

### III. GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS

#### III. 1 First cruise in 1972

##### Ship and personnel

Under the contract with Tokai University, the work was carried out from the Tokaidaigaku-maru II of the University. The ship was commanded by Captain Magoshichi Sato with ten officers, thirteen crew and four cook/stewards. The speci-

Table 3. Personnel of G.S.J. team of the 1972 cruise.

Name	Position	Speciality
Eiji Inoue	Geological Survey	Chief scientist, geology
Seizo Nakao	ditto	Co-chief scientist, Sedimentology
Katsura Ouyama	ditto	Biology
Masaaki Kimura	ditto	Geology
Makoto Yuasa	ditto	Petrology
Toshio Hiroshima	ditto	Geophysics
Kosuke Ito	ditto	Geophysics
Kouji Onodera	ditto	Topography and positioning
Kaichi Ishibashi	ditto	ditto
Masafumi Inoue	ditto	ditto
Yasuhiko Kamata	Professor, Nagasaki University	Sedimentology and paleontology
Hiromi Mitsushio	Assistant prof., Kochi University	Sedimentology
Makoto Inako	Nippon University	Sedimentology
Yasushi Osaka	ditto	ditto
Kenji Kurihara	The University of Tokyo Education	Biology (Foraminifera)
Toshiaki Osada	Komazawa University	Biology (Mollusca)

fications of the ship are as follows:

Length overall : 50.5m  
 Beam : 9.2m  
 Draught loaded : 4.9m  
 Tonnage : 702.6 gross tons

The geological and geophysical cruise was initially planned by Atsuyuki Mizuno, who was the project leader. During the cruise the scientific party consisted of ten G.S.J. staff, fifteen Tokai University staff, and two professors and four students of other universities as shown in Table 3. Among them Eiji Inoue was in charge of the scientific party during the period September 8th to 20th and Seizo Nakao succeeded for the remainder of the cruise.

### Programme of work

The ship sailed from Shimizu port, Shizuoka prefecture, on September 8th, 1972 and arrived in the surveyed area on 10th. The geological and geophysical work was carried out from 10th to 23rd of September. The cruise ended by sailing back to Shimizu port on September 27th. The daily log of the cruise is summarized in Figure 4.

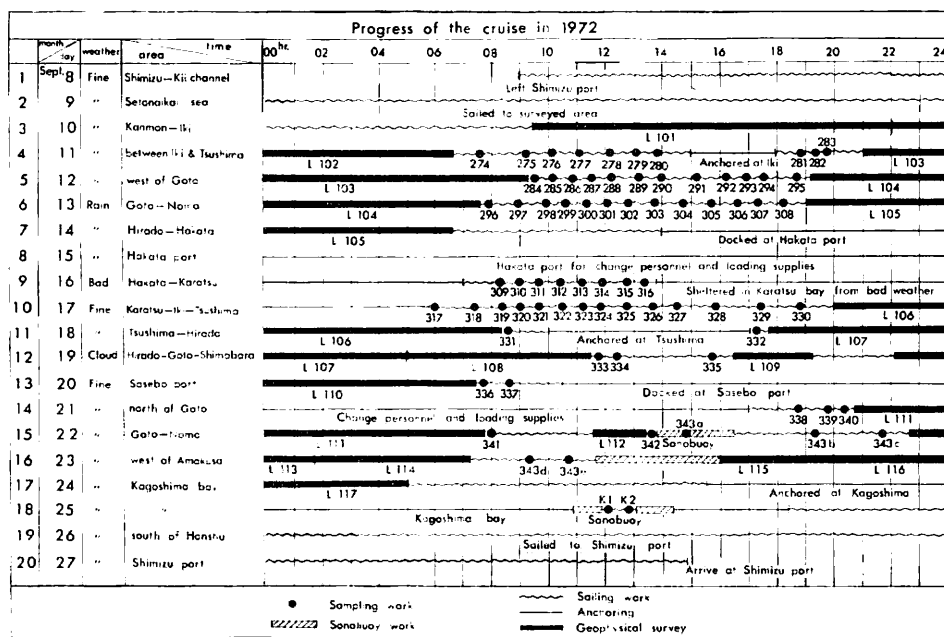


Fig. 4. Progress of the cruise in 1972.

During the cruise, the ship docked at Fukuoka (Hakata) on 14th and 15th, at Sasebo on 20th and 21st, and at Kagoshima on 24th for change of personnel, loading supplies and maintenance work. The ship sheltered off Karatsu from a

Table 4. Record sheet of seismic reflection

Traverse line No.	Beginning					End	
	Month, Day	Time	Station		Depth m	Month, Day	Time
			Lat. N	Long. E			
101	Sept. 10	09 45	34°19.4	130°46.4	85	Sept. 10	11 20
		14 50	34°01.0	130°18.7			22 10
102	10	22 10	33°37.9	129°46.0	56	11	06 40
103	11	21 04	33°43.4	129°32.5	87	12	09 19
104	12	19 12	32°50.8	127°59.8	178	13	07 40
105	13	19 06	32°14.0	129°35.2	180	14	06 44
106	17	20 00	33°18.5	128°59.0	112	18	08 20
107	18	17 45	34°07.8	129°19.6	76	19	05 00
108	19	05 00	33°11.8	129°18.2	75	19	11 30
109	19	16 30	32°33.3	129°57.0	70	19	19 17
110	19	23 50	32°28.5	129°41.2	86	20	06 10
110	21	21 00	33°16.8	129°16.8	86	22	02 08
112	22	11 31	32°39.7	129°58.3	40	22	13 22
113	22	22 40	32°20.2	129°26.5	163	23	01 44
114	23	01 40	32°35.6	129°26.4	115	23	07 12
115	23	16 00	32°40.2	130°00.5	31	23	19 20
116	23	19 20	32°27.8	129°48.8	92	24	00 20
117	24	00 20	32°00.2	129°49.4	250	24	05 02

typhoon. The twenty days of the cruise can be broken down as follows:

Days surveyed	10.5
Days lost or in harbour	4.5
Days on passage	5.0

## Methods

Depth measurements were made by the N.E.C. Precision Depth Recorder throughout the cruise.

The geophysical survey consisted of seismic reflection method using 200-joule sparker equipment and magnetic survey using shipborne proton magnetometer. The geophysical work was mostly done by night, while the sampling of the sediments was carried out in the daytime. Through the geophysical surveys the average speed of the ship was about 5 knots. At first time, the traverse lines had been planned as connections between lands, of which rocks were well known, however, some of the lines must have been changed according to weather and sea conditions. The actual traverse lines are shown in Figure 5, and the work is listed in Table 4. The total extension of the lines was 1,450km.

