

# Data Listing of the Bottom Materials Dredged and Cored from the Northern Philippine Sea

Tsunemasa SHIKI<sup>1</sup>, Atsuyuki MIZUNO<sup>2</sup> and Kazuo KOBAYASHI<sup>3</sup>

<sup>1</sup> *Faculty of Science, Kyoto University*

<sup>2</sup> *Geological Survey of Japan*

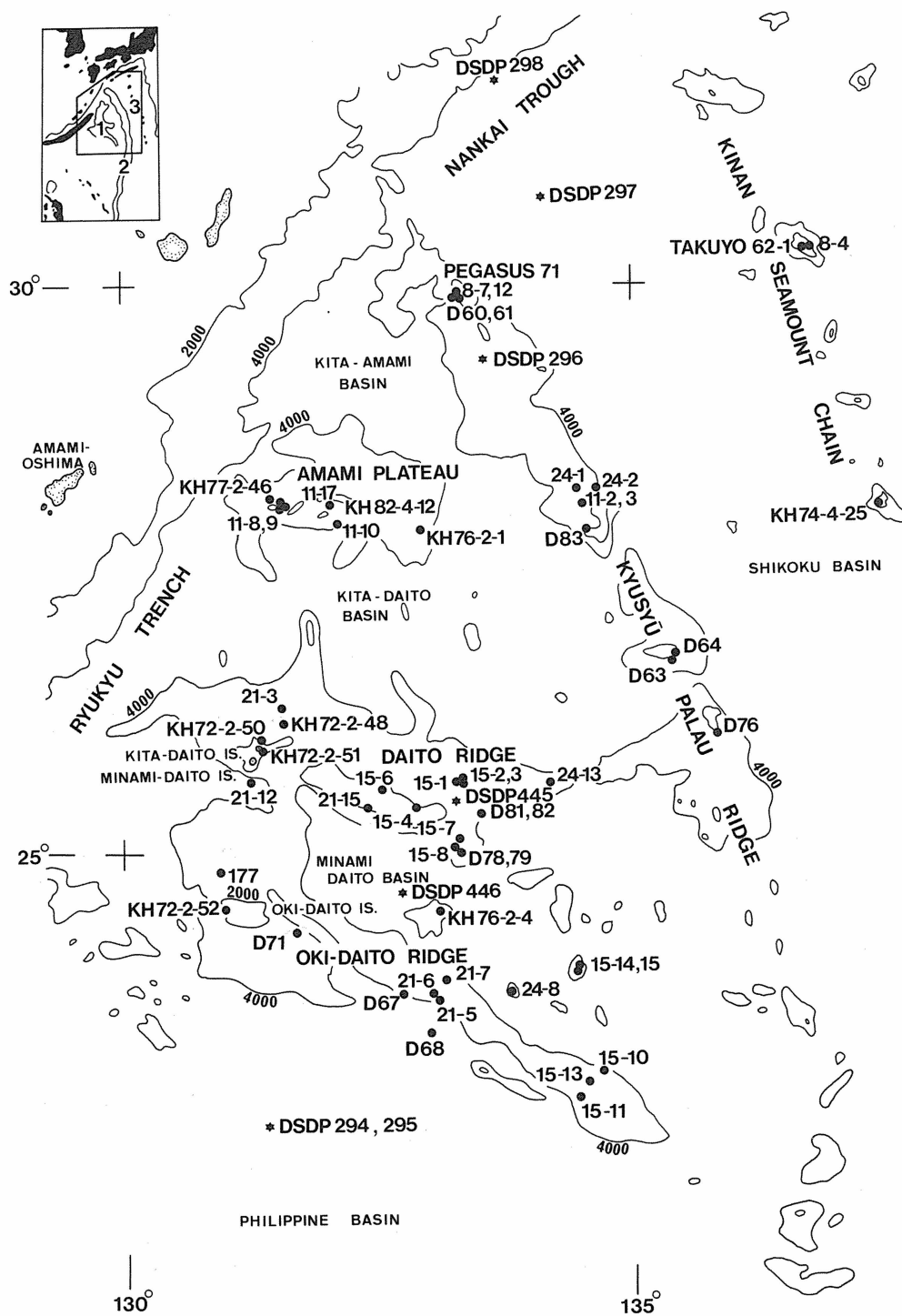
<sup>3</sup> *Ocean Research Institute, University of Tokyo*

## Introduction

The Northern Philippine Sea has been intensely studied during the 1970's and in the early 1980's by Japanese marine geologists and geophysicists mostly organized into or related to the Japanese Geodynamics Project. Above all, particular attention has been given to remnant arcs developed in the northwestern area of the sea, represented by the Kyushu-Palau Ridge and the Daito Ridge Group comprising Amami Plateau, Daito Ridge, and Oki-Daito Ridge. Special effort has been made to obtain geological data in order to discuss in detail the geohistory and geotectonics of these ridges, relying also on the geophysical data gained through the many Japanese GDP cruises, some R/V Hakuho-Maru KH cruises of the Ocean Research Institute, the University of Tokyo, and a R/V Hakurei-Maru GH cruise of the Geological Survey of Japan. As a result, there have been accumulated many dredge data of the rocks and the bottom sediments from the remnant arcs and other topographic highs in the Northwestern Philippine Sea. Besides these, we have obtained some piston core data from the same region and some dredged-rock data from the Kinan Seamount Chain in the Shikoku Basin of the Northeastern Philippine Sea.

Many authors have discussed the geological development and other relevant aspects of the remnant arcs or of the entire Northern Philippine Sea, from the GDP data and the data of the deep-sea drilling cores (DSDP Leg. 31 and IPOD Leg. 58) in some sites in the area. It seems, however, that many problems remain to be investigated, particularly concerning the origin and evolution of the remnant arcs. In this connection, compilation of existing geological data should be helpful for further study. An article was published in 1977, which contained a list of rock samples and piston and gravity cores obtained from the Daito Ridge Group, the Kyushu-Palau Ridge, and nearby deep-sea basins by that time (MIZUNO *et al.*, 1977). Since then, many additional data have been accumulated through two GDP cruises and two R/V Hakuho-Maru KH cruises.

In this article, we will present a comprehensive list of the dredged rock samples from the topographic highs such as ridges (remnant arcs) and seamounts in the Northern Philippine Sea, together with some piston core data obtained from the area, relying on the data



**Fig. 1.** Map showing the location of dredged rock samples together with DSDP sites in the Northwestern Philippine Sea.

