VII. BOTTOM SAMPLES OBTAINED BY DREDGE AND ROCK-CORER FROM THE AREA NORTHEAST OF HACHIJOJIMA ISLAND, IN THE NORTHERN PART OF IZU-OGASAWARA ARC

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Introduction

Many islands belonging to the Ogasawara Arc, one of the island arcs surrounding in the Pacific Ocean, are found in the sea south of central Japan. All the islands consist of volcanic rocks and they form a volcanic front from Izu-Oshima Island to the Iwo Islands (Volcano Islands), except for the Ogasawara Islands (of the outer arc of the Iwo Islands) which are composed of Paleogene rocks. The geology of these islands was summarized by TSUYA (1937). More recently, geological maps of some of the islands were published in quadrangle series at a scale of 1:50,000 (ISSHIKI, 1959, 1960, 1978 and 1980). Despite these data, geological knowledge of the Arc, especially of the basement rocks, has been sparse in comparison with that of the Japanese Islands and the Ryukyu Arcs. As mentioned in Chapter I, it was expected that basement rocks from this area would be obtained during the present cruise. Sampling work in the area was carried out at 164 sites by dredging, rock-coring, piston-coring, grab-sampling and drilling. Information about the samples obtained by dredge and rock-coring are summarized here. Brief descriptions of the samples are given in Table VII-1, and the sampling sites are shown in Figure VII-1. Columnar sections of the cores are shown in Figure VII-2.

Sediments

The description of the surface sediments is in Chapter VIII. The sediments obtained as cores are described here. These sediments are mainly from the western, northern and eastern sides of the central banks, and are seldom found on the top and southern side of the banks. The sediments comprise fine to medium sand and some silt with ash or scoria layers.

1) Sandy sediments

The sandy sediments surround the northern half of the Kitakurose Bank. Fine sand is the main component of the core taken from the western and eastern slopes of the Bank. However, the sediments are slightly coarser, medium sand and some coarse sand, on the saddle between Mikurajima Island and the Bank and on the northern slope of the Bank. As mentioned in chapter IX, the effect of the Kuroshio current can be recognized on the saddle and the slope, and therefore it is considered that the distribution of medium sand is also affected

