  
ching and rolling center of the ship.

Except several rough weather days, the record may be  
used for analysis.

There were some troubles in power source, they were  
lag of 60 Hz. and spark noise which caused wrong oper-  
ation of timing unit.

#### Preliminary results:

According to the comparison between T.S.S.G.'s re-  
sults and hand calculated values read from the ana-  
logue record upon several lines, it may be said that  
both results are quite parallel but have constant dis-  
crepancies which may be caused from the incomplete  
corrections of horizontal acceleration and nonlinear  
( $f^2$ ) effect.

Estimated drift which is determined by comparing data  
on the one way and return at the same position  
(38-00N, 163-59E) is about 1.6 mgal/day.

#### Magnetic Measurement

Object: Total magnetic force measurement by means of a  
Rubidium magnetometer (Varian V-4938).

In order to obtain the short period variations of the  
earth's magnetic field on board, sensor of the

magnetometer was located in and around the No.1 research room.

Results: Induced and remanent magnetic field of the hull was unexpectedly large and changed periodically due to the ship's movement. Their variations were  $\pm 300$ -500 gammas caused by ordinary pitching and rolling, -1,000( $0^\circ$ ) to +8,000 gammas( $180^\circ$ ) by heading of the ship, and more than 10,000 gammas difference by setting positions.

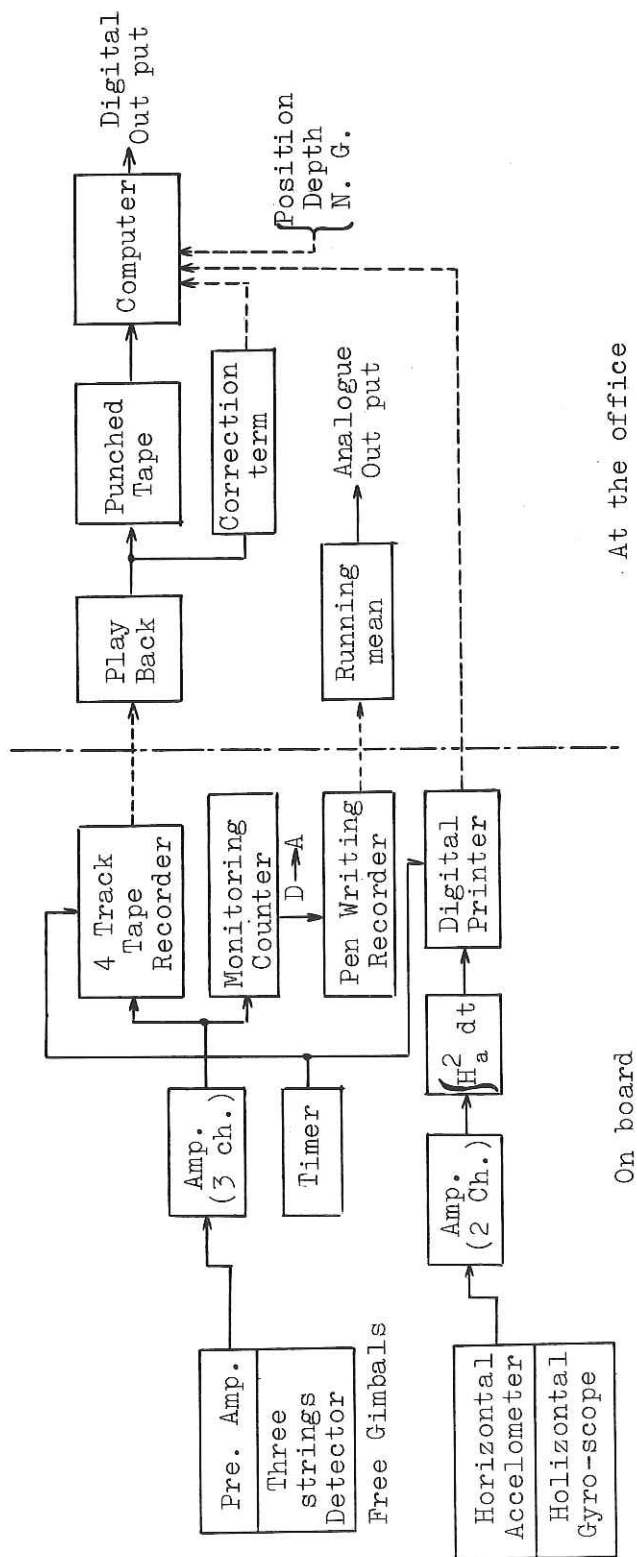


Fig. 9-1 Block diagram of G.S.I. type ship-borne gravity meter.

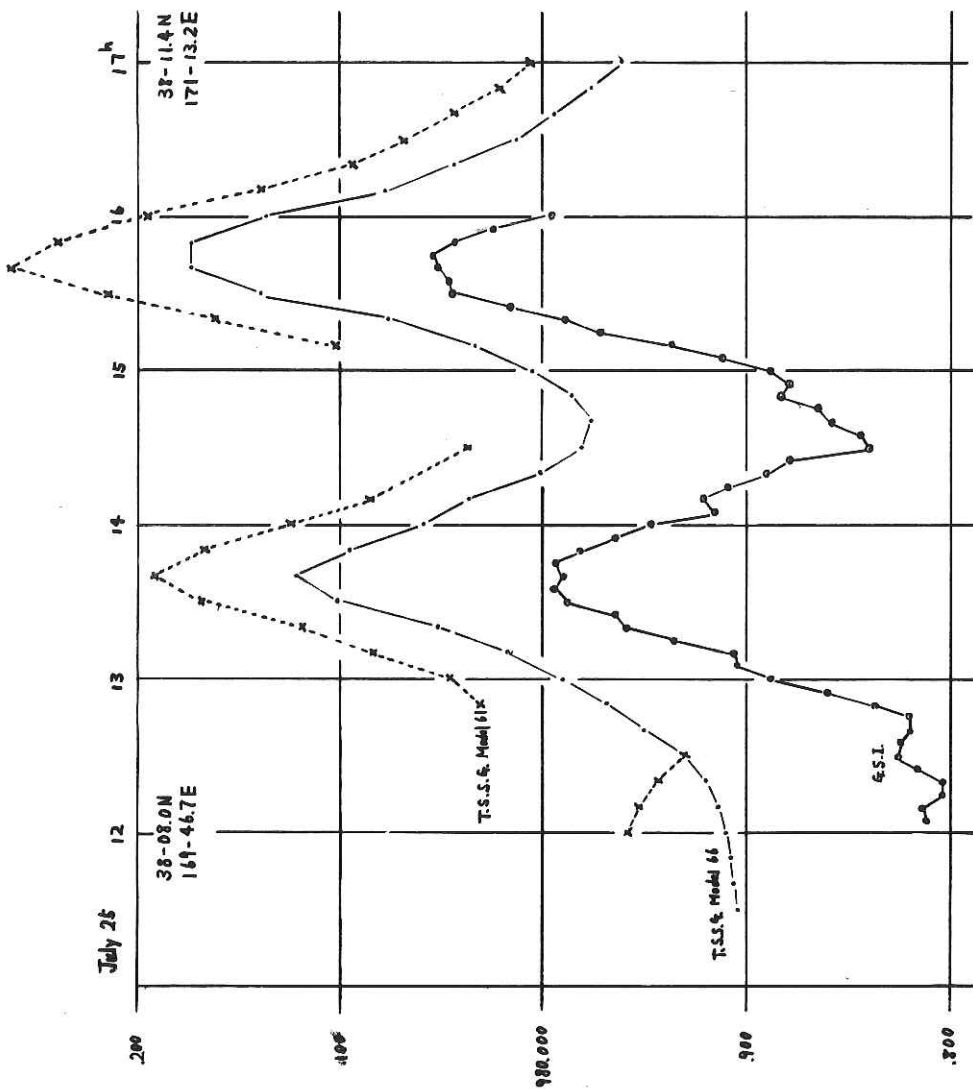


Fig.9-2. Relation between the results of T.S.S.G.-66, T.S.S.G.-61 and G.S.I.

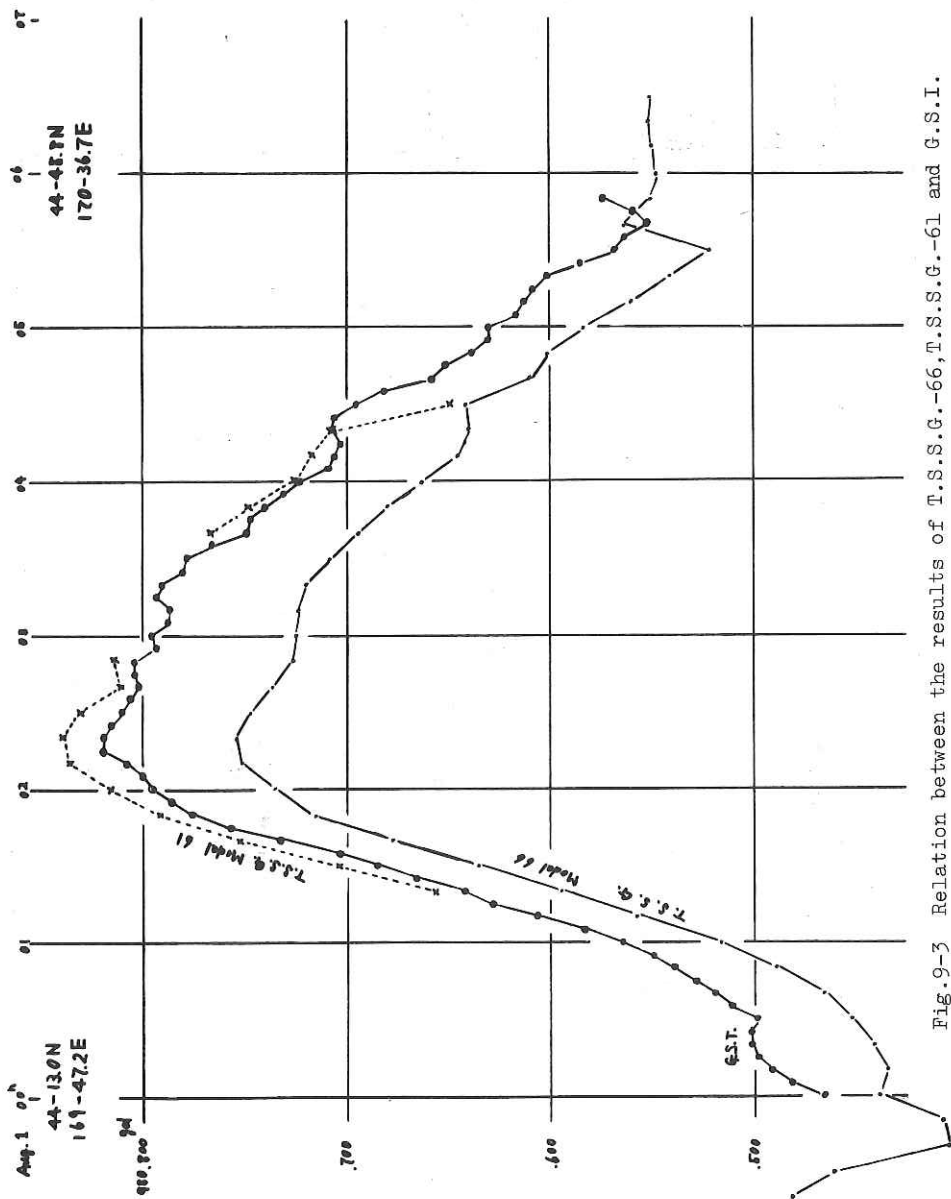


Fig.9-3 Relation between the results of T.S.S.G.-66, T.S.S.G.-61 and G.S.I.

# 10. Reflection profiling (Air-Gun) Survey.

Eiichi Honza, Masao Inoue, Shoji Fujii.

Continuous reflection profiling survey was carried out along the tracks shown in the table below.

Both "Horizon A" and "Horizon B" (named by Ewing et al.) are recognized in most parts of the sections and the other local reflectors are seen on the "Horizon A" and "Horizon B". Quite different type of reflector is seen in the Shatsky Rise in which thick sediments distribute on the top of the Rise surrounded with the marginal rise of basement rock.

The detail of the investigation will be reported later.

Table 10-1

log	latitude N.	longitude E.	gun-pressure	filter
1	36° 59.5	142° 23.2	68 Kg/cm	53-150 c/s
	36° 59.0	-142° 48.3		
2	38° 13.6	171° 45.1	80	37.5-150
	38° 50.5	172° 06.0		
3	41° 01.0	178° 24.4	80	53-150
	-42° 34.0	-178° 00.0		
4	44° 40.0	170° 19.4	84	75-212
	-44° 24.0	-170° 59.6		
5	44° 26.8	170° 19.4	90	53-150
	-44° 33.0	-171° 59.6		
6	44° 27.9	171° 58.5	88	53-212
	-44° 39.8	-170° 55.5		
7	44° 36.1	171° 00.2	80	53-150
	-44° 24.2	-170° 19.0		
8-1	44° 03.3	167° 33.3	90	37.5-150
	-41° 25.5	-167° 30.3		
8-2	40° 42.8	167° 28.4	90	37.5-150
	-38° 28.8	-166° 50.8		
9	38° 26.7	165° 58.0	90	37.5-150
	-37° 38.0	-162° 34.6		
10	37° 07.9	162° 41.2	95	37.5-150
	-36° 00.0	-140° 40.0		

## 11. Magnetic lineations in the North Pacific Ocean.

O. Isezaki

In the northern part of the Pacific Ocean, the lineations of the magnetic anomaly continue from east pacific to north pacific making " THE GREAT MAGNETIC BIGHT ".

According to the results of magnetic survey chiefly carried out by the staff of the Lamont Geological Observatory, the lineations of east to west trend seems to continue to the west part of the north pacific to the Emperor Ridge.

On the other hand, the lineations in the north west pacific near and around Japan run nearly east to west in the region from  $150^{\circ}$  E to  $163^{\circ}$  E.

One of the problems which we are interested in, is whether or not the magnetic lineations near and around Japan is linked to the " GREAT MAGNETIC BIGHT ".

Although the magnetic survey was carried out throughout the cruise, North to South magnetic profile along  $167,5^{\circ}$  E is the most effective for the study of the present purpose. By comparing the results with that of the R/V Oceanographer and other vessels continuity and the change in the direction of the lineations between the east and west parts of the Emperor Ridge can be assessed.

## 12. Ocean-bottom seismographic observation and bottom-current observation.

Shozaburo Nagumo

### Content

- 12-1. Purpose of observation.
- 12-2. Method of observation.
- 12-3. Location and period of observation.
- 12-4. Instruments and Mooring systems.
- 12-5. Field Operations.
  - 12-5-1. Preparations.
  - 12-5-2. Deployment of ocean-bottom seismograph.



- 12-5-3. Deployment of bottom-current meter.
- 12-5-4. Recovery of ocean-bottom seismograph.
- 12-5-5. Recovery of bottom-current meter.
- 12-6. Result of observation.
- 12-7. Discussion and Remarks.

12-1. Purpose of observation.

In order to clarify the existence of the present-day tectonic activity around the Emperor Ridge, an ocean-bottom seismographic observation were carried out at the top of Suiko Seamount. At the same time, an observation of bottom current was undertaken with the seismographic observation for monitoring the existence of any abnormal bottom current.

Since natural earthquakes are caused to occur by the deformation of the earth's crust or mantle, the existence of any seismic activity is considered as an indication of the presence of present-day tectonic activity. Whether or not the seismic activity exists in and around the Emperor Ridge is one of the current problem for clarifying the tectonics of the Northern Pacific Ocean, and for examining the reality of mantle convection hypothesis for island arc tectonics.

The ocean-bottom seismographic observation is very often disturbed by the bottom-current. The abnormal bottom-current easily causes undersirable vibration to the pressure vessel of seismograph. Therefore, the observation of the bottom-current is needed for identifying the earthquake vibration. The observation of bottom-current itself, however, is another very important problem as well.

12-2. Method of observation.

Both the ocean-bottom seismographic observation and the bottom-current meter observation were performed by the method of anchored-buoy mooring system.

The instruments which are contained in a pressure vessel are placed upon or a little above the sea-bottom. The complete automatic recording is performed within the pressure vessel. After a certain period of observation, the instruments are

recovered by winding up rope systems which connect the pressure vessel to the surface buoy.

The flat-top of the Suiko Seamount was selected as the place of observation. The each instrument was placed about two miles apart along the same line of Loran.

If one wants to draw any conclusion about the presence of seismic activity in this area, the period of observation should, at least, be more than one month. However, owing to the cruise schedule for the comprehensive geophysical survey in the Northern Pacific Ocean, the period of seismographic observation was limited only to four days. This made the seismographic observation in this cruise as preliminary survey.

#### 12-3. Location and period of observation.

The locations and periods of ocean-bottom seismographic observation and bottom-current meter observation are listed in Table 12-1.

#### 12-4. Instrument and Mooring system.

The ocean-bottom seismograph is the FM magnetic tape recorder type which has been developed by the Earthquake Research Institute, University of Tokyo.

The bottom-current meter is optical film digital recorder type ( Model 102, GEODYNE ), and was prepared for use by Associate Professor Kenzo Takano and Mr. Sugimori, Ocean Research Institute, University of Tokyo.

The sketch of anchored-buoy mooring system are shown in Fig. 12-1. and Fig. 12-2.