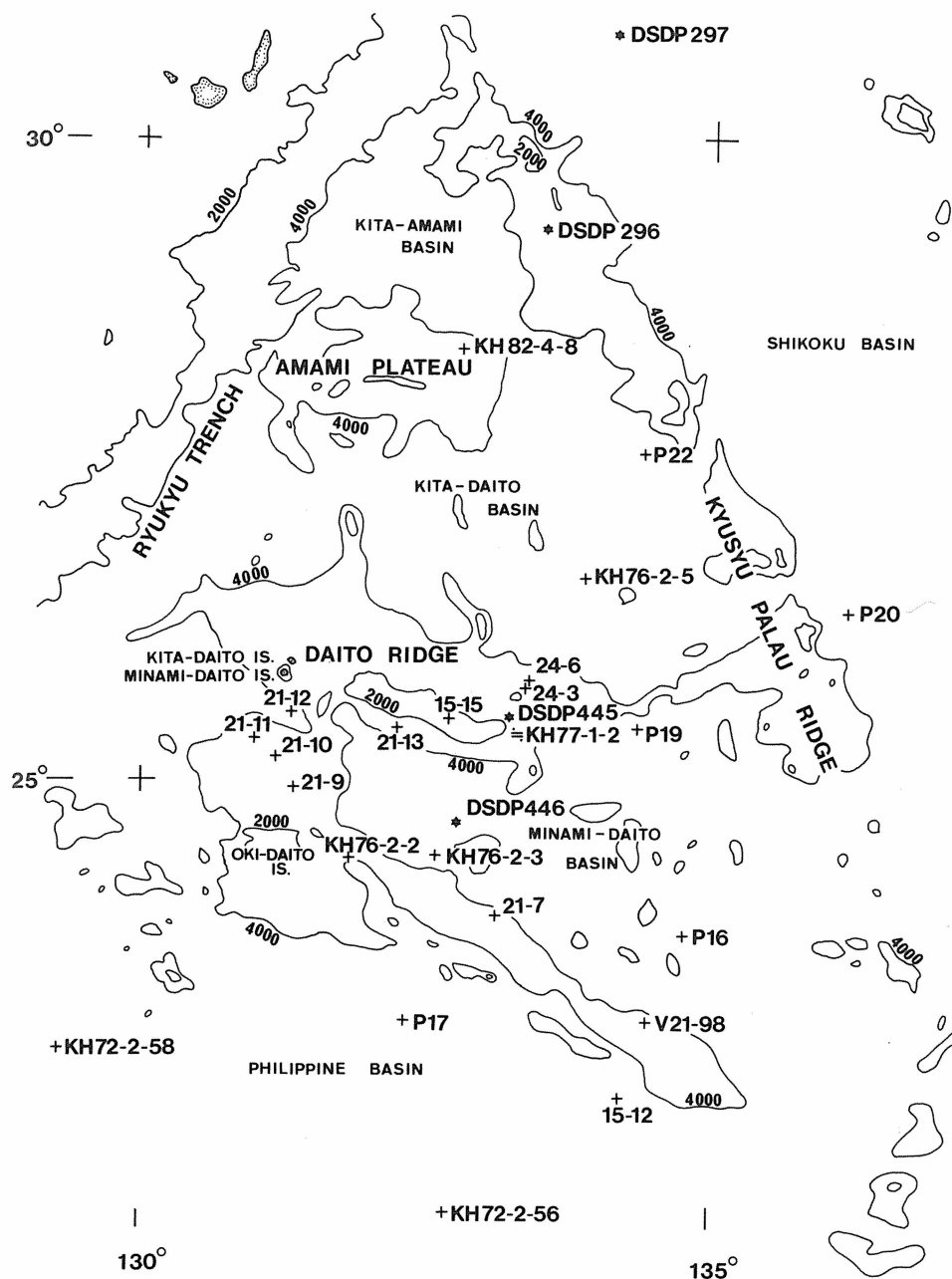


Fig. 2. Map showing piston and gravity coring in the Northwestern Philippine Sea.

published up to now (Fig. 1, Fig. 2).

### **Dredge hauls from the Daito Ridge Group**

Dredge hauls from the Daito Ridge Group are classified into the following five groups including various rocks of unknown ages from many sites (Table 1).

#### *Pre-Middle Eocene basement rocks*

Pre-Middle Eocene basement rocks consist of acidic plutonic rocks, basaltic and andesitic volcanic and volcanoclastic rocks, clastic rocks (arkosic wacke, fine-grained sandstone, etc.), metamorphic rocks, and ultramafic rocks. The evidenced basement rocks are tonalite (GDP-11-17; ca. 75 m.y. K-Ar age for hornblende) and basalt (GDP-11-9; ca. 82–85 m.y. K-Ar age), both from the Amami Plateau.

A metamorphic rock represented by hornblende schist from the Daito Ridge (GH74-7-183) has K-Ar age of ca. 49 m.y. Thermally metamorphosed tremolite schist and peridotite occurred also as clasts in conglomerate of unknown age at the same site. It seems that the basement rocks of the Daito Ridge suffered two phases of metamorphism, namely the high pressure–low temperature metamorphism of an older age, and the thermal metamorphism of a younger age. The former must have been in the pre-Eocene time (possibly pre-Cenozoic). The latter most probably corresponds to the above mentioned K-Ar age (TOKUYAMA *et al.*, 1980). Some volcanic rocks from the Daito Ridge suffered thermal metamorphism also (GDP-15-1), and the Middle Eocene conglomerate in Site 445 of DSDP suffered metamorphism as well (MILLS, 1980). These data reveal that the Middle Eocene thermal metamorphism was extensive in the Daito Ridge.

Moreover, Deep-Sea drilling elucidated the presence of clasts of reef limestone of Barremian to Maestrichtian comprising *Orbitolina* and basalt of 59 m.y.  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  age in the Middle Eocene conglomerate beds in Site 445, which are thought to have been derived from the Daito Ridge (MILLS, 1980; OZIMA *et al.*, 1980).

#### *Middle Eocene Nummulites-bearing rocks*

Middle Eocene *Nummulites*-bearing rocks (limestone and phosphorized limestone) and plenty of individual specimens of *Nummulites boninensis*, accompanied by *Astericyclina penuria* in some places, were collected from the topographic highs of the Amami Plateau, Daito Ridge, and Oki-Daito Ridge. This, together with seismic reflection data, suggests that Middle Eocene shallow marine calcareous deposits are widely distributed on the main topographic highs of the Daito Ridge Group, overlying the pre-Eocene rocks as inferred above.

#### *Oligocene calcareous semi-consolidated sediments*

Pelagic semi-consolidated calcareous mudstone or chalk was collected from the Daito Ridge (GDP-24-13). It comprises calcareous nannofossils ranging from Middle to Late Oligocene.



*Neogene semi-consolidated sediments*

Pliocene carbonate rock (KH-76-2), mudstone of calcareous nannofossil bearing mudstone of Middle to Late Miocene (GDP-24-2) were collected from the Amami Plateau, and Early Pliocene calcareous mudstone with planktonic foraminifers (GH74-7-167) and semi-consolidated calcareous mud of Neogene were collected from the Oki-Daito Ridge and the Daito Ridge (GDP-21-15), respectively.

*Rocks undated*

Geologic ages of the other rocks have not yet been evidenced. The larger part belongs to volcanogenic rocks of basic to intermediate nature, with some exceptions of clastic rocks of siltstone, sandstone, and conglomerate. Phosphate and/or calcareous rocks from many places of the Ridge Group are of unknown age also.

Some parts of the volcanogenic rocks are inferred to be post-Eocene mainly from seismic reflection records of the sampling sites (OKUDA *et al.*, 1976; RM GDP-21, 1977; MISAWA *et al.*, this volume). Some tuffaceous sediments contain microfossils possibly of Eocene and Miocene (GDP-15-11, RM GDP-15, 1976; RM GDP-24, 1978; SHIKI, 1979). MIZUNO *et al.* (1979) postulated that most of the volcanic rocks of unknown age at least on the Daito Ridge may represent either Eocene or younger volcanic activity. However, there must also be older (Paleocene and Cretaceous) volcanogenic rocks among the rocks of unknown age throughout the entire Daito Ridge Group.

