

Preliminary Report  
of  
The Hakuho Maru Cruise KH 80-3

July 14 - September 6, 1980  
Japan Trench, Shatsky Rise, Guam,  
Ponape and Ogasawara Areas  
(IPOD, WESTPAC)

Ocean Research Institute  
University of Tokyo  
1981

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by  
the Scientific Members of the Expedition  
edited by  
Kazuo KOBAYASHI  
1981

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# 1. SCIENTISTS ABOARD THE R.V. HAKUHO MARU FOR THE CRUISE KH 80-3

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OMURA, Akio**	Department of Geology, Kanazawa University
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YAMANO, Makoto	Earthquake Research Institute, University of Tokyo
YOKOKAWA, Ikuro	Department of Earth Sciences, Chiba University

\* From Tokyo to Guam only

\*\* From Guam to Tokyo only

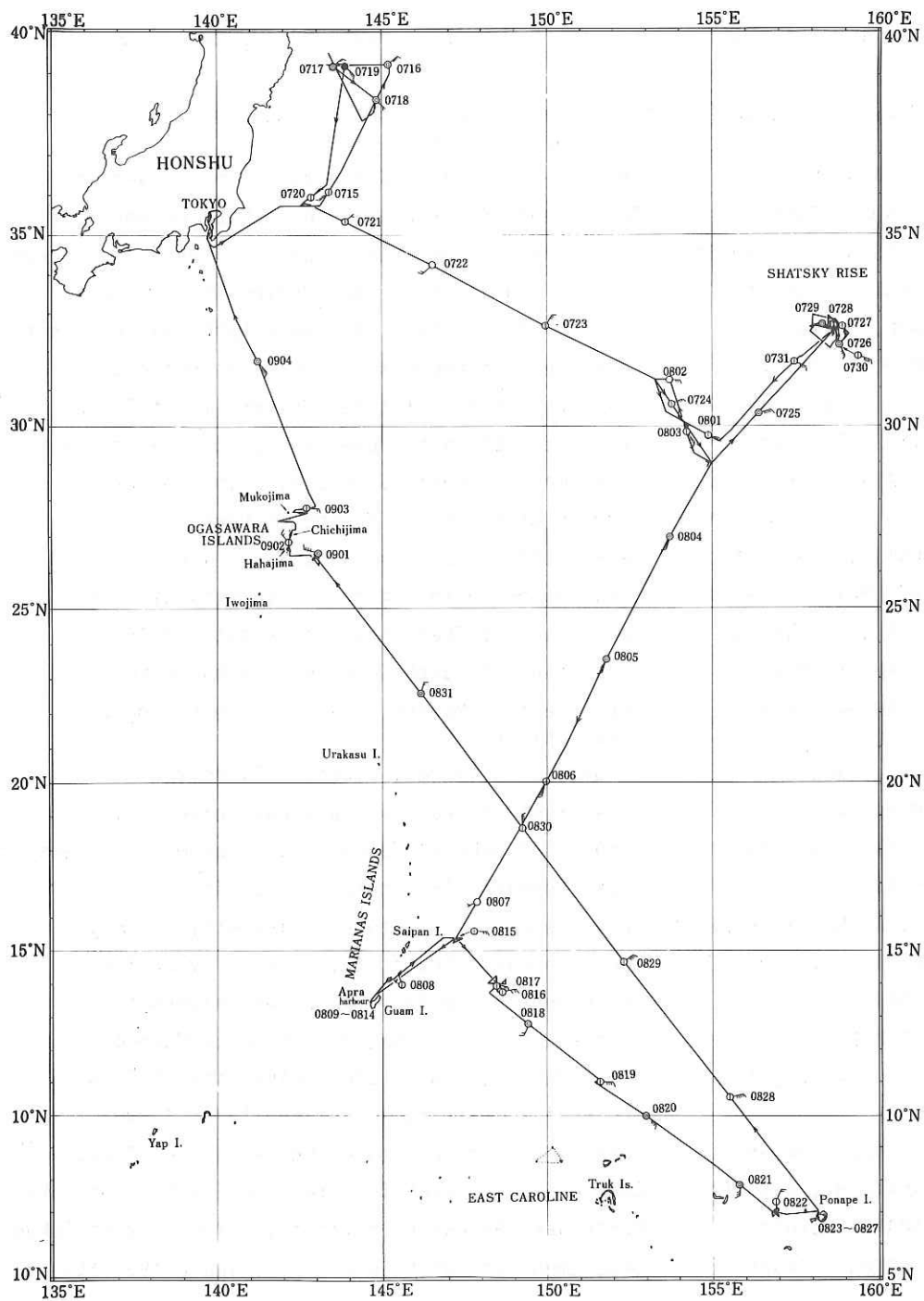


Fig. 2-1. KH 30-3 Noon Positions.

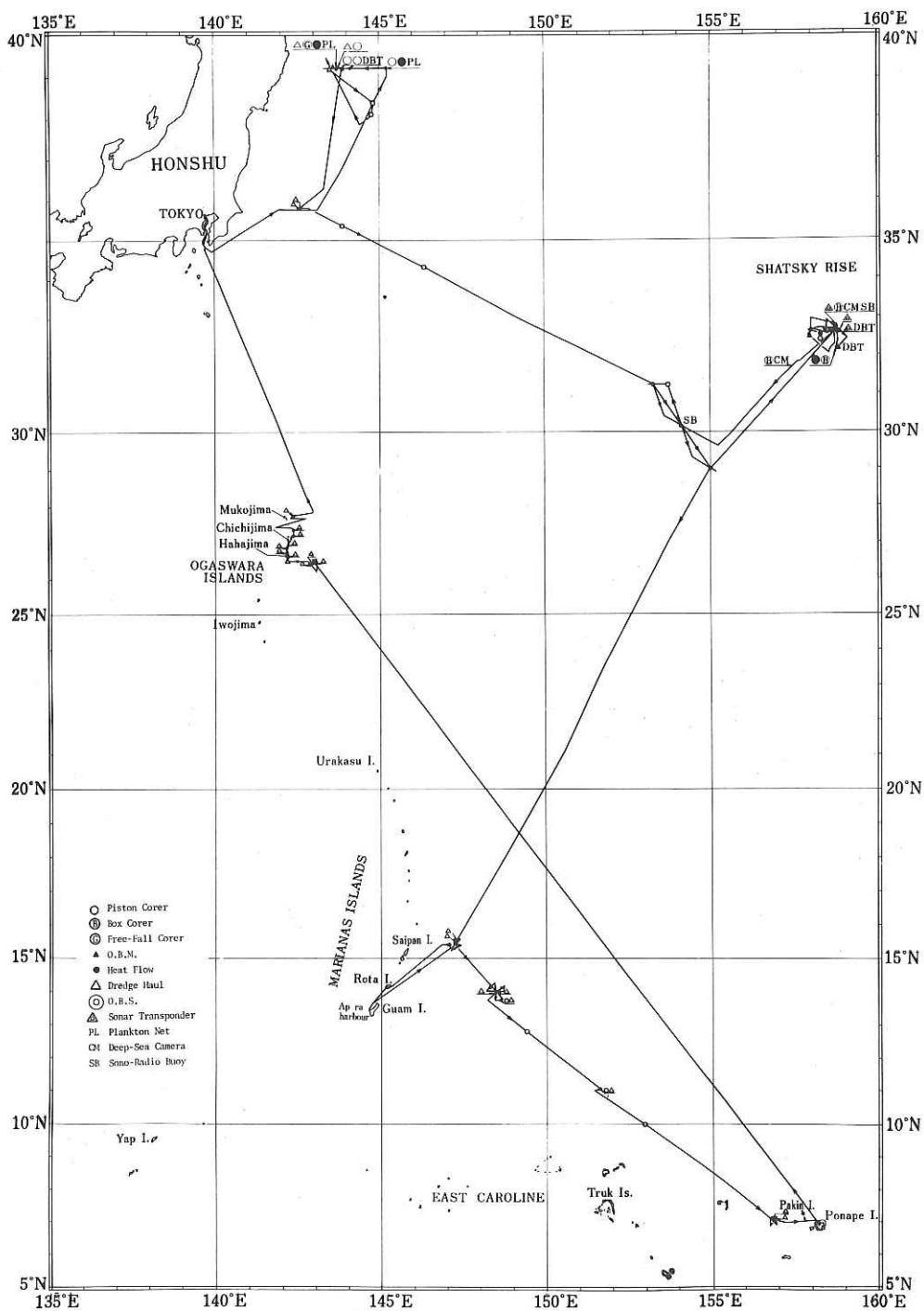


Fig. 2-2. KH 80-3 Research Stations.

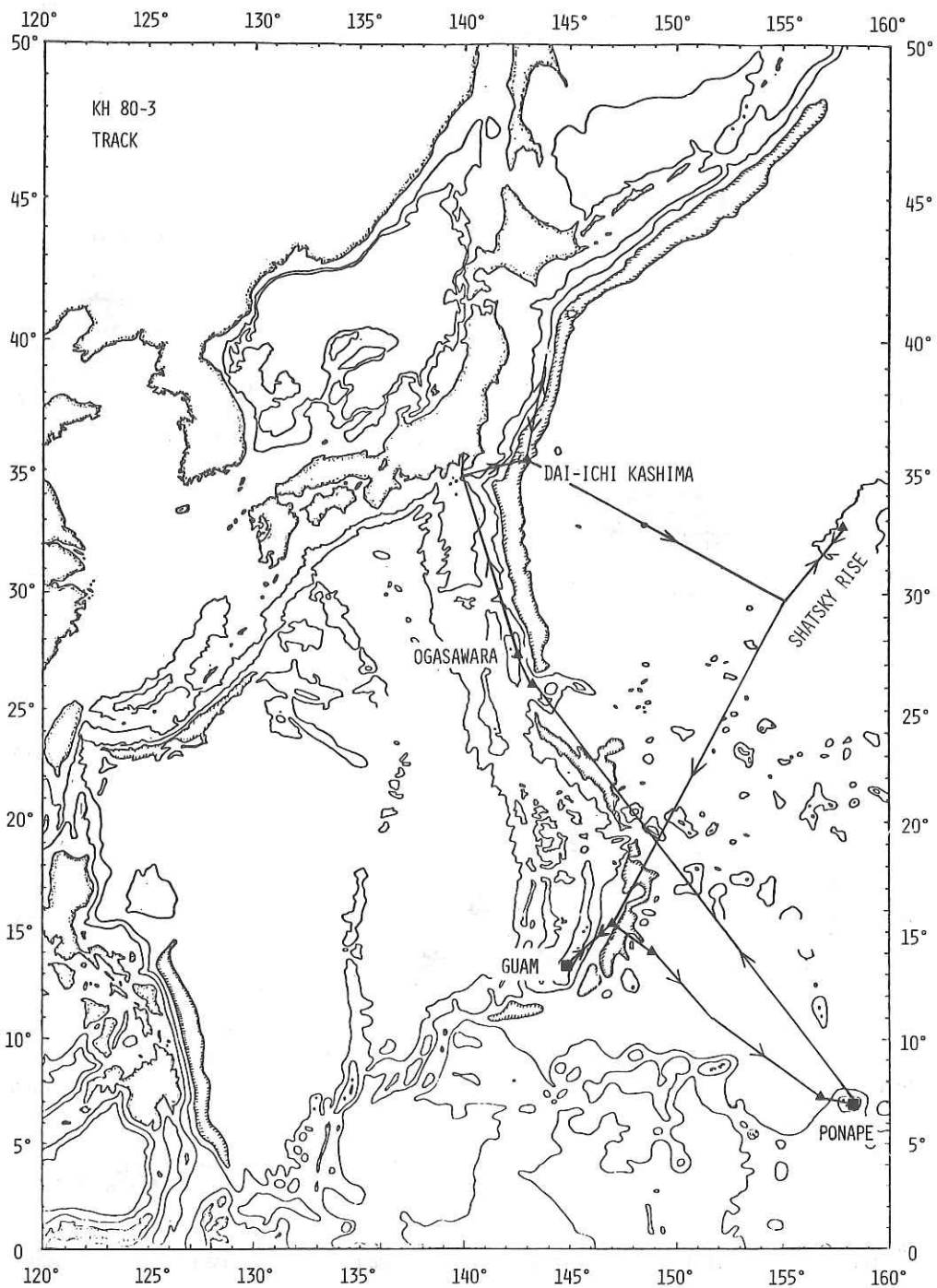


Fig. 2-3. Ship's tracks plotted on simplified topographic map.

### 3. LIST OF RESEARCH STATIONS CRUISE KH80-3

Stn. No.	Position		Investigation	Water* Depth(m)	Date & Time**		Remarks
	Lat.(N)	Long.(E)					
(Tokyo to Guam)							
1	39°21.0	145°12.8	Piston Coring	5440	July 16	10:38	Hit on Bottom
1(B)	39°20.0 19.7	145°11.0 10.8	Heat Flow (1) (2)	5430 5430	16	14:32 15:20	
2	39°17.1	143°33.6	Ocean Bottom Magnetometer	2920	17	09:42	on Bottom (anchored Buoy)
2(B)	39°12.7 12.2	143°32.4 31.9	Pipe Dredge	3030 3050	17	11:54 12:48	on Bottom final on Bottom
3	39°15.5 15.4	143°43.4 43.0	Pipe Dredge	3900 3880	17	17:05 17:21	on Bottom final on Bottom
3(B)	39°14.7	143°41.3	Gravity Coring	3805	17	20:40	Hit on Bottom (Conductivity)
3(C)	39°14.0	143°41.2	Heat Flow	3805	17	22:56	
4	38°25.1	144°50.0	Piston Coring	5470	18	10:12	Hit on Bottom
5	38°08.7	144°45.0	Piston Coring	5550	18	15:55	Hit on Bottom
(2)	39°16.7 16.8 17.3	143°32.4 32.4 32.0	Ocean Bottom Magnetometer	2850	19	08:02 08:50	catch Buoy leave Bottom retrieve
6	39°14.1	143°55.6	Heat Flow	5000	19	13:45	
7	35°50.1 51.7	142°34.5 36.9	Dredge Haul	5315 5200	20	16:03 19:25	on Bottom final on Bottom
8	35°46.0 48.4	142°38.4 41.7	Dredge Haul	3780 3620	20 21	23:28 01:33	on Bottom final on Bottom
9	35°22.6	143°54.1	Piston Coring	5720	21	11:00	Hit on Bottom
10	35°16.0	144°05.8	Piston Coring	5680	21	16:12	Hit on Bottom
10(B)	35°16.5	144°05.6	D.B.T.	5680	21	17:58 18:24	Start End
11	34°16.3	146°21.9	Piston Coring	5790	22	11:00	Hit on Bottom
12	34°08.4	146°34.2	Piston Coring	5820	22	16:07	Hit on Bottom

Stn. No.	Position Lat.(N) Long.(E)		Investigation	Water* Depth(m)	Date & Time**		Remarks
OBS #16	31°16.5	153°13.6	Ocean Bottom Seismograph	6250	July 24	06:35	Set Pop-up
#17	30°10.3	154°05.9	" "	5810	24	15:18	Set Pop-up
#18	29°04.3	154°56.6	" "	5870	25	00:15	Set Pop-up
(SHATSKY RISE CREST)							
13	32°11.9	158°49.7	Ocean Bottom Magnetimeter	3040	26	10:07	on Bottom (anchored Buoy)
13(B)	32°13.3	158°48.6	D.B.T.	3000	26	11:00	1000m
14	32°03.8	158°46.1	Box Corer	3090	26	14:24	Hit on Bottom
14(B)	32°05.0	158°44.5	Heat Flow(1)	3100	26	16:45	
	05.1	43.9	(2)			17:59	
	05.6	43.4	(3)			19:15	
15	32°35.8	158°50.4	D.B.T.	2480	27	08:52	
TRP #1	32°36.4	158°49.4	Sonar Transponder	2480	27	10:20	Set #1
#2	32°39.4	158°48.8	" "	2550	27	11:32	Set #2
#3	32°38.6	158°52.2	" "	2510	27	12:49	Set #3
16	32°40.0	158°46.7	Box Corer	2450	28	10:01	Hit on Bottom
16(B)	32°41.9	158°46.1	Camera	2470	28	13:30 13:58	
SB-1	32°39.2	158°50.7	Sonobuoy	2500	28	16:30	Set #1
	32°49.3	158°40.5	" "	2540		19:00	Set #2
	32°42.4	158°51.0	" "	2500		22:13	Retrieve #1
	50.6	40.8	" "	2560		23:40	Retrieve #2
17	32°43.5	158°18.5	Heat Flow(1)	2660	29	08:55	
	43.9	18.3	(2)			11:25	
18	32°44.9	158°17.6	Piston Haul	2640	29	13:44	Hit on Bottom
19A	32°40.6	157°59.5	Dredge Haul	3020	29	18:06	on Bottom
	41.7	158°00.7		3000		20:02	final on Bottom

Stn. No.	Position Lat.(N) Long.(E)		Investigation	Water* Depth(m)	Date & Time**		Remarks
July							
19B	32°40.6 41.7	158°03.4 04.7	Dredge Haul	2660 2600	29 30	22:36 00:44	on Bottom final on Bottom
20	32°00.1	158°38.8	Box Corer	3160	30	09:46	Hit on Bottom
(13)	32°12.6 12.8	158°48.1 49.6	Ocean Bottom Magnetometer	3000	30	12:15 13:06	Catch Buoy leave Bottom
TRP #1	32°36.2	158°49.9	Transponder		30	18:22	retrieve
#2	32°38.9	158°49.3	"" ""		30	20:58	"" ""
#3	32°38.5	158°52.6	"" ""		30	23:33	"" ""
21	31°43.5	157°26.7	Box Corer	3950	31	10:40	Hit on Bottom
21(B)	31°44.1	157°25.7	Camera	4000	31	15:00 15:25	
Aug.							
SB-2	30°11.4	154°05.1	Sonobuoy	5830	01	16:40	Set
22	31°16.2	153°42.9	Piston Coring	5750	02	10:56	Hit on Bottom
OBS #16	31°16.6	153°14.5	Ocean Bottom Seismograph	6250	02	22:12	retrieve #16
#17	30°10.9	154°05.8	"" ""	5820	03	09:40	retrieve #17
#18	29°04.5	154°56.5	"" ""	5890	03	21:05	retrieve #18
(Guam to Ponape)							
23A	15°33.3 33.0	147°16.2 15.1	Dredge Haul	5020 4950	15	12:30 14:34	on Bottom final on Bottom
23B	15°28.1 28.1	147°16.2 14.0	Dredge Haul	4290 4400	15	18:17 20:49	on Bottom final on Bottom
24A	13°44.3	148°37.9	Piston Coring	5800	16	13:05	Hit on Bottom
24B	13°42.4 41.5	148°36.2 34.7	Pipe Dredge	5750 5730	16	17:00 19:02	on Bottom final on Bottom

Stn. No.	Position Lat.(N) Long.(E)		Investigation	Water* Depth(m)	Date & Time**		Remarks
25A	13°57.2 57.6	148°28.7 27.2	Dredge Haul	2200 2350	Aug. 17	08:44 09:51	on Bottom final on Bottom
25B	13°57.9 59.5	148°31.2 29.0	Dredge Haul	2210 2130	17	12:32 14:31	on Bottom final on Bottom
25C	14°01.7 02.9	148°33.9 32.7	Dredge Haul	3300 3445	17	17:23 18:57	on Bottom final on Bottom
26	12°47.0	148°27.5	Piston Coring	5940	18	10:57	Hit on Bottom
27	12°42.1	148°34.4	Piston Coring	5930	18	16:05	Hit on Bottom
28A	11°03.3	151°34.6	Piston Coring	5800	19	10:51	Hit on Bottom
28B	11°03.0 02.8	151°32.6 31.1	Pipe Dredge	5800 5800	19	14:18 15:20	on Bottom final on Bottom
29	9°59.0	153°00.2	Piston Coring	5520	20	10:46	Hit on Bottom
30	9°50.6	153°13.5	Piston Coring	5480	20	15:57	Hit on Bottom
31A	7°06.0 05.5	156°51.9 51.8	Dredge Haul	2850 2700	21 22	23:16 02:00	on Bottom final on Bottom
31B	7°03.0 02.1	156°52.3 53.1	Dredge Haul	2200 2125	22	08:21 10:39	on Bottom final on Bottom

(Ponape to Tokyo)

32	26°24.9 23.3	142°54.0 55.5	Dredge Haul	1520 1420	Sept. 01	13:25 15:03	on Bottom final on Bottom
33	26°20.9 19.1	142°49.8 49.8	Dredge Haul	3120 3220	01	17:29 19:08	on Bottom final on Bottom
34	26°24.3 23.6	143°00.1 00.4	Dredge Haul	1500 1360	01	21:39 22:42	on Bottom final on Bottom

(OGASAWARA AREA)

35	26°27.9 28.0	142°10.9 10.8	Dredge Haul	163 161	02	06:03 06:22	on Bottom final on Bottom
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Stn. No.	Position Lat.(N) Long.(E)		Investigation	Water* Depth(m)	Date & Time**		Remarks
					Sept.		
36	26°39.3 38.5	142°13.8 13.0	Dredge Haul	235 198	02	07:53 09:06	on Bottom final on Bottom
37	26°49.5 49.5	142°09.2 08.7	Dredge Haul	300 230	02	10:47 11:17	on Bottom final on Bottom
38	26°52.0 52.1	142°08.8 08.6	Dredge Haul	315 280	02	12:12 12:39	on Bottom final on Bottom
39	26°56.4 55.8	142°12.5 11.6	Dredge Haul	528 380	02	14:06 15:20	on Bottom final on Bottom
40	27°11.7 11.1	142°21.3 21.1	Dredge Haul	817 685	02	18:02 18:37	on Bottom final on Bottom
41	27°22.1 21.5	142°20.9 19.6	Dredge Haul	875 615	02	20:36 21:54	on Bottom final on Bottom
42	27°25.7 25.5	142°15.5 15.2	Dredge Haul	290 290	02	23:02 23:22	on Bottom breakdown
43	27°44.8 44.2	142°23.3 23.3	Dredge Haul	1050 990	03	09:32 10:09	on Bottom final on Bottom

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\* Uncorrected Sounder Depth with V=1.5 km/sec.

\*\* Time used in this report is Local Time, unless otherwise noticed.

LT=JST=UT+9 hr; 80071414 LT to 80072121 LT;

80083120 LT to 80090610 LT

LT=JST+1=UT+10 hr; 80072122 LT to 80081921 LT,

80082820 LT to 80083121 LT

LT=JST+2=UT+11 hr; 80081922 LT to 80082821 LT

#### 4. GRAVIMETRY, BATHYMETRY AND POSITION FIXING

T. MATSUMOTO

##### Gravimetry:

Gravity meter system: T.S.S.G.

Gravity meter: Model Z-68-7-14 (string type)

Vertical gyro: Model 72-A (a pair of string freedom gyros)

Data processing system: Model 76-1 (0.05 sec. sampling rate)

Gravity at sea was observed during the whole cruise. The gravity meter system used for observation is shown above, and it is equipped at No. 9 laboratory of Hakuho Maru.

The system was out of order three times shown below during the cruise.

Aug. 12. 2200 - Aug. 13. 0030 (in Guam)

... trouble of the power supply for NOVA

Aug. 28. 0700 - Aug. 28. 1200 (leg 3)

Aug. 29. 0600 - Aug. 29. 1000 (leg 3)

... coercive intermission of data sampling due to unexpected acceleration value

Gravity values in the port of call have some difference from those measured by La Coste gravity meter.

	correct value	observed value	error
Tokyo (Harumi)	979.788gal	979.767(Jul. 14)	-21mgal
Guam (Apra Harbor)	978.533	978.550(Aug. 11-14)	+17
Ponape	-	978.445(Aug. 23-27)	-
Tokyo (Harumi)	979.788	979.835(Sep. 06)	+47

It is necessary to calibrate the gravity value with reference to this.

##### Bathymetry:

Bathymetry was carried out by use of PDR. It was not carried out at the time of trial of the acoustic transponder navigation system. The system was out of order from Jul. 31. 1720 to Aug. 01. 1440. Water depth data of this period were obtained from the air gun record.

Position fixing:

Ship position was fixed by use of both Loran C and NNSS. In this cruise our ship was in the Northwestern Pacific, so Loran C signal could be recieved during the whole cruise. NNSS record was also obtained during the whole cruise, but wrong update fixing was obtained at the time shown below.

Jul. 17. 0836

Jul. 24. 0812

Aug. 05. 1720

Aug. 26. 0606 (in Ponape)

In order to determine ship position accurately by "translocation method" comparing data received at the International Latitude Observatory in Mizusawa (Iwate Pref.), orbit elements and Doppler counts were received around Japan Trench off Sanriku District, north of 37°N.

(The time is expressed in JST in this article)

## 5. MAGNETIC TOTAL FORCE MEASUREMENT

M. WATANABE, T. FURUTA, T. MATSUMOTO  
and K. KOBAYASHI

Magnetic total force was measured every minute throughout the cruise. A conventional model of proton precession magnetometer was used. The sensor was towed about 200 m behind the stern of the ship and the error is supposed to be within a few nanotesla (gammas). Two examples of magnetic profiles between the Japan Trench and the Shatsky Rise and between the Shatsky Rise and Mariana Basin are shown in Figures 5-1 and 5-2.

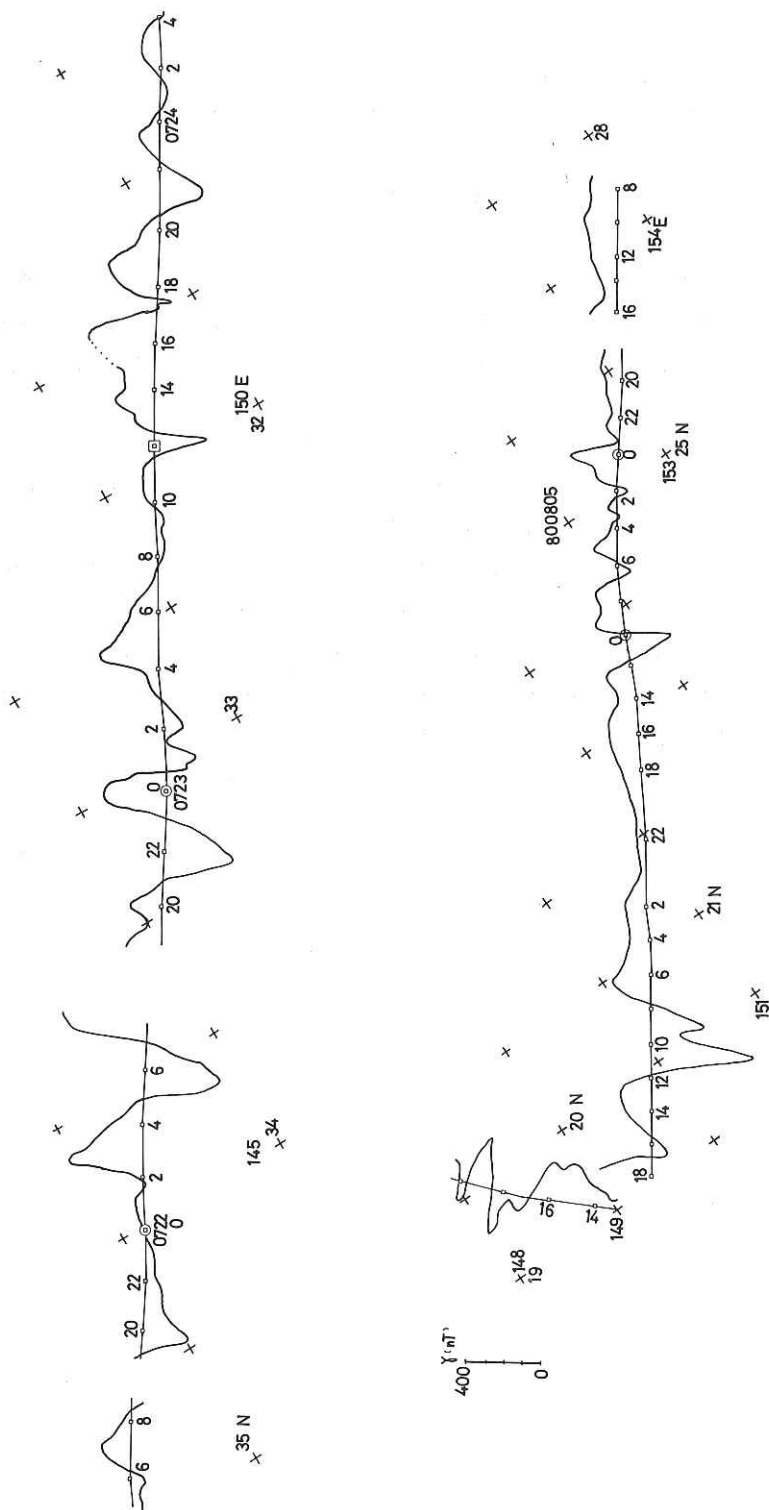


Fig. 5-1. Two examples of magnetic profiles between the Japan Trench and the Shatsky Rise (above) and between the Shatsky Rise and Mariana Basin (below).

## 6. DETAILED SURVEY OF FOUR SEAMOUNTS AND SOUTHWESTERN PORTION OF SHATSKY RISE

K. KOBAYASHI

Four medium-sized seamounts, two west of the Izu-Bonin-Mariana trench and two east of it were surveyed with several crossing tracks. Ship's positions were fixed by NNSS and care was taken to keep at least two fixes on one straight line track so far as possible.

Southwestern portion of Shatsky Rise was studied in detail. Ship's positions were fixed by NNSS and, while the ocean bottom magnetometer was set on bottom, a moored radio-buoy was also used to fix positions.

Water depths, gravity, magnetic total force were measured on these survey tracks. Survey tracks for the four seamounts and Shatsky Rise are shown in Figs 6-1~5. Topography of four seamounts thus obtained are shown in Figs. 6-1~4. Topography of southwestern portion of Shatsky Rise and distribution of other quantities are now being analyzed.

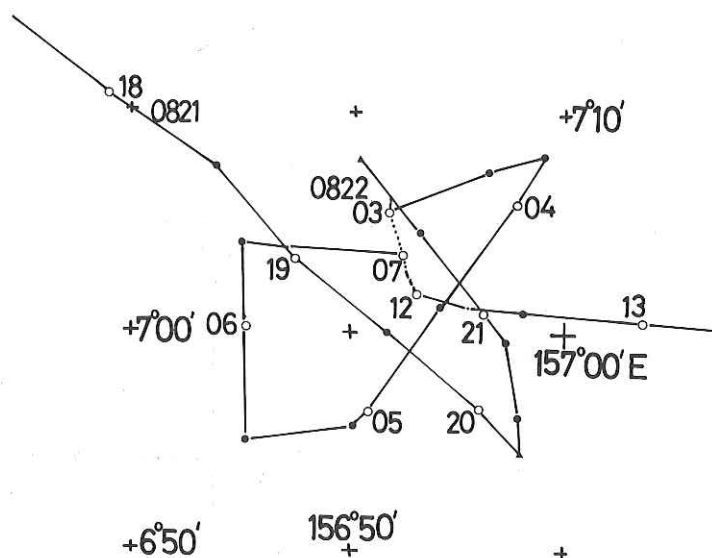


Fig. 6-1-A. Ship's track.

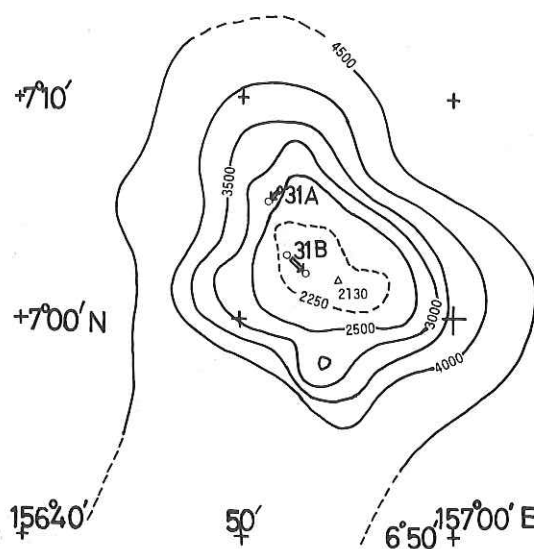


Fig. 6-1-B. Topography drawn from the present survey. Arrow indicates direction of dredge haul.

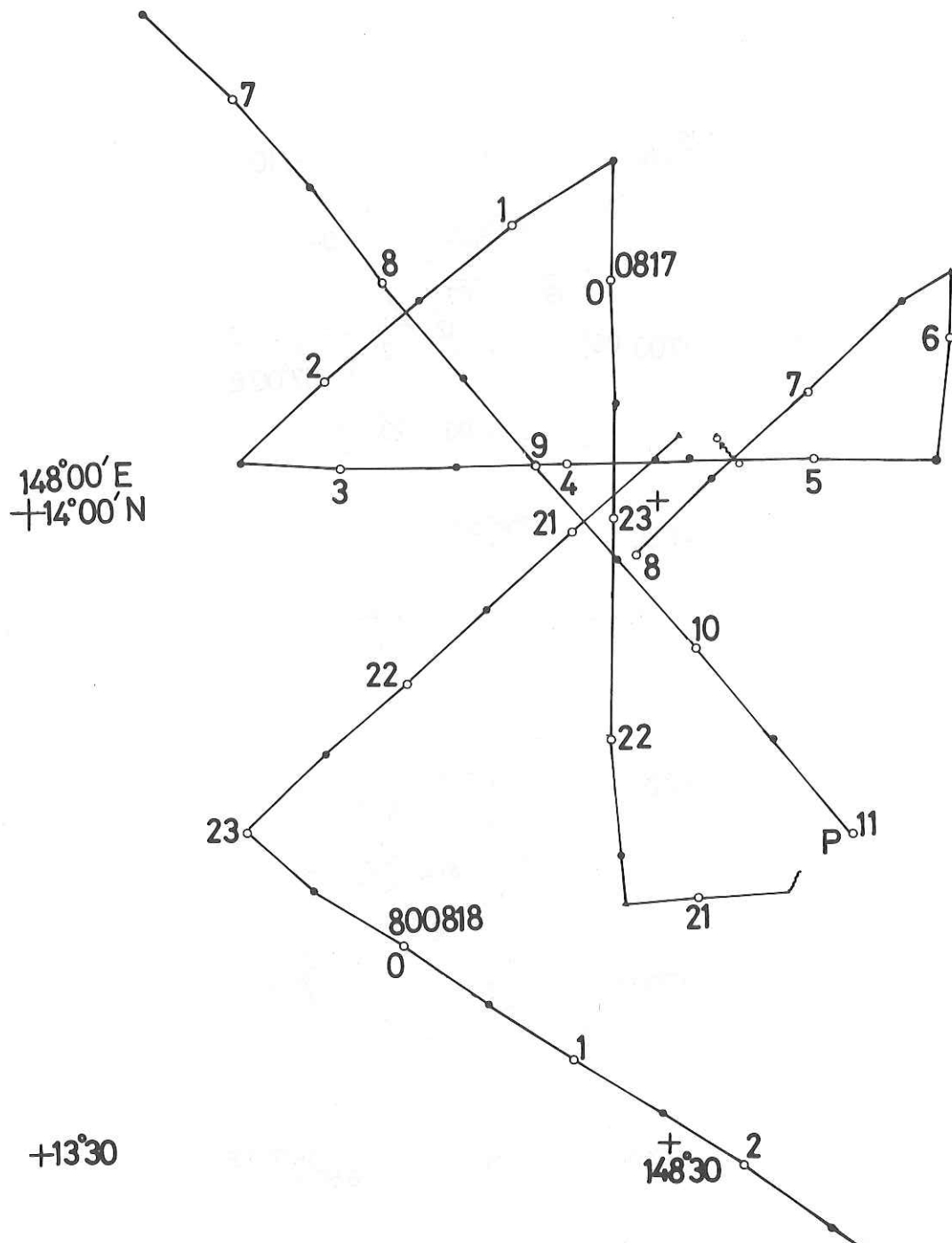


Fig. 6-2-A. Ship's track.



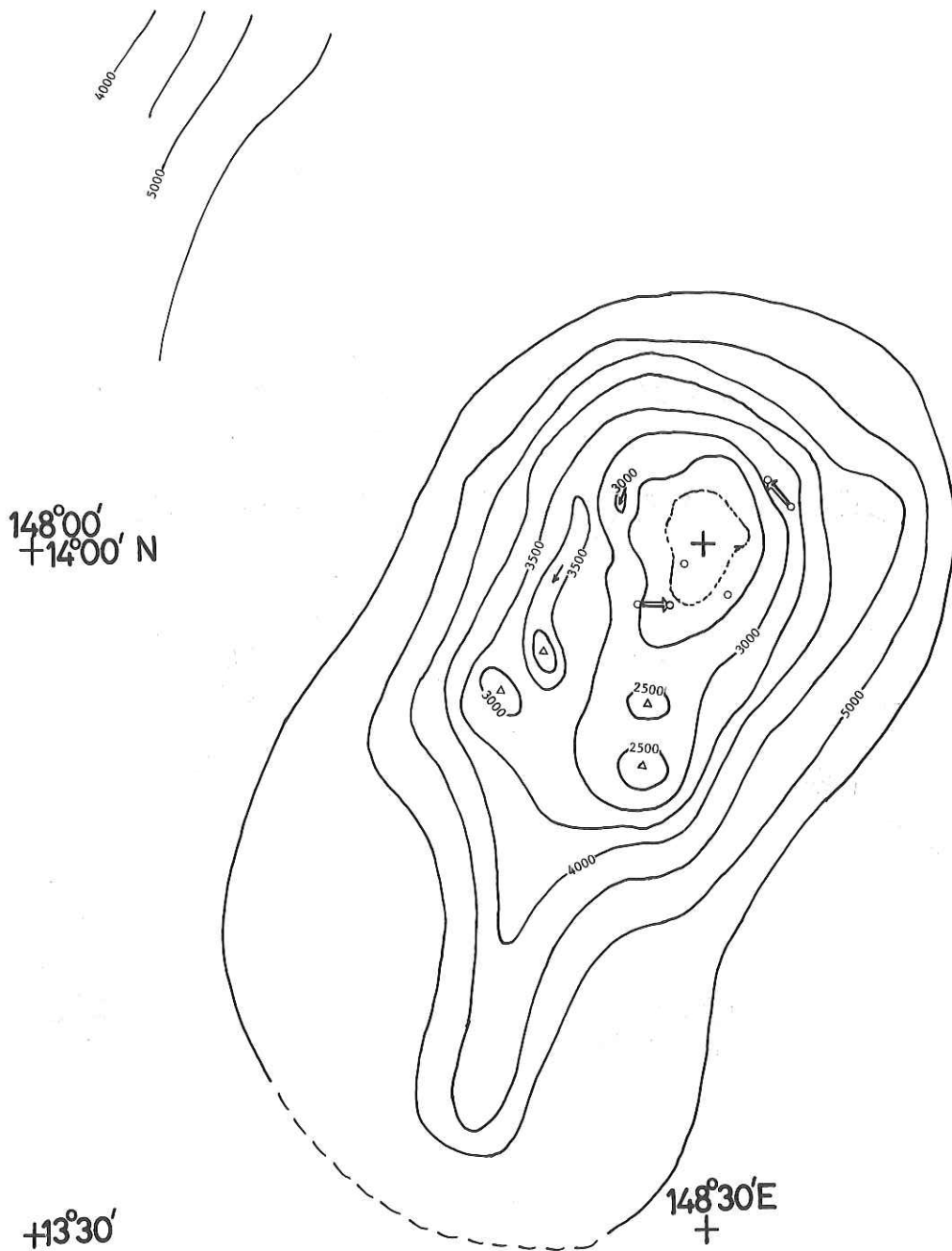


Fig. 6-2-B. Topography drawn from the present survey. Arrow indicates direction of dredge haul.

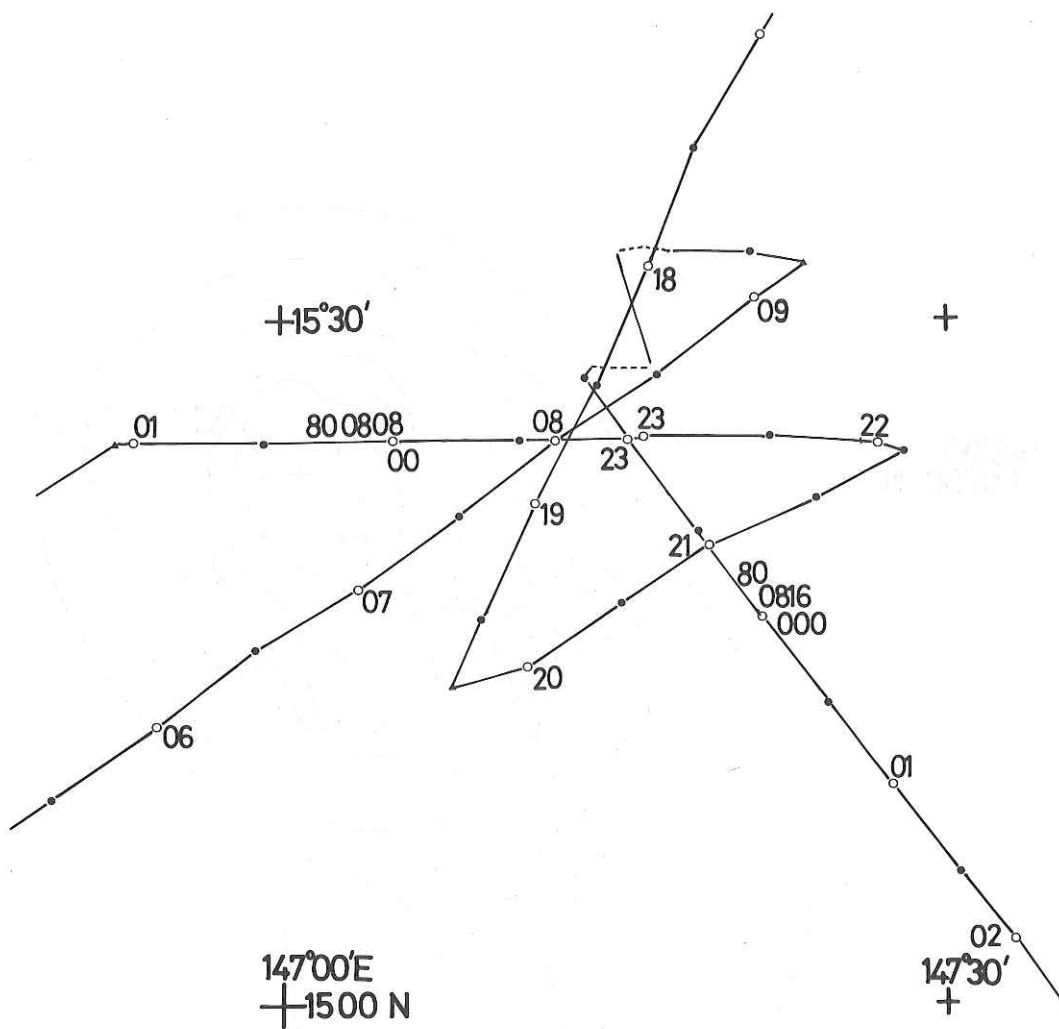


Fig. 6-3-A. Ship's track.

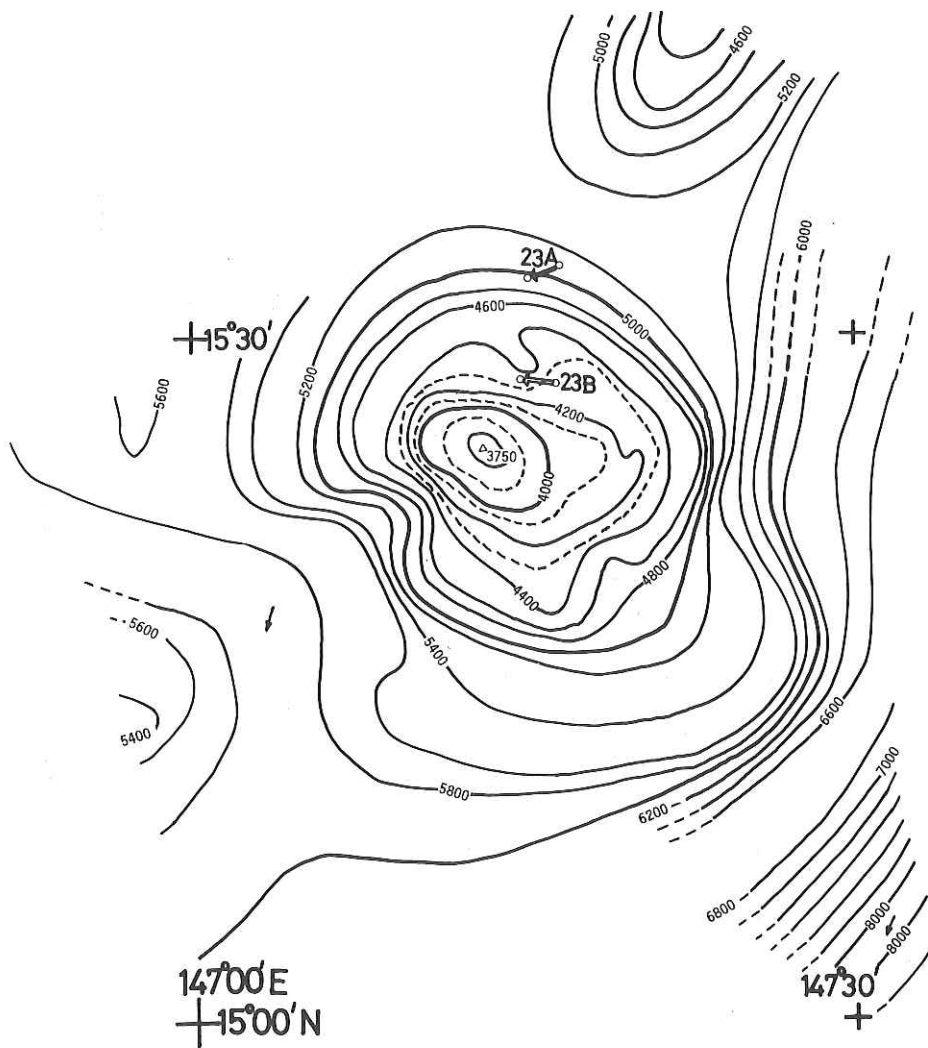


Fig. 6-3-B. Topography drawn from the present survey. Arrow indicates direction of dredge haul.



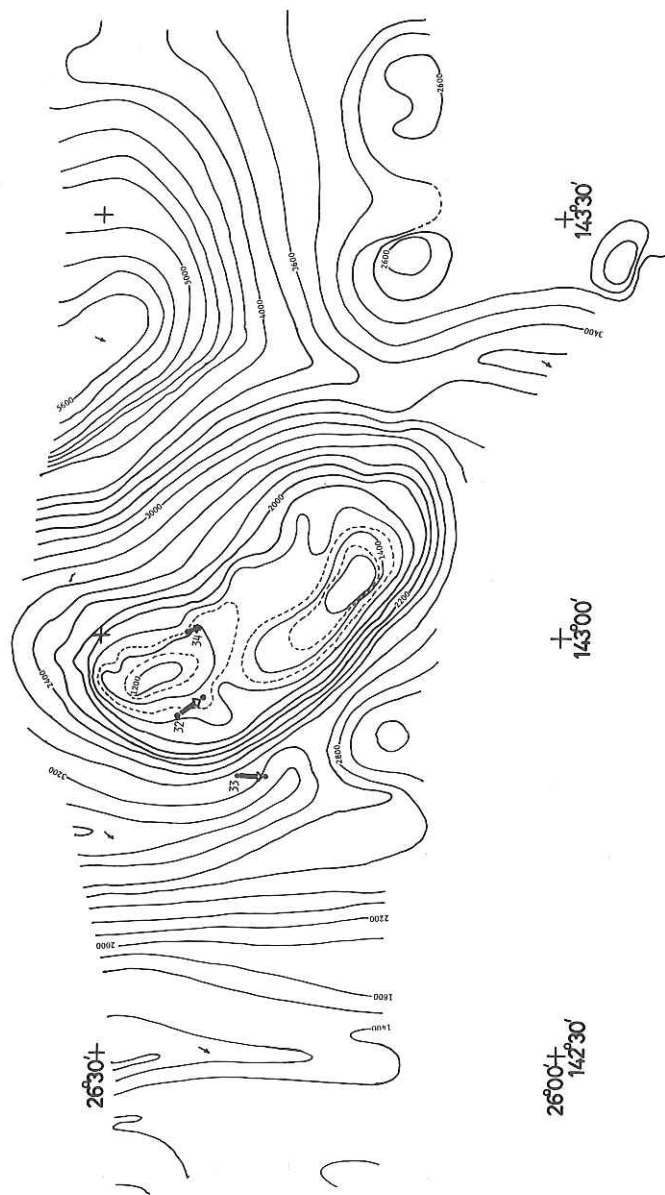


Fig. 6-4-B. Topography drawn from the present survey. Arrow indicates direction of dredge haul.

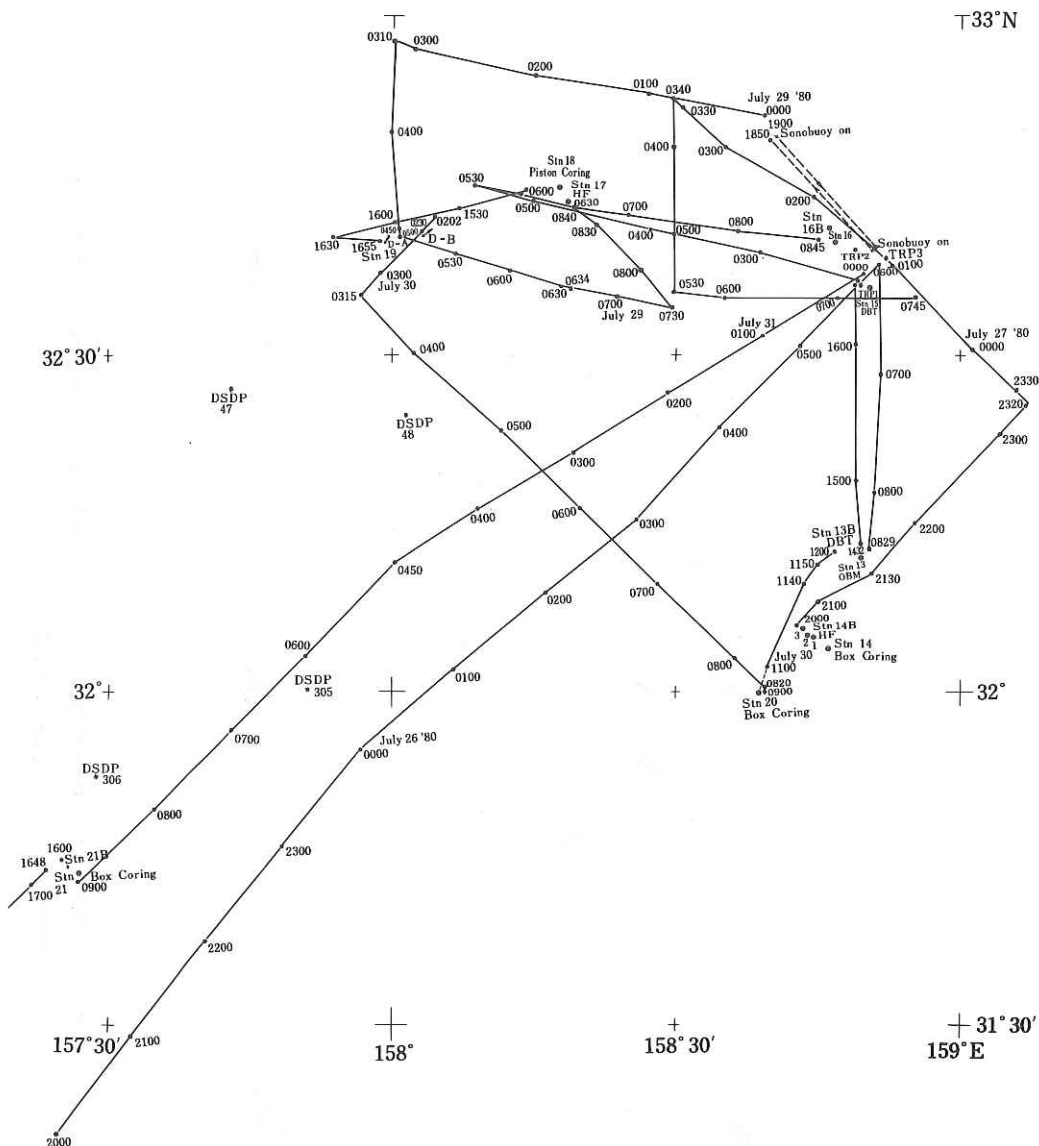


Fig. 6-5. Ship's track for detailed survey of southwestern portion of Shatsky Rise.

## 7. SEISMIC PROFILER AND SEISMIC SONO-RADIO BUOY

H. KINOSHITA, T. ASANUMA, M. MITAMURA,  
S. ARAKAWA, T. URABE, M. YAMANO, S. IMAHORI

During the cruise KH 80-3, series of continuous seismic profiles and two lines of seismic sono-radio buoy observation were furnished. Two types of penumatic sound sources, e.g. Air Gun 1500c (5 liter of high pressure chamber) and 1900c (2 liter) were used; the 5 liter air gun for sono-radio buoy and 2 liter one for seismic profiling operation.

A single channel hydrophone streamer which consists of 25 pieces of ceramic transducers was utilized for seismic profiling. Sono-radio buoy carries only a piece of ceramic transducer of the same characteristics as those for the hydrophone streamer.

Physical and mechanical parameters of the measuring systems are as follows.

### Seismic Profiler

- |                                    |  |
|------------------------------------|--|
| 1. Penumatic sound source          | : Air gun, Bolt 1900c                      |
| 2. penumatic pressures*            | : 65-96 atm.                               |
| 3. Volume of high pressure chamber | : ca. 2 liter (120 inch <sup>3</sup> )     |
| 4. Shooting rate                   | : every 15 or 20 sec.                      |
| 5. Reciever                        | : single channel hydrophone streamer       |
| 6. Frequency range                 | : min. 22 to max. 140 Hz                   |
| 7. Monitor                         | : Universal Graphic Recorder               |
| 8. Recieving device                | : SONY Magnescale (DFR-1514W)<br>4-channel |
| 9. Modulation                      | : FM modulation                            |
| 10. Tape and tape speed            | : TDK L-555, 2.4 cm/sec.                   |

### Sono-radio buoy

- |                                    |  |
|------------------------------------|--|
| 1. Penumatic sound source          | : Air gun, Bolt 1500c                  |
| 2. Penumatic pressures*            | : 67-120 atm                           |
| 3. Volume of high pressure chamber | : ca. 5 liter (300 inch <sup>3</sup> ) |
| 4. Shooting rate                   | : every 20 or 25 sec.                  |
| 5. Sound reciever                  | : single pair of ceramic PZT's         |
| 6. Reciever water depth            | : ca. 40m (120 ft.)                    |

# 7. Radio transmitter

Carrier frequency range : 166-167 MHz  
 Modulation : FM modulation  
 Reciever : TELESEIS; STR 70-2F

8. Other items are the same as 6 to 10 of the profiler (above) except for tape speed; 9.5 cm/sec.

\* Measured by a Bourdon gage installed nearby air compressors.

