VII. ROCKS AND SEDIMENTS

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Samples obtained during this cruise are shown with position and depth in Table I-4. In this chapter, dredged materials will be briefly described.

Dredges are carried out at 34 sites as follows; continental slope: 6 sites, trench slope break: 8 sites, trench slope: 12 sites (2 sites of them are outer trench slope), canyon wall: 3 sites, seamount: 5 sites.

Samples are of five types; soft sediments, exotic gravels, sedimentary rocks (in situ), volcanic rocks (in situ) and nodules of ferromanganese oxide and barite in that order of abundance.

Soft Sediments

Soft sediments were obtained from almost all of the dredged sites, because of the use of chain-bag type and small cylinder type dredges.

Sand, less than medium-sand size, were taken from 5 sites (D141, 158, 160, 164 and 165) which were mainly in the continental slope area. From the stations except for the above and Ryōfū the 1st Seamount, sandy silt, silt and clay were obtained, and pelagic clay was obtained from 2 stations located in the outer trench slope.

The stratigraphic relation between these soft sediments and gravels (pebbles and rubble) which will be mentioned later is not clear. However, it is considered that these sediments rest on gravels at many stations from the fact that the gravels proved difficult to dredge with the small cylinder type dredge but often taken by the chain-bag type dredge which has a large caliber.

Gravels

Gravels which may be a exotic origin are obtained from the above mentioned five provinces of bottom topography and are divided into two types based on the relation between the topographical feature and the kind of rock.

One type consists of rounded gravels of granite, sandstone, chert and others obtained from seamounts (D144, 152, 154 and 159) and the outer trench slope (D148). Where such rocks were obtained from outside the trench, especially from isolated highs they may be in situ rock (e.g. Kyūshū-Palau Ridge and Amami Plateau), it is possible, however, that many of them could have been derived by ice-rafting from the high latitudes (e.g. Emperor Seamounts and Northern Atlantic Ocean). Gravels which were taken during this cruise are not considered to be in situ because they consist of small, rounded gravels of various rock types. They are also not likely to have been derived from adjacent land as such gravels were also obtained from outside of the trench.

Gravels, which were obtained from the inner trench slope and trench slope break (D142, 143, 147, 149, 150, 151, 153, 160, 162, 163, 166, 167 and 171), continental slope (D146, 158, 161, 164 and 165), and canyon wall (D155, 156 and 157), are the second

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Table VII-1 Gravels of D145.

No.	Roundness	Size (cm)	Rock name	No.	Roundness	Size (cm)	Rock name
1*	SR	23.5 × 14.7 × 10.6	bi granite	26*	A	9.6 × 7.8 × 3.8	rhyolite
2*	SR	22.1 × 18.8 × 6.8	aug andesite	27	A	12.1 × 5.4 × 3.3	hornfels
3*	SA	18.7 × 13.2 × 7.0	(bi)-aug-hld andesite	28	A	10.3 × 7.0 × 5.3	andesite
4*	A	15.8 × 12.3 × 7.1	sandstone	29	SA	9.1 × 7.0 × 5.5	granite
5*	A	17.4 × 14.8 × 2.6	glassy tuff	30	A	8.0 × 6.3 × 4.9	chert
6*	A	16.8 × 12.4 × 2.6	rhyolite	31	A	8.4 × 7.3 × 5.3	granite
7	SA	13.5 × 8.8 × 5.3	sandstone	32	A	9.2 × 6.4 × 5.2	andesite
8*	SA	13.5 × 8.0 × 7.6	limestone	33	A	7.8 × 6.7 × 5.0	rhyolite
9*	A	12.5 × 9.1 × 6.6	bi hornfels (sandstone)	34	R	8.6 × 4.9 × 3.7	chert
10*	SR	12.9 × 6.6 × 4.3	bi hornfels (sandstone)	35	A	10.6 × 4.8 × 4.8	siltstone
11*	SA	13.5 × 12.4 × 4.9	bi hornfels (siltstone)	36	SR	7.0 × 4.9 × 4.2	andesite
12*	A	14.0 × 8.3 × 5.1	hld andesite	37	A	9.4 × 4.3 × 4.2	tuff
13	R	11.4 × 8.2 × 5.1	sandstone	38	SA	7.9 × 5.9 × 3.9	sandstone
14*	SA	11.2 × 8.9 × 4.3	lithic tuff (metamorphosed)	39	R	6.5 × 6.3 × 3.0	granite
15	A	11.0 × 8.2 × 5.4	sandstone	40	SA	7.6 × 5.0 × 2.7	chert
16*	A	12.8 × 9.0 × 3.5	calcareous metamorphic rock	41	R	6.5 × 4.6 × 4.4	sandstone
17	R	10.6 × 7.3 × 6.2	granite	42	SR	8.2 × 4.6 × 3.6	andesite
18*	A	11.5 × 7.4 × 4.2	dolerite (metamorphosed)	43	SA	9.0 × 4.6 × 3.0	sandstone
19*	SR	9.8 × 6.4 × 4.3	bi granite	44	SA	7.5 × 5.0 × 3.2	andesite
20	SR	9.3 × 6.6 × 3.8	sandstone	45	SR	7.6 × 4.8 × 3.1	lithic sandstone
21*	R	11.8 × 6.7 × 4.2	ol-aug andesite	46	SA	7.7 × 6.0 × 3.2	sandstone
22*	SA	11.8 × 6.5 × 4.7	hld andesite	47	A	8.2 × 4.7 × 3.5	tuff
23	SA	10.6 × 5.8 × 3.4	rhyolite	48	A	7.2 × 5.6 × 4.1	andesite
24	SR	11.6 × 5.7 × 3.3	sandstone	49	A	7.8 × 5.4 × 5.0	diolite
25*	A	11.8 × 7.9 × 2.7	lithic sandstone	50	SA	6.5 × 4.9 × 3.4	hornfels