#### 12-5. Field operations.

##### 12-5-1. Preparations.

Rope systems were wound in No.6 Winch. Main buoy, light buoy, and radio buoy were prepared several days before development.

##### 12-5-2. Deployment of ocean-bottom seismograph.

Owing to rough sea conditions, piston coring scheduled on July 28, was abandoned. The ship continued to sail for ocean-bottom seismographic observation station. In the morning 06:00 of July 29, the ship stopped. By examining the labouring of ship against high swells, it was decided to conduct the ocean-bottom seismograph deployment as scheduled. The ship came to the station at 11:40. In order to examine the extent of flat-top the Suiko Seamount, the ship continued to sail on course until 11:50. Recognizing the continuation of flat-top, GEK current measurement was performed for obtaining necessary information for the deployment of ocean-bottom seismograph. The value obtained was 0.8, kt.,  $160^{\circ}$ , which was considered abnormal in this area. During GEK measurement, it was discovered that the bottom topography was not flat, but full of cliffs and obstacles (unknown side echoes on P.D.R.). It was decided to come back to the more flat place. Coming back about ten minutes, we came on station at 12:30, of which depth was 1242m. The operation of deployment started immediately. Thinking now, we should have conducted the same zig-zag survey there again so as to make sure the flat extent of bottom topography. To my deep regret, we were too in haste to start the deployment.

It took about 53 minutes from the beginning of operation to the landing of the instrument upon the bottom. The ship drifted due to gale. The depth changed from 1242m to 1270m during operation showing the presence of rough topography. Later, it was gradually revealed that the place where the ocean-bottom seismograph was deployed was not flat, but rough and rocky bed near the edge of a cliff.

It can be said that we were failed at the beginning in selecting the proper place for ocean-bottom seismographic observation. This became the main cause of failure for recovering ocean-bottom seismograph.

The writer thinks that the scientist should be very careful and patient for searching the proper deployment place. Sufficient time should also be shared for such searching before deployment.

### 12-5-3. Deployment of bottom-current meter.

Since the selection of the place of ocean-bottom seismographic observation was not satisfactory, the selection for bottom-current meter was carried out with great care. The place of the bottom-current meter was at first scheduled two miles north from the ocean-bottom seismograph on the same Loran line. However, when the ship sailed towards the scheduled location, it was found that the bottom was no longer flat there. We gave up the scheduled location, and changed to the south of the seismograph station. The ship sailed towards south along the same Loran line, and finally found proper flat place for deployment of the bottom-current meter. We were on station at 15:26 of July 29., the depth was 1300m. The deployment started at 15:30, the landing of the instrument was at 16:13 and the all operation completed at 16:40.

The deployment of anchored-buoy mooring system upon the top of seamount was the first experience for us. Through these operations, we have experienced a lot of things. The first thing is that we should not be too in haste for determining the place of deployment. Sufficient time should be shared, at least several hours, for searching the proper place for deployment of the instrument. Zig-zag course should be taken for examining the flatness of the bottom. Dredging of bottom material would be desirable. The place where outcrops of rocks predominates and where no soft sediment exists, should be best avoided for such mooring buoy operation.

### 12-5-4. Recovery of ocean-bottom seismograph.

In the early morning of Aug. 2 we came to the ocean-bottom seismograph station and bottom-current meter station under heavy rain and gale wind. Owing to the rough weather, however, the recovery operation was postponed to the next day.

Again in the early morning, 05:00 of Aug. 3, we came to the ocean-bottom seismograph station. Since the barometer indicated the recovering of weather, it was decided to wait for a

while at the station until the sea conditions so abate that we can carry out recovery operation. The recovery operation is much more difficult and complex than that of deployment.

From 09:00, the control capability of ship movement was tested against the actual conditions of gale and high swells.

Judging from various situations, it was decided to begin the recovery operation from 09:50. In addition to the rough conditions at sea, the recovery of the ocean-bottom seismograph mooring system was the first experience for this ship. It took about 50 minutes until the main wire rope began to be wound by the No.6 winch after picking up radio-buoy, light-buoy and main-buoy. Later it was found on the record of JJY phase shift, which was observed by Mr. F. Ono, Japan Hydrographic Office, that the wire was already broken and the ship suddenly started to drift at 10:07 in the midst of the picking up operation of light-buoy. It was when the load of 3 thousand ton ship due to high swells was applied to the mooring wirerope.

It was noticed that the tension of winding wire gradually decreased. Finally, the broken end of the wire came up to the deck. To my great regret, we failed for recovering the ocean-bottom seismograph.

The position of the break of wire was at about 1.4 - 1.5 km from the sea surface. Since the water depth was 1270 m, the length of the recovered wire indicated that the break took place at the part of the wire which lay upon the rocky bottom.

The break was not due to tension but due to frictional grind. Components of wire were ground to thinner strip with bright surface. Components of wire were separated each other and were different in length. The aspect of the broken wire was just like a cotton string which was bitten off by teeth. The sketch of the broken wire was shown in Fig. 12-3.

Judging from various evidences, it was thought that the break of wire took place during the recovery operation, the wire being bitten by rock outcrops of the sea-bottom, the load of the 3 thousand ton ship being applied to the mooring wire, repetition of loading due to high swells caused friction grind of the wire at the bitten rock, and being led to the final

break in a short time.

The anchor of the bottom-current meter, which was recovered later, did not carry any mud at all at any part. The dredge, which was carried out immediately after the seismograph recovery operation along the seismograph station, showed that the bottom was outcrops of rocks and there was no sticky soft mud nor soft sediment upon the sea-bottom.

Dredge haul of the lost ocean-bottom seismograph was planned and carried out immediately at this place. Special dredge devices for seismograph were made and attached to the chain dredge for rock samples. The course of dredge was determined by the bottom topography and Radar reflector of the bottom-current meter. It was difficult to make success in dredging the lost seismograph.

#### 12-5-5. Recovery of the bottom-current meter.

The recovery operation of the bottom-current meter was carried out immediately after the dredge haul of the lost ocean-bottom seismograph. Great care was paid for ship control so that any undesirable tensions were applied to the mooring ropes. The ropes were kept upright, or even at inverse gradient during picking up of buoys and winding up of ropes. Fortunately, we were successful in the recovery of the bottom-current meter at 12:40 Aug. 3.

The one of the nails of the anchor had been bent at the edge, showing heavy hook at the bottom.

The success of the continuous observation by mooring buoy system upon the top of seamount may be the first example in the world.

#### 12-6. Result of observation.

##### Ocean-bottom seismograph.

To my deep regret, since we have failed in the recovery of the seismograph, the problem of the existence of seismic activity in the Emperor Ridge was not solved this time.

Even though we could not obtained seismic record, we

really obtained valuable experiences. We wish this hard experiences would be more valuable in future than a roll of seismograph. It is the writer's responsibility to prove this.

Bottom-current meter.

Optical film is scheduled to be developed in Tokyo. The results will be analyzed and reported by Associate Professor Kenzo Takano, Ocean Research Institute, University of Tokyo.

#### 12-7. Discussion and Remarks.

The anchored-buoy mooring system which was used for ocean-bottom seismograph was the one which has been used off Sanriku about a month from May to June this year, and in the Sagami Bay about 20 days in June last year. In spite of these field experiences, the failure of recovery has taken place at the Suiko Seamount.

The most essential defect of this system for the operation at the Suiko Seamount was that the system was not suitable for rocky sea-bottom. Extra wire ropes lie upon the sea-bottom in this system. This will be the main cause of being captured by rock outcrops.

Though the fact that the top of the Suiko Seamount does not have any soft mud was a little beyond our preliminary suppositions, the situation will not be so exceptional. It may not be surprising that the most ocean-bottom upon ridges and continental slopes may lack thick soft mud. Therefore, in the anchored-buoy mooring system in the ocean should be so made that extra ropes are floated above sea-bottom. The mooring system used for the bottom-current meter is of this type.

In addition to this, sufficient strength of ropes would be necessary for operation by 3 thousand ton ship. The limit strength of the mooring system do varies according to the size of ship.

Besides these, one may count several related causes such as undesirable weather condition, too fast selection of seismograph deployment location, the first experience of ocean-bottom seismographic observation, etc. However, these could be

avoided by careful operation and schedule.

It is our desire to build another satisfactory mooring system which matches our ship, R/V Hakuho Maru, as soon as possible.

The success of the bottom-current meter observation encourages us very much giving bright prospects in the future.

Table 12-1.

Log of field operation.

\* Ocean Bottom Seismograph.

EMPLOYMENT START	JUL. 29 12:35	44° 28.7' N 170° 23.2' E 1242 M	SS3X 32475 SS3W 12872 SL2Y 28532 IL2 2258
LANDING	JUL. 29 13:24	44° 28.2' N 170° 24.0' E 1270 M	SS3X 32478 SS3W 12870 SL2Y 28547 IL2 2263
END	JUL. 29 14:09	44° 28.2' N 170° 24.0' E 1270 M	
RECOVERY START	AUG. 3 09:50	44° 27.4' N 170° 25.0' E	
END	AUG. 3 11:42		

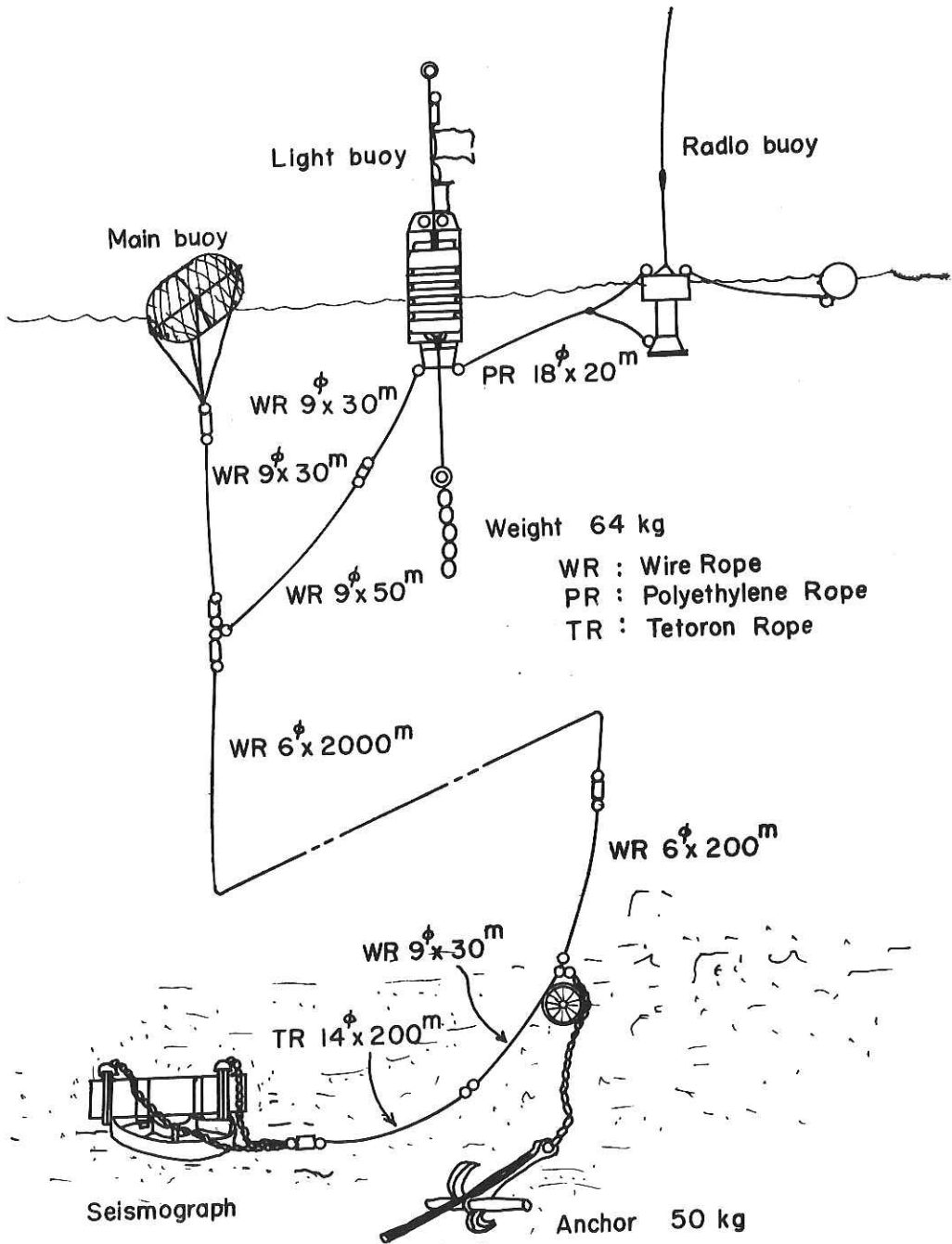
\* Bottom Current Meter.

DEPLOYMENT START	JUL. 29 15:30	44° 26.0' N 170° 22.1' E 1300 M	
LANDING	JUL. 29 16:13	44° 26.0' N 170° 22.9' E 1300 M	IL2 2267 SS3X 32485.6 SS3W 12866.5 SL2Y 28549.2
END	JUL. 29 16:40		
RECOVERY START	AUG. 3 17:30	44° 25.3' N 170° 24.0' E	
END	AUG. 3 20:40	44° 24.6' N 170° 23.8' E	
	Date Time	Position Depth	Loran



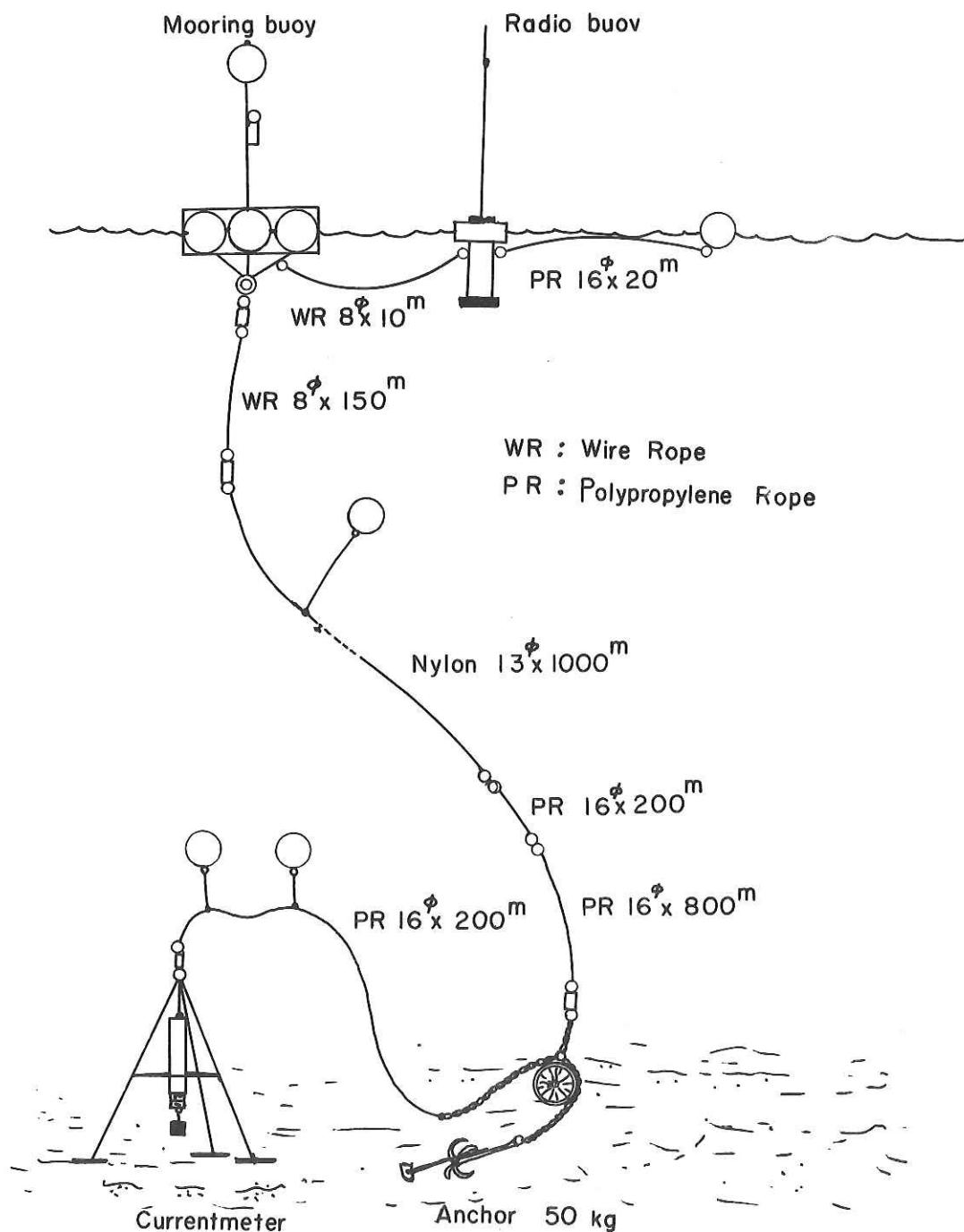
Fig. 12-1

# Mooring System for Ocean-Bottom Seismograph



Mooring System for Bottom Currentmeter

Fig. 12-2



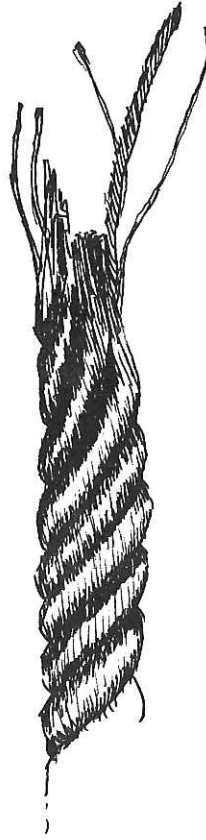


Fig. 12-3 Sketch of broken wire

13. Measurement of arrival time of the standard radio frequency.

Fusakichi Ono

The accuracy of the radio navigation system depends on the stability of the propagation of the radio wave.