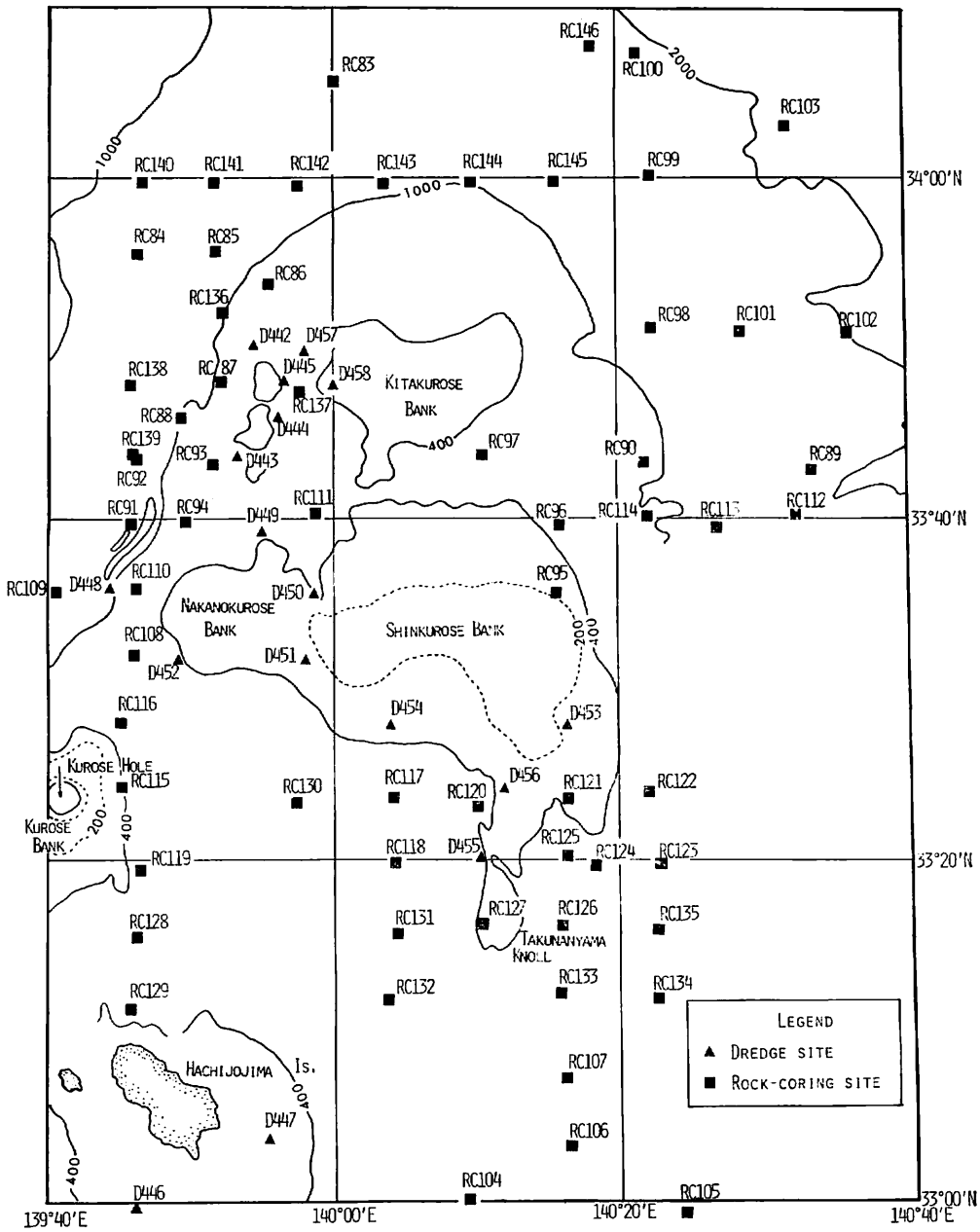


Fig. VII-1 Sampling sites in the area northeast of Hachijojima Island. Solid square: rock-coring, solid triangle: dredge. There is no bathymetric chart for the southeastern part.

Table VII-1 List of samples from cruise GH80-4

St. No.	Samp. No.	Samples	Remarks
1817	RC83	43 cm core of greenish grey, fine-grained tuff.	
1824	RC84	54 cm core of sand with scoria layers.	
1825	RC85	57 cm core of sand (tuffaceous in parts) with ash and scoria layers.	
1826	RC86	No sample.	Smash on hard rock bottom.
1830	D442	Pumice block (23×19×13 cm), rounded cobble, shell fragment and coral.	
1833	RC87	54 cm core of sand with scoriaceous layers.	
1834	RC88	73 cm core of sand with pumice and ash layers.	
1847	RC89	43 cm core of silt with scoriaceous ash layers.	
1849	RC90	About 84 cm core of sand (lower part: tuffaceous).	
1851	RC91	72 cm core of sand (upper) and black ash layer (lower).	
1852	RC92	Several fragments of foraminifera bearing fine sandstone and volcanic rock.	No core sample.
1853	RC93	78 cm core of breccia with calcareous matrix, calcareous sandstone, ferromanganese oxide and pumiceous tuff lying under sand layer.	
1854	D443	Foraminifera rich fine sand containing many fragments of shell and rock, and coarse-grained sandstone (7×4×3 cm).	In situ sandstone.
1855	D444	Volcanic rock fragment (8×7×3 cm) and sponge.	May be in situ. Fuse wire broken.
1856	D445	Matrix-rich, coarse-grained sandstone partly containing volcanic rock rubber layer, and coral.	Rock size; 22×14×9cm. May be in situ.
1858	RC94	23 cm core of ill-sorted coarse and medium sand containing the fragments of shell, calcareous material and pumiceous sandstone.	
1860	RC95	Small fragment of calcareous sandstone	No core sample.
1861	RC96	Fragment of calcareous rock.	No core sample.
1863	RC97	Fragment of calcareous rock.	No core sample.
1867	RC98	41 cm core of sand.	
1875	RC99	100 cm core of sand with scoriaceous ash layers.	
1877	RC100	A small amount of silty clay.	No core sample.
1878	RC101	88 cm core of silt with ash layers.	
1879	RC102	86 cm core of silt with ash spots.	
1883	RC103	12 cm core of grey ash lying under oxidized silt layer.	
1884	D446	Calcareous sandstone.	In situ.
1887	RC104	Fragment of breccia.	No core sample.
1892	D447	Limestone and limy mantled calcareous sandstone and scoria.	
1893	RC105	18 cm core of tuffaceous coarse sandstone	

St. No.	Samp. No.	Samples	Remarks
		including small rubble of pumice and volcanic rock.	
1896	RC106	10 cm core of volcanic (maybe) breccia with black coating surface and pebbles on it.	
1897	RC107	71 cm core of coarse, pumiceous sandstone with black coating surface, coarse pumiceous tuff and lapilli tuff including coarse pumice rubble.	
1902	RC108	No sample.	
1903	RC109	122 cm core of well-sorted fine sand with ash layer.	
1904	D448	In situ volcanogenic rocks surrounded by thin (about 1 mm thick) ferromanganese coat. Rocks are lapilli tuff (22×17×13 cm), volcanic breccia (14×13×9 cm) and sandy tuff (7×6×4 cm).	
1905	RC110	53 cm core of black fine sand (volcanic?), ash or lapilli, and rubble of volcanic rock.	
1906	D449	Altered volcanic rock boulder (maybe from conglomerate (28×22×12 cm), rubble of lapilli tuff (18×12×6 cm), glassy basic volcanic rock (5×3×3 cm) and slightly altered and greenish-colored volcanic rock (7×7×6 cm).	
1907	RC111	No sample.	Smash on hard rock bottom.
1908	D450	A small amount of sandstone with calcareous matrix and volcanic grains.	Fuse wires broken.
1909	D451	Coral, sponge and calcareous ball.	
1910	D452	Volcanic breccia (diameter, 5 cm).	
1912	RC112	133 cm core of silt with sand layers and spots.	
1913	RC113	Probably about 80 cm core of well-sorted fine sand (upper), pumice block, and tuff (lower).	Upper part flowed.
1914	RC114	135 cm core of sand and many ash layers.	
1918	D453	Calcareous rock, coral and sponge.	
1920	D454	Breccia (13×8×7 cm).	
1921	RC115	73 cm core of pumice layer interbedding sand layer.	
1922	RC116	68 cm core of sand, pumice, pumiceous lapilli tuff, and pumiceous breccia.	
1927	RC117	16 cm core of alternation of sandstone and siltstone, and thin sand layer on it.	
1928	RC118	30 cm core of pumice layer and scoriaceous very coarse sand on it.	
1931	RC119	63 cm core of two pumice layers interbedding fine sand layer including organic materials.	
1932	D455	Alternated rock of fine sandstone and matrix rich coarse sandstone (7×7×4 cm) and pebble of volcanic sandstone.	
1933	RC120	Fragment of fine-grained breccia with thin ferromanganese coating on its surface.	No core sample. Smash on hard rock