## Time table of seismic profiler surveys

Time of start and stop* month-day-hour-minutes; JST	Location of start and stop **			
	Lat.(N)	Long.(E)	Lat.(N)	Long.(E)
7-14-20-00 - 7-15-09-00	34°38.0'	139°49.6'	35°47.5'	142°51.6'
18-01-00 - 18-08-00	39°11.9'	143°42.6'	38°24.7'	144°47.7'
18-18-00 - 18-22-00	38°08.5'	144°42.9'	35°44.7'	142°36.9'
21-03-30 - 21-08-30	35°47.4'	142°51.0'	35°25.4'	143°50.3'
21-19-00 - 22-08-00	35°14.6'	144°09.1'	34°16.4'	146°21.8'
22-17-05 - 23-14-30	34°06.9'	146°34.6'	32°24.9'	150°36.8'
23-15-30 - 24-05-00	32°31.8'	150°44.1'	31°18.0'	153°10.0'
24-06-30 - 24-13-30	31°12.2'	153°17.6'	30°13.3'	154°03.6'
24-15-00 - 26-07-30	30°09.0'	154°06.9'	32°12.6'	158°50.3'
26-20-30 - 26-06-30	32°08.0'	158°45.0'	32°35.1'	158°55.4'
28-01-30 - 28-07-30	32°37.8'	158°44.6'	32°40.1'	158°45.0'
28-23-00 - 29-07-30	32°51.1'	158°39.3'	32°42.7'	158°19.6'
30-02-00 - 30-07-20	32°37.2'	158°58.8'	32°00.4'	158°39.5'
30-23-00 - 31-08-00	32°37.1'	158°49.8'	31°42.6'	157°26.9'
31-16-00 - 8-01-15-00	31°42.4'	157°21.9'	30°10.6'	154°05.6'
8-02-00-00 - 02-07-30	29°59.6'	154°11.0'	31°13.1'	153°43.5'
02-12-07 - 02-17-30	31°16.7'	153°41.0'	31°16.0'	153°06.6'
02-21-30 - 03-07-00	31°16.6'	153°14.5'	30°07.2'	154°12.4'
03-09-30 - 03-18-30	30°05.3'	154°07.4'	29°03.1'	155°04.4'
03-21-00 - 04-12-00	28°58.7'	154°52.8'	26°52.6'	153°36.8'
04-16-00 - 06-16-00	26°25.6'	153°20.8'	19°20.5'	149°33.7'
06-18-00 - 07-13-00	19°04.2'	149°24.3'	16°09.8'	147°38.6'
07-15-00 - 08-15-00	15°52.1'	147°27.6'	13°38.9'	144°42.0'
15-22-00 - 16-00-30	15°24.9'	147°15.6'	15°05.9'	147°30.5'
17-19-30 - 18-07-30	14°01.8'	148°29.9'	12°49.7'	149°24.3'
18-17-00 - 19-07-30	12°42.1'	149°36.4'	11°06.1'	151°31.8'
19-19-00 - 20-06-30	10°59.6'	151°27.6'	10°00.7'	152°58.0'
20-16-00 - 21-19-30	09°48.3'	153°17.1'	07°04.5'	156°53.3'
22-10-30 - 22-16-30	07°00.9'	156°58.1'	07°02.3'	158°02.3'

\* : A short halt for checking and repiring the air gun is not taken into consideration.

\*\* : More detailed informations are referred to the Time Table of the Cruise KH 80-3.



# Track line of Sono-Radio Buoy Survey

## Station No. SB-1 (reverse observation)

	Date & Time	Lat.(N)	Long.(E)
start	7-28-15-30	32°39.2'	158°50.7'
reverse	7-28-18-00	32°49.3'	158°40.5'
end	7-28-20-13	32°42.9'	158°51.0'

## Station No. SB-2 (split observation)

	Date & Time	Lat.(N)	Long.(E)
start	8-01-40	30°11.4'	154°05.1'

## 8. PISTON CORING

### 8-1. OPERATION LOGS

Date July 16, 1980 Ship Hakuho Maru KH 80-3 Station 1  
 Latitude 39° 21.0'N Longitude 145° 12.8'E  
 Location NW Pacific basin east of Japan Trench  
 Sea Slightly rough, swell Weather Cloudy, 10 m/s N40°E  
 Bottom Topography Flat Profiler no record  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material Al  
 ID of Pipe 65 mm Core Head Wt. 550 Kg Trigger Wt. 40 Kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit not clear Response at Pull-out unclear  
 Time Lowered 08 h 47 m; Uncorrected Water Depth 5430 m  
 Time Hit 10 h 37 m; Uncorrected Water Depth 5440 m  
 Wire Angle at Hit 5 °; Wire-out at Hit 5494 m  
 Cored Length 0 cm Trigger Cored Length 58 cm  
 Method of Storage packed in vinyl sheet No. of Pipe filled  
 Length of Cores in Pipe 1. cm, 2. cm, 3 cm, 4. cm,  
 5. cm, . cm.  
 No. of Cubic Samples for Paleomagnetism (No. No. )

Date July 18, 1980 Ship Hakuho Maru KH 80-3 Station 4  
 Latitude 38° 25.1'N Longitude 144° 44.4'E  
 Location NW Pacific basin east of Japan Trench off Sendai  
 Sea calm, very low swell Weather partly cloudy, 3 m/s N135°E  
 Bottom Topography marginal swell, flat Profiler thick sediment  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material Al  
 ID of Pipe 65 mm Core Head Wt. 550 kg Trigger Wt. 40 kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out vague  
 Time Lowered 08 h 28 m; Uncorrected Water Depth 5450 m  
 Time Hit 10 h 12 m; Uncorrected Water Depth 5460 m  
 Wire Angle at Hit 0 °; Wire-out at Hit 5563 m  
 Cored Length 0 cm Trigger Cored Length 12 cm

Date July 18, 1980 Ship Hakuho Maru KH 80-3 Station 5  
 Latitude 38° 08.7'N Longitude 144° 45.0'E  
 Location NW Pacific basin east of Japan Trench off Sendai  
 Sea nearly calm, small swell Weather clear-partly cloudy, 6 m/s N130°E  
 Bottom Topography marginal swell Profiler thick sediment  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material Al  
 ID of Pipe 65 mm Core Head Wt. 550 Kg Trigger Wt. 40 Kg  
 Length Main Line 20 m Length Trigger Line 22 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out clear  
 Time Lowered 14 h 05 m; Uncorrected Water Depth 5550 m  
 Time Hit 15 h 54 m; Uncorrected Water Depth 5550 m  
 Wire Angle at Hit 0 °; Wire-out at Hit 5650 m  
 Cored Length 979.5 cm + cc Trigger Cored Length 31 cm  
 Method of Storage 2m container No. of Pipe filled 6  
 Length of Cores in Pipe 1. 134.0cm, 2. 179.5cm, 3 199.0 cm, 4. 187.0 cm,  
 5. 188.5cm, 6. 91.5cm.  
 No. of Cubic Samples for Paleomagnetism 400 (No. 6401 - No. 6800 )

Date July 21, 1980 Ship Hakuho Maru KH 80-3 Station 9  
 Latitude 35° 22.6'N Longitude 143° 54.1'E  
 Location NW Pacific basin east of Dai'ishi Kashima Seamount  
 Sea quite calm, no swell Weather breeze, 1 m/s N  
 Bottom Topography marginal swell, flat Profiler thick sediment  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material Al  
 ID of Pipe 65 mm Core Head Wt. 550 kg Trigger Wt. 40 kg  
 Length Main Line 20 m Length Trigger Line 22 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out clear  
 Time Lowered 09 h 16 m; Uncorrected Water Depth 5730 m  
 Time Hit 11 h 00 m; Uncorrected Water Depth 5730 m  
 Wire Angle at Hit 0 °; Wire-out at Hit 5750 m  
 Cored Length 740.0 cm + cc Trigger Cored Length 55.0 cm  
 Method of Storage 2m container No. of Pipe Filled 5  
 Length of Core in Pipe 1. 89.0cm, 2. 189.0cm, 3. 149.0 cm, 4. 146.0 cm  
 5. 174.0 cm, 6. cm.  
 No. of Cubic Samples for Paleomagnetism 300 (No. 6801 - no. 7100 )

Date July 22, 1980 Ship Hakuho Maru KH 80-3 Station 12  
 Latitude 34° 08.4'N Longitude 146° 34.2'E  
 Location NW Pacific abyssal plain  
 Sea calm Weather breeze, 3 m/s W, clear  
 Bottom Topography flat Profiler thick sediment  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material Al  
 ID of Pipe 65 mm Core Head Wt. 550Kg Trigger Wt. 40 Kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit very clear Response at Pull-out clear  
 Time Lowered 14 h 05 m; Uncorrected Water Depth 5850 m  
 Time Hit 16 h 08 m; Uncorrected Water Depth 5820 m  
 Wire Angle at Hit 0 °; Wire-out at Hit 5939 m  
 Cored Length 996.0 cm + cc Trigger Cored Length 27.0 cm  
 Method of Storage 2m container No. of Pipe filled 6  
 Length of Cores in Pipe 1. 142.5cm, 2. 188.5cm, 3 191.5 cm, 4. 193.0 cm,  
 5. 191.5cm, 6. 97.0 cm.  
 No. of Cubic Samples for Paleomagnetism 437 (No. 7101 - No. 7537 )

Date July 29, 1980 Ship Hakuho Maru KH 80-3 Station 18  
 Latitude 32° 44.9'N Longitude 158° 17.6'E  
 Location Shatsky Rise crestal area  
 Sea ripples Weather clear, breeze, 6 m/s E  
 Bottom Topography moat of flank of a high Profiler fault suspected  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material Al  
 ID of Pipe 65 mm Core Head Wt. 550kg Trigger Wt. 40 kg  
 Length Main Line 20 m Length Trigger Line 21m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out very clear  
 Time Lowered 12 h 43 m; Uncorrected Water Depth 2630 m  
 Time Hit 13 h 44 m; Uncorrected Water Depth 2640 m  
 Wire Angle at Hit 0 °; Wire-out at Hit 2646 m  
 Cored Length 1039.0 cm + cc Trigger Cored Length 24.0cm  
 Method of Storage 2m container No. of Pipe Filled 7  
 Length of Core in Pipe 1. 21.0cm, 2. 185.0cm, 3. 191.0cm, 4. 182.0cm  
 5. 180.0cm, 6. 188.0cm, 7. 101.0 .  
 No. of Cubic Samples for Paleomagnetism 463 (No. 7601 - no. 8063 )

Date August 2, 1980 Ship Hakuho Maru KH 80-3 Station 22  
Latitude 31° 16.2'N Longitude 153° 42.9'E  
Location NW Pacific basin southwest off Shatsky Rise  
Sea Calm, swell appreciable Weather cloudy, Typhoon nearby  
Bottom Topography rugged by 300m, slope of a highProfiler thin sediment

Length of Core Pipe 12 m Wall Thickness 7.5 mm Material A1  
ID of Pipe 65 mm Core Head Wt. 550 Kg Trigger Wt. 40 Kg  
Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
Response at Hit clear Response at Pull-out very clear  
Time Lowered 09 h 10 m; Uncorrected Water Depth 5740 m  
Time Hit 10 h 55 m; Uncorrected Water Depth 5750 m  
Wire Angle at Hit 0 °; Wire-out at Hit 5912 m

Cored Length 1060.0 cm + cc Trigger Cored Length 128.0 cm  
Method of Storage 2m container No. of Pipe filled 7  
Length of Cores in Pipe 1. 49.0 cm, 2. 185.0 cm, 3. 181.0cm, 4. 184.0 cm,  
5. 181.0 cm, 6. 188.0cm. 7. 101.0 cm.  
No. of Cubic Samples for Paleomagnetism 400 (No. 8101 - No. 8500 )

Date August 16, 1980 Ship Hakuho Maru KH 80-3 Station 24A  
Latitude 13° 44.3'N Longitude 148° 37.9'E  
Location East of Mariana Trench  
Sea calm, ripple, no swell Weather partly cloudy, 3 m/s N180°E  
Bottom Topography flat, flank of a seamount Profiler moderate sediment

Length of Core Pipe 12 m Wall Thickness 7.5 mm Material A1  
ID of Pipe 65 mm Core Head Wt. 550 kg Trigger Wt. 40 kg  
Length Main Line 20 m . Length Trigger Line 21 m Length Free Fall 12 m  
Response at Hit clear Response at Pull-out clear  
Time Lowered 11 h 16 m; Uncorrected Water Depth 5800 m  
Time Hit 13 h 05 m; Uncorrected Water Depth 5880 m  
Wire Angle at Hit 0 °; Wire-out at Hit 5900 m  
Cored Length 1061.0 cm +cc Trigger Cored Length 0 cm  
Method of Storage 2m container No. of Pipe Filled 8  
Length of Core in Pipe 1. 24.0 cm, 2. 188.0 cm, 3. 191.0cm, 4. 103.0cm  
5. 146.0cm, 6. 184.0cm. 7. 191.0cm, 8. 40.0cm.  
No. of Cubic Samples for Paleomagnetism 400 (No. 8501 -no. 8900 )

Date August 18, 1980 Ship Hakuho Maru KH 80-3 Station 26  
 Latitude 12° 47.0'N Longitude 148° 27.5'E  
 Location Mariana basin, 250 n.m. east of Mariana Trench  
 Sea calm, no swell Weather breeze, 3 m/s S  
 Bottom Topography flat, small highs infrequent Profiler moderate sediment  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material A1  
 ID of Pipe 65 mm Core Head Wt. 550 Kg Trigger Wt. 40 Kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out very clear  
 Time Lowered 09 h 09 m; Uncorrected Water Depth 5950 m  
 Time Hit 10 h 56 m; Uncorrected Water Depth 5950 m  
 Wire Angle at Hit 5 °; Wire-out at Hit 6065 m  
 Cored Length 1021 cm Trigger Cored Length 55 cm  
 Method of Storage 2m container No. of Pipe filled 6  
 Length of Cores in Pipe 1. 82 cm, 2. 184 cm, 3. 194 cm, 4. 190 cm,  
 5. 184 cm, 6. 187 cm. 7.  
 No. of Cubic Samples for Paleomagnetism 400 (No. 8901 - No. 9300 )

Date August 18, 1980 Ship Hakuho Maru KH 80-3 Station 27  
 Latitude 12° 42.1'N Longitude 148° 34.4'E  
 Location Mariana basin, 12 n.m. ESE of stn. 26  
 Sea calm, very low swell Weather no breeze  
 Bottom Topography flanking plain of a seamount Profiler no record  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material A1  
 ID of Pipe 65 mm Core Head Wt. 550 kg Trigger Wt. 40 kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out very clear  
 Time Lowered 14 h 08 m; Uncorrected Water Depth 5920 m  
 Time Hit 15 h 04 m; Uncorrected Water Depth 5930 m  
 Wire Angle at Hit 2 °; Wire-out at Hit 6040 m  
 Cored Length 1034 cm + cc Trigger Cored Length 42 cm  
 Method of Storage 2m container No. of Pipe Filled 7  
 Length of Core in Pipe 1. 9 cm, 2. 191 cm, 3. 187 cm, 4. 183 cm  
 5. 186 cm, 6. 183 cm. 7. 95 cm  
 No. of Cubic Samples for Paleomagnetism 400 (No. 9301 -no. 9700 )

Date August 19, 1980 Ship Hakuho Maru KH 80-3 Station 28A  
 Latitude 11° 03.3'N Longitude 151° 34.6'E  
 Location central part of Mariana basin  
 Sea Calm, no swell Weather cloudy, 7 m/s N50°E  
 Bottom Topography flat throughout the last 100nm Profiler rugged basement  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material A1  
 ID of Pipe 65 mm Core Head Wt. 550 Kg Trigger Wt. 40 Kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out clear  
 Time Lowered 09 h 10 m; Uncorrected Water Depth 5800 m  
 Time Hit 10 h 52 m; Uncorrected Water Depth 5800 m  
 Wire Angle at Hit 0 °; Wire-out at Hit 5893 m  
 Cored Length 1050 cm Trigger Cored Length 66 cm  
 Method of Storage 2m container No. of Pipe filled 7  
 Length of Cores in Pipe 1. 43 cm, 2. 177 cm, 3. 185 cm, 4. 182 cm,  
 5. 181 cm, 6. 187 cm. 7. 95 cm.  
 No. of Cubic Samples for Paleomagnetism 567 (No. 9701 - No. 10167 )

Date August 20, 1980 Ship Hakuho Maru KH 80-3 Station 29  
 Latitude 9° 59.0'N Longitude 153° 00.2'E  
 Location Mariana basin  
 Sea low swell Weather rain, 4 m/s E  
 Bottom Topography flat Profiler moderate sediment  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material A1  
 ID of Pipe 12 mm Core Head Wt. 550 kg Trigger Wt. 40 kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out clear  
 Time Lowered 09 h 07 m; Uncorrected Water Depth 5520 m  
 Time Hit 10 h 45 m; Uncorrected Water Depth 5520 m  
 Wire Angle at Hit °; Wire-out at Hit 5609 m  
 Cored Length 1039 cm + cc Trigger Cored Length 61 cm  
 Method of Storage 2m container No. of Pipe Filled 7  
 Length of Core in Pipe 1. 32 cm, 2. 188 cm, 3. 183 cm, 4. 183 cm  
 5. 179 cm, 6. 187 cm. 7. 87 cm,  
 No. of Cubic Samples for Paleomagnetism 462 (No. 10201 - no. 10662 )

Date August 20, 1980 Ship Hakuho Maru KH 80-3 Station 30  
 Latitude 9° 50.6'N Longitude 153° 13.5'E  
 Location Mariana basin  
 Sea calm, no swell Weather clear  
 Bottom Topography flat Profiler  
 Length of Core Pipe 12 m Wall Thickness 7.5 mm Material Al  
 ID of Pipe 65 mm Core Head Wt. 550 Kg Trigger Wt. 40 Kg  
 Length Main Line 20 m Length Trigger Line 21 m Length Free Fall 12 m  
 Response at Hit clear Response at Pull-out clear  
 Time Lowered 14 h 12 m; Uncorrected Water Depth 5480 m  
 Time Hit 15 h 56 m; Uncorrected Water Depth 5480 m  
 Wire Angle at Hit 0 °; Wire-out at Hit 5566 m  
 Cored Length 1007 cm Trigger Cored Length 56 cm  
 Method of Storage 2m container No. of Pipe filled 6  
 Length of Cores in Pipe 1. 181 cm, 2. 182 cm, 3 183 cm, 4. 181 cm,  
 5. 182 cm, 6. 98 cm.  
 No. of Cubic Samples for Paleomagnetism 452 (No. 10701 - No. 11152 )



## 8-2. MEGASCOPIC CORE DESCRIPTION

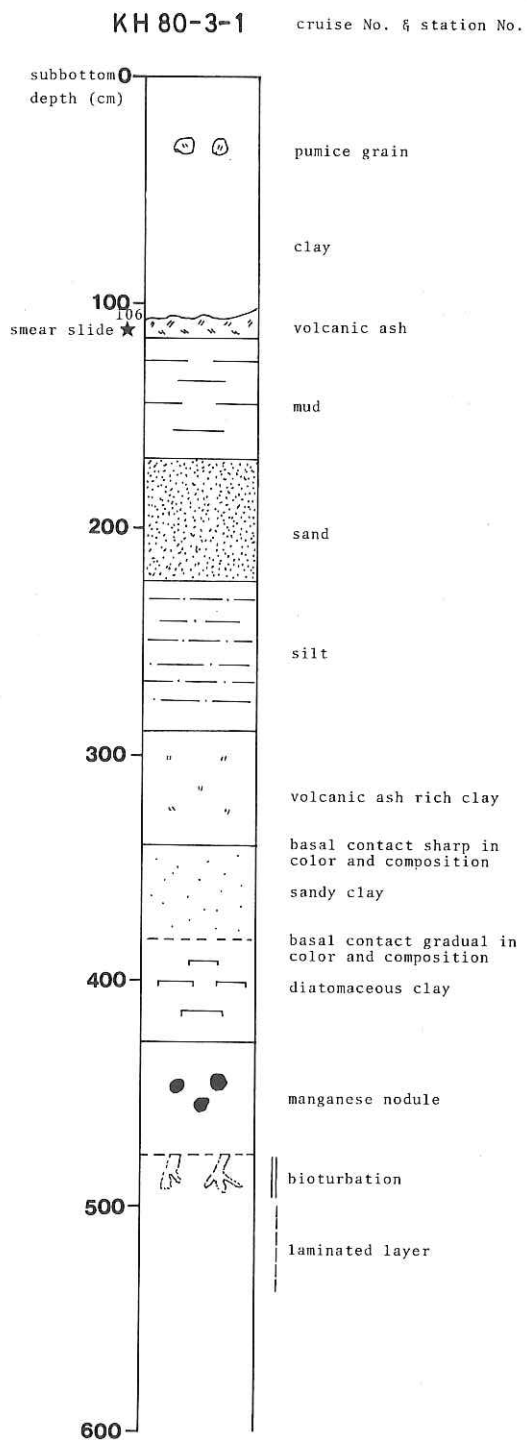


Fig. 8-2-1. Legend of core description.

# KH 80-3-5

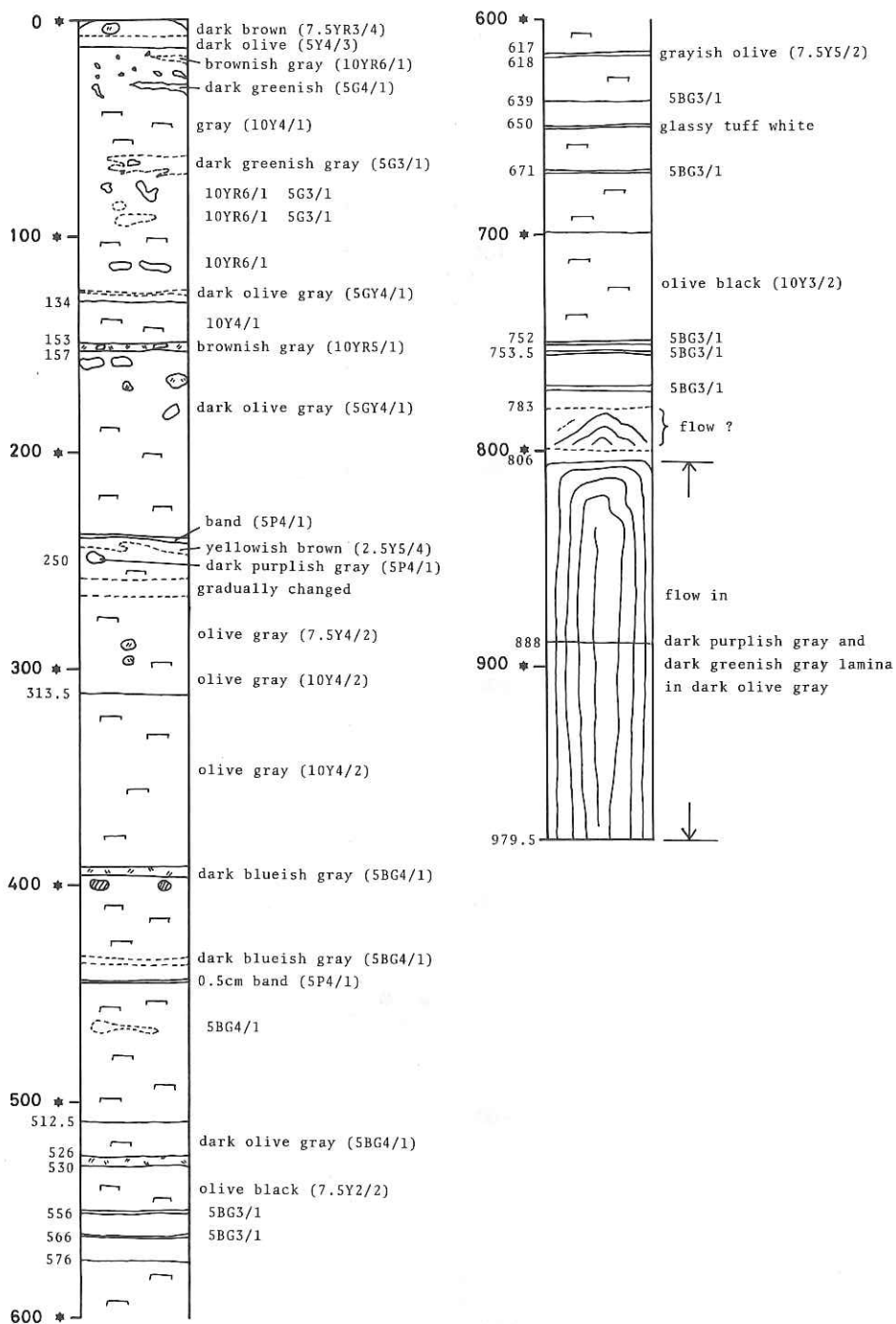


Fig. 8-2-2. Megascopic description of core KH 80-3-5.

# KH 80-3-9

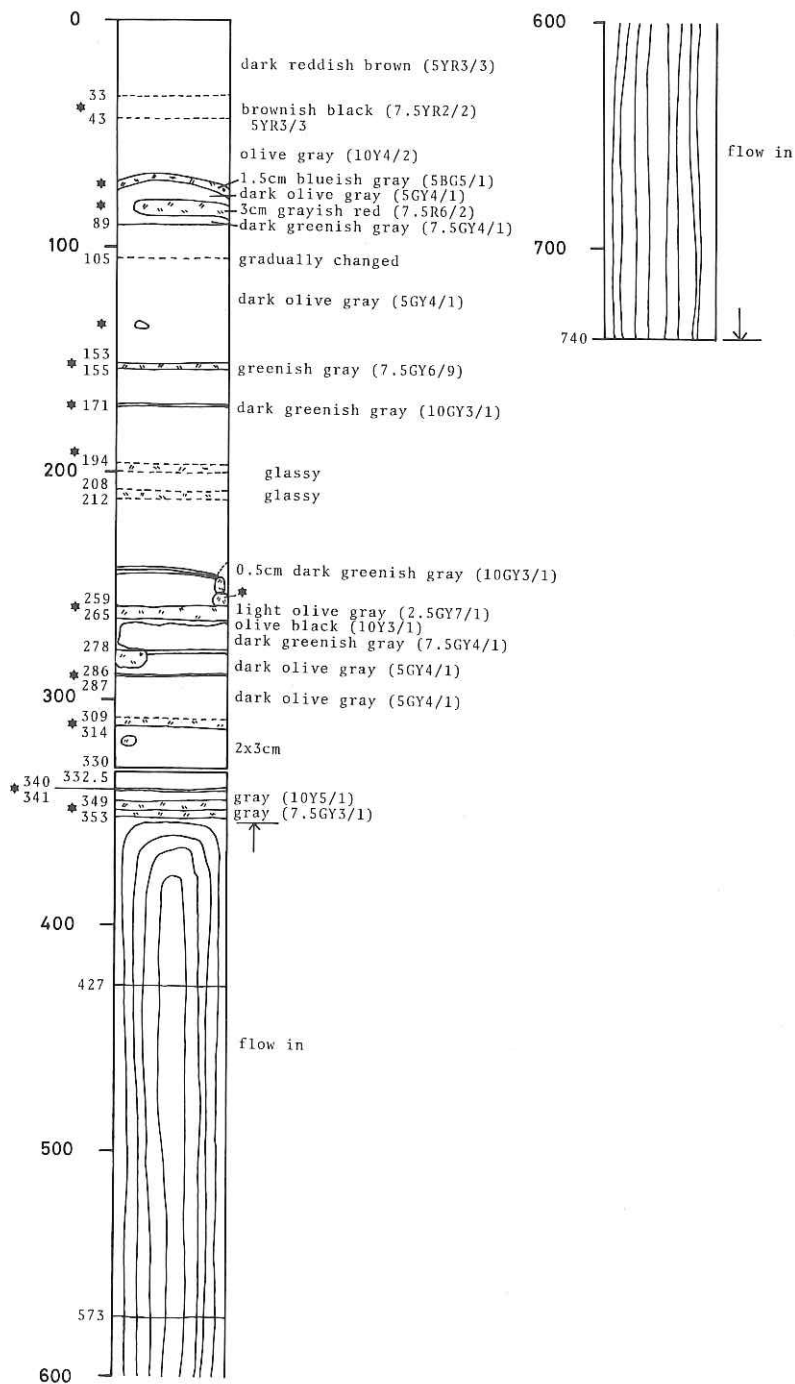


Fig. 8-2-3. Megascopic description of core KH 80-3-9.

# KH 80-3-12

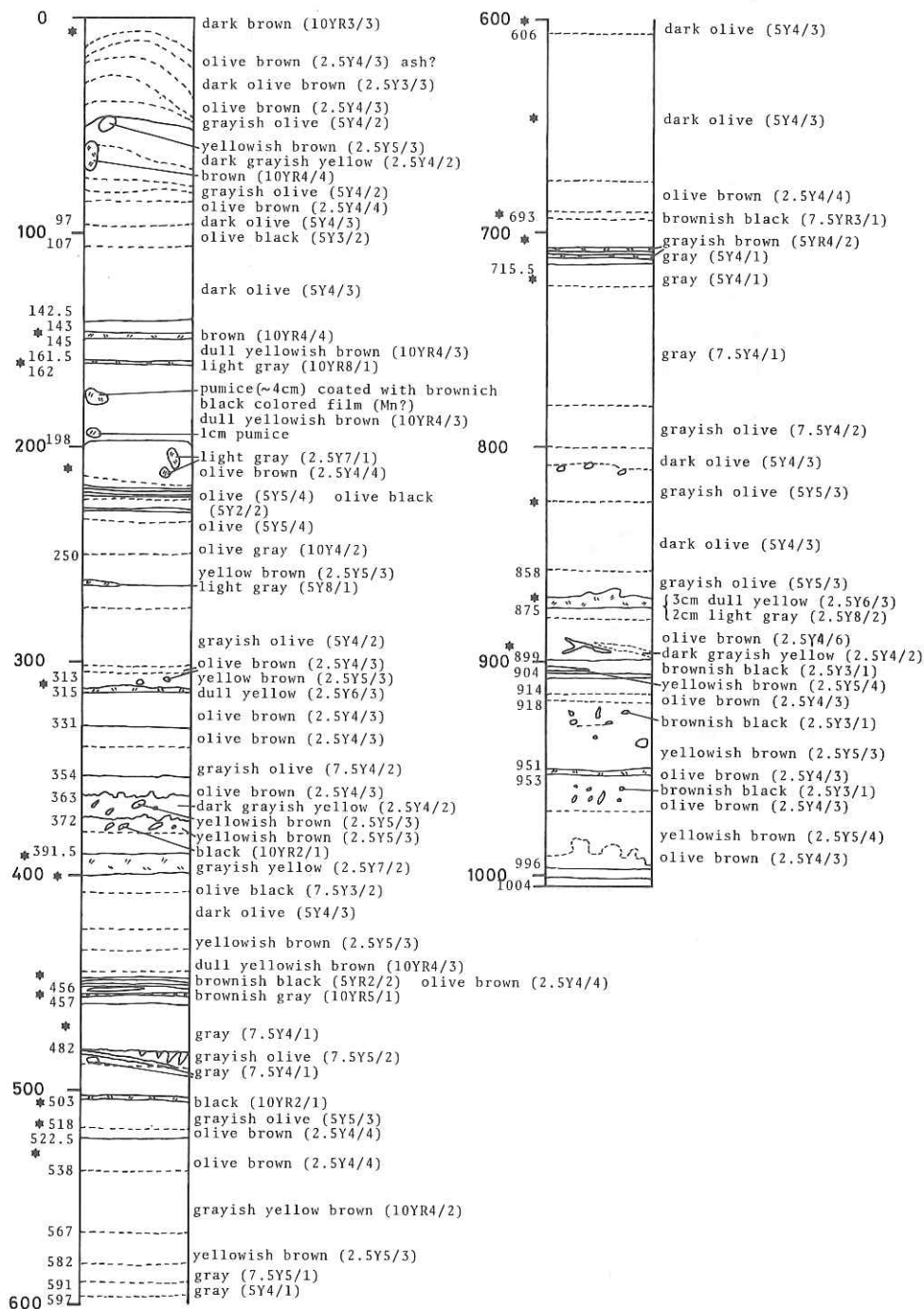


Fig. 8-2-4. Megascopic description of core KH 80-3-12.

# KH 80-3-18

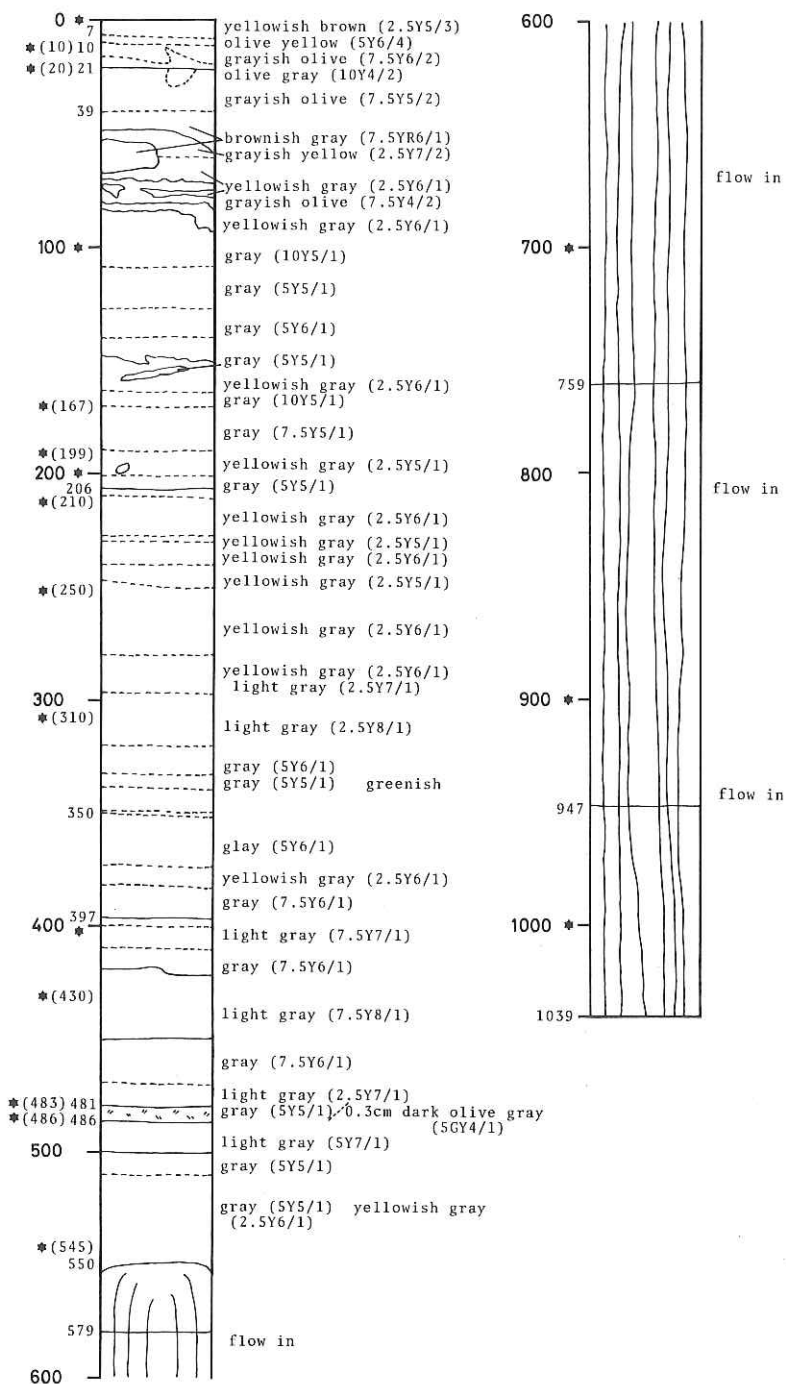


Fig. 8-2-5. Megascope description of core KH 80-3-18.

# KH 80-3-22

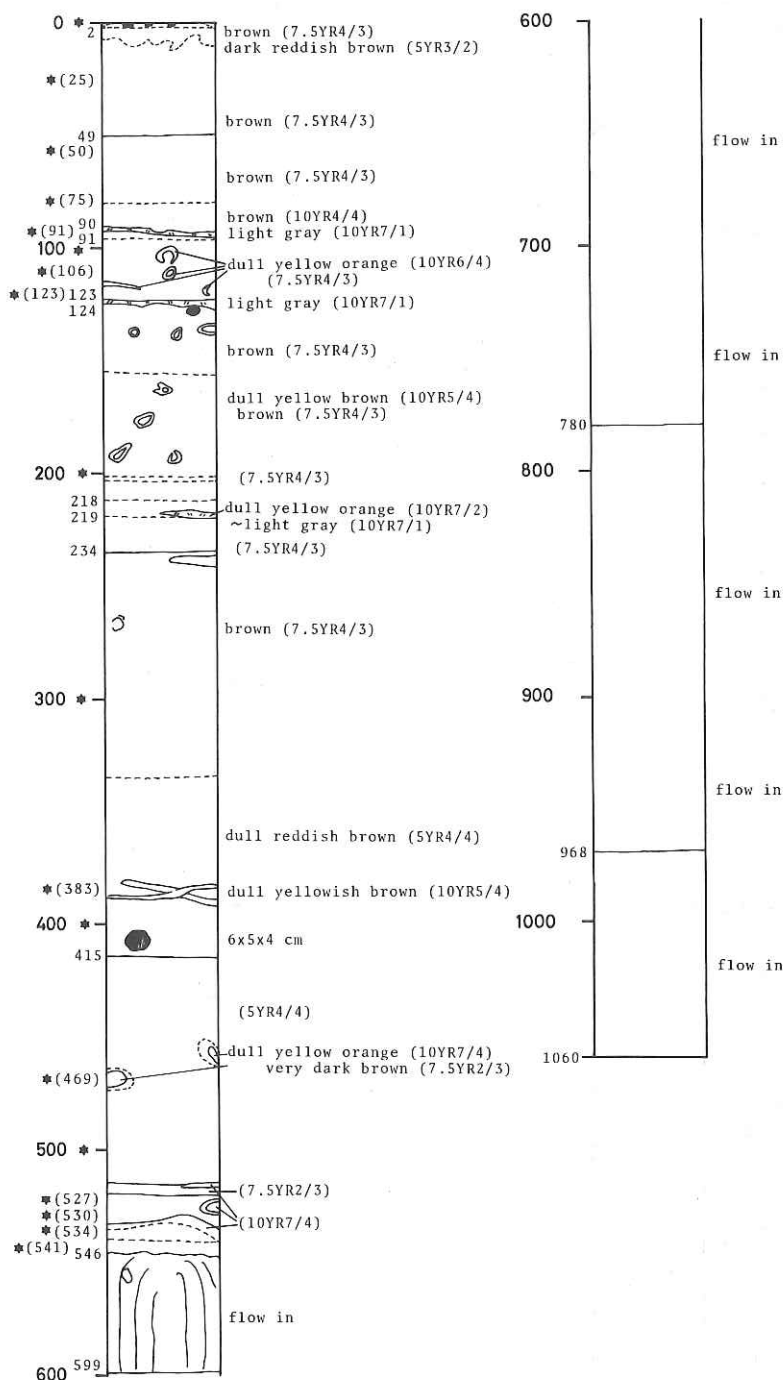


Fig. 8-2-6. Megascope description of core KH 80-3-22.

# KH 80-3-24A

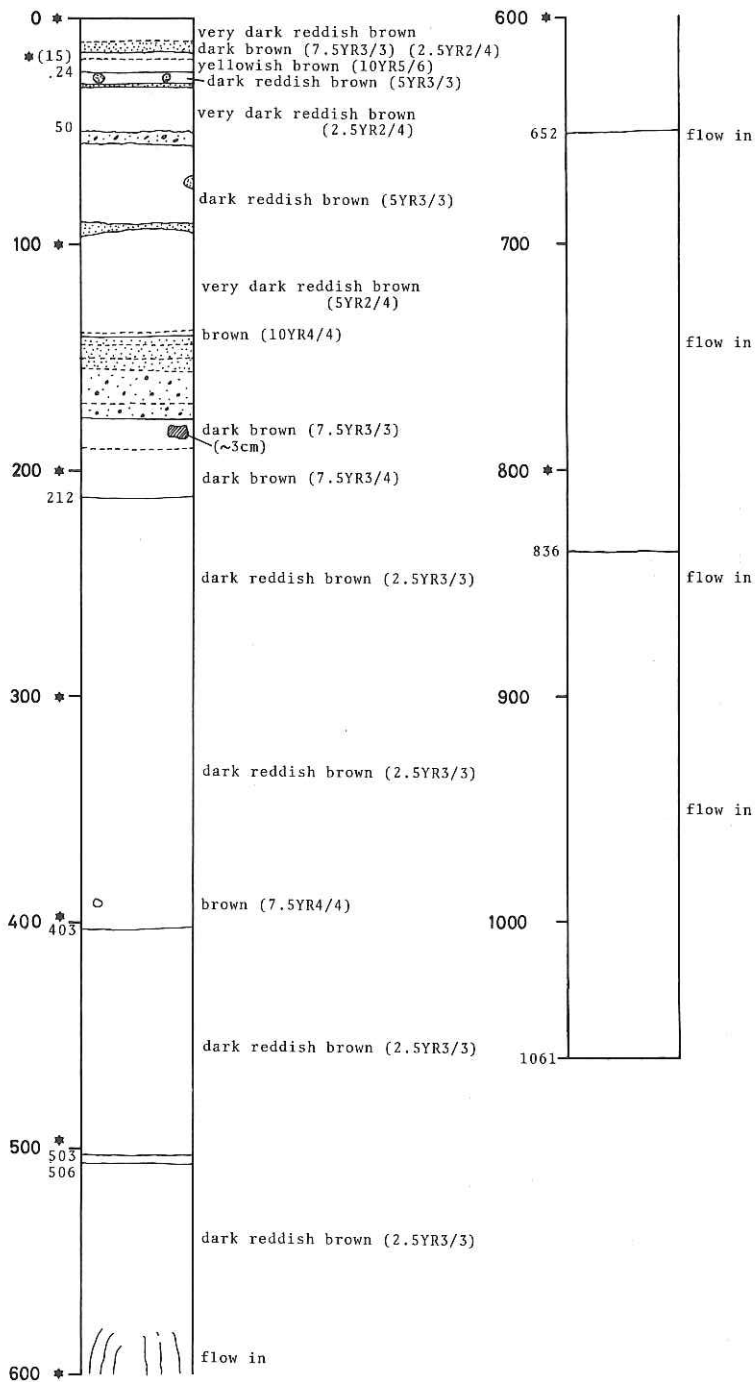


Fig. 8-2-7. Megascopic description of core KH 80-3-24A.

0 very dark reddish brown (5YR2/3)  
brown (10YR4/4)

82 dark brown (7.5YR3/4)

100

dull yellowish brown (10YR4/3)

200 dark brown (7.5YR3/3)  
dark brown (10YR3/4)  
dull yellowish brown (10YR5/4)  
dark brown (7.5YR3/3)  
dark brown (7.5YR3/3)  
dark brown (7.5YR3/4)  
brown (10YR4/4)  
dark brown (10YR3/4)  
brown (10YR4/4)  
brown (10YR4/6)  
brown (10YR4/4)  
brownish black (10YR2/2)  
dark brown (7.5YR3/3)  
brown (10YR4/4)  
brownish black (10YR2/2)  
dark brown (7.5YR3/4)  
dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (7.5YR3/4)

266 dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (10YR3/4)  
dark brown (7.5YR3/4)  
dark brown (10YR3/4)  
brownish black (10YR2/2)

300 dark brown (10YR3/4)

400 dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (10YR3/4)  
dark brown (7.5YR3/4)  
dark brown (10YR3/4)  
brownish black (10YR2/2)

460 dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (7.5YR3/4)  
dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (7.5YR3/4)  
dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (7.5YR3/4)  
dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (7.5YR3/4)  
dark brown (7.5YR3/4)  
dark brown (7.5YR3/4)

600 dark brown (10YR3/4)  
dark brown (7.5YR3/4)  
dark brown (10YR3/4)  
brownish black (10YR2/2)  
dark brown (10YR3/4)  
brown (10YR4/4)  
brownish black (10YR2/2)  
brown (10YR4/4)  
dark brown (10YR3/3)

700 dark brown (10YR3/4)

800 flow in

834 flow in

900 flow in

1000 flow in

1021 flow in

1100 flow in

1118

— 40 —



# KH 80-3-27

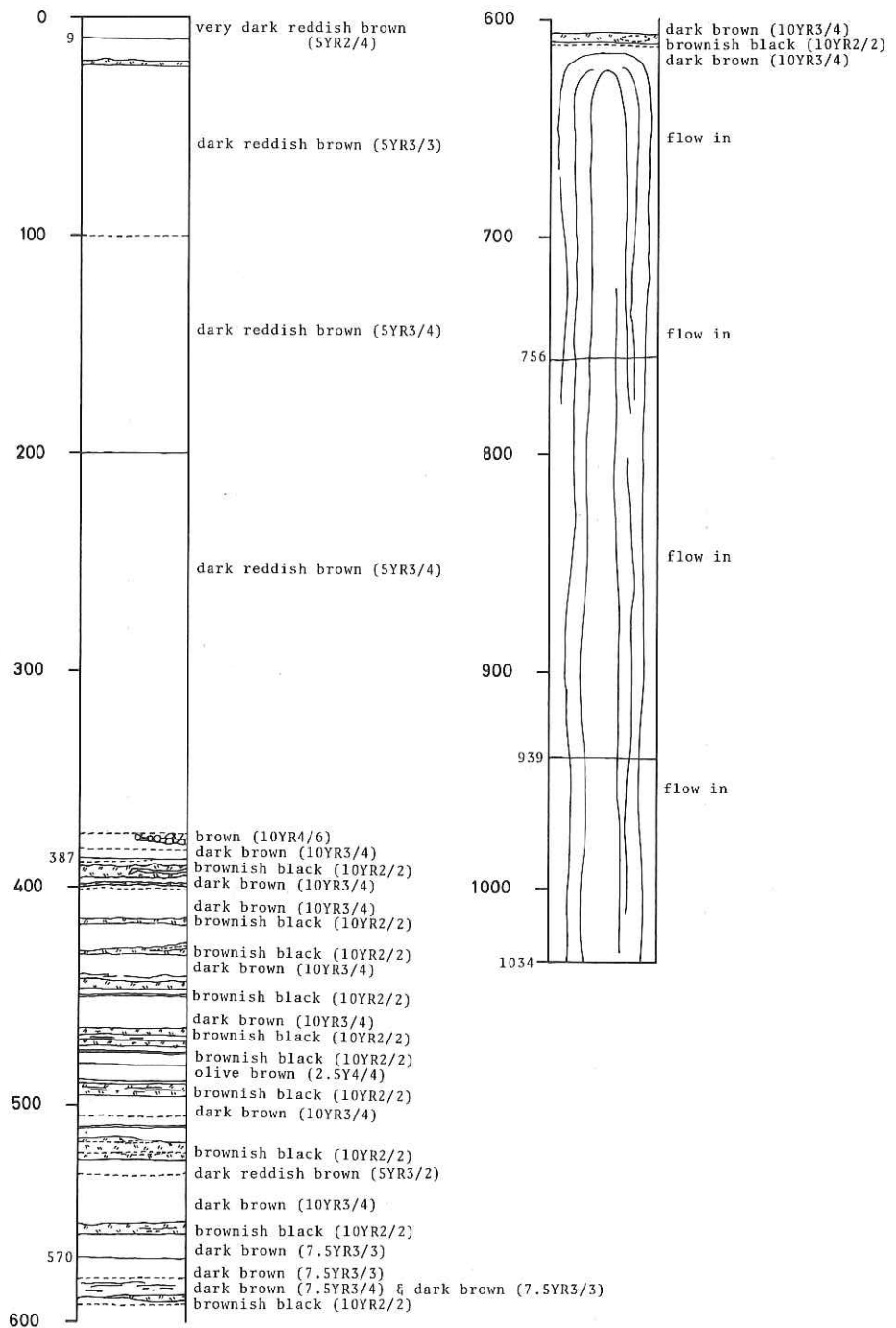


Fig. 8-2-9. Megascopic description of core KH 80-3-27.

# KH 80-3-28A

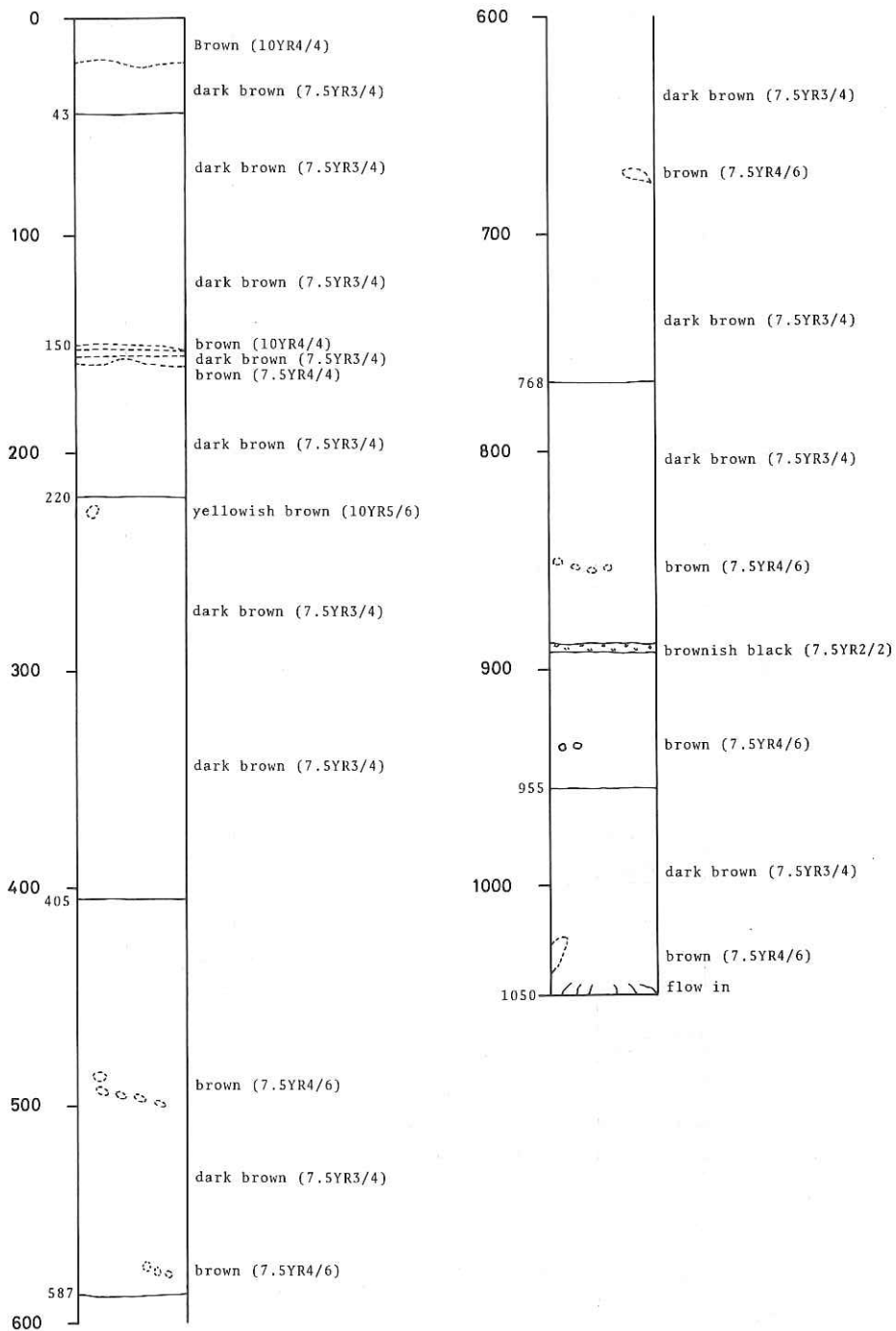


Fig. 8-2-10. Megascope description of core KH 80-3-28A.

## KH 80-3-29

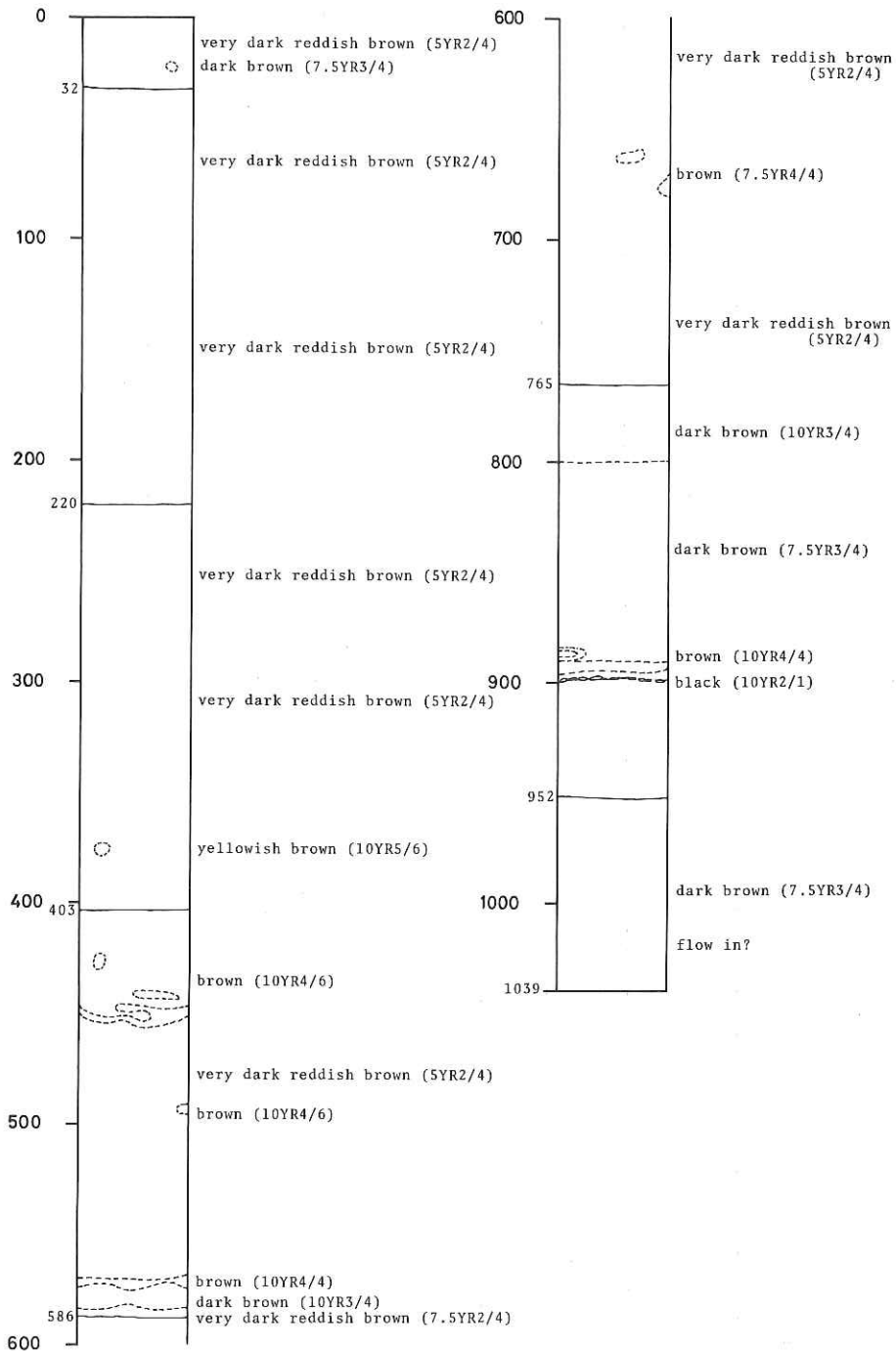


Fig. 8-2-11. Megascopic description of core KH 80-3-29.