In order to study the stability, the measurement of arrival time of the standard radio frequency was carried out during the whole cruise. The measurement was carried out by comparing the phase difference between the crystal frequency standard installed on board the ship and the received frequency standard.

The short wave length radio frequency standards 2.5, 5, 10 and 15 MHz J J Y were compared with 1 Hz standard frequency, by the use of the C. R. T. and the Photographic Continuous Recorder.

The low frequency signal of 40 KHz JG2AS was compared with 40 KHz standard frequency by the use of the phase comparator and a recorder.

The block diagram of the measurement method is shown in Fig. 13-1.

# Block Diagram Comparison Method

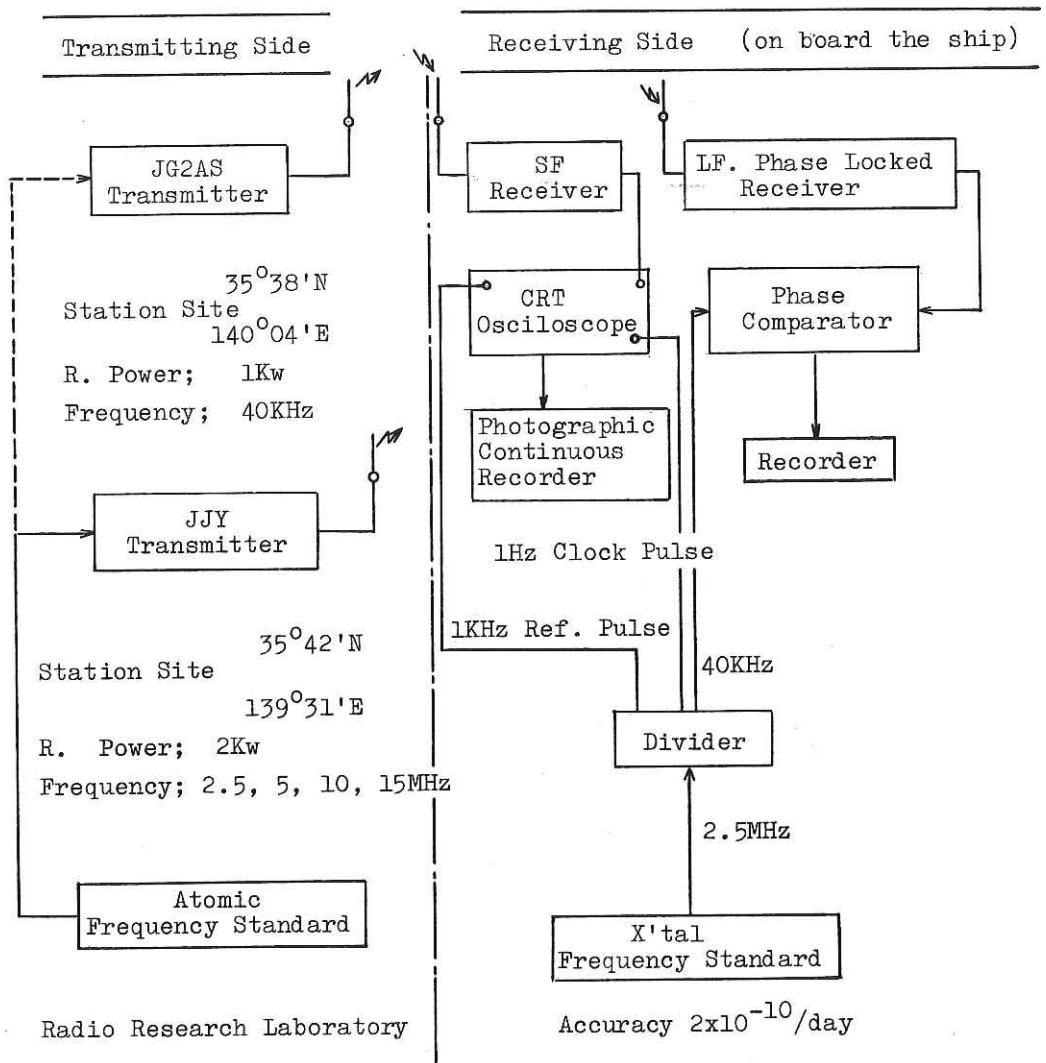


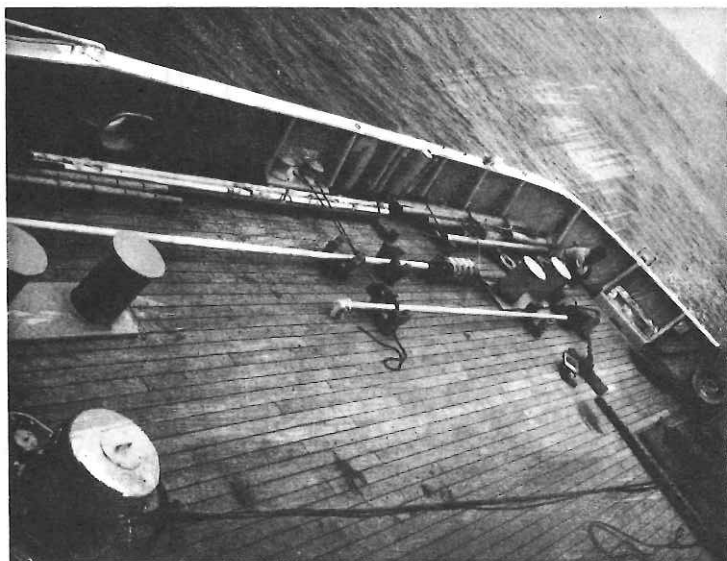
Fig. 13-1

#### 14. Piston corer

K. KITAZAWA and K. KOIZUMI

A new model of piston corer was built using an alloy of Aluminum with Magnesium (JIS H4143) for the pipe and the head with accessories. (see Fig. 14-1)

Only the cutting edge and the piston with cable fitting were made of steel and brass respectively. The sizes are indicated in the table. One straight pipe of 12 m or 6 m in length was used for the present cruise. As the material is commercially available by relatively reasonable cost, it may be expendable when it is bent or when the sediment sample filled in the pipe can not be extruded smoothly. It is sufficiently strong against the bending force and it was only once bent due to the resistant force of the water on the surface of the sea when the swell was too large to lower the pipe from the vessel.



15. The Piston Corer used in the KH-68-3.(Fig. 15-1).

Kinichiro KOIZUMI

Two sets of piston corer was designed and made for the purpose of palaeomagnetic investigation of the ocean bottom.

In designing the corer, it is required that

- 1) a set of corer should be made cheaper than ¥ 400,000.
- 2) core sample at least 6 m long should be sampled.
- 3) the corer should be easy to handle.
- 4) the corer must be nonmagnetic.

In order to fulfil the above requirement,

- 1) Aluminum (A2PI - 1/2H) pipe of 80  $\phi$  mm outer diameter with thickness of 6 mm was used instead of stainless steel (SUS - 27). The length of the pipes is 6 m or 12 m, and the pipe was used without jointing two or more pipes.
- 2) "O" ring was used for increasing the piston effect.
- 3) The shape of the corer was designed in close connection with the Crew of the ship who practically handle the corer.

The Aluminum pipe.

The stainless steel is often used for the corer. The stainless steel is stiff enough, non-magnetic as well as stainless, but is too expensive.

As compared with stainless steel the price of the Aluminum is 1/5 including the cost of labor. Only problem is its mechanical stiffness, it was worried whether the pipe is bent during the penetration through the sediment. When the pipe is vertical, the external force acting on the pipe is the compressional force along the length of the pipe caused by the free fall of the corer and the bending moment is expected to be very small, and if the bending moment happened to act on, the Aluminum pipe without joint is expected to be stronger than the pipes having many weak point at its joints.

As the results of present sampling, the Aluminum corer is proved to have enough mechanical strength during the penetration to the bottom or pulling out from the bottom. The problem lies in the technique of launching or recovering the

corer on board the ship.

#### The piston effect.

Physical meaning of the effect of the piston is not so clearly understood. Many discussions were made during the cruise by scientists, together with the staff of the ship.

The effect of the piston should be considered separately for penetrating and pulling up.

When penetrating into the sediment by the momentum of the free fall, little effect of the piston is expected. The piston may act as an obstacle through friction between the piston and inner wall of the pipe.

When pulling up the corer, large pressure difference will be at the inner and outer pipe of the corer. The pressure difference is expected to be nearly the 500 atm. if the piston and the inner wall of the pipe is perfectly sealed at the bottom of 5000 m. in depth. The pressure difference will be released only when the pipe penetrates further.

To expect this effect, the sealing between the pipe and the piston is improved by the use of the two sets of "O" ring attached to the piston.

In order that the piston remains at the lowest point of the corer until it reaches the surface of the bottom, the piston is tied by a thin wire which resists against the tension 20 kg or less.

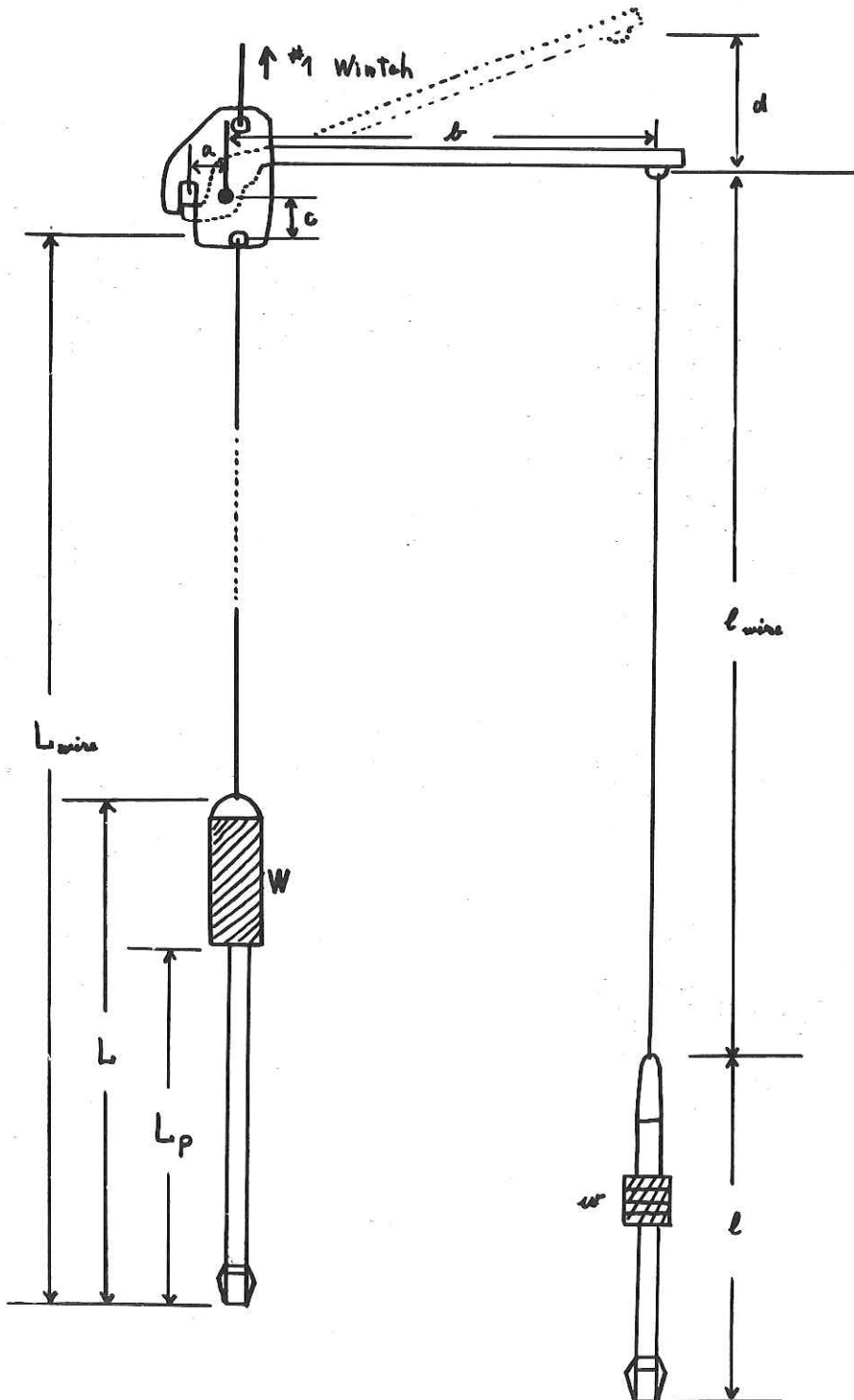
#### The clearance ratio.

The catcher is designed that the clearance ratio is zero. But in the case of the trial at St. 15 - 2, the adapter is attached to the catcher so as to make 5 mm clearance. That is, the diameter of the take in nozzle was made 5 mm smaller than the inner diameter of the main pipe.

The core sample of 10 m length was obtained by the 12 m pipe corer with this nozzle. But the effect of the adapter is not apparent.



Fig. 15-1



16. CORE LOG.

CORE LOG

Date July 22, '68 Ship Hakuho-maru Cruise KH68-3 Station 2

Latitude 38° 01' N Longitude 154° 10' E

Location North Pacific Basin

Sea Slight swell

Bottom Topography flat

Profiler \_\_\_\_\_

Length Core Pipe 6 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 350 kg Trigger Wt. 44 kg

Length Trigger Line 15 m Length Main Line 15 m

Length Free Fall 8 m

Lowered from the side (right).

Time lowered 08 h 05 m; Uncorrected Water Depth 5850 m

Time Hit Unknown; Uncorrected Water Depth \_\_\_\_\_ m

Wire Angle at Hit 10° Wire-out at Hig \_\_\_\_\_ m

Time Surfaced 12 h 53 m; Uncorrected Water Depth \_\_\_\_\_ m

Core Length 0 cm no hit-response because of too

Trigger Core Length 0 cm many pooleies used.

Method of Storage \_\_\_\_\_

Length of Cores in Pipe 1. Top \_\_\_\_\_ cm, 2. \_\_\_\_\_ cm

3. \_\_\_\_\_ cm, 4. \_\_\_\_\_ cm, 5. \_\_\_\_\_ cm

No. of Pipe Filled \_\_\_\_\_

No. of Cubic Samples for Paleomagnetism \_\_\_\_\_

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue,

T. Inoue, K. Kitazawa and Kazuo Kobayashi (in

Alphabetical order)

CORE LOG

Date July 24, '68 Ship Hakuho-maru Cruise KH68-3 Station 4

Latitude 38° 00' N Longitude 165° 30' E

Location East of the Shatsky Rise

Sea Smooth with slight swell

Bottom Topography almost smooth

Profiler \_\_\_\_\_

Length Core Pipe 6 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 350 kg Trigger Wt. 44 kg

Length Trigger Line 15 m Length Main Line 15 m

Length Free Fall 8 m

Time lowered 13 h 35 m; Uncorrected Water Depth 5420 m

Time Hit 14 h 56 m; Uncorrected Water Depth 5420 m

Wire Angle at Hit 2° Wire-out at Hit 5473 m

Time Surfaced 16 h 05 m; Uncorrected Water Depth 5420 m

Core Length 266 cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage lapped by vinyl sheet and contained in  
vinyl pipes

Length of Cores in Pipe 1. Top 68 cm, 2. 75 cm

3. 77 cm, 4. 46 cm, 5. \_\_\_\_\_ cm

No. of Pipe Filled 4

No. of Cubic Samples for Paleomagnetism 96

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue,

T. Inoue, K. Kitazawa and Kazuo Kobayashi

(in Alphabetical order)

CORE LOG

Date July 27, '68 Ship Hakuho-maru Cruise KH68-3 Station 7

Latitude 39° 20' N Longitude 178° 01' E

Location East of the north Hawaiian Rise

Sea Slight swell

Bottom Topography rough

Profiler \_\_\_\_\_

Length Core Pipe 6 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 350 kg Trigger Wt. 44 kg

Length Trigger Line 15 m Length Main Line 15 m

Length Free Fall 8 m

Time lowered 7<sup>h</sup> 45<sup>m</sup> ; Uncorrected Water Depth 5560 m

Time Hit 9<sup>h</sup> 14<sup>m</sup> ; Uncorrected Water Depth 5440 m

Wire Angle at Hit 4° ; Wire-out at High 5485 m

Time Surfaced 10<sup>h</sup> 24<sup>m</sup> ; Uncorrected Water Depth 5440 m

Core Length 242 cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage lapped by vinyl sheets and contained in vinyl pipes.