St. No.	Samp. No.	Samples	Remarks
			bottom.
1934	D456	Calcareous rock, breccia, siltstone and alternated rock of sandstone and fine-grained breccia.	
1935	RC121	Probably about 10 cm core of sandstone rich in calcareous matrix.	Got out of shape.
1936	RC122	Fragment of breccia.	No core sample.
1937	RC123	19 cm core of tuffaceous sandstone (upper), fine-grained breccia and tuff (lower).	
1938	RC124	33 cm core of very coarse, tuffaceous sandstone containing coarse graine row of pumice.	
1939	RC125	18 cm core of pumice and fine-grained breccia.	
1940	RC126	10 cm core of conglomerate (upper) with calcareous, tuffaceous matrix, and altered pumice (lower).	
1941	RC127	83 cm core of pumice layer.	
1944	RC128	36 cm core of sandstone (upper) and pumice layer (lower).	
1945	RC129	Probably over 10 cm core of well-porous pumice (upper) and not well-porous pumice (lower).	
1947	RC130	35 cm core of pumice layer consisting of fibrous (upper), brecciated (middle) and massive (lower) pumice.	
1948	RC131	Medium-grained volcanic sand and volcanic rock fragment.	No core sample.
1950	RC132	About 22 cm core of ill-sorted sand-gravel layer, ill-sorted sand layer and silt layer.	
1952	RC133	Altered pumice fragment.	No core sample.
1953	RC134	Very small amount of sand.	No core sample.
1954	RC135	Very small amount of sand.	No core sample.
1955	RC136	35 cm core of sand with ash layer.	
1956	D457	Coarse, matrix-rich sandstone.	
1957	RC137	19 cm core of conglomerate (upper most) with calcareous matrix, calcareous sand and calcareous rock (lower).	
1958	D458	Limestone (or calcareous rock?).	
1959	RC138	Probably about 20 cm core of pumice graine bearing fine sand.	Flowed.
1960	RC139	87 cm core of sand with ash bearing pumice grain layer.	
1964	RC140	28 cm core of alternation of sand (volcanic origin?) and scoria layers.	
1965	RC141	34 cm core of sand with scoriaceous layer.	
1966	RC142	28 cm core of sand with foraminiferal zone and granule-pebble layer.	
1967	RC143	Very small amount of sand.	No core sample.
1968	RC144	53 cm core of sand.	
1969	RC145	Small amount of sand.	No core sample.
1970	RC146	Small amount of tuff and tuffaceous fine sand.	No core sample.

St. No.	Samp. No.	Samples	Remarks
1971	D459	Foraminifera rich sandy silt, pumice and rock fragment with flow structure on the upper and lower surfaces.	
1972	RC147	62 cm core of thin, tuffaceous sand (upper) and coarse and fine ash layers.	
1973	D460	Fragments of pillow lava (13×9×7, 14×12×4 cm), and pumice.	
1974	D461	Foraminifera bearing silty sand, porous andesitic rock fragment (14×8×6 cm) and siltstone containing altered pumice (10×6×4 cm).	
1975	D462	Foraminifera bearing silty sand, fragment of porous pillowed basaltic rock, and hyaloclastic rubble surrounded all by chilled facies.	
1977	P191	310 cm core of oxidized, tuffaceous silt (upper most), and glassy, thick ash layer.	