In addition to the above, the seismic survey of refraction method using a sonobuoy was carried out experimentally in the Goto-nada and Kagoshima Bay for three days.

The sampling work was made by cylinder-type dredges and a Smith-McIntyre grab. The sampling stations had been planned as about 10km intervals along the

survey in the 1972 cruise.

Station		Depth m	Equipment	Speed of Ship kt	Exten- tion km	Remarks
Lat. N	Long. E					
34°15.2	130°38.2		Sparker 3,000J	5.0	} 122	Sparker trouble
33°37.9	129°46.0	56	Sparker 200J	4.0~6.0		
34°04.9	129°05.4	129	ditto	6.0	100	
32°53.9	128°54.8	70	ditto	6.0	130	
32°32.2	128°51.2	139	ditto	5.5	126	
33°10.7	129°17.7	76	ditto	5.0	118	
34°20.0	129°27.1	85	ditto	5.5	125	
33°11.8	129°18.2	75	ditto	5.5	} 146	rough condition
33°52.1	129°10.9	55	ditto	5.5		
32°33.6	130°16.4	48	ditto	6.0	32	Sparker, trouble
32°46.5	129°06.2	110	ditto	6.0	75	
33°32.1	128°48.5	155	ditto	6.0	51	
32°44.8	130°08.1	37	Sparker			use Sono-buoy, refraction
32°35.6	129°26.4	115	Sparker 200J	6.0	26	
32°18.8	129°59.9	98	ditto	5.5	50	
32°27.8	129°48.8	92	ditto		25	
32°00.2	129°49.4	250	ditto		49	
32°08.5	129°54.6	93	ditto	6.0	23	

traverse lines. The number of the sampling stations was 74.

In addition, another sampling work was done at Kagoshima Bay with a piston corer in order to provide useful information for the interpretation on the stratigraphy of the previous work.

### Position fixing and navigation

Positions of all traverse lines and sampling stations were fixed using the Decca Navigation System, D 7 chain. The lines were pre-plotted on Decca track-plotter charts. At 20 minute intervals, fiducial marks were registered on all records and at the same time deccometer readings were logged. These fixes were plotted on Decca chart of scale 1:500,000.

### Bathymetric surveying equipment

The equipment is Precision Depth Recorder (PDR) NS 16 type of Nippon Electric Company (N.E.C.); 12kHz and 4kw. The equipment has three channels of 0-1,000m, 0-6,000m and 0-10,000m ranges. Continuous depth records are marked on the dry-type recording paper of 486mm wide.

### Geophysical equipment, installation and power supply

The space available on the ship for geophysical equipment consisted of a chart-

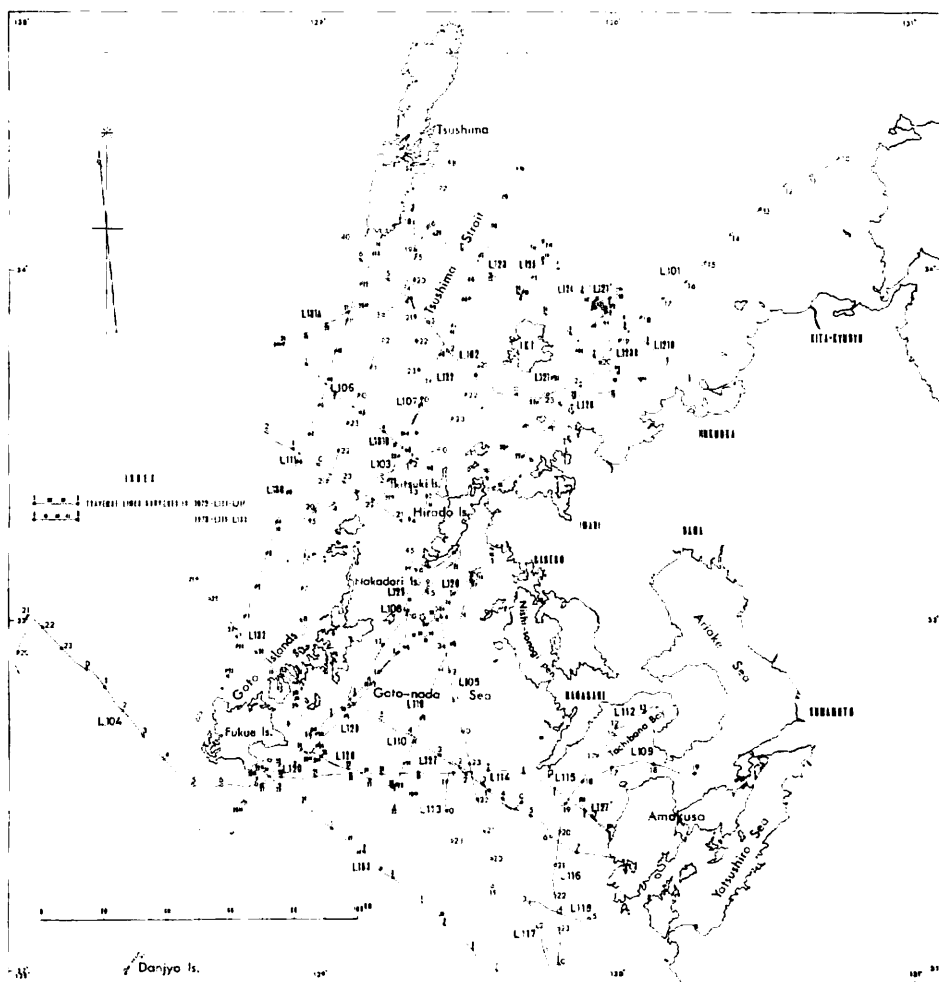


Fig. 5. Traverse lines of seismic reflection surveys in the 1972 and 1973 cruises.

room behind the bridge, two laboratories and the quarter deck. PDR and Decca equipment were installed in the chart-room, and the sparker equipment and magnetometer were set in the laboratories. Interphones were installed between the chart-room and the laboratories. The hydrophone array, spark units and magnetometer fish were all towed astern of the ship.

Decca receiver and the track-plotting units were powered by the ship. A portable generating set, 10kw, 220V diesel generator, belonging to the G.S.J., was installed on the quarter deck and supplied for 200-joule sparker equipment.