# KH 80-3-30

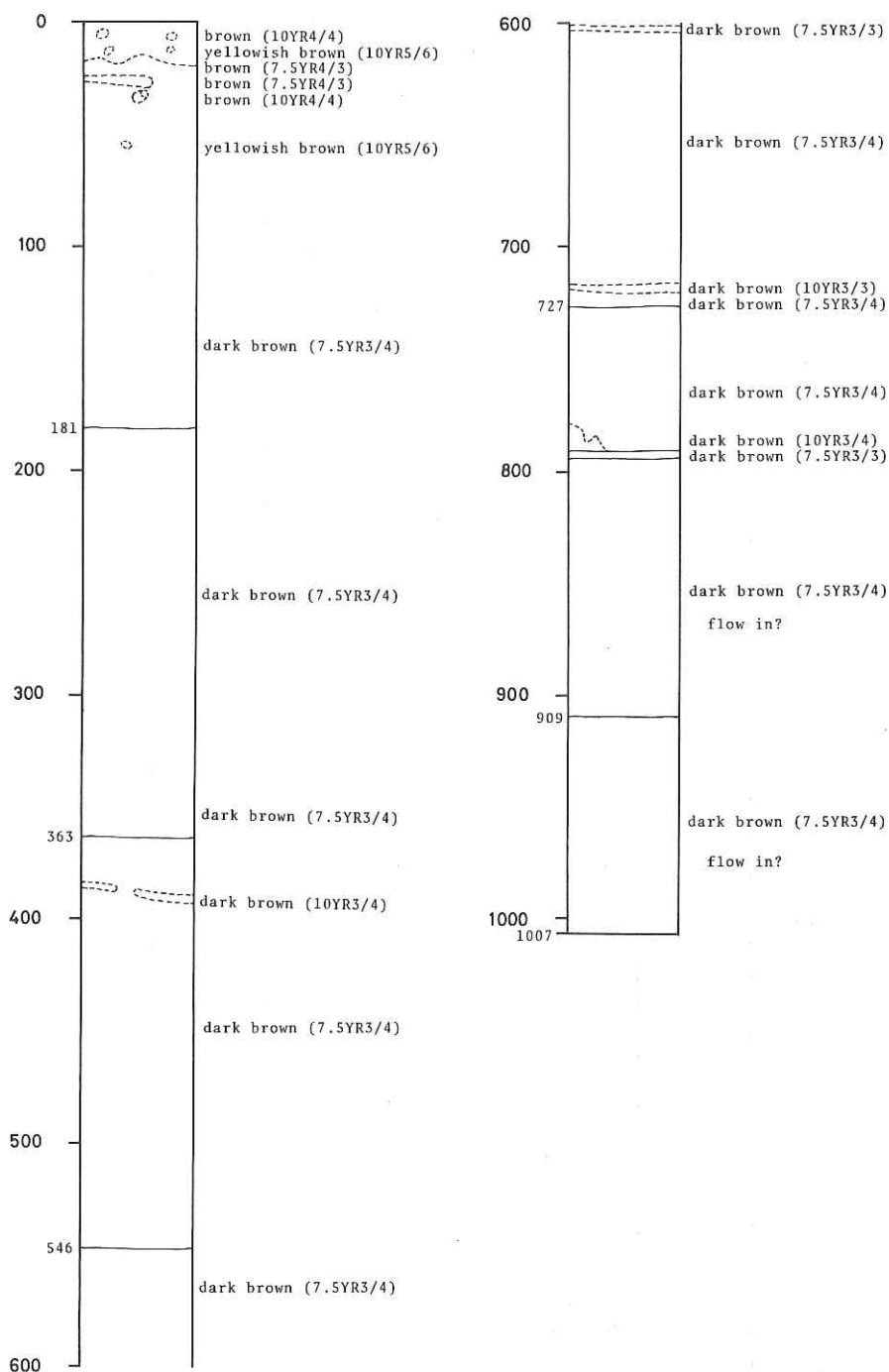


Fig. 8-2-12. Megascopic description of core KH 80-3-30.

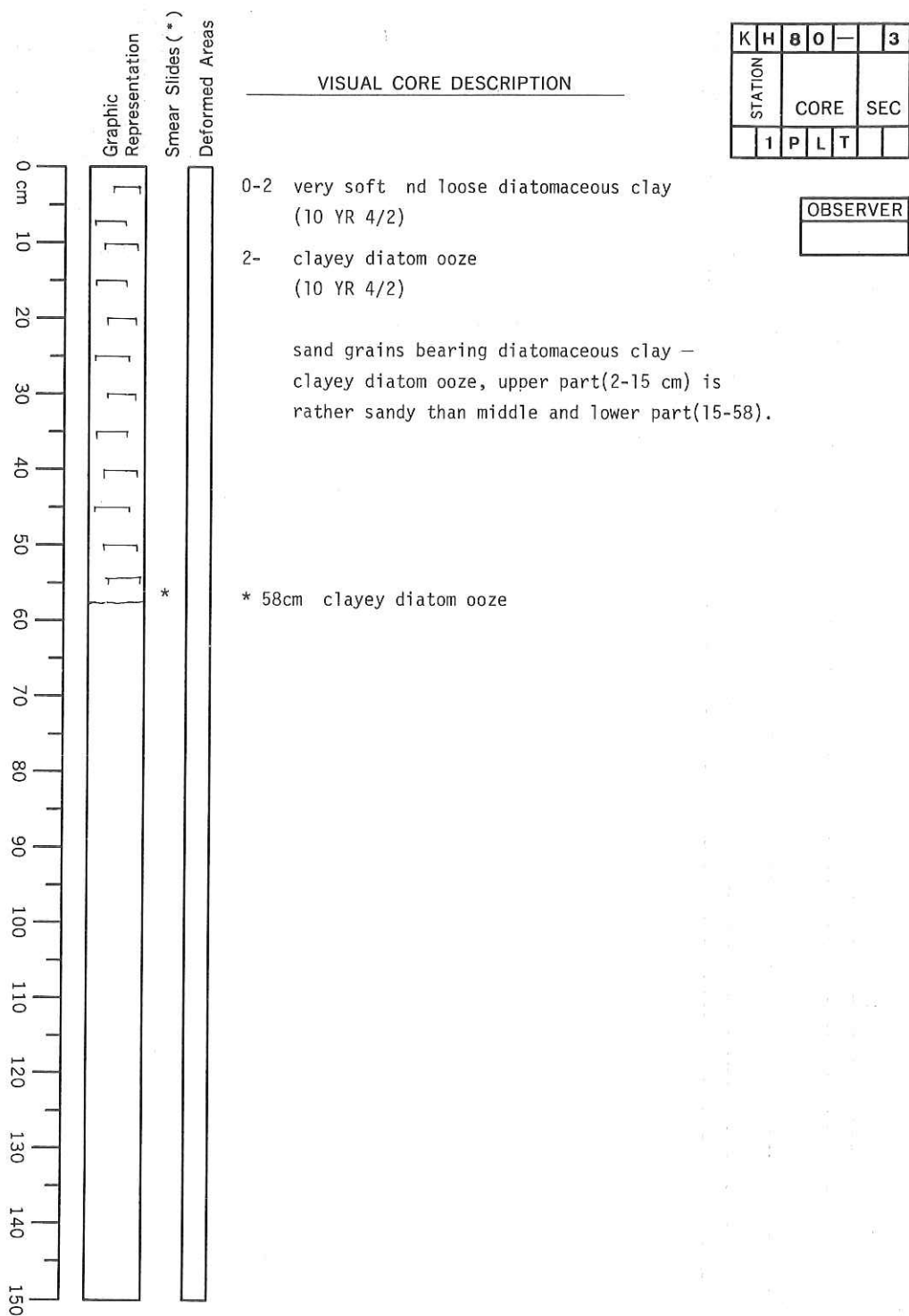
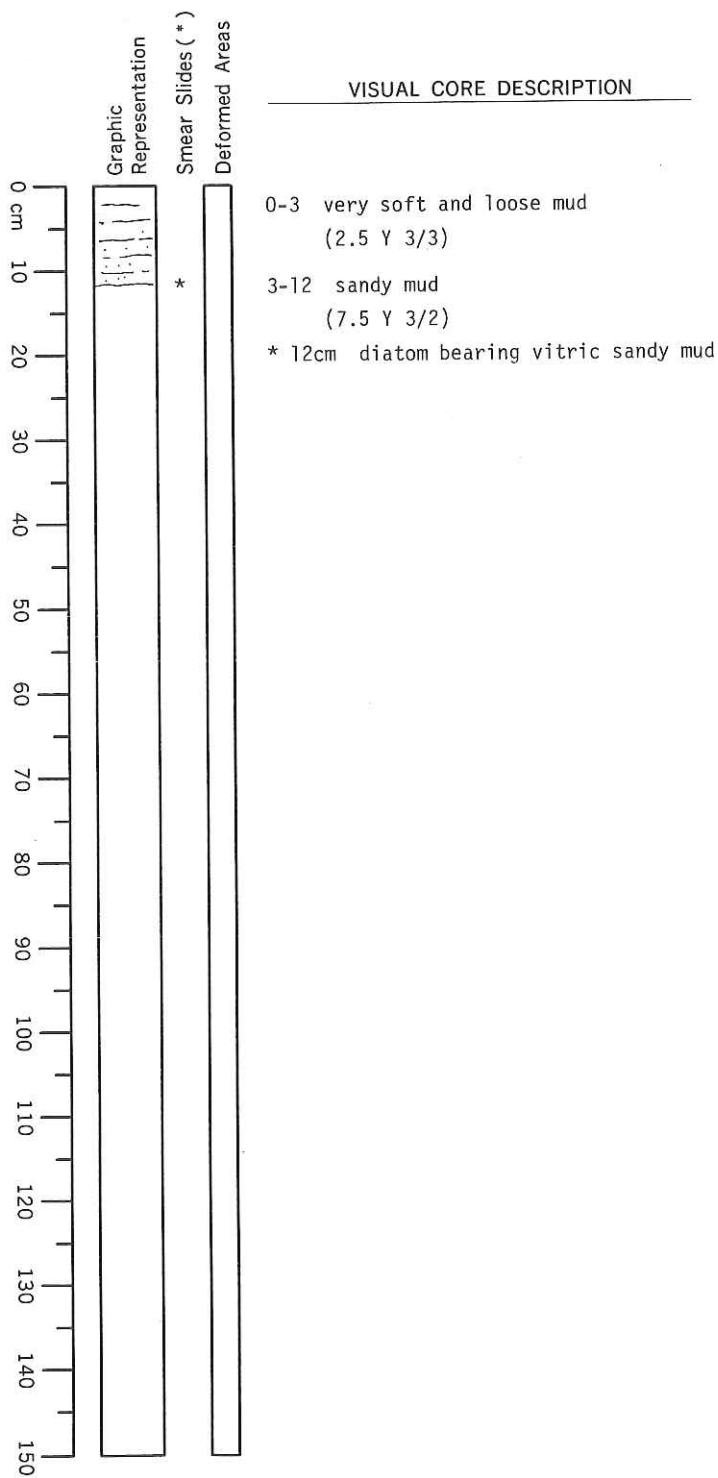


Fig. 8-2-13. Megascopic description of trigger core KH 80-3-1.



K	H	8	0	-	3
STATION		CORE			SEC
4	P	L	T		

OBSERVER

Fig. 8-2-14. Megascopic description of trigger core KH 80-3-4.

8-3. SMEAR SLIDE DESCRIPTION OF CORED SEDIMENTS

SMEAR SLIDE DESCRIPTION

	5, 300	5, 700	7, top	8, top	9, top	9, 39	9, 73	9, 84	9, 100	9, 134
Quartz.										
Feldspar							70	5		2-3
Mica										
Heavy Mins.	10	10	20	5			25	1	10	1
clay	30	30	20	30	30	65	3	45	30	10
Volc. Glass	50	50	50	40	50	20	1	45	50	85
Palagonite										
Glaucanite										
Pyrite										
Micro Nodules			1-3	5	5	10			1	
Zeolite										
Carb. Unspec.								3		
Foraminifera										
Calc. Nannos										
Diatoms	10	10	10	20	5	1			3	
Radiolarians	tr	tr	tr		tr	3			tr	
Sponge Spic.	tr	tr	tr		tr	1			5	
Silicoflag.	tr	tr	tr		tr	tr			tr	
Fish Remains										
Plant Debris										

# SMEAR SLIDE DESCRIPTION

	9, 154	9, 300	12, top	12, 100	12, 200	12, 300	12, 700	16, top	16, 25	22, top
Quartz										
Feldspar	1									tr
Mica										
Heavy Mins.	1	10	tr	5	tr	5	10	tr	tr	tr
Clay	1	30	45	60	40	60	30	30	20	50
Volc. Glass	97	60	tr	30	40	30	40	5	5	30
Palagonite										
Glaucanite										
Micro Nodules		1	10	1	10	1	10	2	1	15
Zeolite										
Carb. Unpsec.										
Foraminifera								10	30	
Calc. Nannos								50	40	
Diatoms		tr	40	3	tr	5	tr	tr	tr	1
Radiolarians		tr	2	tr	10	tr	tr	3	tr	3
Sponge Spic.		2	2	tr	2	tr	tr	tr	tr	tr
Silicoflag.		tr	tr	tr	tr	tr	tr	tr	tr	tr
Fish Remains										
Plant Debris										



SMEAR SLIDE DESCRIPTION

sampled at	22, 25	22, 50	22, 75	22, 91	22, 100	22, 106	22, 123	22, 200	22, 300	22, 383
Quartz										
Feldspar	1	tr	1	1		1				
Mica										
Heavy Mins.	1	tr	1	1		1	1			tr
Clay	60	50	60	3	65	65	3	70	60	60
Volc. Glass	10	20	10	90	5	30	85	1	20	40
Palagonite										
Glaucanite										
Pyrite										
Micro Nodules	20	30	30	5	30	5	10	30	20	3
Zeolite										
Carb. Unpsec.										
Foraminifera										
Calc. Nannos										
Diatoms	1	tr	tr	tr	tr					
Radiolarians	3	1	1		tr	1	tr			
Sponge Spic.	tr					tr				
Silicoflag.	tr	tr	tr							
Fish Remains										
Plant Debris										

# SMEAR SLIDE DESCRIPTION

	22, 400	23A, top	23B, top	24A, top	24A, 100	26, top	26, 100	27, top	27, 100
Quartz		J25	J25	J3	J2	J3	J2	J2	J1
Feldspar									
Mica									
Heavy Mins.	tr	1	2	1	1	1	1	1	1
Clay	60	50	40	70	60	60	70	63	62
Volc. Glass	20			2	4	3	20	3	7
Palagonite									
Glauconite									
Pyrite									
Micro Nodules	20	15	25	20	30	30	5	30	30
Zeolite									
Carb. Unspec.									
Foraminifera									
Calc. Nannos									
Diatoms		1	1					tr	
Radiolarians		7	5	1		1		1	
Sponge Spic.		tr	1	1		1			
Silicoflag.		tr	tr						
Fish Remains									
Plant Debris									

# SMEAR SLIDE DESCRIPTION

	28A, top	28A, 100	288, top	29, top	29, 100	30, top	30, 100
Quartz	J-2	J-1	J-1	J-2	J-1	J-1	J-1
Feldspar							
Mica							
Heavy Mins.	1	1	1	1			
Clay	65	60	82	60	51	77	68
Volc. Glass	1	7	1	1	8	1	1
Palagonite							
Glaucconite							
Pyrite							
Micro Nodules	25	30	10	30	40	15	30
Zeolite							
Carb. Unspec.							
Foraminifera							
Calc. Nannos							
Diatoms	1		1	1		1	
Radiolarians	5		3	5		5	
Sponge Spic.	1		1	1		1	
Silicoflag.	tr			tr			
Fish Remains							
Plant Debris							

#### 8-4. PALEONTOLOGICAL STUDY OF DEEP SEA SEDIMENTS

In this preliminary report, we represent the state of occurrence of microfossils in the sediments obtained during the Hakuho Maru Cruise KH 80-3, and assign the age of the cored materials by biostratigraphic analyses on foraminifers, calcareous nannofossils, radiolarians, distoms, and silicoflagellates.

##### 1. OCCURRENCE OF MICROFOSSILS

T. SAKAI, Y. TANIMURA, H. KOBAYASHI,  
and I. YOKOKAWA

The relative abundance and preservational state of microfossils were obtained by investigation of the smear slides and the washed samples with 63 $\mu$ m mesh screen.

Station 1: Pilot corer, diatomaceous mud.

Siliceous fossils are abundant and well-preserved.

Calcareous fossils are absent.

Station 2B: Pipe dredger, diatomaceous ooze.

Siliceous fossils are abundant and very-well-preserved.

Calcareous fossils are abundant and moderately preserved.

Station 3: Pipe dredger, diatomaceous ooze.

Siliceous fossils are abundant and very-well-preserved.

Calcareous fossils are abundant and moderately preserved.

(Diatomaceous mudstone brocks were obtained together with the soft sediments, but they are not examined yet.)

Station 4: Pilot corer, vitric mud.

Diatoms and silicoflagellates are abundant and well-preserved.

Radiolarians are common and well-preserved.

Calcareous fossils are absent.

Station 5: Piston corer, diatomaceous vitric mud.

Siliceous fossils are common and moderate or well-preserved.

Calcareous fossils are absent.

Station 7: Dredgre, diatomaceous vitric mud.

Siliceous fossils are common and moderately preserved.

Calcareous fossils are absent.

(Only 10 cc sediments were obtained at this station.)

Station 8: Dredger, diatomaceous vitric mud.

Siliceous fossils are common and moderately preserved.

Calcareous fossils are absent.

Station 9: Piston corer, vitric clay-vitric mud.

Siliceous fossils are rare to common and poorly to moderately preserved.

Calcareous fossils are absent.

(Detail is shown in the following section of this chapter.)

Station 10: Pilot corer, vitric clay.

Siliceous fossils are common and moderately preserved.

Calcareous fossils are absent.

Station 11: Pilot corer, diatomaceous vitric clay.

Siliceous fossils are common and moderately preserved.

Calcareous fossils are absent.

Station 12: Piston corer, diatomaceous vitric clay-diatomaceous clay.

Siliceous fossils are common to abundant, and the preservation is poor to moderate about diatoms and silicoflagellates and moderate to good about radiolarians.

Calcareous fossils are absent.

(Detail is shown in the following section of this chapter.)

Station 14: Box corer, foraminiferal nanno ooze.

Siliceous fossils are common and moderately preserved at about 10 cm of the top, and few to rare and poorly preserved below there.

Calcareous fossils are abundant and moderately preserved throughout the core.

Station 16: Box corer, foraminiferal nanno ooze.

Siliceous fossils are common and moderately preserved at about 10 cm of the top, and few to rare and poorly preserved below there.

Calcareous fossils are abundant and well-preserved throughout the core.

Station 18: Piston corer, foraminiferal nanno ooze.

Siliceous fossils are few to common and poorly to moderately preserved.

Diatoms and silicoflagellates were not obtained from the horizon below 400 cm.

Calcareous fossils are abundant and well-preserved.

(Detail is shown in the following section of this chapter.)

Station 19A and 19B: Dredger, foraminiferal nanno ooze.

Both siliceous and calcareous fossils are common and moderately to poorly preserved.

(The samples of sedimentary rocks are not examined yet.)

Station 20: Box corer, foraminiferal nanno ooze.

Siliceous fossils are few to common and moderately to poorly preserved.

Calcareous fossils are abundant and moderate- to well-preserved.

Station 21: Box corer, foraminiferal nanno ooze.

Siliceous fossils are few to common and moderately to poorly preserved.

Calcareous fossils are abundant and moderate- to well-preserved.

Station 22: Piston corer, "brown clay".

Siliceous fossils are rare and poorly preserved except the top of the core where they are common and moderately preserved.

At the horizon below 1 m diatoms and silicoflagellates are absent and below 3m radiolarians also become absent.

Calcareous fossils are absent throughout the core.

(Detail is shown in the following section of this chapter.)

Station 23A and 23B: Dredger, "brown clay".

Siliceous fossils are common and moderately preserved.

Calcareous fossils are absent.

Station 24A: Piston corer, "brown clay".

Calcareous fossils and silicoflagellates are absent.

Radiolarians and diatoms present only the top of the core.

(See the following section of this chapter.)

Station 24B: Pipe dredger, "brown clay".

(The materials of this station are not examined yet.)

Stations 25A, 25B, and 25C.

(The materials of this station are not examined yet.)

Station 26: Piston corer, "brown clay".

Only radiolarians were obtained from the top of the core.

The other fossils are absent throughout the core.

(See the following section of this chapter.)

Station 27: Piston corer, "brown clay".

Siliceous fossils are present only at the top of the core.

Calcareous fossils are absent throughout the core.

(See the following section of this chapter.)

Station 28A: Piston corer, "brown clay".

Siliceous fossils are present only at the top of the core.

Calcareous fossils are absent throughout the core.

(See the following section of this chapter.)

Station 28B: Pipe dredger, "brown clay".

(The materials of this station are not examined yet.)

Station 29: Piston corer, "brown clay".

Siliceous fossils are present only at the top of the core.

Calcareous fossils are absent throughout the core.

(See the following section of this chapter.)

Station 30: Piston corer, "brown clay".

Calcareous fossils and silicofragellates are absent throughout the core.

Radiolarians and diatoms are present only at the top.

(See the following section of this chapter.)

Station 31A and 31B: Dredger, foraminiferal ooze.

Foraminifers are abundant and well-preserved.

The other fossils are not examined yet.

Station 32: Dredger, foraminifers bearing sand and rocks.

Well-preserved foraminifers are common in the sand.

Discoaster brouweri Tan Sin Hok, Discoaster triradiatus Tan Sin Hok, and Cyclcoccolithus macintyreii Bukry and Bramlette of calcareous nanno-fossils were obtained from a soft rock sample.

Station 33: Dredger, calcareous sandy mud and rocks.

Abundant and well-preserved microfossils were obtained from the mud and a piece of the soft rock sample. The composition of each fossil group is not represented.

Station 34: Dredger, calcareous muddy sand and rocks.

Abundant and well-preserved calcareous fossils were obtained from the muddy sand.

Discoaster pentaradiatus Tan Sin Hok, D. brouweri, D. triradiatus, and C. macintyreii were found in the sediments.

Station 35: Dredger, calcareous sand.

The sediments are mainly composed of foraminifers, bryozoans, and granule sized molluscan shell fragments.

Station 36: Dredger, calcareous sand.

Foraminifers and sand sized fragments of molluscan shells are contained

commonly.

Station 40: Dredger, calcareous sand.

Foraminifers and sand sized fragments of molluscan shells are contained abundantly.

Station 41: Dredger, foraminiferal sand.

Foraminiferas are very abundant and well-preserved.

Station 43: Dredger,

From a soft rock sample, Discoaster variabilis Martini and Bramlette, D. brouwri, D. pentaradiatus, and C. macintyreii were obtained.

## 2. MICROPALaeONTOLOGICAL STUDIES OF CORED MATERIALS

Eleven cores taken with the piston corer during the KH 80-3 Cruise (TABLE 1) were examined on foraminifers, calcareous nannofossils, radiolarians, diatoms, and silicoflagellates. We report principally the stratigraphic distribution of the species which are useful for age assignment.

TABLE 1. Coordinates of the cores.

Core	Lat. (N)	Long. (E)	Water depth(m)	Length(cm)
KH 80-3-5	38°08.7'	144°50.0'	5550	991.5
-9	35°22.6'	143°54.1'	5720	747
-12	34°08.4'	146°34.2'	5820	1004
-18	32°44.9'	158°17.6'	2640	1048
-22	31°16.2'	153°42.9'	5750	1069
-24A	13°55.3'	148°37.9'	5800	1061
-26	12°47.0'	148°27.5'	5940	1118
-27	12°42.1'	148°34.4'	5930	1034
-28A	11°03.3'	151°34.6'	5800	1050
-29	9°59.0'	153°00.2'	5520	1039
-30	9°50.6'	153°13.5'	5480	1007



# 1). Preparation and analysis

## a). Planktonic foraminifers

M. ODA

### MATERIALS AND TETHODS

The core of St. 18 (KH 80-3) at the Shatsky Rise Crest was examined. Eleven small cored sediments were sampled with a tube of 3cm diamater about at 50cm intervals. All the samples were disaggregated by soaking in water, wet-sieved on a 250-mesh (opening at 0.063mm) screen dried in oven. Before picking foraminifers, each sample was dry-sieved through a 80-mesh (opening at 0.177mm) screen, and the coarser fraction was used for foraminiferal analysis. 200-odd specimens of planktonic foraminifers were picked up from an aliquot part.

### RESULTS AND DISCUSSION

Planktonic foraminifers occur abundantly throughout the core. Preservation of planktonic foraminiferal tests is moderately good except for some samples where dissolution is noticed.

Globorotalia inflata (d'Orbigny) and Neogloboquadrina dutertrei-incompta group are the most abundant nearly throughout the section. Globigerina bulloides d'Orbigny, Globigerinita glutinata (Egger), Globigerinoides ruber (d'Orbigny), Globorotalia truncatulinoides (d'Orbigny) and Orbulina universa d'Orbigny occur less dominantly in the most of samples. Globigerina digitata Brady, G. falconensis Blow, Globigerinella aequilateralis (Brady), Globigerinoides conglobatus (Brady), G. sacculifer (Brady), and Globorotalia tumida (Brady) occur sporadically. Globorotalia crassaformis (Galloway and Wissler) was commonly found at the lower part of the core and Globorotalia hirsuta (d'Orbigny) at the upper part. Sinistrally coiled specimens of Neogloboquadrina pachyderma (Ehrenberg), arctic to subarctic species, occur sporadically.

Globorotalia tosaensis Takayanagi and Saito co-exists with Globorotalia truncatulinoides at the lower section and is found of its last occurrence at sample 394-397cm. Thompson and Sciarrillo (1978) proposed the extinction datum of Globorotalia tosaensis within the basal part of the Brunhes Normal

Epoch (0.59 Ma) based on the examination of eight deep sea cores from the equatorial Pacific.

Pulleniatina obliquiloculata (Parker and Jones) occurs sporadically throughout the section. All the specimens of this species are dextrally coiled. According to Hays et al.(1969), Saito et al.(1975), Saito (1976, 1977), Thompson and Sciarrillo (1978) and Takayanagi et al.(1979), the coiling direction of Pulleniatina has changed several times, and the Pulleniatina obliquiloculata datum, which is defined by the first appearance of a completely dextral coiling population of P. obliquiloculata, is situated just below the Matuyama Reversed Epoch/the Brunhes Normal Epoch boundary (Takayanagi et al.1979). Thus, a couple of data, the extinction of G. tosaensis in the lower part of the core and the rare but significant occurrence of all dextrally coiled P. obliquiloculata throughout the core, suggest that the whole section of this core approximately corresponds to the interval above the Pulleniatina obliquiloculata datum.

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## b). Calcareous nannofossils

T. TAKAYAMA

### MATERIALS AND METHODS

Only one core (KH 80-3, st. 18) was examined on calcareous nannofossils. Eleven samples were taken from the same horizons of those for foraminiferal analysis (preceding segment).

A very small quantity of the sample was placed in a small glass. Water was added until a depth of 3-4 cm. The glass was placed in a ultrasonic equipment for disaggregating the sediments. After settling of the heavier particulates, a few drops were sucked from the upper layer of the suspension and settled out on a microscopic cover glass (18mm × 18mm). It was dried on an electronic hot-plate gently. Then Entellan-new (mounting media) was spread over it, and a deck glass (76mm × 26mm) was pressed on it. Examination was done under a binocular polarizing microscope at 1500 magnification.

### RESULTS

Abundant and well-preserved calcareous nannofossils were obtained throughout the core. A few specimens reworked from the older deposits were found in almost of the samples. Gephyrocapsa oceanica Kamptner and G. caribbeanica Boudreaux and Hay occur successively from the top to the bottom. Ceratolithus cristatus Kamptner was found in the upper half of the core. Pseudoemiliana lacunosa (Kamptner) Gartner disappears at 343cm. This report does not represent the occurrence of Emiliana huxleyi (Lohmann) Hay, because that the examination with electronic microscopy is not done yet.

## c). Radiolarians

T. SAKAI

### METHODS

The sampled sediments were disaggregated by boiling in a solution of sodium hexametaphosphate and hydrogen peroxide for about 30 minutes. Then they were wet-sieved through 63µm mesh screen and remaining coarse fraction dried. A dried sample was strewn on a glass slide (76mm × 27mm) which had been

thinly painted with a solution of gum tragacanth nearly the same width as that of a cover glass (36mm × 24mm), and the gum moistened with aqueous vapor to fix the radiolarians on the slide. When the gum was dry, the radiolarians were removed by turning the slide over and patting it gently. Next a drop of xylene and 0.5 to 0.6 ml of Enteran-new were put on the slide and then sealed with a cover glass. One to four slides were prepared from each sample to investigate 2000 or more specimens for one sample.

Although more than 200 radiolarian species were recognized through the investigation, this report discussed only those of biostratigraphic importance. They are:

Buccinosphaera invaginata Haeckel  
Collosphaera tuberosa Haeckel  
Sphaeropyle robusta Kling  
Axoprunum angelinum (Campbell and Clark)  
Stylocentron aciculatum (Hays)  
Spongodiscus sp. (of Sakai, 1980)  
Eucyrtidium matuyamai Hays  
Lychnocanoma sp. (of Sakai, 1980)  
Pterocanium prismatium Riedel  
Anthocyrtidium angulare Nigrini  
Lamprocyrtis haysi Kling  
L. neoheteroporos Kling  
L. heteroporos (Hays)  
Theocorythium trachelium (Ehrenberg) s.str.  
T. vetulum Nigrini

The stratigraphic position of the upper and/or lower limit of the species mentioned above is shown in Fig. 8-4-5.

## RESULTS AND DISCUSSION

The results of the observation are summarized in following lines and Fig. 8-4-2. The total abundance and the state of preservation of the radiolarians are indicated as follow: A, abundant; C, common; F, few; R, rare; B, absent; G, good; M, moderate; and P, poor (Sakai, 1980).

### Station 5

Abundant and good-preserved radiolarians were recovered throughout the

core of this station. In this core, the lowermost occurrence of B. invaginata lie at 480cm from the top, and the uppermost occurrence of Lychnocanoma sp. and Spongodiscus sp. are at 50cm and 705cm respectively. C. tuberosa, L. haysi, and T. trachelium are present through the core. The other selected species are absent. The sporadical occurrence of B. invaginata might be an influence of the location of the core which lie at rather north than the area of its distribution.

#### Station 9

B. invaginata, C. tuberosa, Lychnocanoma sp., L. haysi, and T. trachelium were found, and any other selected species was not detected in this core. The lowermost occurrence of B. invaginata is at 251cm. The uppermost occurrence of Lychnocanoma sp., and Spongodiscus sp. are at 100cm and 271cm respectively. The lowermost occurrence of B. invaginata is regarded here as the first appearance of it, although a few doubt arises from the preservation at the lower part of the core (270-357cm) being rather poor than the upper.

#### Station 12

Abundant and good- to moderate-preserved radiolarians were recovered throughout the core. The following paleontological events were observed:

Last occurrence of Lychnocanoma sp. at 200cm from the top.

First occurrence of B. invaginata at 300cm

Last occurrence of Spongodiscus sp. at 470cm.

Last occurrence of S. acquilonium at 600cm.

First occurrence of C. tuberosa at 680cm.

Last occurrence of A. angelinum at 700cm.

The lowermost sample (at 1001-1004cm) contains L. haysi, L. neoheteroporos, and T. trachelium, and lacks S. robusta, E. matuyamai, P. prismatium, A. angulare, T. heteroporos, and T. vetulum. Thus the bottom of the core is judged higher stratigraphically than the horizon of E. matuyamai being extinct.

#### Station 18

Radiolarians were commonly obtained from the core, and the state of the preservation was moderate to poor, except the uppermost part where they were abundant and good-preserved. B. invaginata was found from the uppermost sample (0-2cm) only. The occurrence of C. tuberosa was sporadical but limited within the interval from the top to 310cm horizon. Lychnocanoma sp., Spongodiscus sp., and S. acquilonium were found with their upper limits at

50cm, 150cm, and 250cm respectively. The uppermost occurrence of A. angelinum was found at 340cm. The successional order of the evens, except the lowermost occurrence of B. invaginata, shows a good correspondence with that of the station 12. The poor state of preservation might be the reason that B. invaginata was not found from any other sample than that of top.

#### Station 22

Radiolarians are abundant and good-preserved at the uppermost part of the core, and abundant to common and moderate-preserved at the upper part (30cm-50cm). Below there, they decrease in number and go poor in preservation toward the lower part rapidly, and then they disappear at 250cm. B. invaginata occurs at the top and 70cm. The lowermost occurrence of C. tuberosa is at 95cm. Lychnocanoma sp. and Spongodiscus sp. are found only at 110cm and 150cm respectively. The uppermost occurrence of S. acqulonium and A. angelinum are at 165cm and at 185cm respectively. The base of the core could not be assigned in biochronology for the absence of the radiolarians.

#### Station 24A

Only one sample from the top of the core contains the radiolarians. They are common and moderately preserved. The radiolarian assemblage mostly consists of the Quaternary species, and contains the Cretaceous and Paleogene, reworked, species such as Amphipyndax stocki (Campbell and Clark), Dictyomitra doudecimcostata (Squinabol), Podocyrtis papalis (Ehrenberg), Thyrsoyrtis hirusuta (Krashennikov), Thyrsoyrtis triacantha (Ehrenberg), and Tristylopyris tricerus (Ehrenberg). The assemblage lacks S. acqulonium, A. angelinum, and other selected species which are extinct in Pleistocene. It thus appears that the age of the core-top is the latest Pleistocene or Holocene.

#### Station 26 and 27

Common and good-preserved radiolarians were obtained only from the top of the both cores. C. tuberosa was found and S. acqulonium and A. angelinum was absent at the top. Cretaceous radiolarians, Amphipyndax enesseffi Foreman (from St. 26) and Arthostrobium urna Foreman (from St. 27) occurred also at the top of the cores.

#### Station 28A

Few but well-preserved radiolarians were obtained from the top of the core. C. tuberosa is contained and both S. acqulonium and A. angelinum is absent in the top. The interval of 30cm-130cm contains a few radiolarian specimen,

but lacks any species useful for age assignment. The radiolarians are absent in the samples from 150cm to the bottom. Ethmodiscus (diatoms) occurs abundantly from the sample of the top.

#### Stations 29 and 30

The top of the both cores contain abundant and very-well-preserved radiolarians and very abundant Ethmodiscus (diatoms). At about 30cm the radiolarians are rare and poor, at about 50cm, very few and very poor, and at 80cm and below they are completely absent. From the core-top of the Station 30 B. invaginata and C. tuberosa were obtained, and from that of the Station 29 C. tuberosa was found. S. acquilonium and A. angelinum were not found from these two cores.

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#### d). Diatoms

Y. TANIMURA

In order to detect the state of preservation in cores and to carry out biostratigraphic correlation, examined were the diatom remains in the pieces of the core (about 2cm in thickness), taken at about 10-100cm interval.

#### METHODS AND PROCEDURES

A cleaning and preparation of slide were done as follows:

- 1) Dried sediment sample weighing 0.2-0.5g was placed in a 100ml beaker with a boiled solution of hydrogen peroxide ( $H_2O_2$ , 15%) for the oxidation of organic matters in sample.
- 2) After boiling for about 10 min the beaker was filled with water, and kept at room temperature for about 10 min.
- 3) For the slide preparation, one to three drops of the residue were placed on 18 × 18mm cover glass. After drying, it was mounted on a slide with Pleurax.

In this study, prepared slides were examined under the microscope at

10 × 40 magnification using higher magnification, and 10 × 100 magnification with oil immersion objective lens of 100 ×, when needed. Slide were examined in one of two ways: 1) Through scanning at least half area of each slide, checked is the presence or absence of marker taxa, such as recognized in both the Northwest Pacific diatom zonation of Koizumi (1977) and the tropical Pacific of Burkle and Opdyke (1977), although the tropical taxa are usually less abundant than the boreal taxa; and 2) Examination was done on the occurrence of the selected marker species in each sample by a whole area observation at the 10 × 40 magnification. The marker species selected in this report are:

Actinocyclus ochotensis Jousé

Denticulopsis seminae (Simonsen and Kanaya) Simonsen

Pseudoeunotia doliolus (Wall.) Grunow

Rhizosolenia curvirostris Jousé

The taxonomic discussion on those taxa may be found in Kolbe (1954), Simonsen and Kanaya (1961), Donahue (1970) and Simonsen (1979).

#### PRESERVATIONAL STATE OF DIATOM VALVES AND THE LAST OCCURRENCE OF RHIZOSOLENIA CURVIROSTRIS

The results of microscopic observation are summarized in the following lines and Fig. 8-4-3.

The preservational state of the valves in each sample are classified into four grades, and expressed as excellent, good, fair and poor as shown in the figure. I found excellent-to good-preserved diatoms from the upper part of the core KH 80-3-5. The preservation of valves were fair to poor throughout the cores KH 80-3-9 and -12 and the upper or uppermost part of the cores KH 80-3-18, -22, -24A, -26, -27, -28A, -29 and -30.

In the figure, the presence of the selected marker taxa recognized by the half areal scanning is shown by the solid circle (●), and the presence or absence of those taxa ascertained by a whole areal observation are indicated by the open circle (○) and the cross (×) respectively. It is clear from the figure that only the last occurrence of Rhizosolenia curvirostris (TABLE 2) shown by the large arrow (➡) with letter symbol R. c. in the figure, is a useful clue for correlation among some cores.



TABLE 2. The horizon of the last occurrence of Rhizosolenia curvirostris in the cores.

Core	Subbottom depth
KH 80-3-5	759 - 771 cm
KH 80-3-12	479 - 492 cm

The correlation of the cores KH 80-3-5 and -12, based on the last occurrence of *R. curvirostris*, are indicated by dashed line in the figure. Other cores, KH 80-3-9, -18, -22, -24A, -26, -27, -28A, -29 and -30, could not be correlated for absence of diagnostic species or badly preserved diatom remains in the samples from those cores.

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## e). Silicoflagellates

H. KOBAYASHI

The preliminary study of silicoflagellates in deep-sea sediments was examined for four cores collected from the Stations 5, 9, 12 and 18 at the Northwestern Pacific (TABLE 1). The aims of this study on board was mainly to know the sedimentation rates or geologic ages.

### METHODS OF STUDY

1) A sample of sediment was treated with boiling hydrogen peroxide ( $H_2O_2$ , 15%) in a 200 ml beaker to remove the organic matter. In St. 18 core samples, hydrochloric acid (HCl, 3%) was used instead of hydrogen peroxide.

2) After boiling for about 10 min., samples was diluted with distilled water, and ultrasonic procedure was done for 10 sec.

3) Five hr. later, the top of the solution was drained and filled with distilled water again. This procedire was repeated two or three times.

4) A few drops of the residue were placed on a 24 × 40 mm cover glass. After drying on a hot plate, it was mounted on a slide glass with Canada balsam.

For the silicoflagellate study, samples taken at about 10-100cm intervals in cores 5, 9, 12 and 18, were examined. Each sample represents the sediments of 2cm in thickness. Light microscope techniques were used in this study. The slides were examined under a microscope at 10 × 10 magneification, and at 10 × 40 magnification when needed.

The established marker species, used in the study, are:

Dictyocha mandrai Ling

Dictyocha messanensis Haeckel

Distephanus octangulatus Wailes

Distephanus octonarius Deflandre

The taxonomic discussion of these taxa are found in Ling (1970, 1972) and Loeblich et al.(1968).

### PRESERVATION

The preservational state of the skeleton of silicoflagellates are indicated as: G, good; M, moderate; P, poor; and B, barren in Fig. 8-4-4. Good to

moderate preserved specimens are found in the upper part of the St. 5 core. Poor in the lower part of this core, and in the other three cores except for the top (Fig. 8-4-4).

#### THE LAST OCCURRENCE OF DISTEPHANUS OCTONARIUS

The presence or absence of the established marker species are shown by the solid circle (●) and the cross (×) respectively (Fig. 1). Only in St. 5 core, which was collected from the most northern part of the Northwest Pacific in this cruise, the last occurrence of this species was defined. The large arrow (↗) with letter symbol D.o. in Fig. 8-4-4 indicates the top of this species.

The horizon of the last occurrence of *Distephanus octonarius* in St. 5 core is: 599-622 cm

But in the other three cores, this species could not be found because of the influence of the Kuroshio Current than the Oyashio Current.

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Amer., 106, 1-319.

## 2). Age assignment and rate of sedimentation

T. SAKAI, Y. TANIMURA, H. KOBAYASHI,  
T. TAKAYAMA, and M. ODA

Many paleontologic events, which were represented by first occurrence, last occurrence, change in coiling direction, or acme of a taxon, were previously reported. From them, we selected out the chronostratigraphically useful events which occurred in the last two million years (Fig. 8-4-5). In the examined cores in this study, the following events were noticed:

- First occurrence of B. invaginata (Radiolaria)
- Last occurrence of R. curvirostris (diatom)
- Last occurrence of D. octonarius (Silicoflagellata)
- Last occurrence of S. acquilonium (Radiolaria)
- Last occurrence of A. angelinum (Radiolaria)
- Last occurrence of P. lacunosa (calc. nannofossil)
- First occurrence of C. tuberosa (Radiolaria)
- Last occurrence of G. tosaensis (Foraminifera)

All they are found in the late Pleistocene age.

Both the first occurrence of C. tuberosa and the last occurrence of P. lacunosa were reported to be nearly the same in the horizon with the last occurrence of A. angelinum, and the first occurrence of B. invaginata was shown near at a half way from the top of the cores to the last occurrence of A. angelinum (Takayanagi et al., 1979, etc.). One of the authors (T. Sakai) here estimate that the first occurrence of B. invaginata is about 0.2 Ma in age, according that the last occurrence of A. angelinum is dated 0.4 Ma (Hays and Shackleton, 1976). The relation of the events mentioned above were obtained although in the equatorial Pacific, the same relation was found out in the cores of Stations 12, 18, and 22 which are place in the north western Pacific. Therefore we thought that the estimation of the age was reasonable, and asked the rate of sedimentation at each station based on these dates. In the calculation the top of the cores were supposed to be zero in age.

In each core the paleontological events were found at the following

subbottom depth. The number shown in the parentheses represents the depth of the examined sample just above or below the horizon where the event was found to note the accuracy of the sampling interval.

#### Station 5

First occurrence of B. invaginata, 480 cm (490).

Last occurrence of D. octonaris, 622 cm (599).

Last occurrence of R. curvirostris, 771 cm (759).

C. tuberosa occurs throughout the core. S. acquilonium, A. angelium and the other species which disappear before C. tuberosa appears are absent. Thus the core is assigned to the late Brunhes Epoch — that is the latest Pleistocene and Holocene in age. The rate of sedimentation is estimated to be 24 to 25 mm/1000yrs.

#### Station 9

First occurrence of B. invaginata, 251 cm (271).

The preservation of the fossils in the sediments below 270 cm horizon was rather than that above 250 cm. Therefore the lowermost occurrence of B. invaginata, of which shell is delicate and easy to be fragmented and resolved, might represent the younger age than that of the first appearance of this species. C. tuberosa occurs through the core, and D. octonarius and any selected species which disappears before its extinction are absent. Thus the age of the core is assigned to the Latest Pleistocene and Holocene. The estimated rate of sedimentation is 13 mm/1000yrs, or more.

#### Station 12

First occurrence of B. invaginata, 300 cm (310).

Last occurrence of R. curvirostris, 492 cm (479).

Last occurrence of S. acquilonium, 600 cm (561).

First occurrence of C. tuberosa, 680 cm (688).

Last occurrence of A. angelinum, 700cm (688).

D. octonarius was found only from one sample at 850 cm below the core-top. The estimated rate of the sedimentation is 15-18 cm/1000yrs., and the bottom of the core is about 0.6 Ma under the assumption of the constant sedimentation rate through the core. The core is the late Pleistocene to Holocene in age.

#### Station 18

Last occurrence of S. acquilonium, 250 cm (200).

First occurrence of C. tuberosa, 310 cm (340).

Last occurrence of A. angelinum, 340 cm (310).

Last occurrence of P. lacunosa, 343 cm (296).

Last occurrence of G. tosaensis, 393 cm (346).

B. invaginata was found only in the sample at the top of the core. R. curvirostris was only found at 430 cm. Any specimen of D. curvirostris could not be obtained. The estimated rate of sedimentation is 8-9cm/1000yrs, and the oldest age of the core (at 546 cm) is assigned to about 0.7 Ma under the assumption of the constant rate through the core. The core is the late Pleistocene to Holocene in age.

#### Station 22

First occurrence of C. tuberosa, 150 cm (165).

Last occurrence of S. acqilonium, 165 cm (150).

Last occurrence of A. angelinum, 185 cm (165).

In this core the preservation of the microfossils is very poor, but the last occurrence of A. angelinum is reasonably represented the extinction level of the species. Thus the rate of sedimentation was estimated to be 4.1-4.6 mm/1000yrs. Although the age of the core-bottom (550cm) was calculated to be 1.3-1.2 Ma under the assumption of the constant rate, we regarded for the bottom to be older than that calculated because that the compaction of the sediments was advanced in the lower part of the core. This core may be assigned to Pleistocene through Holocene in age.

#### Station 24A, 26, 27, 28A, 29, and 30

Except the uppermost parts, the microfossils examined in this report could not be obtained from the cores of these six stations. Thus the most parts of the core (from 25 cm to the bottom of the core) could not be assigned in age, biostratigraphically. The top of the cores from Stations 26, 27, 28A, 29, and 30 are assigned to the latest Pleistocene or the Holocene in age based on the occurrence of C. tuberosa. The top of the station 24A is also assigned to the latest Pleistocene or the Holocene in age, judging from the existence of the Quaternary radiolarians and the lack of both S. acqilonium and A. angelinum. The rate of sedimentation of these six cores were not estimated.

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TABLE 3. Rate of sedimentation estimated on paleontologic events,  
at the five stations of Northwest Pacific.

Station	L o c a t i o n		Rate of Sedimentation (mm/1000yrs)
	Latitude	Longitude	
KH 80-3-5	38°08.7'N	144°45.0'E	24 - 25
-9	35°22.6'N	143°54.1'E	13 - more
-12	34°08.4'N	146°34.2'E	15 - 18
-18	32°44.9'N	158°17.6'E	8 - 9
-22	31°16.2'N	153°42.9'E	4 - 5

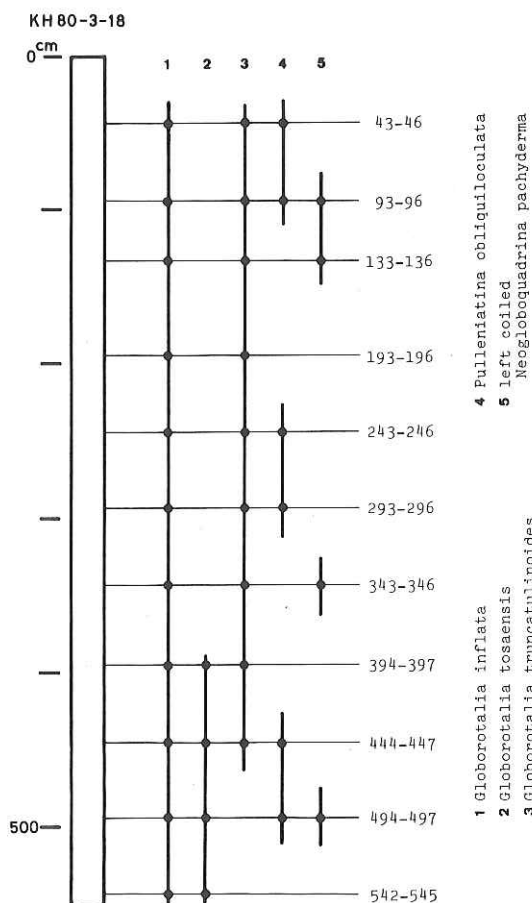


Fig. 8-4-1. Stratigraphic distribution of selected foraminiferal species.

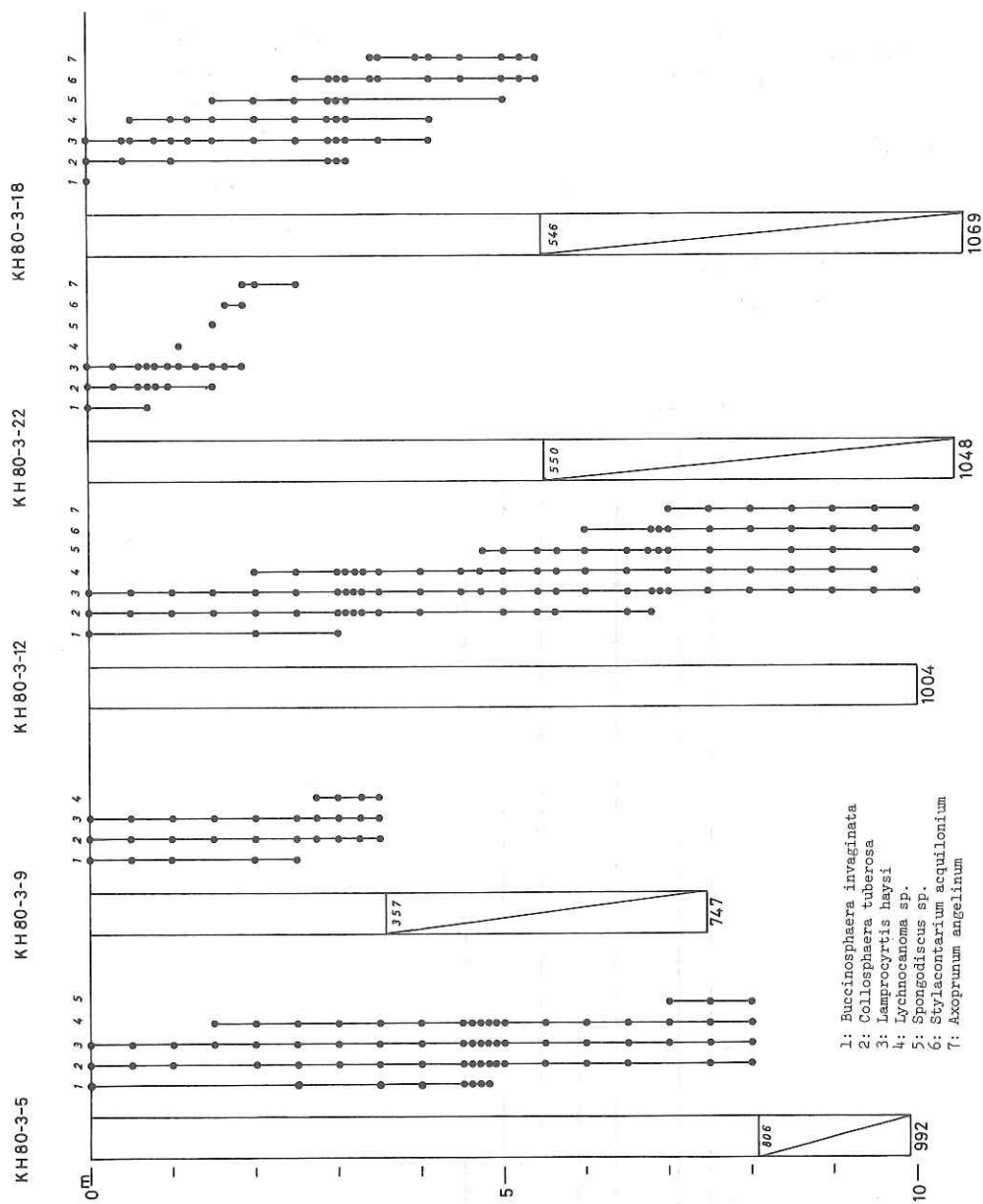


Fig. 8-4-2. Stratigraphic distribution of selected radiolarian species.



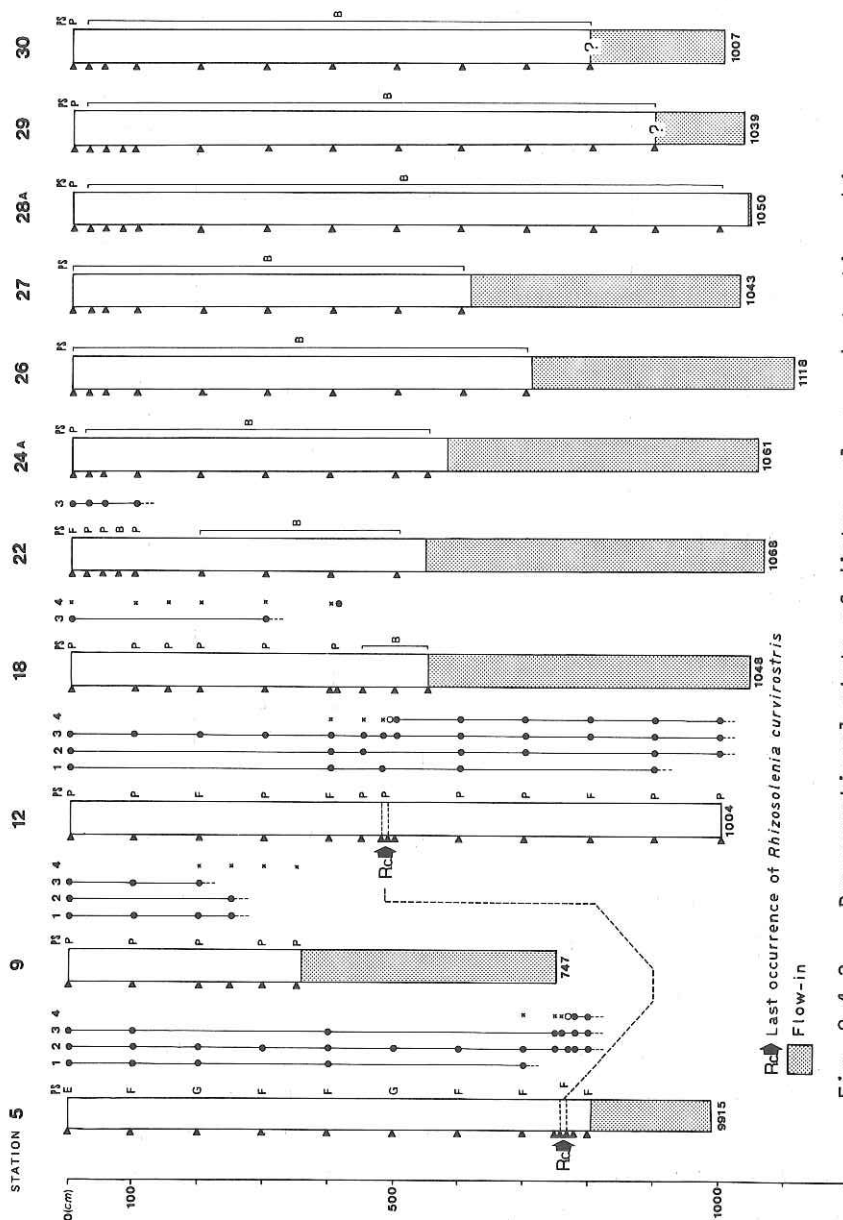


Fig. 8-4-3. Preservation state of diatom valves and stratigraphic distribution of selected diatom species. PS: Preservation state (E: excellent, G: good, F: fair, P: poor, B: barren), (▲): Position of sample, 1: *Actinocyclus ochotensis*, 2: *Denticulopsis seminae*, 3: *Pseudoenotia doliolus*, 4: *Rhizosolenia curvirostris*.