The conglomerate at GH 74-7-183 including clasts of metamorphic ultramafic, and volcanic rocks mentioned above was tentatively supposed to be Oligocene, overlying the *Nummulites*-bearing rocks (MIZUNO *et al.*, 1975), although its stratigraphic situation and geologic age are still problematic.

At any rate, further studies of the precise geologic ages of the above-mentioned rocks should be made in future.

**Dredge hauls from the Kyushu-Palau Ridge**

Dredge hauls from the seamounts of Komahashi-Daini, Komahashi, Kita-Koho, and Minami-Koho are listed in Table 2. They contain acidic intrusive rocks, intermediate-basic volcanogenic rocks, limestones, semi-consolidated mudstone, etc.

Granodiorite from the Minami-Koho Seamount was dated ca 48.5 m.y. (K-Ar age; GH 74-7-175), and K-Ar age of tonalite from Komahashi-Daini (GDP-8-12, GH74-7-150-1) was ca 37.4—37.5 m.y. Limestone of Late Oligocene—Middle Miocene with benthic foraminifers of shallow-sea nature was found at Komahashi-Daini (GDP-8-7) and Komahashi (GDP-11-3). Accompanied by limestone, andesite and basalt were collected at Komahashi. Similar occurrence was discovered at another site at Komahashi, where augite basalt and hyaloclastic, tuff-breccia of basaltic andesite are associated with coral-bearing limestone (GH74-7-184). Such association may indicate that volcanogenic-calcareous sedimentary sequence of Oligocene-Miocene similar to that at DSDP Site 296 (29°20.4'N, 133°31.52'E, south of Komahashi-Daini; at a depth of 2920m) is rather widely distributed in the northern part of the Kyushu-Palau Ridge including the Komahashi-Daini and Komahashi Seamounts, but the calcareous sedimentary sequence is represented by near-

shore facies in the summit area of the seamounts instead of by pelagic facies in deeper area as in DSDP Site 296.

Younger sediments are known as Middle-Late Pliocene semi-consolidated mudstones (GDP-24-2).

Geological data are still too sparse and insufficient for discussing the detailed feature of the geologic evolution of the entire Kyushu-Palau Ridge. Further studies are required.

### Dredge hauls from the Kinan Seamount Chain

Basalt or altered basaltic tuff, etc. was obtained from three seamounts of Hakuho, Daini-Kinan, and Kinan (Table 1). The data from the latter two seamounts are insufficient for discussing in detail the nature of the constituents, but those concerning the pillow basalt from the Hakuho Seamount (KH74-4-25) are enough to give the mineralogical and chemical characterization of the seamount. The petrochemical nature of the rock seems to resemble that of MORB but differs in higher content of K<sub>2</sub>O (Tokuyama and Fujioka, 1976; Tokuyama, this volume).

### Short cores from the Daito Ridge Group

About ten short gravity and piston cores (several tens centimeters long) from the topographic highs have been obtained mainly through GDP cruises (Table 2). They mostly consist of calcareous or foraminiferal ooze, which seems to cover the top of the ridges as thin veneer. A hiatus of about 2 m.y. between the Late Pliocene and the Late Pleistocene was found in core GDP-11-15 (Amami Plateau) through micropaleontological studies (KONDA *et al.*, 1977). It is necessary to carry out further detailed studies on the other sites to confirm the geographical extent of the hiatus throughout the ridge group.

### Piston cores from deep-sea basins

All the cores from the basin bottoms in the Daito Ridge Group Region, together with the northern margin of the Philippine Basin, consist mostly of brownish pelagic clay interbedded with volcanic ash layers (Table 2). The rate of the Recent sedimentation in the small basins in the Daito Region is much higher than that of the Philippine Basin.

**Table 1.** Dredge hauls from the Daito Ridge Group.

Remarks (common to Tables 1–5):

- 1) The listed data have already been published except for KH76-2 and GDP-24 cruises.
- 2) A pair of location (Latitude in N and Longitude in E) in the left column implies a series of hit-bottom—leave bottom time.
- 3) In the column, (manganese nodule) means that dredged samples are coated with manganese layer and/or occur as a nucleus of manganese nodule.
- 4) In the right column, RM-GDP-8, RM-GDP-11, etc., stand for Research Members of the GDP-8 Cruise, Research Members of the GDP-11 Cruise, etc., respectively. (1985) # means report involved in this book.

## AMAMI PLATEAU

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|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) GDP-11-8<br>28-03.0, 131-34.8-<br>28-03.8, 131-34.9<br>1580-1690  | Andesite tuff and basalt:<br>Phosphate and zeolite rock<br>(manganese nodule)                                                                                                                                                                                                                                                    | SHIKI, TOKUOKA, <i>et al.</i> (1975); AOKI (1975);<br>AOKI <i>et al.</i> (1975); AOKI <i>et al.</i> (1976);<br>ISHIKAWA and AOKI (1978), AOKI and ISHIKAWA<br>(1985) # ; TOKUYAMA (1985) # ; MUSASHINO and<br>SHIKI (1985) # : volcanogenic rocks; biotite<br>bearing hornblende andesite tuff,<br>clinopyroxene (orthopyroxene or olivine<br>pseudomorph) bearing andesite, biotite-<br>clinopyroxene-hornblende bearing andesite<br>tuff, glassy andesitic tuff, basalt and<br>clinopyroxene andesite tuff.                                                                                                                                                                                                                                                                                                                                                                       |
| 2) GDP-11-9<br>28-04.0, 131-37.8<br>1350-1410                        | <i>Nummulites boninensis</i> ,<br><i>Asterocyclina penuria</i> ,<br><i>Paraster nummuliticus</i> ?<br>– bearing limestone; Olivine<br>basalt andesite tuff,<br>phosphate and zeolite rock<br>(manganese nodule)                                                                                                                  | RM-GDP-11; SHIKI, TOKUOKA, <i>et al.</i> (1975);<br>KONDA (1975); KONDA <i>et al.</i> (1975); KONDA <i>et al.</i><br>(1977); AOKI <i>et al.</i> (1976); ISHIKAWA and<br>AOKI (1978), AOKI and ISHIKAWA (1985) # ;<br>TOKUYAMA (1985) # ; MUSASHINO and SHIKI<br>(1985) # : Middle Eocene type larger<br>foraminiferas are collected from<br>foraminiferal sand, which includes the<br>Eocene arenaceous foraminiferas of <i>Am-<br/>modiscus ariakensis</i> and <i>Ammodiscoides</i> cfr.<br><i>hanzawai</i> ; Volcanogenic rocks<br>Orthopyroxene-clinopyroxene andesite tuff,<br>olivine (pseudomorph)-clinopyroxene basalt,<br>hornblende-orthopyroxene bearing glassy<br>andesite tuff, etc.; augite-olivine-bearing<br>basalt has the K-Ar age of $85.1 \pm 2.1$ and<br>$82.4 \pm 2$ m.y., and $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of<br>$0.7038 \pm 4$ and $0.7030 \pm 2$ . |
| 3) GDP-11-10<br>27-55.5, 132-0.50<br>–27-55.0, 132-05.9<br>2140–2250 | Augite-olivine basalt<br>(manganese nodule)                                                                                                                                                                                                                                                                                      | SHIKI, TOKUOKA, <i>et al.</i> (1975); AOKI (1975);<br>AOKI <i>et al.</i> (1975); AOKI and ISHIKAWA<br>(1985) #                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 4) GDP-11-17<br>28-05.0, 132-01.4–<br>28-05.9, 132-01.8<br>1800-2110 | Plutonic rocks: augite gab-<br>bro, biotite-hornblende<br>tonalite, and biotite-<br>hornblende granodiorite<br>(manganese nodule)<br>Volcanic rocks: augite<br>basalt, hornblende-augite-<br>olivine basalt, oxyhorn-<br>blende andesite, and<br>hornblende-clinopyroxene-<br>olivine (pseudomorph)<br>basalt (manganese nodule) | SHIKI, TOKUOKA, <i>et al.</i> (1975); AOKI (1975);<br>SUWA and AOKI (1975); AOKI <i>et al.</i> (1975);<br>AOKI <i>et al.</i> (1976); ISHIKAWA and AOKI (1978);<br>AOKI and ISHIKAWA (1985) # ; TOKUYAMA<br>(1985) # ; MUSASHINO and SHIKI (1985) # : all<br>kinds of plutonic rocks belong to single<br>rock series; tonalite has the K-Ar ages of<br>$69.5 \pm 2.0$ as to the bulk rock and $75.1 \pm 2.4$<br>m.y. as to hornblende contained and is con-<br>sidered to be older than 75.1 m.y.; also it<br>has $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of $0.7032 \pm$ and K/Rb<br>ratio of 1110, which shows somewhat dif-<br>ferent nature of the rock as compared with<br>granite and granodiorite generally distributed<br>in the Japanese Islands; the occurrence of<br>oxyhornblende andesite implies that a part<br>of the volcanism, at least, occurred under               |