Length of Cores in Pipe 1. Top 120 cm, 2. 122 cm

3. \_\_\_\_\_ cm, 4. \_\_\_\_\_ cm, 5. \_\_\_\_\_ cm

No. of Pipe Filled 2

No. of Cubic Samples for Paleomagnetism 93

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue,

T. Inoue, K. Kitazawa and Kazuo Kobayashi

# CORE LOG

Date Aug. 4, '68 Ship Hakuho-maru Cruise KH68-3 Station 11-1

Latitude 44° 27' N Longitude 171° 59' E

Location East flank (deep) of the Sea Mt. Suiko

Sea moderate with rough swell

Bottom Topography smooth

Profiler \_\_\_\_\_

Length Core Pipe 12 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 520 kg Trigger Wt. 44 kg

Length Trigger Line 25 m Length Main Line 25 m

Length Free Fall 12 m

Time lowered 12<sup>h</sup> 25<sup>m</sup> ; Uncorrected Water Depth 5925 m

Time Hit 13<sup>h</sup> 40<sup>m</sup> ; Uncorrected Water Depth 5925 m

Wire Angle at Hit 0° Wire-out at Hit 6003 m

Time Surfaced 15<sup>h</sup> 15<sup>m</sup> ; Uncorrected Water Depth 5925 m

Core Length 565 cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage lapped by vinyl sheets and contained in vinyl pipes.

Length of Cores in Pipe 1. Top 80 cm, 2. 81.5 cm

3. 90 cm, 4. 94.5 cm, 5. 91 cm, 6. 102 cm, 7. 24 cm

No. of Pipe Filled 7

No. of Cubic Samples for Paleomagnetism 114

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue,

T. Inoue, K. Kitazawa and Kazuo Kobayashi

CORE LOG

Date Aug. 4, '68 Ship Hakuho-maru Cruise KH68-3 Station 11-2

Latitude 44° 27' N Longitude 171° 59' E

Location East flank of the Sea Mt. Suiko

Sea rough swell

Bottom Topography \_\_\_\_\_

Profiler \_\_\_\_\_

Length Core Pipe 6 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 350 kg Trigger Wt. \_\_\_\_\_ kg

Length Trigger Line \_\_\_\_\_ m Length Main Line \_\_\_\_\_ m

Length Free Fall \_\_\_\_\_ m

Time lowered 15<sup>h</sup> 45<sup>m</sup> ; Uncorrected Water Depth 5925 m

Time Hit 17<sup>h</sup> 24<sup>m</sup> ; Uncorrected Water Depth 5925 m

Wire Angle at Hig 0° Wire-out at Hig 5937 m

Time Surfaced 18h 30 m ; Uncorrected Water Depth 5925 m

Core Length 3 cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage lapped by a vinyl sheet (unoriented).

Length of Cores in Pipe 1. Top \_\_\_\_\_ cm, 2. \_\_\_\_\_ cm

3. \_\_\_\_\_ cm, 4. \_\_\_\_\_ cm, 5. \_\_\_\_\_ cm

No. of Pipe Filled \_\_\_\_\_

No. of Cubic Samples for Paleomagnetism X

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue,

T. Inoue, K. Kitazawa and Kazuo Kobayashi

CORE LOG

Date Aug. 5, '68 Ship Hakuho-maru Cruise KH68-3 Station 12-1

Latitude 44° 40' N Longitude 171° 00' E

Location \_\_\_\_\_

Sea \_\_\_\_\_

Bottom Topography \_\_\_\_\_

Profiler \_\_\_\_\_

Length Core Pipe 12 m No. of Pipe 1 Material Al

I.D. of Pipe \_\_\_\_\_ mm Wall Thickness \_\_\_\_\_ mm

Core Head Wt. \_\_\_\_\_ kg Trigger Wt. \_\_\_\_\_ mg

Length Trigger Line \_\_\_\_\_ m Length in Main Line \_\_\_\_\_ m

Length Free Fall \_\_\_\_\_ m

Time lowered 9<sup>h</sup> 29<sup>m</sup> ; Uncorrected Water Depth 6370 m

Time Hit \_\_\_\_\_ ; Uncorrected Water Depth \_\_\_\_\_ m

Wire Angle at Hit \_\_\_\_\_ Wire-out at Hit \_\_\_\_\_ m

Time Surfaced \_\_\_\_\_ ; Uncorrected Water Depth \_\_\_\_\_ m

Failed due to an erratic trigger at 610 m of the wire-out

Pipe bent when recovered.

Core Length \_\_\_\_\_ cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage \_\_\_\_\_

Length of Cores in Pipe 1. Top \_\_\_\_\_ cm 2. \_\_\_\_\_ cm

3. \_\_\_\_\_ cm, 4. \_\_\_\_\_ cm, 5. \_\_\_\_\_ cm

No. of Pipe Filled \_\_\_\_\_

No. of Cubic Samples for Paleomagnetism \_\_\_\_\_

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue

T. Inoue, K. Kitazawa and Kazuo Kobayashi

CORE LOG

Date Aug. 5, '68 Ship Hakuho-maru Cruise KH68-3 Station 12-2

Latitude 44° 40' N Longitude 171° 00' E

Location The flank of the Suiko

Sea rough swell

Bottom Topography near the scarp

Profiler

Length Core Pipe 6 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 520 kg Trigger Wt. 54 kg

Length Trigger Line 25 m Length Main Line 15 m

Length Free Fall 8 m

Time lowered 10<sup>h</sup> 44<sup>m</sup> ; Uncorrected Water Depth 6350 m

Time Hit 12<sup>h</sup> 11<sup>m</sup> ; Uncorrected Water Depth 6350 m

Wire Angle at Hit  Wire-out at Hit 6415 m

Time Surfaced 13h 25m; Uncorrected Water Depth 6350 m

Core Length 0 cm possibly due to sandy bottom.

Yrigger Core Length 0 cm

Method of Storage

Length of Cores in Pipe 1. Top  cm, 2.  cm

3.  cm, 4.  cm, 5.  cm

No. of Pipe Filled

No. of Cubic Samples for Paleomagnetism

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue

F. Inoue, K. Kitazawa and Kazuo Kobayashi



CORE LOG

Date Aug. 9, '68 Ship Hakuho-maru Cruise KH68-3 Station 15-1

Latitude 38° 28' N Longitude 165° 58' E

Location \_\_\_\_\_

Sea \_\_\_\_\_

Bottom Topography \_\_\_\_\_

Profiler \_\_\_\_\_

Length Core Pipe 2.5 m No. of Pipe 2 Material Stainless  
steel

I.D. of Pipe 80 mm Wall Thickness 4 mm

Core Head Wt. 461 kg Trigger Wt. 54 kg

Length Trigger Line 19.9 m Length Main Line 20.0 m

Length Free Fall 13.1 m

Time lowered 9<sup>h</sup> 08<sup>m</sup> ; Uncorrected Water Depth 5505 m

Time Hit 10<sup>h</sup> 17<sup>m</sup> ; Uncorrected Water Depth 5505 m

Wire Angle at Hit 0° Wire-out at Hit 5540 m

Time Surfaced 11h 33m; Uncorrected Water Depth 5505 m

Core Length 459 cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage lapped by vinyl sheets and contained in  
vinyl pipes.

Length of Cores in Pipe 1. Top \_\_\_\_\_ cm, 2. \_\_\_\_\_ cm

3. \_\_\_\_\_ cm, 4. \_\_\_\_\_ cm, 5. \_\_\_\_\_ cm

No. of Pipe Filled \_\_\_\_\_

No. of Cubic Samples for Paleomagnetism \_\_\_\_\_

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue

T. Inoue, K. Kitazawa and Kazuo Kobayashi

CORE LOG

Date Aug. 9, '68 Ship Hakuho-maru Cruise KH68-3 Station 15-2

Latitude 38° 26' N Longitude 165° 59' E

Location East flank of the Shatsky Rise

Sea very smooth

Bottom Topography flat

Profiler \_\_\_\_\_

Length Core Pipe 12 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 520 kg Trigger Wt. 54 kg

Length Trigger Line 24 m Length Main Line 25 m

Length Free Fall 11 m

Time lowered 12<sup>h</sup> 55<sup>m</sup> ; Uncorrected Water Depth 5492 m

Time Hit 14<sup>h</sup> 17<sup>m</sup> ; Uncorrected Water Depth 5492 m

Wire Angle at Hit 0° Wire-out at Hit 5517m

Time Surfaced 15h 30m; Uncorrected Water Depth 5492 m

Core Length 970 cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage lapped by vinyl sheets and contained in vinyl pipes.

Length of Cores in Pipe 1. Top 375 cm, 2. 370 cm

3. 120 cm, 4. 80 cm, 5. 25 cm

No. of Pipe Filled 5

No. of Cubic Samples for Paleomagnetism 342

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue,

T. Inoue, K. Kitazawa and Kazuo Kobayashi

# CORE LOG

Date Aug. 9, '68 Ship Hakuho-maru Cruise KH68-3 Station 15-3

Latitude 38° 26' N Longitude 165° 59' E

Location East flank of the Shatsky Rise

Sea very smooth

Bottom Topography flat

Profiler \_\_\_\_\_

Length Core Pipe 6 m No. of Pipe 1 Material Al

I.D. of Pipe 68 mm Wall Thickness 6 mm

Core Head Wt. 350 kg Trigger Wt. 54 kg

Length Trigger Line 14 m Length Main Line 15 m

Length Free Fall 7 m

Time lowered 15<sup>h</sup> 55<sup>m</sup> ; Uncorrected Water Depth 5492 m

Time Hit 17<sup>h</sup> 12<sup>m</sup> ; Uncorrected Water Depth 5492 m

Wire Angle at Hit 0° Wire-out at Hit 5533 m

Time Surfaced 18h 40m; Uncorrected Water Depth 5492 m

Core Length 550 cm

Trigger Core Length \_\_\_\_\_ cm

Method of Storage lapped by vinyl sheets and contained in vinyl pipes.

Length of Cores in Pipe 1. Top 110 cm, 2. 106 cm

3. 107 cm, 4. 115 cm, 5. 87 cm, 6. 24 cm

No. of Pipe Filled 6

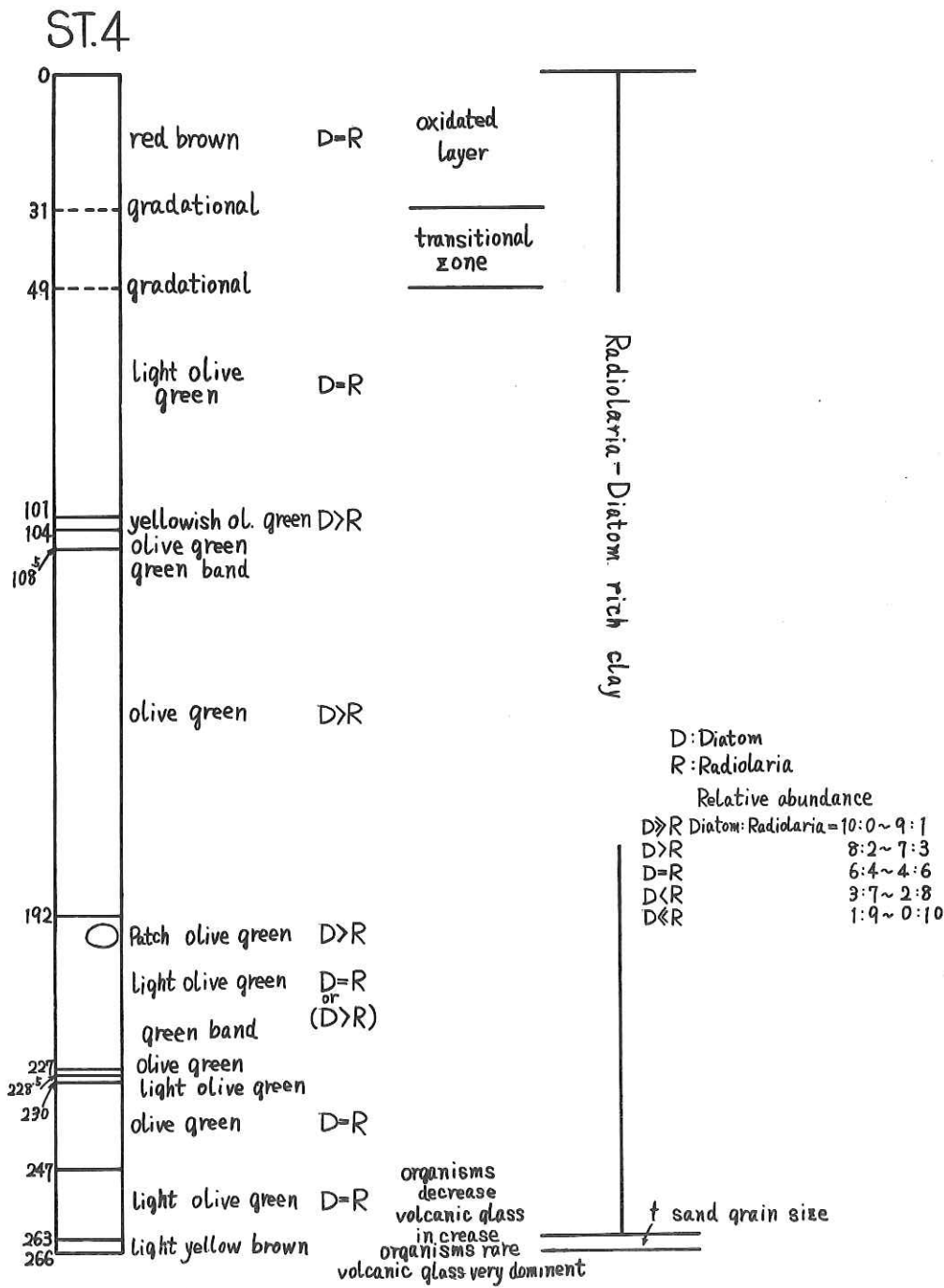
No. of Cubic Samples for Paleomagnetism 71

Worked by H. Hasegawa, E. Honza, A. Fujiwara, M. Inoue,

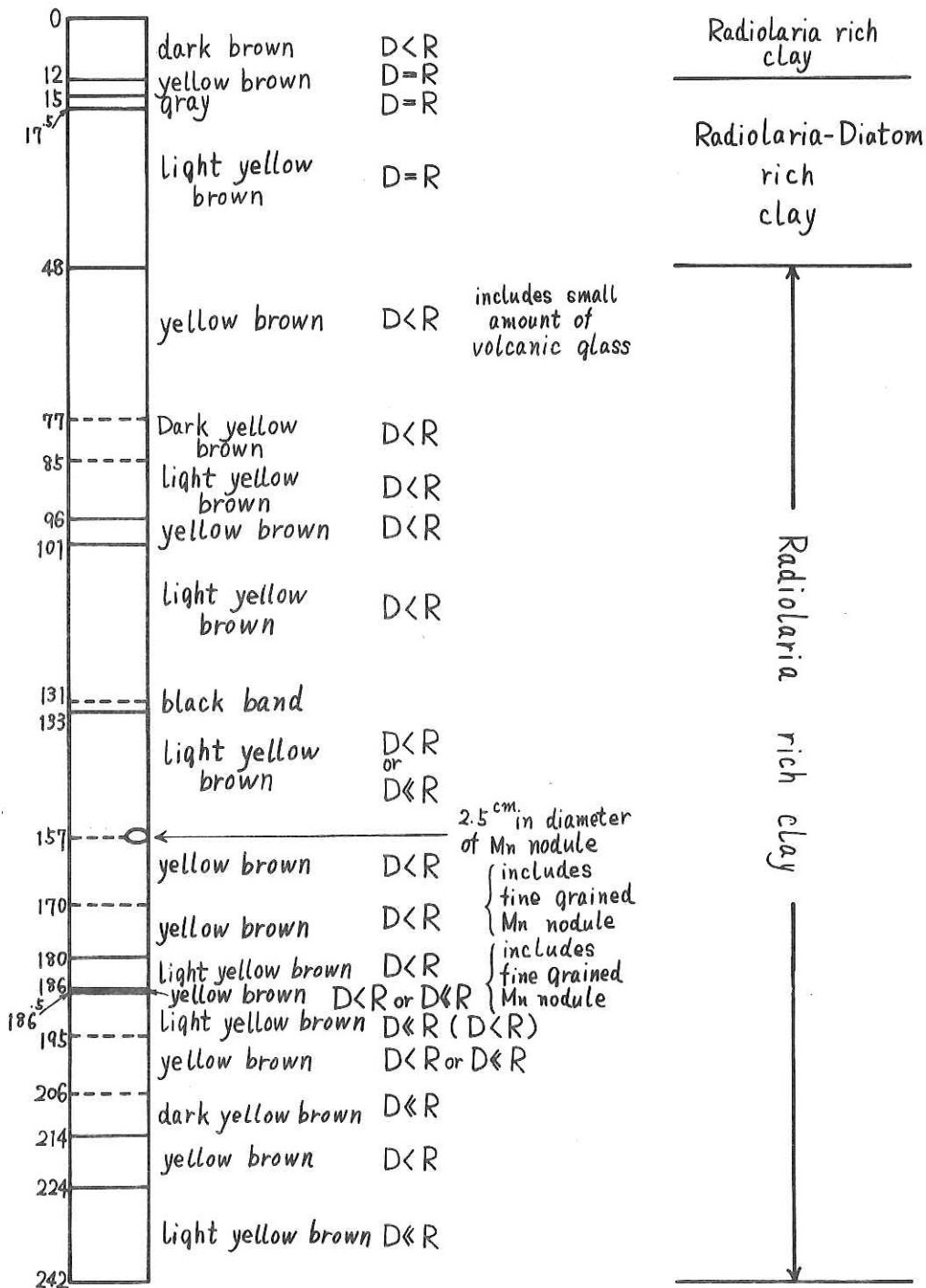
T. Inoue, K. Kitazawa and Kazuo Kobayashi