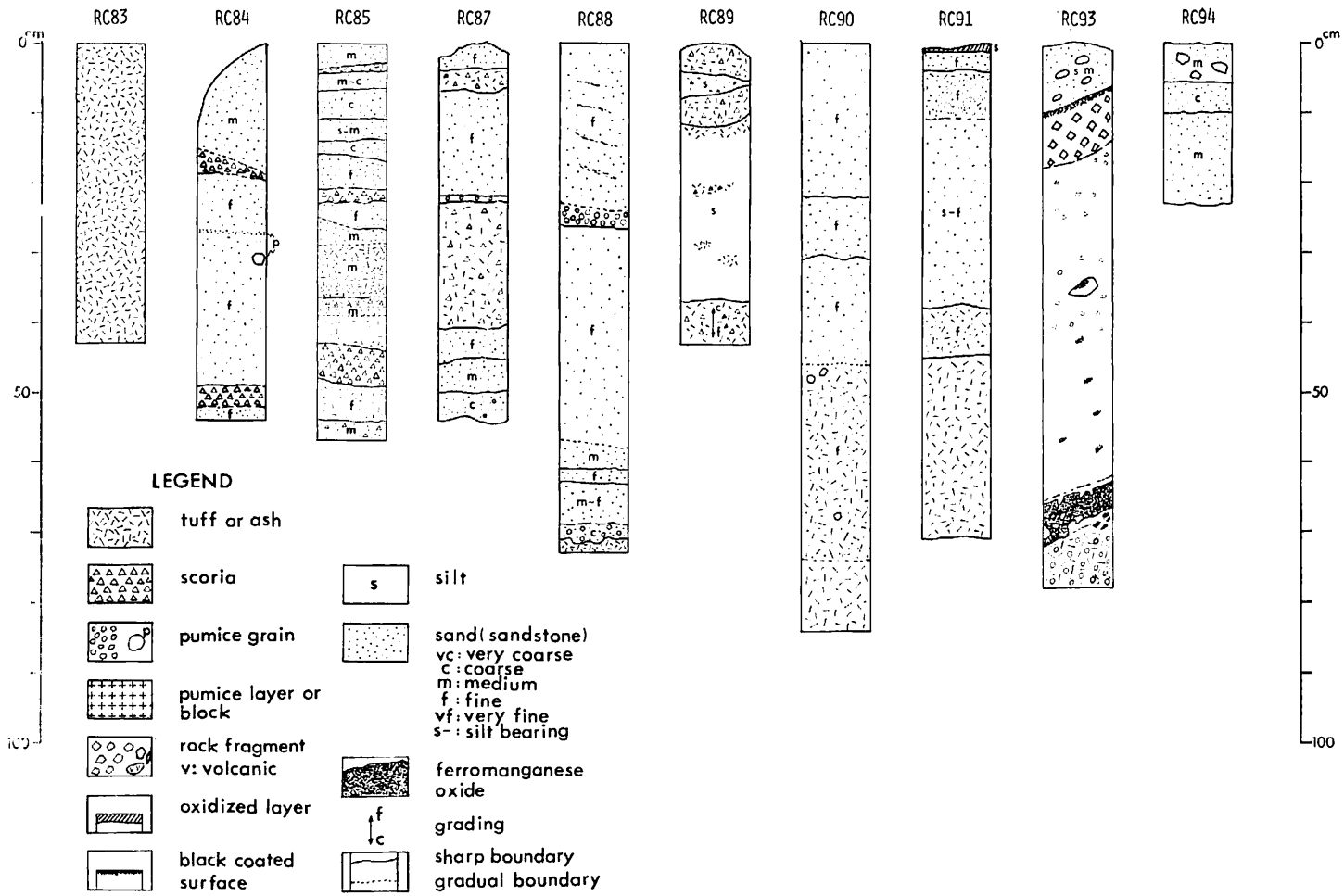
by the current. The effect of the current might be weak on the east and west slopes of the Kitakurose Bank where the fine sand occurs.

Medium sand with gravel is found on the west slope of the Kitakurose Bank (RC93 and 94). A calcareous sand layer underlies the sand. As mentioned later, the tops of the Banks are covered by calcareous rocks, so the calcareous sand is thought to have been supplied from these rocks. The flat tops are not considered to have been affected by recent erosion, so the above mentioned calcareous sand must be relatively older sediment. The medium sand above it is 6–10 cm thick and thinner than that from deeper part. In addition to this, the sand contains different components, grains of pumice and rock fragments, from the deeper one. Because of these, the origin of the medium sand on the calcareous sand is judged to be different from that of the sandy sediments affected by the current.

Sandy sediments are very thin or non-existent between the central Banks and Hachijojima Island. On the sea floor east-southeast of Takunanyama Knoll, basement rocks crop out.

