# I. OUTLINE OF CRUISE GH80-4 IN THE AREA NORTHEAST OF HACHIJOJIMA ISLAND

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## Introduction

Since 1979, the Marine Geology Department of the Geological Survey of Japan has been conducting marine geological and geophysical investigations in the sea around Japan, under the five-year programme entitled "Further Geological and Geophysical Investigation of Continental Shelves around Japan". The main purpose of the project is to prepare geological maps of the continental shelves and slopes off the Pacific coast of the Japanese Islands, on a scale of 1:200,000 (Fig. I-1).

In 1980, over a total period of 100 days, the department carried out three

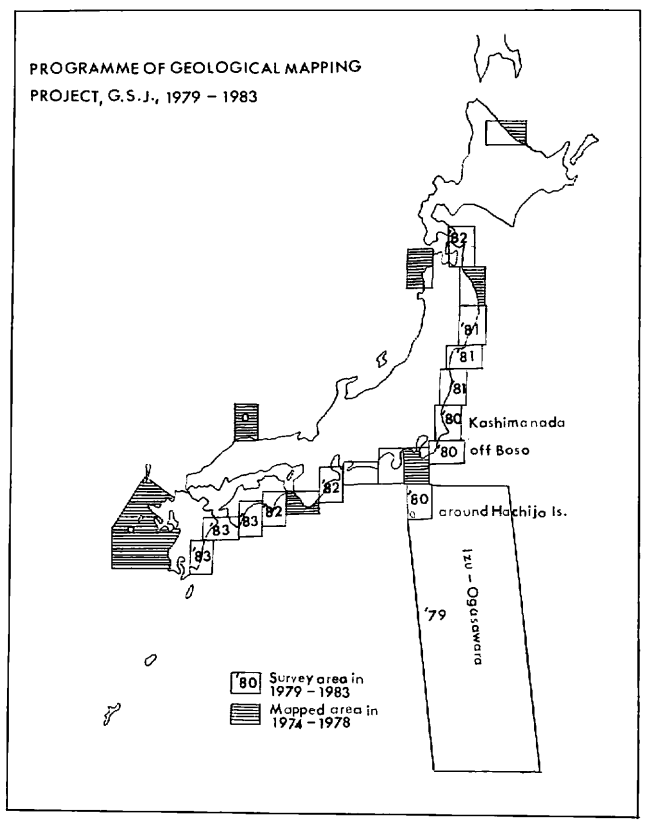


Fig. I-1 Programme of the five year project of "Further Geological and Geophysical Investigations of Continental Shelves around Japan".

research cruises in the area off the Boso Peninsula, the Kashimanada Sea, and the area northeast of Hachijojima Island. This report concerns the investigation in the last-named area during cruise GH80-4.

## Geological Setting of the Surveyed Area

The surveyed area corresponds to the northern part of the Ogasawara Arc (Izu-Ogasawara Arc) which is one of the main arc-trench systems in the Pacific Ocean. The major linear structure of the Ogasawara Arc** is defined by three parallel ridges trending N-S, that is, the Izu*, Shichito* and Ogasawara Ridges, and the Ogasawara Trench** parallel to the ridges (Fig. I-2). The ridges join