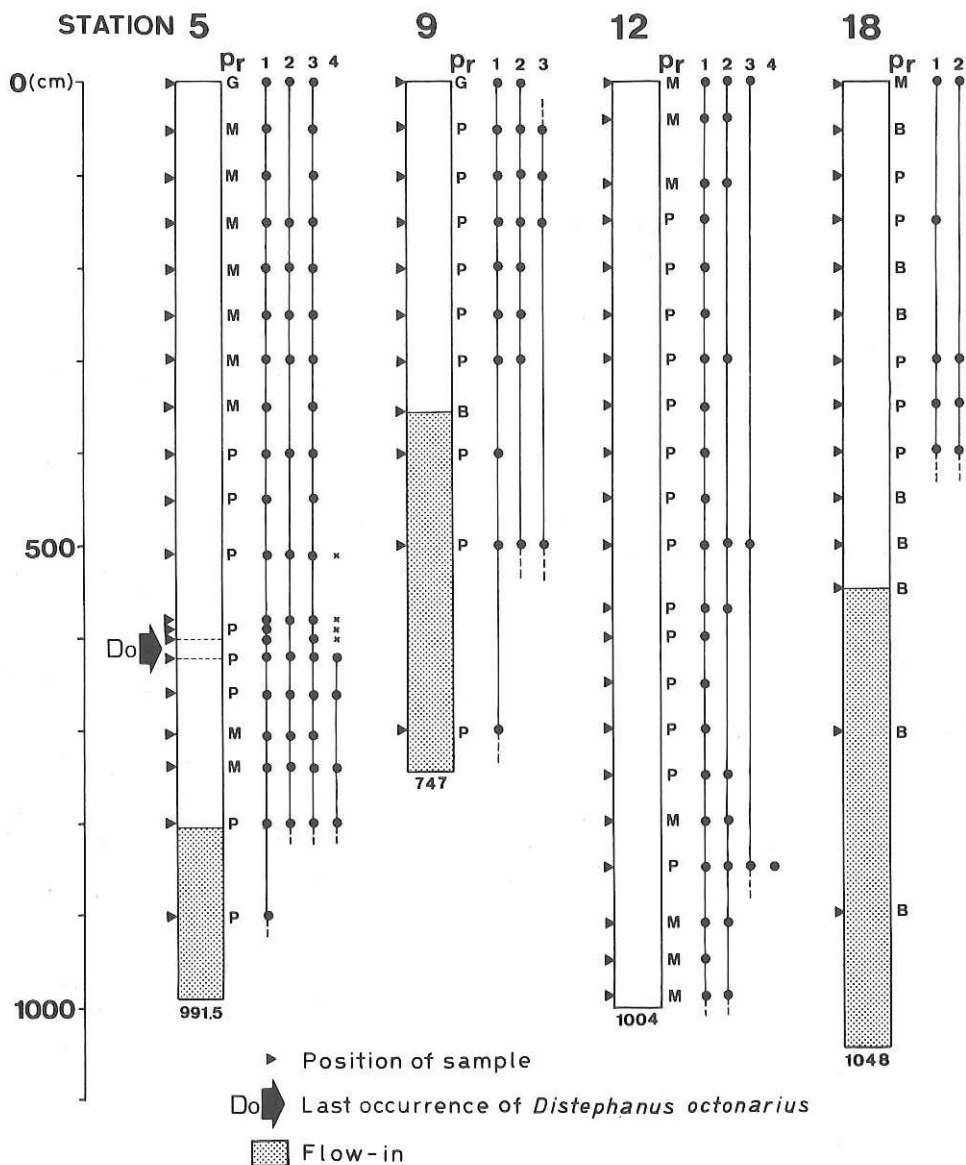


Fig. 8-4-4. Stratigraphic distribution of selected silicoflagellate species and preservational state of silicoflagellate skeletons. Pr: Preservational state (G: good, M: moderate, P: poor, B: barren), Do: last occurrence of *Distephanus octonarius*. [Shaded Box]: flow-in.  
 1: *Dictyocha mandrai*, 2: *Dictyocha messanensis*, 3: *Distephanus octangulatus*, 4: *Distephanus octonarius*.

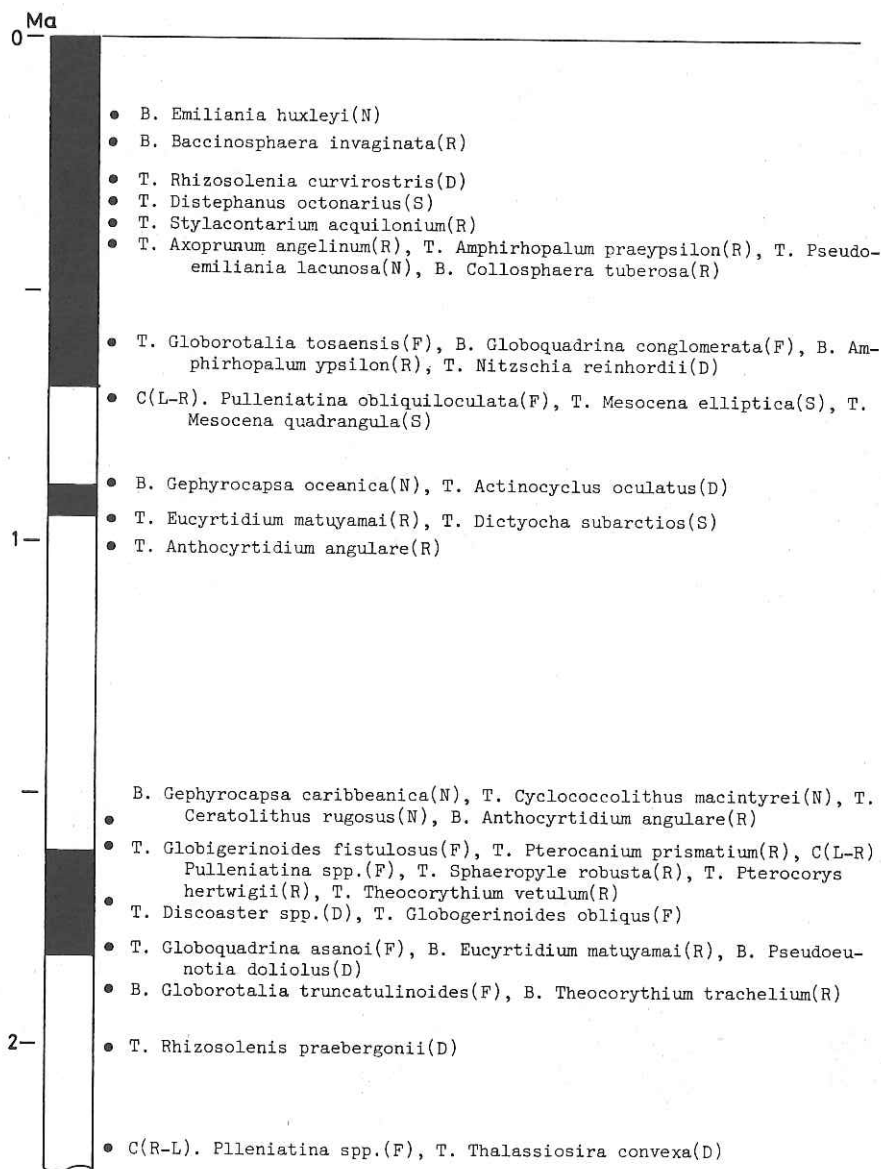


Fig. 8-4-5. The stratigraphic order and the relation with the magnetostratigraphy of the Paleontologic events.  
 B: First occurrence, T: Last occurrence, C(L-R): Change of the coiling direction from left to right, C(R-L): Change of the coiling direction from right to left.  
 (F): Foraminifera, (N): Calcareous nannofossils, (R): Radiolaria, (D): Diatom, (S): Silicoflagellata.

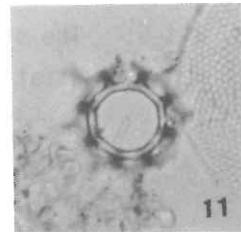
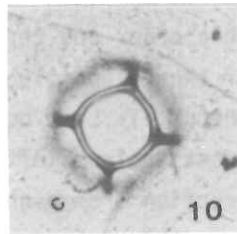
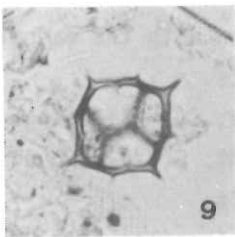
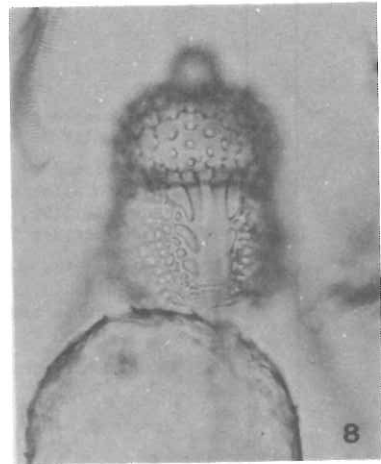
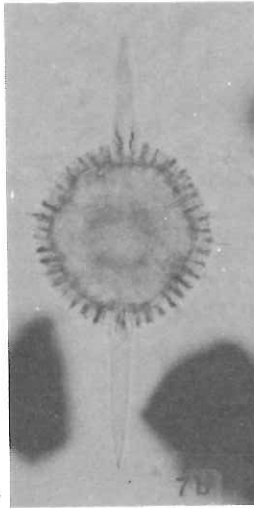
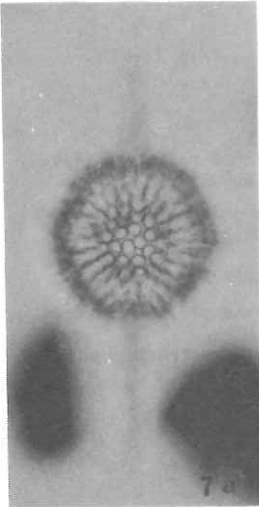
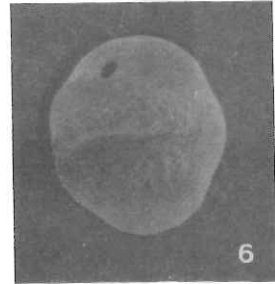
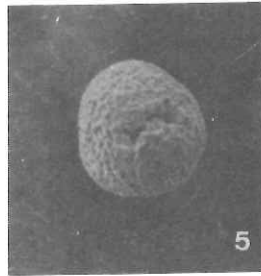
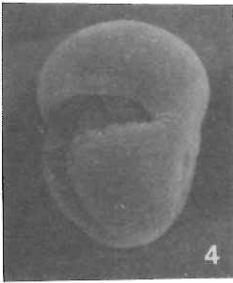
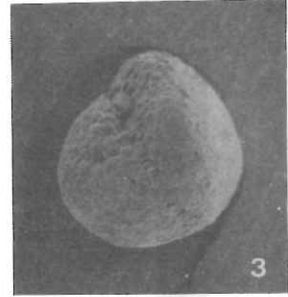
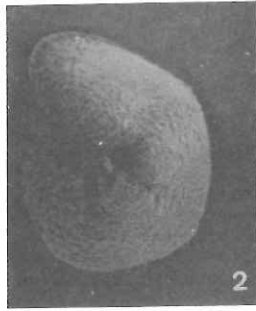
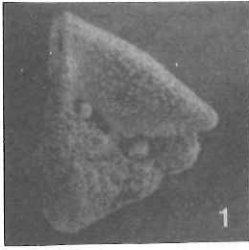


Plate 8-4-1

Plate 8-4-1

Some microfossils obtained during the cruise KH-80-3.

Foraminifera

- 1, 2 Globorotalia truncatulinoides (d'Orbigny)  
1, sample KH80-3-18, 343-346 cm, side view; 2, sample KH80-3-18, 394-397 cm, umbilical view; x50.
- 3 Globorotalia tosaensis Takayanagi and Saito  
Sample KH80-3-18, 494-497 cm, umbilical view; x80.
- 4 Globorotalia inflata (d'Orbigny)  
Sample KH80-3-18, 494-497 cm, side view; x50.
- 5 Neogloboquadrina pachyderma (Ehrenberg)  
Sample KH80-3-18, 343-346 cm, umbilical view; x80.
- 6 Pulleniatina obliquiloculata (Parker and Jones)  
Sample KH80-3-18, 444-447 cm, umbilical view; x50.

Radiolaria

- 7 Axoprunum angelinum (Campbell and Clark)  
Sample KH80-3-12, 699-701 cm; x200.
- 8 Lychnocanoma sp.  
Sample KH80-3-5, 349-351 cm; x200.

Silicoflagellata

- 9 Dictyocha mandrai Ling  
Sample KH80-3-9, 299-301 cm; x500.
- 10 Distephanus octangulatus Wailes  
Sample KH80-3-5, 179-181 cm; x500.
- 11 Distephanus octonarius Deflandre  
Sample KH80-3-12, 849-851 cm; x500.

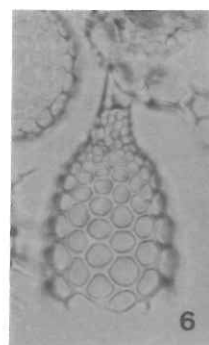
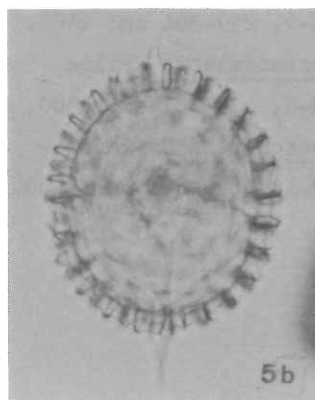
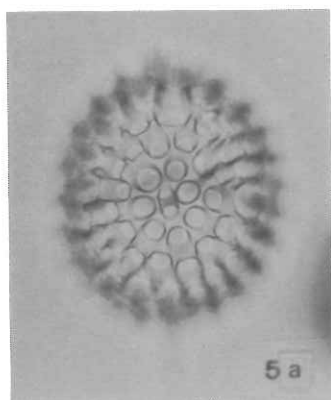
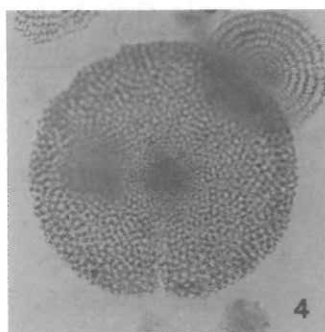
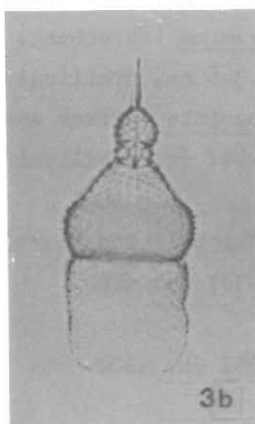
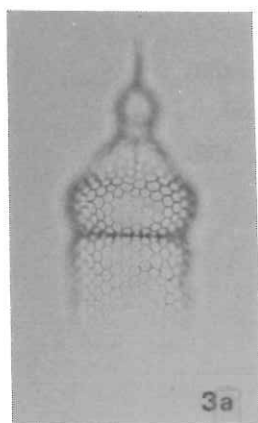
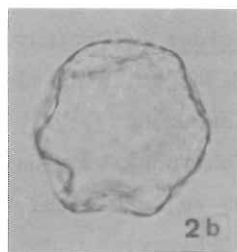
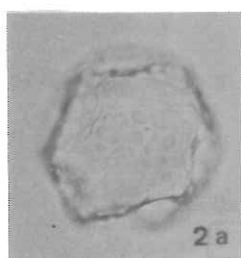
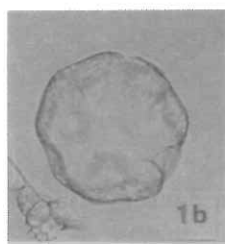
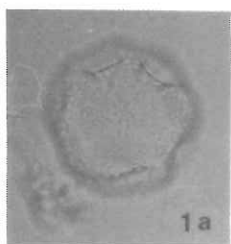


Plate 8-4-2

## Plate 8-4-2

Some microfossils obtained during the cruise KH-80-3.

### Radiolaria

- 1 Buccinosphaera invaginata Haeckel  
Sample KH80-3-30, 0-2 cm; x200.
- 2 Collosphaera tuberosa Haeckel  
Sample KH80-3-30, 0-2 cm; x200.
- 3 Theocorythium trachelium (Ehrenberg)  
Sample KH90-3-30, 0-2 cm; x200.
- 4 Spongodiscus sp.  
Sample KH80-3-5, 349-351 cm; x100.
- 5 Stylocystis aciculiformis (Hays)  
Sample KH80-3-12, 699-701 cm; x200.
- 6 Lamprocyrtis haysi Kling  
Sample KH80-3-9, 0-2 cm; x200.

### Diatoms

7. Rhizosolenia curvirostris Jouse  
Sample KH80-3-5, 799-801 cm; x400.

## 8-5. MEASUREMENTS OF WIRE TENSIONS AND SHEAR STRENGTHS OF SEDIMENTS

### I. NAKAHARA

Wire tensions and shear strength of core samples were measured on the recent cruise.

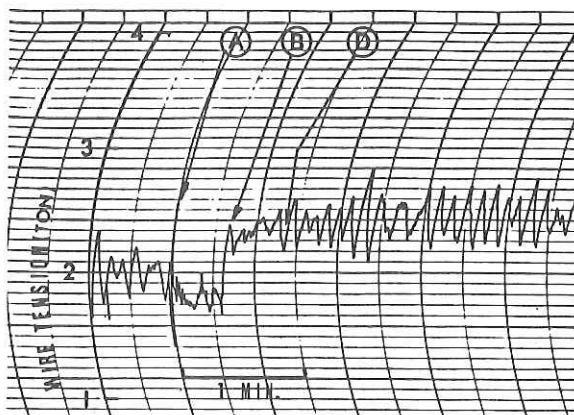
The subjects of the present measurements are to find the method with which the penetrated length of the corer could be estimated and to study the relationship between the wire tension and the shear strength of sediments. The items of the measurements were the wire tension, the hauling speed and the vertical acceleration of gallows side. The hand-operated vane-tester was used for measuring the shear strength.

The following figures show some typical examples of tension records and the measurements of shear strength .



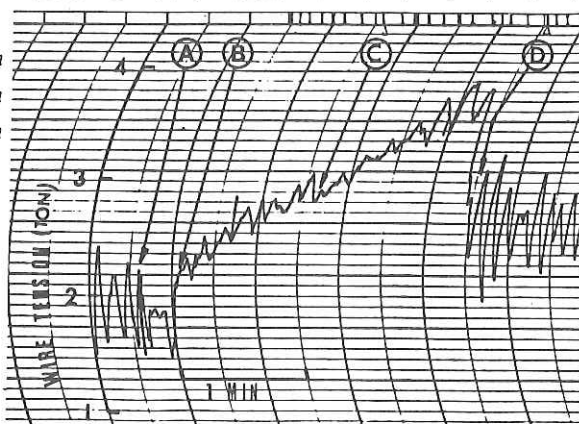
St. 4

Depth 5470 m  
Wire-out 5559 m  
Core length 0 m



St. 5

Depth 5550 m  
Wire-out 5650 m  
Core length 9.92 m



St. 28A

Depth 5800 m  
Wire-out 5893 m  
Core length 10.59m

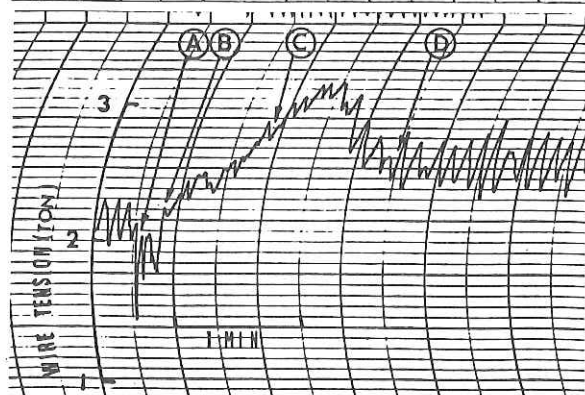


Fig. 8-5-1. Tension records in piston coring.

A: free fall, B: hauling-in of wire rope, corer still stays,  
C: beginning point of drawing out, D: off bottom.

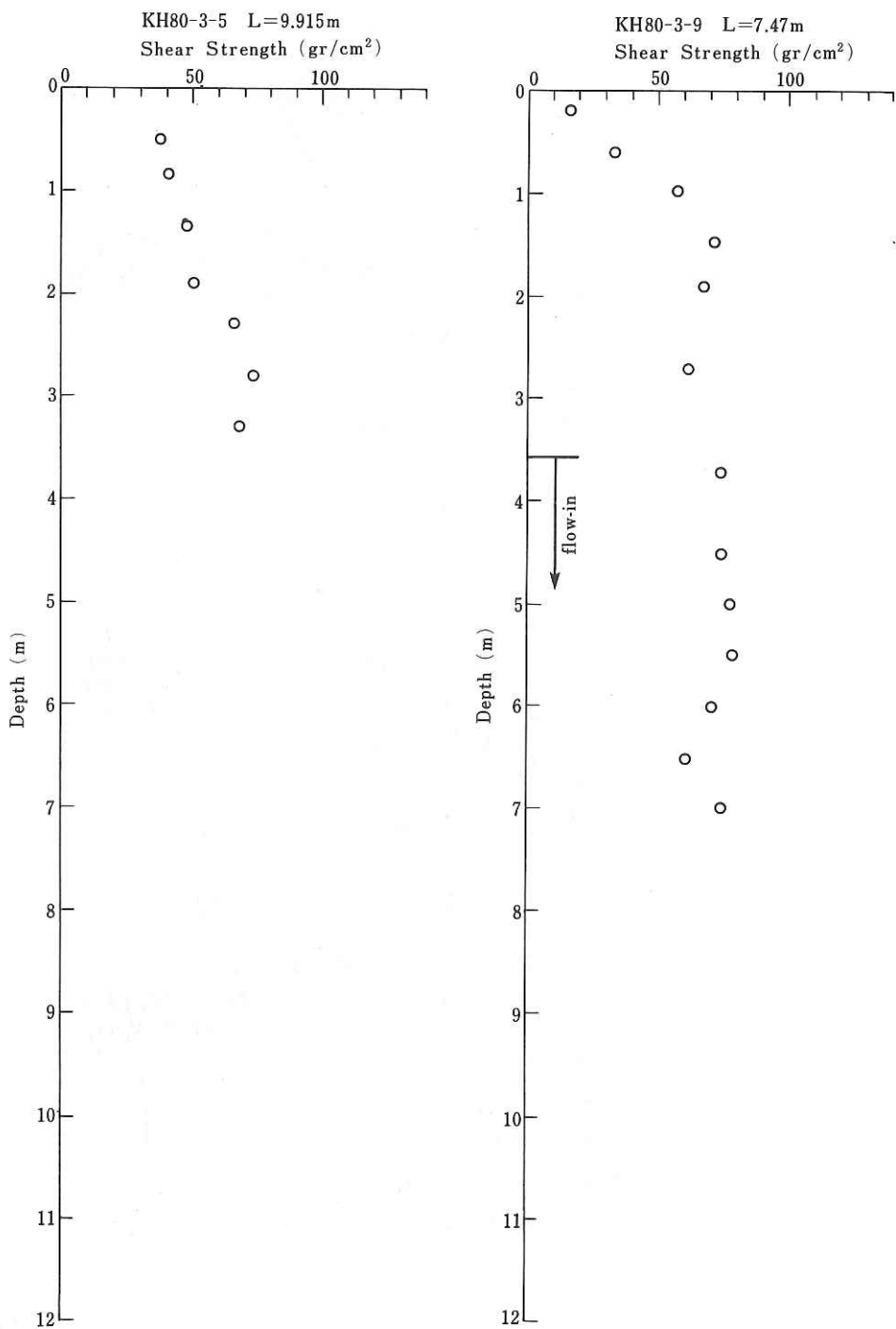


Fig. 8-5-2. Shear strength of core samples KH 80-3-5 and KH 80-3-9.

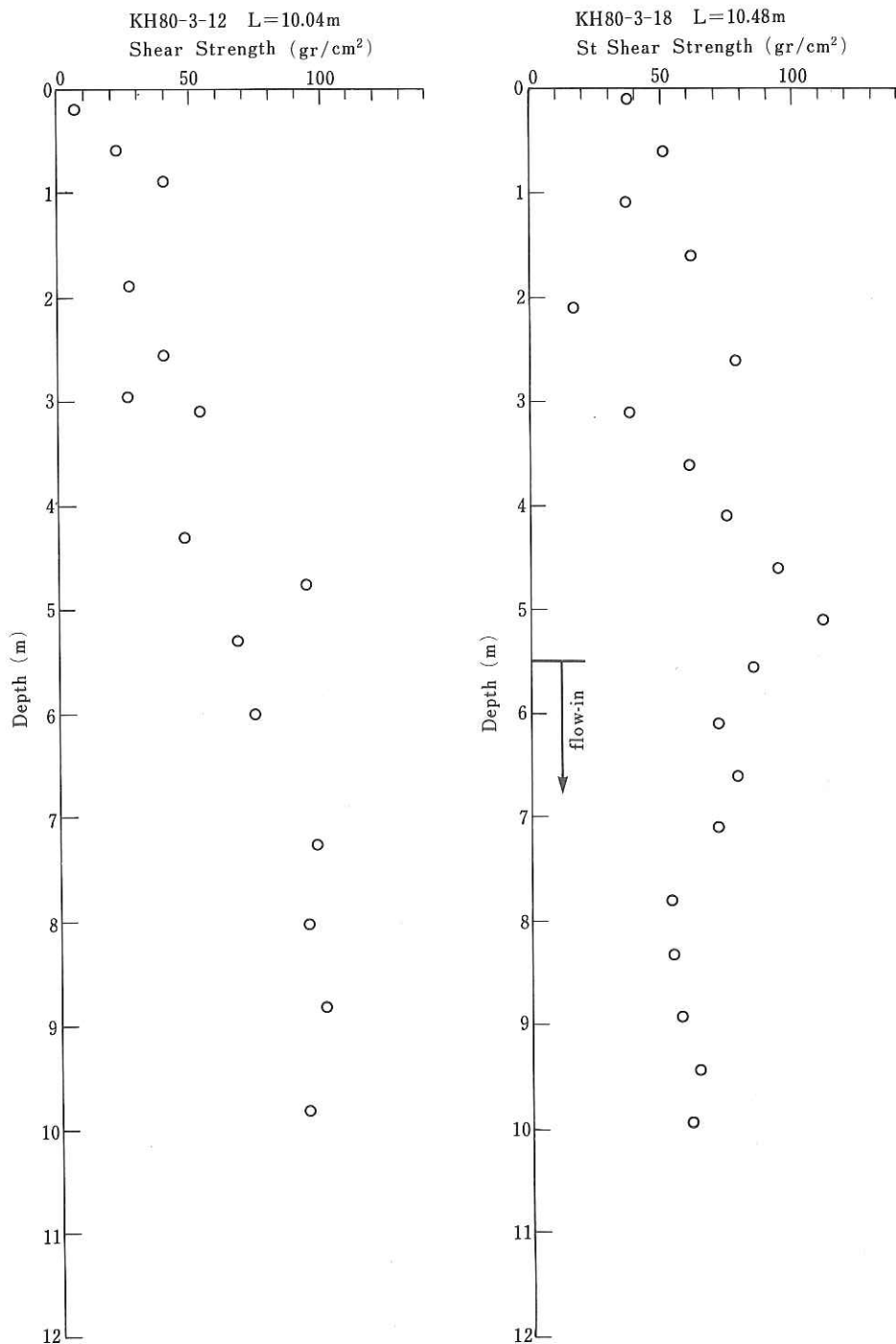


Fig. 8-5-3. Shear strength of core samples KH 80-3-12 and KH 80-3-18.

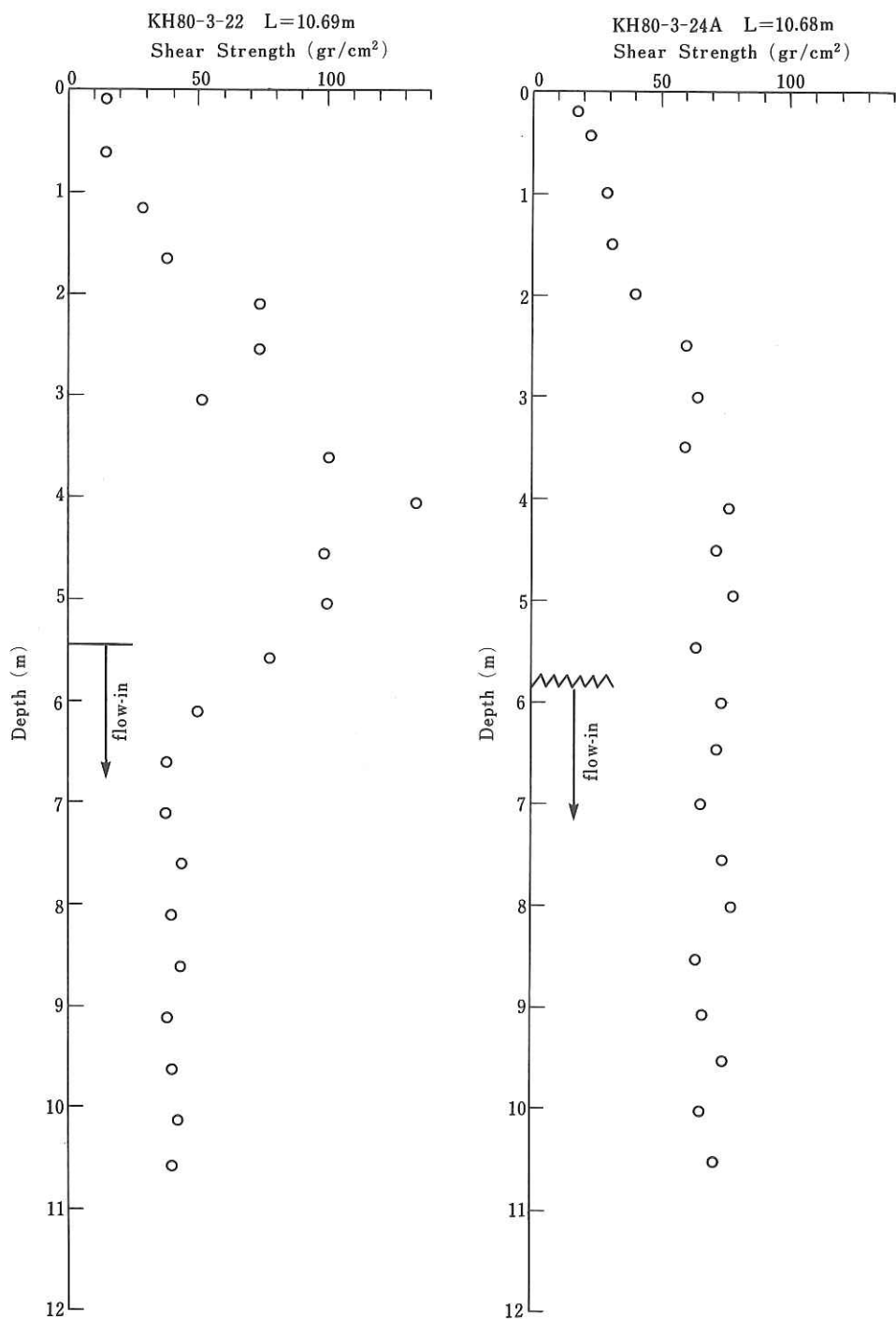


Fig. 8-5-4. Shear strength of core samples KH 80-3-22 and KH 80-3-24A.

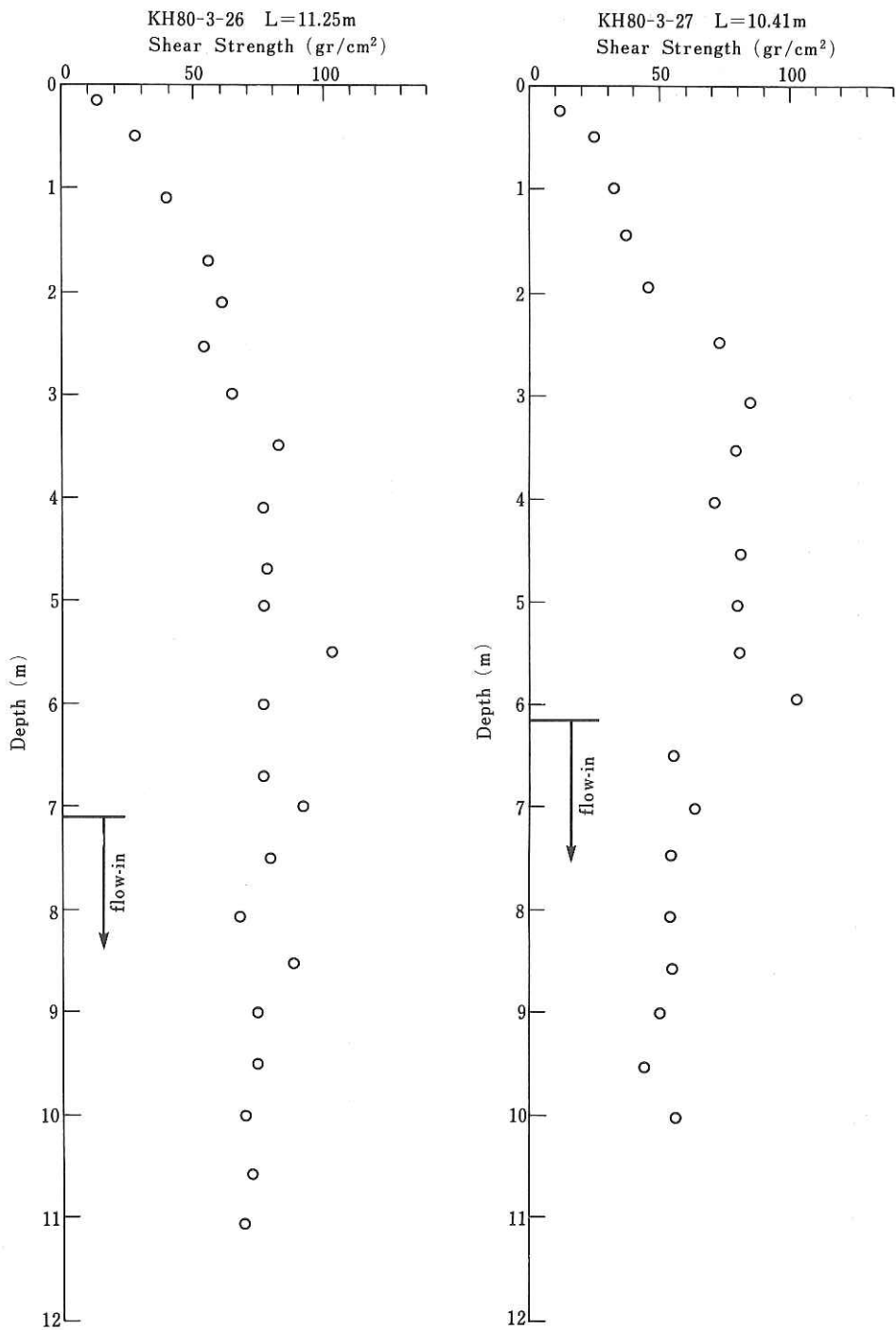


Fig. 8-5-5. Shear strength of core samples KH 80-3-26 and KH 80-3-27.

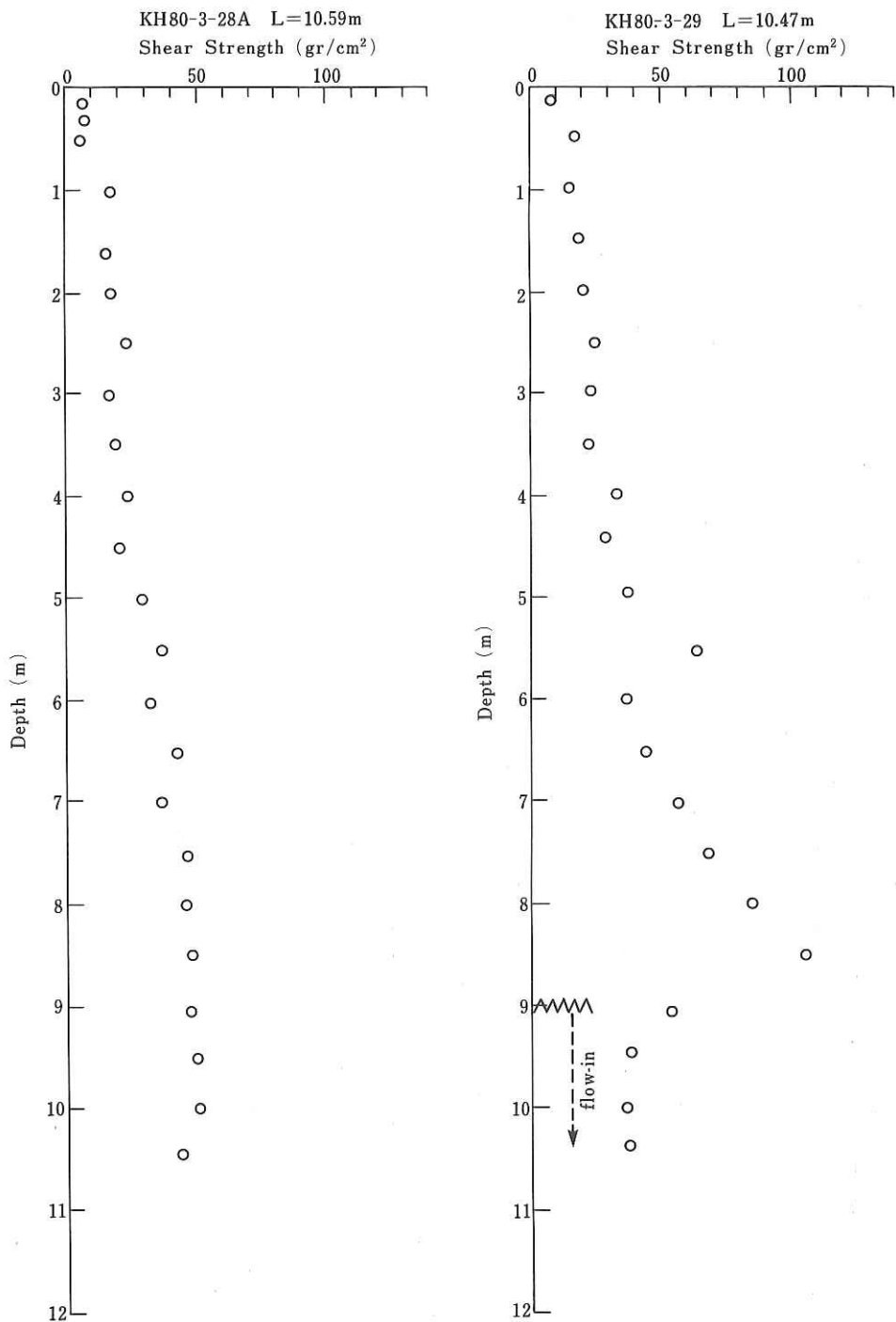


Fig. 8-5-6. Shear strength of core samples KH 80-3-28A and KH 80-3-29.

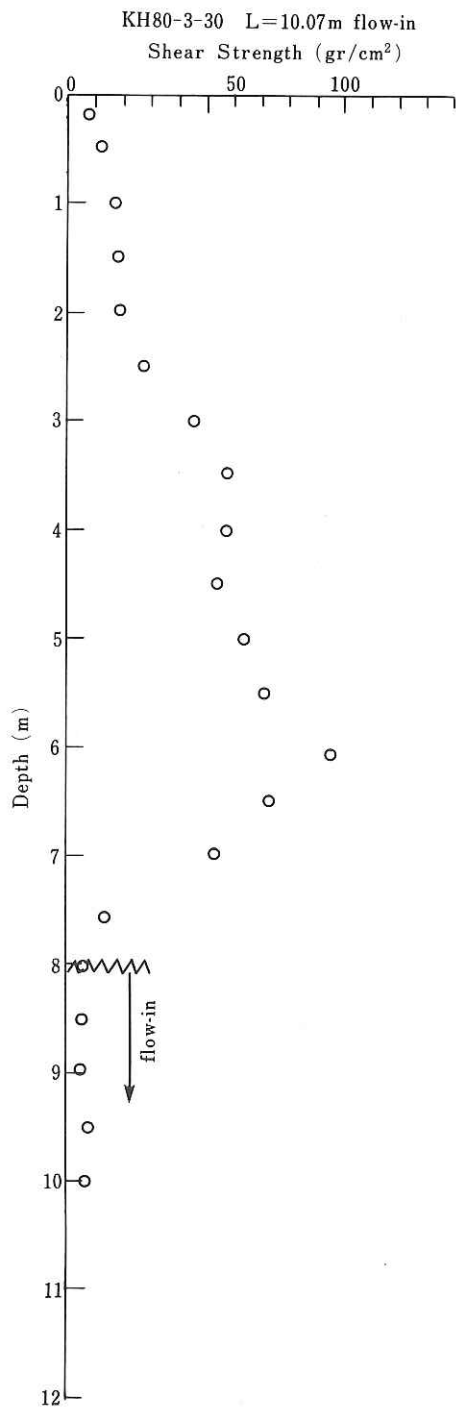


Fig. 8-5-7. Shear strength of core samples KH 80-3-30.

## 9. DREDGE HAULS

### 9-1. OPERATION LOGS

Date July 17, 1980 Ship Hakuho Maru KH 80-3 Station No. 2B  
 Location Northwestern Pacific, west of Japan Trench  
 Weather cloudy Wind 4m/s, NEN Sea very low swell  
 Bottom Topography slope  
 Type of Dredge pipe dredge Add.Wt. 100 kg  
 Time lowered 10 h 51 m Uncorr. Water Depth 3050 m  
 Initial Time on Bottom 11 h 54 m Uncorr. Water Depth 3030 m  
 Wire Length 3198 m Wire Angle 20°  
 Ship Position Lat. 39°12.7'N Long. 143°32.4'E  
 Direction of Haul 220° Ship Speed 0.5 kt. (till 12 h 46 m)  
 Speed Wire-in 0.3 m/sec (from 12 h 17 m) Winch No. 5  
 Final Time on Bottom 12 h 49 m Uncorr. Water Depth 3055 m  
 Wire Length 3278 m Wire Angle ~ 20°  
 Ship Position Lat. 39°12.2'N Long. 143°31.9'E  
 Time Surfaced 13 h 54 m  
 Dredged Materials Dark olive(7.5Y 4/3) silt(120 liter), containing many  
 pebble gravels and granules (basalt lava, andesite lava, granite, etc.)

Date July 17, 1980 Ship Hakuho Maru KH 80-3 Station No. 3  
 Location Northwestern Pacific, west of Japan Trench  
 Weather cloudy Wind 2m/s, NNE Sea very low swell  
 Bottom Topography slope  
 Type of Dredge pipe dredge Add.Wt. 100 kg  
 Time lowered 15 h 43 m Uncorr. Water Depth 4000 m  
 Initial Time on Bottom 17 h 05 m Uncorr. Water Depth 3890 m  
 Wire Length 4100 m Wire Angle 15°  
 Ship Position Lat. 39°15.5'N Long. 143°43.4'E  
 Direction of Haul 212° Ship Speed 0.2 kt. (till 17 h 23 m)  
 Speed Wire-in 0.3 m/sec (from 17 h 23 m) Winch No. 5  
 Final Time on Bottom 17 h 27 m Uncorr. Water Depth 3885 m  
 Wire Length 4125 m Wire Angle ~ 15°  
 Ship Position Lat. 39°15.4'N Long. 143°43.0'E Surfaced 18:42  
 Dredged Materials Olive gray(10Y 4/2) silt(85 liter), containing many  
 granules (basalt lava, andesite lava, gabbro, granite, sandstone, chart  
 etc.), calcareous nodules and plenty of mudstones.



Date July 20, 1980 Ship Hakuho Maru KH 80-3 Station No. 7  
 Location Dai-ichi Kashima Seamount  
 Weather clear partly cloudy Wind 3m/s, 60°N Sea calm, very low swell  
 Bottom Topography flat, saddle of two highs  
 Type of Dredge Nalwalk chain-bag Add.Wt. 200 kg  
 Time lowered 14 h 15 m Uncorr. Water Depth 5280 m  
 Initial Time on Bottom 16 h 03 m Uncorr. Water Depth 5310 m  
 Wire Length 5549 m Wire Angle 5° ~ 10°  
 Ship Position Lat. 35°50.1'N Long. 142°34.5'E  
 Direction of Haul N40°E Ship Speed 0.8 kt. (till 19 h 02 m)  
 Speed Wire-in 0.2 m/sec (from 19 h 02 m) Winch No. 1  
 Final Time on Bottom 19 h 25 m Uncorr. Water Depth 5200 m  
 Wire Length 5900 m Wire Angle ~ 5°  
 Ship Position Lat. 35°51.7'N Long. 142°36.9'E  
 Time Surfaced 20 h 40 m  
 Dredged Materials Dark olive silt(10 mliter).

Date July 20, 1980 Ship Hakuho Maru KH 80-3 Station No. 8  
 Location Dai-ichi Kashima Seamount  
 Weather cloudy Wind 5m/s, 120°N Sea calm, very low swell  
 Bottom Topography flat, top of seamount  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50 kg  
 Time lowered 22 h 09 m Uncorr. Water Depth 4020 m  
 Initial Time on Bottom 23 h 27 m Uncorr. Water Depth 3800 m  
 Wire Length 4239 m Wire Angle 10°  
 Ship Position Lat. 35°46.0'N Long. 142°38.4'E  
 Direction of Haul 25° Ship Speed <sup>-0.1</sup> to +0.3 kt. (till 00 h 55 m)  
 Speed Wire-in 0.2 m/sec (from 00 h 55 m) Winch No. 5  
 Final Time on Bottom 01 h 33 m Uncorr. Water Depth 3630 m  
 Wire Length 3995 m Wire Angle ~ 30°  
 Ship Position Lat. 35°48.4'N Long. 142°41.7'E  
 Time Surfaced 02 h 45 m  
 Dredged Materials Dark olive silty fine sand(4 liter), containing several granules of volcano-clastics and one pumice (80-60-50 mm).

Date July 29, 1980 Ship Hakuho Maru KH 80-3 Station No. 19A  
 Location Shatsky Rise ( $\sim 32^{\circ}40'N$ ,  $158^{\circ}00'E$ )  
 Weather fine Wind 8m/s, E Sea very low swell  
 Bottom Topography frank of topographic high  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50 kg  
 Time lowered 17 h 09 m Uncorr. Water Depth 3020 m  
 Initial Time on Bottom 18 h 06 m Uncorr. Water Depth 3020 m  
 Wire Length 3250 m Wire Angle  $10^{\circ} \sim 15^{\circ}$   
 Ship Position Lat.  $32^{\circ}40.6'N$  Long.  $157^{\circ}59.5'E$   
 Direction of Haul  $100^{\circ}$  Ship Speed 1.2 kt. (till 19 h 14 m)  
 Speed Wire-in 0.35 m/sec (from 19 h 14 m) Winch No. 5  
 Final Time on Bottom 19 h 56 m Uncorr. Water Depth 3000 m  
 Wire Length 3100 m Wire Angle  $08^{\circ} \sim 17^{\circ}$   
 Ship Position Lat.  $32^{\circ}41.5'N$  Long.  $158^{\circ}00.7'E$   
 Time Surfaced 20 h 50 m  
 Dredged Materials 8 pumices, 1 scoria, 2 Mn-nodules(core; altered lava, pumice).

Date July 29, 1980 Ship Hakuho Maru KH 80-3 Station No. 19B  
 Location Shatsky Rise ( $\sim 32^{\circ}40'N$ ,  $158^{\circ}03'E$ )  
 Weather fine Wind 9m/s,  $110^{\circ}N$  Sea very low swell  
 Bottom Topography west slope of topographic high  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50 kg  
 Time lowered 21 h 45 m Uncorr. Water Depth 2690 m  
 Initial Time on Bottom 22 h 36 m Uncorr. Water Depth 2650 m  
 Wire Length 2855 m Wire Angle  $15^{\circ} \sim 20^{\circ}$   
 Ship Position Lat.  $32^{\circ}40.6'N$  Long.  $158^{\circ}03.4'E$   
 Direction of Haul  $90^{\circ}$  Ship Speed 0.3~0.8 kt. (till 23 h 50 m)  
 Speed Wire-in 0.1~0.2m/sec (from 23 h 50 m) Winch No. 5  
 Final Time on Bottom 00 h 44 m Uncorr. Water Depth 2600 m  
 Wire Length 2850 m Wire Angle  $30^{\circ} \sim 35^{\circ}$   
 Ship Position Lat.  $32^{\circ}41.7'N$  Long.  $158^{\circ}04.7'E$   
 Time Surfaced 01 h 50 m  
 Dredged Materials Pale brown fine sand(1 liter) with many granules, about 200 Mn-nodules (core; lava, limestone and phospholite), fush and altered pyroclastic rocks.

Date August 15, 1980 Ship Hakuho Maru KH 80-3 Station No. 23A  
 Location Inside high of Mariana Trench (East of Saipan I)  
 Weather fine Wind 6m/s, 85°N Sea very low swell  
 Bottom Topography north east slope of topographic high  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50+50 kg  
 Time lowered 10 h 22 m Uncorr. Water Depth 5000 m  
 Initial Time on Bottom 12 h 30 m Uncorr. Water Depth 5030 m  
 Wire Length 5451 m Wire Angle 23°  
 Ship Position Lat. 15°33.3'N Long. 147°16.2'E  
 Direction of Haul 180° Ship Speed 0.6 kt. (till 13 h 55 m)  
 Speed Wire-in 0.2 m/sec (from 13 h 55 m) Winch No. 5  
 Final Time on Bottom 14 h 32 m Uncorr. Water Depth 4950 m  
 Wire Length 5000 m Wire Angle 12°  
 Ship Position Lat. 15°33.0'N Long. 147°15.1'E  
 Time Surfaced 15 h 50 m  
 Dredged Materials Brown silty fine sand(30 mliter).

Date August 15, 1980 Ship Hakuho Maru KH 80-3 Station No. 23B  
 Location Terrace of a topographic high in Mariana Trench  
 Weather calm Wind 2m/s, 155°N Sea no swell  
 Bottom Topography slope  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50+50 kg  
 Time lowered 16 h 56 m Uncorr. Water Depth 4300 m  
 Initial Time on Bottom 18 h 17 m Uncorr. Water Depth 4300 m  
 Wire Length 4796 m Wire Angle 03°  
 Ship Position Lat. 15°28.1'N Long. 147°16.2'E  
 Direction of Haul 250° Ship Speed 0 ~ 0.6 kt. (till 20 h 20 m)  
 Speed Wire-in 0.5 m/sec (from 20 h 20 m) Winch No. 5  
 Final Time on Bottom 20 h 50 m Uncorr. Water Depth 4400 m  
 Wire Length 4500 m Wire Angle 22°  
 Ship Position Lat. 15°28.1'N Long. 147°14.0'E  
 Time Surfaced 22 h 02 m  
 Dredged Materials Brown silty fine sand(5 liter) with many granules,  
 about 100 clastics of siltstone, sandstone, mudstone, mud breccia and  
 tuff.

Date August 16, 1980 Ship Hakuho Maru KH 80-3 Station No. 24B  
 Location East of Mariana Trench  
 Weather clear fine Wind 6m/s, 50°N Sea calm, ripple,  
 no swell  
 Bottom Topography flat flank of a seamount  
 Type of Dredge pipe dredge Add.Wt. 100 kg  
 Time lowered 14 h 58 m Uncorr. Water Depth 5770 m  
 Initial Time on Bottom 17 h 00 m Uncorr. Water Depth 5760 m  
 Wire Length 6000 m Wire Angle 14° ~ 18°  
 Ship Position Lat. 13°42.4'N Long. 148°36.2'E  
 Direction of Haul 257° Ship Speed 0.1 ~ 1 kt. (till 18 h 21 m)  
 Speed Wire-in 30 m/sec (from 18 h 21 m) Winch No. 1  
 Final Time on Bottom 19 h 02 m Uncorr. Water Depth 5750 m  
 Wire Length 6210 m Wire Angle 20°  
 Ship Position Lat. 13°41.5'N Long. 148°34.7'E  
 Time Surfaced 20 h 40 m  
 Dredged Materials Brown silty fine sand(100 liter).

Date August 17, 1980 Ship Hakuho Maru KH 80-3 Station No. 25A  
 Location Seamount in Mariana Basin  
 Weather clear fine Wind 5 ~ 6m/s, 90°N Sea ripple,  
 small swell  
 Bottom Topography flank (west) of a seamount  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50+50 kg  
 Time lowered 08 h 05 m Uncorr. Water Depth 2200 m  
 Initial Time on Bottom 08 h 42 m Uncorr. Water Depth 2200 m  
 Wire Length 2140 m Wire Angle 26° ~ 29°  
 Ship Position Lat. 13°57.2'N Long. 148°28.7'E  
 Direction of Haul 290° Ship Speed 0.3~1.2 kt. (till 09 h 37 m)  
 Speed Wire-in 12 m/sec (from 09 h 37 m) Winch No. 5  
 Final Time on Bottom 09 h 51 m Uncorr. Water Depth 2380 m  
 Wire Length 2620 m Wire Angle 29°  
 Ship Position Lat. 13°57.6'N Long. 148°27.2'E  
 Time Surfaced 10 h 35 m  
 Dredged Materials About 20 Mn-nodules (core; altered lava and pyroclastics),  
 2 pumices.