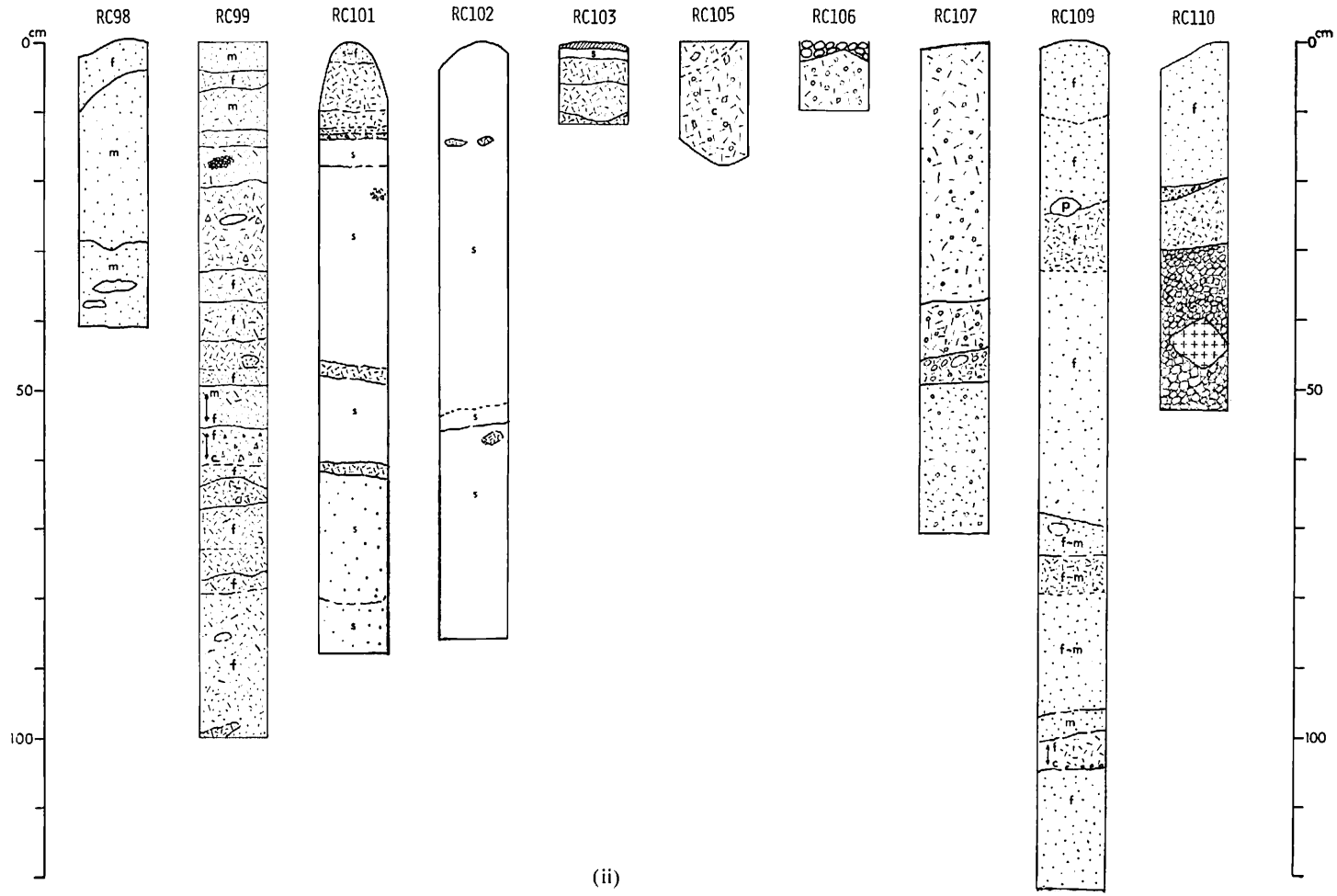
2) Silty sediments

The distribution of silty sediments taken with a rock-corer is restricted to the canyon east of the Kitakurose Bank. It conforms to the area with "type-II" layer in the 3.5 kHz PDR shown in Figure III-1 (Chapter III). Moreover, the sites of these silty sediments correspond to the area in which the upper layer (defined by air-gun profiling, Chapter VI) crops out. However, as the silty sediments sampled are about 130 cm at most, it is not known whether the sediments correspond directly to the layer. As shown in the chapter on surface sediments, they may be a part of the sediments affected by the current and a fine facies transported further.