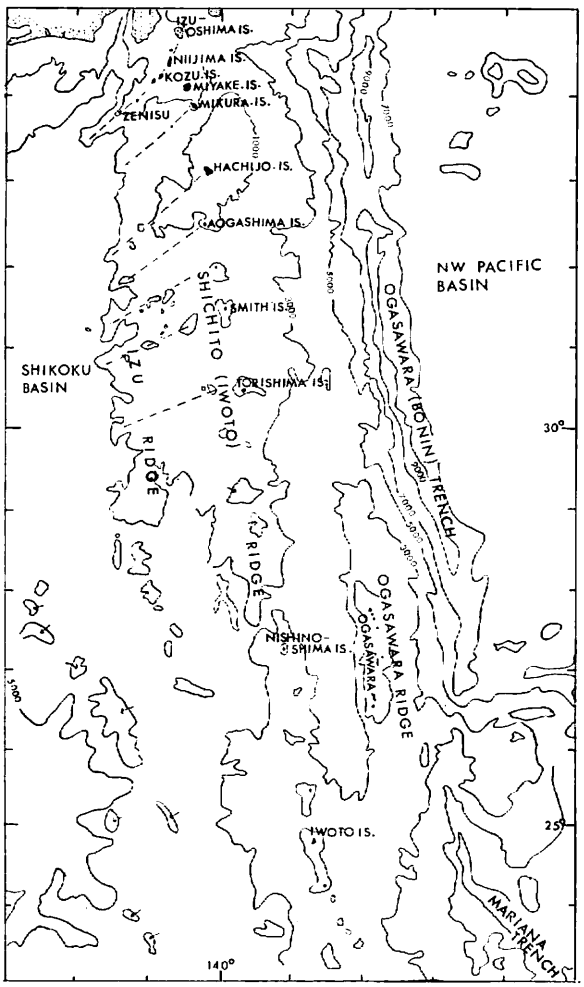


Fig. I-2 Geographic illustration of the Ogasawara Arc. Dash lines show echelon ridges.

* Previously named the Nishishichito and Shichito-Iwojima Ridges respectively.

** Previously called the Izu-Ogasawara Arc and the Izu-Ogasawara Trench respectively.

Honshu near the Izu Peninsula, and the Ogasawara Trench bends to become the Japan Trench southeast of the Boso Peninsula. Sagami Trough extends northwest from the bend, and this point is recognized as a triple junction.

The three parallel ridges are easily recognizable near the Ogasawara Islands where the Ogasawara Ridge is well defined. The extension of Ogasawara Ridge, however, becomes indistinct north of this area, while the en echelon arrangement of topographic highs which cross the main structural trend obliquely is conspicuous. One of the en echelon highs is the row formed by Omurodashi, Niijima and Kozushima Islands and the Zenisu Rocks.

The main constituents of the basement of the ridges from Izu-Oshima to the Torishima Islands, at the northern end of the Ogasawara Arc, are altered volcanic rocks accompanied by plutonic rocks, as shown by studies of the ejecta from Quaternary volcanoes in the area. The en echelon structures are the result of deformation of these rocks. Rocks of this nature protrude above sea level at the Zenisu Rocks.

The volcanic islands, Izu-Oshima, Miyakejima and Hachijojima, from a N-S trending volcanic front on the Shichito Ridge, which is itself a volcanic arc lying along the Ogasawara Trench. All of these islands are composed of low-alkali tholeiite. However, the islands lying further from the Trench, consist of volcanic rocks belonging to the calc-alkali rocks series. For instance, the Onoharajima and Inambajima Islands are composed of calc-alkali andesite and the Niijima and Kozushima Islands consist of calc-alkali rhyolite and dacite. This is considered to reflect a zonal arrangement. In the above case, the arrangement will have resulted from the activity of the recent arc-trench system.

From the above information, the two trends in the northern part of the Ogasawara Arc may be interpreted as follows:
a), The en echelon structures with NE-SW trend have formed independently of the recent activity of the arc-trench system. b), On the other hand, the N-S trending zonal arrangement is the result of the recent activity of the arc-trench system, and it cuts the en echelon structure.

According to previous magnetic studies volcanic rocks are expected to be main constituent of the banks. However, such rocks were not observed because the top of the bank is covered by thick limestone (INOUE ed., 1976; HONZA *et al.* ed., 1981).

The geological significance of the banks is examined on the basis of the above points. The banks are considered to be the northeastern extension of Hachijojima Island and a part of the en echelon arrangement, whereas the frontal arc of the recent volcanic front is a part of the N-S trending zonal structure.

Older rocks of the en echelon ranges only outcrop at the Zenisu Rocks. Elsewhere on the highs older rocks are covered by younger volcanics and found only as xenoliths in the younger rocks.

It is possible that information gained by the present survey about older rocks from the banks where younger volcanic activity has not occurred will provide a clue for the explanation of the geological history of the en echelon ranges.