The sparker seismic profiling equipment, manufactured by N.E.C., is a 200- and 30,000-joule sparker high resolution seismic profiling equipment. This was used through whole the surveying term, in order to detect geological structure in detail within about 100m below the sea bed in the shallow water. The equipment is composed of three units: that is, transmitter, towing and receiver/recorder units. The

transmitter unit has two types of acoustic sources of 200-joule (model NQS-158) and 30,000-joule (model NE-17M), however, the latter met with very serious trouble at the beginning of the survey, therefore it was almost not used until the third period of the survey.

The towing unit is composed of electrode, hydrophone and cables. The towing cables of the electrode and the hydrophone are 70m long. The graphic recorder with two channels is able to change the detectable range from 50m to 800m, but 200m range was used in many cases.

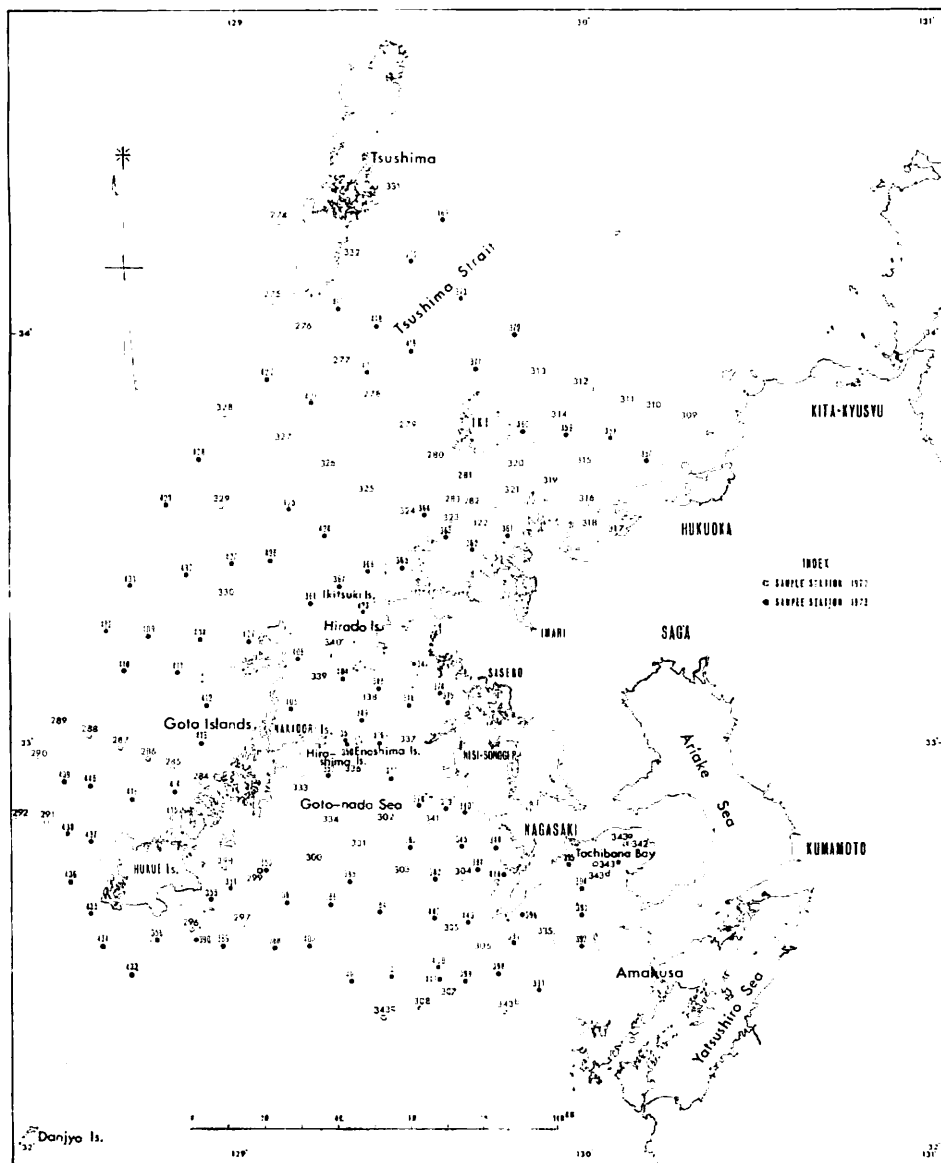


Fig. 6. Sampling station map in the Goto-nada and the Tsushima Strait.



Fig. 7. Sampling stations in Kagoshima Bay.

The sonobuoy system manufactured by N.E.C. was tested in the third period of the cruise. The system is composed of three units; that is, sound source, transmission and receiver/recorder units. For the system, the 200- and 30,000-joule sparker acoustic sources were employed. The transmission unit consists of sonobuoy, hydrophone and cable. The hydrophone is lowered down from the sonobuoy by a cable and a rope of 100m long. After the hydrophone receives acoustic waves, which are emitted from the acoustic source on board and refracted through undersea strata, it sends electric signal to the sonobuoy through the cable. The sonobuoy radiates the signal toward the ship and a receive antenna catches it. The receiver/recorder unit is composed of receiver, recorder and data recorder. The signal sent from the buoy is amplified by the receiver and recorded on wet-type recording paper and magnetic tape.

### Sampling equipment

The bottom sediments and rock fragments were obtained with two simple cylinder-type dredges and a Smith-McIntyre grab. The larger cylinder-type dredge is 40cm

in diameter and 90cm long and the smaller one is 16cm in diameter and 60cm long. The former was mostly used to obtain coarse sediments, rock and gravel, and the latter was used to dredge soft sediments. The Smith-McIntyre grab was used when the undisturbed surface of sea bottom sediments was needed. The surfaces of the sediments obtained with the grab were well preserved in many cases.

### III. 2 Second cruise in 1973

#### Ship and personnel

The work was carried out by the Wakashio chartered from the Fuyo Ocean Development and Engineering Co., Ltd. The ship is a catamaran-type, built by the Nippon Kokan Co. in 1971, and suitable for marine research of shallow sea.

The specifications of the ship are as follows.

Length	:	33.0m
Beam	:	12.0m
Draught	:	3.3m
Gross tonnage	:	368.3t
Max. speed	:	10 kt
Cruising range	:	3,000 nautical miles

Table 5. Personnel of G.S.J. team of the 1973 cruise.