Date August 17, 1980 Ship Hakuho Maru KH 80-3 Station No. 25B  
 Location Seamount in Mariana Basin  
 Weather fine, partly cloudy Wind 5m/s, 95°N Sea ripple, small swell  
 Bottom Topography East flank of a seamount (-2070m)  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50+50 kg  
 Time lowered 11 h 47 m Uncorr. Water Depth 2275 m  
 Initial Time on Bottom 12 h 32 m Uncorr. Water Depth 2200 m  
 Wire Length 2180 m Wire Angle 37°  
 Ship Position Lat. 13°57.9'N Long. 148°31.2'E  
 Direction of Haul 310° Ship Speed ~ 0.8 kt. (till 13 h 56 m)  
 Speed Wire-in 0.5 m/sec (from 13 h 56 m) Winch No. 5  
 Final Time on Bottom 14 h 31 m Uncorr. Water Depth 2130 m  
 Wire Length 2800 m Wire Angle 30°  
 Ship Position Lat. 13°59.3'N Long. 148°29.0'E  
 Time Surfaced 15 h 21 m  
 Dredged Materials 16 limestones(grainstone), 1 pumice, about 450 Mn-nodules (core; grainstone, palagonitized volcanic rock, basalt lava and altered lava).

Date August 17, 1980 Ship Hakuho Maru KH 80-3 Station No. 25C  
 Location Seamount in Mariana Basin  
 Weather fine Wind 6m/s, 60°N Sea ripple, small swell  
 Bottom Topography East flank of a seamount (top=2070)  
 Type of Dredge Nalwalk chain-bag Add.Wt. 50+50 kg  
 Time lowered 16 h 17 m Uncorr. Water Depth 3120 m  
 Initial Time on Bottom 17 h 18 m Uncorr. Water Depth 3250 m  
 Wire Length 3360 m Wire Angle 10°  
 Ship Position Lat. 14°01.7'N Long. 148°33.9'E  
 Direction of Haul 270° Ship Speed 0.3~1.0 kt. (till 18 h 43 m)  
 Speed Wire-in 0.3 m/sec (from 18 h 43 m) Winch No. 5  
 Final Time on Bottom 18 h 51 m Uncorr. Water Depth 3350 m  
 Wire Length 3437 m Wire Angle 25°  
 Ship Position Lat. 14°02.9'N Long. 148°32.7'E  
 Time Surfaced 19 h 50 m  
 Dredged Materials 16 limestones(wackestone), 20 (pillow) basalts with thin Mn-coring, 15 altered basalt with thin Mn-coring, 25 Mn-nodules (core; phosphorite, volcanic breccia, altered lava). (breakdown of small pipe) dredge)

Date August 19, 1980 Ship Hakuho Maru KH 80-3 Station No. 28B  
 Location Mariana Basin, east  
 Weather clear Wind breeze Sea calm  
 Bottom Topography flat  
 Type of Dredge pipe dredge Add.Wt. 200 kg  
 Time lowered 12 h 35 m Uncorr. Water Depth 5800 m  
 Initial Time on Bottom 14 h 18 m Uncorr. Water Depth 5800 m  
 Wire Length m Wire Angle  
 Ship Position Lat. 11°03.0'N Long. 151°32.6'E  
 Direction of Haul Ship Speed 1 kt. (till 15 h 00 m)  
 Speed Wire-in 0 m/sec (from h m) Winch No. 5  
 Final Time on Bottom 15 h 20 m Uncorr. Water Depth 5800 m  
 Wire Length 6000 m Wire Angle 10°  
 Ship Position Lat. 11°02.8'N Long. 151°31.1'E  
 Time Surfaced 16 h 45 m  
 Dredged Materials Red clay (about 50 liter).

Date August 21, 1980 Ship Hakuho Maru KH 80-3 Station No. 31A  
 Location Seamount (west of Ponape I.)  
 Weather rain Wind 5m/s, 315°N Sea calm  
 Bottom Topography western slope of a seamount  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150+50 kg  
 Time lowered 22 h 22 m Uncorr. Water Depth 3050 m  
 Initial Time on Bottom 23 h 16 m Uncorr. Water Depth 2850 m  
 Wire Length 2950 m Wire Angle 30° (23 h 26 m)  
 Ship Position Lat. 7°06.0'N Long. 156°51.9'E  
 Direction of Haul 147° Ship Speed ~ 0.5 kt. (till 23 h 49 m)  
 Speed Wire-in 0.2 m/sec (from 23 h 55 m) Winch No. 5  
 Final Time on Bottom 01 h 59 m Uncorr. Water Depth 2750 m  
 Wire Length 2830 m Wire Angle 31°  
 Ship Position Lat. 7°05.5'N Long. 156°51.8'E  
 Time Surfaced 02 h 59 m  
 Dredged Materials About 40 Mn-nodules (core; altered volcanic breccia, altered lava, carbonate rock, phosphorite), pale yellow sand.

Date August 22, 1980 Ship Hakuho Maru KH 80-3 Station No. 31B  
 Location Seamount (west of Ponape I.)  
 Weather fine Wind 2m/s, Sea calm  
 Bottom Topography western slope of a seamount very small swell  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 07<sup>h</sup> 39<sup>m</sup> Uncorr. Water Depth 2220 m  
 Initial Time on Bottom 08<sup>h</sup> 20<sup>m</sup> Uncorr. Water Depth 2200 m  
 Wire Length 2275 m Wire Angle 0 (25°: 9<sup>h</sup> 12<sup>m</sup>)  
 Ship Position Lat. 7°03.0'N Long. 156°52.3'E  
 Direction of Haul 100° Ship Speed -0.6~1.5 kt. (till 10<sup>h</sup> 34<sup>m</sup>)  
 Speed Wire-in 0.4 m/sec (from 10<sup>h</sup> 34<sup>m</sup>) Winch No. 5  
 Final Time on Bottom 10<sup>h</sup> 38<sup>m</sup> Uncorr. Water Depth 2115 m  
 Wire Length 2310 m Wire Angle 16°  
 Ship Position Lat. 7°02.1'N Long. 156°53.1'E  
 Time Surfaced 11<sup>h</sup> 20<sup>m</sup>  
 Dredged Materials About 150 Mn-nodules (core, altered lava, tuff, volcanic breccia, phosphorite, limestone, carbonate rock), 10 pumice, sand and basaltic lava.

Date Sept. 1, 1980 Ship Hakuho Maru KH 80-3 Station No. 32  
 Location Topographic high inside of Bonin Trench  
 Weather fine, partly cloudy Wind 3-5m/s, 280°N Sea calm, no swell  
 Bottom Topography slope, rugged  
 Type of Dredge nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 12<sup>h</sup> 52<sup>m</sup> Uncorr. Water Depth 1500 m  
 Initial Time on Bottom 13<sup>h</sup> 25<sup>m</sup> Uncorr. Water Depth 1510 m  
 Wire Length 1527 m Wire Angle 10°  
 Ship Position Lat. 26°24.9'N Long. 142°54.0'E  
 Direction of Haul 158° Ship Speed 1.2 kt. (till 14<sup>h</sup> 35<sup>m</sup>)  
 Speed Wire-in 0.3 m/sec (from 14<sup>h</sup> 35<sup>m</sup>) Winch No. 5  
 Final Time on Bottom 15<sup>h</sup> 03<sup>m</sup> Uncorr. Water Depth 1430 m  
 Wire Length 1450 m Wire Angle 35°  
 Ship Position Lat. 26°23.3'N Long. 142°55.5'E  
 Time Surfaced 15<sup>h</sup> 27<sup>m</sup>  
 Dredged Materials About 300 cobble to pebble gravels (serpentinite with Mn-coring, scoria, pumice lapilli tuff, fine tuff, basaltic lava), Mn-nodules (core; serpentinite, basaltic lava), dark gray sand.

Date Sept. 1, 1980 Ship Hakuho Maru KH 80-3 Station No. 33  
 Location Topographic high inside of Bonin Trench (western slope)  
 Weather fine, partly cloudy Wind 6m/s, 305°N Sea calm, no swell  
 Bottom Topography slope  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 16 h 26 m Uncorr. Water Depth 2850 m  
 Initial Time on Bottom 17 h 28 m Uncorr. Water Depth 3120 m  
 Wire Length 3328 m Wire Angle 10°  
 Ship Position Lat. 26°20.9'N Long. 142°49.8'E  
 Direction of Haul 130° Ship Speed 1.2 kt. (till 18 h 30 m)  
 Speed Wire-in 0.3 m/sec (from 18 h 30 m) Winch No. 5  
 Final Time on Bottom 19 h 08 m Uncorr. Water Depth 3220 m  
 Wire Length 3400 m Wire Angle  
 Ship Position Lat. 26°19.1'N Long. 142°49.8'E  
 Time Surfaced 20 h 05 m  
 Dredged Materials About 200 cobbel to pebble gravels (boninite, dolerite(?),  
 volcanic breccia, lapilli tuff, fine tuff, basaltic lava, altered  
 volcanic rocks).

Date Sept. 1, 1980 Ship Hakuho Maru KH 80-3 Station No. 34  
 Location Topographic high inside of Bonin Trench (eastern slope)  
 Weather fine, partly cloudy Wind 4m/s, 275°N Sea calm, no swell  
 Bottom Topography slope  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 21 h 12 m Uncorr. Water Depth 1400 m  
 Initial Time on Bottom 21 h 38 m Uncorr. Water Depth 1500 m  
 Wire Length 1544 m Wire Angle 10°  
 Ship Position Lat. 26°24.3'N Long. 143°00.1'E  
 Direction of Haul 135° Ship Speed kt. (till h m)  
 Speed Wire-in m/sec (from h m) Winch No. 5  
 Final Time on Bottom 22 h 42 m Uncorr. Water Depth 1360 m  
 Wire Length 1400 m Wire Angle  
 Ship Position Lat. 26°23.6'N Long. 143°00.4'E  
 Time Surfaced 23 h 00 m  
 Dredged Materials About 100 boulder to pebble gravels (scoria, pumice,  
 lapilly tuff, fine tuff, altered lava, siltstone).



Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 35  
 Location South of Hahajima  
 Weather fine Wind 4-5m/s, 270°N Sea small swell  
 Bottom Topography  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 05 h 55 m Uncorr. Water Depth 163 m  
 Initial Time on Bottom 06 h 03 m Uncorr. Water Depth 160 m  
 Wire Length 168 m Wire Angle ~ 10°  
 Ship Position Lat. 26°27.9'N Long. 142°10.9'E  
 Direction of Haul 0° Ship Speed 0~1.0 kt. (till 06 h 20 m)  
 Speed Wire-in 0.3 m/sec (from 06 h 20 m) Winch No. 5  
 Final Time on Bottom 06 h 22 m Uncorr. Water Depth ~ 162 m  
 Wire Length 145 m Wire Angle ~ 10°  
 Ship Position Lat. 26°28.0'N Long. 142°10.8'E  
 Time Surfaced 06 h 26 m  
 Dredged Materials 17 limestone(rhodolith) pebbles, 2 pumices, 1 sponge.

Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 36  
 Location East of Hahajima  
 Weather fine Wind 5m/s, 325°N Sea calm, small swell  
 Bottom Topography  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 07 h 45 m Uncorr. Water Depth 240 m  
 Initial Time on Bottom 07 h 51.5 m Uncorr. Water Depth 236 m  
 Wire Length 247 m Wire Angle  
 Ship Position Lat. 26°39.3'N Long. 142°13.8'E  
 Direction of Haul 250° Ship Speed 0.3 kt. (till 09 h 00 m)  
 Speed Wire-in 0.35 m/sec (from 09 h 00 m) Winch No. 5  
 Final Time on Bottom 09 h 05 m Uncorr. Water Depth 195 m  
 Wire Length 195 m Wire Angle  
 Ship Position Lat. 26°38.5'N Long. 142°13.0'E  
 Time Surfaced 09 h 12 m  
 Dredged Materials Olive sand(1 liter), 1 fish.

Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 37  
 Location North of Hahajima  
 Weather fine Wind 5m/s, 75~90° Sea swell  
 Bottom Topography steep cliff facing eastwards  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg + chain  
 Time lowered 10 h 40 m Uncorr. Water Depth 300 m  
 Initial Time on Bottom 10 h 47 m Uncorr. Water Depth 300 m  
 Wire Length 310 m Wire Angle  
 Ship Position Lat. 26°49.5'N Long. 142°09.2'E  
 Direction of Haul 270° Ship Speed 1.0 kt. (till 11 h 08 m)  
 Speed Wire-in 0.1 m/sec (from 11 h 11 m) Winch No. 5  
 Final Time on Bottom 11 h 16 m Uncorr. Water Depth 222 m  
 Wire Length 250 m Wire Angle  
 Ship Position Lat. 26°49.5'N Long. 142°08.7'E  
 Time Surfaced 11 h 25 m  
 Dredged Materials 115 limestone pebbles (grainstone, packstone and rhodolith).

Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 38  
 Location Between Chichijima and Hahajima  
 Weather fine Wind 5m/s, 330°N Sea swell  
 Bottom Topography steep cliff  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg +chain  
 Time lowered 12 h 01 m Uncorr. Water Depth 310 m  
 Initial Time on Bottom 12 h 11 m Uncorr. Water Depth 313 m  
 Wire Length 326 m Wire Angle  
 Ship Position Lat. 26°52.0'N Long. 142°08.8'E  
 Direction of Haul 270° Ship Speed ~ 0.1 kt. (till 12 h 30 m)  
 Speed Wire-in 0.3 m/sec (from 12 h 30 m) Winch No. 5  
 Final Time on Bottom 12 h 39 m Uncorr. Water Depth 280 m  
 Wire Length 300 m Wire Angle 37°  
 Ship Position Lat. 26°52.1'N Long. 142°08.6'E  
 Time Surfaced 12 h 47 m  
 Dredged Materials No recovery (breakdown of fuse wire).

Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 39  
 Location South of Chichijima  
 Weather fine Wind 4.5m/s, Sea swell  
 Bottom Topography steep cliff (relief 250 m or more)  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 13 h 51 m Uncorr. Water Depth 520 m  
 Initial Time on Bottom 14 h 05 m Uncorr. Water Depth 536 m  
 Wire Length 558 m Wire Angle  
 Ship Position Lat. 26°56.4'N Long. 142°12.5'E  
 Direction of Haul 270° Ship Speed 1.2 kt. (till 14 h 36 m)  
 Speed Wire-in 18 m/sec (from 15 h 02 m) Winch No. 5  
 Final Time on Bottom 15 h 19 m Uncorr. Water Depth 380 m  
 Wire Length 382 m Wire Angle  
 Ship Position Lat. 26°55.8'N Long. 142°11.6'E  
 Time Surfaced 15 h 31 m  
 Dredged Materials 14 limestone pebbles (grainstone, wackestone).

Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 40  
 Location West of Otoutojima  
 Weather fine Wind 3m/s, 350°N Sea swell  
 Bottom Topography steep cliff  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 17 h 45 m Uncorr. Water Depth 880 m  
 Initial Time on Bottom 18 h 02 m Uncorr. Water Depth 820 m  
 Wire Length 906 m Wire Angle 30°  
 Ship Position Lat. 27°11.7'N Long. 142°21.3'E  
 Direction of Haul 280° Ship Speed 0.2-0.6 kt. (till 18 h 26 m)  
 Speed Wire-in 0.3 m/sec (from 18 h 26 m) Winch No. 5  
 Final Time on Bottom 18 h 37 m Uncorr. Water Depth 690 m  
 Wire Length 770 m Wire Angle  
 Ship Position Lat. 27°11.1'N Long. 142°21.1'E  
 Time Surfaced 18 h 54 m  
 Dredged Materials About 20 volcanic and pyroclastic rocks, 7 limestone (wackestone), 1 calcareous conglomerate, 1 tuffaceous sandstone.

Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 41  
 Location Northeast of Chichijima  
 Weather fine Wind 2.5m/s, Sea swell  
 Bottom Topography steep slope with relief of 420m  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 20 h 20 m Uncorr. Water Depth 915 m  
 Initial Time on Bottom 20 h 36 m Uncorr. Water Depth 872 m  
 Wire Length 942 m Wire Angle  
 Ship Position Lat. 27°22.1'N Long. 142°20.9'E  
 Direction of Haul Ship Speed 0.5 kt. (till 21 h 20 m)  
 Speed Wire-in 18 m/sec (from 21 h 36 m) Winch No. 5  
 Final Time on Bottom 21 h 53 m Uncorr. Water Depth 615 m  
 Wire Length 635 m Wire Angle  
 Ship Position Lat. 27°21.5'N Long. 142°19.6'E  
 Time Surfaced 22 h 04 m  
 Dredged Materials Lots of pyroclastic rocks, 1 fish, 1 sponge.

Date Sept. 2, 1980 Ship Hakuho Maru KH 80-3 Station No. 42  
 Location Southeast of Nakoudojima  
 Weather fine Wind 5m/s, 30°N Sea swell  
 Bottom Topography  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 22 h 55 m Uncorr. Water Depth 295 m  
 Initial Time on Bottom 23 h 02 m Uncorr. Water Depth 292 m  
 Wire Length 310 m Wire Angle  
 Ship Position Lat. 27°25.7'N Long. 142°15.5'E  
 Direction of Haul 290° Ship Speed 0.5 kt. (till 23 h 17 m)  
 Speed Wire-in m/sec (from h m) Winch No. 5  
 Final Time on Bottom 23 h 20 m Uncorr. Water Depth 288 m  
 Wire Length 290 m Wire Angle  
 Ship Position Lat. 27°25.5'N Long. 142°15.2'E  
 Time Surfaced 23 h 27 m  
 Dredged Materials No recovery, "breakdown"

Date Sept. 3, 1980 Ship Hakuho Maru KH 80-3 Station No. 43  
 Location East of Mukojima (Harinoiwa)  
 Weather fine, Wind 1.5m/s, Sea calm, moderate swell  
 Bottom Topography slope  
 Type of Dredge Nalwalk chain-bag Add.Wt. 150 kg  
 Time lowered 09 h 12 m Uncorr. Water Depth 1000 m  
 Initial Time on Bottom 09 h 31 m Uncorr. Water Depth 1045 m  
 Wire Length 1084 m Wire Angle 30°  
 Ship Position Lat. 27°44.8'N Long. 142°23.3'E  
 Direction of Haul 250° Ship Speed 0.5 kt. (till 10 h 05 m)  
 Speed Wire-in 0.3 m/sec (from 09 h 59 m) Winch No. 5  
 Final Time on Bottom 10 h 09 m Uncorr. Water Depth 992 m  
 Wire Length 1000 m Wire Angle 10°  
 Ship Position Lat. 27°44.2'N Long. 142°23.3'E  
 Time Surfaced 10 h 26 m  
 Dredged Materials About 30 tuff, 2 scorias, 3 pumices.

## 9-2. POSITION OF DREDGE HAULS

T. ISHII

Twenty-seven sites were selected for the investigations of dredge hauls in this cruise, that is, pipe-dredge with 150 liter capacity and Nalwalk chain-bag dredge with small pipe-dredge (8 liter capacity) were operated at four sites to collect soft sediments and twenty-three sites to collect hard rocks, respectively. The areas of dredge hauls are as follows;

for sediments; West of Japan Trench (Station 2B and 3)

West of Mariana Basin (24B)

East of Mariana Basin (28B)

for hard rocks; Dai-ichi Kashima Seamount (7 and 8)

Shatsky Rise (19A and 19B)

Inside high of Mariana Trench (23A and 23B)

Seamount in Mariana Basin (near Mariana Trench) (25A, 25B and 25C)

Seamount in Mariana Basin (west of Ponape Island)  
(31A and 31B)

Topographic high in the landward side of Bonin Trench  
(32, 33 and 34)

East of Ogasawara Islands (35-43)

Precise position of each station is given in the Operation logs of dredge hauls (Chapter 9-1) and shown in Figs. 9-2-1 and -2.

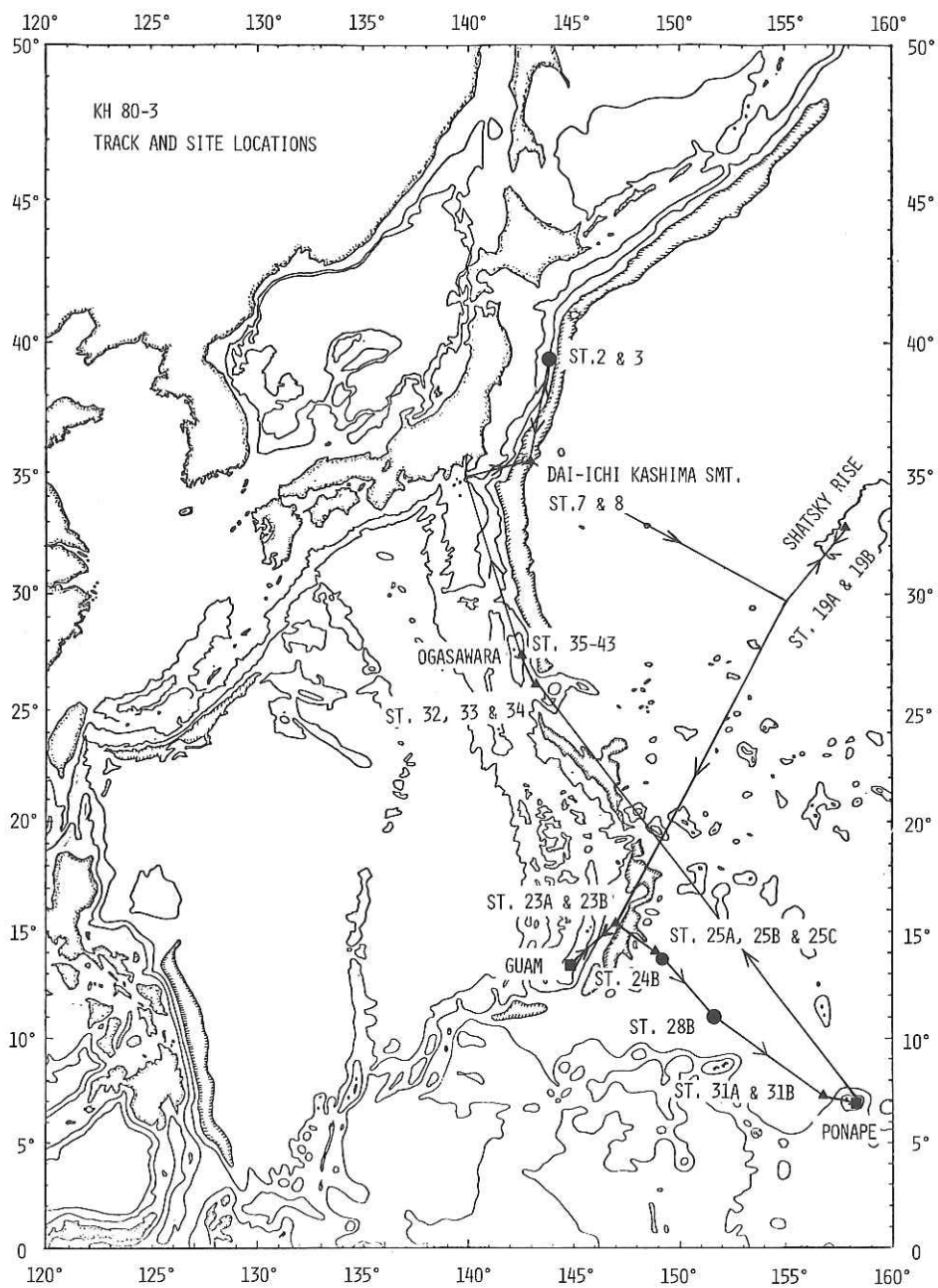


Fig. 9-2-1. Position of dredge hauls (circle: pipe dredge, triangle: chain-bag dredge).

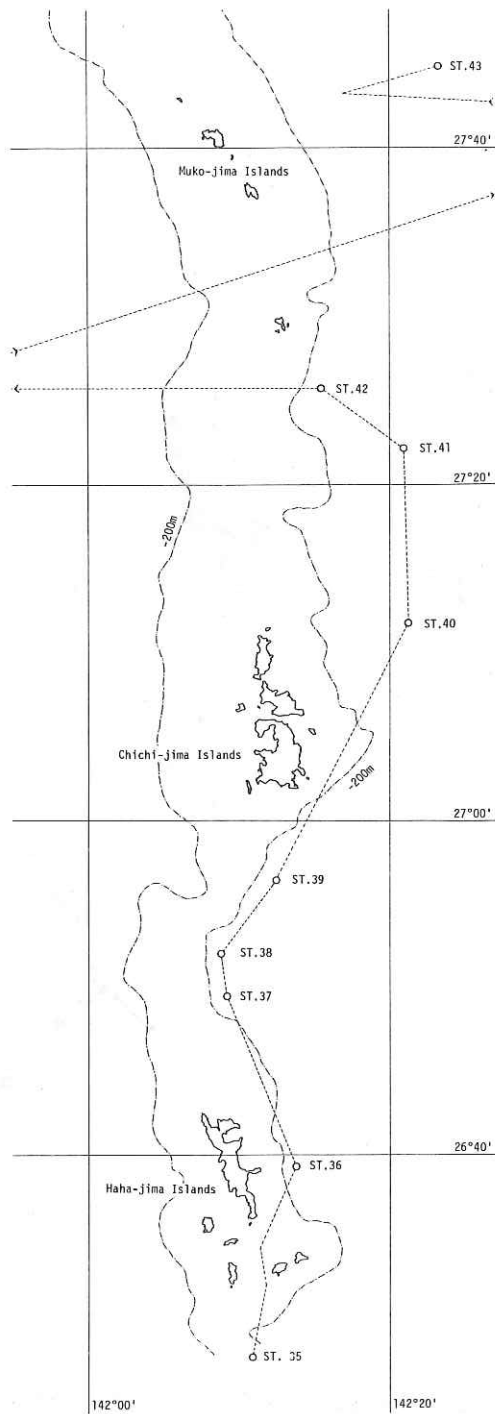


Fig. 9-2-2. Position of dredge hauls of Ogasawara Islands area.



### 9-3. DESCRIPTION OF SAMPLES

T. ISHII, K. KONISHI and A. OMURA

More than two thousand rocks were dredged in this cruise. Because most of the dredged hard rock-samples are more or less covered by soft sediments and/or Mn-coating, these rocks were at first separated from soft sediments, and cut into two or more pieces for observation and description of visual features inside of each sample. Washed samples were classified into several groupes according to lithological characteristics. After numbering the samples in order of size, diameter (L, M and S), roundness, weight, thickness of Mn-coating, lithology and remarks of each sample were described as shown in TABLE 1 excluding data on soft sediments. In the TABLE, roundness is described after Power's system, that is, 0.10=very angular, 0.20=angular, 0.30=subangular, 0.40=subrounded, 0.60=rounded and 0.85=well-rounded.

The samples from stations KH 80-3-23B, 25B, 25C, 31A, 31B plus 35-43, and 19A, 19B, 32, 33 plus 34 are described by Konishi, Omura and Ishii, and Ishii, respectively.

Boninite (from St. 33), serpentinites (from St. 32) and many fresh igneous rocks (from St. 19A, 19B, 25A, 25B, 25C, 31A, 31B, 32 and 33) have been in progress in their petrological and geochemical investigations.

#### REFERENCES

Powers, M.C., 1953. A new roundness scale for sedimentary particles.  
J. Sed. Pet. 23, 117-119.

#### ACKNOWLEDGMENTS

We thank Miss Sayuri Washida for her help in preparation of manuscript.

TABLE 1. List of dredged materials.

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology	&	Remarks(Paleon-tological, etc.)
	L	M	S						
19A01	110-	85-	65	0.20	180		pumice		
02	105-	100-	70	0.25	280		"		
03	65-	65-	60	0.35	95		"		
04	120-	75-	70	0.30	115		"		
05	100-	60-	50	0.35	65		"		
06	55-	45-	35	0.30	40		"		gray
07	60-	50-	30	0.30	45		"		"
08	55-	45-	40	0.35	30		"		
09	70-	55-	30	0.30	40		scoria		
10	80-	55-	50	0.35	250	0- 2	Mn-nodule		core, altered lava
11	70-	55-	35	0.20	110	3- 6	"		core, " tuff(?)
12					2340		Brown silt		
13					400		"		

Sample No.	Diameter(mm) L M S			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleon-tological, etc.)
19B001	70-	60-	35	0.40	170	8- 12	Mn-nodule	c., phospholite
002	45-	40-	25	0.30	60	1- 4	"	c., tuff
003	60-	65-	40	0.45	125	7- 13	"	c., "
004	50-	40-	30	0.35	70	2- 9	"	c., phospholite
005	45-	30-	25	0.35	40	1- 4	"	c., "
006	40-	30-	30	0.35	50	1- 7	"	c., "
007	70-	40-	25	0.40	130	1- 8	"	c., tuff
008	85-	70-	20	0.40	170	1- 5	"	c., "
009	70-	60-	40	0.30	100	2- 6	"	c., lapilli tuff
010	70-	50-	15	0.25	70	0- 3	"	c., basalt lava, fresh(?)
011	75-	70-	40	0.40	140	8- 18	"	c., phospholite
012	60-	40-	35	0.30	105	1- 11	"	c., "
013	105-	80-	30	0.20	120	0- 4	"	c., tuff
014	75-	70-	20	0.20	65	0- 6	"	c., lapilli tuff
015	90-	50-	30	0.30	140	1- 12	"	c., altered tuff
016	75-	30-	20	0.25	40	2- 11	"	c., phospholite
017	85-	60-	25	0.25	110	0- 12	"	c., altered lapilli tuff
018	30-	20-	15	0.20	15	1- 12	"	c., " " "
019	40-	30-	15	0.40	30	0- 1	"	c., pumice
020	50-	25-	10	0.30	15		"	c., "
021	80-	50-	15	0.40	50			scoria
022	80-	60-	50	0.35	160			"
023	55-	40-	35	0.25	30			"
024	45-	40-	20	0.25	60	0- 6	Mn-nodule	c., basic lava, fresh
025	60-	60-	35	0.35	90	0- 12	"	c., " " "
026	60-	55-	40	0.20	85	0- 15	"	c., " ", altered
027	45-	30-	20	0.25	30	0- 1	"	c., " ", fresh
028	65-	50-	35	0.60	150	No		lava, (andesitic?)
201	105-	90-	90	0.35	675	10- 30	Mn-nodule	c., basalt lava(pillow)
202	110-	95-	90	0.35	575	11- 20	"	c., " ", phospholite
203	110-	75-	70	0.30	550	17- 25	"	c., " "
204	90-	80-	60	0.35	460	7- 11	"	c., " " (pillow)
205	105-	80-	45	0.30	360	3- 13	"	c., " & lapilli tuff
206	75-	55-	40	0.35	220	3- 7	"	c., " lava (pillow)
207	80-	70-	35	0.40	250	3- 6	"	c., " "
208	70-	55-	50	0.30	210	3- 7	"	c., " "
209	85-	60-	50	0.35	240	3- 5	"	c., " "

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology & Remarks(Paleon- tological, etc.)
19B210	75-	60-	50	0.35	180	4- 7	Mn-nodule c., basalt lava
211	80-	70-	45	0.40	190	7- 14	"(layerd) c., " "
212	50-	50-	45	0.30	100	1- 2	" c., " "
213	65-	60-	45	0.30	150	1- 4	" c., " "
214				0.30	310	0- 5	" c., " "
215	65-	60-	50	0.30	180	3- 7	" c., " "
216	50-	50-	45	0.25	160	1- 5	" c., basalt lava, phospholite
217	50-	50-	40	0.40	80	7- 12	" c., basalt lava, alterd
218	70-	65-	40	0.30	185	3- 7	" c., " "
219	75-	70-	35	0.30	120	1- 2	" c., " "
220	55-	40-	25	0.30	60	3- 9	" c., " " (pillow?)
221	65-	50-	35	0.35	80	1- 2	" c., " " (pillow)
222	90-	80-	70	0.30	460	5- 12	" c., " " "
223	70-	50-	40	0.30	230	1- 3	" c., " "
224	100-	85-	70	0.40	480	9- 22	" c., " " (pillow)
225	65-	55-	35	0.30	180	1- 5	" c., " " , alterd
226	55-	50-	50	0.30	120	1- 5	" c., " " , lapilli
227	70-	55-	45	0.25	190	1- 3	" c., " "
228	80-	65-	55	0.30	160	1- 7	" c., " "
229	60-	50-	45	0.60	125	12- 18	" c., " "
230	55-	55-	50	0.30	120	5- 7	" c., " "(pillow?)
231	50-	50-	45	0.60	120	12- 18	" c., " "
232	80-	30-	20	0.40	80	2- 5	" c., " "
233	75-	60-	35	0.30	140	1- 2	" c., " " (pillow)
401	135-	110-	130	0.15	1250	50	Mn-nodule no core
402	115-	90-	90	0.40	830	13- 25	" c., basalt lava, alterd
403	110-	100-	100	0.40	700	4- 30	" c., phospholite
404	95-	90-	60	0.40	810	10- 35	" c., basalt lava
405	80-	70-	70	0.30	375	5- 35	" c., " " , alterd
406	90-	75-	70	0.40	430	15- 32	" c., " " "
407	70-	70-	60	0.50	305	30	" no core
408	85-	80-	60	0.40	430	11- 28	" c., tuff, alterd
409	80-	60-	50	0.40	205	12- 30	" c., basalt lava
410	60-	50-	40	0.60	115	13- 20	" c., tuff, alterd
411	100-	70-	50	0.40	230	6- 20	" c., basalt lava, alterd
412	60-	60-	25	0.40	75	8- 16	" c., phospholite
413	60-	60-	60	0.70	200	22- 30	" c., basalt

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
19B414	75-	50-	50	0.35	205	25	Mn-nodule	no core
415	60-	50-	50	0.70	140	17- 25	"	c., basalt lava, alterd
416	60-	55-	50	0.60	170	19- 22	"	c., " " & phos.
417	50-	50-	45	0.60	80	18- 22	"	c., " " "
418	65-	50-	50	0.60	190	18- 22	"	c., tuff, alterd
419	65-	60-	50	0.55	200	17- 25	"	c., basalt lava, alterd
420	70-	60-	50	0.35	200	13- 33	"	c., " " "
421	70-	60-	60	0.60	200	22- 28	"	c., " " "
422	45-	50-	50	0.60	90	15- 27	"	no core
423	55-	50-	40	0.50	105	11- 23	"	c., tuff
424	50-	50-	40	0.85	100	25	"	no core
425	50-	40-	40	0.60	90	20	"	"
426	45-	40-	35	0.60	60	10- 13	"	c., tuff
427	45-	45-	40	0.70	90	25	"	no core
428	60-	55-	55	0.85	110	6- 26	"	c., tuff
429	55-	45-	40	0.80	75	15- 20	"	c., phospholite
430	55-	45-	40	0.70	90	15- 20	"	c., "
431	50-	45-	40	0.70	80	15- 25	"	c., "
432	75-	65-	45	0.40	140	35	"	no core
433	50-	45-	30	0.40	70	30	"	"
434	40-	40-	40	0.80	50	13- 16	"	c., phospholite
435	55-	45-	45	0.60	75	7- 19	"	c., "
436	65-	45-	45	0.50	105	12- 19	"	c., lapilli tuff
437	55-	45-	45	0.80	100	25	"	no core
438	55-	55-	40	0.50	90	25	"	"
439	55-	55-	45	0.60	120	20- 26	"	c., basalt lava
440	50-	40-	35	0.65	65	11- 17	"	c., phospholite
441	65-	50-	35	0.40	95	30	"	no core
442	30-	25-	20	0.40	15	8- 12	"	c., basalt lava, alterd
443	40-	35-	25	0.60	30	20	"	no core
444	50-	35-	15	0.40	20	5	"	"
445	65-	20-	20	0.30	20	5	"	"
446	45-	40-	15	0.30	40	5	"	"
447	30-	25-	25	0.40	20	1- 12	"	c., tuff
448	60-	60-	25	0.35	80	5	"	no core
449	60-	50-	20	0.30	45	5	"	"
450	40-	30-	20	0.20	30	5	"	"
451	30-	25-	15	0.35	15	5	"	"

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &		Remarks(Paleontological, etc.)
	L	M	S						
19B601	80-	60-	55	0.40	240	8- 15	Mn-nodule	c., basalt lava(alterd,G)	
602	105-	70-	40	0.30	300	2- 5	"	c., basalt lava(?)( " , B)	
603	85-	70-	45	0.30	200	0- 4	"	c., " " ( " , G)	
604	55-	55-	40	0.30	200	0- 1	"	c., " " (?) ( " , B)	
605	80-	50-	45	0.40	200	2- 4	"	c., " " ( " , G)	
606	70-	35-	35	0.60	160	0- 2	"	c., " " ( " , G)	
607	65-	60-	50	0.50	220	10- 25	"	c., " " ( " , B)	
608	60-	55-	45	0.50	140	9- 15	"	c., " " ( " , G)	
609	60-	45-	40	0.60	140	12- 20	"	c., " " ( " , G)	
610	75-	50-	40	0.30	160	8- 18	"	c., " " ( " , G)	
611	55-	50-	45	0.35	130	3- 10	"	c., " " ( " , G)	
612	60-	55-	35	0.35	90	3- 5	"	c., " " ( " , BG)	
613	65-	55-	25	0.30	105	0- 1	"	c., " " ( " , BG)	
614	65-	45-	35	0.30	120	2- 6	"	c., " " ( " , B&G)	
615	60-	55-	45	0.30	105	4- 11	"	c., " " (?) ( " , B)	
616	55-	45-	35	0.35	90	2- 4	"	c., " " ( " , G)	
617	55-	45-	45	0.30	85	2- 10	"	c., " " ( " , B)	
618	45-	40-	35	0.80	60	5- 8	"	c., " " ( " , G)	
619	55-	40-	25	0.35	70	0- 1	"	c., " " (?) ( " , Y), phospholite	
701	85-	80-	50	0.30	280	0- 4	"	c., " " ( " , Y)	
702	65-	60-	50	0.30	220	0- 6	"	c., " " (?) ( " , B)	
703	75-	60-	45	0.35	230	10- 13	"	c., " " ( " , B)	
704	70-	55-	40	0.40	190	13- 19	"	c., " " ( " , Y)	
705	60-	40-	40	0.30	120		"	c., " " ( " , B)	
706	70-	35-	25	0.30	105	1- 5	"	c., " " ( " , B)	
707	65-	50-	45	0.35	160	4- 7	"	c., " " ( " , B)	
708	65-	60-	45	0.50	185	14- 18	"	c., " " ( " , B)	
709	65-	50-	50	0.60	160	11- 15	"	c., " " ( " , G)	
710	70-	40-	35	0.40	130	0- 2	"	c., " " ( " , Y)	
711	55-	30-	30	0.35	75	1- 2	"	c., " " ( " , Y)	
712	60-	40-	35	0.35	100	1- 2	"	c., " " ( " , B)	
713	60-	35-	30	0.25	80	1- 2	"	c., " "(partly alterd,B)	
714	65-	50-	35	0.35	65	2- 9	"	c., " "(alterd, B)	
715	70-	50-	30	0.35	120	8- 19	"	c., " "(alterd, BG)&phos.	
716	65-	50-	25	0.40	80	0- 1	"	c., " " (?) ( " , P)	
717	55-	50-	40	0.35	90	4- 7	"	c., " " ( " , B)	
718	50-	45-	40	0.50	100	10- 12	"	c., " "(partly alterd,B)	

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
19B719	55-	30-	25	0.35	60	0- 7	Mn-nodule	c., basalt lava(?) (alterd, B)
720	40-	35-	30	0.30	75	6- 8	"	c., " " (alterd, B)
721	40-	30-	25	0.30	85	2- 10	"	c., " " ( " , BG)
801	200-	135-	95	0.40	2180	1- 60	Mn-nodule	c., phospholite
802	65-	45-	20	0.35	75	1- 2	"	c., tuff (alterd, B)
803	95-	80-	65	0.40	385	13- 30	"	c., lapilli tuff(?) (alterd, Y)
804	120-	85-	30	0.40	405	4- 10	"	c., " " " ( " , W)
805	110-	70-	60	0.30	575	5- 20	"	c., " " " ( " , B)
806	80-	75-	50	0.30	360	1- 30	"	c., basalt lava (alterd, B)
807	85-	75-	55	0.60	280	16- 20	"	c., " " ( " , B)
808	75-	60-	55	0.35	220	3- 8	"	c., " " ( " , B)
809	85-	60-	40	0.45	195	10- 15	"	c., " " (?) ( " , B)
810	65-	35-	25	0.35	75	3- 10	"	c., phospholite & lapilli tuff
811	70-	50-	35	0.30	100	2- 6	"	c., lapilli tuff(?) (alterd, B)
812	65-	50-	30	0.30	90	4- 8	"	c., basalt lava (alterd, B)
813	55-	45-	40	0.35	85	6- 12	"	c., " " (?) ( " , Y)
814	75-	45-	40	0.35	110	1- 5	"	c., lapilli tuff ( " , W)
815	60-	50-	35	0.40	130	2- 8	"	c., tuff (?) (alterd, B)
816	60-	45-	40	0.35	145	6- 10	"	c., lapilli tuff(?) ( " , B)
817	80-	70-	35	0.35	180	5- 12	"	c., " " " ( " , B)
818	60-	55-	55	0.50	195	10- 16	"	c., tuff (?) (alterd, B)
819	50-	40-	35	0.35	80	6- 11	"	c., " " ( " , B)
820	65-	60-	45	0.35	250	2- 5	"	c., basalt lava (alterd, P)
821	50-	45-	45	0.40	130	3- 5	"	c., " " ( " , Y)
901					450	Small	Mn-nodules	
902					30	"	"	
903					600		Pine sand (pale brown)	

Abbreviations: c.=core, phos.=phospholite, B=brown, G=green,  
BG=brownish green, Y=yellow, P=pink, W=white.

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology	&	Remarks(Paleon-tological, etc.)
	L	M	S						
23B001	350-	300-	75	0.40	5800	thin layer	homogen. siltstone		bioturbated sand infilling veinlets
002	290-	175-	55	0.30	1500		breccia		
003	175-	125-	45	0.40	565		altered tf. siltstone		bored, filled w/sand
004	200-	95-	40	0.40	550		"		
005	225-	90-	35	0.40	550		"	, cgic.	bored
006	140-	125-	65	0.40	900		cgic. fine sandstone		
007	180-	105-	45	0.30	405		altered tf. siltstone		
008	135-	105-	65	0.50	570		bioturbated siltstone		veinlet
009	140-	95-	50	0.40	270		mud breccia		
010	145-	85-	30	0.30	150		altered tf. siltstone		
011	110-	85-	45	0.35	270		homogen. siltstone		
012	130-	70-	30	0.30	115		altered tf. siltstone		
013	115-	80-	60	0.50	285		homogen. siltstone		bioturbated?
014	105-	75-	50	0.25	220		mud breccia		
015	115-	95-	45	0.20	260		homogen. siltstone		Mn-disseminated sporadically
016	120-	70-	40	0.30	145		altered tf. siltstone		
017	105-	95-	25	0.35	155		"		
018	105-	70-	65	0.30	205		mud breccia		
019	120-	70-	30	0.30	125		siltstone & bored silts		microbored
020	100-	95-	45	0.35	190		homogen. siltstone w/clay layer		clayey layeres intercalated
021	105-	55-	40	0.40	155		homogen. siltstone		
022	70-	60-	35	0.35	80		tf. sandstone		
023	90-	50-	50	0.50	155		homogen. siltstone		tuffaceous
024	90-	85-	20	0.35	65		altered siltstone		
025	120-	75-	30	0.30	100		altered tf. siltstone		
026	85-	65-	40	0.35	135		homogen. siltstone		
027	115-	65-	35	0.30	140		homogen. tf. siltstone		w/cracks & veinlet Mn-scattered
028	90-	75-	35	0.25	95		homogen. siltstone		microbored at bottom
029	80-	70-	25	0.30	65		siltstone with sand breccia.		"
030	80-	60-	30	0.25	75		altered tf. siltstone		



Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
	L	M	S						
23B031	65-	40-	35	0.40	40		poorly sorted siltstone		pyroclastic grains scattered
032	75-	65-	25	0.30	50		siltstone		
033	75-	65-	25	0.35	70		homogen. siltstone		
034	95-	75-	25	0.20	60		altered tf. siltstone		microbored both sides
035	65-	50-	40	0.35	90		homogen. siltstone		veinlets
036	80-	75-	30	0.25	70		altered tf. siltstone		bored
037	90-	50-	20	0.35	55		"		microbored
038	75-	60-	35	0.30	100		tf. siltstone ("pseudobreccia")		veinlet pseudobreccia
039	95-	60-	20	0.30	55		altered tf. siltstone		microbored on bottom
040	85-	55-	20	0.30	55		"		"
041	80-	55-	30	0.30	80	2mm on top	homogen. siltstone (coarse)		disseminated with Mn
042	80-	45-	35	0.35	75	thin layer	"		"
043	65-	60-	40	0.30	65		"		"
044	60-	50-	25	0.35	45		altered tf. siltstone		
045	75-	55-	25	0.25	45		"		
046	75-	60-	15	0.25	30		"		
047	65-	40-	35	0.20	50		sandstone (muddy)		
048	70-	50-	25	0.20	35		homogen. siltstone		
049	70-	50-	10	0.25	20		altered tf. siltstone		microbored
050	60-	40-	25	0.25	30		SS. & silts. in contact		
051	75-	35-	20	0.30	15		homogen. siltstone		
052	70-	55-	25	0.25	40		"		Mn-scattered
053	80-	50-	20	0.20	35		altered tf. siltstone		microbored
054	80-	60-	15	0.20	35		"		carbonate chip (breccia) microbored
055	90-	35-	10	0.20	15		"		microbored
056	55-	40-	35	0.35	45		SS. & siltstone in contact		
057	55-	35-	20	0.30	15		fine sandstone		
058	55-	35-	20	0.25	15		altered tf. siltstone		
059	70-	35-	10	0.25	5		"		microbored

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleon-tological, etc.)
23B060	55-	35-	25	0.20	15		homogen. siltstone	
061	60-	40-	20	0.25	15		"	
101	340-	150-	80	0.35	2200			bored in filled w/mud
102	255-	150-	65	0.35	1700		bioturbated siltstone	
103	150-	115-	95	0.30	1005		mud conglomerate (breccia)	matrix tf.?
104	110-	55-	45	0.30	140		siltstone with /tf.??	
105	110-	60-	30	0.30	90		conglomerate	top bored
106	90-	40-	20	0.30	40		altered tf. siltstone	bottom; microbored
107	75-	70-	20	0.25	50	2mm on top	mud conglomerate	
108	85-	45-	20	0.25	45		mudstone, conglomerate in contact	
109	70-	40-	15	0.25	15		altered tf. siltstone	microbored
110	50-	45-	30	0.20	45		mud conglomerate	same as No.103
111	55-	35-	20	0.25	20		siltstone, sandstone in contact	
112	75-	50-	20	0.35	40		altered tf. siltstone	
201	230-	170-	75	0.50	1800		tuff, same as No.001.	veinlet & sand
202	280-	165-	40	0.40	1285		tuff	veinlets (apparently breccia like)
203	105-	95-	60	0.40	320		tuff, network veinlets	"
204	85-	75-	70	0.50	245		"	"
205	115-	60-	45	0.35	145		"	"
206	90-	60-	40	0.30	150		homogen. siltstone	
207	85-	60-	35	0.40	110		fine sandy tuff	
208	65-	60-	30	0.35	50		veinlet tuff	
209	80-	50-	50	0.30	120		mud conglomerate (tuffaceous)	angular breccia 1-8mm in diameter
210	80-	75-	35	0.35	85		homogen. tuff	microbored
211	65-	35-	20	0.30	15		siltstone	
212	70-	45-	20	0.20	25		medium sand tuff	
213	55-	45-	30	0.20	40	1mm on top	mud breccia	matrix sand
214	55-	40-	35	0.35	30		homogen. tf. siltstone	
215	60-	45-	30	0.40	25		tuff	

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
23B301	155-	110-	45	0.35	390		mudstone (same as No.101)	ichnofossils microbored
302	140-	115-	30	0.25	305		altered tf. siltstone	bored, microbored microbored & trails
303	155-	80-	45	0.25	250		trails on siltstone	bored & microbored
304	175-	55-	25	0.30	165		altered tf. siltstone	microbored
305	120-	65-	40	0.20	130		"	trails bores & microbores
306	115-	80-	35	0.50	200		"	(cgic.)
307	115-	95-	45	0.30	160		"	trails, macrobore & microbores
308	120-	60-	25	0.30	100		trails (cgic.)	microbored on bottom 5mm thick
309	100-	70-	35	0.30	105	filmy	altered tf. siltstone	siltstone, mudstone in contact
310	90-	70-	25	0.30	75		homogen. siltstone	
311	80-	65-	30	0.25	50		altered tf. siltstone	bottom microbored
312	75-	60-	25	0.30	55		homogen. mudstone	bored & microbored
313	70-	65-	20	0.20	40		altered tf. siltstone	bottom microbored
314	85-	55-	15	0.20	40		"	"
315	90-	55-	40	0.20	65		"	live Serpulids
316	80-	55-	20	0.25	40		"	
317	85-	55-	15	0.20	35		"	
318	100-	35-	20	0.30	45		mudstone, tuff in contact	
319	70-	70-	25	0.20	50		homogen. siltstone	microbored thoroughly
320	80-	65-	20	0.20	40		altered tf. siltstone	trails microbored
321	90-	35-	10	0.25	20		"	"
322	50-	35-	30	0.30	15		homogen. mudstone	
401	30-	30-	20	0.35	15		cemented cgic. sandstone	with shell

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
	L	M	S						
23B501	220-	125-	60	0.30	1280		mudstone & siltstone		veneered with mud bored
502	165-	100-	30	0.30	510		altered tf. siltstone		veneered with mud microbored
503	150-	90-	70	0.20	480		tuff (network veinlets)		veneered with mud (same as 203,204)
504	90-	90-	25	0.25	155		trails on siltstone		microbored
505							fragments		"
601					4500		mud		3 lit.

Abbreviations: tf.=tuff or tuffaceous, w/=with, homogen.=homogeneous  
cgic.=conglomeratic, volc.=volcanic, silts.=siltstone,  
sands.=sandstone.