terrestrial environment, though the age is uncertain.

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| 5) | KH72-2(=GDP-3)-46<br>28-05.9, 131-38.0–<br>28-05.9, 131-38.6<br>2470-3000 | Augite-hypers thenes andesite<br>(manganese nodule)                                                                                    | ISHIBASHI (1975): Detailed data not available                                                                                                                                   |
| 6) | KH76-2-1<br>27-51.0, 132-58.6–<br>27-51.5, 132-59.1<br>2740-3000          | Altered carbonate rock?<br>(manganese nodule),<br>Pliocene carbonate rock,<br>and augite and hypersthene-<br>bearing hornblende dacite | KONISHI <i>et al.</i> (1983): Annular pebbles of<br>trondhjemite and rounded pebbles of<br>andesite (?) from a conglomeratic<br>substratum on which a thick crust has<br>grown. |
| 7) | KH-82-4-12<br>28-08.3, 132-07.3–<br>28-07.6, 132-07.1<br>2030-1910        | Trondhjemite, basalt (?),<br>calcareous siltstone, and<br>calcareous sandstone<br>(manganese nodule)                                   |                                                                                                                                                                                 |

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#### DAITO RIDGE

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|----|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) | GDP-15-1<br>25-39.5, 133-18.0–<br>25-38.5, 133-17.3<br>2720-2840 | Metamorphic rocks: black<br>schist and acidic igneous<br>rock suffered thermal<br>metamorphism<br>Plutonic rocks: hornblende-<br>biotite granodiorite, gabbro<br>Volcanic and volcanoclastic<br>rocks: clinopyroxene<br>andesite, two pyroxene<br>andesite, altered andesite<br>Other igneous rocks: altered<br>dolerite<br>Clastic rocks: arkosic<br>wacke, fine-grained sand-<br>stone, tuffaceous calcareous<br>sandstone, radiolaria bear-<br>ing fine-grained tuffaceous<br>claystone | RM-GDP-15 (1976); ISHIKAWA and AOKI<br>(1978); AOKI and ISHIKAWA (1985) #: rocks<br>were obtained as small angular pebbles of<br>less than 1 cm dia., which may have been<br>reworked from their bed rocks; a part of the<br>clastic rocks might be the original rock of<br>the metamorphic rock and intruded by the<br>intrusive rocks. |
| 2) | GDP-15-2<br>25-40.9, 133-22.7–<br>25-41.0, 133-22.1<br>2490-2505 | Clinopyroxene andesite, two<br>pyroxene andesites, olivine<br>basalt, biotite-green horn-<br>blende andesite tuff                                                                                                                                                                                                                                                                                                                                                                          | RM-GDP-15 (1976); ISHIKAWA and AOKI<br>(1978); AOKI and ISHIKAWA (1985) #;<br>MUSASHINO and SHIKI (1985) #                                                                                                                                                                                                                               |
| 3) | GDP-15-3<br>25-41.3, 133-20.3–<br>25-40.4, 133-20.2<br>2375-2450 | Plutonic rock: gabbro<br>Volcanic and volcanoclastic<br>rocks: clinopyroxene-<br>hornblende andesite,<br>clinopyroxene andesite,<br>andesitic tuff breccia<br>Phosphate and zeolite rock<br>(manganese nodule)                                                                                                                                                                                                                                                                             | RM-GDP-15 (1976); ISHIKAWA and AOKI<br>(1978); AOKI and ISHIKAWA (1985) #;<br>MUSASHINO and SHIKI (1985) #                                                                                                                                                                                                                               |