Name	Position	Speciality
Eiji Inoue	Geological Survey	Chief scientist, geology
Katsura Ouyama	ditto	Biology (Mollusca)
Kazuo Oshima	ditto	Sedimentology
Masaki Kimura	ditto	Geology
Toshio Hiroshima	ditto	Geophysics
Yoshihisa Okuda	ditto	Geophysics and geology
Makoto Yuasa	ditto	Petrology
Koji Onodera	ditto	Topography, positioning
Kaichi Ishibashi	ditto	ditto
Yoshiro Masai	ditto	Cameraman
Hiromi Mitsushio	Kochi University	Sedimentology
Kei Kuroda	Kouchi University	Sedimentology
Makoto Inako	Nippon University	Sedimentology

The ship was manned by Skipper Mitsuro Takagi and ten crew, with the G.S.J. team, which consisted of nine G.S.J. staff, two assistant professors and a student of universities. Eiji Inoue was in charge of the team through the cruise.

#### Position fixing and navigation

The Loran A/C system was used to navigate the ship along the geophysical traverse lines or between sampling stations. The positions were plotted on Loran-chart on the scale of 1:200,000 at 15 minute intervals, but the data of time, posi-



tion and depth were printed on the recording paper of Automatic Tracking Loran A/C Recorder at a minute interval. The position errors involved in the use of this system are of the order of some hundreds meters, however in near shore survey the errors were checked by the radar system. The depth was recorded by analog/digital precision depth recorder.

### Object and methods

The cruise was planned as a continuation of the work which was carried out in 1972. The main object of the cruise is to obtain more detailed geological and geophysical data over the area surveyed in 1972, and to complete the previous work.

The survey consisted of reflection seismic surveys using 2,000- and 4,000-joule sparker equipment and a sub-bottom profiler, and sampling of sediments by grabs and a dredge. The geophysical survey was mostly carried out by night, while the sampling work was restricted within daylight hours.

During reflection seismic survey the speeds of the ship were kept to 5.0kt in average; the speeds were changed between 4 and 7kt according to the weather and sea conditions in order to obtain well seismic records.

The sampling work was made by a cylinder-type dredge, a Smith-McIntyre grab, a Shipek and a gravity corer. At almost all sampling stations, the dredge and the Smith-McIntyre grab were used. The former was for sampling of coarse sediments and rocks, and the latter was mainly used for soft sediment sampling. The dredging time at each station was between 3 and 5 minutes usually, but the results of the dredging were almost satisfied.

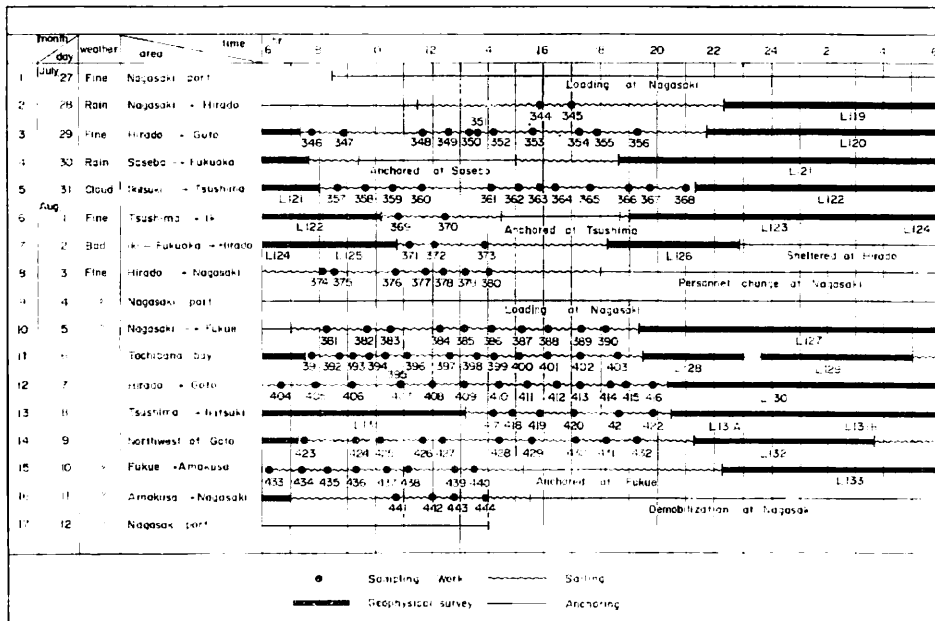


Fig. 8. Progress of the cruise in 1973.

### Programme of work

The Wakashio was equipped at Nagasaki harbor on 27th of July, 1973, and left the harbor on 28th. Geophysical and geological survey was carried out for 14 days from 28th to 11th of August, except 9th of August when the ship docked at Nagasaki for change of personnel, loading supplies and maintenance work. On 12th of August the Wakashio was unloaded and demobilized. The synopsis of the daily log of the cruise is summarized in Figure 8.

The total duration of the cruise was 17 days and can be broken down as follows.

Days surveyed	14
Days lost or in harbour	3

### Data obtained

Traverse lines of seismic reflection survey is shown in Table 6 and Figure 5. The total distance traversed was 1,270km and the number of the lines was fifteen from L 119 to L 133. The sub-bottom profiler of 3.5kHz was also operated through sailing between sampling stations, which are 101 in total number and are broken down as follows.

Using Smith-McIntyre grab	49	stations
Using cylinder-type dredge	53	"
Using Shipek grab	3	"
Using gravity corer	1	"

The sampling stations are shown in Figure 6, and the sampling work and the samples obtained are listed in Table 7.

### Note on equipment

**Installation:** All equipment of the Precision Depth Recorder, the Loran A/C recorder, sparker and the sub-bottom profiler were installed in the laboratory aft of the bridge. Electrical power, 440 volt a.c., for all of the equipment was supplied from the ship. Hydrophone eel and sparker electrode were streamed from the stern. The transducer of the sub-bottom profiler was rigged at the starboard between the bow and the stern, a few meters below water-line.

All equipment of sampling of sediments were prepared at the stern deck and operated by the winch of 10.6 PS having a wire rope of 6mm in diameter and 2,000m long through a davit portside. A container was mounted at the center of the deck for sample storage.