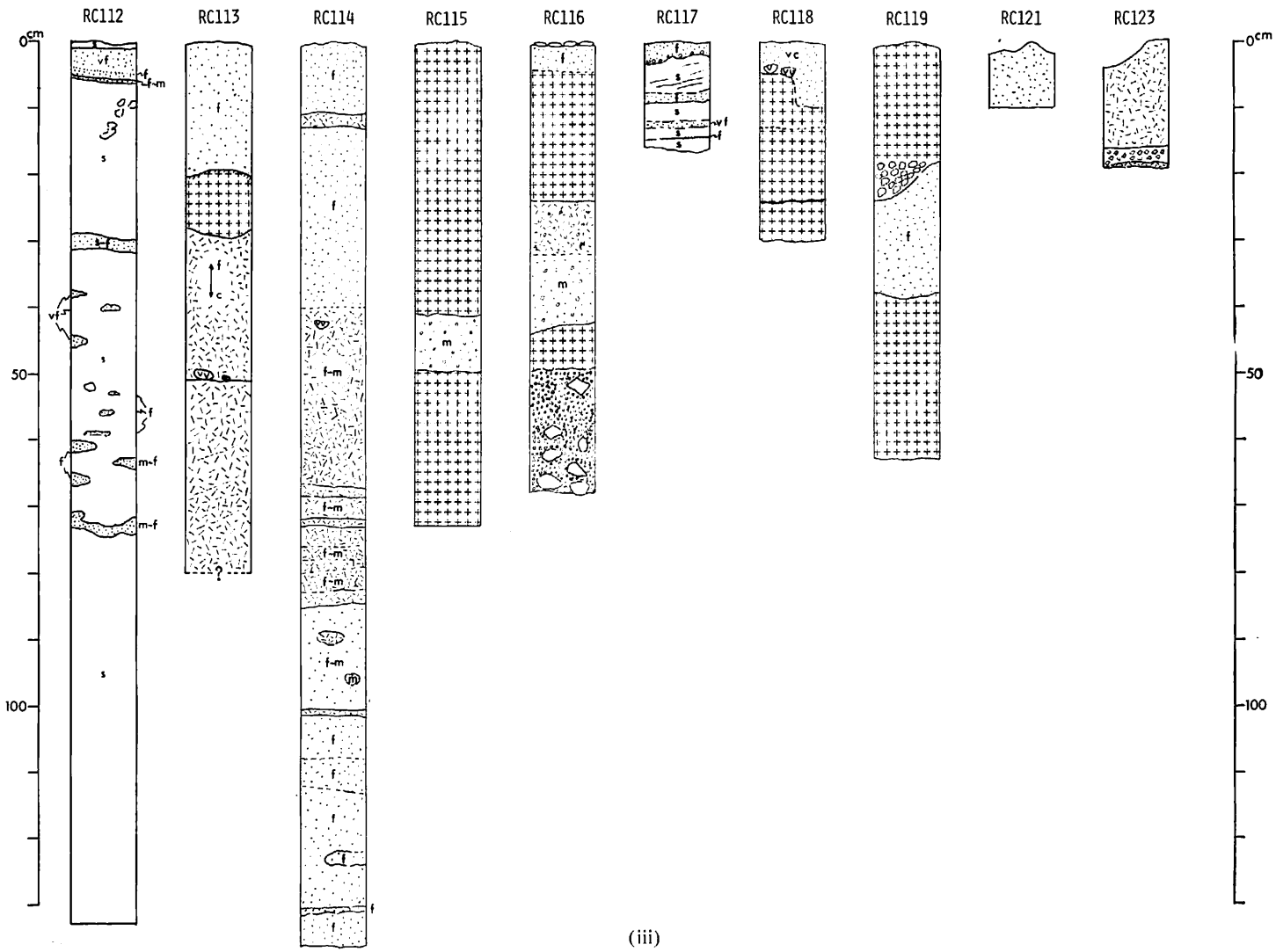


(i)

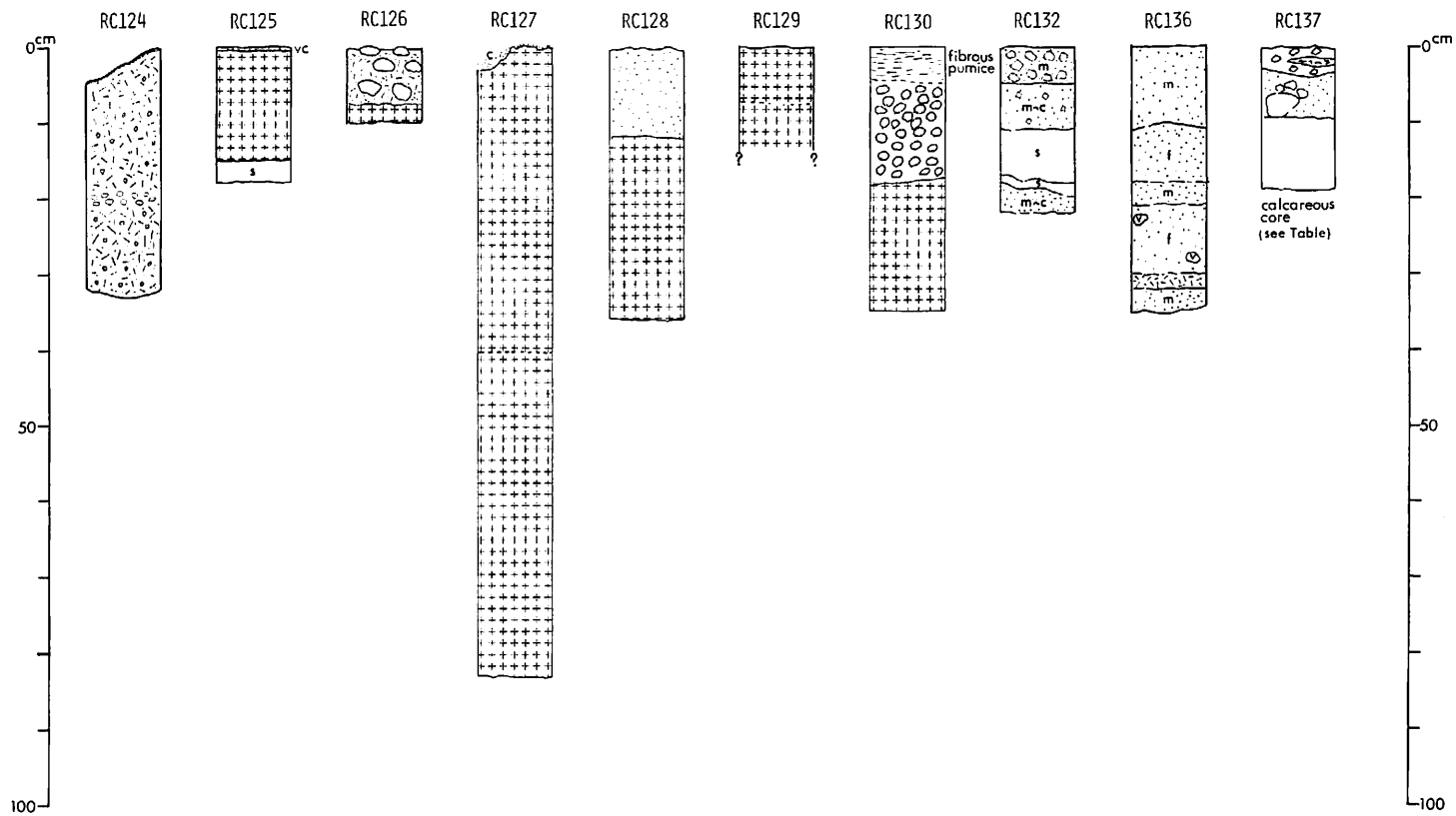
Fig. VII-2 Columnar sections of the rock-cores and piston-cores.