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
25B001	325-	195-	90		3000		grainstone, loosely cemented globigerinids	
002	265-	170-	95		2000		grainstone, globigerinids	
003	180-	130-	70	0.50	2000		grainstone, indurated globigerinids	older(?) much bored indurated & thickly Mn coated
004	155-	130-	85	0.60	1600		"	"
005	130-	95-	65		390		grainstone, globigerinids	soft
006	150-	100-	80		490		"	"
007	135-	80-	50		390		"	"
008	120-	110-	65		315		"	"
009	125-	75-	55		280		"	"
010	110-	100-	40	0.45	200		"	indurated, bored
011	95-	70-	50		60		"	soft
012	70-	55-	25		40		"	" piece
013	65-	45-	25		50		"	"
014	70-	40-	35		45		"	"
015	75-	40-	25		40		"	"
016	70-	35-	30		40		"	"
021	60-	55-	30	0.45	40		pumice	Mn-stained
031*	420-	330-	70	0.35	6300	+	Mn-nodules (core altered volcanic rock)	palagonitized core brown, compact, bored
032	380-	370-	70	0.45	6000	+	( " )	bottom thin coat
033	345-	160-	85	0.55	5500	+	loosely cemented grainstone	
034	290-	240-	70	0.45	3500	+	core, "	bored top mamillated
035	360-	175-	45	0.35	2500	+		
036	240-	200-	65	0.35	2200	+	Mn-nodule (no cutting)	mamillated top convex
037	270-	175-	70	0.35	2000	+	Mn-nodule (palagonitized volc. rock)	fairly smooth surface
038	255-	240-	55	0.35	2000	+	Mn-nodule (no core left)	mamillated
039	260-	240-	150		5000	+	Mn-nodule	significantly convex

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleon-tological, etc.)
25B040*	225-	160-	65	0.40	2000	+	Mn-nodule (core palago. volc. rock)	mamillated
041	240-	185-	50	0.35	1500	+	altered basalt	mamillated with flat top
042	269-	195-	35	0.35	2000	+	altered (almost basalt gone)	top. mamillated
043	190-	170-	45	0.30	1400	+	Mn-nodule (no core)	
044	190-	165-	60	0.25	1205	+	" (palago. basalt)	
045	160-	130-	85	0.55	1160	+	" (no cutting)	
046	220-	145-	125	0.60	3000	+	replaum (without core)	infilled with loose formed ooze
047	160-	125-	100	0.55	2000	+	loosely cemented replaum ooze	
048	130-	105-	95	0.60	1125	+	loosely cemented ooze	
049	175-	130-	85	0.45	1600	+	"	concave
050	160-	110-	50		880	+	"	fragment
051	195-	160-	45		985	+	without core	"
052	210-	160-	45	0.40	1395	+	smooth surface (without core)	
053	200-	150-	50		1010	+	bottom (carbonate?) (without core)	fragment
054	140-	130-	40		760	+	(without core)	"
055	200-	100-	45	0.35	850	+	( " )	mamillated
056	135-	90-	85	0.60	1150	+	(round) no cutting	
057	145-	140-	35		560	+	(without core)	fragment, mamillated crust
058	135-	95-	35		370	+	altered basalt	fragment, mamillated crust
059	125-	105-	55	0.40	550	+	"	concave top mamillated
060	160-	100-	50	0.40	620	+	Mn-nodule (without core)	concave
061	215-	160-	40		1210	+	" ( " )	fragment
062	145-	130-	75	0.30	890	+	no cutting	concave (ashtray)
063	165-	160-	55	0.40	935	+	(no core)	
064	150-	70-	70		510	+	replaced(without core)	fragment
065	170-	140-	50		605	+	( " )	"
066	150-	90-	35	0.35	415	+	(no core left)	
067	170-	135-	65	0.45	1230	+	no cutting	

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Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
25B068*	200-	95-	55		995	+	(altered basalt)		fragment
069	170-	110-	45	0.30	555	+	(without core)		
070	210-	160-	60		1800	+	(altered basalt)		fragment
071	125-	100-	80	0.55	795	+	no cutting		
072	195-	110-	40	0.30	615	+	(without core)		
073	135-	95-	50		375	+	(altered basalt)		
074	145-	105-	45		305	+			fragment
075	150-	120-	40		505	+	(without core)		
076	180-	110-	40	0.25	420	+	altered basalt		
077	145-	120-	40		600	+	palagonized basalt		fragment
078	170-	100-	40		510	+	(without core)		"
079	155-	105-	40	0.35	515	+	( " )		
080	130-	115-	50	0.40	525	+	( " )		
081	130-	80-	45		510	+	( " )		fragment
082	150-	100-	20		285	+	( " )		"
083	165-	95-	60	0.50	695	+	( " )		
084	130-	115-	50	0.40	500	+	no cutting		
085	120-	110-	50		350	+	(without core)		
086	165-	95-	45		540	+	( " )		
087	150-	95-	50		500	+	( " )		
088	135-	105-	40		490	+	(no core)		
089	130-	110-	40		445	+	basalt?		
090	110-	105-	40	0.40	420	+	no cutting		
091	100-	80-	45	0.30	215	+	basalt?		
092	110-	80-	25	0.35	160	+	"		
093	95-	90-	30		175	+	"		
094	90-	80-	30	0.35	170	+	no cutting		
095	105-	90-	35		195	+	"		
096	120-	90-	25	0.35	265	+	"		
097	115-	80-	30		230	+	basalt?		
098	120-	45-	35		150	+	no core		
099	120-	75-	60	0.45	400	+	palagonite basalt		
100	100-	95-	50		305	+	no core		
101	120-	70-	45		305	+	"		

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Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology & Remarks(Paleontological, etc.)
25B102*	105-	80-	45		250	+	basalt
103	95-	70-	45		210	+	no core
104	100-	95-	40	0.40	240	+	no cutting
105	125-	110-	30		260	+	no core
106	105-	100-	40	0.35	250	+	"
107	135-	60-	30		295	+	"
108	100-	80-	40	0.40	260	+	Mn-nodule loosely cemented ooze
109	105-	70-	45	0.40	230	+	" (altered basalt)
110	115-	90-	30		230	+	"
111	100-	90-	40		220	+	loosely cemented ooze
112	100-	75-	35	0.35	165	+	(altered basalt)
113	80-	75-	35		195	+	(no core left)
114	90-	60-	40	0.40	195	+	(altered basalt)
115	90-	80-	40	0.45	185	+	loosely cemented ooze
116	100-	55-	45	0.45	195	+	" (no core left)
117	95-	65-	35	0.55	180	+	"
118	90-	75-	20	0.35	135	+	(altered basalt)
119	100-	70-	30	0.35	165	+	( " )
120	85-	75-	30	0.40	130	+	(no core left)
121	95-	80-	25	0.45	205	+	( " )
122	95-	65-	30	0.30	140	+	altered basalt
123	90-	65-	25	0.35	130	+	(no core left)
124	100-	65-	35	0.30	160	+	altered basalt
125	95-	65-	35		190	+	(no core left)
126	100-	65-	50	0.35	165	+	altered basalt?
127	120-	85-	45		260	+	"
128	110-	75-	35	0.30	130	+	(no core left)
129	105-	65-	40	0.35	200	+	altered basalt?
130	130-	85-	40	0.35	290	+	"
131	160-	75-	30		145	+	basalt?
132	115-	75-	25	0.30	160	+	Mn-nodule altered basalt?
133	115-	70-	20	0.30	140	+	altered basalt
134	105-	60-	30	0.35	180	+	no core
135	100-	80-	50	0.35	215	+	loosely cemented ooze

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Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
25B136*	90-	75-	30		130	+	some basalt ?	
137	100-	80-	45	0.35	240	+	altered basalt	
138	90-	75-	35	0.30	155	+	no cutting	
139	90-	70-	40	0.35	165	+	no core	
140	105-	65-	40		210	+	altered basalt	
141	100-	80-	30		160	+	"	
142	85-	55-	40	0.45	205	+	(altered core ??)	
143	85-	50-	30	0.45	155	+	no cutting	
144	80-	75-	25	0.35	100	+	no core	
145	90-	80-	35		230	+	basalt ?	
146	80-	65-	45	0.55	225	+	core loosely cemented grainstone	
147	90-	80-	35		195	+	no core	
148	100-	80-	25	0.30	140	+	"	
149	80-	70-	25	0.30	110	+	basalt ?	
150	80-	50-	25	0.40	110	+	"	
151	95-	50-	30		110	+	no core	
152	80-	60-	30	0.45	140	+	no cutting	
153	100-	70-	25	0.40	150	+	"	
154	90-	55-	25	0.40	120	+	"	
155	85-	70-	25	0.35	125	+	no core	
156	75-	55-	25	0.40	120	+	Mn-nodule no core	
157	90-	55-	30	0.40	130	+	no core	
158	90-	55-	30	0.30	115	+	"	
159	80-	60-	25	0.40	120	+	"	
160	70-	40-	35	0.50	105	+	altered basalt	
161	75-	60-	30		100	+	no core	fragment
162	65-	50-	35	0.50	115	+	loosely cemented ooze	
163	95-	60-	35	0.40	200	+	no cutting	
164	90-	75-	40		160	+	no core	fragment
165	85-	60-	25		115	+	basalt ?	"
166	105-	50-	30	0.35	145	+	no core	knobbly
167	90-	50-	30	0.40	130	+	"	"
168	65-	50-	40	0.60	120	+	"	"
169	85-	50-	25	0.35	90	+	"	"

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology	&	Remarks (Paleontological, etc.)
	L	M	S						
25B170*	90-	60-	35	0.40	125	+	no core		knobly
171	75-	70-	25		85	+	"		fragment
172	80-	65-	40	0.50	165	+	basalt ?		
173	80-	60-	20	0.25	95	+	no core		
174	85-	70-	25		100	+	altered basalt ?		
175	95-	95-	20	0.35	145	+	"		
176	65-	55-	35	0.50	130	+	"		
177	75-	60-	30	0.40	140	+	"		concave
178	80-	60-	45		120	+	loosely cemented ooze		fragment
179	70-	55-	35	0.45	135	+	altered basalt ?		
180	80-	50-	30		90	+	Mn-nodule basalt		fragment
181	75-	65-	50	0.45	145	+	no core		
182	65-	65-	30	0.40	125	+	altered basalt ?		
183	60-	60-	30	0.45	110	+	no core		
184	75-	65-	20	0.25	75	+	"		
185	70-	55-	35	0.35	115	+	basalt		
186	70-	65-	45	0.55	180	+	loosely cemented ooze		
187	65-	65-	25	0.40	85	+	no cutting		central hollow
188	70-	50-	40		100	+	no core		fragment
189	80-	55-	25		110	+	altered basalt ?		"
190	95-	50-	20		80	+	no core		"
191	95-	70-	30	0.30	160	+	altered basalt ?		
192	65-	50-	30	0.40	95	+	"		
193	90-	70-	40		155	+	no core		fragment
194	80-	65-	25	0.40	115	+	no core		
195	80-	70-	35	0.40	110	+	altered basalt ?		
196	85-	60-	25		80	+	"		fragment
197	90-	65-	25	0.25	100	+	no core		
198	65-	45-	40	0.55	105	+	loosely cemented ooze		
199	85-	65-	40	0.55	175	+	"		
200	70-	55-	25	0.35	65	+	altered basalt ?		
201	75-	50-	25	0.35	100	+	"		
202	75-	55-	25	0.35	85	+	no core		
203	80-	55-	20		100	+	altered basalt ?		fragment

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
25B204*	75-	55-	35		85	+	Mn-nodule, no core	fragment
205	75-	55-	35	0.50	130	+	basalt ?	
206	85-	65-	25	0.40	115	+	"	
207	75-	55-	30	0.35	120	+	no core	concave
208	75-	45-	25		65	+	basalt ?	fragment
209	90-	70-	25	0.35	125	+	"	central hollow
210	80-	70-	30	0.40	115	+	"	
211	85-	70-	30	0.35	150	+	no core	
212	90-	45-	25	0.40	140	+	"	
213	80-	50-	40	0.30	110	+	basalt ?	
214	95-	50-	40	0.20	115	+	altered basalt ?	concave
215	70-	60-	40	0.50	135	+	basalt ?	
216	90-	60-	30	0.40	140	+	"	
217	85-	65-	25		95	+	"	
218	80-	55-	25	0.40	90	+	"	
219	65-	65-	25	0.35	110	+	no core	
220	80-	55-	25	0.25	85	+	basalt ?	
221	75-	60-	40	0.35	105	+	"	
222	85-	60-	25	0.35	105	+	no core	concave
223	70-	45-	40	0.50	110	+	basalt ?	
224	75-	50-	45	0.55	165	+	loosely cemented ooze	
225	75-	65-	40	0.50	175	+	"	
226	90-	80-	25	0.40	120	+	"	
227	70-	45-	40	0.35	105	+	basalt ?	concave
228	95-	60-	20	0.30	85	+	Mn-nodule, basalt ?	knobby
229	55-	55-	35	0.45	105	+	basalt ?	"
230	80-	45-	35	0.35	110	+	no core	"
231	90-	55-	30	0.40	170	+	"	
232	95-	65-	25	0.35	120	+	basalt	
233	95-	80-	25	0.30	130	+	no core	
234	75-	50-	35	0.35	135	+	basalt ?	
235	70-	50-	30	0.45	95	+	"	
236	80-	65-	20	0.35	105	+	no core	
237	85-	75-	20	0.40	115	+	"	

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
25B238 *	85-	65-	20	0.30	90	+	basalt ?	
239	75-	60-	30	0.40	110	+	no core	
240	75-	55-	30	0.35	125	+	"	
241	85-	50-	25		100	+	basalt ?	fragment
242	90-	55-	25	0.30	120	+	no core	mamillated
243	75-	55-	20		75	+	basalt ?	fragment
244	60-	55-	30	0.35	65	+	basalt	
245	65-	50-	40	0.35	100	+	basalt ?	
246	70-	50-	30		80	+	basalt	fragment
247	85-	50-	30	0.35	90	+	no core	
248	65-	50-	40	0.50	135	+	"	
249	75-	45-	35		90	+	"	fragment
250	80-	60-	30	0.35	95	+	"	
251	70-	50-	40	0.40	125	+	basalt ?	
252	60-	55-	40	0.30	75	+	Mn-nodule, alt. basalt	mamillated
253	85-	50-	20		80	+	altered basalt	fragment
254	60-	50-	35	0.50	105	+	basalt ?	
255	75-	55-	35	0.90	90	+	basalt	
256	70-	50-	20	0.30	65	+	no core	
257	90-	45-	35	0.30	85	+	"	
258	60-	45-	35	0.40	85	+	"	
259	75-	60-	25	0.35	80	+	"	
260	65-	55-	40	0.40	120	+	basalt ?	
261	55-	45-	40	0.50	75	+	basalt	
262	70-	60-	30	0.35	100	+	no cutting	concave
263	85-	50-	35	0.35	100	+	basalt ?	
264	80-	60-	25	0.35	110	+	no core	knobby
265	70-	45-	25		70	+	"	
266	65-	50-	35	0.35	95	+	"	
267	65-	55-	40	0.40	125	+	basalt ?	
268	55-	50-	30	0.35	80	+	no core	
269	70-	50-	25	0.40	95	+	altered basalt	
270	60-	40-	35	0.60	90	+	no core	
271	65-	65-	20		80	+	"	

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology	&	Remarks(Paleon-tological, etc.)
	L	M	S						
25B272 *	75-	40-	30	0.50	90	+	no core		
273	70-	55-	25	0.40	95	+	"		
274	65-	55-	35	0.30	85	+	no cutting		concave
275	65-	45-	30	0.50	90	+	loosely cemented ooze		
276	50-	45-	35	0.50	80	+	Mn-nodule, no core		
277	55-	40-	30	0.50	75	+	loosely cemented ooze ?		
278	70-	35-	30	0.35	65	+	no core		
279	70-	50-	40	0.56	155	+	"		
280	75-	65-	25		70	+	basalt ?		fragment
281	70-	50-	25		70	+	no core		"
282	75-	45-	20		65	+	"		"
283	65-	50-	35	0.35	95	+	"		concave
284	75-	50-	35	0.40	90	+	no core		
285	90-	70-	45		125	+	loosely cemented ooze		fragment
286	55-	35-	35	0.50	75	+	basalt		
287	50-	45-	30	0.45	60	+	no core		
288	50-	45-	35	0.55	100	+	basalt		
289	70-	45-	40	0.35	90	+	no core		
290	70-	55-	30		80	+	basalt		fragment
291	65-	50-	30	0.40	85	+	no core		
292	55-	40-	35	0.55	80	+	"		
293	65-	50-	25		65	+	basalt		fragment
294	65-	45-	30		50	+	no core		"
295	70-	45-	40	0.60	130	+	basalt		
296	55-	45-	30	0.50	85	+	loosely cemented ooze		knobby
297	70-	40-	40	0.55	100	+	no core		
298	70-	40-	30	0.40	90	+	"		
299	70-	50-	30	0.45	115	+	basalt ?		
300	75-	45-	35	0.45	100	+	Mn-nodule, no core		knobby
301	75-	55-	30	0.40	105	+	no core		
302	85-	45-	30	0.40	100	+	"		
303	65-	60-	25		70	+	basalt		fragment
304	70-	55-	30	0.35	145	+	basalt ?		
305	55-	35-	30	0.40	80	+	no core		

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology	&	Remarks(Paleontological, etc.)
	L	M	S						
25B306*	75-	65-	15	0.35	75	+	no core		crest
307	80-	80-	30	0.40	115	+	"		concave
308	50-	50-	40	0.55	105	+	basalt ?		
309	60-	60-	25	0.40	90	+	"		concave
310	70-	60-	20	0.40	75	+	no core		
311	75-	50-	30	0.40	90	+	"		concave
312	70-	50-	30		65	+	altered basalt ?		fragment
313	60-	45-	40	0.55	100	+	basalt ?		
314	70-	55-	20		60	+	no core		fragment
315	65-	60-	25		80	+	"		"
316	65-	55-	25	0.40	80	+	"		concave
317	70-	40-	30		50	+	loosely cemented ooze		fragment
318	65-	40-	35	0.50	95	+	no core		
319	65-	50-	30	0.55	80	+	loosely cemented ooze		
320	65-	40-	35	0.45	75	+	"		
321	55-	45-	30	0.55	85	+	altered basalt ?		
322	75-	40-	35	0.40	95	+	no core		
323	60-	40-	35	0.55	85	+	"		
324	65-	55-	35	0.40	85	+	Mn-nodule, no cutting		concave(hollow)
325	60-	60-	40	0.50	110	+	no core		
326	70-	60-	30		85	+	"		fragment
327	70-	55-	35	0.40	110	+	basalt ?		concave
328	75-	70-	25		90	+	no core		fragment
329	65-	40-	30	0.40	65	+	"		
330	70-	40-	25		60	+	no cutting		fragment
331	65-	55-	40	0.40	105	+	no core		hollow, concave
332	80-	55-	35		110	+	"		fragment
333	70-	55-	35	0.50	345	+	"		
334	70-	30-	25		60	+	"		fragment
335	55-	40-	25	0.40	50	+	"		
336	60-	40-	35	0.55	65	+	loosely cemented ooze		
337	85-	45-	30		105	+	no core		
338	85-	55-	35	0.35	90	+	"		concave
339	55-	50-	40		75	+	"		fragment

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology	&	Remarks(Paleontological, etc.)
	L	M	S						
25B340*	60-	60-	35		90	+	no core		fragment
341	75-	60-	35	0.40	110	+	"		concave
342	75-	60-	40	0.55	190	+	altered basalt		surface mamillated
343	75-	65-	30	0.35	90	+	no core		
344	75-	65-	25	0.45	100	+	"		
345	75-	70-	35	0.35	95	+	"		
346	90-	60-	20	0.30	100	+	"		
347	70-	55-	40	0.50	115	+	"		
348	70-	45-	25		60	+	Mn-nodule, no core		fragment
349	60-	40-	30	0.55	75	+	altered basalt		
350	65-	45-	40		80	+	"		fragment
351	70-	40-	35	0.45	75	+	"		
352	70-	60-	30	0.40	95	+	no core		
353	55-	45-	35	0.55	80	+	basalt		
354	55-	45-	45	0.50	90	+	no core		
355	80-	65-	20	0.35	95	+	"		
356	70-	65-	30	0.40	120	+	altered basalt		
357	60-	40-	25		45	+	no core		fragment
358	65-	55-	30	0.50	125	+	altered basalt		
359	70-	50-	35		90	+	"		fragment
360	80-	50-	35	0.40	90	+	no core		concave
361	65-	45-	30	0.40	65	+	"		
362	55-	50-	35	0.50	80	+	loosely cemented ooze		
363	70-	55-	20		50	+	no core		fragment
364	55-	40-	30	0.55	65	+	"		
365	65-	55-	40	0.50	120	+	"		
366	75-	65-	25		70	+	loosely cemented ooze		
367	50-	45-	40	0.50	65	+	basalt ?		
368	70-	45-	25		55	+	no core		fragment
369	75-	50-	25		75	+	"		"
370	75-	40-	35	0.35	95	+	basalt		
371	65-	35-	35		80	+	basalt ?		fragment ?
372	60-	40-	25		65	+	Mn-nodule, no core		fragment
373	75-	55-	25		75	+	basalt		"

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
25B374 *	50-	30-	30	0.35	50	+	no core	
375	45-	40-	15		35	+	"	fragment "crust"
376	60-	50-	35		80	+	limestone	fragment, white
377	55-	45-	25		50	+	no core	" "
378	60-	30-	25		40	+	"	" "
379	65-	50-	30	0.35	75	+	"	
380	50-	40-	25	0.40	30	+	basalt ?	
381	60-	35-	15		35	+	no core	fragment
382	55-	45-	20	0.35	50	+	"	
383	55-	40-	25		30	+	loosely cemented ooze	fragment
384	60-	35-	25	0.40	50	+	no core	
385	55-	30-	25		40	+	basalt ?	fragment
386	60-	40-	30		60	+	no core	"
387	60-	35-	35	0.35	65	+	"	
388	55-	40-	25		40	+	"	fragment
389	70-	40-	25		55	+	basalt	"
390	40-	25-	25		30	+	"	"
391	55-	45-	30		40	+	"	"
392	55-	35-	35		50	+	no core	"
393	60-	35-	30		60	+	"	"
394	50-	40-	30		45	+	"	"
395	55-	40-	20	0.35	40	+	"	
396	50-	30-	20		25	+	Mn-nodule, no core	fragment
397	70-	45-	30	0.35	75	+	no core	concave
398	80-	55-	20	0.35	90	+	"	crest
399	50-	30-	20		30	+	"	fragment
400	55-	35-	25		55	+	"	"
401	75-	45-	25	0.40	60	+	"	
402	50-	30-	30	0.50	45	+	"	
403	60-	40-	30	0.50	70	+	"	
404	50-	45-	25	0.45	40	+	"	
405	50-	45-	35	0.55	75	+	"	
406	65-	65-	20	0.35	65	+	"	flat
407	45-	30-	30	0.55	45	+	"	

\* The samples from No. 031 to No. 448 are Mn-nodules.



Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology	&	Remarks(Paleon-tological, etc.)
	L	M	S						
25B408*	45-	40-	35		35	+	no core		fragment
409	70-	50-	30		60	+	"		"
410	55-	35-	30	0.45	60	+	basalt ?		
411	70-	45-	30		55	+	"		fragment
412	50-	40-	15		35	+	no core		"
413	55-	45-	20	0.40	40	+	"		
414	65-	40-	25		55	+	"		fragment
415	60-	45-	30		60	+	"		"
416	45-	30-	30		30	+	"		"
417	70-	30-	20		35	+	"		"
418	50-	40-	40	0.55	75	+	"		
419	70-	50-	30	0.35	90	+	white limestone		
420	55-	45-	30		45	+	Mn-nodule basalt		fragment
421	50-	35-	25	0.50	45	+	no core		
422	50-	35-	35	0.55	65	+	basalt ?		
423	60-	40-	25		50	+	no core		fragment
424	55-	45-	30	0.40	70	+	"		
425	40-	30-	30	0.35	30	+	"		
426	55-	45-	35	0.60	95	+	altered basalt ?		
427	65-	45-	15		40	+	no core		fragment
428	55-	40-	20-		60	+	"		"
429	65-	40-	25	0.35	60	+	"		
430	65-	45-	25		70	+	"		fragment
431	75-	55-	25	0.40	70	+	"		
432	50-	35-	20	0.40	35	+	"		
433	45-	40-	30	0.55	60	+	"		
434	55-	40-	40	0.55	80	+	"		
435	50-	35-	35		50	+	"		fragment
436	60-	50-	20		55	+	"		"
437	50-	40-	20		40	+	"		"
438	60-	40-	20		30	+	"		"
439	70-	50-	35	0.35	90	+	"		
440	70-	50-	20		60	+	"		fragment
441	50-	35-	35	0.55	60	+	"		

\* The samples from No. 031 to No. 448 are Mn-nodules.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
25B442*	60-	40-	25	0.40	50	+	no core	
443	55-	40-	30	0.35	55	+	"	
444	60-	35-	30		55	+	Mn-nodule, no core	fragment
445	45-	35-	20		40	+	no core	"
446	40-	30-	25	0.50	30	+	altered basalt	
447	55-	40-	30	0.35	45	+	no core	
448	60-	35-	25		40	+	"	fragment

\* The samples from No. 031 to No. 448 are Mn-nodules.

Abbreviations: volc.=volcanic, palago.=palagonite, alt.=altered.

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
25C001	240-	165-	155	0.45	4500	thin film only partly	wackestone		bored
002	195-	155-	130	0.55	4300	"	"		
003	155-	140-	95	0.60	1700	"	"		bored
004	175-	120-	60	0.35	930	"	"		" irregular
005	175-	115-	70	0.55	1100	"	"		
006	145-	90-	90	0.45	950	"	"		bored
007	210-	155-	45	0.50	1330	Mn-dissem. all over inside	"		"
008	185-	155-	20	0.45	840	1.0-1.5mm on top	"		well indurated
009	105-	100-	65	0.55	560	Mn-impreg.	"		indurated
010	95-	85-	60	0.60	610		"		bored
011	80-	55-	45	0.55	180		"		"
012	95-	60-	20	0.45	105	Mn-dissem. inside	"		
013	85-	70-	40	0.60	205	"	"		bored
014	90-	70-	55	0.65	295		"		
015	95-	70-	40	0.55	250		"		bored
016	75-	70-	55	0.60	255		"		"
021	350-	250-	190	0.35	17500	<sup>+</sup> crust	pillow basalt		nearly aphyric w/vesicules
022	370-	295-	85	0.25	11500	+	alkaline basalt		
023	270-	165-	135	0.45	4600	thick Mn- crust	"		
024	265-	160-	110	0.15	6200	+	"		
025	190-	120-	90	0.40	2700	thick crust	"		fresh
026	155-	100-	90	0.20	1180	+	"		
027	105-	70-	60	0.30	690	+	"		
028	115-	85-	60	0.30	510	thin filmy	basalt		
029	120-	90-	55	0.25	675	"	"		
030	90-	80-	70	0.30	450	"	"		
031	90-	80-	75	0.25	550	"	"		
032	95-	65-	60	0.25	490	"	"		

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
25C033	105-	65-	50	0.30	365	thin filmy	basalt		
034	120-	80-	50	0.15	440	"	"		
035	105-	70-	35	0.20	360	"	"		
036	85-	65-	60	0.35	300	"	"		
037	80-	60-	60	0.20	200	"	"		vesicules not flattened
038	70-	55-	30	0.20	100	"	"		
039	60-	50-	45	0.30	125	"	"		
041	135-	105-	90	0.25	1005	thin film	alt. basalt, green		
042	110-	100-	60	0.30	645	"	"		
043	150-	90-	75	0.35	890	thick crust	"		
044	90-	60-	35	0.45	210	"	alt. basalt, pale green		
045	70-	65-	35	0.50	170	"	"		
046	115-	75-	60	0.40	395	+	alt. basalt, brick brown		
047	185-	70-	35	0.45	190	thin film	"		
048	100-	70-	25	0.40	220	1.0-2.0mm crust	"		
049	(120)						alt. basalt, olive-colored		
051	160-	85-	55	0.40	705	+	FeMn-nodule		
052	115-	110-	55	0.50	630	+	"		(stromatolitic texture)
053	90-	70-	25	0.50	170	thick	"		
054	110-	95-	40	0.55	445	"	"		
055	85-	75-	35	0.60	250	100mm thick	"		
061	350-	290-	75	0.15	5500	only surface	FeMn-nodule (breccia)		knobby
062	245-	200-	60	0.20	2500	"	"		(phosphorite)
063	185-	160-	75	0.35	2000	"	"		( " )
064	140-	120-	75	0.40	1030	"	"		( " )
065	130-	100-	60	0.35	1045	"	"		( " )
066	150-	95-	50	0.25	715	thin filmy	"		( " )
067	165-	125-	50	0.20	1330	top surface only	"		( " )
068	90-	55-	50	0.35	255	"	"		( " )

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
25C069	85-	55-	40	0.35	245	top surface only	FeMn-nodule (phosphorite)	
070	100-	75-	35	0.35	280	+	"	"
071	70-	60-	25	0.40	160	top surface only	"	"
072	65-	55-	45	0.35	185	thin film	"	"
073	100-	70-	50	0.40	235	"	"	"
074	70-	55-	40	0.35	135	only partly	"	"
075	75-	65-	60	0.40	230	"	"	"
076	115-	105-	60	0.30	585	+	"	"
077	70-	50-	25	0.30	80		"	" (frag.)
078	130-	100-	45	0.60	710	+ crust	"	"

Abbreviations: dissem=disseminated, impreg.=impregnated.

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
31A01	430-	250-	120	0.30	11200	+	FeMn-nodule	c., alt. volc. breccia
02	330-	325-	170	0.35	14500	+	"	"(original rock retained?)
03	260-	195-	110	0.40	4250	+	"	c., alt. basalt
04	175-	155-	85	0.50	2000	+	"	"
05	155-	125-	70	0.55	1600	+	"	"
06	180-	145-	80	0.55	1600	+	"	"
07	80-	60-	45	0.55	215	+	"	c., no core left
08	180-	110-	60	0.25	685	+	"	c., phosph. carbon. rock
09	195-	105-	40	0.35	725	+	"	fragment c., carbon. rock
10	180-	125-	60	0.25	760	+ knobby	"	fragment "
11	150-	80-	40	0.30	275	+ lustious	"	c., phosph. carbon. rock
12	165-	105-	50	0.30	340	+ "	"	c., carbon. rock
13	150-	95-	65	0.25	355	+ knobby	"	"
14	170-	100-	55	0.35	520	+ "	"	"
15	165-	115-	30	0.30	340	+ lustious	"	"
16	125-	110-	45	0.30	270	+ "	"	"
17	130-	120-	50	0.30	300	+ lustrous only on top surface	"	"
18	95-	65-	40	0.35	120	+	"	"
19	130-	75-	40	0.40	265	+	"	"
20	130-	60-	25	0.30	95	+ flaky	"	
21	110-	60-	15	0.30	70	+ lustious	"	c., phosphorite
22	110-	60-	40	0.25	130	+ "	"	"
23	85-	70-	20	0.30	110	+	"	"
24	95-	60-	25	0.25	70	+ lustious	"	"
25	75-	50-	25	0.30	65	+	"	c., phosphorite
26	80-	60-	35		95	+	"	c., carbonate rock
27	70-	50-	15	0.30	50	+	"	c., phosphorite
28	70-	55-	20	0.35	50	+	"	c., no core left
29	65-	40-	15	0.30	30	+	"	c., phosphorite
30	65-	55-	10	0.30	25	+	"	"
31	70-	50-	20	0.25	35	+	"	c., carbonate rock
32	80-	45-	30	0.35	85	No	"	"
33	65-	45-	30	0.30	60	No	"	"
34	65-	60-	25	0.20	50	+ lustious	"	c., phosphorite
35	65-	40-	20	0.20	40	No	"	c., carbonate rock
36	85-	40-	10	0.25	30	+	"	c., phosphorite
37	80-	30-	20	0.25	30	+	"	"
38	75-	35-	20	0.30	45	No	"	c., carbonate rock

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology & Remarks(Paleon- tological, etc.)	
	L	M	S					
31A39	65-	40-	15	0.20	40	No	FeMn-nodule	c., carbonate rock
40	55-	45-	25	0.25	30	only filmy	coat	" c., carbon. rock
41	45-	40-	20	0.30	10	+	"	c., phosphorite
42	30-	20-	15	0.40	5	No	pumice	
43	20-	20-	10	0.40	5	No	"	
51					530	No	sand	
52					530	No	residual sand	
53								c., phosphorite (fragments)
54					355			" ( " )
55					270			" ( " )

Abbreviations: c.=core, alt.=alterd, volc.=volcanic, phosph.=phosphorite,  
carbon.=carbonate.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology	&	Remarks(Paleontological, etc.)
	L	M	S						
31B001	320-	250-	200	0.40	13800	+	FeMn-nodule		
002	335-	225-	180	0.45	15500	+	"		
011	580-	180-	180	0.50	16000	+ knobby	"		c., alt. basalt tf.
012	350-	205-	120	0.45	7000	+ "	"		c., alt. basalt lava
013	225-	150-	95	0.45	3200	+ "	"		"
014	190-	145-	120	0.45	3300	+	"		c., alt. basalt tf.
015	225-	130-	70	0.45	2000	50mm crust on top	"		c., alt. basalt lava
016	200-	145-	80	0.40	2000	20mm	"	"	c., alt. basalt tf.
017	155-	120-	35	0.40	785	+	"		"
018	135-	90-	75	0.45	930	5-10mm	"		"
019	135-	100-	60	0.50	855	10-20mm	"		"
020	125-	90-	60	0.50	460	+	"		"
021	115-	90-	50	0.50	515	+	"		" (Fe-Mn disseminated
022	130-	105-	70	0.45	640	20mm on top	"		" in core)
023	110-	100-	55		400	+	"		" (frag.)
024	105-	75-	55		315	+	"		c., alt. basalt lava
025	80-	55-	55	0.50	255	+	"		" (frag.)
026	110-	60-	60	0.45	325	+	"		c., micro-breccia
027	90-	60-	45	0.50	190	+	"		"
028	90-	60-	55		190	+	"		" (frag.)
029	90-	60-	45		135	+	"		c., alt. basalt tf.
030	85-	60-	30		140	+	"		" (frag.) (frag.)
031	65-	50-	35	0.50	95	+	"		"
032	85-	50-	40		135	+	"		" (frag.)
033	60-	45-	35	0.55	85	+	"		"
034	50-	45-	40		60	+	"		" (frag.)
035	90-	45-	40		130	+	"		" (frag.)
036	50-	45-	15		25	+	"		" (frag.)
037	40-	25-	15		10	+	"		" (frag.)
051	360-	250-	90	0.40	8500	+	"		c., phosphatized ls.
052	380-	200-	70	0.40	6000	+	"		c., alt. basalt tf.
053	330-	230-	85	0.45	7000	10-100mm	"		" (dendritic)
054	350-	255-	60	0.35	4700	+	"		"
055	255-	180-	135	0.45	3900	+	"		" (calcitic veinlets)
056	265-	180-	115	0.50	4500	+	"		"
057	180-	170-	75	0.50	1600	+	"		"



Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
31B058	210-	150-	60	0.40	1600	+	FeMn-nodule	c., alt.	basalt tf.
059	165-	135-	90	0.55	1700	+	"	"	"
060	280-	135-	100	0.45	3200	50-60mm	"	c., almost no core left	
061	185-	130-	60	0.45	1175	+	"	c., alt.	basalt tf.
062	180-	100-	80	0.40	1110	+	"	"	"
063	170-	150-	70	0.55	1500	+	"	" (Fe Mn disseminated	
064	220-	125-	50	0.40	1700	+	"	inside core)	
065	230-	95-	40	0.40	1025	+	"	c., almost no core left	
066	120-	95-	70	0.50	800	+	"	c., alt.	basalt tf.
067	150-	85-	55		810	+	"	c., phosph. ls.	
068	135-	95-	65	0.45	745	+	"	c., micro-breccia	
069	105-	85-	65		340	+	"	c., alt.	basalt tf.
070	100-	65-	55		260	+	"	c., micro-breccia	(frag.) "
071	85-	60-	35		160	10mm on top	"	c., alt.	basalt tf. "
072	120-	95-	55		480	10mm on top	"	c., phosphatized rock	"
073	120-	100-	40		485	+	"	"	" "
074	95-	85-	55		370	+	"	c., alt.	tf. "
075	95-	80-	70	0.45	420	+	"	"	"
076	85-	70-	50	0.45	225	+	"	" (breccia-like tex- ture)(diagenetic?)	
077	70-	55-	30		120	20mm on top	"	" (frag.)	
078	80-	60-	45		120	7mm on top	"	" (frag.)	
079	95-	85-	40		270	8mm on top	"	c., alt. tf. (stromatolite-like texture)(replacement), (frag.)	
080	85-	70-	30		160	+	"	c., alt. tf.	
081	80-	65-	35		160	10mm on top	"	"	
082	55-	55-	50	0.50	140	+	"	"	
083	75-	50-	45		90	7mm	"	" (frag.)	
084	75-	55-	35	0.50	100	1-8mm	"	"	
085	80-	55-	30	0.40	140	+	"	"	
086	80-	50-	40		110	10-20mm	"	" (frag.)	
087	90-	60-	35		155	+	"	" breccia? (frag.)	
088	65-	45-	30	0.40	70	10mm	"	"	
089	75-	40-	35		100	20mm on top	"	" (1/2; gift to governor)	
090	40-	25-	20		20	+	"	" (frag.) (frag.)	
091	130-	80-	50		485	+	"	"	"
092	80-	60-	30	0.40	120	2-8mm	"	c., alt.	tf?
093	85-	70-	40	0.50	190	2-3mm	"	c., alt.	tf.
094	85-	80-	25	0.40	145	1-4mm	"	"	
095	70-	50-	35	0.40	110	1-2mm	"	"	

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology	&	Remarks(Paleontological, etc.)
	L	M	S						
31B096	90-	50-	35		120	3mm on top	FeMn-nodule		c., alt. tf.
097	75-	50-	40		80	+	"		"
098	70-	45-	20		50	1-2mm on top	"		"
099	60-	45-	25		45	7-8mm on top	"		"
100	60-	40-	35		55	5mm on top	"		"
101	50-	35-	30		40	+	"		"
102	75-	45-	30	0.35	115	+	"		c., no core left
103	60-	40-	25		50	+	"		" (frag.)
104	65-	40-	35	0.45	90	8mm	"		c., alt. tf.
105	55-	40-	20		30	+ filmy	"		c., alt. carbonate rocks (frag.)
106					200	+	"		c., no core left [Gift to Governor]
111	320-	200-	45	0.35	2800	+	"		c., alt. carbonate rs.
112	180-	150-	70		1300	+	"		" (frag.)
113	135-	100-	55	0.40	830	+	"		" (megafossils)
114	110-	85-	55	0.35	675	+	"		"
115	100-	85-	45	0.35	440	+	"		"
116	100-	70-	40	0.40	345	+	"		c., tuff(?)
117	125-	75-	25	0.30	200	+	"		c., alt. carbonate rs.
118	100-	65-	30	0.35	220	+	"		" (breccia-like texture) (diagenetic)
119	85-	75-	45	0.45	280	+	"		"
120	100-	80-	45	0.35	315	+	"		"
121	60-	55-	35	0.50	150	+	"		"
122	50-	35-	30		65	+	"		" (frag.)
131	100-	80-	25	0.25	160	less than 1mm	"		c., wackestone
132	75-	55-	45	0.35	75	+	"		"
133	85-	55-	45		115	+	"		c., phosphatized
134	95-	55-	35	0.40	175	+	"		carbonate rock (frag.)
135	80-	65-	45	0.35	165	+	"		c., packstone
136	75-	55-	30	0.30	105	6-20mm	"		"
137	65-	55-	45		105	+	"		c., alt. carbonate
138	80-	65-	40	0.35	165	+	"		rock (frag.)
139	90-	65-	40	0.35	180	+	"		c., almost no core left
141	250-	225-	100		4200	+	"		" c., alt. carbonate rock (megafossils; frag.)

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology	&	Remarks(Paleon-tological, etc.)
	L	M	S						
31B151	130-	90-	35	0.35	320	10-20mm	FeMn-nodule	c.,	basaltic tuff
152	105-	70-	25		140	10-20mm	"		"
153	95-	60-	35	0.30	170	10-20mm	"		" (breccia?)
154	85-	65-	25	0.45	165	10-20mm	"		"
155	80-	50-	30		90	filmy coating	"		"
156	65-	60-	30	0.40	90	10-20mm	"		"
158	80-	60-	20	0.40	65	filmy coating	"		"
159	85-	65-	30	0.40	85	"	"	c.,	basaltic tuff
160	60-	50-	20	0.45	50	"	"		"
161	45-	30-	15		5	"	"		" (frag.)
162	30-	20-	10		3	"	"		" (frag.)
157	55-	45-	30		40	10-20mm	"		
171	85-	60-	50		110		pumice	(frag.)	
172	80-	55-	40	0.45	55		"		
173	65-	60-	35	0.40	60		"		
174	60-	40-	40	0.40	40		"		
175	50-	40-	35	0.35	30		"		
176	50-	40-	25		15		"	(frag.)	
177	50-	35-	25	0.35	15		"		
178	45-	35-	25	0.35	15		"		
179	40-	25-	20	0.40	10		"		
180	35-	25-	20	0.35	5		"		
181	30-	20-	15	0.35	3		"		
191	70-	60-	30	0.50	120			c., alt.	alkali-basalt
192	55-	50-	35	0.35	75			"	lava
201							sand		
202							FeMn-crust	c.,	fragments
203								c.,	loose fragments
204									"

Abbreviations: alt.=alterd, tf.=tuff, frag.=fragment, ls.=limestone,  
 phosph.=phosphorite.

Sample No.	Diameter(mm) L M S	Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology & Remarks(Paleon- tological, etc.)
32001	160-155-135	0.35	3400	2- 5	serpentinite ("hartzbergite" origin)
002	145-115- 85	0.35	1400	0- 3	"
003	105- 85- 60	0.35	590	0- 1	"
004	65- 55- 40	0.40	150	0- 1	"
005	110- 70- 40	0.35	200	0- 3	tufacious sandstone
006	90- 80- 55	0.30	270	0- 3	" "
007	70- 50- 40	0.30	140	0- 1	serpentinite
008	90- 75- 40	0.30	600	0- 1	"
009	65- 55- 40	0.40	230	0- 1	tuff breccia (silicified ?)
010	60- 45- 35	0.30	110	0- 2	basalt lava (aphyric)(fresh, gray)
011	60- 50- 45	0.40	140	0- 1	" " " " "
012	50- 40- 15	0.30	40	1- 3	" " " (silicified ?)
013	35- 30- 15	0.30	30	1- 2	" " " "
014	180-140- 90	0.20	1400	0- 1	lapilli tuff (stratified)
015	50- 40- 20	0.30	40	0- 1	serpentinite
016	105- 80- 35	0.40	230	1- 6	alterd lapilli tuff
017	110-100- 55	0.35	290	0- 7	tufaceous sandstone, basalt lava
018	125- 45- 40	0.60	110	0- 2	" "
019	230- 65- 40	0.10	190		scoria ? (unusual shape)
020	50- 50- 35	0.40	110	0- 1	serpentinite
101	170- 90- 75	0.60	455		pumice (white)
102	120- 90- 65	0.60	130		" (pale brown)
103	90- 60- 60	0.60	80		" (gray)
104	135-120- 60	0.35	310		" ( " )
105	95- 65- 50	0.40	125		" ( " )
106	95- 80- 50	0.40	50		" ( " )
107	90- 65- 50	0.40	70		" (pale brown)
108	100- 60- 55	0.35	145		" (white)
109	95- 60- 40	0.50	70		" (pale brown)
110	100- 80- 40	0.50	40		" (white)
111	90- 70- 50	0.40	105		" (dark gray)
112	70- 55- 50	0.30	25		" (pale brown)
113	95- 80- 50	0.40	85		" (white)
114	80- 55- 35	0.25	60		" (gray & white)
115	80- 55- 50	0.25	85		" (gray & white, layered)
116	75- 40- 35	0.35	25		" (gray)
117	70- 50- 45	0.50	35		" (white)

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
32 118	75-	35-	25	0.50	50		pumice (gray)	
119	70-	35-	30	0.50	15		" (white)	
120	60-	60-	40	0.40	35		" ( " )	
121	70-	35-	30	0.40	15		" ( " )	
122	55-	40-	35	0.30	20		" (gray)	
123	40-	35-	30	0.40	20		" (white)	
124	55-	40-	35	0.30	15		" ( " )	
125	60-	50-	35	0.40	25		" ( " )	
126	80-	60-	45	0.35	140		" ( " )	
127	70-	55-	50	0.35	80		" ( " )	
128	65-	65-	40	0.40	90		" ( " )	
129	55-	45-	35	0.35	30		" ( " )	
130	75-	70-	50	0.30	50		" (dark brown)	
131	60-	55-	40	0.40	30		" (white)	
132	60-	55-	30	0.35	40		" ( " )	
133	65-	55-	40	0.50	30		" (gray)	
134	50-	40-	35	0.35	40		" (pale brown)	
135	40-	35-	35	0.35	20		" (gray)	
136	65-	65-	50	0.50	30		" (white and pale brown)	
137	55-	40-	30	0.35	10		" (white)	
138	55-	40-	25	0.35	20		alterd tuff	
139	65-	60-	50	0.30	30		pumice (white)	
140	55-	50-	35	0.35	20		" (pale brown)	
141	60-	55-	35	0.30	30		" (white)	
142	65-	40-	40	0.30	40		" ( " )	
143	55-	45-	45	0.35	30		" (gray)	
144	55-	45-	40	0.40	30		" (gray and white, layered)	
145	65-	45-	40	0.35	20		" (pale brown)	
146	60-	45-	35	0.35	20		" ( " " )	
147	45-	40-	35	0.50	10		" ( " " )	
148	55-	45-	30	0.30	20		" (white)	
149	65-	65-	45	0.45	90		" (pale brown)	
150	50-	45-	35	0.40	10		" (white)	
151	65-	60-	40	0.35	40		" ( " )	
152	75-	50-	40	0.35	30		" ( " )	
153	65-	40-	35	0.40	35		" (gray)	
154	45-	30-	30	0.30	15		" (white)	
155	40-	40-	30	0.35	10		" ( " )	

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
32 156	80-	60-	25	0.40	40		pumice (pale brown to pink)	
157	55-	45-	35	0.30	10		" (white)	
158	45-	30-	25	0.35	20		" (white and gray)	
159	45-	45-	20	0.35	30		" ( " " )	
160	40-	20-	20	0.30	5		" (white)	
161	45-	45-	30	0.30	15		" ( " )	
162	60-	40-	25	0.35	50		" ( " )	
163	60-	50-	30	0.35	50		" (brown)	
164	55-	40-	20	0.35	30		" (white)	
165	50-	40-	30	0.30	35		" ( " )	
166	50-	35-	30	0.35	30		" ( " )	
167	45-	40-	35	0.35	30		" ( " )	
168	40-	40-	20	0.35	25		" (gray) (heavy)	
169	50-	35-	30	0.35	20		" ( " )	
170					90		5 pumices and tufaceous sandstone	
201	330-	230-	100	0.30	3700	0- 5	tufaceous mudstone	
202	250-	220-	115	0.20	4460		basalt lava, aa lava (?)	
203	260-	200-	80	0.40	2910	0- 1	tufaceous sandstone	
204	180-	150-	85	0.35	1300	0- 7	" "	
205	270-	200-	70	0.30	2600	0- 3	" mudstone	
206	210-	140-	90	0.30	1850	0- 6	" sandstone	
207	160-	120-	65	0.50	525		" siltstone	
208	120-	100-	55	0.50	335		" "	
209	140-	130-	55	0.30	545	0- 1	" sandstone	
210	160-	105-	50	0.60	380	0- 2	" "	
211	145-	80-	55	0.40	290	0- 1	" "	
212	140-	100-	35	0.40	170	0- 1	" "	
213	120-	105-	45	0.30	250	0- 1	" "	
214	125-	100-	25	0.30	285	0- 1	" "	
215	95-	85-	60	0.50	175	0- 1	" "	
216	100-	75-	35	0.40	155	0- 1	" siltstone	
217	250-	140-	65	0.30	1300	0- 1	" sandstone with volc. lap.	
218	170-	80-	65	0.40	475	0- 1	" sandstone	
219	140-	135-	45	0.40	505	0- 1	" siltstone	
220	105-	85-	45	0.30	270	0- 1	" "	
221	125-	115-	65	0.35	360	0- 1	" "	
222	105-	100-	60	0.30	355	0- 1	" sandstone	

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology	&	Remarks(Paleontological, etc.)
	L	M	S						
32 223	105-	90-	35	0.30	135	0- 1	tufaceous	sandstone	
224	110-	95-	45	0.35	175	0- 1	"	"	
225	90-	70-	55	0.40	140	0- 1	"	"	
226	105-	70-	45	0.35	160	0- 1	"	"	
227	130-	60-	40	0.40	145	0- 1	"	"	
228	110-	70-	35	0.40	120	No	"	"	
229	170-	130-	90	0.30	735	0- 7	"	"	
230	120-	110-	80	0.30	370	1- 3	"	"	
231	190-	90-	75	0.25	650	0- 5	"	"	
232	145-	115-	70	0.40	620	0- 1	"	"	
233	125-	120-	85	0.40	640	0- 1	"	"	
234	110-	95-	55	0.40	405	0- 1	"	"	
235	115-	80-	50	0.40	260	0- 1	"	"	
236	110-	70-	45	0.45	180	0- 1	"	"	
237	80-	70-	35	0.30	130	0- 1	"	"	
238	90-	70-	35	0.35	140	1- 7	"	"	(coarse)
239	70-	40-	40	0.35	120	0- 1	"	"	( " )
240	75-	35-	30	0.40	60	0- 1	"	"	
241	80-	65-	30	0.35	75	0- 1	"	"	
242	120-	100-	25	0.30	175	0- 4	"	"	
243	110-	85-	45	0.40	200	0- 1	"	"	
244	75-	60-	55	0.35	115	0- 1	"	"	
245	95-	45-	40	-	100	0- 1	"	"	
246	80-	70-	40	0.35	100	0- 1	"	"	
247	70-	60-	55	0.30	90	1- 2	"	"	
248	70-	55-	40	0.20	70	0- 1	"	"	(coarse)
249	65-	60-	25	0.30	75	0- 1	"	"	
250	70-	65-	35	0.30	70	0- 1	"	"	
251	65-	60-	45	0.60	55	No	"	"	
252	70-	55-	35	0.60	70	No	"	"	
253	95-	55-	40	0.50	60	0- 1	"	"	
254	70-	60-	40	0.35	70	0- 1	"	"	
255	60-	45-	25	0.40	35	0- 2	"	"	
256	50-	50-	30	0.60	35	0- 1	"	"	
257	70-	65-	15	0.40	50	0- 1	"	"	(coarse)
258	85-	65-	40	0.30	90	0- 2	"	"	
259	80-	50-	30	0.40	60	0- 1	"	"	
260	70-	55-	20	0.50	60	No	"	"	

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
32 261	70-	45-	35	0.50	55	0- 1	tufaceous sandstone		
262	80-	50-	35	0.35	60	No	"	"	
263	50-	40-	30	0.60	25	No	"	"	
264	70-	60-	60	P*	50	0- 3	"	"	
265	70-	50-	35	0.50	65	0- 1	"	"	
266	60-	50-	20	P	45	0- 4	"	"	
267	60-	50-	35	0.35	90	0- 1	"	"	(coarse)
268	100-	65-	30	P	110	0- 2	"	"	
269	85-	50-	30	0.40	70	0- 10	"	"	
270	55-	45-	25	0.40	35	0- 4	"	"	
271	70-	55-	25	P	40	0- 4	"	"	
272	60-	50-	25	0.30	30	0- 1	"	"	
273	95-	35-	30	0.35	65	0- 1	"	"	(coarse)
274	80-	45-	20	0.40	25	0- 1	"	"	
275	60-	40-	20	P	25	0- 1	"	"	
276	90-	35-	35	P	60	No	"	"	
277	60-	45-	15	P	25	0- 1	"	"	
278	65-	40-	30	0.35	25	0- 1	"	"	
279	55-	50-	25	0.40	25	0- 1	"	"	(coarse)
280	55-	40-	30	0.30	30	0- 1	"	"	
281	75-	45-	45	0.30	55	0- 1	"	"	
282	80-	50-	35	0.30	60	0- 1	"	"	
283	70-	40-	40	0.35	85	0- 1	"	"	(coarse)(dense)
284	80-	70-	45	P	85	0- 6	"	"	
285	65-	50-	35	0.40	70	0- 1	"	"	(coarse)
286	85-	45-	30	0.80	70	0- 1	"	"	
287	90-	60-	45	0.50	90	0- 2	"	"	
288	80-	80-	50	0.35	120	0- 2	"	"	
289	85-	80-	55	0.30	100	0- 2	"	"	
290	70-	50-	30	0.35	50	0- 1	"	"	
291	75-	55-	35	0.30	95	0- 1	"	"	
292	65-	60-	35	0.45	85	No	"	"	
293	95-	75-	15	0.20	85	0- 1	"	"	(coarse)
294	85-	55-	25	0.50	80	0- 1	"	"	
295	90-	60-	25	0.30	65	0- 1	"	"	
296	80-	55-	25	0.35	45	0- 1	"	"	
297	70-	55-	40	P	50	0- 3	"	"	
298	80-	40-	35	0.35	40	0- 2	"	"	



Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks (Paleontological, etc.)
	L	M	S					
32 299	85-	55-	40	0.50	75	0- 1	tufaceous sandstone	
300	80-	35-	30	0.40	50	0- 1	" "	
301	65-	40-	25	0.35	30	0- 1	" "	
302	80-	50-	30	0.35	65	0- 1	" "	(fine)
303	60-	45-	15	0.50	50	No	" "	
304	55-	50-	35	0.30	50	0- 1	" "	
305	100-	45-	35	0.25	95	0- 1	lapilli tuff (with gabbro?)	
306	45-	40-	40	0.25	25	0- 1	pumice (?) (white)	
307	50-	40-	25	0.40	10	0- 1	tufaceous sandstone	
308	50-	40-	25	0.40	20	0- 1	" "	
309	60-	30-	25	0.20	20	0- 1	" "	
310	50-	40-	20	0.40	25	0- 1	" "	
311	45-	30-	20	P	15	0- 3	" "	
312	45-	40-	15	P	15	0- 3	" "	
313	45-	40-	15	0.30	15	0- 1	" "	
314	45-	30-	30	0.35	15	0- 1	pumice	
315	30-	20-	20	0.15	15	0- 1	serpentinite	
316	40-	30-	10	0.25	10	0- 1	tufaceous sandstone	
317	45-	25-	5	0.45	10	3	Mn-nodule (no core)	
318	30-	30-	15	0.15	15	1	" (c., gabbro, fresh)	
319	30-	20-	15	0.15	10	1	" (c., " " )	
320	25-	25-	15	0.20	15	1	" (c., " " )	
321	30-	20-	15	0.15	10	1	" (c., serpentinite)	
322	25-	20-	20	0.30	10	1	" (c., gabbro, fresh)	
323	20-	20-	15	0.30	10	0- 1	" (c., basalt lava, fresh)	
324	30-	20-	15	0.20	10	1	serpentinite	
325	30-	20-	10	0.25	10	1	Mn-nodule (c., gabbro, fresh)	
326	30-	20-	15	0.25	10	1- 2	" (c., serpentinite)	
327	25-	25-	20	0.30	10	1- 2	" (c., altered basalt ?)	
328	25-	25-	15	0.30	10	0- 1	" (c., " " )	
329	25-	20-	15	0.35	10	0- 1	" (c., basalt lava)	
330	25-	15-	15	P	5	0- 1	" (c., serpentinite)	
331	20-	20-	15	0.30	5	1	" (c., gabbro, fresh)	
332	20-	15-	10	0.30	5	0- 1	" (c., altered basalt)	
333	15-	15-	10	0.30	0-5	0- 1	" (c., " " )	
334	20-	20-	15	0.40	0-5	1- 2	" (c., " " )	
335	15-	15-	10	0.35	0-5	1	" (c., basalt, fresh)	
336	15-	10-	10	0.40	0-5	3	" (no core)	

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
	L	M	S					
32 337	20-	10-	10	P	0-5	0- 1	alterd tuff	
338	15-	10-	10	0.40	0-5	0- 1	Mn-nodule (c., basalt lava, fresh)	
351					475		fragments of pyroclastic rocks	
352					65		"	" "
353					50		"	" "
354					1410		dark gray sand with granules	
401	130-	95-	80	0.30	570		scoria (brownish, dense)	
402	120-	105-	90	0.25	300		" ( " )	
403	120-	65-	50	0.30	225		" (dense)	
404	120-	85-	55	0.25	225		"	
405	115-	90-	55	0.20	200		"	
406	80-	80-	75	0.30	185		"	
407	90-	60-	60	0.30	105		"	
408	90-	60-	55	0.30	90		"	
409	85-	60-	55	0.25	150	0- 1	scoriaceous tuff (?) (brown)	
410	130-	90-	60	0.25	220	0- 1	" " " "	
411	70-	70-	30	0.25	70	0- 1	" " " "	
412	85-	50-	50	0.30	85		scoria	
413	80-	55-	50	0.20	160	0- 1	scoriaceous tuff (?) (brown)	
414	70-	70-	55	0.30	95		scoria with fragment of lava	
415	100-	70-	45	0.30	125	0- 1	scoriaceous tuff (?) (brown)	
416	70-	60-	55	0.25	70		scoria	
417	85-	55-	50	0.30	65		"	
418	80-	60-	55	0.30	95		"	
419	70-	60-	50	0.30	50		"	
420	60-	55-	50	0.30	70		"	
421	80-	50-	45	0.30	70		"	
422	70-	55-	45	0.30	70	0- 1	" (red)	
423	85-	60-	35	0.35	40		"	
424	80-	60-	30	0.30	70	0- 1	scoriaceous tuff (?) (brown)	
425	80-	45-	30	0.30	40		scoria (brown)	
426	60-	50-	35	0.30	45		"	
427	60-	45-	40	0.30	25		"	
428	65-	45-	40	0.30	40		" (brown)	
429	70-	55-	40	0.30	30		"	
430	55-	45-	30	0.35	35		scoriaceous tuff (?) (brown)	

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
	L	M	S					
32 431	65-	60-	35	0.30	55		scoriaceous tuff (?)	(brown)
432	60-	45-	40	0.25	30		scoria	(brown)
433	55-	45-	40	0.30	15		pumice	(gray)
434	55-	35-	30	0.30	25		scoria	
435	60-	45-	30	0.25	25		"	
436	55-	40-	35	0.25	30		"	(brown)
437	50-	45-	25	P	20		scoriaceous tuff (?)	(brown)
438	55-	40-	35	0.25	25		scoria	(brown)
439	55-	30-	15	0.25	10		"	
440	50-	30-	25	0.30	15		"	
441	50-	40-	20	0.30	20		"	(brown)
442	45-	35-	20	P	15	0- 1	scoriaceous tuff	(brown)
443	30-	30-	20	0.25	10		scoria	(brown)
444	50-	40-	35	0.25	35		"	
445	45-	45-	35	0.30	35		"	
446	60-	40-	30	0.30	25		"	
447	55-	40-	25	0.30	30		"	(brown)
448	50-	35-	35	0.25	20		"	
449	55-	35-	30	0.30	20		"	(brown)
450	45-	30-	30	0.25	25		"	
451	35-	35-	30	0.30	15		"	
452	35-	30-	20	0.30	15		"	
453	45-	30-	25	0.30	20		"	
454	40-	30-	20	0.25	15		"	
455	30-	25-	20	0.30	10		"	

Abbreviations: volc.=volcanic, lap.=lapilli.