**SE-1002 precision depth recorder:** The equipment manufactured by the Oki Electric Industry Co., Ltd. was used for bathymetry. The transmit frequency is switched between 100kHz (directivity of 9) and 29kHz (directivity of 13). Depth measurement ranges are 5–500m in 100kHz frequency and 20–2,000m in 29kHz. The digital depth data is converted to analog and printed on the recording paper of 340mm width at the below scale accuracy.

Table 6. Record sheet of seismic

No. of Traverse	Beginning					End	
	Month, Day	Time	Station		Depth m	Month, Day	Time
			Lat.	Long.			
119	July 28	22 20	32°29.0	129°15.8	236.3	July 29	07 15
120	29	20 53	32°28.0	129°43.8	234.5	30	07 34
121	30	18 42	33°24.2	129°34.0	35.3	31	08 00
122	31	21 12	33°20.7	129°13.5	94	Aug. 01	10 00
123	Aug. 01	19 00	34°09.8	129°19.4	73	02	04 26
124	02	04 26	33°54.0	129°57.25	71.5	02	07 00
125	02	07 00	34°04.0	129°46.0	102	02	10 45
126	02	18 15	33°41.1	130°04.9	42	02	22 55
127	05	19 20	32°33.4	128°47.6	92	06	07 30
128	06	19 30	32°29.9	129°17.9	258	06	23 00
129	06	23 43	32°36.9	128°58.1	138	07	05 00
130	07	20 20	32°49.0	128°40.4	75	08	13 15
131A	08	20 30	33°53.8	129°08.3	111	09	00 00
131B	09	00 08	33°47.15	129°53.05	138	09	07 15
132	09	21 15	33°06.9	128°35.1	(140)	10	03 35
133	10	22 15	32°33.9	129°48.5	77	11	07 00

Range 1                    1mm=200cm        full scale 600m  
 Ranges 2 and 3        1mm=800cm        full scale 2,400m

**N.E.C. sparker profiling system:** A 30,000-joule sparker seismic profiling equipment, manufactured by the Nippon Electric Co., Ltd., was used and operated with either 3,000- or 4,000-joule pulses fired once each second. A visigraph (visilight 5M 21) connected with FM data recorder (TEAC R70A) for the purpose of monitoring and analyzing the signal waves. A ten element hydrophone array was towed about 100m. Two or three times, rather serious break downs of the hydrophone occurred and a spare hydrophone fish was used through repairing of the hydrophone troubled.

**Raytheon sub-bottom profiler:** The equipment is composed of a transducer at 3.5kHz (type TR75A), a receiver, a transceiver (model PTR-105A), correlation processor (CESP II), precision depth recorder and a recorder (UGR 196A). The transducer is designed for use in the 3.5 to 4.5kHz frequency range, and for opera-

reflection survey in the 1973 cruise.

Station		Depth m	Equipment	Speed of Ship Kt	Extension km	Remarks
Lat.	Long.					
33°02.1	129°29.5	40.2	Sparker 3,000J	4.0~4.5		Goto, Nomo→Hirado
33°07.1	129°31.5	41.6	Sparker 4,000J Reytheon 3.5 kHz	4.0~4.5		Sparker trouble from 22:50 to end, Tukue→Hirado 3.5 KC well Hirado→Iki
33°41.9	130°15.65	28.7	Sparker 2,000J Reytheon 3.5 kHz	4.0		Hirado→Iki
33°17.0	129°40.8	107	Sparker 3,000J Reytheon	4.0~4.5		Hirado→Tsushima
33°54.0	129°57.25	71.5	Sparker 3,000J Reytheon 3.5 kHz	5.0~6.0		Tsushima→Iki
34°04.0	129°46.4	102	ditto	5.0~6.0		Around Iki
33°55.4	129°40.4	99.6	ditto	3.0~5.0		give up
33°23.45	129°37.25	41.5	ditto	5.0~6.0		Karatsu→Hirado
32°28.3	129°53.1	83	Sparker 4,000J Reytheon 3.5 kHz	6.0		
32°37.1	128°59.0	169	ditto	7.0		
33°08.9	129°18.45	69.5	ditto	7.0		
34°03.9	129°11.9	50	ditto	5.0~6.0		
33°47.3	128°53.4	135	Sparker 3,000J	5.0		
33°19.6	129°22.1	75	ditto	5.0		
32°36.5	128°59.4	(80)	ditto	6.0		
31°59.8	129°36.0	(400)	ditto Reytheon 3.5 kHz	6.0		

tion at 600 watts maximum input power. The transceiver is composed of transmitter section which has maximum power output of 2,000 watts and maximum gain of 106dB. Instrumental failure accounted for no serious loss of time.

**Cylinder-type dredge:** This is 16cm in diameter and 60cm long. It was mainly used for sampling of coarse sediment or rock fragments at many stations as well as the Smith-McIntyre grab. The dredge was not faulted in sampling, easily operated, and obtained gravel or rock fragments, inspite of very short dredging time.

**Smith-McIntyre grab:** The grab was mostly useful for taking fine grained sediments with well preserved sea bottom surface. The undisturbed area observed in the grab is 100cm<sup>2</sup>.

**Shipek grab:** It was operated only at early three stations, because the connecting part of the grab was broken at St. 348 and it could not be used after that time.

Table 7. List of sampling stations and sediments obtained in the Goto-nada and the Tsushi type dredge, SM=Smith-McIntyre grab, S=Shipek grab, C=gravity corer, and P=