17. Columnar description of the core samples

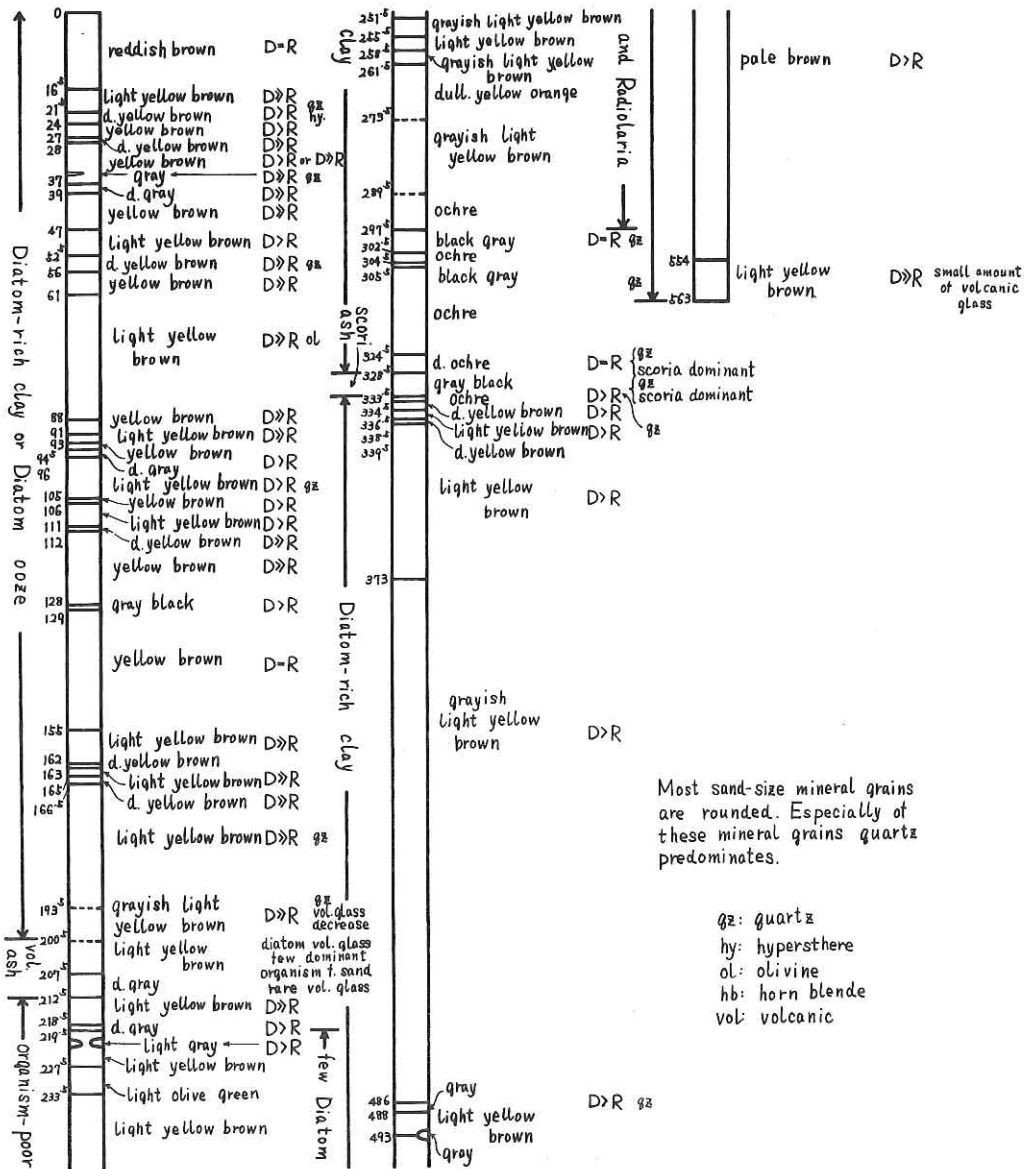
M. Inoue



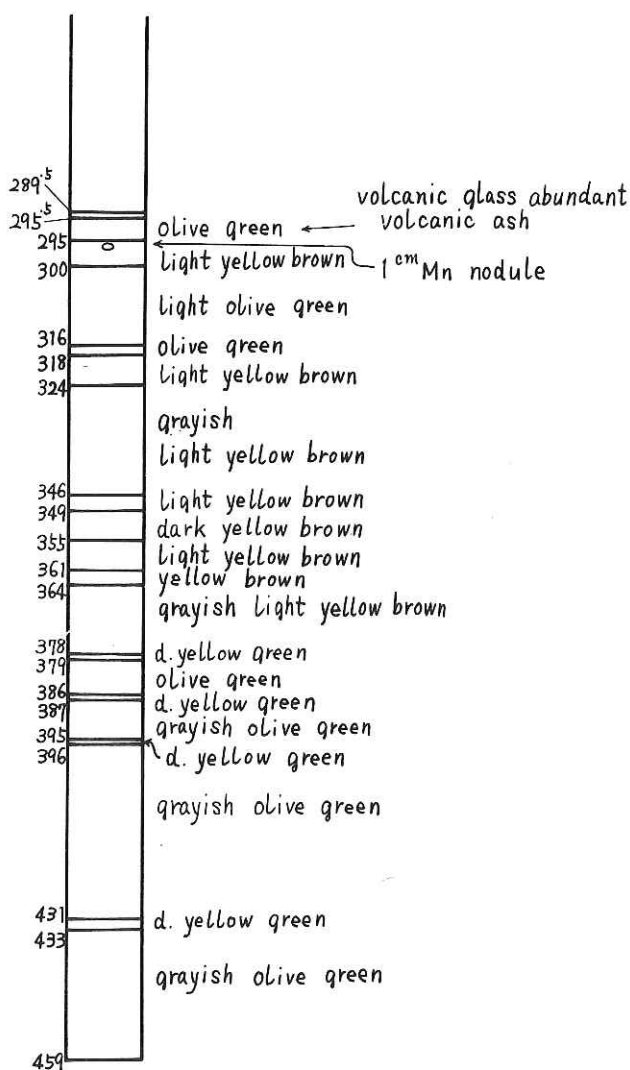
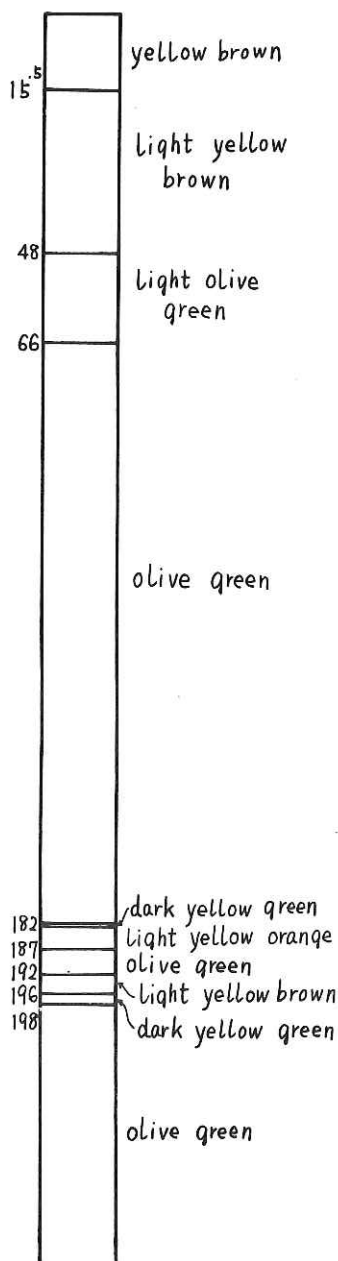
# ST. 7

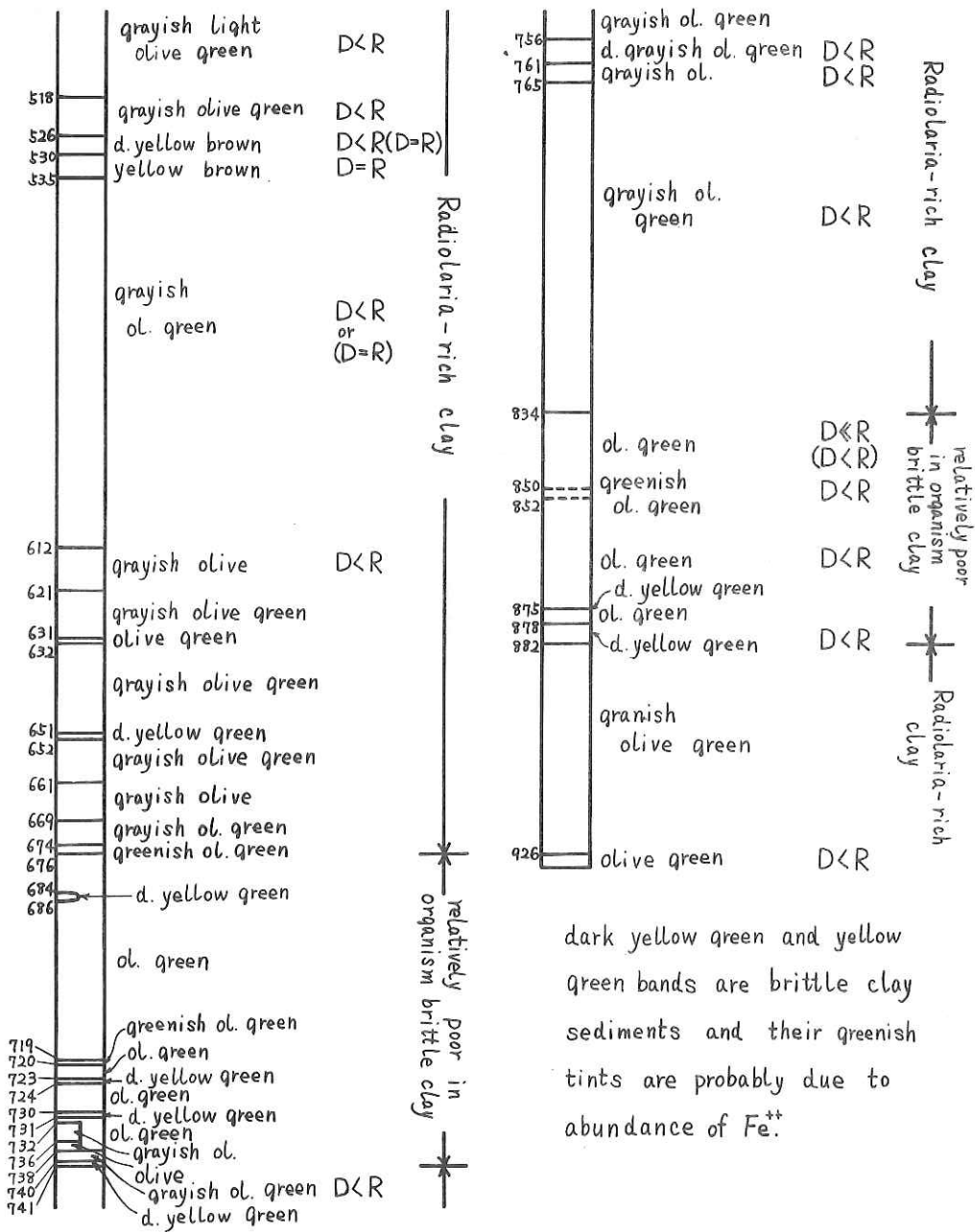


# ST.11



# ST.15-1

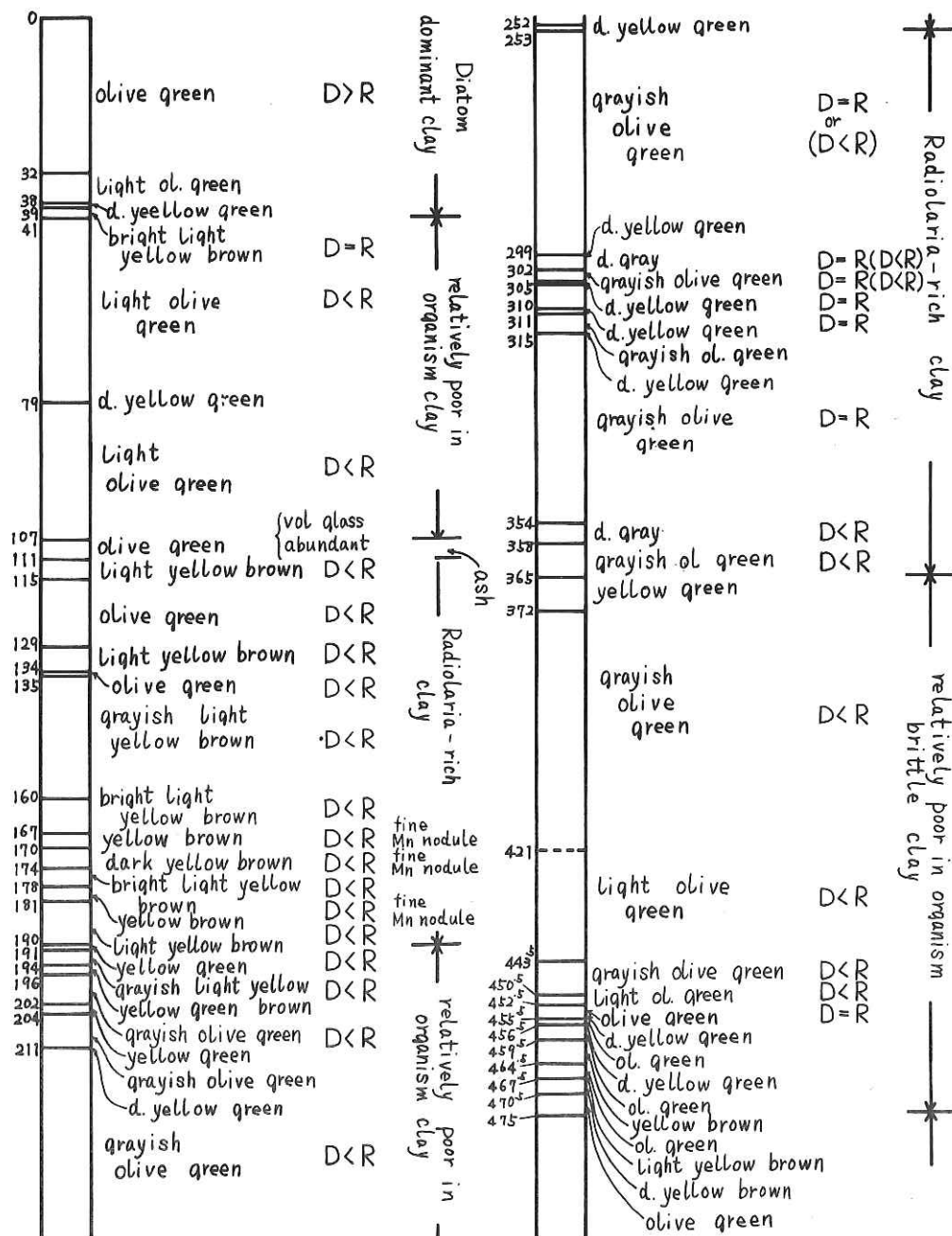




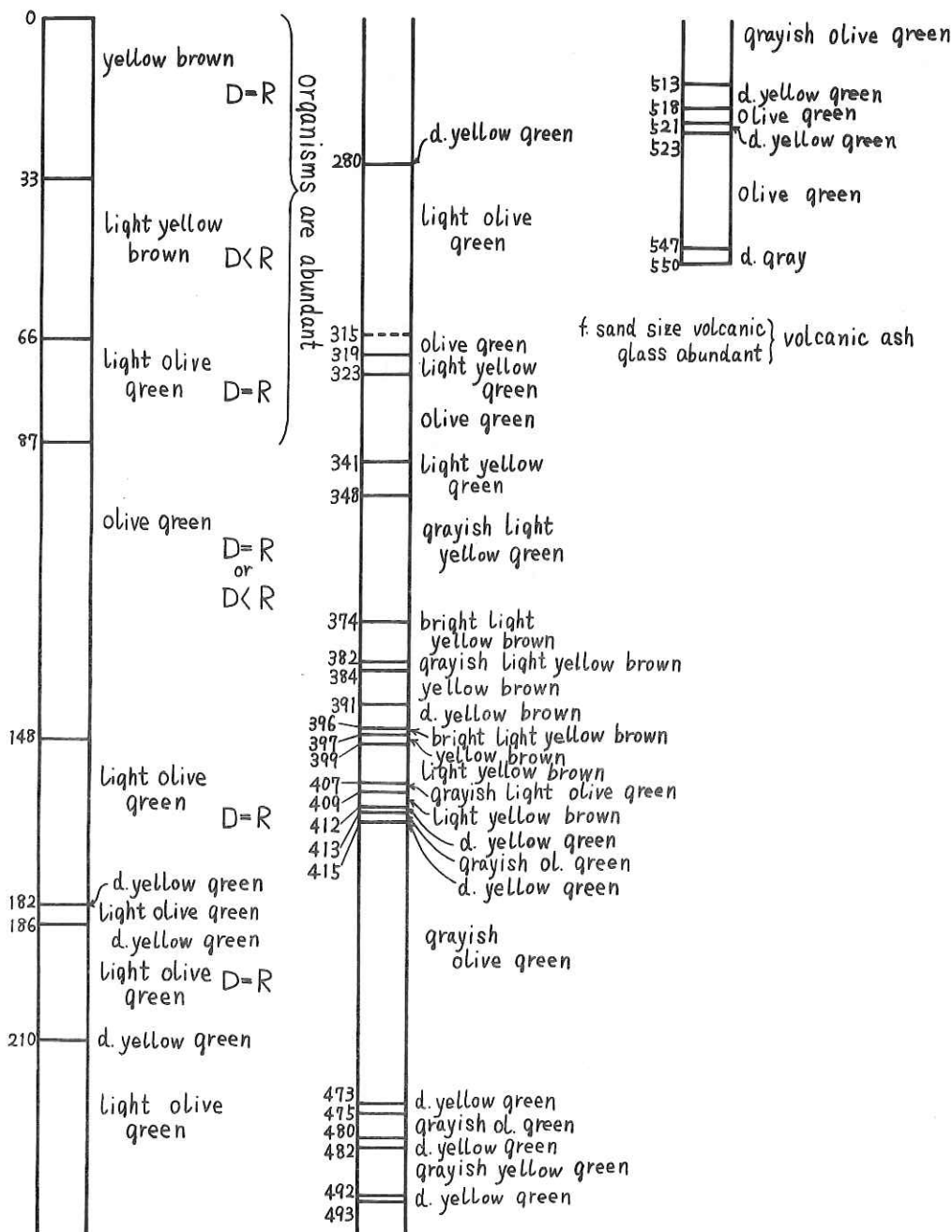
dark yellow green and yellow green bands are brittle clay sediments and their greenish tints are probably due to abundance of  $Fe^{++}$ .