RC98
RC99
RC101
RC102
RC103
RC105
RC106
RC107
RC109
RC110
cm
0
50
100
f
m
s
P
f-m
c

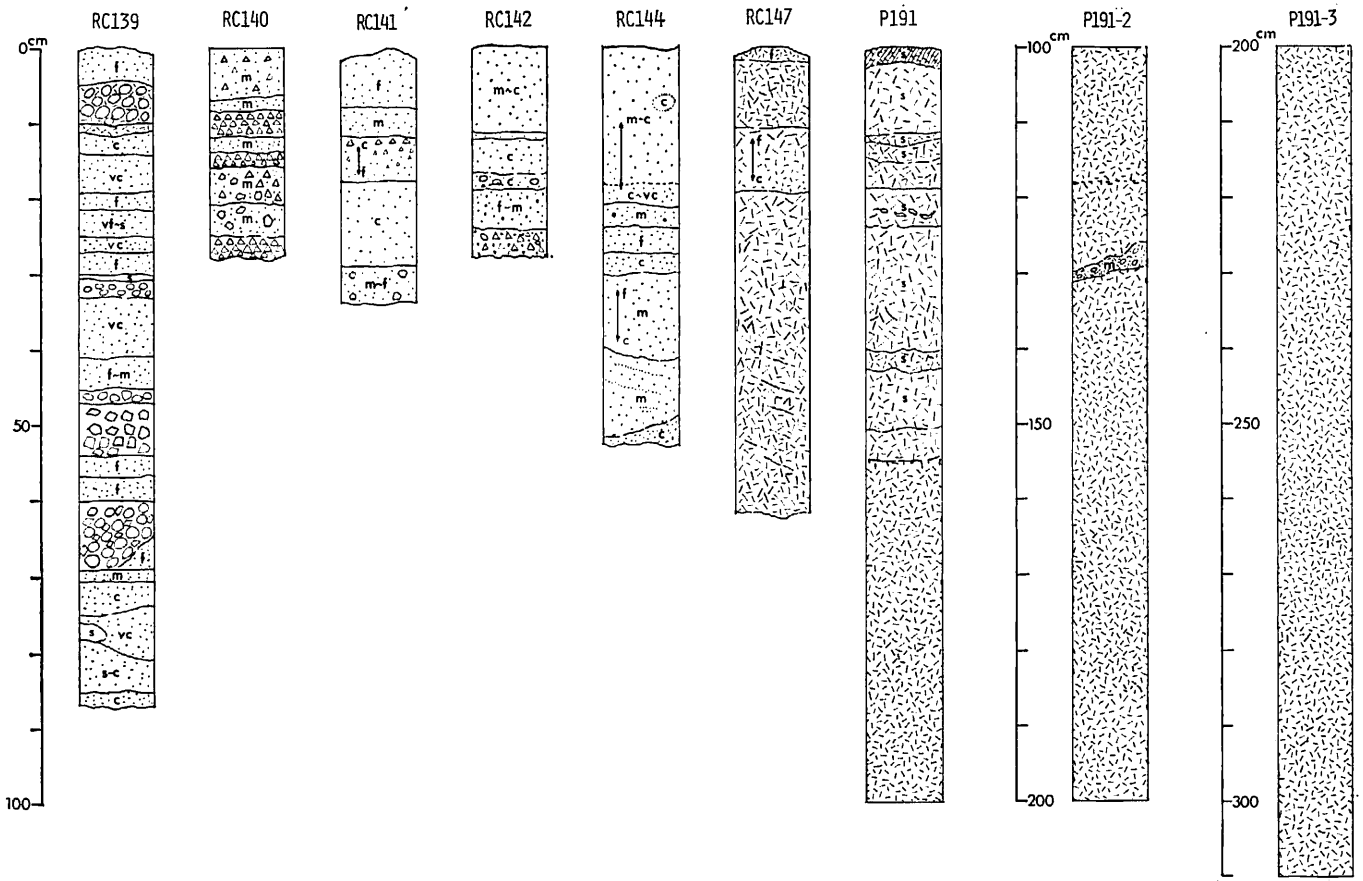
(ii)


RC112
RC113
RC114
RC115
RC116
RC117
RC118
RC119
RC121
RC123
0cm
50
100
vf
f
f-m
s
m
m-f
c
vc

(iii)


RC124
RC125
RC126
RC127
RC128
RC129
RC130
RC132
RC136
RC137
0 cm
50
100
vc
s
c
?
?
fibrous pumice
m
m-c
s
m-c
m
f
m
f
m
calcareous core
(see Table)

(iv)


RC139
RC140
RC141
RC142
RC144
RC147
P191
P191-2
P191-3
0cm
50
100
100cm
150
200
200cm
250
300

(v)

3) Volcanic sediments

Volcanic ash and scoria layers, interbedded the sandy and silty sediments and having sharp boundaries, are regarded as volcanic sediments.