Station	Month, Day	Time	Lat.	Long.	Depth m	Sampler
274	1972 Sept. 11	07 40	34°15.9	129°07.5	115	D, SM
275	"	09 12	34°04.5	129°06.4	128	D
276	"	10 10	34°00.1	129°11.6	95	d
277	"	11 03	33°55.0	129°18.4	130	D, SM
278	"	12 10	33°50.1	129°23.5	110	d
279	"	13 04	33°45.6	129°30.0	97	d
280	"	13 52	33°41.2	129°34.3	77	d
281	"	18 58	33°38.2	129°40.6	63	d
282	"	19 28	33°34.3	129°41.0	65	d
283	"	19 50	33°34.7	129°37.8	70	d
284	12	09 26-09 39	32°54.0	128°53.8	82	D
285	"	10 06-10 18	32°56.1	128°48.7	97	D, SM
286	"	10 42-11 04	32°57.7	128°44.5	100	D, d
287	"	11 29-11 46	32°59.3	128°39.8	110	D
288	"	12 07-12 30	33°01.0	128°34.3	163	D
289	"	13 04-13 21	33°02.2	128°29.1	180	D
290	"	13 53-14 10	32°57.3	128°25.4	173	D
291	"	15 10-15 22	32°48.6	128°27.0	77	D
292	"	16 07-16 28	32°48.5	128°21.2	222	D
293	"	16 53-17 05	32°48.1	128°15.6	196	d
294	"	17 38	32°49.5	128°07.8	171	d
295	"	18 32-19 00	32°50.1	128°00.2	180	d
296	13	07 48-08 07	32°32.3	128°52.0	147	D
297	"	08 52-09 08	32°32.9	129°00.9	214	D
298	"	09 53-10 01	32°41.2	128°59.2	125	d
299	"	10 31-10 40	32°41.1	129°05.2	142	d
300	"	11 20-11 30	32°42.0	129°13.6	139	d
301	"	12 07	32°43.9	129°21.2	128	d
302	"	12 48-12 54	32°47.9	129°25.7	98	d
303	"	13 39-13 48	32°40.2	129°28.9	114	d
304	"	14 48-14 53	32°40.0	129°39.4	84	d
305	"	15 38-15 47	32°32.6	129°35.3	95	d
306	"	16 31-16 39	32°29.0	129°42.5	77	d
307	"	17 20-17 28	32°24.3	129°35.8	87	d
308	"	18 06-18 20	32°20.6	129°31.9	93	D
309	16	08 18-08 25	33°46.8	130°18.6	40	d
310	"	08 55-09 06	33°48.6	130°12.7	50	D
311	"	09 30-09 43	33°49.4	130°08.2	50	d, SM
312	"	10 19-10 31	33°51.9	130°00.1	51	D
313	"	11 05-11 13	33°53.5	129°52.4	78	d
314	"	11 55-12 03	33°47.1	129°56.1	50	d
315	"	12 45-12 54	33°40.3	130°00.5	38	D

ma Strait through the 1972 and 1973 cruises, D=large cylinder-type dredge, d=small cylinder-piston corer.

Sediments	Remarks	Area
grey c. shell Sand	coal slag micaceous	Tsushima-Iki
grey c. shell Sand		ditto
grey c. shell Sand		ditto
grey m. Sand		ditto
light grey m. Sand		ditto
green grey m. Sand		ditto
mddy f. Sand		ditto
green grey m. Sand		West of Iki
green grey m. Sand f. Sand		ditto ditto
light grey m. Sand		West of Goto
green grey c. Sand		ditto
green grey c. Sand		ditto
rock fragment, pebble		Southwest of Goto
green grey f. Sand		ditto
green grey f. Sand		ditto
green grey m. Sand		ditto
rocks & shell Sand		ditto
green grey mddy Sand		ditto
green grey m. Sand		ditto
green grey f. Sand		ditto
green grey m. Sand		ditto
green grey c. Sand		semi-consolidated
green grey sdy silt	ditto	
green grey mddy Sand	ditto	
green grey mddy Sand	ditto	
green grey m. Sand	Goto-Nishisonogi	
green grey mddy f. Sand	ditto	
green grey mddy f. Sand	bearing granules	
green grey m. Sand	ditto	
green grey m. Sand	ditto	
green grey m. Sand	West of Nomo	
brown grey c. Sand	ditto	
brown grey v. c. Sand	ditto	
brown grey m.-c. Sand	bearing pebbles	
blue grey c. Sand	bearing granules	near Hakata Bay
brown grey granule~v. c. Sand	bearing pebbles	ditto
brown grey v. c. Sand		ditto
brown grey granule~v. c. Sand		East of Iki
green grey c. Sand		ditto
brown grey v. c. Sand		ditto
brown grey c. Sand		Off Itoshima

(Table 7. continued)

Station	Month, Day	Time	Lat.	Long.	Depth m	Sampler
316	16	13 25-13 40	33°34.7	130°01.1	26	d, SM
317	17	06 00	33°32.1	130°07.8	11	SM, d
318	"	07 24-07 29	33°32.3	130°03.6	28	d, SM
319	"	08 20-08 24	33°37.5	129°54.5	48	d
320	"	08 59-09 12	33°40.0	129°48.4	50	d, SM
321	"	09 36-09 45	33°36.2	129°47.9	50	D
322	"	10 25-10 39	33°31.3	129°42.7	62	d, SM
323	"	11 05-11 16	33°32.0	129°37.3	75	d, SM
324	"	11 50-12 00	33°33.0	129°30.3	78	d, SM
325	"	12 43-12 56	33°36.5	129°22.8	97	d, SM
326	"	13 36-13 44	33°40.0	129°15.8	101	d
327	"	14 26-14 43	33°43.7	129°08.2	129	d
328	"	15 43-16 06	33°48.1	128°57.9	160	D
329	"	17 23-17 31	33°34.8	128°57.5	152	d
330	"	18 45-18 56	33°20.8	128°58.0	118	d
331	18	08 26-08 34	34°20.1	129°27.4	90	d
332	"	17 11-17 23	34°10.6	129°19.5	66	D
333	19	11 32-11 40	32°52.1	129°10.9	55	D
334	"	12 17-12 32	32°47.5	129°16.2	103	d, SM
335	"	15 50-15 57	32°31.2	129°53.5	77	d, SM
336	20	07 31-07 40	32°55.0	129°20.5	56	D
337	"	08 30-08 44	32°59.4	129°29.6	62	D
338	21	18 44-18 55	33°06.7	129°25.0	56	D
339	"	19 39-19 52	33°08.7	129°14.7	69	D
340	"	20 15-20 31	33°13.7	129°16.6	83	D
341	22	07 46-07 56	32°47.7	129°34.0	80	D
342	"	13 23-13 26	32°44.8	130°08.1	37	d
343a	"	14 44-14 50	32°44.1	130°07.5	39	d
343b	"	19 15-19 26	32°20.2	129°46.4	100	d
343c	"	21 41-21 57	32°19.3	129°25.4	209	D
343d	23	09 26-09 34	32°40.8	130°01.1	35	d
343e	"	10 31-10 36	32°41.3	130°01.8	36	d
K1	25	12 10-12 32	31°25.9	130°33.8	57	d
K2	"	12 50-13 10	31°26.5	130°36.8	200	p
344	1973 July 28	15 57-16 07	32°44.3	129°45.15	64	S, SM
345	"	16 59-17 06	32°44.6	129°39.5	80	SM, S
346	29	07 40-07 55	33°05.5	129°30.0	56	SM
347	"	08 49-08 52	33°11.55	129°31.0	44	SM
348	"	11 46-11 53	33°07.95	129°24.7	62	S, SM
349	"	12 41	33°03.25	129°21.8	69	d
350	"	13 25	32°59.75	129°19.15	16	d