Data Listing of the Bottom Materials

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| 4) GDP-15-4<br>25-27.8, 132-53.1<br>25-27.9, 132-53.2<br>1160-1245           | <i>Nummulites</i> -bearing<br>limestone, manganese-<br>coated zeolitic mudstone,<br>and individual specimens of<br>larger foraminifer     | RM-GDP-15 (1976); ISHIKAWA and AOKI<br>(1978); AOKI and ISHIKAWA (1985) #;<br>MUSASHINO and SHIKI (1985) #: the individual<br>specimens of larger foraminifer are con-<br>sidered to have been derived from<br><i>Nummulites</i> -bearing limestone. They contain<br><i>Nummulites boninensis</i> , <i>Discocyclina</i> 2 spp.,<br>and <i>Asterocyclina</i> sp. |
| 5) GDP-15-6<br>25-32.7, 132-32.9–<br>25-32.7, 132-32.7<br>1770-1785          | <i>Nummulites boninensis</i>                                                                                                              | RM-GDP-15 (1976): <i>Nummulites</i> occurs as<br>an individual specimen of megalospheric<br>form, associated with <i>Discocyclina</i> sp.                                                                                                                                                                                                                       |
| 6) GDP-15-7<br>25-16.2, 133-14.5<br>25-16.5, 133-15.1<br>2190-2580           | <i>Nummulites boninensis</i> ,<br><i>Discocyclina</i> sp.,<br><i>Asterocyclina</i> sp., green<br>schist, dolerite, tuff, and<br>phosphate | RM-GDP-15 (1976); ISHIKAWA and AOKI<br>(1978); AOKI and ISHIKAWA (1985) #;<br>MUSASHINO and SHIKI (1985) #: the rocks,<br>together with fossils, were obtained from<br>foraminiferal sand of the upper Pliocene-<br>Holocene; <i>Nummulites</i> is represented by<br>many specimens of megalospheric form and<br>one specimen of microspheric form.             |
| 7) GDP-15-8<br>25-12.1, 133-10.5–<br>25-12.2, 133-10.6<br>3200-3400          | Zeolite rock                                                                                                                              | RM-GDP-15 (1976); ISHIKAWA and AOKI<br>(1978); MUSASHINO and SHIKI (1985) #                                                                                                                                                                                                                                                                                     |
| 8) GDP-21-3<br>26-18.9, 131-30.3–<br>26-18.3, 131-30.5<br>2575-3060          | Altered basalt fragment cat-<br>ched in phosphate rock<br>(manganese nodule)                                                              | RM-GDP-21 (1977)                                                                                                                                                                                                                                                                                                                                                |
| 9) GDP-21-12<br>25-34.2, 131-19.2<br>4425                                    | Phosphate rock?<br>(manganese nodule)                                                                                                     | RM-GDP-21 (1977): caught at the bottom of<br>corer.                                                                                                                                                                                                                                                                                                             |
| 10) GDP-21-15<br>25-27.0, 132-19.2–<br>25-27.1, 132-18.5<br>2918-3029        | Semi-consolidated<br>calcareous mud, and small<br>manganese nodules                                                                       | RM-GDP-21 (1977); MUSASHINO and SHIKI<br>(1985) #                                                                                                                                                                                                                                                                                                               |
| 11) GDP-24-13<br>25-41.1, 134-10.5–<br>25-39.7, 134-09.8<br>2010-2550        | Oligocene chalk                                                                                                                           | RM-GDP-24 (1978); MUSASHINO and SHIKI<br>(1985) #: comprising calcareous nannofossils<br>ranging from the Middle to Late Oligocene<br>( <i>Cocolithus eopelagicus</i> , <i>Discoaster deflan-<br/>drei</i> , etc.) and planktonic <i>foraminifers</i> of the<br>Late Oligocene ( <i>Globigerina augulisuturalis</i> ,<br>etc.)                                  |
| 12) GH74-7-179 (D78)–<br>25-03.8, 133-18.8<br>25-04.0, 133-19.0<br>2720-2770 | Siltstone (manganese<br>nodule)                                                                                                           | MIZUNO, NOHARA, <i>et al.</i> (1975): detailed data<br>not available.                                                                                                                                                                                                                                                                                           |

T. SHIKI *et al.*

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| 13) GH74-7-180 (D79)<br>25-02.5, 133-20.5–<br>25-02.5, 133-20.4<br>1690        | Tuffaceous rock and altered<br>andesite (manganese nodule)                                                                                                                          | MIZUNO, NOHARA, <i>et al.</i> (1975); MIZUNO,<br>OKUDA, <i>et al.</i> (1975): detailed data not<br>available.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 14) GH74-7-183 (D82)<br>2-23.0, 133-32.0–<br>25-23.4, 133-31.7<br>1820-1800    | Metamorphic rocks: horn-<br>blende schist, tremolite<br>schist, diopside-chlorite<br>schist<br>Ultramafic rock peridotite<br>Conglomerate with schist<br>pebbles (manganese nodule) | MIZUNO, NOHARA, <i>et al.</i> (1975); MIZUNO,<br>OKUDA, <i>et al.</i> (1975); YUASA and WATANABE<br>(1977); TOKUYAMA (1980): the rocks were col-<br>lected from the acoustic basement:<br>Mineralogical data of the metamorphic<br>rocks suggest that there were two metamor-<br>phic events. The older one was intermediate<br>to high-pressure metamorphism, and the<br>younger was contact metamorphism, and the<br>younger was contact metamorphism by a<br>Paleocene magmatic event. The K–Ar age of<br>the schist, $49 \pm 3.7$ m.y., may indicate the<br>second metamorphic event. The con-<br>glomerate contains angular-subangular peb-<br>bles of tremolite schist and serpentinite, and<br>a minor amount of basalt pebble, besides<br>volcanogenic plagioclase grains. |
| 15) KH72-2(= GDP-3)-48<br>26-11.6, 131-33.3–<br>26-11.7, 131-32.0<br>3029-2838 | Pyroxene andesite                                                                                                                                                                   | ISHIBASHI (1975): detailed data not available                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 16) KH72-2(= GDP-3)-50<br>25-59.4, 131-21.4–<br>25-59.1, 131-21.0<br>1491-1863 | Hornblende andesite                                                                                                                                                                 | ISHIBASHI (1975): detailed data not available                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 17) KH72-2(= GDP-3)-51<br>25-56.9, 131-21.4–<br>25-57.2, 131-20.8<br>1270-502  | Pyroxene andesite tuff and<br>tuff-breccia, and (?) dacite                                                                                                                          | ISHIBASHI (1975): detailed data not available                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 18) KH-77-1<br>25-23.7, 133-05.2–<br>25-24.1, 133-06.4<br>1400                 | Micro-manganese nodules                                                                                                                                                             | FUJIOKA <i>et al.</i> (1980)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

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#### OKI-DAITO RIDGE

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- |                                                                      |                                                                                                                                    |                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) GDP-15-10<br>23-03.3, 134-45.5–<br>23-03.1, 134-45.3<br>2210-2560 | <i>Nummulites boninensis</i> and<br>other larger foraminiferas                                                                     | RM-GDP-15 (1976): <i>Nummulites boninensis</i><br>is represented by megalospheric form; the<br>other larger foraminiferas are <i>Discocyclus</i><br>sp. and <i>Asterocyclus</i> 3 spp.                                                                                 |
| 2) GDP-15-11<br>22-47.5, 134-28.7–<br>22-47.9, 134-30.5<br>2880-3700 | Zeolite rock, phosphate<br>rock, calcareous rock,<br>clinopyroxene basalt,<br>pumice, tuffaceous sand-<br>stone (manganese nodule) | RM-GDP-15 (1976): AOKI and ISHIKAWA<br>(1985) #: possible <i>Lacazinella</i> sp. of Eocene<br>was obtained from a rock; a tuffaceous rock<br>contains Middle Miocene Radiolaria, <i>Cyr-<br/>tocapella terapera</i> and others (S. SUGANO,<br>personal communication). |