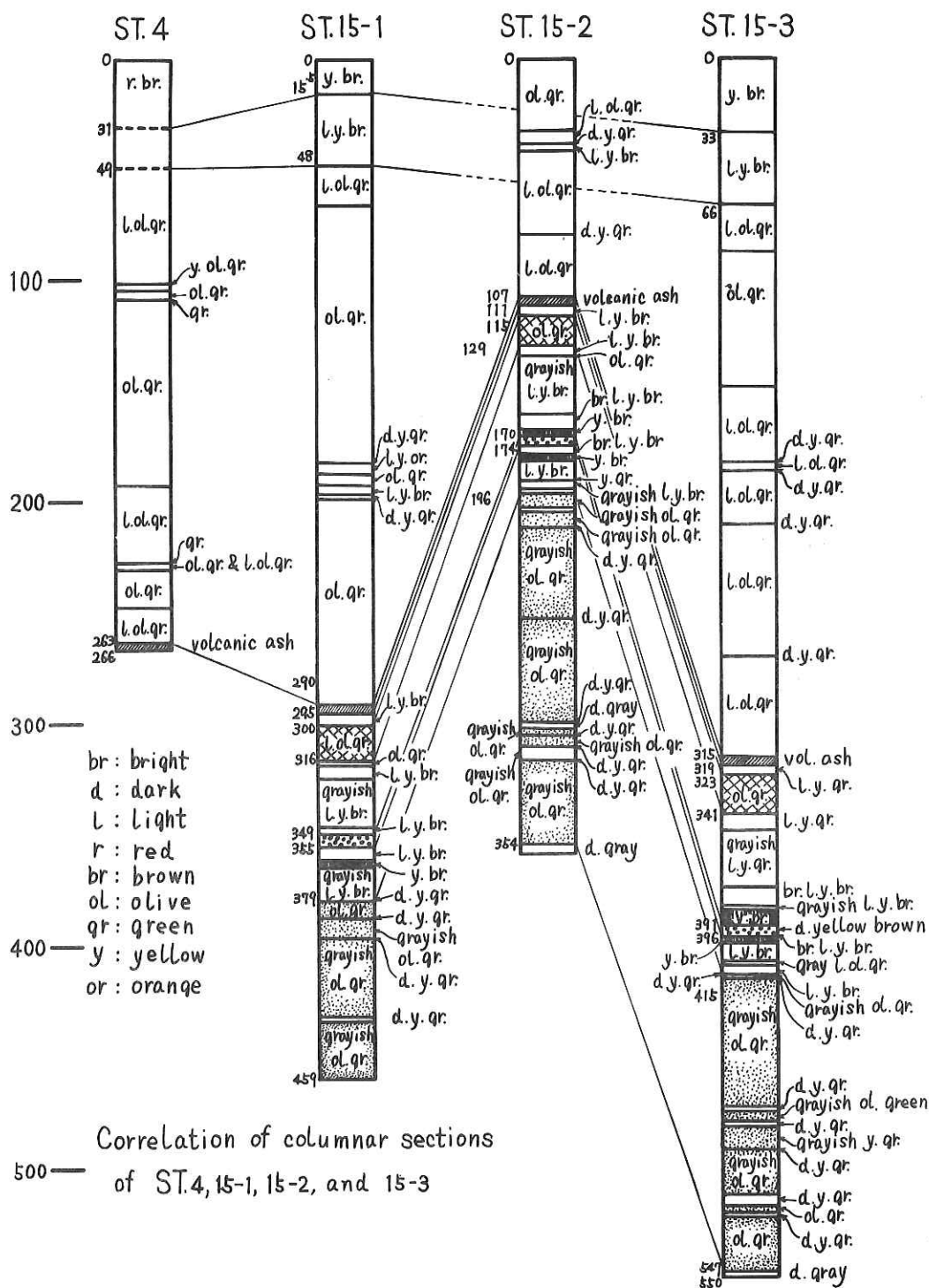


# ST.15-2



# ST.15-3





18. Macro fossils

Shoji Fujii, Eiichi Honza, Masao Inoue

Collected macro-fossils in this cruise are as follows:

Sample and locality No.	Fossil	Size (mm)	Mode of occurrence	Geological age
9-4-24	Otolith of whale	50 x 30 x 25	collected with other gravels	recent ?
9-8-24	Fragments of Gastropoda	14 x 10	in conglomerate	unknown
9-9-17	Isurus sp.		in conglomerate	unknown

## 19. Measurement of the density and porosity

Shigeo Iwamura

Density and porosity of the bottom sediments was measured with the bottom samples obtained by the piston corer at the two stations 4 and 7 in the north Pacific Ocean basin

N  $38^{\circ}09'$ , E  $165^{\circ}30'$ ; N  $39^{\circ}20'$ , E  $178^{\circ}01'$ . Sample was filled in a cubic plastic case of about 2 cm in its dimension. Measurement of weight was carried out using a small balance with sensitivity of 0.1 gr installed on a gimbal with oil damper to eliminate the effect of pitching and rolling of the ship.

The tables represent weight and density of sediment immediately after extrusion from the corer as well as the porosity which is estimated as the difference in weight after the sample is dried. (Tables, 19-1, 19-2).

Table 19-1 ST 4.

Sample No.	distance from the bottom	Weight of sample M	density $d = \frac{M}{V}$	porosity $n_e$
1	5 cm	10.9 g	$\frac{g}{cm^3}$ 1.22	82.0 %
2	15	11.4	1.17	74.2
3	25	11.9	1.14	79.8
4	35	12.4	1.39	75.3
5	45	11.8	1.33	80.9
6	55	11.8	1.33	79.8
7	65	11.6	1.30	83.2
8	75	11.8	1.33	82.0
9	85	11.4	1.28	83.1
10	95	11.2	1.16	80.9
11	105	11.4	1.28	85.4
12	115	11.7	1.32	85.4
13	125	11.6	1.30	84.3
14	135	11.1	1.25	78.7
15	145	11.4	1.28	80.9
16	155	11.5	1.29	83.1
17	165	11.6	1.30	83.1
18	175	11.6	1.30	84.3
19	185	11.4	1.28	83.1
20	195	11.5	1.29	85.4
21	205	11.4	1.28	82.0
22	215	11.7	1.31	80.9
23	225	11.0	1.24	74.2

Table 19-2 ST 7.

Sample No.	distance from the bottom	Weight of sample M	density $d = \frac{M}{V}$	porosity $n_e$
1	5 cm	12.7	1.43	83.0
2	24	12.4	1.34	85.4
3	70	12.6	1.46	82.0
4	132	12.3	1.30	77.5
5	165	11.6	1.27	78.7
6	217	11.3	1.27	77.5
7	222	11.5	1.29	85.4

## 20. Forms of samples for the study of radioactivity induced by cosmic rays

H. HASEGAWA, A. FUJIWARA and T. INOUE

The core sample from the station 15, No.1 and a part of the core sample from the station 15, No.3 are prepared for the study of radioactivity induced by cosmic rays. Four kinds of radioisotopes, shown in Table 20-1, are to be measured. Among these, Ni-59 and Mn-53 are treated at Cosmic Ray laboratory, Kyoto University, and Al-26 and Be-10 are detected by the members of the chemical branch of Institute for Nuclear Study, University of Tokyo.

Several specimens, each about 1gr, were taken from various depth of each core sample. These specimens are used for the Th-Io dating of the cores. The columns of sediments will be divided according to the depths from the sea floor. Each specimen will be about 200gr in weight. Al, Be, Ni, and Mn are analysed chemically, and then their activities will be measured by scintillation counters, or proportional counters. Because of the very low activity of these nuclides, the measurements will continue for one year.

Table 20-1

Radio-nuclide	Half-life (year)	Decay	Source	Target
$^{59}\text{Ni}$	$8 \times 10^4$	7kev X	Solar cosmic rays (alpha)	Cosmic dust in interplanetary space
$^{26}\text{Al}$	$7.4 \times 10^5$	$\beta^+$ , $\gamma$	Uncertain	Uncertain
$^{53}\text{Mn}$	$2 \times 10^6$	6kev X	Solar cosmic rays (proton)	Cosmic dust in interplanetary space
$^{10}\text{Be}$	$2.7 \times 10^6$	$\beta^-$	Galactic cosmic rays	Atmosphere

## 21. DREDGE

Kazuo Kobayashi

A chain-bag dredge was newly built for this cruise according to the original drawing by Dr. A.J. Nalwalk, but after slight modifications to suit the facilities of factory.

General shape of the dredge is shown in an Fig. 21-1 Main part of the dredge (seen in the photo) is connected to 8 mm  $\emptyset$  30cm wire, to a 1 m row of chains, 10 Kgs of weight, a swivel and then to the winch wire. a 12 mm  $\emptyset$ , 3m wire is also connected between a shackle bound with the bottom of the chain bag through a ring tied on the side of the frame so that the dredge is turned over and easily released from the bottom when it is trapped by rough bottom rocks and the 8 mm $\emptyset$



wire is broken.

This dredge was used all the dredge station except St.9-4. It was proved that this type of dredge is very powerful to collect rocks, boulders and manganese nodules on the deep ocean floor. In the present time the haul was not really 'brave' because only one set of this model was brought on board. Therefore, most of the hauls were done on the relatively smooth bottom. More basement rocks may possibly be obtained if the haul is done on rougher bottom surfaces with a careful safety installation of this type of dredge.

The chains of the chain bag were often broken in the present hauls. Chains thicker than mm  $\emptyset$  (the present size) must be used. A head weight of 10 kgs was not installed at the St 9-3 and 9-5 but its installation at the other stations greatly improved the dredging power.

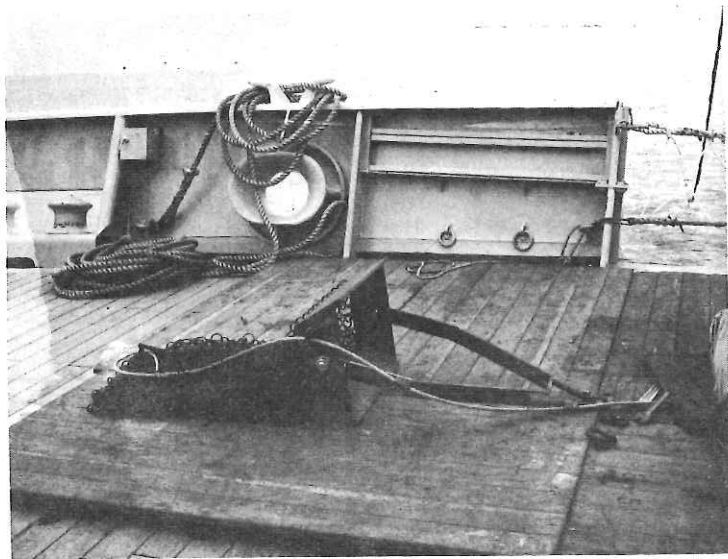


Fig. 21-1

22. Dredge Log

DREDGE LOG

Date July 30, '68 Ship Hakuho-maru Cruise KH68-3 Station 9-3

Latitude 44° 29' N Longitude 170° 22' E

Location Crest of the Sea Mt. Suiko

Sea smooth with low swell

Bottom Topography flat

Type of Dredge Nalwalk's chain dredge St. 60 kg

Time lowered 14<sup>h</sup> 23<sup>m</sup>; Uncorrected Water Depth 1215 m

Initial Time on Bottom 15<sup>h</sup> 36<sup>m</sup>; Uncorr. Water Depth 1200 m

Wire Angle 45° Wire Length 2000 m

Direction of Haul 315° Ship Speed during on-Bottom 0 kt

Speed Wire-in 10 m/min, No. 1 winch

Final Time on Bottom \_\_\_\_\_; Uncorr. Water Depth \_\_\_\_\_ m

Wire Angle \_\_\_\_\_ Wire Length \_\_\_\_\_ m

Time Surfaced \_\_\_\_\_

Description of Dredge a lead weight lost.

some chains broken

Dredged Materials 1 round boulder of two-pyroxene andesite

Worked by M. Anma, H. Aoki, S. Fujii, E. Honza,

M. Inoue, S. Iwamura, K. Kitazawa,

and Kazuo Kobayashi (in alphabetical order)

DREDGE LOG

Date July 31, '68 Ship Hakuho-maru Cruise KH68-3 Station 9-4

Latitude 44° 38' N Longitude 170° 15' E

Location crest of the Sea Mt. Suiko

Sea Very smooth

Bottom Topography smooth slope

Type of Dredge Stainless Steel Pipe Dr. St. 50 kg

Time lowered \_\_\_\_\_; Uncorrected Water Depth 1319 m

Initial Time on Bottom 10<sup>h</sup> 35<sup>m</sup>; Uncorr. Water Depth 1265 m

Wire Angle 48° Wire Length 1800 m

Direction of Haul 180° Ship Speed during on-Bottom 0 kt

Speed Wire-in 0.1 0.3 m/sec No. 5 winch

Final Time on Bottom 11<sup>h</sup> 53<sup>m</sup>; Uncorr. Water Depth 1265 m

Wire Angle 0° Wire Length 1290 m

Time Surfaced \_\_\_\_\_

Description of Dredge scratched lines with Mn-oxide.

Dredged Materials 26 small rocks

Worked by M. Anma, H. Aoki, S. Fujii, E. Honza,

M. Inoue, S. Iwamura, K. Kitazawa

and Kazuo Kobayashi

DREDGE LOG

Date July 31, '68 Ship Hakuho-maru Cruise KH68-3 Station 9-5

Latitude 44° 35' N Longitude 170° 17' E

Location Crest of the Sea Mt. Suiko

Sea Very smooth

Bottom Topography smooth

Type of Dredge Nalwalk's chain dredge St. 40 kg

Time lowered 13<sup>h</sup> 53<sup>m</sup>; Uncorrected Water Depth 1190 m

Initial Time on Bottom 14<sup>h</sup> 02<sup>m</sup>; Uncorr. Water Depth        m

Wire Angle 30° Wire Length 1450 m

Direction of Haul 180° Ship Speed during on-Bottom 0 kt

Speed Wire-in 0.1 m/sec No. 5 winch

Final Time on Bottom 15<sup>h</sup> 10<sup>m</sup>; Uncorr. Water Depth 1150 m

Wire Angle        Wire Length        m

Time Surfaced       

Description of Dredge no damage.

Dredge Materials a number of pebbles and granules in a  
packet of the Dredge.

Worked by M. Anma, H. Aoki, S. Fujii, E. Honza,

M. Inoue, S. Iwamura, K. Kitazawa

and Kazuo Kobayashi

DREDGE LOG

Date Aug. 1, '68 Ship Hakuho-maru Cruise KH68-3 Station 9-6

Latitude 44° 35' N Longitude 170° 20' E

Location small plateau down the crest

Sea low swell

Bottom Topography smooth

Type of Dredge Nalwalk's chain dredge Wt. 80 kg

Time lowered 8<sup>h</sup> 21<sup>m</sup>; Uncorrected Water Depth 1358 m

Initial Time on Bottom 9<sup>h</sup> 05<sup>m</sup>; Uncorr. Water Depth 1385 m

Wire Angle 40° Wire Length 2000 m

Direction of Haul 330° Ship Speed during on-Bottom 0 kt

Speed Wire-in 0.1 m/sec No. \_\_\_\_\_ winch

Final Time on Bottom 9<sup>h</sup> 40<sup>m</sup>; Uncorr. Water Depth 1375 m

Wire Angle 30° Wire Length 1620 m

Time Surfaced \_\_\_\_\_

Description of Dredge some chain broken

Dredged Materials 6 boulders of rocks.