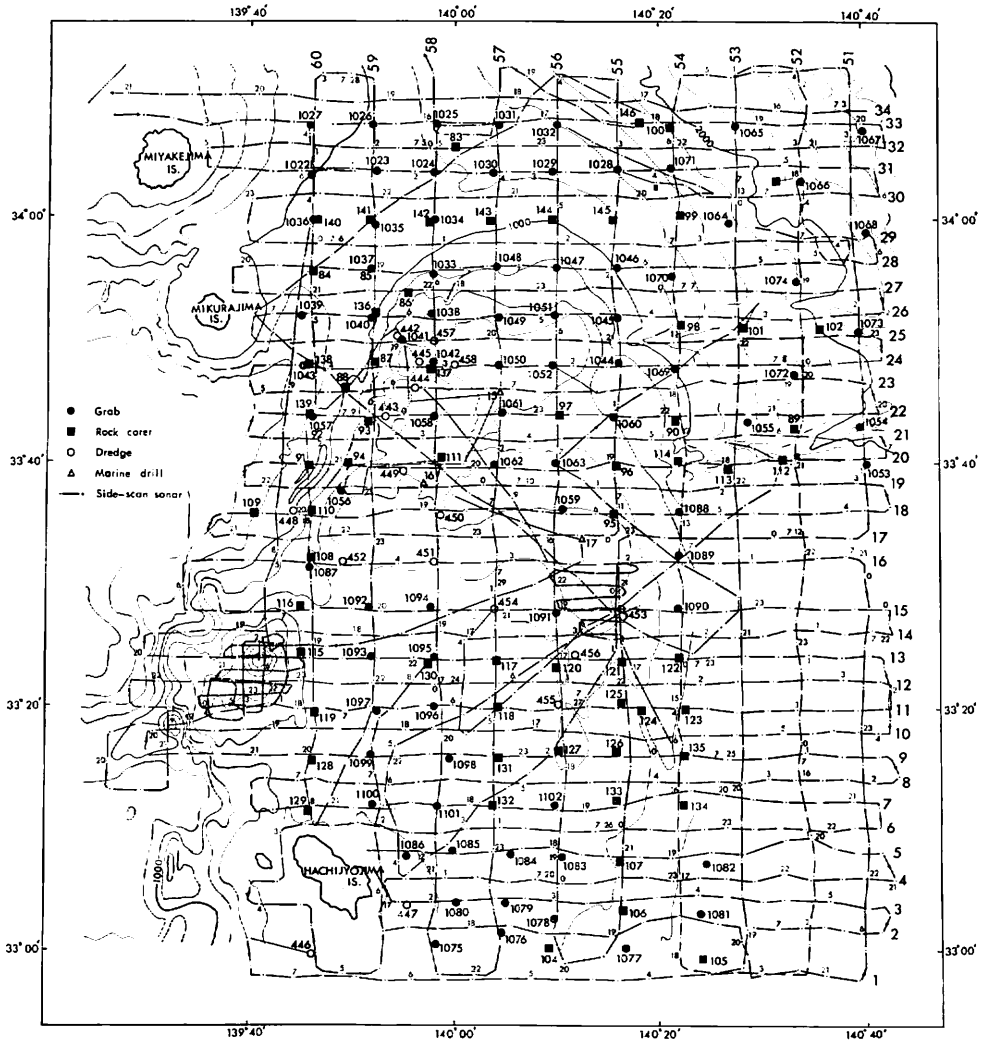


Fig. I-3 Seismic traverses and sampling sites of cruise GH80-4 in the area northeast of Hachijojima Island.

## Outline of the cruise

*Ship and personnel*

The Hakurei-maru, constructed in 1974, was chartered from the Metal Mining Agency for this research cruise. The specifications of the vessel are as follows;

| | |
|---|---|
| Length (o.a.) | 86.95 m |
| Length (p.p.) | 77.00 m |
| Breadth (mld.) | 13.40 m |

| | |
|---|---|
| Depth (mld.) | 5.30 m |
| Draft (mld.) | 5.00 m |
| Gross tonnage | 1,821.60 t |
| Service speed | 15.00 kt |
| Trial speed | 17.78 kt |
| Endurance | 15,000 sea miles |
| Complement | 55 persons |
| Officer and crew | 35 persons |
| Scientists | 20 persons |
| Main engine | 3,800 ps, 230 rpm 1 set |
| Main generator | 600 kw 3 sets |
| Propeller | 4 bladed variable pitch type, 1 set |
| Special equipment | Bow thruster 1 set |

The vessel, which has 34 officers and crew, was commanded by Captain Hideaki OKUMURA. The scientific party consisted of a total of nine scientists and ten students from several universities which are listed in Table I-1. E. INOUE was the party chief throughout the cruise and M. YUASA and K. TAMAKI acted as survey planners of the geological and geophysical surveys in the area around