Data Listing of the Bottom Materials

|    |                                                                            |                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----|----------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3) | GDP-15-13<br>22-58.0, 134-32.5–<br>22-58.7, 134-33.2<br>1940-1970          | Phosphate rock, <i>Nummulites boninensis</i> and other larger foraminiferas | RM-GDP-15 (1976): <i>Nummulites boninensis</i> is represented by megalospheric form; the other larger foraminiferas are <i>Discocyclus</i> sp. and <i>Asterocyclus</i> 2 spp.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4) | GDP-21-5<br>23-45.0, 133-02.3–<br>23-45.2, 133-01.9<br>2730-2735           | <i>Nummulites boninensis</i> ,<br>Dolerite, basalt, andesite,<br>and tuff   | RM-GDP-21 (1977); ISHIKAWA and AOKI (1978); Aoki and Ishikawa (1985) #; MUSASHINO and SHIKI (1985) #: olivine (pseudomorph)—clino—pyroxene basalt, olivine bearing basalt, altered basaltic tuff, two-pyroxene andesite, andesitic tuff, and zeolitic rock (manganese nodule); associated sediments (foram ooze) contain <i>Nummulites</i> and <i>Discoaster</i> (Pliocene species).                                                                                                                                                                                                                                           |
| 5) | GDP-21-6<br>23-45.8, 133-02.0–<br>23-47.5, 133-00.9<br>1970-1980           | Phosphate rock (and<br>calcareous rock?)<br>(manganese nodule)              | RM-GDP-21 (1977); MUSASHINO and SHIKI (1985) #: Some of the rocks contain <i>Nummulites boninensis</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 6) | GH74-7-159 (D67)<br>23-48.1, 132-46.6–<br>23-48.5, 132-47.1<br>2290-2110   | Phosphate rock?<br>(manganese nodule)                                       | MIZUNO, NOHARA, <i>et al.</i> (1975): detailed data are not available.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 7) | GH74-7-160 (D68)<br>23-28.0, 133-03.0–<br>23-27.8, 133-02.3<br>2990 +      | Augite basalt and augite<br>dolerite (manganese nodule)                     | MIZUNO, NOHARA <i>et al.</i> (1975); MIZUNO, OKUDA, <i>et al.</i> (1975): upper Miocene nanoplanktons are found in manganese crusts of the nodules (S. NISHIDA, personal communication); Detailed data of the igneous rocks are not available.                                                                                                                                                                                                                                                                                                                                                                                 |
| 8) | GH74-7-167 (D71)<br>24-20.0, 131-42.2–<br>24-19.2, 131-41.5<br>2340-2330   | <i>Nummulites</i> -bearing<br>limestone. and calcareous<br>mudstone         | MIZUNO, NOHARA, <i>et al.</i> (1975); MIZUNO, OKUDA, <i>et al.</i> (1975); MIZUNO, KONDA <i>et al.</i> (1977); <i>Nummulites boninensis</i> (megalo- and microspheric forms), <i>Asterocyclus penuria</i> , and <i>Asterocyclus</i> sp. were abundantly found in limestone and as individual specimen; Eocene large <i>Venericardia</i> (“ <i>Venericor</i> ”) and gastropods were also collected; calcareous mudstone contains abundant planktonic foraminiferas indicating the Early Pliocene (N19) ( <i>Globorotalia margaritae</i> , <i>G. multicamerata</i> , <i>G. crassula</i> , <i>Globoquadrina altispira</i> , etc.) |
| 9) | KH72-2(= GDP-3)-52<br>24-29.5, 131-00.0–<br>24-29.3, 131-00.3<br>2496-2436 | Pyroxene andesite                                                           | ISHIBASHI (1975): detailed data are not available.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**Table 2.** Dredge hauls from the seamounts in the Minami-Daito Basin.

|    |                                                                   |                                                                                |                                                |
|----|-------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------|
| 1) | GDP-15-14<br>23-59.1, 134-30.0–<br>23-59.1, 134-30.0<br>2880-3020 | Calcareous rock                                                                | RM-GDP-15 (1976): detailed data not available. |
| 2) | GDP-15-15<br>23-59.6, 134-30.0–<br>24-00.1, 134-29.3<br>2640-3000 | Phosphate rock and zeolitic mudstone and andesite (manganese nodule)           | RM-GDP-15 (1976)                               |
| 3) | GDP-24-8<br>23-50.1, 133-50.1–<br>23-50.1, 133-49.4<br>3280-3320  | Altered tuff and tuffbreccia (manganese nodule)                                | RM-GDP-24 (1978)                               |
| 4) | KH-76-2-4<br>24-31.5, 133-06.8–<br>24-31.9, 133-06.1<br>2600-2700 | Calcareous or phosphatic rock (Upper Pliocene), and manganese nodule fragments | (unfinished)                                   |

**Table 3.** Dredge hauls from the Kyushu-Palau Ridge.

## KOMAHASHI-DAINI SEAMOUNT

|    |                                                                  |                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) | GDP-8-7<br>29-53.4, 133-20.2–<br>29-52.8, 133-20.1<br>975-1018   | Limestone and phosphate rock (manganese nodule)                                                                                                                                                                                                                               | SHIKI, TOKUOKA, <i>et al.</i> (1975); SHIKI, AOKI, <i>et al.</i> (1974); KONDA <i>et al.</i> (1975); USUI <i>et al.</i> (1976); MUSASHINO and SHIKI (1985) #: the limestone contains <i>Orbulina universa</i> , <i>Amphistegina</i> , <i>Lepidocyclina</i> , <i>Miogypsinidae</i> , which indicate the Middle Miocene or younger age; the mineral and chemical compositions of ferro-manganese oxides coating the rocks are presented in USUI <i>et al.</i> (1976).                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 2) | GDP-8-12<br>29-55.6, 133-18.5–<br>29-55.0, 133-20.0<br>2250-2280 | Plutonic rocks:<br>Trondhjemite, biotite-hornblende tonalite, biotite granodiorite, quartz diorite, diorite porphyrite (manganese nodule)<br>Volcanic rock:<br>clinopyroxene andesite (manganese nodule)<br>Other rocks:<br>tuff, sandstone, zeolitic rock (manganese nodule) | RM-GDP-8 (1974); SHIKI, TOKUOKA, <i>et al.</i> (1975); SHIKI, AOKI, <i>et al.</i> (1974); SUWA and AOKI (1975); AOKI <i>et al.</i> (1975); AOKI <i>et al.</i> (1976), ISHIZAKA (1975); NISHIMURA (1975); SHIBATA and OKUDA (1975); USUI <i>et al.</i> (1976); HARADA and NISHIDA (1975); ISHIKAWA and AOKI (1978); AOKI and ISHIKAWA (1985) #; MUSASHINO and SHIKI (1985) #: the plutonic rocks obtained are characterized by consisting mainly of plagioclase and quartz, with few K-feldspar, and belong to single rock series; tonalite has $37.4 \pm 6.4$ m.y. K-Ar age and $51$ m.y. $\pm 20\%$ fission track age; a part of the rocks is characterized by high K/Rb (543, 1118) and low K/Na ratio; the mineral and chemical compositions and microfossils (nannoplankton, planktonic foraminifera, etc.) have been studied by Usui <i>et al.</i> (1976) and Harada and Nishida (1975), respectively. |



# Data Listing of the Bottom Materials

|    |                                                                           |                                                   |                                                                                                                                                             |
|----|---------------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3) | GH74-7-150-1 (D60)<br>29-52.0, 133-17.0<br>29-52.0, 133-17.0<br>1040-1070 | Biotite-hornblende tonalite<br>(manganese nodule) | MIZUNO, NOHARA, <i>et al.</i> (1975); MIZUNO, OKUDA, <i>et al.</i> (1975); SHIBATA <i>et al.</i> (1977): tonalite is dated at $37.5 \pm 1.9$ m.y. K-Ar age. |
| 4) | GH74-7-150-2 (D61)<br>29-53.0, 133-19.5<br>29-53.0, 133-19.5<br>530+      | Biotite-hornblende tonalite<br>(manganese coated) | MIZUNO, NOHARA, <i>et al.</i> (1975); MIZUNO, OKUDA, <i>et al.</i> (1975)                                                                                   |
| 5) | 29°51.3, 133°19.0<br>900-1299                                             | plagiogranite and andesite                        | OSTAPENKO and NARYJENYI (1976), (Japanes translation AOKI <i>et al.</i> , 1977): plagiogranite was thought to have K-Ar age of 14 m.y.                      |