Worked by M. Anma, H. Aoki, S. Fujii, E. Honza,

M. Inoue, S. Iwamura, K. Kitazawa and

Kazuo Kobayashi

DREDGE LOG

Date Aug. 1, '68 Ship Hakuho-maru Cruise KH68-3 Station 9-7  
Latitude 44° 37' N Longitude 170° 18' E  
Location Small plateau down the crest  
Sea low swell  
Bottom Topography smooth

Type of Dredge Nalwalk's chain dredge Wt. 80 kg  
Time lowered 10<sup>h</sup> 21<sup>m</sup> ; Uncorrected Water Depth 136<sup>1</sup>/<sub>2</sub> m  
Initial Time on Bottom 11<sup>h</sup> 19<sup>m</sup> ; Uncorr. Water Depth 1365 m  
Wire Angle 55° Wire Length 2350 m  
Direction of Haul \_\_\_\_\_ Ship Speed during on-Bottom 0 kt  
Speed Wire-in 0.1 m/sec No. \_\_\_\_\_ winch  
Final Time on Bottom 12<sup>h</sup> 05<sup>m</sup> ; Uncorr. Water Depth \_\_\_\_\_ m  
Wire Angle 42° Wire Length 1820 m  
Time Surfaced \_\_\_\_\_

Description of Dredge normal.

Dredged Materials about 50 Kgs. of boulders of rocks  
including granite and one with the glacial  
scratches.  
about 50 Kgs. of large Mn-nodules.

Worked by M. Anma, H. Aoki, S. Fujii,  
E. Honza, M. Inoue, S. Iwamura,  
K. Kitazawa and Kazuo Kobayashi

DREDGE LOG

Date Aug. 1, '68 Ship Hakuho-maru Cruise KH68-3 Station 9-8  
Latitude 44° 33' N Longitude 170° 17' E  
Location crest of the Sea Mt. Suiko  
Sea low swell  
Bottom Topography \_\_\_\_\_

Type of Dredge Nalwalk's chain Dredge Wt. 80 kg  
Time lowered 14<sup>h</sup> 20<sup>m</sup>; Uncorrected Water Depth 1195 m  
Initial Time on Bottom 15<sup>h</sup> 03<sup>m</sup>; Uncorr. Water Depth \_\_\_\_\_ m  
Wire Angle 43° Wire Length 2000 m  
Direction of Haul 85° Ship Speed during on-Bottom 0 kt  
Speed Wire-in 0.1 m/sec No. \_\_\_\_\_ winch more than 100 Kgs.  
tension responses.  
Final Time on Bottom 16<sup>h</sup> 03<sup>m</sup>; Uncorr. Water Depth 1232 m  
Wire Angle 23° Wire Length 1500 m  
Time Surfaced \_\_\_\_\_

Description of Dredge chain slightly broken.

Dredged Materials 32 boulders (50 Kgs.) of rocks.

Worked by M. Anna, H. Aoki, S. Fujii.

E. Honza, M. Inoue, S. Iwamura,

K. Kitazawa and Kazuo Kobayashi

DREDGE LOG

Date Aug. 3, '68 Ship Hakuho-maru Cruise KH68-3 Station 9-9

Latitude 44° 30' N Longitude 170° 25' E

Location Crest of the Sea Mt. Suiko

Sea Moderate, long swell

Bottom Topography Smooth

Type of Dredge Chain Dredge with special devices for search of the seism. St. 80 kg

Time lowered 14<sup>h</sup> 23<sup>m</sup> ; Uncorrected Water Depth 1275 m

Initial Time on Bottom 15<sup>h</sup> 30<sup>m</sup> ; Uncorr. Water Depth 1290 m

Wire Angle 60° Wire Length 1200 m

Direction of Haul 0° Ship Speed during on-Bottom 2 kt

Speed Wire-in 20 m/min No. 1 winch

Final Time on Bottom 16<sup>h</sup> m ; Uncorr. Water Depth 1275 m

Wire Angle 52° Wire Length 2650 m

Time Surfaced \_\_\_\_\_

Description of Dredge slight damage with chains.

Dredged Materials 100 Kgs. of boulders of rocks, some  
coated with Mn oxide,  
some Mn oxide with small pebbles as cores.

Worked by M. Anma, H. Aoki, S. Fujii, E. Honza,

M. Inoue, S. Iwamura, K. Kitazawa and

Kazuo Kobayashi



DREDGE LOG

Date Aug. 10, '68 Ship Hakuho-maru Cruise KH68-3 Station 16-1

Latitude 37° 37' N Longitude 162° 37' E

Location Crest of the North Shatsky Rise

Sea Calm

Bottom Topography Smooth, thick sediment?

Type of Dredge Nalwalk's Chain Dredge Wt. 80 kg

Time lowered 10<sup>h</sup> 44<sup>m</sup>; Uncorrected Water Depth 3350 m

Initial Time on Bottom 11<sup>h</sup> 50<sup>m</sup>; Uncorr. Water Depth 3350 m

Wire Angle 50° Wire Length 5000 m

Direction of Haul 90° Ship Speed during on-Bottom 2 kt

Speed Wire-in 20 m/min No.        winch

Final Time on Bottom 12<sup>h</sup> 34<sup>m</sup>; Uncorr. Water Depth 3350 m

Wire Angle 30° Wire Length 4561 m

Time Surfaced                     

Description of Dredge no damage.

Dredged Materials Diatom coze and sand

some black magnetic spherule included in a  
net attached to the main Dredge

Worked by M. Anma, H. Aoki, S. Fujii, E. Honza,

M. Inoue, S. Iwamura, K. Kitazawa, and

Kazuo Kobayashi.

DREDGE LOG

Date Aug. 10, '68 Ship Hakuho-maru Cruise KH68-3 Station 16-2

Latitude 37° 07' N Longitude 162° 39' E

Location Slope of a small sea Mt. in the Shatsky Rise.

Sea Smooth and calm

Bottom Topography \_\_\_\_\_

Type of Dredge Nalwalk's Chain Dredge Wt. 80 kg

Time lowered 16<sup>h</sup> 24<sup>m</sup> ; Uncorrected Water Depth 4400 m

Initial Time on Bottom 17<sup>h</sup> 58<sup>m</sup> ; Uncorr. Water Depth 2920 m

Wire Angle 32° Wire Length 4920 m

Up to the

Direction of Haul crest Ship Speed during on-Bottom 2 kt

Speed Wire-in 10 m/min No. \_\_\_\_\_ winch (while stopping)

Final Time on Bottom 19<sup>h</sup> 35<sup>m</sup> ; Uncorr. Water Depth 2920 m

Wire Angle 10° Wire Length 3000 m

Time Surfaced 20<sup>h</sup> 07<sup>m</sup>

Description of Dredge no damage, weak tension pulses before  
3800 m of the wire length, little of no  
response around 3800 m and about 1 ton  
pulse around 3700 m.

Dredged Materials 23 boulders of edged rocks (seemingly of  
the same type), many pumices and Mn  
nodules.

Worked by M. Anma, H. Aoki, S. Fujii, E. Honza,  
M. Inoue, S. Iwamura, K. Kitazawa and  
Kazuo Kobayashi.

## 23. List of Dredged Materials

Sample No.	Size (a x b x c)			Roundness	Weight kg	Mn - coating mm	Remarks *
9-3-1	15.6 x	11.1 x	8.9	SR	1.3	a < 1	2 px andesite
9-4-1		n.d		n.d	n.d	a ≐ 40	Mn - nodule
9-4-2		n.d		n.d	n.d	a ≐ 30	Mn - nodule
9-4-3		n.d		n.d	n.d	a ≐ 20	Mn - nodule
9-4-4	14.0 x	11.0 x	4.5	SR	n.d	a ≐ 15	Mn - nodule
9-4-5		n.d		n.d	n.d	a ≐ 15	Mn - nodule
9-4-6		n.d		n.d	n.d	-	Mn - nodule
9-4-7		n.d		n.d	n.d	a ≐ 20	Mn - nodule
9-4-8		n.d		n.d	n.d	a ≐ 30	Mn - nodule
9-4-9	9.0 x	4.0 x	2.5	A	n.d	a > 20	Core of Mn - nodule
9-4-10	2.0 x	1.7 x	1.5	M	n.d	a < 1	
9-4-11	6.5 x	5.0 x	0.7	A	n.d	a < 1	
9-4-12	4.5 x	3.5 x	1.2	A	n.d	a < 1	
9-4-13	5.5 x	3.0 x	2.5	SA	n.d	p < 1	
9-4-14	4.5 x	4.0 x	2.0	R	n.d	p < 1	
9-4-15	5.5 x	4.5 x	0.7	M	n.d	-	
9-4-16	3.5 x	2.8 x	1.3	SA	n.d	a < 1	

Sample No.	Size (a x b x c)			Roundness	Weight	Mn - coating	Remarks
	cm	cm	cm		kg	mm	
9-4-17	7.0 x	4.0 x	0.6	A	n.d	a < 1	
9-4-18	6.0 x	4.0 x	3.0	R	n.d	p < 1	
9-4-19	4.5 x	2.5 x	0.5	A	n.d	p < 1	
9-4-20	3.0 x	3.0 x	2.0	A	n.d	a < 1	
9-4-21	5.0 x	3.5 x	1.0	A	n.d	p < 1	
9-4-22	5.0 x	3.0 x	2.0	SA	n.d	p < 1	
9-4-23	4.5 x	3.0 x	2.0	A	n.d	a < 1	
9-4-24	4.0 x	2.5 x	1.5	SA	n.d	-	
9-4-25		n.d			n.d		
9-4-26		n.d			n.d		
9-6-1	5.0 x	2.0 x	3.5	M	n.d	p < 1	
9-6-2	3.5 x	2.5 x	1.3	A	n.d	-	
9-6-3	4.2 x	3.0 x	0.7	R	n.d	-	
9-6-4	4.0 x	2.5 x	2.0	A	n.d	-	
9-6-5	10.5 x	8.0 x	1.3	R	n.d	p < 1	
9-6-6	10.5 x	7.5 x	2.5	SA	n.d	p < 1	

Sample No.	Size (a x b x c)			Roundness	Weight kg	Mn - coating	Remarks
9-7-1	8.0 x	7.0 x	3.0 cm	M	n.d.	a < 1	Altered rock
9-7-2	24.0 x	15.0 x	11.0	SR	n.d.	p < 1	Altered porphyrite
9-7-3	29.0 x	18.0 x	17.0	R	n.d.	p < 1	Biot-Hb. granite
9-7-4	14.0 x	11.0 x	4.5	SR	n.d.	a < 1	
9-7-5	2.0 x	1.5 x	1.0	R	n.d.	-	Granite
9-8-1		n.d		n.d	n.d		Mn - nodule
9-8-2	11.0 x	8.5 x	7.5	M	n.d	-	Andestic tuff
9-8-3	10.0 x	8.0 x	7.0	SA	n.d	a < 1	
9-8-4	10.5 x	7.0 x	4.0	R	n.d	p < 1	
9-8-5	9.0 x	9.0 x	8.0	M	n.d	p < 1	
9-8-6	9.0 x	7.5 x	6.0	A	n.d	p < 1	Augite andesite
9-8-7	9.0 x	7.0 x	5.0	M	n.d	p < 1	Mudstone
9-8-8	14.0 x	11.0 x	7.0	M	n.d	a < 1	
9-8-9	9.0 x	8.0 x	5.5	A	n.d	p < 1	
9-8-10	9.5 x	6.0 x	6.0	A	n.d	a < 1	Chert ?
9-8-11	10.5 x	7.0 x	4.0	SA	n.d	-	Sandstone
9-8-12	17.0 x	7.0 x	3.5	A	n.d	a < 1	

Sample No.	Size (a x b x c)			Roundness	Weight kg	Mn - coating mm	Remarks
9-8-13	16.0 x	8.0 x	7.0	M	n.d	p < 1	Striation ?
9-8-14	18.0 x	12.5 x	9.0	SR	n.d	a = 1	
9-8-15	11.5 x	8.5 x	5.5	M	n.d	-	
9-8-16	10.0 x	9.0 x	4.5	M	n.d	p < 1	Conglomerate with fossil
9-8-17	8.0 x	7.0 x	4.5	M	n.d	p < 1	
9-8-18	8.5 x	6.0 x	4.5	M	n.d	a < 1	
9-8-19	8.5 x	7.0 x	5.5	M	n.d	a < 1	
9-8-20	14.0 x	7.0 x	2.5	A	n.d	a < 1	
9-8-21	15.0 x	8.0 x	6.0	R	n.d	-	
9-8-22	6.0 x	5.0 x	3.5	SR	n.d	p < 1	
9-8-23	8.0 x	5.0 x	5.0	SR	n.d	a < 1	
9-8-24	8.5 x	7.0 x	3.5	SA	n.d	p < 1	
9-8-25	7.0 x	6.5 x	4.5	M	n.d	a < 1	
9-8-26	8.5 x	6.0 x	4.0	A	n.d	p < 1	
9-8-27	10.0 x	7.0 x	4.0	R	n.d	-	
9-8-28	10.0 x	6.0 x	4.0	SR	n.d	p < 1	
9-8-29	11.0 x	6.0 x	4.5	R	n.d	p < 1	
9-8-30	9.5 x	6.5 x	5.0	M	n.d	p < 1	

Sample No.	Size (a x b x c)			Roundness	Weight kg	Mn - coating	Remarks
9-8-31	9.5 x	8.0 x	5.0	M	n.d	a $\div$ 2	Fragments of various Rocks
9-8-32	7.5 x	6.5 x	5.5	SA	n.d	p < 1	
9-8-33							
9-8-34							
9-9-1	11.0 x	6.5 x	4.0	SA	0.5	a < 1	Fine grained sandstone
9-9-2	9.0 x	6.5 x	4.0	SA	0.5	a < 1	
9-9-3	10.0 x	7.0 x	5.0	M	n.d	a < 5	
9-9-4	24.0 x	11.0 x	6.0	M	1.2	a < 1	
9-9-5	18.0 x	10.0 x	4.0	SA	0.6	a < 1	Basaltic rock
9-9-6	12.0 x	8.0 x	7.0	R	1.0	-	
9-9-7	14.5 x	14.5 x	5.0	SR	1.0	p < 1	
9-9-8	18.0 x	12.0 x	6.0	M	1.5	p < 2	
9-9-9	15.0 x	11.0 x	11.0	R	2.5	p $\div$ 1	Sponge
9-9-10		n.d			n.d	-	
9-9-11	16.0 x	8.0 x	7.5	SR	1.5	p < 5	
9-9-12	18.0 x	9.0 x	5.0	M	1.2	a < 1	
9-9-13	20.0 x	16.0 x	13.0	M	5.2	a < 1	Basaltic rock

Sample No.	Size x (a x b x c) cm cm cm	Roundness	Weight kg	Mn - coating mm	Remarks
9-9-14	23.0 x 15.0 x 7.5	SR	3.0	a < 5	
9-9-15	27.0 x 14.0 x 9.5	M	6.0	p < 15	
9-9-16	27.0 x 20.0 x 15.0	SR	15.0	a $\approx$ 30	Core of Mn - nodule
9-9-17	n.d	n.d	12.5	a $\approx$ 35	Core of Mn - nodule
9-9-18	26.5 x 11.0 x 14.0	M	6.0	a < 20	
9-9-19	n.d	n.d	9.5	a $\approx$ 20	Core of Mn - nodule
9-9-20	n.d	n.d	8.5	a < 20	Core of Mn - nodule
16-2-11	18.0 x 10.5 x 10.0	A	2.5	a < 2	
16-2-2	15.0 x 5.0 x 4.0	A	0.6	a < 5	
16-2-3	8.0 x 7.0 x 5.5	A	0.2	a < 5	
16-2-4	8.0 x 7.0 x 6.0	A	0.6	p < 5	
16-2-5	10.0 x 10.0 x 5.5	SA	0.8	p < 5	
16-2-6	12.0 x 12.0 x 9.5	A	1.3	p < 5	
16-2-7	14.0 x 12.0 x 9.0	M	1.4	a < 1	
16-2-8	13.0 x 10.0 x 9.5	A	1.4	p < 5	
16-2-9	12.0 x 10.0 x 9.0	A	1.0	p < 5	
16-2-10	10.0 x 10.0 x 8.0	SA	0.5	p < 1	Volcanics



Sample No.	Size (a x b x c)			Roundness	Weight	Mn - coating	Remarks
	cm	cm	cm		kg	mm	
16-2-11	9.0 x	7.0 x	6.0	SA	0.5	a < 5	Total Weight of pumices with various size
16-2-12	6.0 x	5.5 x	5.0	A	0.1	p < 1	
16-2-13	10.5 x	5.0 x	3.5	A	0.1	p < 1	
16-2-14	8.0 x	7.0 x	3.0	A	0.1	p < 1	
16-2-15	8.0 x	6.5 x	5.0	A	0.2	a < 2	
16-2-16	6.0 x	5.0 x	5.0	M	0.1	a < 1	
16-2-17	6.0 x	5.0 x	4.0	A	0.1	a < 1	
16-2-18	12.0 x	4.0 x	4.0	SA	0.1	a < 1	
16-2-19					2.7		
16-2-20	10.0 x	5.0 x	5.0	SA	0.3	a < 1	
16-2-21	6.5 x	5.5 x	4.0	SA	0.3	a < 1	Total weight of Mn-nodule with various size
16-2-22	7.0 x	5.5 x	4.5	A	0.2	a < 1	
16-2-23	7.5 x	4.5 x	4.5	A	0.1	a < 1	
16-2-24	9.5 x	6.5 x	5.5	A	0.4	a < 1	
16-2-25					4.0		

Remarks:

Notation

R: Round

SR: Sub Round

M: Mediate

SA: Sub Angular

A: Angular

n.d: not determined

a: all coated

p: partly coated

\* Petrographic names were tentatively given using only available facilities during the cruise and are subject to change after more detailed investigation.