*Microscopic observation. aug: augite, bi: biotite, hld: hornblende, ol: olivine.

type. Such gravels may consist of land derived material, especially, in the dredge haul from the frontal slope of the Tōhoku Arc.

The size, roundness and rock type for 50 pebbles selected in order of size, dredged off Sendai (D145), are shown in Table VII-1. They are many andesite and sandstone fragments from this station. Gravels for a selected 100 pieces in order of size, dredged off

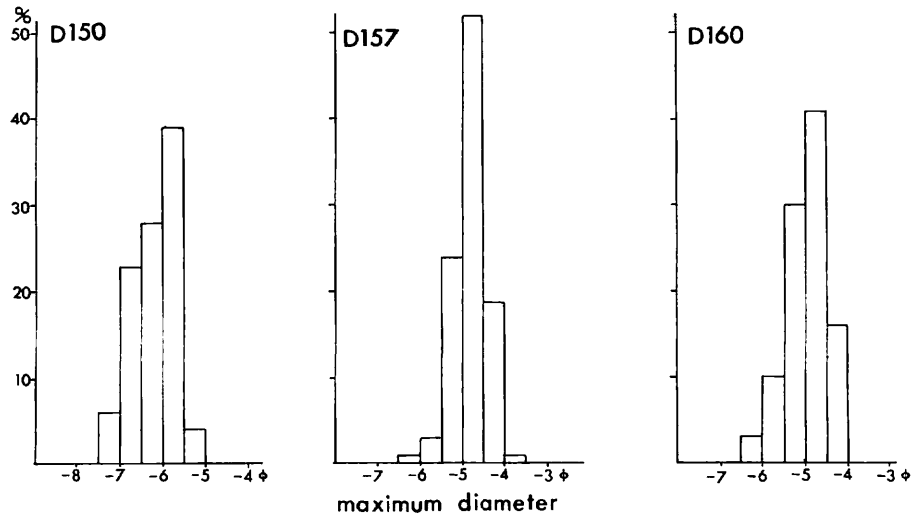

Fig. VII-1 Distribution of maximum diameter (ϕ) (horizontal axis).