The distributional area of ash corresponds closely to that of sandy and silty sediments, except in the area between the central banks and Hachijojima Island. No ash layers are found on the top of the central banks or south of the banks. It is considered that the sources of the ash layers are volcanic islands lying to the northwest or west or volcanoes even further distant, since volcanoes, which could be sources of these layers not known to the east and north of the area. Since no attempt has been made to correlate the ash layers in each core, the distribution of each ash layer will not be discussed. On the whole, however, it is certain that the ash layers are unevenly distributed; they are concentrated in the area of the sandy sediments and do not appear on the top of the banks. This is different from the distribution of ash on land. Although it is natural that coarse sediments deposit unevenly in an area where a current flows around a high, the deposition of the ash falls is also characterized by uneven distribution, as mentioned above. Therefore, even if an ash layer is deposited near a high, it is not necessarily supplied from the high.

The distribution of the scoria layer is restricted to the area northwest of the central banks. As this area corresponds to the saddle between the banks and Mikurajima and Miyakejima Islands, it is considered that the scoria layer originated from either or both.

Rocks

1) Calcareous rocks

Calcareous rocks were obtained from the tops and upper slopes of the central banks and the slope of Hachijojima Island. The sites are of relatively shallow depth, and on the basis of the sampling results of the present and previous cruises (GH74–3; INOUE ed., 1976, and HONZA *et al.* ed., 1981), the flat top plains of the banks especially are expected to be covered by calcareous rocks.

The calcareous rocks are mainly young limestone containing the remains of corals and calcareous algae. When the rock-corer hit these rocks, the shoe of the corer was crushed and the core tube was bent. As it is too hard for the corer to penetrate such rocks, a core sample of limestone was not obtained with this rock-coring apparatus. Three cores of limestone of 1 to 3 meters were taken with a submersible marine drill MD500H during GH79–4 (HONZA *et al.* ed., 1981) and the present cruises.

Other calcareous rocks in addition to the limestone are sandstone and breccia with a calcareous matrix. These rocks were obtained from the upper slope of the banks and off Hachijojima Island. The grains of the sandstone and the rubble of the breccia are of volcanic origin, and the calcareous material of the matrix is considered to have been supplied by erosion from shallower parts (top of the banks or paleo-beach of Hachijojima Island).

2) Volcanic rocks

Samples of valcanic rocks were taken from the row of small mountains west of the Kitakurose and Nakanokurose Banks, and from the slope of the latter. The rocks are andesitic and basaltic in nature, and are often altered. The rubble from D448 is mantled by a glassy rim and has a quench texture. It is therefore thought to have erupted in a subaqueous environment. However, as the rubble is porous, the eruption is considered to have occurred at the shallow depth.

These sites are located at greater depth than the capped-limestone. The mountains where the rocks were sampled have no flat top, so it appears that they have never reached or protruded above sea level, and it is possible that they formed after the erosion of the tops of the banks.

3) Pumice layers obtained in cores

Two types of pumice were obtained. One type occurred as a thin bed consisting of small grains of pumice and the other as a thick layer of agglutinated pumice. The former is often observed in sediment cores and the latter is distributed in a narrow zone east of the Kurose Hole. The two layers are recognized in the core from near the hole (RC115, RC116 and RC119). The thickness of the upper layer becomes thinner in cores from sites further from the hole. From this, it is considered that the upper pumice layers have been supplied from the Kurose Hole, by the eruption of a large quantities of pumice during its formation.

The agglutinated pumice layer is also recognized near and at the Takunan-yama Knoll (RC125, RC126 and RC127), its thickness suggesting that it is a component of the Knoll. A little sand was found on the uneven surface of the layer. The surface of the layer is coated by a black film which is probably ferromanganese oxide.

4) Sedimentary rocks

The most widely distributed rocks in the surveyed area are sedimentary rocks. The types of sedimentary rock are tuff, sandstone, breccia and siltstone. They are distributed on the slopes around the central banks, on the mountains west of the Kitakurose Bank, and on the very small high east of Hachijojima Island. The grains of the sandstone and the rubble of the breccia are of volcanic origin. They might be supplied from the basement rocks of the banks and from the volcanic islands west of the area.

Glassy tuff was taken from the upper part of the small canyon north of the Kitakurose Bank (RC83). It is a different type of rock from the above mentioned sandstone and breccia. The distribution of the tuff was not ascertained during the present cruise.

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Appendix: Sampling results from the area southwest of Sumisujima (Smith) Island

Sampling work was carried out at seven sites, using dredges, a rock-corer, a piston-corer and a grab sampler. The results are listed in the last of Table VII-1, and the columnar sections of cores are shown in Figure VII-2.

The highs within the depression southwest of Sumisujima Island were dredged. Andesitic and basaltic volcanic rocks were obtained. At two sites (D460 and D462), pillow lava fragments were found.

The rock-corer was used on the valley between the highs (RC147). An ash layer 62 cm thick was obtained. A thick ash layer was recovered in a piston core from the bottom of the depression (P191).