Table I-1 Scientific staff of cruise GH80–4

| Name | Organization | Speciality |
|---|---|---|
| Eiji INOUE | Geological Survey of Japan | Chief scientist. |
| Takemi ISHIHARA | Ditto | Co-chief scientist, geophysicist, NNSS & gravity. |
| Yasumasa KINOSHITA | Ditto | Geologist. Sampling work. |
| Makoto YUASA | Ditto | Geologist. Survey planner. |
| Yoshio INOUCHI | Ditto | Geologist. Sedimentology. |
| Kensaku TAMAKI | Ditto | Geologist. Seismic survey. |
| Ko-ichi NAKAMURA | Ditto | Geologist. Seismic survey. |
| Yukinobu OKAMURA | Ditto | Ditto |
| Eiji SAITO | Ditto | Topographer. Bathymetry & positioning. |
| Keishi WATANABE | Tokai University | Student. Sampling work. |
| Takemi CHIHIRO | Ditto | Ditto |
| Taijiro FUKUDA | Ehime University | Student. Sampling work & geophysical survey. |
| Nobuyuki ENDO | Ditto | Ditto |
| June TERUYA | Ditto | Ditto |
| Yoshihiro FUKUDA | Ryukyu University | Ditto |
| Shizuhiro SUGINO | Ditto | Ditto |
| Toshihiko TAKAYAMA | Ditto | Ditto |
| Hiromi ABE | Ditto | Ditto |
| Ribun ONODERA | Tokyo Toritsu University | Ditto |
| Tishu EGUCHI | Koken Boring Machine Co. | Engineer of MD500H drill. |
| Kazuo SAKI | Japan National Oil Corp. | Geologist. |
| Yoshiyuki KANEDA | Ditto | Geophysicist. |

Hachijojima and the area near Smith (Sumisu) Island respectively.

T. EGUCHI, an engineer of the Koken Boring Machine Co. Ltd., who was on board to direct the operation of the drilling machine MD500H, and K. SAKI and Y. KANEDA of the Japan National Oil Corporation who were on board for technical study on the Hakurei-maru, embarked at Hachijojima Island on July 25, and left the vessel at Okada Port of Izu-Oshima Island on July 31.

Nine foreign geologists and geophysicists from nine countries embarked at Okada Port on July 31, to participate in the Group Training Course in Offshore Prospecting organized by the Japanese Government (Table I-2). They were guided by T. SAITO and O. MATSUBAYASHI of the G.S.J. and J. INAGAKI of the Japan International Cooperation Association.

Table I-2 Foreign participants in the Group Training Course in Offshore Prospecting

| Name | Nation | Organization & speciality |
|---|---|---|
| U. Myint KYI | Burma | Myanma Oil Corporation, Ministry of Industry. Geologist. |
| M. Rajagopal RAO | India | Oil & Natural Gas Commission. Geophysicist. |
| Changiz AMIRBEHBOUDI | Iran | National Iranian Oil Company. Geophysicist. |
| Chang Jeong HAE | Korea | Korea Research Institute of Geoscience & Mineral Resources. Geologist. |
| L. PONNAMBALAM | Malaysia | Geological Survey Dept. of Malaysia. Geologist. |
| Rory Delgado PEREZ | Peru | Petroleos del Peru. Geologist. |
| Macario A. del ROSARIO | Philippines | Bureau of Mine and Geosciences. Geophysicist. |
| Thara LECKUTHAI | Thailand | Department of Mineral Resources. Geologist. |
| Alaattin PINCE | Turkey | Mineral Research and Exploration Institute of Turkey. Geophysicist. |
| Jun INAGAKI | Japan | Japan International Cooperation Agency. Leader of the party. |
| Tomosaburo SAITO | Japan | Geological Survey of Japan. Leader of the party. |
| Osamu MATSUBAYASHI | Japan | Geological Survey of Japan. Lecturer. Geophysicist. |

*Method and survey equipment*

1) Geophysical survey

Seismic reflection profiling, shallow sub-bottom profiling, gravity and geomagnetic measurements were carried out along the traverse lines set up at intervals of 7.4 km (4 sea miles) in an east to west direction, and at intervals of 3.7 km (2 sea miles) in a north to south direction (Fig. I-3). The surveys were carried out at a ship speed of 10 knots each night throughout the cruise.

The sound source for the seismic reflection profiling was two Bolt-type air-guns; a 120 $in^3$ air-gun firing at 2,000 p.s.i.g. and a 40 $in^3$ air-gun firing at 1,500 p.s.i.g. The air-guns fired alternatively at 7 second intervals. The signal was received by a 100-element hydrophone array, which was towed at a distance of 200 m from the stern.

Shallow sub-bottom profiling was carried out with 3.5 kHz echogram of 40 beam width, manufactured by the Raytheon Co. Ltd. An NS-16 type 12 kHz precision depth recorder with a 17° beam width, made by the Nippon Electric Co. Ltd., was used for bathymetry.