## KOMAHASHI SEAMOUNT

|    |                                                                          |                                                                                                                               |                                                                                                                                                                                                                                                                                                    |
|----|--------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) | GDP-11-2<br>28-04.8, 134-39.8–<br>28-04.5, 134-39.8<br>535-560           | Limestone? and dolerite<br>(manganese nodule)                                                                                 | SHIKI, TOKUOKA, <i>et al.</i> (1975): detailed data not available                                                                                                                                                                                                                                  |
| 2) | GDP-11-3<br>28-05.5, 134-37.5–<br>28-05.5, 134-38.0<br>620-1350          | Augite-olivine<br>(pseudomorph)–andesite,<br>olivine (pseudomorph)<br>clinopyroxene basalt<br>(manganese nodule)<br>Limestone | SHIKI, TOKUOKA, <i>et al.</i> (1975); AOKI (1975); KONDA <i>et al.</i> (1975); AOKI <i>et al.</i> (1975); ISHIKAWA and AOKI (1978); AOKI and ISHIKAWA (1985) #: limestone contains the Late Oligocene-Middle Miocene fossils of <i>Miogypsina</i> , <i>Spiroclypeus</i> , and <i>Marginopora</i> ? |
| 3) | GDP-24-1<br>28-15.4, 134-32.5–<br>28-25.3, 134-32.5<br>2410-2460         | Olivine (pseudomorph)–<br>pyroxene basalt tuffbreccia,<br>basaltic tuff, and sandy<br>tuff. (manganese nodule)                | (unfinished)                                                                                                                                                                                                                                                                                       |
| 4) | GDP-24-2<br>28-13.1, 134-42.0–<br>28-13.6, 134-41.7<br>3440-3580         | semi-consolidated mudstone                                                                                                    | (unfinished): Middle—Late Pliocene                                                                                                                                                                                                                                                                 |
| 5) | GH74-7-184 (D83)<br>24-51.0, 134-34.7–<br>27-51.3, 134-34.0<br>2230-1540 | Coral-bearing limestone,<br>augite basalt, hyaloclastic<br>tuff-breccia, tuff, and<br>volcanic conglomerate                   | MIZUNO, NOHARA, <i>et al.</i> (1975); MIZUNO, OKUDA, <i>et al.</i> (1975): tuff-breccia and tuff are mainly of basic andesite; the rocks obtained can be correlated with the volcanoclastic rocks in the lower half of DSDP Hole 296.                                                              |

## KITA-KOHO SEAMOUNT

|    |                                                                             |                |                                      |
|----|-----------------------------------------------------------------------------|----------------|--------------------------------------|
| 1) | GH74-7-153-1 (D63)<br>26-44.5, 135-24.6–<br>26-45.3, 135-25.0<br>520-345    | Phosphate rock | MIZUNO, NOHARA, <i>et al.</i> (1975) |
| 2) | GH74-7-153-2 (D64)<br>26-46.1, 135-27.2–<br>26-46.2, 135-27.0<br>430*-460** | Carbonate rock | MIZUNO, NOHARA, <i>et al.</i> (1975) |

## MINAMI-KOHO SEAMOUNT

|                                                                            |                                                                                       |                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) GH74-7-175 (D76)<br>26-06.0, 135-52.7–<br>26-05.0, 135-52.5<br>1100-980 | Biotite-hornblende<br>granodiorite (manganese<br>nodule) titanite, basalt<br>hornfels | MIZUNO, NOHARA, <i>et al.</i> (1975); MIZUNO,<br>OKUDA, <i>et al.</i> (1975); MIZUNO <i>et al.</i> (1977):<br>granodiorite includes many inclusions of<br>hornblende-titanite-augite basalt and has<br>48.5 ± 1.4 m.y. K-Ar age. |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Table 4.** Dredge hauls from the Kinan seamount Chain.

## DAINI-KINAN SEAMOUNT

|                                                                  |                       |                                                                        |
|------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------|
| 1) GDP-8-4<br>30-08.3, 136-51.5–<br>30-08.1, 136-43.5<br>770-980 | Altered basaltic tuff | SHIKI, AOKI <i>et al.</i> (1974); SHIKI, TOKUOKA, <i>et al.</i> (1975) |
|------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------|

## KINAN SEAMOUNT

|                             |                 |                                                                                                                                                                        |
|-----------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) 30-10.5, 136-42.5<br>750 | Palagonite tuff | Dredged by RV Takuyo, Hydrographic Of-<br>fice, Japan, in 1962; Probably altered from<br>calcareous rock. bryozoans, calcareous<br>algae, molluscs etc. are contained. |
|-----------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## HAKUHO SEAMOUNT

|                                                                       |               |                                                                                                                            |
|-----------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------|
| 1) KH-74-4-25<br>28-01.0, 137-26.4–<br>28-01.2, 137-27.8<br>2790-2250 | Pillow basalt | TOKUYAMA and FUJIOKA (1976): texture and<br>chemical composition of various parts of the<br>pillow were studied in detail. |
|-----------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------|

**Table 5.** Data of the main piston and gravity cores obtained in the Northwestern Philippine Sea.

## AMAMI PLATEAU

|                                           |                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) GDP-11-15<br>28-06.2, 131-35.2<br>1830 | Gravity core, 50cm long;<br>calcareous ooze | SHIKI, TOKUOKA, <i>et al.</i> (1975); KONDA (1975);<br>NISHIMURA <i>et al.</i> (1977): calcareous nan-<br>noplankton, benthonic foraminiferas, and<br>planktonic foraminiferas were studied in<br>detail; their vertical distributions imply that<br>the upper 15cm of the core belongs to the<br>upper Pleistocene (NN20-21, N22-23) and<br>the lower 35cm to the upper Pliocene, and a<br>time hiatus of about 2 m.y. is present inbet-<br>ween; faunal character of benthonic<br>foraminiferas suggests an increase of water<br>depth about 1000m during the late<br>Pleistocene. |
|-------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## KITA-DAITO BASIN

|                                                  |                                                                                                              |                                                                                                                                                                           |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) GH74-7-185 (P22)<br>27-34.5, 134-24.5<br>4575 | Piston core, 539cm long;<br>clay; the upper half is tuf-<br>faceous, interbedded with<br>volcanic ash layers | MIZUNO, NOHARA, <i>et al.</i> (1975); INOKUCHI and<br>MIZUNO (1977): normally magnetized<br>throughout the core; sedimentation rate<br>(average), more than 7.8mm/1000 y. |
| 2) KH-76-2-5<br>26-35.0, 133-52.0<br>5150        | Gravity core, 35cm long;<br>reddish brown and orange<br>clay with a few brownish<br>black thin layer         |                                                                                                                                                                           |