Sediments	Remarks	Area
green grey mddy f. Sand		Off Itoshima
dark grey Mud grey green f. Sand brown grey v. c. Sand brown grey v. c. shell Sand brown grey v. c. Sand green grey sdy Mud green grey sdy Mud green grey mddy c. Sand green grey m. Sand green grey m. Sand green grey m. Sand brown gery m. Sand green grey m. Sand green grey m. Sand	shell rich  semi-consolidated  bearing granules	Itoshima Bay ditto South of Iki ditto ditto Off Yobuko  Iki-Hirado West of Iki ditto South of Tsushima ditto Tsushima-Goto ditto
granule~v. c. Sand Rock and v. c. shell Sand	Shale fragments	East of Tsushima ditto
white green v. c. shell Sand green grey muddy c. Sand black f. Sand	bearing granules	East of Goto ditto Mouth of Shimabara
light grey m. Sand shell Sand		East of Goto West of Sakito
shell Sand shell Sand shell Sand	coquinite, sponge	South of Hirado West of Hirado ditto
green grey sdy Mud green brownish grey Mud green brownish grey Mud green grey m. Sand green grey c. Sand	shell fragments	Tachibana Bay ditto ditto Amakusa-nada ditto
green grey Mud green grey muddy m. Sand		Tachibana Bay ditto
dark grey muddy Sand pumice pebbles		Kagoshima Bay ditto
green grey sdy Silt~f. Sand green grey silty m. Sand	shell rich, mica rich	Off Nagasaki ditto
green grey v. c. s.~f. Sand green grey Sand~Silt whitish yellow c. Sand peb. v. c. Sand v. c. Sand or Rock	shell Sand, Coals  shells, Sandstone, Coals diorite, andesite, quartz rock fragments	East of Hirado ditto ditto ditto East of Nakadori



(Table 7. continued)

Station	Month, Day	Time	Lat.	Long.	Depth m	Sampler
351	29	13 35	33°00.3	129°18.9	27	d
352	"	14 23	32°54.7	129°15.15	49	d
353	"	15 41	32°45.9	129°09.8	115	SM
354	"	17 23	32°38.75	128°58.7	134	SM
355	"	17 52	32°36.85	128°55.45	78	d
356	"	19 23	32°30.9	129°46.0	150	d
357	31	08 40	33°41.3	130°11.5	28	d
358	"	09 42	33°44.7	130°05.2	52	d
359	"	10 43	33°45.1	129°57.5	45	SM
360	"	11 42	33°45.6	129°50.0	37	d
361	"	14 13	33°30.5	129°47.5	38	d
362	"	15 08	33°28.3	129°41.13	53	SM
363	"	15 51	33°30.2	129°36.45	57	SM
364	"	16 28	33°33.35	129°32.1	80	SM
365	"	17 46	33°25.6	129°28.3	61	d
366	"	18 59	33°25.1	129°22.9	81	d
367	"	19 48	33°22.8	129°18.0	80	d
368	"	21 00	33°20.3	129°13.15	89	d
369	Aug. 01	10 51-11 08	34°16.4	129°36 0	111	SM
370	"	12 30	34°10.3	129°30.4	117	d
371	02	11 05-11 13	33°54.8	129°41.9	95	d
372	"	12 02	33°59.8	129°48.6	97	d
373	"	13 58	33°04.7	129°48.6	115	d
374	03	08 04	33°07.3	129°35.3	72	d
375	"	08 28-08 57	33°05.9	129°36.75	59	d, C
376	"	10 46	32°59.9	129°24.8	44	d
377	"	11 44	32°54.6	129°26.9	59	d
378	"	12 28	32°50.65	129°31.7	75	d
379	"	13 14	32°50.7	129°36.35	70	d
380	"	14 00	32°49.6	129°39.9	54	d
381	05	08 16-08 38	32°41.2	129°42.0	73.5	d
382	"	09 39	32°39.8	129°34.4	104	d
383	"	10 30-10 37	32°44.5	129°30.1	107	SM
384	"	12 15	32°35.0	129°24.8	118	SM
385	"	13 05	32°39.4	129°19.6	149	d
386	"	14 08	32°36.0	129°16.3	184	SM
387	"	15 11	32°36.3	129°08.65	182	SM
388	"	16 12	32°29.7	129°06.6	235	SM
389	"	17 24	32°30.0	128°52.8	214	d
390	"	18 07	32°30.9	128°52.8	172	d
391	06	07 41	32°23.5	129°52.5	81	SM
392	"	08 34	32°30.0	129°54.7	39	d

Sediments	Remarks	Area
pebbles	hornfels, bl. shale, dioritic rocks	East of Nakadori
light grey shell c. Sand		ditto
green grey silty f. Sand	quartz grains	ditto
green grey c. Sand	rock fragments	East of Fukue
brown grey m. Sand		ditto
green grey m. Sand		South of Fukue
grey-brown v. c. Sand	granite mds.	Mouth of Hakata Bay
dark grey c. Sand	basalt, granite, sedimentary rocks	Off Fukuoka
green brown c.~f. Sand	shells rich	ditto
boulder, pebble	andesite	West of Iki
m.~f. Sand	Coaly shale?	North of Imari
silty f.~m. Sand	Shale, Coal fragment	ditto
green grey f. Sand	Coal fragment	Between Hirado and Iki
green grey muddy f.~m. Sand	Olivine grains	ditto
green grey m.~f. Sand		North of Hirado
green m.~c. Sand	Coal slags	ditto
green grey f. Sand		Between Hirado and Goto
shell c. Sand		ditto
shell c. Sand	obsidian	East of Tsushima
		ditto
v. c. shell Sand	granitic, dioritic rocks	North of Iki
green grey c. Sand~granule		Between Iki and Tsushima
grey brown shell c. Sand		ditto
green grey silty m.~c. Sand		Off Nishisonogi
dark grey silty Sand & Mud	Semi-consolidated, plant fossils	ditto
white brown v. c. Sand~granule	granitic pebbles	ditto
grey brown m.~f. Sand	well sorted	ditto
green grey muddy c.~m. Sand	schist fragments	ditto
dark grey muddy m. Sand	black schist fragment	ditto
d. green grey muddy f. Sand	schist, mds. fragment	ditto
d. green muddy m.~c. Sand		Between Goto & Nagasaki
	schist granules, shell fossils	ditto
d. green sdy mud	granules of schist, shell fossils	ditto
d. green m.~c. Sand	semi-consolidated	ditto
grey brown f. Sand	well sorted	ditto
grey green silty m. Sand		ditto
sandy mud,	semi-consolidated	ditto
muddy Sand		ditto
green grey m.~c. Sand		South of Fukue
green grey mdy m. Sand		ditto
grey green m. Sand	Well sorted	Tachibana Bay
light brown c. Sand	shell Sand	ditto