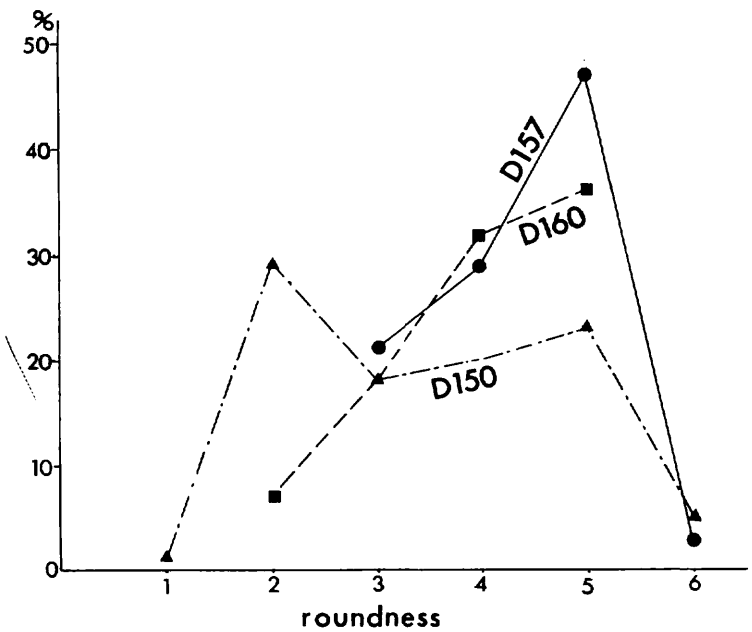

Fig. VII-2 Distribution of the roundness of gravels (horizontal axis).
Numbers showing roundness are based on Powers (1953). Solid triangle: D150, solid circle: D157, solid square: D160.

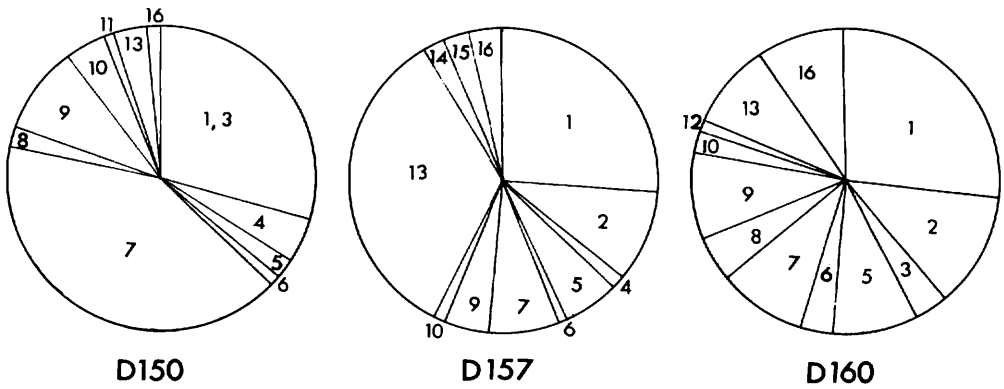

Fig. VII-3 Varieties and proportion of gravels.
1: sandstone, 2: mudstone, 3: slate, 4: conglomerate, 5: chert, 6: rhyolite, 7: andesite, 8: basalt and dolerite, 9: granitic rocks, 10: gabbro, 11: limestone, 12: quartz porphyry, 13: hornfels, 14: amphibolite, 15: gneiss, 16: others.

eastern Hokkaido (D150, 157 and 160), are shown in Figs. VII-1, 2 and 3. As a great many gravels were obtained during the D150 dredge, selected samples (100 pieces) is not sufficient for a representative analysis. On the other hand, the gravels of D157 and 160 consist of about 100 fragments, and therefore may be a good representation of the rock types present.

Sedimentary Rocks

The sedimentary rocks mainly consist of angular rubble larger than cobble size, and they are shown by rock name in Table I-4. These rocks are obtained from areas where the lower strata are expected to be exposed on or near the bottom surface on the basis of the seismic profile. However, the rocks cannot be correlated with the profile. The ages on the basis of mega- and micro-fossils in the rocks are described in the other chapter. The rocks are apparently younger than the Miocene sedimentary rocks observed on land.

Volcanic Rocks

Volcanic rocks were dredged at five stations (Table VII-2).