## DAITO RIDGE

|                                              |                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) GDP-15-5<br>25-30.7, 132-42.0<br>1720     | Short gravity core;<br>foraminiferal ooze                                                                                                        | RM-GDP-15 (1976): calcareous nan-<br>noplankton remains contained show the<br>Earliest Pleistocene.                                                                                                                                                                                                                                                                                                 |
| 2) GDP-21-12<br>25-34.2, 131-19.2<br>4425    | Piston core, 47.7cm long;<br>pale yellowish orange clay<br>and yellowish brown clay                                                              | RM-GDP-21 (1977): 0-7.5cm—pale<br>yellowish orange clay, Holocene.<br>7.5-46cm—yellowish brown clay, calcareous<br>fossils are rare. 46-47.7cm—pale yellowish<br>orange calcareous ooze, lowest pleistocene or<br>upper Pliocene. Derived fossils of older<br>pliocene time are contaminated.<br>0-15 cm—normally magnetized. 15-30 cm—<br>reversely magnetized. 30-47.5 cm—normally<br>magnetized. |
| 3) GDP-21-13<br>25-25.0, 132-17.1<br>3460    | Gravity core, 51 cm long;<br>foraminiferal ooze                                                                                                  | RM-GDP-21 (1977)                                                                                                                                                                                                                                                                                                                                                                                    |
| 4) GDP-24-3<br>25-46.4, 133-21.2<br>3230     | Gravity core, 57cm long;<br>calcareous ooze                                                                                                      | (unpublished): Recent                                                                                                                                                                                                                                                                                                                                                                               |
| 5) GDP-24-6<br>25-48.5, 133-22.3<br>3139     | Piston core, 460cm long;<br>lower half is disturbed by<br>flow-in; calcareous                                                                    | (unpublished): Recent in whole                                                                                                                                                                                                                                                                                                                                                                      |
| 6) KH-77-1-2<br>25-31.3, 133-15.5<br>3400    | Piston core, 882cm long;<br>light brown silty clay, light<br>brown clayey ooze,<br>yellowish brown<br>diatomaceous clay, light<br>grayclay, etc. | FUJIOKA <i>et al.</i> (1980); in Preliminary Report<br>Hakuho Maru Cruise KH-77-1 (ed. NASU<br>and KOBAYASHI): one thick (23cm) and three<br>thin volcanic ash layers are interbedded.                                                                                                                                                                                                              |
| 7) KH-82-4-St.8<br>28-23.1, 132-45.9<br>2630 | Piston core, 754.5cm long;<br>grayish yellow brown                                                                                               | Preliminary Report Hakuho Maru Cruise<br>KH-82-4 (1983) (ed. K. KOBAYASHI): Three<br>volcanic ash layer are interbedded                                                                                                                                                                                                                                                                             |

## MINAMI-DAITO BASIN

|                                                  |                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) GH74-7-172 (P19)<br>25-160, 134-22.0<br>5290  | Piston core 556cm long; the uppermost part is interbedded with a volcanic ash layer 1.5cm thick. | MIZUNO, NOHARA, <i>et al.</i> (1975); INOKUCHI and MIZUNO (1977): normally magnetized throughout the core; sedimentation rate is calculated as more than 8.1mm/1000 y.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 2) GH74-7-156 (P16)<br>23-47.0, 134-45.3<br>5100 | Piston core 552cm long; the lower half is disturbed by flow-in; clay                             | MIZUNO, NOHARA, <i>et al.</i> (1975)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3) KH-76-2-3<br>24-27.2, 132-35.4<br>4660        | Piston core 960cm long; homogenous dark brown to light-brown silty clay                          | 0-570cm—reddish or yellowish brown clay, 570-860cm; yellowish brown laminated clay, alternation of clay of yellowish orange and yellowish brown color. 860-992cm—disturbed by flow-in but seems to be the alternation as above. Largely tuffaceous as a whole.<br>42-48cm—light yellowish orange volcanic ash. 695-700cm—volcanic ash with pumice gravels. 705-722cm—compact volcanic ash. Tonouchi and Kobayashi (1980) ;<br>0-565cm—normally magnetized (Brunhes), 565-740cm—reversely magnetized, 740-820cm—normally magnetized (Jaramillo). age of bottom; 1.09 m.y. (from extrapolation); sedimentation rate (Brunhes epoch) is calculated as 8.3mm/1000 y. |

## OKI-DAITO RIDGE

|                                           |                                                        |                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) Lamont V21-98<br>23-06, 134-26<br>2134 | Piston core, 517cm long; calcareous foraminiferal ooze | TAKAYAMA (1969); TAKAYAMA (1970); TAKAYAMA (1973); UJIE (1975); UJIE and MIURA (1975): detailed studies were made on nannoplankton and planktonic foraminifera fossils; the core ranges from the Uppermost Miocene (N18, the latest stage of the Gilbert Epoch) through the Quarternary; sedimentation rate (average) is 1.4mm/1000 y. |
| 2) GDP-21-7<br>23-58.0, 133-07.8<br>3100  | Piston core, 47cm long; foraminiferal ooze             | RM-GDP-21 (1977): microfossils from the bottom of the core show the Earliest Pleistocene. Derived fossils of Eocene and Miocene—Pliocene are found.                                                                                                                                                                                    |
| 3) GDP-21-9<br>24-58.8, 131-18.5<br>2535  | Piston core, 34cm long; foraminiferal ooze             | RM-GDP-21 (1977): Recent.                                                                                                                                                                                                                                                                                                              |
| 4) GDP-21-10<br>25-14.0, 131-10.9<br>3020 | Gravity core, 59cm long; foraminiferal ooze            | RM-GDP-21 (1977): Pleistocene to Recent. Depositional environment deeper than 2000m is assumed on the bases of benthonic foraminiferal assemblage.                                                                                                                                                                                     |

## Data Listing of the Bottom Materials

- |    |                                        |                                                |                                                                                                                                    |
|----|----------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| 5) | GDP-21-11<br>25-22.5, 130-59.0<br>3317 | Piston core, 45 cm long;<br>Calcareous ooze    | RM-GDP-21 (1977): Recent. Depositional environment deeper than 2000m is assumed on the bases of benthonic foraminiferal assemblage |
| 6) | KH-76-2-2<br>24-25.5, 131-48.9<br>2030 | Piston core, 50 cm long;<br>Foraminiferal sand |                                                                                                                                    |

## PHILIPPINE BASIN (northern margin)

- |    |                                               |                                                                                   |                                                                                                                                                                                                                                                                    |
|----|-----------------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) | GDP-15-12<br>22-37.8, 134-13.5<br>5160        | Piston core, 572 cm long;<br>clay                                                 | RM-GDP-15 (1976); 0-ca. 3.6m interval is normally magnetized.                                                                                                                                                                                                      |
| 2) | GH74-7-158 (P17)<br>23-06.5, 132-19.8<br>5550 | Piston core, 556 cm long;<br>clay interbedded with thin<br>layers of volcanic ash | MIZUNO, NOHARA, <i>et al.</i> (1975); INOKUCHI and MIZUNO (1977): 0-333 cm—normally magnetized (Brunhes), 333-402 cm—reversely magnetized, 402-446 cm—normally magnetized (Jaramillo), 446-556 cm—reversely magnetized; sedimentation rate (average) 48 mm/1000 y. |

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