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
33 01	140-115-115			0.30	2700	F1*	basalt lava	
02	150-145-110			0.35	2380	F1	" " (alterd, PG)	
03	145-130-105			0.35	1850	F3*	" "	
04	130- 75- 60			0.25	850	F1	"boninite" (fresh, black)	
05	165-120- 95			0.30	1325		basalt lava & lapilli tuff	
06	115-110-100			0.60	875	F2*	" " (alterd, PG)	
07	120- 85- 80			0.40	760	F2	" " ( " PG)	
08	115- 70- 60			0.30	525	F2	" " ( " PB)	
09	80- 70- 70			0.30	470	F2	" " (pillow)	
10	110- 80- 50			0.25	465	F2	" " (alterd, PG)	
11	190-135-100			0.30	2305	F1	" " ( " PG)	
12	135-135- 70			0.25	1040	F2	" "	
13	185-105- 75			0.15	1145	F2	basalt, volcanic breccia	
14	140-120- 85			0.20	1605	F1	dorelite (?)	
15	115- 95- 90			0.25	1025	F2	basalt lava & lapilli tuff	
16	180-100- 90			0.20	1475	F2	basalt lava (brecciated)	
17	140-120-115			0.30	2230	F2	" "	
18	125-110- 75			0.15	1360	F2	" " ( " )	
19	105- 75- 55			0.30	400	F3	lapilli tuff (alterd, DG)	
20	85- 80- 65			0.35	515	F2	basalt lava	
21	100- 95- 75			0.30	685	F3	tuff breccia (alterd, PG)	
22	120-110-100			0.25	905	F3	lapilli tuff (alter, gray)	
23	100- 80- 75			0.25	770	F2	" " ( " DG)	
24	140-100- 65			0.25	805	F1	" " ( " G)	
25	95- 70- 70			0.25	340	F2	basalt lava ( " PG)	
26	75- 65- 65			0.35	355	F2	" " ( " PG)	
27	80- 80- 50			0.35	330	F1	" " ( " PB)	
28	90- 70- 60			0.30	415	F1	" " (pillow?, alterd, PB)	
29	80- 70- 45			0.25	320	F2	lapilli tuff (fresh?, black)	
30	75- 60- 55			0.30	210	F3	basalt lava (alterd, PB)	
31	105- 70- 65			0.30	340	F3	tuff breccia ( " PB)	
32	110- 70- 65			0.30	410	F2	lapilli tuff ( " PG)	
33	75- 70- 50			0.35	305	F2	basalt lava ( " PB)	
34	85- 80- 70			0.30	360	F2	" " ( " PB)	
35	85- 80- 65			0.25	345	F1	" " (brecciated, alterd, DG)	
36	105- 70- 45			0.25	380	F1	" " (alterd, DG)	
37	95- 80- 55			0.30	320	F2	" " ( " DG)	
38	85- 70- 55			0.35	315	F3	" " ( " PG)	

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
33	39	85-	80-	65	0.35	370	F2	tuff breccia (alterd, PB)
40		80-	75-	65	0.25	360	F2	basalt lava ( " DG)
41		85-	50-	45	0.35	225		" " ( " B)
42		65-	60-	55	0.25	260	F3	tuff breccia ( " B)
43		80-	65-	60	0.30	280	F3	basalt lava ( " PG)
44		80-	65-	50	0.20	260	F1	tuff breccia ( " DG)
45		70-	55-	55	0.25	235	F2	" " ( " DG)
46		70-	55-	55	0.35	250	F2	basalt lava ( " B)
47		100-	60-	40	0.30	245	F2	" " (gray)
48		75-	60-	50	0.35	225	F1	" " (alterd, DG)
49		80-	45-	40	0.25	125	F3	" " ( " gray)
50		70-	55-	55	0.30	190	F2	" " ( " gray)
51		85-	60-	50	0.25	255	F1	" " ( " DG)
52		70-	50-	45	0.25	155	F2	" " ( " gray)
53		65-	60-	55	0.35	230	F2	" " ( " G)
54		80-	65-	40	0.30	200	F2	lapilli tuff ( " PB)
55		80-	55-	35	0.30	145	F3	" " ( " PG)
56		70-	65-	30	0.30	140	F3	basalt lava ( " DG)
57		70-	65-	35	0.25	200	F1	" " ( " PG)
58		60-	40-	40	0.30	115	F1	" " ( " DG)
59		60-	60-	55	0.40	160	F3	" "(?)( " B)(flow tex?)
60		70-	50-	45	0.30	200	F1	" " (fresh, gray)
61		85-	65-	45	0.35	185	F3	" " (alterd, PG)
62		65-	55-	50	0.35	195	F2	" " ( " PG)
63		65-	55-	45	0.35	115	F1	" " (fresh, gray)
64		70-	45-	40	0.25	115	F3	tuff breccia ( " gray)
65		75-	65-	55	0.30	210	F3	basalt lava (alterd, B)
66		65-	55-	55	0.35	140	F2	" " ( " B)
67		60-	50-	40	0.30	165	F1	" " ( " G)
68		65-	55-	40	0.20	135	F2	" " ( " DG)(brecciated)
69		60-	50-	40	0.25	110	F2	" " ( " DG & B)
70		65-	60-	35	0.30	150	F1	" "(pillow?)(alterd, DG)
71		80-	60-	40	0.30	175	F1	" " (alterd, G)
72		70-	55-	50	0.25	155	F3	tuff breccia ( " G)
73		65-	50-	50	0.25	145	F2	basalt lava ( " DG)(brecciated)
74		90-	55-	35	0.35	140	F2	" " ( " DG)
75		75-	60-	40	0.30	180	F2	" " (fresh, gray)
76		60-	55-	40	0.30	90		fine tuff (alterd, white)

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
33 77	70-	65-	45	0.20	125	F2	lapilli tuff	(alterd, DG)
78	70-	55-	50	0.25	145	F1	basalt lava	( " DG)(brecciated)
79	65-	55-	50	0.25	135	F1	" "	( " DG)
80	60-	50-	45	0.20	120	F3	lapilli tuff	(fresh, gray)
81	75-	55-	50	0.30	140	F3	" "	(alterd, PG)
82	80-	45-	25	0.25	165	F1	basalt lava	( " gray)
83	65-	55-	35	0.30	105	F1	" "	( " PG)
84	65-	55-	35	0.30	115	F2	" "	( " PG)
85	80-	50-	35	0.35	145	F3	" "	( " PG)
86	60-	50-	40	0.25	100	F2	" "	( " DG)
87	55-	55-	45	0.30	135	F3	" "	( " B)
88	65-	50-	30	0.30	100	F2	" "	( " PG)
89	55-	45-	40	0.30	170	F3	" "	( " DG)
90	70-	65-	40	0.25	120	F2	tuff breccia	(fresh, gray)
91	65-	50-	35	0.35	110	F3	basalt lava	(alterd, PG)
92	55-	45-	30	0.25	85	F1	" "	( " DG)
93	50-	50-	30	0.30	85	F2	" "	( " DG)
94	55-	40-	35	0.30	105	F1	" "	( " gray)
95	50-	50-	40	0.30	105	F1	" "	( " gray)(coarse)
96	55-	50-	40	0.25	90	F2	" "	( " G)
97	60-	50-	25	0.25	70	F1	" "	( " G)
98	65-	55-	30	0.25	115	F2	lapilli tuff	(fresh, gray)
99	55-	40-	35	0.30	75	F3	" "	(alterd, PB)
100	70-	50-	25	0.25	70	F1	basalt lava	(fresh, gray)
101	50-	45-	40	0.40	95	F3	" "	(alterd, G)
102	55-	40-	35	0.30	95	F3	" "	( " gray)
103	65-	40-	25	0.30	95	F2	tuff breccia	( " gray)
104	65-	50-	30	0.30	70	F3	" "	( " PG)
105	40-	35-	35	0.30	65	F1	basalt lava	( " PG)
106	60-	40-	30	0.25	50	F1	" "	( " DG)
107	60-	35-	30	0.25	50	F1	" "	( " DG)
108	55-	30-	25	0.25	50	F1	" "	( " G)
109	55-	45-	35	0.30	75	F3	" "	( " G)
110	60-	40-	35	0.30	80	F3	" "	(fresh, gray)
111	65-	45-	35	0.25	80	F1	" "	(alterd, DG)
112	60-	50-	35	0.20	105	F1	tuff breccia	( " PG)
113	55-	50-	30	0.25	90	F1	basalt lava	( " DG)
114	60-	40-	30	0.30	75	F1	" "	( " PG)

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
33 115	45-	40-	35	0.25	65	F2	basalt lava	(alterd, B)
116	70-	55-	35	0.30	95	F2	" "	(fresh, gray)
117	70-	50-	45	0.25	70	F1	tuff breccia	(alterd, B)
118	60-	45-	35	0.30	90	F2	basalt lava	( " B)
119	50-	40-	35	0.30	75	F3	" "	( " B)
120	45-	35-	35	0.30	60	F1	" "	( " G)
121	45-	40-	30	0.25	60	F2	" "	( " B)
122	45-	40-	25	0.30	50	F2	" "	( " DG)
123	45-	45-	35	0.25	50	F3	lapilli tuff	( " B)
124	50-	40-	30	0.35	30	F3	tuff	( " B)
125	45-	40-	30	0.30	50	F2	basalt lava	( " DG)
126	45-	40-	35	0.30	70	F3	" "	( " PB)
127	50-	45-	20	0.30	40	F1	" "	( " PG)
128	60-	40-	25	0.25	55	F2	" "	( " DG)
129	50-	45-	30	0.35	30	F3	tuff	( " PB)
130	50-	40-	30	0.25	40	F2	lapilli tuff	( " PB)
131	40-	40-	30	0.30	50	F3	basalt lava	( " PG)
132	55-	40-	30	0.30	50	F2	tuff	( " B)
133	50-	35-	35	0.25	45	F2	basalt lava	( " B)
134	45-	30-	30	0.30	45	F2	" "	( " B)
135	60-	45-	15	0.30	30	F3	" "	( " B)
136	40-	35-	25	0.25	30	F1	lapilli tuff	( " G)
137	40-	40-	25	0.30	30	F1	basalt lava	(fresh)(pillow?)
138	35-	25-	20	0.35	20	F1	" "	(alterd, PB)
139	40-	30-	25	0.25	25	F1	" "	( " DG)
140	35-	35-	25	0.25	35	F2	" "	(fresh, gray)
141	40-	40-	25	0.25	35	F2	lapilli tuff	(alterd, DG)
142	35-	35-	20	0.30	20	F1	basalt lava	( " G)
143	35-	30-	25	0.25	20	F1	" "	(fresh, gray)
144	35-	35-	25	0.25	25	F1	" "	(alterd, DG)
145	35-	30-	30	0.30	30	F1	" "	(fresh, gray)(pillow?)
146	55-	35-	20	0.30	30	F1	" "	(alterd, DG)
147	45-	30-	20	0.30	25	F2	" "	( " PB)
148	40-	30-	25	0.25	20	F2	" "	( " PB)
149	40-	25-	20	P	20	F1	" "	( " DG)
150	35-	30-	15	P	15	F2	" "	( " PG)
151	35-	30-	25	0.30	20	F1	tuff	( " PG)
152	40-	20-	20	P	20	F2	basalt lava	( " PG)

Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
33 153	35-	25-	20	0.25	15	F1	lapilli tuff	(fresh, gray)	
154	30-	30-	20	0.30	15	F2	" "	(alterd, PG)	
155	35-	25-	20	P*	20	F2	" "	( " B)	
156	25-	25-	15	P	10	F2	basalt lava	( " B)	
157				P	15	F2	lapilli tuff	( " B)	
158	45-	30-	15	P	20	F3	basalt lava	( " B)	
159	30-	20-	15	P	5		scoria		
160	25-	20-	20	0.35	10	F1	basalt lava	(alterd, G)	
161	35-	20-	15	0.25	10	F1	" "	(fresh, gray)(pillow?)	
162	25-	20-	15	0.30	10	F1	" "	(alterd, G)	
163	30-	20-	15	0.30	15	F2	" "	( " G)	
164	30-	20-	20	0.30	15	F1	" "	( " G)	
165	25-	20-	20	P	10	F1	" "	( " G)	
166	30-	20-	10	0.25	10	F1	" "	( " G)W/white matrix?	
167	30-	20-	20	0.30	10		" "	(fresh, gray)	
168	20-	20-	10	0.35	5	F2	" "	(alterd, PG)	
169	25-	20-	15	0.30	5	F2	" "	( " G)	
170	20-	15-	10	0.35	5	F2	" "	( " G)	
171	20-	20-	10	0.25	5		" "	( " DG)	
172	25-	20-	15	0.20	5	F1	" "	( " PG)	
173	20-	15-	10	0.25	5	F1	" "	( " PG)	
174	20-	10-	10	0.30	5	F3	" "	(fresh, gray)	
175	30-	25-	10	P	5		" "	(fresh, black) aa lava?	
176	20-	15-	10	0.35	5	F1	" "	(alterd, G) W/kig crystal?	
177				P	5	F2	" "	(fresh, gray)	
178	15-	15-	10	P	5	F2	" "	(alterd, G)	
179	25-	20-	10	P	5		" "	(fresh, black) aa lava?	
180	20-	15-	10	P	5	F2	lapilli tuff	(alterd, G)	
181	20-	15-	15	0.25	5	F1	basalt lava	( " PG)	
182	20-	15-	15	0.30	5	F2	" "	( " G)	
183	20-	20-	15	0.35	5	F3	" "	( " G)	
184	20-	15-	10	0.30	5	F1	" "	( " G)	
185	20-	10-	10	0.30	5	F1	" "	( " G)	
186	20-	10-	10	0.25	5	F1	tuff	( " G)	
187	20-	15-	10	P	5	F3	basalt lava	( " B) aa lava?	
188	20-	15-	10	0.25	5	F1	" "	( " G)	
189	20-	15-	10	P	5		" "	(fresh, black)	
190	20-	20-	10	0.30	5	F1	" "	(alterd, G)	



Sample No.	Diameter(mm) L M S			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
33 191	15-	15-	10	0.25	5	F1	basalt lava	(alterd, G)
192	20-	10-	10	0.30	5	F1	" "	( " G)
193	15-	15-	10	0.25	5	F1	" "	( " G)
194	20-	10-	10	P	5	F2	lapilli tuff	( " G)
195	15-	15-	10	0.30	5	F1	basalt lava	( " G)
196	15-	10-	5	P	5		" "	( " G)
197	20-	10-	10	0.25	5	F2	" "	(fresh, gray)
198	20-	10-	10	0.30	5	F1	" "	(alterd, G)
199					65		fragments of volcanic rock	

Abbreviations etc.: F=filmy Mn-corting, F1>F2>Fe, \*\*P=piece, W/=with,  
D=dark, P=pale, G=green, B=brown, tex.=texture.

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleon-tological, etc.)
	L	M	S					
34 01	410-280-160			0.30	12840	0- 4	tufaceous sandstone	
02	380-270-130			0.30	13230	0- 1	" siltstone	
03	250-180-110			0.30	4290	0- 1	" sandstone	
04	230-170-110			0.25	3320	0- 3	" " with volc. lapilli	
05	160-150- 95			0.30	2110		" "	
06	225-140- 60			0.30	1700	0- 1	" siltstone	
07	220-100- 75			0.25	1120	0- 1	" sandstone with volc. lapilli	
08	170-100- 80			0.25	1080	0- 1	" "	
09	180-100- 50			0.30	1180	0- 1	" "	
10	140-110- 50			0.30	550	0- 1	" siltstone with alterd volc.lap.	
11	135-100- 55			0.30	425	0- 1	" sandstone	
12	165-100- 65			0.30	665	0- 1	alterd lapilli tuff	
13	140-120- 55			0.30	715		tufaceous sandstone	
14	115-110- 55			0.30	540	0- 3	" "	
15	150-105- 35			0.35	405	0- 1	" "	
16	125-115- 45			0.25	340	0- 8	" "	
17	115- 85- 50			0.25	365	0- 1	" "	
18	90- 70- 60			0.30	405	0- 1	alterd basalt lava (brown)	
19	125- 60- 55			0.30	260	0- 1	alterd tuff (brown) with lamination	
20	80- 80- 60			0.30	310		tufaceous sandstone	
21	95- 60- 55			0.25	255	0- 1	alterd lapilli tuff	
22	90- 70- 65			0.25	375		" " "	
23	85- 65- 65			0.35	285		" tuff	
24	85- 70- 50			0.25	185	0- 1	" lapilli tuff	
25	75- 60- 45			0.25	140	0- 4	" " "	
26	75- 65- 40			0.30	75	0- 1	" " "	
27	75- 75- 60			0.30	155		scoria (fresh)	
28	80- 65- 50			0.30	185		tufaceous sandstone (lap. tuff?)	
29	75- 70- 30			0.30	70		" "	
30	60- 55- 35			0.35	95		" "	
31	70- 60- 35			0.30	115		" "	
32	70- 55- 25			0.30	85		" "	
33	70- 50- 30			0.25	70	0- 2	alterd lapilli tuff	
34	60- 40- 30			0.35	55		tufaceous sandstone	
35	65- 45- 35			0.30	70	0- 1	" "	
36	75- 50- 25			0.30	60	0- 1	" "	
37	80- 45- 20			0.30	55	0- 1	" "	
38	80- 50- 25			0.30	70	0- 1	" "	

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleon-tological, etc.)
34 39	65-	35-	20	0.25	30	0- 2	alterd lapilli tuff	
40	70-	55-	30	0.30	75	0- 1	tufaceous sandstone	
41	65-	50-	20	0.30	55	0- 1	" "	
42	60-	45-	30	0.30	60		" "	
43	45-	45-	30	0.35	50		" "	
44	50-	50-	20	0.35	35		" "	
45	55-	35-	20	0.35	35		" "	
46	70-	60-	25	0.30	135		" "	
47	45-	40-	25	0.30	40	0- 1	basalt lava (fresh, gray)	
48	45-	45-	25	0.30	25	0- 1	tufaceous sandstone	
49	55-	55-	35	0.30	90		" "	
50	50-	45-	40	0.30	60	0- 1	" "	
51	50-	35-	20	0.30	35	0- 1	" "	
52	70-	50-	30	0.30	55	0- 1	" "	
53	55-	40-	30	0.35	35	0- 1	" siltstone	
54	60-	45-	35	0.30	30	0- 1	pumice	
55	45-	35-	25	0.30	20		tufaceous siltstone	
56	40-	35-	25	0.30	20	0- 1	" sandstone	
57	40-	30-	25	0.30	15		" siltstone	
58					830		fragments of tufac. sands.& silts.	
59					1120		" " " "	

Abbreviations: volc.=volcanic, lap.=lapilli, tufac.=tufaceous,  
sands.=sandstone, silts.=siltstone.

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
3501	135-	105-	85	0.40	1075		rhodolith	
02	115-	70-	50	0.35	370		"	
03	100-	100-	85	0.45	935		"	
04	100-	90-	70	0.45	502		"	hollow core
05	130-	75-	45	0.30	408		"	
06	90-	75-	60	0.40	450		"	
07	80-	65-	65	0.45	425		"	
08	105-	70-	65	0.45	610		"	
09	55-	50-	45	0.45	145		"	
10	55-	50-	35	0.45	110		"	
11	60-	60-	40	0.45	165		"	
12	60-	50-	25	0.40	80		"	
13	75-	60-	45	0.45	240		"	bivalve core
14	55-	45-	40	0.40	115		"	
15	55-	45-	35	0.35	65		"	
16	50-	35-	20	0.35	50		"	
17	45-	30-	15	0.35			"	
21	120-	90-	75				sponge	
31	75-	45-	40	0.35	70		pumice	
32	60-	45-	40	0.40	65		"	

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology	&	Remarks(Paleon- tological, etc.)
	L	M	S						
37001	160-	110-	30	0.25	650		grainstone		
002	130-	90-	65	0.35	910		packstone		
003	135-	115-	55	0.25	625		grainstone		bivalve shell
004	120-	105-	25	0.30	360		"		
005	120-	100-	70	0.35	700		packstone		
006	100-	100-	65	0.36	665		rhodolith		
007	135-	130-	20	0.25	425		grainstone		
008	85-	80-	65	0.35	445		rhodolith		
009	95-	90-	65	0.35	520		"		
010	110-	90-	60	0.25	440		"		
011	105-	100-	65	0.30	615		"		
012	120-	100-	40	0.30	360		grainstone		
013	80-	70-	50	0.35	360		packstone		
014	100-	80-	35	0.35	380		grainstone		
015	100-	85-	60	0.35	440		rhodolith		
016	90-	80-	55	0.25	265		packstone		
017	90-	75-	65	0.40	440		"		
018	105-	75-	40	0.35	280		"		
019	125-	60-	45	0.20	370		rhodolith		
020	100-	65-	55	0.30	375		"		
021	100-	80-	40	0.35	325		"		
022	100-	90-	35	0.25	255		"		
023	80-	80-	75	0.35	365		"		
024	110-	60-	60	0.20	235		"		
025	80-	75-	55	0.35	425		"		
026	100-	75-	55	0.35	385		"		
027	95-	70-	60	0.35	400		"		
028	105-	60-	55	0.30	325		"		
029	80-	80-	60	0.40	295		"		
030	90-	75-	55	0.30	390		"		
031	80-	80-	60	0.35	365		"		
032	90-	75-	45	0.30	290		"		
033	95-	80-	50	0.35	270		grainstone		
034	115-	85-	25	0.30	230		"		

Sample No.	Diameter(mm)			Roundness	Wt(g)	Mn-coating(mm)	Lithology & Remarks(Paleontological, etc.)
	L	M	S				
37035	85-	70-	30	0.35	220		rhodolith
036	105-	80-	35		265		packstone
037	85-	85-	40	0.40	255		"
038	85-	85-	25	0.30	150		"
039	100-	75-	40	0.30	230		rhodolith
040	95-	65-	60	0.35	380		"
041	90-	80-	40	0.35	240		"
042	90-	65-	40	0.35	215		grainstone
043	80-	65-	50	0.35	205		rhodolith
044	95-	65-	50	0.35	250		"
045	85-	70-	55	0.30	280		"
046	95-	65-	60	0.25	200		"
047	100-	75-	35	0.30	205		packstone
048	85-	65-	25	0.30	160		"
049	90-	80-	45	0.30	220		rhodolith
050	90-	85-	40	0.35	210		packstone
051	95-	70-	55	0.30	220		rhodolith
052	90-	60-	35	0.40	220		"
053	75-	60-	40	0.40	185		"
054	90-	65-	35	0.30	205		"
055	105-	70-	35	0.30	185		packstone
056	85-	75-	45	0.35	230		rhodolith
057	90-	75-	50	0.35	295		"
058	100-	65-	50	0.30	345		grainstone
059	90-	70-	50	0.30	305		rhodolith
060	100-	75-	50	0.35	300		"
061	85-	85-	35	0.35	265		packstone w/rhodolith
062	90-	60-	40	0.30	245		rhodolith
063	90-	75-	30	0.30	200		grainstone
064	100-	70-	40	0.35	285		"
065	85-	55-	35	0.30	115		rhodolith w/hydrocoral
066	85-	60-	50	0.25	190		rhodolith
067	85-	70-	45	0.25	150		"
068	85-	65-	30	0.30	180		packstone

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleontological, etc.)
	L	M	S					
37069	115-	60-	45	0.25	320		rhodolith	
070	85-	70-	30	0.30	145		grainstone	
071	85-	80-	30	0.30	175		packstone	
072	95-	50-	45	0.35	185		"	
073	100-	65-	50	0.25	290		"	
074	80-	65-	50	0.30	210		rhodolith	
075	95-	60-	35	0.30	170		"	
076	80-	55-	45	0.35	215		"	
077	80-	60-	15	0.30	105		packstone	
078	90-	65-	25	0.30	170		"	
079	90-	60-	50	0.35	195		rhodolith	
080	95-	70-	45	0.35	255		"	
081	85-	60-	40	0.30	160		packstone	
082	85-	60-	20	0.35	110		"	
083	100-	70-	45	0.30	235		"	
084	70-	70-	40	0.35	170		"	
085								
086	80-	60-	45	0.35	195		rhodolith	
087	75-	60-	30	0.35	140		packstone	
088	90-	70-	30	0.30	165		rhodolith	
089	70-	50-	35	0.35	125		packstone	
090	85-	75-	25	0.35	205		"	
091	85-	80-	40	0.40	240		"	w/rhodolith
092	75-	70-	30	0.35	165		rhodolith	
093	80-	65-	35	0.35	145		"	
094	70-	50-	35	0.30	125		"	
095	60-	55-	45	0.35	210		"	
096	60-	55-	30	0.30	85		packstone	
097	70-	60-	40	0.35	135		rhodolith	
098	60-	60-	45	0.40	165		"	
099	60-	60-	40	0.35	205		"	
100	55-	45-	45	0.35	85		"	
101	75-	50-	50	0.30	160		"	
102	55-	55-	40	0.30	130		"	

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
	L	M	S					
37103	65-	50-	30	0.35	120		rhodoliths	
104	55-	40-	40	0.35	115		rhodolith	branching
105	75-	70-	30	0.35	140		"	
106	75-	65-	40	0.35	135		"	
107	65-	45-	45	0.40	195		"	
108	65-	55-	45	0.35	140		"	
109	75-	60-	40	0.30	150		"	
110	65-	55-	45	0.30	155		"	
111	50-	50-	40	0.30	95		"	
112	90-	50-	40	0.30	160		"	
113	60-	50-	40	0.35	115		"	
114	70-	60-	40	0.40	135		"	
115	50-	50-	45	0.40	120		"	



Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleon-tological, etc.)
3901	185-	90-	50	0.35	730		grainstone	
02	110-	95-	50	0.30	570		"	
03	120-	90-	20	0.25	195		"	
04	65-	55-	40	0.40	135		"	hollow core
05	85-	45-	35	0.35	145		"	
06	70-	45-	35	0.20	65		"	
07	85-	45-	20	0.30	100		"	
08	75-	55-	25	0.25	90		wackestone	
09	75-	75-	30	0.35	165		grainstone	bored
10	75-	45-	35	0.40	105		"	
11	95-	55-	30	0.25	80		"	
12	55-	45-	45	0.25	115		"	hollow core
13	45-	45-	40	0.45	85		"	bored
14	105-	80-	45	0.25	190		"	

Sample No.	Diameter(mm)			Round-ness	Wt(g)	Mn-coat-ing(mm)	Lithology &	Remarks(Paleontological, etc.)
4031	135-	105-	40	0.30	555		wackestone	
32	110-	60-	45	0.30	280		"	
33	70-	45-	30	0.35	95		"	
34	60-	60-	35		150		"	fragment
35	60-	55-	25	0.35	80		"	
36	65-	45-	20	0.30	75		"	
37	50-	45-	10		25		"	fragment
38	35-	30-	15		15		"	"
39	25-	20-	15		10		"	"

Sample No.	Diameter(mm)			Round- ness	Wt(g)	Mn-coat- ing(mm)	Lithology &	Remarks(Paleon- tological, etc.)
4301	180-	125-	70	0.30	750		tuff	bored
02	170-	90-	70	0.30	565		"	"
03	125-	75-	60	0.35	260		"	"
04	100-	80-	60	0.35	275		"	"
05	85-	75-	35	0.30	160		"	"
06	120-	60-	35	0.25	160		"	"
07	85-	65-	25	0.30	100		"	"
08	75-	65-	45	0.30	110		"	burrowed and bored
09	80-	50-	30	0.35	60		"	bored
10	100-	50-	30	0.30	80		"	"
11	60-	50-	35	0.30	35		"	
12	70-	40-	35	0.35	60		"	
13	60-	35-	30	0.40	50		"	
14	80-	50-	25	0.40	70		"	
15	75-	45-	30	0.40	70		"	
16							"	
17	70-	40-	20	0.35	50		"	
18	85-	40-	30	0.40	60		"	
19	35-	30-	20	0.35	20		"	
20	35-	30-	25	0.40	20		"	
21	50-	40-	15	0.30	25		"	
22	85-	30-	25	0.30	50		"	
23	60-	40-	25	0.30	50		"	
24	50-	35-	25	0.40	30		"	
25	60-	55-	25	0.40	60		"	
26	55-	40-	25	0.30	25		"	

#### 9-4. SEDIMENTOLOGICAL AND PALEONTOLOGICAL STUDIES OF CARBONATE ROCKS AND THEIR DIAGENESIS

K. KONISHI

Carbonate rocks diverse in age, origin and diagenetic history have been recovered from the dredge hauls at Stations 25, 31, 34, 35, 37, 39, 40 and 43(Table 0).

Typically pelagic, silicate-free deep-water carbonates were represented with the samples at the seamount St.25, where a chronological succession can be suggested tentatively on the basis of lithologic and paleontologic differences in the carbonate rock types; (1) the upper, "Globigerinid limestone" of Latest Tertiary(or even Quaternary), very friable and entirely free from ferro-manganese encrustation, (2) the middle, "Carbonate Mudstone" of Late Tertiary, appreciably cemented and slightly altered, and veneered with ferro-manganese film, and (3) the lower, "Shell-bearing Carbonate Wackestone to Mudstone" of Early Tertiary(?), considerably phosphatized and heavily coated with ferro-manganese oxides. The last type of the limestones may be of a relatively shallow "upper fore-reef" rather than of deep-water in origin.

Correlation of the carbonate-cap between the two seamounts surveyed, Sts. 25 and 31, should await micropaleontological examination, though the granule-rich carbonate wackestone possibly overlying directly above the volcanic basement rocks(alkaline basalt) at St.31A resembles the "Shell-bearing Carbonate Wackestone" of St.25C in appearance. It cannot be ruled out that future study of thin sections prepared from partially phosphatized as well as silicified carbonate rocks, which are best exemplified with the specimens at St.31B, might result in a find of much older(e.g. Late Cretaceous) shallow-water carbonate rocks.

Definitely shallow-water carbonate rocks have been dredged only from the area around Ogasawara(Bonin) Islands. Besides abundance of rhodoliths (100% at St.35 and 61% at St.37), fossil grainstones and packstones, all of which are most likely related to the Quaternary(Pleistocene) reef-building, predominate on shelf margin shallower than 350m, whereas a deeper facies consisting of fore-slope(upper "arc-trench gap") of the frontal arc in the depth between 800m and 1500m.

Together with phosphatization and silicification in association with

ferro-manganese encrustation, diagenetic processes ongoing at the carbonate-water interface, especially various types of submarine cementation under deep-water environment, will be thoroughly studied petrographically as well as geochemically. Coupled with the detailed biostratigraphical analysis of foraminiferal and coccolithphorid assemblages, these works both paleontological and sedimentological will provide basic informations pertinent to elucidate the tectonic history of the two seamounts and island arcs (Bonin and Marianas).

## 10. HEAT FLOW MEASUREMENT

M. YAMANO, H. FUJISAWA, and H. KINOSHITA

The heat flow measurement was carried out in the Japan Trench area and the Shatsky Rise area. Since a newly-obtained multiple-penetration type probe did not work well, only one heat flow value was obtained by the Bullard type apparatus.

### INSTRUMENTS

Two different type of heat flow probes were used. One is a multiple-penetration type probe (POGO), manufactured by Applied Microsystems Ltd.. It has seven equally-spaced thermistors, and can measure not only temperature gradient but also in situ thermal conductivity by observing decay of a calibrated heat pulse (Hyndman et al., 1979). Purpose of this cruise was mainly to examine performance of POGO in the actual deep ocean bottom, and if things worked well, we would be able to obtain new data at the points.

The other is a 2m-long conventional Bullard type probe, in which four thermistors are installed. The four thermistors make two couples, and give two different temperature gradients, one is that between the bottom and top of the probe and the other is that between the bottom and the middle point (Uyeda et al., 1961). We used this probe auxiliarily when POGO was out of order.

### RESULTS

The measurement was carried out at three stations in the Japan Trench area and two stations in the Shatsky Rise area.

#### Japan Trench area

##### St. 1(B)

(All station numbers shown in this report are common to those defined officially in this cruise.)

We penetrated the POGO twice into the ocean bottom at the station 1(B). But the measurement was unsuccessful because of leakage of water into the pressure housing, and this caused a damage on an electronic circuit.

### St. 3(B,C)

At the station (C) temperature gradient was measured by the Bullard probe, but bottom sediment for thermal conductivity measurement was sampled at a different site (Station B) by a gravity corer. The geothermal gradient between the bottom and top of the probe is estimated to be  $0.026 \pm 0.002^\circ\text{C}/\text{m}$ , and that between the bottom and middle point to be  $0.041 \pm 0.004^\circ\text{C}/\text{m}$ . Since the penetration seemed partial, we take the latter value as a real temperature gradient in the ocean bottom. Thermal conductivity of the sediment was measured by the needle probe method (Von Herzen and Maxwell, 1959), and an average value of the conductivity is  $1.9 \pm 0.1 \text{ mcal}/\text{cm sec } ^\circ\text{C}$ . Thus a heat flow value at this site ( $39^\circ 14.0'\text{N}$ ,  $143^\circ 41.2'\text{E}$ ) is calculated to be  $33 \pm 5 \text{ mW}/\text{m}^2$ . This value is consistent with those in the low heat flow zone which extends from the trench axis to the volcanic front (e.g. Watanabe et al., 1977).

### St. 6

The Bullard probe and the gravity corer were lowered simultaneously, but the recording system did not work well. Cause of this trouble is considered that some element of the recording circuit did not function owing to low temperature in the ocean bottom.

### Shatsky Rise area

#### St. 14(B)

We penetrated the POGO three times into the ocean bottom at this point. Because of irregular rotation of the tape recorder in the probe and incomplete connection of the electrical leads between the thermistors and the temperature measuring circuit, temperature record was scattered, so it is hardly possible to estimate the geothermal gradient. A heat pulse was generated only at the first penetration. The calculated thermal conductivity based on this heat pulse, however, is about  $4 \text{ mcal}/\text{cm sec } ^\circ\text{C}$ , which is unusually high as compared with that of the ordinary oceanic sediment. We think this to be attributed to the scattered data.

### St. 17

The POGO hit on the bottom twice, but seemed not to have penetrated into the sediment. All through this measurement the recording system worked very

irregularly and gave very erratic data, or at intervals it stopped recording and gave no data. Cause of those malfunctioning of the system seems to be attributed to incomplete restoration of the damage from water leakage at the station 1(B).

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## 11. OCEAN BOTTOM SEISMOMETER OBSERVATION FOR LONG-RANGE REFRACTION EXPERIMENT AT THE NORTHWESTERN PACIFIC BASIN

T. URABE and S. IMAHORI

### GENERAL REMARKS

Long-range refraction experiment is one of the most powerful means in studying seismic velocity structure of the upper mantle. In the northwestern Pacific Basin, three longshot experiments have already been made by Japanese groups in 1974 (longshot-2), 1977 (longshot-4) and 1978 (longshot-5) (Asada and Shimamura, 1976; Asada and Shimamura, 1979; Asada, 1980). The past observation and explosion sites are shown in Fig. 1. The results of these experiments strongly suggest the existence of a lateral velocity anisotropy in a wide depth range of the upper mantle of this region; a high velocity layer of 8.6 km/s is found in the profile of the longshot-2, while not in the profiles of the longshot-4 and -5.

To confirm the existence of the anisotropy, a new longshot experiment was planned and carried out in the Hakuho Maru KH 80-3 cruise.

### OPERATION

Our present experiment in KH 80-3 cruise is intended mainly to obtain further informations about the anisotropy. The direction of the profile was chosen to be in between the profiles of the longshot-2 and that of the longshot-4 (and -5). Shatsky Rise was avoided since the structure of this region may be a continental one. The observation and explosion sites are shown in Fig. 2. Three ocean bottom seismometers(OBS) were placed in line at the SE end of the profile, whose length is 1650 km, 150 km apart each by the R/V Hakuho Maru. At the same time, by another vessel, a network of 12 OBSs were deployed near the other end of the profile and 8 explosions, which ranges from 250 kg to 600 kg, were detonated in the northwest part of the profile.

All of three OBSs used are pop-up type, which are released by C-MOS timer (Yamada, 1980). Since this type of OBS is free from troublesome rope works, operations of the deployments and the retrievals are easier and less time consuming in the comparison with the tethered type. The seismometer system including recorder, clock and batteries is capsulated in a 43 cm-O.D. glass sphere which endures water depth of 7500 m. The total weight of the system

in air is 78 kg before the deployment and 30 kg after retrieval.

A set-up operation on the deck was finished within some ten minutes, and at the same time, a precise positioning was made by NNSS and Loran-C. A 27 MHz radio transmitter and a flashing light are attached for the recovery.

The three OBSs came up to the sea surface approximately on time. They were picked up on to the deck within 20 to 70 minutes from their surfacing.

Just before the release of each OBS, an air gun was operated along a profile through the OBS site by the group of the Chiba University, in order to study the shallow crustal structure just beneath the OBS sites.

A list is shown in Table 1, which is the deployments and retrieval operations.

## RESULTS

The operations were successful. The recovered three OBS cassettes were reproduced on board. The recorded noise levels were generally low so that the seismic signals were recorded with a good signal-to-noise ratio. The recorded tapes were first duplicated to open reel tapes in the laboratory. The open reel tapes were reproduced at the tapespeed of 9.5 cm/s, which is about 200 times faster of the recorded signals, and fed into a minicomputer. Simultaneously, the reproduced signals were fed into a visicorder to obtain visible records. The obtained records have the frequency response of from 3 seconds to 25Hz, hence a lot of rather distant earthquakes, which occurred along the Izu-Ogasawara Trench and Japan Trench were clearly recorded by the OBSs. Several earthquakes swarms were also recorded, in spite the epicentral distances exceed 1000 km. More than 40 earthquakes per day were also recorded which indicates the high sensitivity of the OBS as well as the low attenuation of the seismic waves that travel beneath the northwest Pacific Basin.

The results of the long range shots are being analyzed in combination with the records which were obtained by the other research vessel. Since the range of the explosion studies covered up to 1650 km, some interesting informations about the deeper part of the oceanic lithosphere are being obtained. The direction of the present profile was planned to be the direction of the maximum velocity, so that the results will confirm the velocity anisotropy of a huge scale, which has not been obtained elsewhere.

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Table 1. List of deployment and retrieval operations of the three OBSs

### Deployments:

	Day & Time	Lat.(N)	Long.(E)	Water depth (m)
OBS 16	July 24 05:35	31°16.5'	153°13.6'	6250
OBS 17	July 24 14:18	30°10.3'	154°05.9'	5810
OBS 18	July 24 23:15	29°04.3'	154°56.6'	5870

### Retrievals:

OBS 16	Aug. 02 21:12	31°16.6'	153°14.5'	6250
OBS 17	Aug. 03 08:40	30°10.9'	154°05.8'	5820
OBS 18	Aug. 03 20:05	29°04.5'	154°56.5'	5890

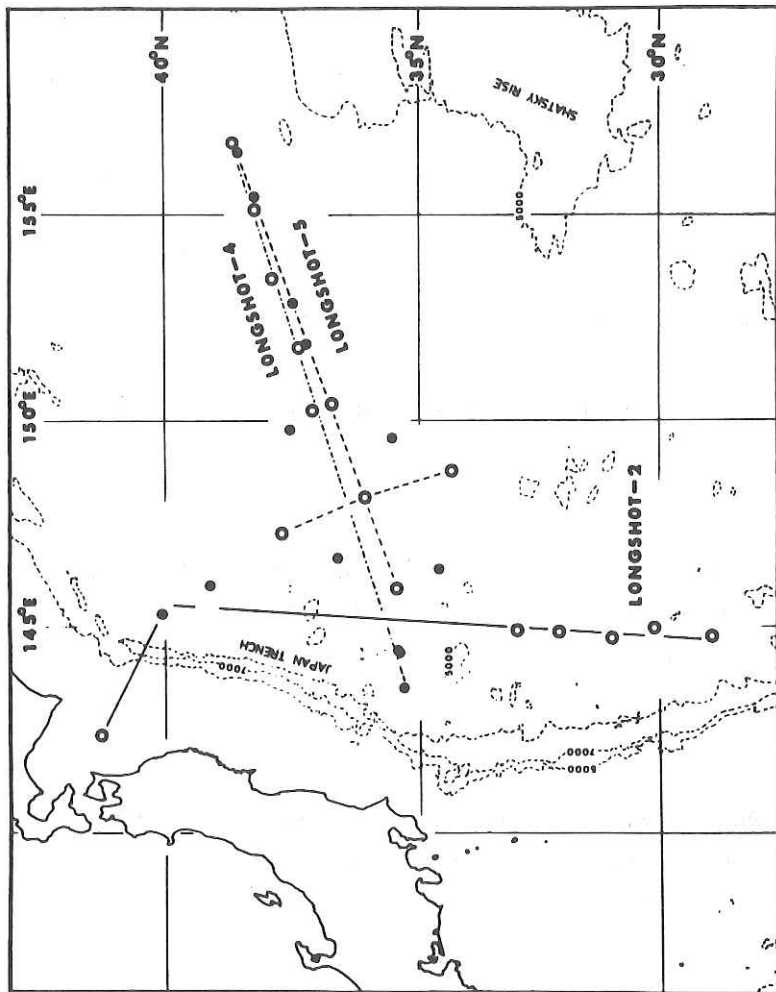


Fig. 11-1. Three longshot experiments in the northwestern Pacific Basin made in 1974(longshot-2), 1977(longshot-4) and 1978(longshot-5). Open circles are OBS sites and solid circles are explosions.

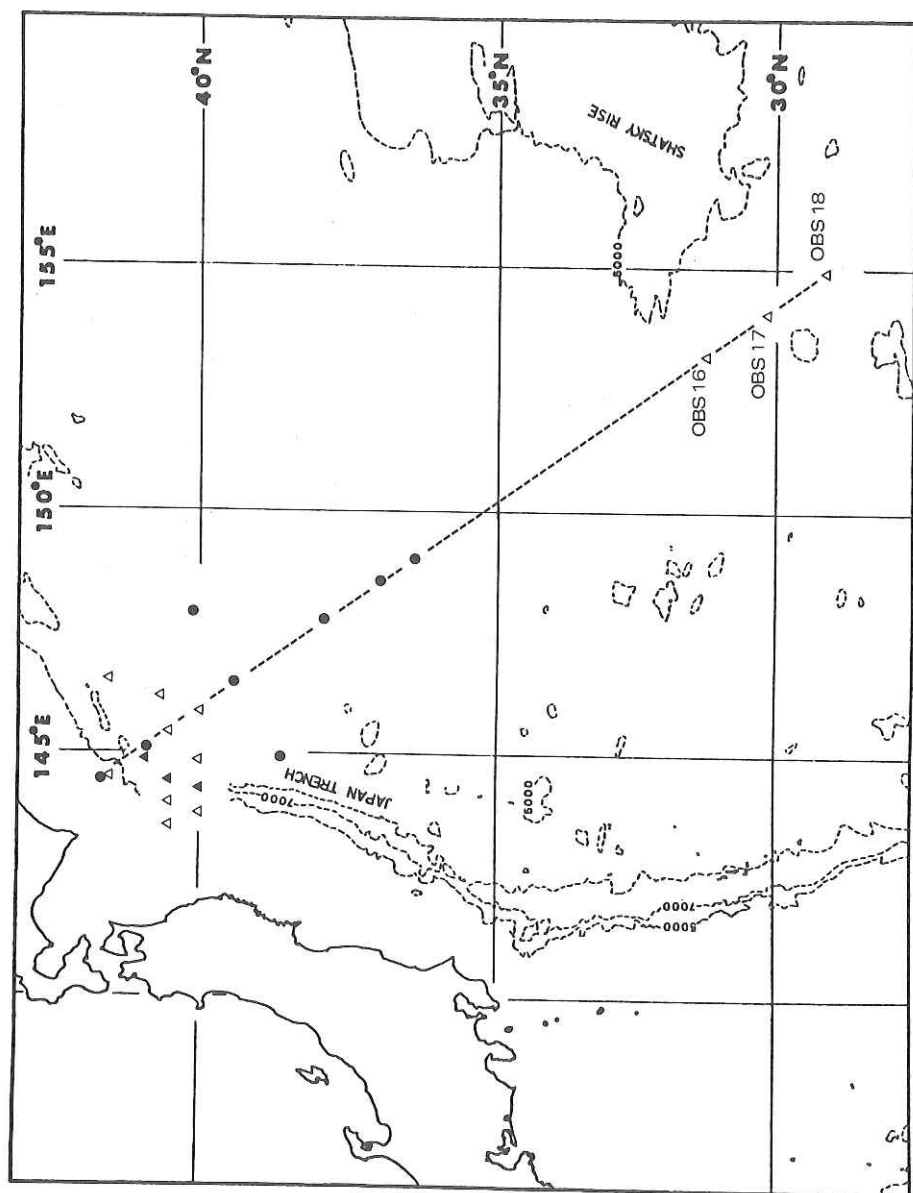


Fig. 11-2. Observation and explosion sites of the present experiment. Triangles are OBSs and solid circles are explosions. OBS 16, 17 and 18 were deployed by the R/V Hakuho Maru.

## 12. DESCRIPTION OF THE VERTICAL SUCCESSION OF SEDIMENTS AND TRACE FOSSILS IN THE BOX CORE SAMPLES

D.D. SWINBANKS

### COLOUR

Colour was determined by reference to soil colour charts and are coded according to Munsell's system.

### SEDIMENT CLASSIFICATION

Sediment classification is based on that used in DSDP initial Reports. However, as the term 'ooze' conveys no information about sediment texture (i.e., grain size) -- a very important property of sediments no matter what their origin-- a textural description is given in parenthesis after one sediment name. The textural term 'mud' is used to refer to a mixture of silt and clay in unspecified proportions. The qualifying term 'muddy', as in muddy nanno ooze, indicates the presence of >10% non-biogenic clay and does not refer to texture. The qualifying terms 'foraminifer' and 'nannofossil' are abbreviated to foram and 'nanno' respectively.

TABLE 1. Station List for Box Corer (Spade Corer)

Station No.	Corrected depth	Position	Core Depth	Sediment	Remarks
St.14	3066 (m)	32°03.8'N, 158°46.1'E	-	-	Failure due to Wire Trouble
St.16 (SC14)	2434	32°40.0'N, 158°46.7'E	30 cm	foram nanno ooze	
St.20 (SC15)	3162	32°00.1'N, 158°38.8'E	25 cm	foram nanno ooze	
St.21 (SC16)	3948	31°43.5'N, 157°26.7'E	30-35 cm	muddy nanno ooze above foram nanno ooze	

The sediment collected by box corer was subdivided with 32 subcores (Fig. 1) and will be used for the studies listed below.

M M M manganese nodules

┌ vertical range of a boundary or trace fossil

### Trace Fossil Terms

#### Chondrites



#### Zoophycos



#### Chondrites

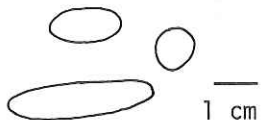
(large)



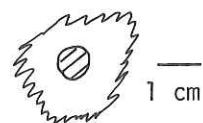
#### Rind burrow



#### Planolites



#### Halo burrow



#### Planolites

(composite)



Fig. 12-1. Explanation of terms and symbols in core descriptions.

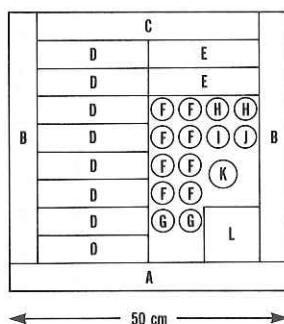


Fig. 12-2. Sampling from box core sediment.(plan view)



# STATION 16 (SC-14)

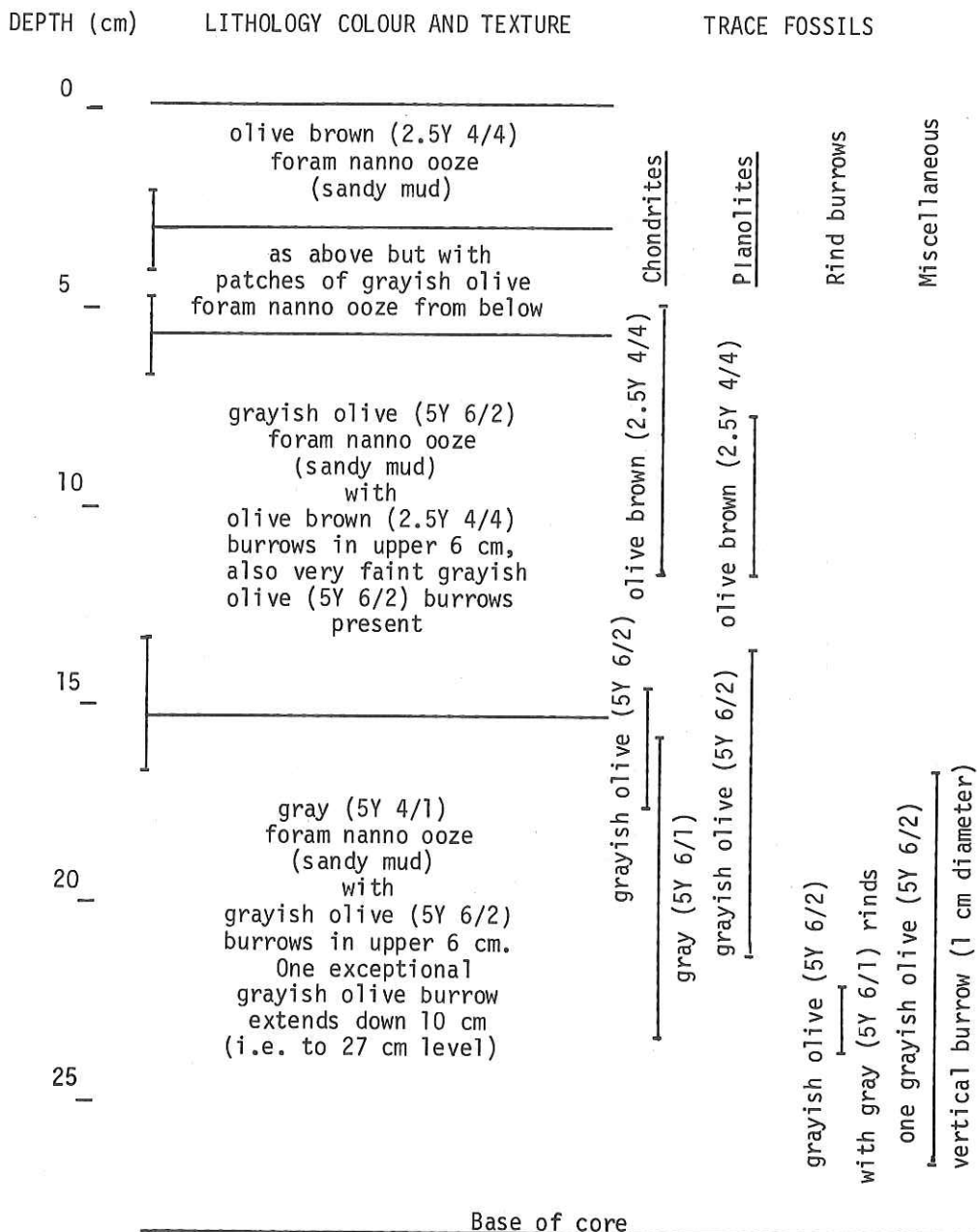


Fig. 12-3. Megascopic description of box corer sediment of station 16.

# STATION 20 (SC-15)

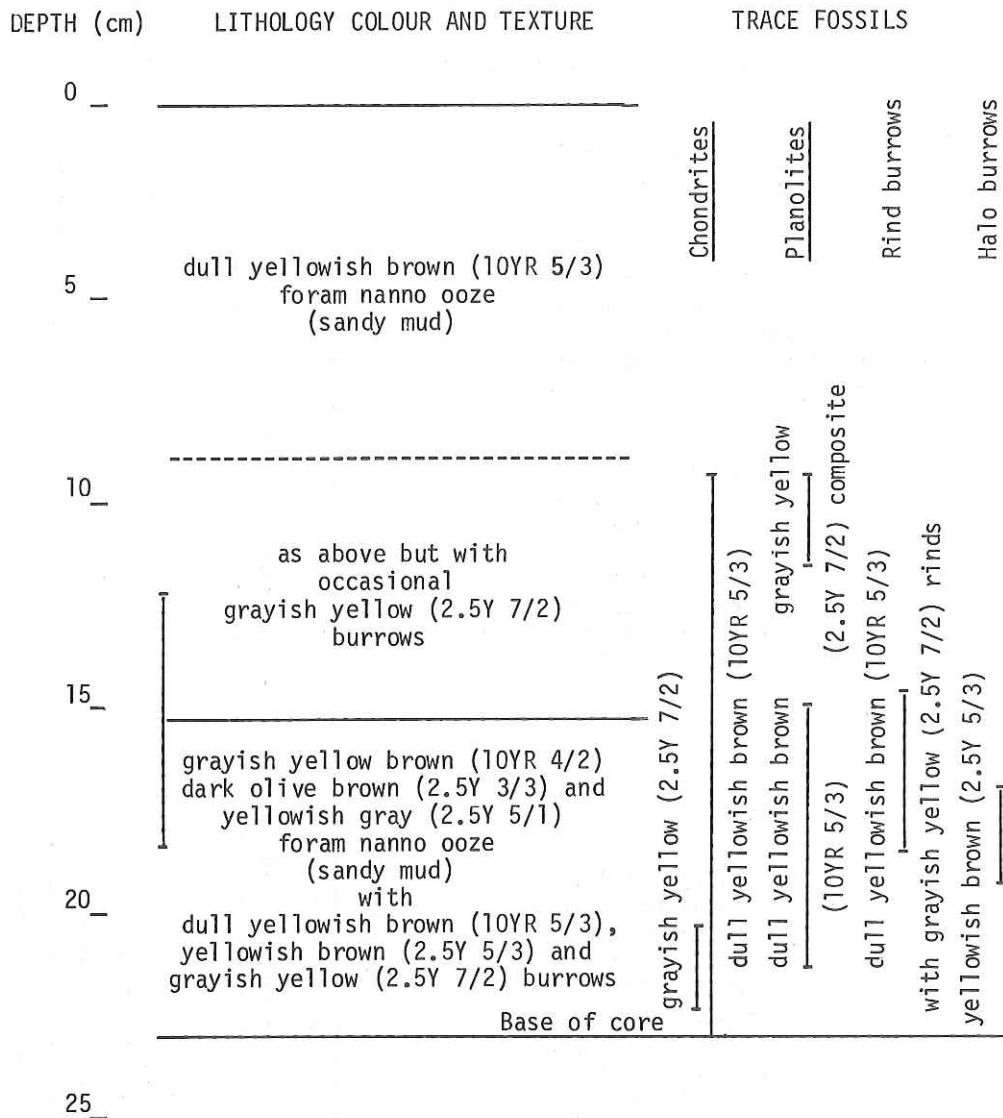


Fig. 12-4. Megascopic description of box corer sediment of station 20.