Gravity and geomagnetic measurements were carried out with a S63 air-sea gravity-meter made by the Lacoste & Romberg Co. Ltd. and a G801 Marine proton magnetometer made by the Huwlett & Packard Co. Ltd. respectively.

A side-scanning survey was conducted on the tops of the Kurose, Shinkurose and Kitakurose Banks for two nights as a pre-site survey before the marine drill was operated. The equipment was manufactured by the EG & G Co. Ltd., and the transducer was towed about 100 m above the sea bottom at a maximum water depth of 500 m.

A heatflow measurement was conducted at one site on the deepsea floor, in a depression near Smith (Sumisu) Island. Heatflow within the sediments was measured for ten minutes by a heatflowmeter attached to the core barrel of the piston-corer.

2) Sampling work

Sampling work was carried out during the daytime throughout the cruise. Sampling sites were situated approximately at intervals of 11 km (6 sea miles) in east to west and 7.4 km (4 sea miles) in north to south direction along the geophysical traverse lines. In addition, special sampling sites were chosen at some significant localities from the results of the reflection records which were obtained during the previous night.

The samplers used most were a HONZA-KAGAMI type chain-bag dredge of 40 cm in diameter, gravity rock-corers of 2 m length and 58 mm diameter, and a Smith-McIntyre grab modified to carry an under-sea camera attachment. The former two were used to take rock samples and the last was used for soft sediments. These were used selectively according to sea-bottom conditions.

A submersible rock drill model MD500H, which was manufactured by joint cooperation of the G.S.J. and the Koken Boring Machine Co. Ltd., and which can take a rock core of 6 m maximum length at a maximum water depth of 500 m and is driven by a 48 v battery, was operated for two days at three sites on the tops of the banks.

A piston-corer of 4 m length was used at only one site, in a depression near Smith Island, and a heatflow measurement was made at the same time.

3) On-board sediment sample processing

Two short, small cases were inserted into the sediments taken with the grab and thus box cores of these sediments were recovered from the cases. The cores

were sliced and photographed with soft X-ray equipment. The residual of the grab sediments was washed through a 4 mm sieve and pebbles, rock fragments and animal remains were recovered.

4) Sea floor photography

The Hydroproducts undersea camera attached to the frame of the Smith-McIntyre grab was used at all sites where grab sampling was carried out. The camera switch hung from the frame of the grab at the end of 2 m of string, and activated the camera before the grab arrived at the sea bottom. The camera was also employed in the submarine drilling operations.

5) Ship positioning and navigation

The ship position was fixed by the Navy Navigation Satellite System (NNSS) of the Magna Vox Co. Ltd. and Decca chain, at intervals of 15 minutes throughout the geophysical survey and sampling operations.

*Progress of the work* (Table I-3)

The Hakurei-maru sailed from Funabashi Port on July 2 and gravity measurements were started at midnight on July 3. When the vessel arrived at the survey area, the first day was spent in observation of the activities of fishing vessels within the area to avoid conflict between fishing and geological research activities. Geological and geophysical surveys were carried out in the northern half of the area surveyed from July 4 to 16. Throughout these days sea conditions were rather rough, wave height was 2 or 3 m and wind speed usually exceeded 10 m/sec.

The vessel anchored at Sokodo Port of Hachijojima Island on the morning of July 17 and stayed in port until the evening of the 19th, during which time some of the scientific staff was changed.

Geophysical and geological research in the middle and southern parts of the area surveyed was conducted from the evening of July 19 to the evening of the 24th, in calm sea conditions. The vessel called at Kaminato Port of Hachijojima to pick up an engineer and two scientists on the morning of July 25.

The drilling operations, using the MD500H machine, were carried out at three sites on the flat tops of the Shinkurose and Kitakurose Banks on July 28 and 29. As the result of the drilling, two short rock cores of probable Quaternary limestone were obtained.

The geological and geophysical surveys in the area were largely completed by July 30 and the vessel anchored at Okada Port of Izu-Oshima Island during the morning of July 31. Some of the scientific members left the vessel, while nine foreign geologists and geophysicists of the Group Training Course in Offshore Prospecting embarked.

Geological and geophysical investigations were conducted on August 2 and 3 in a narrow area near Smith Island, south of Hachijojima. Piston-coring, continuous undersea-photography and heatflow measurement were then carried out in order to demonstrate these methods to the foreign trainees. Rough sea conditions, due to the approach of Typhoon No. 10, were experienced on August 4.