## 24. Magnetic Spherules in the Deep Sea Sediment and in the Clean Air

H. HASEGAWA, A. FUJIWARA and T. INOUE

Magnetic spherules in deep sea sediments are very interesting as to their origin; some people believe them as extraterrestrial matter. However their physical and chemical properties have not yet investigated precisely.

We tried to collect the magnetic spherules with a net every time the rock dredging was done. The net is covered with a polyvinylchloride tube of 12 cm in diameter and 50 cm in length. Sands, relatively large dead planktons and grains of magnetic substances can be caught by the net. It was connected with the tail of the chain bag of the rock dredging apparatus by about one meter wire or nylon rope.

Summary of the collection work is shown in Table 24-1.

Table 24-1

Station number	Depth(m)	Main components	Remarks
9 - 4	1265--1319	Diatom Globigerina Sand	Not yet found
9 - 5	1150	-	Failed
9 - 6	1385	Diatom Globigerina Sand	Not yet found
9 - 7	1365	-	Failed
9 - 8	1195-1232	Diatom Globigerina Sand	Not yet found
16 - 1	3350	Globigerina	Found
16 - 2	4400-2900	Globigerina	130 spherules were found

Collected samples were washed by sea water, and examined under the stereoscopic microscope. Then the grains of magnetic substances were extracted by the use of electromagnet and again examined under the stereoscopic microscope. Up to now about 130 spherules were found. The size range is between  $10\ \mu$  to  $100\ \mu$ . They are similar to those found from Mid-Pacific area in KH-67-5 cruise by Yamakoshi and Kawakubo.

Throughout the present cruise we exposed glass dishes with silicon grease on the bridge to catch spherules in the clear air. Up to now we found two spherules similar to those found in deep sea sediment.

Detailed studies on the magnetic spherules, especially their radioactivity, will be done in the near future.

## 25. Air Chemistry

K. Kawamura

### Object

It is generally accepted that the main source of atmospheric  $\text{NH}_3$  exists on land. On the other hand, there have been two different views on the source of atmospheric  $\text{NO}_2$  on global basis: one is the soil origin hypothesis (give by K.Kawamura), and the other considers the main source is the oxidation of atmospheric  $\text{NH}_3$ . If the main source of atmospheric  $\text{NO}_2$  as well as  $\text{NH}_3$  exists on land, their concentrations in the maritime atmosphere will probably be lower than those in the continental air. But, little is known about the concentrations of these chemical constituents in the maritime atmosphere. The main purpose of this study is the determination of the absolute values of  $\text{NO}_2$  and  $\text{NH}_3$  in the surface air on the Pacific.

### Sampling and Sample Analysis

$\text{NO}_2$  in air was collected by sucking the air through a

bubbler containing Griess-Saltzman's solution, and the degree of pink coloration is visually compared with standards.  $\text{NH}_3$  was collected by flowing the air through a glass fiber filter treated with 0.1N  $\text{H}_2\text{SO}_4$  solution and was determined with Nessler's reagent. The results show that there are no marked interdiurnal and day-to-day variations in  $\text{NO}_2$  concentration, and the average value is  $1.2 \text{ g/m}^3$ . This value corresponds to roughly one-third of  $\text{NO}_2$  concentration in the clean air on the continents.

Ninety two independent observations of atmospheric  $\text{NH}_3$  were made during the period of the cruise.

1001 surface water samples and 61 of 60 meter depth water samples were taken at stations No.1,3,5,10, and 13 to measure activities of Sr-90 and tritium in the laboratory (See Table 26-1).

## 26. Marine Inorganic Chemistry

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### Objects

One object is to solve technical problems of the research works which will be done during the coming "Southern Cross Cruise" in the Southern Pacific. Another object is to have water samples. The water samples taken are used to extract dissolved gases for the analysis of  $\text{O}^{18}/\text{O}^{16}$  ratio in dissolved oxygen, to analyze isotopic ratios of water ( $\text{D/H}$  and  $\text{O}^{18}/\text{O}^{16}$ ), and to determine calcium and tritium contents in sea water.

### Stations

Water samples were taken at 6 stations (Station No. 1,3,5, 10,13, and 14) which are shown in Table 26-1.

## Sampling

All the sample waters were taken with 2 liter Nansen sampler. Combination of echo sounder on board and sonar pinger (EG&G Model 220) enabled us to determine exactly the distance between the deepest Nansen sampler and sea floor. The shortest distances between the sampler and sea floor were 61 m, 14 m, 19 m at station No. 3, No. 5, No. 13, and No. 14, respectively. Although the signal from sonar pinger was very clear, no echo could be detected with echo sounder at station No. 10 where the depth is 5,920 m (uncorrected). The property of bottom sediment may have some effect on the reflection of pinger signal.

## Samples

### (a) Routine analyses

Salinity was measured with Auto Lab Model 601 MK III salinometer.  $p_H$  was measured with Hitachi-Horiba Model F-5  $p_H$  meter. Dissolved oxygen was measured by Winkler method. Three bottles of potassium iodate standard solution (made by Sagami Central Chemical Institute) were used to determine concentration of thiosulfate solution. They gave quite consistent results within the experimental error during the whole course of the measurement. The results are shown in Table 26-1.

### (b) Samples for isotope analysis

Every 50 ml water sample, which was used to measure salinity, was sealed in glass-ampule just after the salinity measurement. Its isotopic ratios ( $D/H$  and  $O^{18}/O^{16}$ ) are to be measured by mass spectrometry in the laboratory.

### (c) Extraction of dissolved gases for isotopic analysis of dissolved oxygen.

500 ml or 1000 ml sea water in Nansen sampler was introduced into evacuated glass flask which was flushed with helium gas before pumping. More than 95% of volume of dissolved gases was extracted to the attached glass flask which was sealed off and brought back to the laboratory for further processing.

### (d) Measurement of calcium.

20 ml sample water was used to measure calcium(+strontium)

content by adding GEDTA solution using GHA as an indicator.

(e) Tritium sample

500 ml water samples were stored in plastic bottle, and they are to be sent to University of Heidelberg, C-14 Laboratory for tritium analysis. The samples were taken at stations No.1,3,5, and 13.

### Mass Spectrometry

Modified version of Hitachi RMS-4 mass spectrometer with gas extraction and inlet system was examined whether it can be used on board as an instrument for routine analysis of dissolved gases. Analyzer tube of 125 mm radius and  $60^\circ$  deflection was pumped with 100 l oil diffusion pump without cold trap. Output voltage of most abundant ion in residual gas ( $M/e=28$ ) is less than 1% of that of sample nitrogen. One sea water sample could be analyzed in 6 minutes. Although the sensitivity changed due to the malfunction of emission regulator of ion source and the preliminary results of gas analysis was not satisfactory, mass spectrometer proved to be very useful for the gas analysis of dissolved gases ( $N_2, O_2, Ar$ , and  $CO_2$ ) on board.

### Gas Chromatography

Ohkura Gas Chromatograph with disc integrator was also examined for the analysis of dissolved gases in sea water. 50 ml/min, hydrogen gas was used as carrier gas and suitable combination of column materials enabled us to separate nitrogen, oxygen and argon, and carbon dioxide completely. The necessary time for analysis of one sea water sample was 9 minutes.

Table 26-1. Results of Routine Analysis of KH 68-3 Cruise

Time listed is Japan Standard Time and shows the beginning and end of Nansen cast. All the depth was calculated from the data of reversing thermometers attached to Nansen sampler. Uncorrected depth are read from recorder chart of echo sounder.

Station No.1  $37^{\circ}03.3'N, 143^{\circ}28.3'E$  Depth 7,270 m  
(uncorrected) July 20, 1968, 0755-1210

Sample No.	Depth (meter)	Temp. ( $^{\circ}C$ )	Salinity (‰)	p <sub>H</sub>	Dissolved Oxygen (cc/l.)
1-0	0	23.5	34.378	8.18	4.91
1-10	8	23.32	375	8.20	4.92
1-20	16	23.40	390	8.21	4.92
1-30	24	22.93	437	8.23	5.01
1-50	40	20.96	581	8.24	5.14
1-75	55	18.73	669	8.20	4.59
1-100	70	18.06	736	8.21	4.62
1-150	100	16.37	684	8.18	4.54
1-200	128	15.05	628	8.18	4.74
1-300	180	13.36	529	8.12	3.94
1-400	234	11.69	420	8.06	3.90
1-500	279	10.35	324	8.07	(4.32)
1-600	328	9.55	335	7.99	3.25
1-700	383	8.43	302	7.96	3.07
1-800	466	5.25	312	7.94	(3.98)
1-1000	800	4.03	310	7.77	1.45
1-1200	940	3.46	361	7.74	1.21
1-1500	1150	2.94	435	7.71	1.07
1-2000	1521	2.37	521	7.70	1.17
1-2500	1894	2.07	579	7.75	1.57
1-3000	2267	1.83	623	7.76	2.17
1-3500	2656	1.70	649	7.79	2.62
1-4000	3060	1.61	666	7.87	2.82
1-4500	3490	1.53	676	7.88	3.11
1-5000	3949	1.51	684	7.84	3.42

Table 26-1 (continued)

Station No.3     $38^{\circ}00.5'N$ ,  $160^{\circ}01.8'E$     Depth 5,332 meter  
 July 23, 1968,    0745-1455

Sample No.	Depth (meter)	Temp. ( $^{\circ}C$ )	Salinity (‰)	p <sub>H</sub>	Dissolved Oxygen (cc/l.)
2-0	0	20.8	34.399	8.09	5.21
2-10	9	20.66	395	8.19	5.24
2-25	22	19.25	534	8.24	5.43
2-50	43	17.86	612	8.27	5.63
2-100	84	14.50	640	8.21	5.12
2-150	124	13.43	552	8.20	5.11
2-200	164	12.72	482	8.21	5.37
2-300	248	11.42	387	8.17	5.13
2-400	332	10.07	274	8.14	5.06
2-500	419	8.27	116	8.06	4.41
2-600	508	6.43	011	7.91	3.75
2-700	597	5.18	029	7.80	2.71
2-800	688	4.69	105	7.75	2.10
2-1000	870	3.88	250	7.69	1.26
2-1200	1054	3.33	357	7.66	0.99
2-1000	1190	2.96	400	7.64	0.78
2-1200	1361	2.65	458	7.64	0.81
2-1500	1627	2.36	526	7.66	1.02
2-2000	2088	1.98	598	7.72	1.68
2-2500	2554	1.74	639	7.77	2.29
2-3000	3001	1.57	664	7.79	2.81
2-3500	3452	1.52	677	7.82	3.12
2-4000	3907	1.52	685	7.90	3.29
2-4500	4366	1.52	688	7.92	3.35
2-5000	4817	1.54	692	7.87	3.57
2-5500	5271	1.56	694	7.88	3.71



Table 26-1 (continued)

Station No.5    38°00.0'N, 168°01.0'E    Depth 5,388 meter  
 July 25, 1968    0121-0526

Sample No.	Depth (meter)	Temp. Temp.	Salinity (‰)	pH	Dissolved Oxygen (cc/l.)
3-0	0	20.6	34.503	8.15	5.31
3-10	9	19.33	483	8.19	5.48
3-25	22	16.39	376	8.22	5.97
3-50	44	14.62	402	8.22	6.02
3-100	88	10.50	206	8.18	6.00
3-150	133	9.22	172	8.12	5.54
3-200	176	8.47	102	8.10	5.30
3-300	266	6.98	33.968	8.04	5.11
3-400	356	5.57	904	7.93	4.07
3-500	466	5.14	998	7.80	2.73
3-600	536	4.49	34.047	7.70	2.06
3-700	629	4.07	100	7.68	1.60
3-800	720	3.87	188	7.67	1.27
3-1000	778	3.67	258	7.66	1.06
3-1000	896	3.36	308	7.64	0.87
3-1200	959	3.15	347	7.65	0.80
3-1200	1071	2.96	389	7.65	0.75
3-1500	1234	2.70	450	7.65	0.77
3-2000	1682	2.15	555	7.68	1.21
3-2500	2149	1.82	622	7.75	1.95
3-3000	2613	1.62	651	7.81	2.53
3-3500	3073	1.53	671	7.83	2.99
3-4000	3533	1.50	678	7.92	3.17
3-4500	3987	1.47	682	7.94	3.35
3-5000	4447	1.49	691	7.89	3.58
3-5500	4913	1.54	694	7.87	3.61
3-6000	5374	1.60	694	7.92	3.48

Table 26-1 (continued)

Station No.10    44°30.8'N, 171°59.4'E    Depth 5,920 meter  
 (uncorrected)    August 4, 1968    0528-0958

Sample No.	Depth (meter)	Temp. (°C)	Salinity (‰)	p <sub>H</sub>	Dissolved Oxygen (cc/l.)
4-0	0	11.8	33.010	8.19	6.46
4-10	10	11.59	011	8.20	6.50
4-25	25	11.51	032	8.20	6.50
4-50	50	7.54	348	8.19	6.73
4-75	73	4.82	374	8.16	6.92
4-100	94	4.51	416	8.14	6.87
4-150	137	4.33	608	8.07	5.87
4-200	182	3.92	701	7.96	4.53
4-300	272	3.86	845	7.82	2.95
4-400	364	3.90	982	7.75	2.02
4-500	457	3.64	34.056	7.79	1.50
4-600	553	3.57	156	7.74	1.15
4-700	649	3.27	202	7.69	0.88
4-800	746	3.17	265	7.69	0.83
4-1000	848	3.01	332	7.71	0.77
4-1000	942	2.89	368	7.69	0.79
4-1200	1033	2.78	404	7.71	0.74
4-1500	1292	2.44	486	7.73	0.87
4-2000	1747	2.05	572	7.74	1.40
4-2500	2209	1.80	627	7.78	2.01
4-3000	2672	1.65	664	7.85	2.60
4-3500	3130	1.53	678	7.86	2.97
4-4000	3590	1.51	683	7.92	3.15
4-4500	4050	1.49	691	7.94	3.27
4-5000	4505	1.52	694	7.92	3.52
4-5500	4971	1.56	698	7.90	3.55
4-6000	5424	1.63	694	7.94	3.41

Table 26-1 (continued)

Station No.13    44°58.6'N, 167°30.8'E    Depth 5,703 meter  
 August 7, 1968    0609-1102

Sample No.	Depth (meter)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (cc/l.)
5-0	0	12.4	32.947	8.29	6.54
5-10	10	12.29	952	8.30	6.56
5-25	24	12.23	950	8.29	6.52
5-50	47	8.99	33.521	8.24	6.51
5-75	70	3.49	299	8.18	7.08
5-100	92	3.55	381	8.13	6.88
5-150	137	4.12	602	7.99	6.38
5-200	182	3.32	611	7.84	4.83
5-300	274	3.18	785	7.77	2.85
5-400	364	3.63	985	8.08	1.86
5-500	460	3.45	34.060	7.70	1.26
5-600	556	3.60	192	7.71	1.20
5-700	652	3.27	229	7.68	0.88
5-800	744	3.10	280	7.66	0.80
5-1000'	916	2.85	360	7.65	0.75
5-1200'	1093	2.61	427	7.68	0.88
5-1000	1106	2.59	433	7.67	0.86
5-1200	1284	2.44	474	7.68	0.94
5-1500	1554	2.24	533	7.70	1.12
5-2000	2017	1.89	605	7.75	1.71
5-2500	2475	1.71	642	7.85	2.34
5-3000	2929	1.59	668	7.86	2.84
5-3500	3391	1.52	678	7.86	3.16
5-4000	3845	1.52	683	7.92	3.26
5-4500	4300	1.50	695	7.94	3.36
5-5000	4756	1.53	695	7.89	3.62
5-5500	5224	1.57	695	7.88	3.62
5-6000	5684	1.54	698	7.92	3.50

Table 26-1 (continud)

Station No.14 40°59.9'N, 167°30.8'E Depth 5,640 meter  
August 8, 1968 0750-1210

Sample No.	Depth (meter)	Temp. (°C)	Salinity (‰)	p <sub>H</sub>	Dissolved Oxygen (cc/l.)
6-0	0	18.0	34.059	8.21	5.56
6-10	10	17.99	063	8.23	5.59
6-25	23	16.52	183	8.24	5.90
6-50	46	14.46	306	8.24	6.09
6-75	69	11.76	303	8.22	6.04
6-100	91	10.50	251	8.19	5.77
6-150	136	9.01	139	8.15	5.61
6-200	181	7.84	013	8.13	5.58
6-300	272	6.75	33.952	8.04	4.77
6-400	363	5.49	913	7.95	3.87
6-500	453	4.70	956	7.88	2.70
6-600	547	4.24	34.062	7.77	1.86
6-700	641	4.11	160	7.72	1.48
6-800	735	3.81	226	7.71	1.21
6-1000	907	3.27	326	7.68	0.87
6-1000'	1026	2.99	381	7.67	0.76
6-1200	1087	2.89	396	7.66	0.78
6-1200'	1201	2.70	443	7.67	0.82
6-1500	1479	2.38	511	7.69	0.96
6-2000	1938	1.99	585	7.73	1.50
6-2500	2403	1.76	628	7.77	2.18
6-3000	2871	1.60	665	7.81	2.75
6-3500	3327	1.52	674	7.83	3.08
6-4000	3787	1.53	680	7.90	3.20
6-4500	4250	1.51	685	7.92	3.35
6-5000	4709	1.53	692	7.86	3.54
6-5500	5174	1.57	693	7.86	3.58
6-6000	5631	1.64	693	7.97	3.44