# STATION 21 (SC-16)

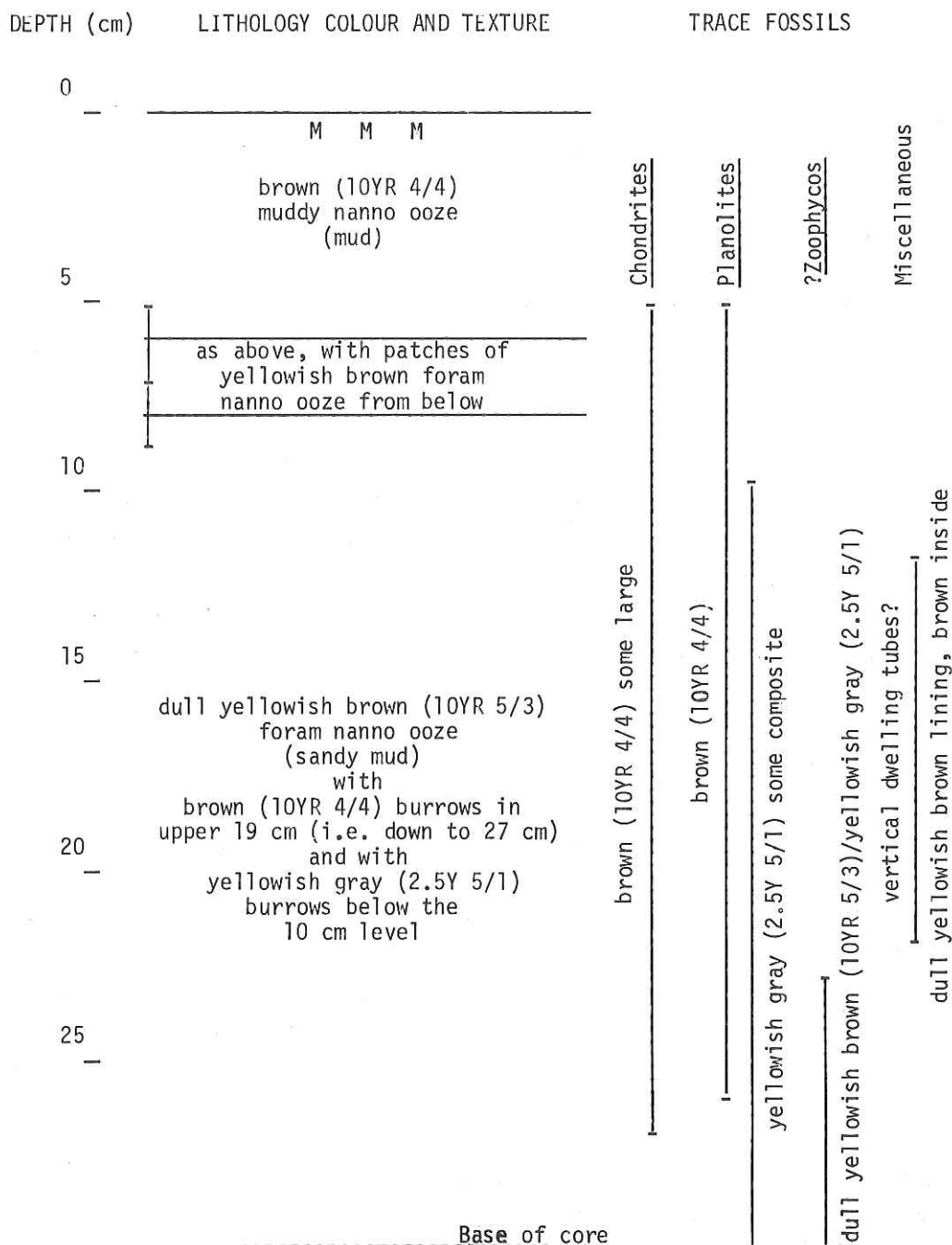


Fig. 12-5. Megascopic description of box corer sediment of station 21.

### 13. TAXONOMY AND ECOLOGY OF BENTHIC CRUSTACEANS IN THE NORTHWESTERN CENTRAL PACIFIC

S. GAMO

#### LOWER BENTHIC CRUSTACEANS

For cruise KH 80-3, studies will concentrated on the smaller crustaceans living within the sediment, e.g., harpacticoid copepods, and the malacostraceans, cumaceans, tanaidaceans, isopodeans, and amphipodeans, which all belong to peracarideans.

The sediment collected by tube dredge, box corer, and stone dredge was passed through a 200 $\mu$  mesh sieve and the crustaceans listed above were sorted under a dissecting microscope, fixed and preserved.

Crustaceans were obtained from 17 stations (Table 1). Taking into account the fact that the gear used was different at each station, the numerical population density and number of species were high at the stations near to the land or in shallow areas such as Chatsky Rise, while on the ocean bottom and in the area around the Ogasawara Islands, both the numerical density and number of species were slightly lower. In Ogasawara area, the low density and low number of species seems to be related to the lack of soft bottom sediment. Although these tendencies are general and could be seen in other kinds of organisms, if more precise studies were carried out not only on the samples collected in this cruise but also those collected in other cruises, many truths regarding the taxonomy, distribution and ecology of these organisms may be revealed that would contribute greatly to later studies.

#### THE LARVAE OF BRACHYURANS COLLECTED BY SURFACE PLANKTON NET AT NIGHT

On the cruise KH 80-3, during dredging or when ship was drifting or moving at low speed, surface plankton net sampling was carried out for 30 minutes between the time one hour after sunset to mid night. Megalopa larvae of decapodean brachyurans and larvae of squillideans were collected. The reason why the study was carried out only on the last stage larvae, megalopa, for brachyurans is that by culturing these larvae, I could obtain the juveniles I could them identify. As expected, only two megalopa larvae could be collected from the station KH 80-3-8 above Kashima Sea Mount from a total of 14 stations. In addition, at KH 80-3-31A and KH 80-3-32, juveniles of

Plagusia depressa tuberculata and Planes cyaneus, the natural habitat of which is exposed rocky shores, were collected from drift material collected by the crew. In the cruise KH 80-1, the larvae of brachyurans or squillideans were collected only from one station in the Ogasawara area.

From this cruise, very rare data for the study of the relationships of the distribution and migration of crustaceans between islands and estuaries to currents and the distribution of larvae could be obtained when combined with data from other cruises.

# OCCURRENCES OF BENTHIC CRUSTACEANS

Position Method	Kashima		Shatsky Rise						Guam				Mariana Basin				Ponape								Ogasawara							
	3A	3B	16	19A	19B	20	21					24B	25B	28B	31A									32	33	34	35	40	41			
	P	P	B	D	D	B	B					P	D	P	D									D	D	D	D	D	D			
Name																																
Harpacticoid Copepoda	10	5	39 (4)	2	5	13 (4)	5					1	-	1	1									2	-	-	4	5	-			
	1	1	-	-	-	-	-					-	-	-	-									-	-	-	-	-	-			
Leptostraca																																
Cumacea	-	-	-	-	-	-	-					-	-	-	-									-	-	-	1	-	-			
Tanaidacea	6	-	2	-	1	3	4 (2)					-	-	-	-									-	1	-	-	-	-			
Isopoda	2	-	10	-	-	1	4 (2)					-	1*	-	-									-	-	-	-	-	-			
Amphipoda	4	-	-	-	-	-	-					-	-	-	-									-	-	2	5	1	1			

P: pipe dredge, B: box corer, D: small pipe dredge attached to chain bag dredge,

\*: This spp. is sampled from the cracks of manganese nodule dredged by chain bag.

Parenthesised numbers denote the number of spp.

#### 14. SAMPLING FOR THE STUDIES OF EXTRATERRESTRIAL MATTER

K. YAMAKOSHI, K. KOBAYASHI AND M. OHKI

The final goal of this study is to obtain extraterrestrial information from metallic silicate spherules from deep sea sediments, sea water and atmosphere on the ocean, which can not be or hardly obtained from meteorites and lunar samples. In this cruise several sampling procedures were carried out; piston coring, box-core sampling with cylindrical dredger and sweeping of sea water surfaces and also air-filtration with plankton-nets. And aged, cosmic spherule sampling from ferromanganese nodules is also in progress.

Red clay core samples will be processed for studies of time variation of accretion rate of extraterrestrial dust onto the earth. Total weight and size distribution of the spherules of "cosmic" origin will be determined at the respective depth. Dredged clays were preliminarily processed on the vessel and contents of cosmic dusts were estimated. During the voyage, sea water sweep and air filtration with plankton nets (Norpac type; 69 and 94  $\mu\text{m}$ ) were done in order to obtain fresh spherules, which were not chemically degenerated in the sea bottom. Because of little contamination of K and Ca due to sea water, they are valuable samples for high sensitive mass spectrometry. And also the sea water sweep and air filtration will provide basic data for cosmic dust sampling programme at high altitudes with a big balloon flight at Sanriku Balloon Flight Center in May, 1981.

#### SPHERULE CONCENTRATION IN THE SEDIMENTS

Preliminary determinations of spherule concentrations in dredged sediments were carried out as following procedures;

One to two kg wet sediments were diluted with ca. 15 liters of water and filtered with a 149  $\mu\text{m}$  sieve (100 mesh). The magnetic fractions in the residue were gathered with a handmagnet. The metallic spherules were picked out with fine tweezers under a view of stereoscope. The size and numbers of the spherules were determined and then the total weights of the metallic spherules were obtained by integral calculations assuming a size distribution of  $dn=cS^{-3}dS$ . In the table next, the total weight of the used sediment and the fraction larger than 149  $\mu\text{m}$ , which were brought to dryness in a oven heated at 110  $^{\circ}\text{C}$ , and the estimated spherule weight are shown. In the last

column the metallic spherule concentration in the sediments were calculated.

sample (KH 80-3)	sediment (total, T)  (gm)	sediment ( $\geq 149\mu\text{m}$ fraction) (F) (gm)	fraction ratio (F/T) (%)	metallic spherule weight ( $\mu\text{gm}$ )	metallic spherule content (ppm)	remarks
St-21	-	750	-	20	0.03	foraminiferal clay & ooze
St-24B	545	2175	25.0	1300	0.60	volcanic component
St-28B	20	865	23.1	600	0.69	siliceous ooze contami- natio

#### SPHERULE COLLECTION WITH PLANKTON NETS

The Norpac type, NXX13 (94  $\mu\text{m}$ ) and NXX17 (69  $\mu\text{m}$ ), plankton nets were used for spherule collection at the sea surface. When the vessel was in drift (long-wire sampling), the plankton nets were set at the sea surface. After the sampling, the magnetic fractions were gathered by a handmagnet. And from them metallic spherules were picked up with fine tweezers. The obtained spherules in size larger than 100  $\mu\text{m}$  were listed below;

Station No. (KH 80-3)	metallic spherules larger than 100 $\mu\text{m}$ per 2 hrs. 1 net
14	1.0
16	2.8
18	1.0
19	0.6
20	1.1
21	0.2
23	0.5
24	0.8
25	2.0
26	2.3
mean	1.2

And the total number of metallic spherules in various size groups are also shown next page;



size interval	spherules
400 - 300 $\mu\text{m}$	2
300 - 200	3
200 - 100	46
100 - 50	38
total	89

In order to know the spherule concentration in sea water, a simple calculation was done. We assumed the averaged drift velocity of the vessel to the sea water at the standing point to be  $\approx 0.5$  kt. And the opening cross-section of the net to be ca.  $0.112 \text{ m}^2$ , so the total flow rate into the net was ca.  $202 \text{ m}^3/2 \text{ hrs}$ . Therefore we have the spherule concentration (size larger than  $100 \mu\text{m}$ ) to be  $1.2/202 = 6 \times 10^{-3} \text{ spherule/m}^3$ . This value was not so inconsistent with that obtained from the annual accretion rate of the cosmic dust onto the earth.

#### SPHERULE COLLECTION IN ATMOSPHERE WITH A PLANKTON NET

On the compass deck of the vessel a plankton net was set toward the wind direction. At the inner end of the net three polyethylene covered rod magnets were mounted in order to gather the inhaled particles. From Aug. 28th to Sep. 1st the net was exposed. The averaged wind velocity was about  $8 \text{ m/s}$ . After the exposure, the plankton net was washed out with cleanser and solid particles were gathered. They observed with a stereoscope. The obtained spherules were as follows;

size interval	metallic spherules	The spherule concentration was estimated in the same manner as done in the sea water surface. The air-mass flown through the net during the exposure time ( $5400 \text{ min.}$ ) $= 4.3 \times 10^5 \text{ m}^3$ . Therefore the spherule concentration (size larger than $100 \mu\text{m}$ ) is $\approx 7/4.3 \times 10^5 = 1.6 \times 10^{-5} \text{ spherules/m}^3$ .
0 - 20 $\mu\text{m}$	17	
20 - 40	14	
40 - 60	12	
60 - 80	9	
80 - 100	1	
100 - 200	5	
200 - 300	2	
total	60	

This value was also not so inconsistent with that obtained in the sea water surface. None of the silicate and glassy spherules were recognized.

## 15. GROWTH HISTORIES OF MANGANESE NODULES

A. OMURA

During the cruise, a great number of ferromanganese nodules, or simply manganese nodules, were collected at several locations by means of a chain bag dredge and a box corer. These nodule samples were registered after collection and their size, shape and weight were measured (see the separate pages in this report).

Altered basalt was predominant as nucleus material in nodule at locations named St. Nos. 25B, 31A and 31B, whereas phosphoritic nucleus seemed to be dominant at St. No. 21, and a good many of carbonate cores were found in nodules from St. No. 25B.

Internal texture of ferromanganese deposits was not necessarily concentric but irregular in many cases, especially in the case of nodules with "knobby" or rugged surface. Concentric (or layer) structure of ferromanganese deposits was clearly observed in some nodules with smooth surface, which came from St.No.31A. Although the thickness of ferromanganese deposits in each nodule was not accurately measured, it seems not to be uniform among nodules collected at the same locality.

The objective of this study is to document the growth histories of manganese nodules. The growth rates of deep-sea manganese nodules have been regarded as the order of millimeter per million years. It is, however, the truth that many scientists have doubts about such extremely slow growth rates. Because most of all deep-sea nodules are known to be existent on the surface of ocean floor. Why are they buried in sediments? The sedimentation rates of deep-sea sediments are thought to be far and away faster (5.0 through 1 mm per thousand years) than the growth rates of manganese nodules. This simple question is still remained unsolved. In order to prove the problem, it is the best way to compare directly the growth rate of a manganese nodule with the sedimentation rate of the sediments surrounding or underlying the nodule. There is little such an attempt up to the present, because of the technical difficulty to get both manganese nodules and the associated sediment from deep-sea bottom at the same time. Fortunately, a box corer brought small-sized (about 2 cm in maximum diameter) but many nodules together with the bottom sediment at St. No. 21. For the above mentioned reason, these samples

are expected to provide the significant informations to document the growth histories of manganese nodules.

Other nodule samples with irregular surface also are taken interest in a way of their growth. Because the ferromanganese deposits have an appearance showing that they permeated into the nucleus material during the history of a nodule.

After the cruise, all of the nodule samples are examined as following process:

- (1) Observation of the micro-texture, on a polished surface or section, with optical microscope.
- (2) X-radiography, to know a way of increment of ferromanganese deposits.
- (3) Observation by means of an electron microscope, if necessary.
- (4) Scraping the ferromanganese deposits along the contemporaneous surface in some selected nodules.
- (5) Radiochemical treatment for quantitative analyses of uranium, thorium and protactinium isotopes ( $^{238}\text{U}$ ,  $^{234}\text{U}$ ,  $^{232}\text{Th}$ ,  $^{230}\text{Th}$ ,  $^{231}\text{Pa}$ , and so on).
- (6) Estimation of growth rate of each nodule by the use of the  $^{230}\text{Th}$  and  $^{231}\text{Pa}$  methods.
- (7) Comparison between the growth rate of a nodule and the sedimentation rate of the associated sediment, which came from St. No. 21.

## 16. GEOCHEMISTRY OF OCEANIC SEDIMENTS COLLECTED FROM KH 80-3

Y. MINAI, T. TOMINAGA\*, Y. NAKAMURA\*\*,  
and H. WAKITA\*\*

We have studied geochemistry of oceanic sediments collected from various area in the world. This study has been performed to clarify the relation of the chemical abundance to the origin of sediments based on regional and variations in the chemical composition. As the series of those studies, we analyzed oceanic sediments collected from KH 80-3 cruise.

One of the authors, (Y. M.), measured on board pH and Eh in sediments (Table 1). The oxidative zone of blue clay core and red clay samples show relatively high Eh value.

In the laboratory, we analyzed chemical composition of these samples by Instrumental Neutron Activation Analysis (INAA) which is a non-destructive and multi-elemental analytical technique. It is suitable for analysis of oceanic sediments often containing organic matter. The results of this analysis are shown in Table 2. In future, we also intend to analyze the elements (i.e. Si) which cannot be analyzed by INAA, using other technique.

We are also interested in chemical 'states' of elements as well as their contents of oceanic sediments. We have applied Mössbauer spectroscopy, a useful technique to chemical state analysis, in some geochemical systems. We have investigated regional variation of chemical states of iron in oceanic sediments by means of Mössbauer spectroscopy. We are planning to analyze chemical states of iron in sediments collected from KH 80-3 by this technique.

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26	Depth (cm)	10	50	100	200	300	400	505	600	700	
	pH	7.6	7.3	7.4	7.3	7.2	7.1	7.2	7.2	7.4	
	Eh (mV)	280	280	295	305	260	280	270	300	285	
27	Depth (cm)	8	30	50	100	150	205	250	300	350	405
	pH	7.0	7.0	7.0	6.9	6.8	7.0	6.9	6.9	7.0	7.0
	Eh (mV)	310	340	300	300	285	280	280	290	295	300
28A	Depth (cm)	10	30	50	100	200	300	400	500	600	700
	pH	7.1	6.9	7.0	6.9	6.9	6.9	6.9	6.8	6.9	6.9
	Eh (mV)	255	265	275	265	270	265	300	300	295	285
29	Depth (cm)	20	50	100	200	300	400	500	600	700	800
	pH	7.0	7.0	6.9	6.9	6.9	7.0	6.9	6.9	6.9	7.1
	Eh (mV)	300	280	280	280	310	300	280	295	275	280
30	Depth (cm)	10	20	50	100	200	300	400	500	600	700
	pH	7.1	7.0	6.9	6.9	6.9	6.8	6.9	6.8	6.9	7.0
	Eh (mV)	320	305	300	290	315	285	285	285	280	280

TABLE 2. The INAA data of oceanic sediments collected from KH 80-3  
(All of samples for this analysis are obtained at 1 m depth  
from each core top)

st. No.	5	9	12	18	22	24A	28A	30
$\text{Al}_2\text{O}_3$ (%)	25	15	15	4.7	16	15	18	14
$\text{TiO}_2$	1.3	0.4	0.8	0.2	1.0	0.8	1.3	1.2
$\text{Fe}_2\text{O}_3^*$	5.4	6.0	6.2	1.9	7.2	10	9.0	10
$\text{MnO}$	0.1	0.08	0.1	0.03	0.5	0.9	1.0	1.1
$\text{MgO}$	6.5	5.9	4.5	1.4	6.7	4.4	8.0	6.8
$\text{CaO}$	2	2	3	29	2	2	1	
$\text{Na}_2\text{O}$	2.9	2.9	3.0	1.3	2.6	2.8	2.6	2.6
Ba (ppm)	680	560	350	650	960	210	740	1100
Co	16	24	15	6.8	39	120	17	120
Cr	50	49	33	23	57	210	81	83
Cs	7.0	6.5	4.7	3.5	9.0	4.3	12	12
Hf	2.2	2.3	1.9	1.5	3.0	3.2	6.2	13
Sb	1.1	2.1	0.99	0.17	0.77	2.0	4.0	4.6
Sc	18	19	20	5.5	19	23	22	24
Ta	1.2	1.1	0.63	0.4	1.7	4.6	1.8	8.9
Th	7.4	7.7	4.3	4.2	12	8.3	10	15
V	200	170	150	41	160	150	170	180
La	17	21	15	14	30	88	49	59
Ce	44	39	24	25	75	118	84	108
Sm	3.7	4.2	3.5	2.7	5.5	18	11	15
Eu	0.93	1.0	0.97	0.67	1.4	5.2	2.9	3.9
Tb	0.31	0.43	0.34	0.18	0.45	1.5	1.3	1.6
Yb	2.3	2.6	1.5	1.7	3.0	9.6	5.2	9.9
Lu	0.32	0.42	0.42	0.24	0.49	1.5	0.95	1.2

\* total iron as  $\text{Fe}_2\text{O}_3$

## 17. GEOCHEMISTRY OF VOLCANIC ROCKS DREDGED FROM KH 80-3

Y. MINAI, T. TOMINAGA\*, Y. NAKAMURA\*\*,  
and H. WAKITA\*\*

We have studied alteration process in volcanic rocks in ocean floor from geochemical point of view. We are now analyzing dredged rocks collected from KH 80-3 for this purpose. We will report preliminary results of a few samples.

In Table 1, are represented geochemical data of dredged rocks from KH 80-3 obtained by instrumental neutron activation analysis.

We are planning to analyze other elements and other samples to study alteration process and geochemical character of dredged rocks from sea mounts.

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TABLE 1. The INAA data of volcanic rocks dredged from KH 80-3

st. No.	19B	23B	25C	31B
Sample No.	204	011	22	151
$Al_2O_3$ (%)		16	15	17
$TiO_2$		1.0	2.0	3.2
$Fe_2O_3^*$	7.5	8.6	6.1	13
MnO		1.0	0.1	0.5
MgO		5.2	2.8	8.6
CaO		5	14	7
$Na_2O$	2.6	3.3	4.4	3.6
Ba (ppm)		180	420	700
Co	32	57	21	57
Cr	61	200	10	140
Cs	1.4	0.5	0.4	0.4
Hf	7.6	4.9	20	9.5
Sb	1.7	1.3	0.85	0.98
Sc	19	26	15	17
Ta	1.4		9.1	9.7
Th	0.28	1.6	5.7	8.7
V		130	53	160
La	67	26	197	47
Ce	23	22	118	159
Sm	9.1	6.4	27	11
Eu	3.0	2.0	8.9	4.1
Tb	0.90	0.74	2.7	0.83
Yb	7.1	4.3	15	4.2
Lu	1.3	0.72	2.3	0.45

\* total iron as  $Fe_2O_3$

18. MEASUREMENT OF DAILY VARIATION OF THE EARTH  
MAGNETIC FIELD BY USE OF AN OCEAN BOTTOM  
MAGNETOMETER (OBM)

J. SEGAWA

OCEAN BOTTOM MAGNETOMETER (OBM)

A proto-type flux-gate ocean bottom magnetometer has been built using gimbal-suspended three component magnetic sensors (Ring-core sensors), a cassette digital magnetic recorder and an aluminum pressure-tight vessel. The magnetic sensor has a sensitivity of 0.5 nT and the voltage output is converted to a digital form using a stable 16-bit AD converter. The 16-bit data from three component sensors are stored on a digital magnetic tape. Effect of the ambient temperature on the readings of magnetic field is of the ratio about 2 to 3 nT/°C. Orientation of the sensors are determined by comparing measured horizontal components with the approximate intensity of horizontal magnetic field estimated from the site of observations. Lithium batteries are used for the power supply. In the case of this proto-type magnetometer, the measurement as long as a week is possible to make, although the cassette tape recorder is capable of recording as long data as twenty days. The aluminum pressure-tight vessel 1200mm long and 190 mm in diameter can put up with the pressure at the depth of 8000 m. In the present cruise the magnetometer was moored by a 1.5 ton bouy using 12φ nylon ropes and 16φ polypropylene ropes. A conventional radio-bouy, a radar reflector and a minicum lamp were also attached to the main bouy for convenience of recovery operation.

OBSERVATION SITE

Magnetic observations at the sea floor were conducted twice during the present cruise. The first site of observation was off the Sanriku-coast, Northeast Honshu (39°17'.1N, 143°33'.6E), where the sea depth is 2980 m. The recorder of the OBM was switched on at 07<sup>h</sup>25<sup>m</sup> a.m. on 17 July (JST) and the OBM was lowered into water at 08<sup>h</sup>30<sup>m</sup> a.m. It took about one hour and a half to deploy the OBM at a depth of 2980 m. The recovery operation began at 08<sup>h</sup>00<sup>m</sup> a.m., and ended at 10<sup>h</sup>14<sup>m</sup>, 19 July. The second magnetic observation was made on 26 July at the Schatsky Rise. The deployment of the OBM

started at 08<sup>h</sup>46<sup>m</sup> a.m. and ended at 10<sup>h</sup>46<sup>m</sup> a.m. The site where the OBM was placed is 32°11'.9N, 158°49'.7E where the sea depth is 3040 m. Recovery of the OBM at the second site was made on 30 July, beginning at 12<sup>h</sup>26<sup>m</sup> p.m. and ending at 14<sup>h</sup>26<sup>m</sup> p.m.

## RESULTS

Fig. 1 is the measured time variation of magnetic field at the first site off the Sanriku coast. Unfortunately, two of the three component sensors did not work, and only the Y-component field that is one of the horizontal components was measured. Although this single component data is readable and can be correlated with the record of the magnetic variometer at the Kakioka magnetic observatory of the Japan Meteorological Agency, they are contaminated by unknown periodic noises. Since the direction of the Y-component is unknown, although it is thought to be oriented in magnetic North-East, a quantitative comparison with the records of Kakioka is difficult. The periodic noises are of the amplitude less than  $\pm 5$  nT, and if this kind of noises are neglected it is found that there is no instrumental drift in the record of about two days. The phase of a sudden magnetic storm commencement (s.s.c.) is clearly recognized at 19<sup>h</sup>30<sup>m</sup> (UT) on 18 July.

Fig. 2 shows the data measured at the Schatsky Rise. In this case the Z component sensor did not work. It was found later that the driving coil of the Z sensor was short-circuited, and consumed an unusually large electric power, resulting in a quick discharge of the batteries which would otherwise have worked for a week at least. The records of X and Y components are better than the previous ones except that a significant drift is recognized with both components. Water temperature at the sea bottom as deep as 3000 m is so stable that the daily variation is  $\pm 0.01^\circ\text{C}$  at the most. So, the temperature is not responsible for this drift. The most probable reason of the drift is the voltage change of the batteries and the magnetic effect of battery that is housed in iron steel due to the change of electric current flowing inside. In order to remove the magnetic effect from the battery, non-magnetic battery housed in aluminum case should be used for the new magnetometer. In the measurement at the Schatsky Rise, the X sensor is directed roughly in magnetic North-South, and the Y sensor East-West. Comparison with the Kakioka's records shows that the observations at the bottom as deep as 3000 m are lacking in short-period variations. Variations with a

period one to two hours are not always correlated with the Kakioka's records.

#### FUTURE PLAN

Our Ocean Bottom Magnetometer will be equipped with automatic release devices for the next operation. Both aluminum and glass sphere vessels are used for housings. The ring-cored magnetic sensors and their electronics are further refined and made of the low power consumption. Non-magnetic batteries will be used and the method of data record will be significantly improved.

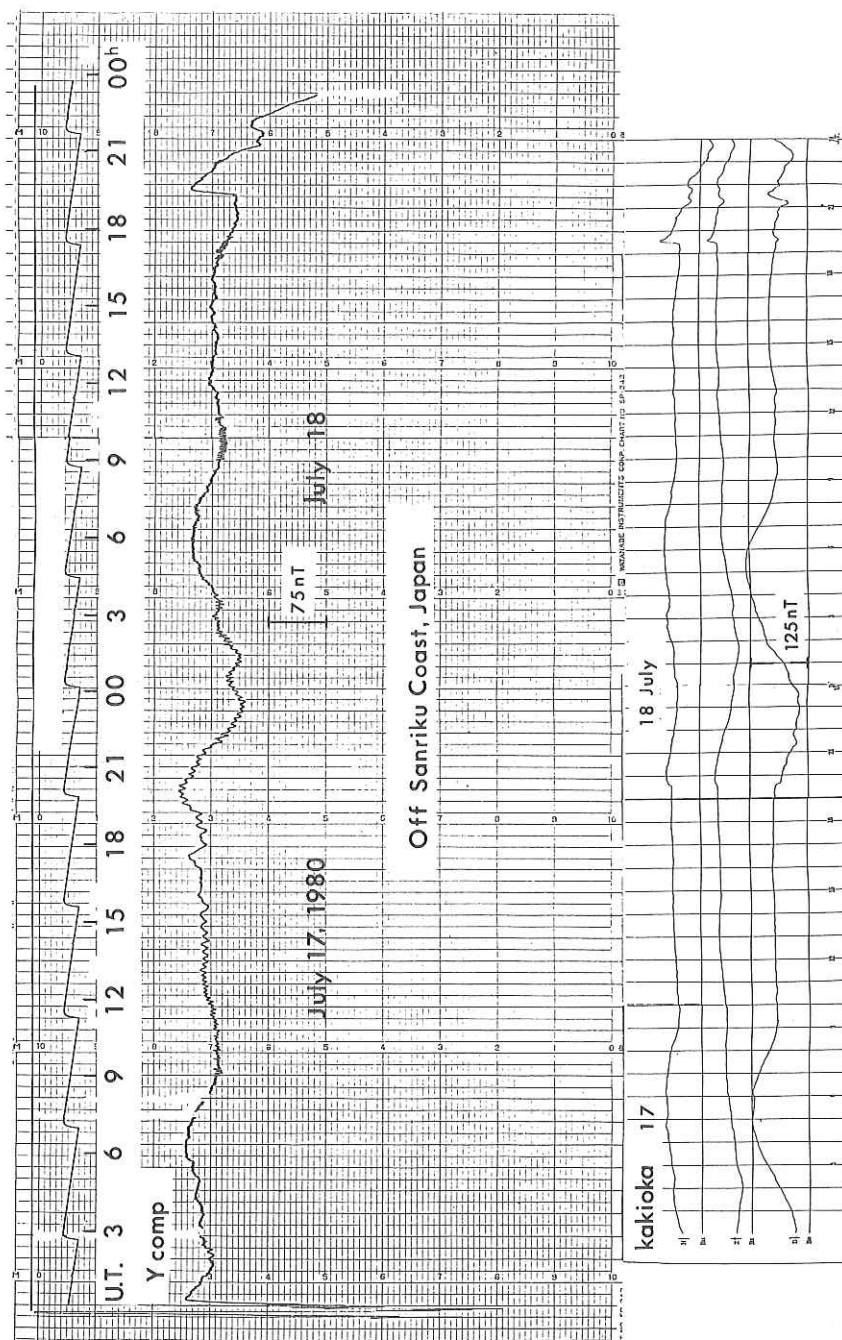


Fig. 18-1. Daily variation of magnetic field measured at the sea floor of a depth of 2980m off the Sanriku coast, Northeast Honshu between 00<sup>h</sup> 00<sup>m</sup> 17th and 00<sup>h</sup> 00<sup>m</sup> 19th July(UT). Lower profiles are the records at the Kakioka Magnetic Observatory during the same period.

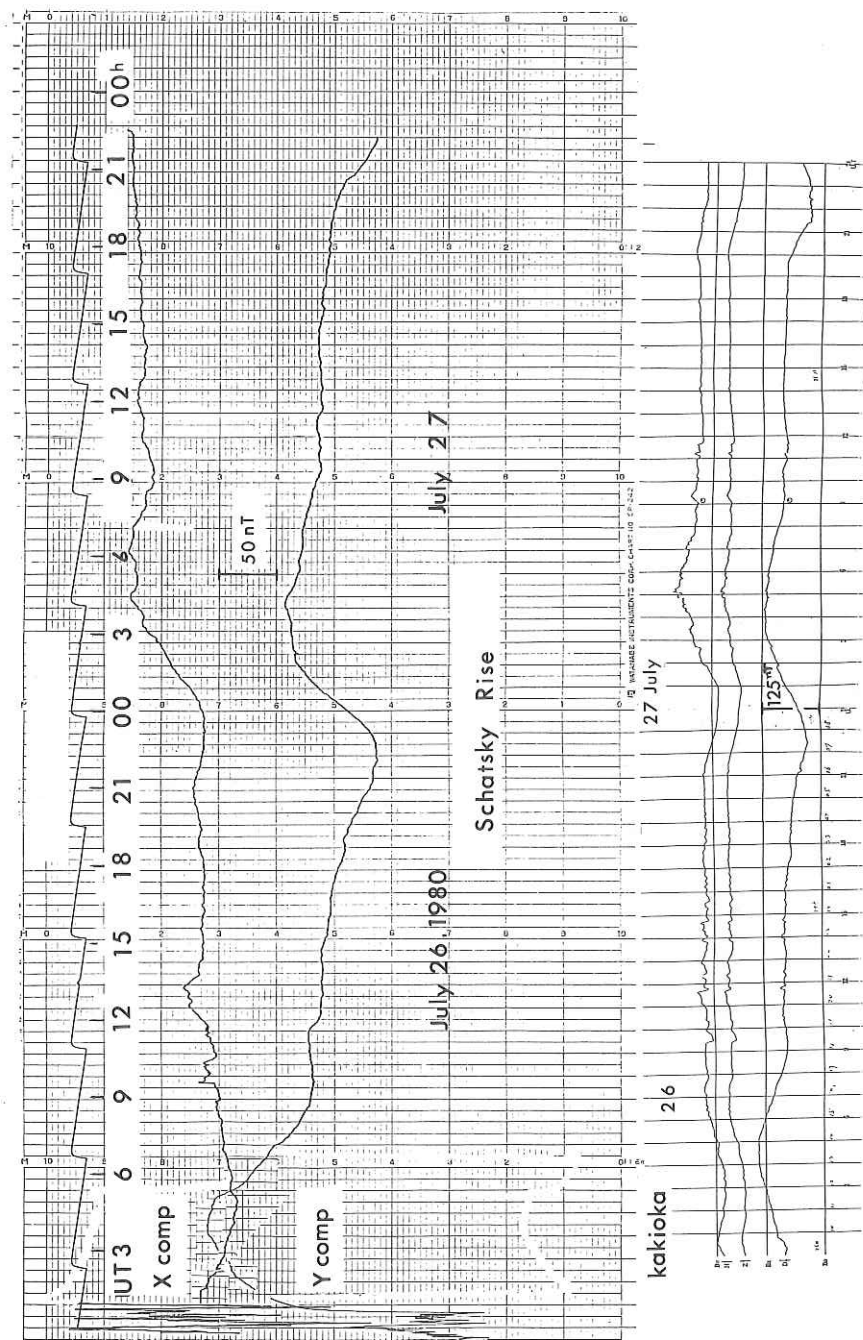


Fig. 18-2. Daily variation of magnetic field measured at the sea floor of a depth of 3040m at the Shatsky Rise between 01<sup>h</sup> 00<sup>m</sup> 26th and 23<sup>h</sup> 00<sup>m</sup> 27th July (UT). Lower profiles are the records at the Kakioka Magnetic Observatory during the same period.

## 19. FIRST TRIAL USE OF ACOUSTIC TRANSPONDER SYSTEM

T. FURUTA, M. WATANABE, T. MATSUMOTO  
M. MITAMURA

Acoustic transponder navigation system is provided for the accurate navigation system for marine research. This navigation system is Model 620 series (Ocean Research Equipment Inc.) and constituted of the following units:

- 1) Three ocean bottom transponders.
- 2) Interrogate transducer towed by vessel.
- 3) 610 interrogate equipment with minicomputer.
- 4) 685 interrogate control equipment.
- 5) Recorder (X-Y plotter, printer).

The ship position using this system is to be decided within 100 m relative to the transponder system. By other navigation system such as NNSS and Loran-C the absolute accuracy of ship position can be within 10 m.

The first trial of this system was ventured from June 26th to June 30th at the Shastky Rise of 2500 m water depth. The spans of transponders were approximately 2.7 n.m. However trouble of equipment prevented positioning and only acoustic release command was successful with the following data;

Sinking speed of transponder; 80 m/min  
Rising speed of transponder; 50 m/min  
Maximum towing speed of transducer; 3-5 kt.

## 20. FIRST TRIAL USE OF A Q.I. DEEP-SEA CAMERA

T. ISHII, M. WATANABE, and T. FURUTA

Deep sea camera system was prepared to observe the ocean bottom materials, especially in rocky area. The system consists of the following four units.

- 1) Camera sphere --- moter-driven 35mm camera with time controller
- 2) Flash sphere --- two stroboscopic light sources
- 3) Sonar pinger --- EG and G Model 220 sonar pinger
- 4) Frame --- stainless steel frame (1350×1300×1000mm)

Camera plus controller, and flash were contained in individual pressure-resistant glass spheres ( $\phi=36$ cm, 1.5cm, thick). This system was originally developed by Hashimoto et al.(1975) as a free-fall deep sea camera. In this cruise, the system was mounted in a stainless steel frame (Fig. 20-1, Wt.: 100kg) with a sonar pinger for repeated use of the camera when in operation in rocky areas. The whole system was lowered and raised by No. 3 winch.

As shown in operation logs, two-operations of deep-sea photography were attempted during this cruise. Both operations were unsuccessful, because stroboscopic light sources did not aline themselves with the camera. All developed negatives of ocean bottom at the station 16B were so pale that it was difficult to recognize what the bottom materials are. This camera system has many problems which should be improved.

### REFERENCES

- Hashimoto, J., Hattori M., Natori K. and Aoki T., 1978. A self-buoyant free-fall deep sea camera system using submersible glass spheres (In Japanese). Jamstectr 3, 24-28.



TABLE 1. OPERATION LOGS OF DEEP SEA CAMERA

Date	July 28, 1980	July 31, 1980
Ship	Hakuho Maru KH 80-3	Hakuho Maru KH 80-3
Station No.	16B	21B
Location	Northwestern Pacific	Northwestern Pacific
Weather	Fine	Fine
Wind	7m/sec 140°N	9-10m/sec 140°N
Sea	very low swell	small swell
Bottom Topography	flat	flat
Type of Camera	Q.I. Deep-sea Camera	Q.I. Deep-sea Camera
Film	Kodak tri X pan (ASA=400)	Kodak tri X pan (ASA=400)
Film length	10m (250 frames)	10m (250 frames)
Lens focussed	2.0m	2.0m
Iris	5.6	5.6
Shutter Speed	1/60	1/60
Shutter Interval	6 sec.	6 sec.
Shutter set Time	13:30-13:55	15:00-15:25
Add. wt.	0 kg	80(20×4) kg
Time lowered	12 <sup>h</sup> 13 <sup>m</sup>	12 <sup>h</sup> 58 <sup>m</sup>
Water Depth	2480m	3990m
Speed Wire-out	0.8m/sec	0.7m/sec
Initial Time on Bottom	13 <sup>h</sup> 24 <sup>m</sup>	14 <sup>h</sup> 55 <sup>m</sup>
Wire Length	2524m	4120m
Ship Position	32°41.9'N, 158°46.1'E	31°44.1'N, 157°25.7'E
Direction of Haul	320°N	350°N
Ship Speed	0 kt	0 kt
Final Time on Bottom	13 <sup>h</sup> 58 <sup>m</sup>	16 <sup>h</sup> 25 <sup>m</sup>
Water Depth	2480m	3990m
Ship Position	32°41.9'N, 158°46.1'E	31°44.1'N, 157°25.7'E
Winch No.	No. 3	No. 3
Time Surfaced	15:00	16:25
Remarks	Combined with Box Corer	Combined with Box Corer
Target	No. 16	No. 21
Result	No	No
	unsuccessful	unsuccessful

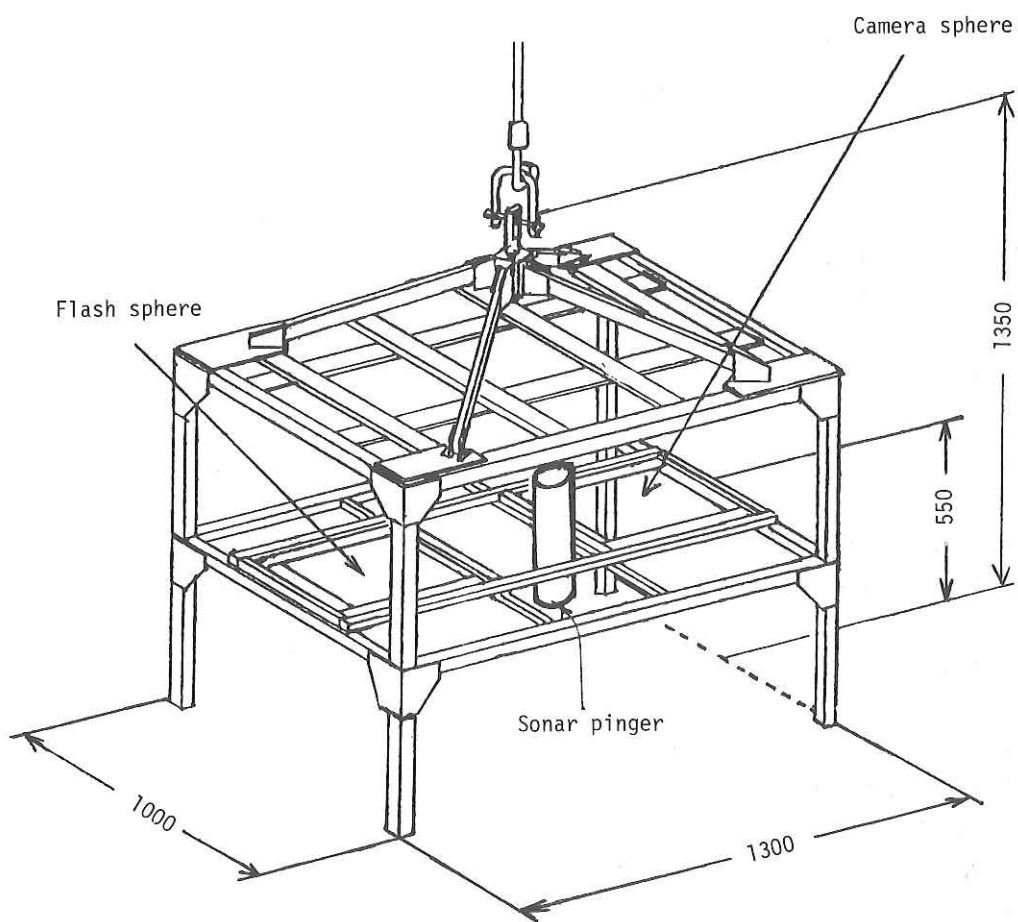


Fig. 20-1. Stainless steel frame for mounting deep sea camera system (unit in mm).

## 21. SHALLOW-CORING OF REEF FLAT AT EASTERN AGANA BAY, GUAM\*

K. KONISHI, A. OMURA and T. TANAKA

A shallow-coring with the use of "submarine" drilling equipment was performed at a site on reef-flat platform of the present-day fringing reef system in eastern Agana Bay, the northwestern coast of the Central Guam. It is located at 200 m northeast of the northern end of Paseo de Susana Park (Fig. 1).

The purpose of this study is two-fold: (1) to test feasibility of the newly modified parts of the drilling equipment, and (2) to examine the origin of the platform whether it represents an erosional truncation of the Pleistocene limestone or the Holocene depositional veneer.

The equipment was off-loaded from R/V Hakuho Maru on Aug. 9 and loaded back on board on Aug. 12, during her stoppage on Guam. The drilling site was selected for its easy access and previously well-documented work (Randall, 1978; transect 3 off Ipao Beach, East Agana Bay; Fig. 3, Tables 1-3, 5).

The total penetration of 4<sup>m</sup>77<sup>cm</sup> recovered 4<sup>m</sup>17<sup>cm</sup> of very coralliferous reefoid limestone. Increase both in numbers of metal crown chips in drilling bit and in rate of rotation (from 80 RPM to 145 RPM) has resulted in the successful recovery.

Such genera as Pocillopora, Porites and Favia, besides spicularite of Sinularia (alcyonarian coral) have been identified in the cored sample. Only those which still retain the original aragonitic mineralogy will be radiochemically dated with both radiocarbon and non-destructive <sup>238</sup>U: <sup>226</sup>Ra methods.

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\* The present work was carried out under a cooperative assistance of Richard H. Randall and his students at Marine Laboratory, University of Guam.

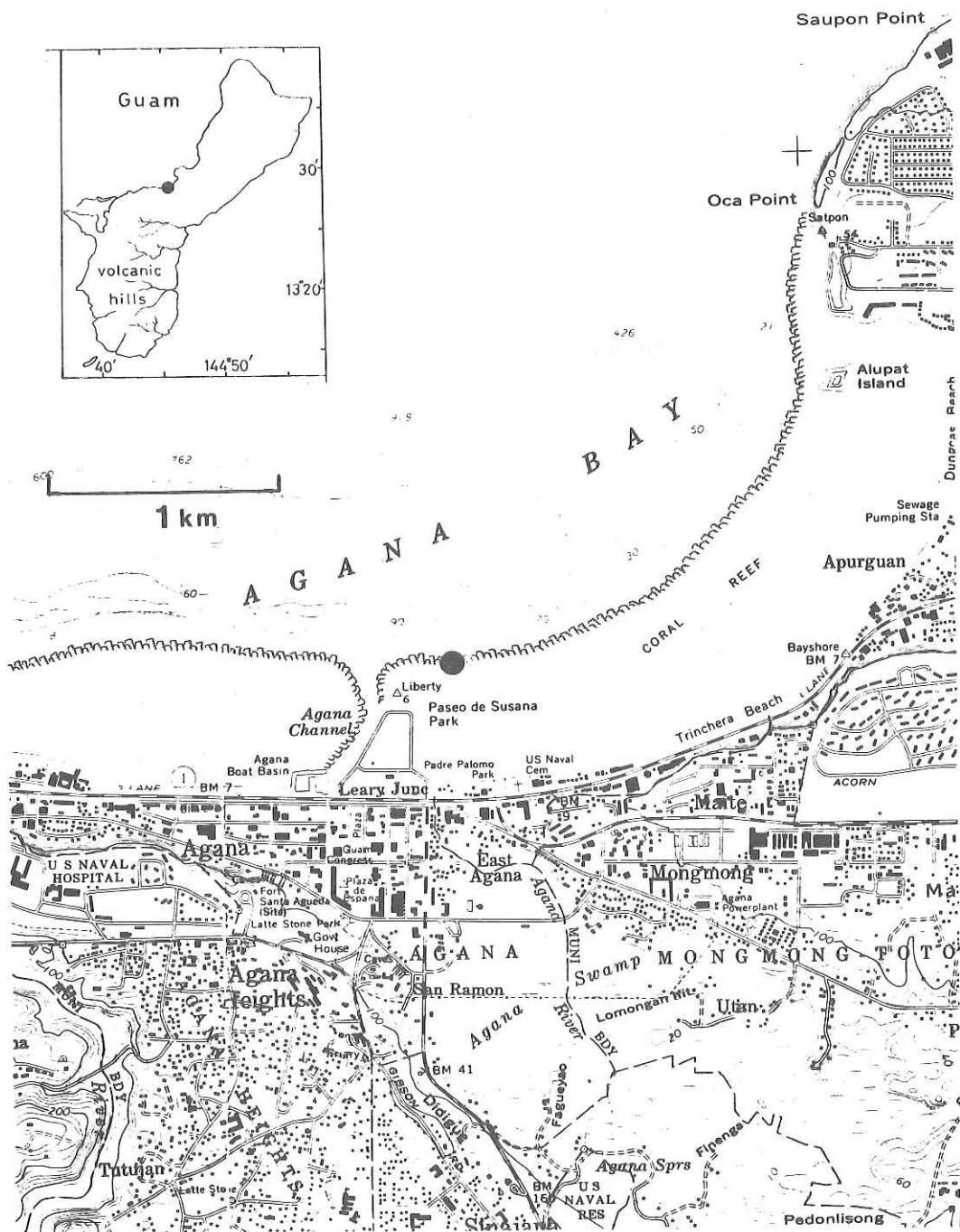


Fig. 21-1. Index map of coring site.

22. SCLEROCHRONOLOGICAL STUDIES OF PORITES LUTEA  
( A MASSIVE HERMATYPIC CORAL):  
CROWTH RATE AND PALEOENVIRONMENTAL ANALYSIS

T. TANAKA

Two large colonies of a massive hermatypic coral (Porites lutea) were collected during the KH 80-3 cruise; the one more than 1 meter in diameter was from the shallow passage south of the northern breakwater in Agana Port and the other about 40 cm in diameter was sampled at the southern edge of the lagoon just behind the reef-flat of the barrier reef system, north of Kolonia, Ponape.

Both specimens are to be sliced and X-rayed to study for the secular variations of both growth rate and oxygen and carbon isotope ratios in skeletons.

## 23. ONLAND COLLECTION OF IGNEOUS ROCKS AT GUAM AND PONAPE ISLANDS

T. ISHII

Geology and igneous petrology of Guam Island have been investigated in detail by the U.S. Geological Survey (J.I. Tracey et al., 1964 and J.T. Stark, 1963, respectively). The stratigraphic sequence of the volcanic rocks on Guam has been divided into two formations in their investigations, that is, Umatac Formation (Miocene) and Alutom Formation (Eocene and Oligocene), which are products of submarine volcanisms. On the basis of these studies, representative volcanic rocks were collected in the present program for comparative studies with the volcanic from the Japanese Islands. Samples of Umatac and Alutom Formation were collected at the Cetti River area and the Masso River area, respectively, as follows:

Date: August 12, 1980

Collected Sample: volcanic rocks of Alutom Formation, altered and fresh basalts from lapilli in lapilli tuff.

Location: the Masso River area, higher parts of the Nimits Hill.

Outcrops are located along the Spruance Drive.

Date: August 13, 1980

Collected Samples: volcanic rocks of Umatac Formation, altered basalt lapilli from lapilli tuff, fresh dacite from pillow lava ( $\phi > 2\text{m}$ ).

Location: the Cetti River area, outcrops are located along the cliffs of the Cetti River.

Date: August 14, 1980

Collected Samples: volcanic rocks of Alutom Formation, altered basalts from volcanic block in volcanic breccia, fresh basalt from pillow (?) lava.

Location: the Masso River area, lower parts of the Nimits Hill.

Geology and igneous petrology of Ponape Island have been investigated by Tayama (1936), Yoshii (1936) and Yagi (1960). The island consists of lavas, dolerites and pyroclastic rocks of the oceanic island type-alkali rock series. The following igneous rocks have been reported from Ponape Island.

(Olivine-)titanaugite alkali basalt, olivine dolerite, (aegirite-augite)

-sodalite trachyte, aegirin-augite trachyte, melilite-bearing monchiquite, barkevikite, olivine-augite lamprophyre, augite-orthopyroxene (alkali) andesite, etc.

On the basis of Tayama's studies, representative igneous rocks were collected in the northeastern areas (Fig. 23-1) of Ponape Island as follows:

Date: August 25, 1980

Collected Samples and Location: two-pyroxene (alkalic) andesite lavas and breccias (L. No.1; Japtic Island), many pyroxene-bearing olivine nodules from olivine-titanaugite basalt dike (L. No.2; Param Island), gabbroic xenolithes and olivine nodules from olivine-titanaugite basalt lava (L. No.4; Waterfall).

Date: August 26, 1980

Collected Sample and Location: olivine dolerites (L. No.5; Peipalap Peak), aphyrie basalt lava (L. No.6).

Date: August 27, 1980

Collected Sample and Location: olivine-titanaugite basalt lava (L. No.7; "Pshenmarak").

The rocks with vertical columnar joints are predominant in the island as observed in thick lava flows (L. No.1, 4 and 7) and dolerite (L. No. 5). The ruins of Nanmatol might be constructed from those rocks. It may be the first report in Ponape Island that olivine nodules are concentrated in the above-mentioned basalt dike with 50 cm thick of the Paran Island (L. No.2).

More than 150 samples of igneous rock were collected from Guam and Ponape Islands for petrological studies during this cruise.

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REMARKS added on sampling of igneous rocks for PALEOMAGNETISM ;

Oriented hand-samples of rocks were collected at three localities shown as follows;

Locality	Number of Sample	
1 (JAPTIK Is.)	5	basalt
2 (PARAM IS.)	6	dolerite
4 (water-fall)	3	basalt

Direction and intensity of natural remanent magnetization of these rocks as well as their magnetic stability are now being measured. Magnetochemistry of ferromagnetic minerals contained in these samples is also investigated.

Localities shown by  in Fig. 23-1 indicate those at which paleo-magnetic samples were collected. Horizontal plane and magnetic north are indicated on each sample by red pencil.



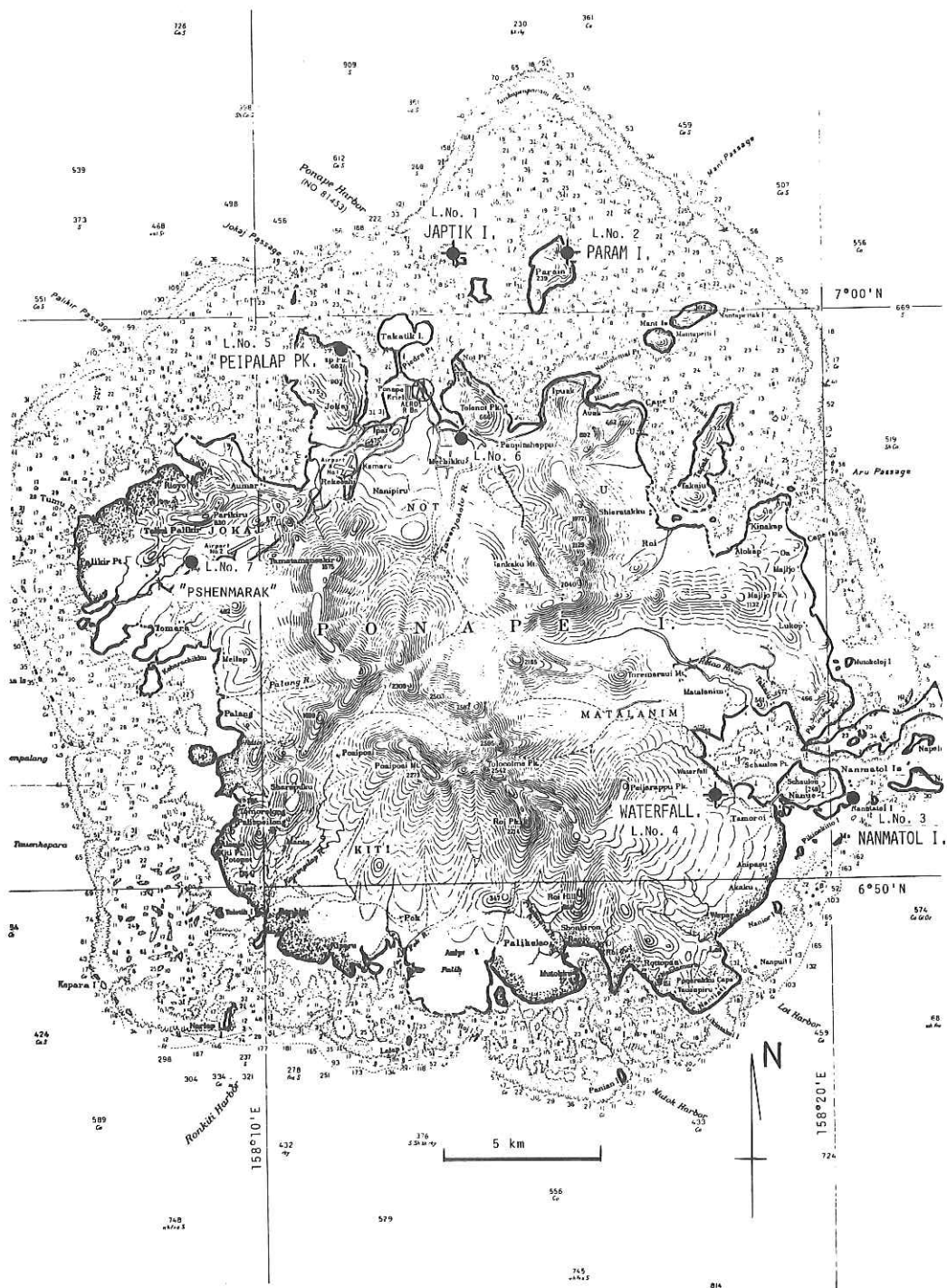


Fig. 23-1. Locality map of collected samples in Ponape Island.  
(circle: sampling site, cross: oriented sample).