Table I-3 Progress of the work during cruise GH80–4

| Day | Weather | Area surveyed | Works |
|---|---|---|---|
| July 2 | Cloudiness | Funabashi Port to south | Left the port at 1300. Sailing to the area surveyed. |
| 3 | Fine | North of Hachijojima | Observation of the area and geophysical survey. |
| 4 | Fine | East of Miyake. & Mikura. Is. | Geophysical survey & sampling work. |
| 5 | Fine & cloud | Northeast of Kita-kurose Bank | Ditto |
| 6 | Fine & cloud | Kitakurose Bank | Ditto |
| 7 | Fine & cloud | Ditto | Ditto |
| 8 | Fine & rain | Ditto | Ditto |
| 9 | Cloudiness | Ditto | Ditto |
| 10 | Rain | Ditto | Ditto |
| 11 | Rain | Shinkurose Bank | Ditto |
| 12 | Rough | Kitakurose Bank | Geophysical survey. Gave up sampling work. |
| 13 | Fine | Kitakurose to Ogasawara Trench | Geophysical survey & sampling wrok. |
| 14 | Fine | Trench to Kitakurose Bank | Ditto |
| 15 | Fine | Kitakurose Bank | Ditto |
| 16 | Fine | East of Hachijojima | Ditto |
| 17 | Cloudiness | Sokodo Port of Hachijojima | Arrived at the port at 1000. Personnel change. |
| 18 | Fine | Ditto | Anchored. Personnel change. |
| 19 | Fine | Sokodo Port to east of Hachijojima | Left the port at 1600 and geophysical survey. |
| 20 | Fine | East of Hachijojima | Geophysical survey & sampling. |
| 21 | Fine | Shinkurose Bank | Ditto |
| 22 | Fine | Ditto | Ditto |
| 23 | Fine | Kurose-Shinkurose | Ditto |
| 24 | Fine | Shinkurose Bank | Ditto |
| 25 | Rain | Hachijojima and north of the Island | Personnel change and geophysical survey & sampling work. |
| 26 | Fine | Shinkurose Bank | Geophysical survey & sampling. |
| 27 | Fine & rain | Kitakurose Bank | Ditto |
| 28 | Fine & cloud | Ditto | Geophysical survey & submarine drilling. |
| 29 | Fine | Shinkurose Bank | Ditto |
| 30 | Cloudiness | Kitakurose Bank | Geophysical survey & sampling. |
| 31 | Cloudiness | Okada Port of Izu-Oshima | Arrived at the port at 1000. Personnel change & embarkation of foreign scientists. |
| August | | | |
| 1 | Cloudiness | Izu-Oshima to south | Left the port at 1000 & geophysical survey. |
| 2 | Fine | West of Smith Is. | Geophysical survey & sampling. |
| 3 | Rough | Ditto | Ditto |
| 4 | Very rough | From Smith Is. to north | Sheltered from typhoon no. 10. |
| 5 | Fine | Funabashi Port | Arrived at the port. Unloaded survey equipment. |

The work was interrupted and the vessel sailed back north to shelter from the typhoon.

On the morning of August 5 the vessel arrived at Funabashi Port and the MD500H machine and other survey equipment were unloaded.

Total sailing time of the vessel throughout the cruise was 29 days and 10.5 hours.

*Data obtained*

The geological mapping of the area surveyed is completed and the geological and geophysical features and conditions of deposition of the surface sediments in the area of the cruise are well understood. The final results of the investigations will be published as a geological map on a scale of 1:200,000. Data obtained during the cruise are summarized as follows;

| | | |
|---|---|---|
| Total cruise distance | 10,691 km | (5,772.8 sea miles) |
| Bathymetry and gravity measurement traverses | 10,691 km | (5,772.8 sea miles) |
| Seismic survey traverses | 6,440 km | (3,477.2 sea miles) |
| Side scanning traverses | 250 km | ( 134.8 sea miles) |
| Total no. of sampling stations | 171 | (St. 1808–1978) |
| Dredge samples | 21 | (D442–462) |
| Rock-corer samples | 65 | (RC83–147) |
| Grab samples | 82 | (G1022–1103) |
| Piston-corer samples | 1 | (P191) |
| Marine drill samples | 2 | (H15, 17) |
| Sea bottom photographs | 85 | |

The locations, working times and working conditions of sampling operations at all sites are listed in Appendix—1.

## References


HONZA, E., INOUE, E. and ISHIHARA, T., ed. (1981) Geological Investigation of the Ogasawara (Bonin) and the Northern Mariana Arc Systems. April-August 1979 (GH79-2, 3 & 4 cruises). Geol. Surv. Japan, *Cruise Report* No. 14.

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