Many alkaline basaltic rocks were obtained from the southwestern slope of Kashima the 1st Seamount (D140). The maximum size of the blocks is 28.5 cm × 19 cm × 16.5 cm. Four kind of rocks are shown in Table VII-2. There is no clue as to the occurrence of the rocks. Although the alkali olivine dolerite is rather fresh, others are more or less altered. Crack in the rocks are sometimes filled by quartz and alunite.

Large amounts of brecciated pillows were dredged from Ryōfū the 1st Seamount (D144), which are augite basalt. Chilled margins, radial joints and the cracking of the pillow surfaces are present.

Samples of D152 were obtained from an un-named seamount (top at a depth 3,450 m) east off Cape Erimo. Here, rounded pumice and sandstone were also dredged with the volcanic rocks. Although the samples are rather small and few in number, and may have been in situ because three pieces of egg size rubble are the same kind of rocks that have

Table VII-2 Rock description.

Station No.	Sample No.	Rock name	Phenocryst	Groundmass	Remarks
436	D140-4	augite olivine basalt	olivine (reddish), plagioclase (rare) and augite (rare).	plagioclase, olivine, clinopyroxene, and opaque minerals.	Slightly porous. D140-10, 15, 22, 25 and so on are the same as this sample.
	D140-5	mugearite (fine-grained)	plagioclase (very rare) and augite (very rare).	plagioclase (very fine and needle like or swallow tail shapes), clinopyroxene, olivine (reddish), and opaque minerals.	Flow structure. D140-6, 13, 17 and so on are the same as this sample.
	D140-7	mugearite (medium-grained)	plagioclase, augite and olivine (small).	plagioclase (oligoclase?), clinopyroxene, alkali feldspar, olivine and opaque minerals.	Trachytic texture. D140-11, 12, 26 and so on are the same as this sample.
	D140-8	alkali olivine dolerite	olivine and plagioclase.	plagioclase, titanaugite, olivine and opaque minerals.	Subophitic texture. D140-9, 16 and so on are the same as this sample.
441	D144	augite basalt	augite (rare) and plagioclase (rare and small).	plagioclase (quench, oligoclase?), clinopyroxene(?), olivine (reddish), pale brown mica and opaque minerals.	All samples from this station are pillow and its fragments. Chilled margin and radial joint are well developed.
453	D152-5	olivine basalt	olivine (reddish).	plagioclase, clinopyroxene, olivine and opaque minerals.	Partly glassy.
456	D154-5	olivine hornblende basalt	hornblende (pale reddish brown), olivine (reddish), augite (pale greenish).	plagioclase, hornblende, brown mica, and opaque minerals.	Agglutinated by apatite and zeolite.
480	D172-2	alkali dolerite	titanaugite, olivine and brown hornblende (rare).	plagioclase, alkali feldspar, biotite, apatite and opaque minerals.	

been recognized as products of submarine explosions as suggested by chilled margin and quench crystals.

Small amounts of samples were taken from Takuyō the 1st Seamount (D154), which consist of many rock fragments of one kind as shown in Table VII-2, which may constitute a part of the Seamount. They are breccias agglutinated by apatite, zeolite and/or volcanic glass.

From the outer slope of the Japan Trench, small amounts of alkali dolerite and volcanic glass fragments (probably crust of pillow lava) were obtained. The dredged site was selected on the basis of the seismic profile where the acoustic basement was uplifted and exposed by antithetic faults.

Nodules of Manganese Oxide and Barite

Manganese nodules and crusts were obtained from seamounts (D144, 152 and 154) and from the outer trench slope (D148). The maximum size of the nodules is 7.5 cm × 5 cm × 4 cm in D154. Others consist of pebbles of shale and pumice coated by a thin film or crust of ferromanganese oxide.

Barite nodule were obtained from the trench slope break off Nemuro along with large amounts of gravels (D150). They have a spherical shape and are slightly less than a ping-pong ball in size. Zonal structure is not observed. These nodules mainly consist of microfossils and very fine-grained barite crystals occupying interstices between and in them. Small peaks of calcite are observed with the barite peaks in the X-ray diffraction pattern. Small amounts of crystal fragments of plagioclase and augite are also present as identified by microscope observation.

Reference Cited

POWERS, U. C. (1953) A new roundness scale for sedimentary particles. *J. Sediment. Petrol.*, vol. 23, p. 117–119.