(Table 7. continued)

Station	Month, Day	Time	Lat.	Long.	Depth m	Sampler
393	06	09 11	32°34.6	130°00.1	69.5	SM
394	"	09 43	32°38.4	129°59.95	62	d
395	"	10 21	32°41.95	129°57.55	44	d
396	"	12 03	32°34.6	129°49.65	68	d
397	"	12 41	32°30.5	129°48.15	78	d
398	"	13 32	32°25.85	129°45.5	100	SM
399	"	14 16	32°24.75	129°39.8	84	SM
400	"	15 06	32°26.8	129°34.0	96	SM
401	"	16 07	32°25.3	129°26.85	150	SM
402	"	17 14	32°24.7	129°19.8	216	SM
403	"	18 35	32°30.0	129°12.5	273	SM
404	07	06 36	33°09.4	129°18.55	83	d
405	"	07 53	33°08.15	129°16.25	56	d
406	"	09 09	33°12.25	129°10.6	66	d
407	"	10 54	33°14.05	129°02.20	70-78	d
408	"	12 00	33°15.15	128°53.6	112	d
409	"	13 07	33°15.6	128°44.6	173	SM
410	"	14 21	33°10.55	128°40.3	156	d
411	"	15 28	33°10.32	128°49.65	108	d
412	"	16 29	33°05.45	128°54.8	90	SM
413	"	17 17	33°59.8	128°53.85	93	SM
414	"	18 20	33°52.6	128°49.16	86	SM
415	"	18 54	32°48.8	128°48.65	68	d
416	"	19 52	32°51.5	128°41.8	76	SM
417	08	14 06	34°03.5	129°17.8	97	d
418	"	14 59	34°00.95	129°24.4	116	SM
419	"	15 54	33°57.4	129°30.4	97	SM
420	"	17 02	33°54.3	129°22.75	120	SM
421	"	17 02	33°49.8	129°13.0	116	SM
422	"	19 54	33°55.3	129°05.3	118	SM
423	09	07 22	33°19.2	129°22	73	d
424	"	09 15	33°30.3	129°15.3	100	SM
425	"	10 10	33°34.2	129°07.1	113	SM
426	"	11 33	33°26.6	129°06.0	110	SM
427	"	12 20	33°26.2	128°59.15	121	SM
428	"	14 21	33°41.55	128°53.45	124	SM
429	"	15 30	33°34.9	128°47.65	145	SM
430	"	17 02	33°24.6	128°51.20	162	SM
431	"	18 07	33°23.0	128°41.5	136	SM
432	"	19 17	33°16.3	128°37.2	139	SM
433	10	06 13	32°25.7	128°41.6	241	SM
434	"	07 26	32°30.0	128°36.5	193	SM

Sediments	Remarks	Area
d. grey green m.~c. Sand green grey muddy Sand f. Sand & silt grey green vf.~sdy Mud m. Sand muddy f. Sand grey brown m.~c. Sand grey green f. Sand grey green m. Sand grey green v. f. Sand grey green v. f. Sand	Red rock fragments     shell abundant  Well sorted	Tachibana Bay ditto ditto ditto Off Amakusa ditto ditto Between Amakusa & Goto ditto ditto ditto
f. Sand & Silt f. Sand  white brown v. c. shell Sand v. c. shell Sand grey green shell c. Sand grey green muddy f.~m. Sand rock fragments green grey f. Sand green grey v. f. Sand green grey f. Sand light brown m.~c. Sand  pebble & rock frag. m.~c. Sand	andesite pebble Well sorted, clastics of granite and Tertiary sediments Thickness 0.5~1 m Beach rocks littoral sed.  bearing granule Rhyoritic and chert      Well sorted	South of Hirado West of Nakadori  North of Nakadori ditto West of Nakadori ditto ditto ditto ditto Between Nakadori and Fukue North of Fukue ditto
very c. shell Sand light brown c. shell Sand l. brown c. shell Sand & f. Sand l. brown shell m. Sand l. brown m. Sand l. brown m. Sand	Quartz porphyry? pebb.	Between Iki & Tsushima ditto ditto ditto South of Tsushima ditto
g. green muddy f. Sand grey green f. Sand grey green f.~m. Sand green grey f.~m. Sand green grey silty f. Sand grey brown m.~c. Sand green grey f.~m. Sand grey green muddy f.~m. Sand grey green f.~m. Sand green grey m. Sand	bearing granule	Near Ikitsuki Northwest of Nakadori ditto ditto ditto ditto ditto ditto ditto ditto
grey green muddy f. Sand light grey m.~c. Sand	Almost rocky bottom	South west of Fukue ditto

Station	Month, Day	Time	Lat.	Long.	Depth m	Sampler
435	10	08 15	32°34.8	128°34.4	75	SM
436	"	09 14	32°39.4	128°30.8	126	d
437	"	10 20	32°45.1	128°34.5	119	d
438	"	11 02	32°46.5	128°30.4	129	SM
439	"	12 45	32°54.2	128°29.8	145	d, SM
440	"	13 25	32°53.55	128°34.45	127	d
441	11	10 44	32°25.0	129°35.2	100	d
442	"	11 59	32°34.05	129°34.25	102	d
443	"	12 43	32°33.45	129°40.2	84	d
444	"	13 53	32°40.4	129°46.5	58	d

**Gravity corer:** The corer is 3.5cm in diameter and 1.0m long, without inner plastic tube. The corer was operated only at St. 375, where relict sediments including plant fossils occurred, and obtained the core of silt and very fine sand of 55cm long. The core sample was observed and divided into three parts for sedimentological, paleontological and chemical analyses. The gravity corer should be used at more places but it was difficult to use the corer at other station, because most parts of the surveyed area are covered by sand.