

VII. ROCKS AND SEDIMENTS

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Sampling operations were carried out at 39 sites by dredge (26 hauls), rock-coring (8 hauls), and piston-coring (5 hauls). The materials obtained by piston-coring are described in another chapter, while rocks and sediments obtained by dredge and rock-coring are described here.

Surveyed area of this cruise is divided into two parts, which are the southwestern part of the Sea of Okhotsk (western part of the Kuril Basin and east off northern Hokkaido) and the northern part of the Japan Sea. Numbers of sampling sites of both parts are as follows;

Southwest part of the Sea of Okhotsk	dredge	9 sites
	rock-coring	5 sites
Northern part of the Japan Sea	dredge	17 sites
	rock-coring	3 sites

i) Southwestern part of the Sea of Okhotsk

Distribution of bed rock outcrops is restricted to the parts of the continental shelf and slope, and the Kitami–Yamato Bank. Although some seamounts were expected to exist in the surveyed area of the Kurile Basin, according to Hydrographic office chart, No. 6301, we did not find any seamounts in any of the “seamount” positions described in the chart that we passed over.

Rock-coring (RC14–RC18) was carried out on the flat continental shelf and near the edge of the shelf, and on the flat top of Kitami–Yamato Bank.

Of these stations, pebble bearing sand and sand–sandy silt respectively were obtained from RC16 and RC17 on the continental shelf off Monbetsu, and the core did not hit hard bed rock. About an 80 cm length core of silty sand (upper 70 cm length) and siltstone (lower 10 cm length) was sampled on the edge of the continental shelf east of Soya Strait (RC14). The layer partly consisting of this rock is to be found on the seismic profile K3. In situ siltstone was obtained from the flat top of southern and northern parts of the Kitami–Yamato Bank (RC15 and RC18). As the siltstone of RC18 involves *Sagarites*, it is considered to be correlated to upper Miocene age.

The Toyokoro-Tokoro Zone (geosynclinal deposits and extrusive rocks of Jurassic and Cretaceous age) of the eastern part of Hokkaido is expected to extend to near the Kitami–Yamato Bank area. However, based on the seismic profiles of K5 and K6, the bed rock considered to be the extension of the Zone is buried under the continental shelf west of the Bank, and it does not crop out on the bottom surface.

Dredging was carried out on the mid-slope basement high (D234–D239), on the slope of Kitami–Yamato Bank (D240 and D241) and on a knoll near the Bank (242).

The mid-slope basement high located northeast of Kitami–Yamato Bank is about 880 m deep at its top and its slope continues to the bottom of Kurile Basin edge at about 3100 m depth. Samples were obtained from the top (D235), the upper slope (D234)

and the lower slope (D239) of the high northeast of the Bank. Fine-medium sand with minor pebbles was taken from the top. A large amount of in situ siltstone with burrows was taken from the upper slope. From the lower slope, in situ siltstone was also obtained with a greenish-colored volcanic rock (max. $6.5 \times 5.5 \times 3.5$ cm). It is not clear whether this rock is in situ or not. On the basis of the seismic profile K2, the siltstone from the upper slope is suggested to be on the lower slope layer.

Similar highs on the slope area located east off the Nakashiretoko Peninsula which is the southeast peninsula of southern Sakhalin (D236–D238) where the top of the high was not confirmed. Silty clay and pebbles were mainly obtained from these highs and rock fragments of bluish green-colored siltstone from site D236, however, it is doubtful whether this is in situ.

Stations D240 and D241 are located at the eastern and western slope of the Bank. Station D242 is on the slope of small knoll in a narrow trough limited to the west edge of the Bank. Shell (fossil) bearing conglomerate and siltstone were obtained from D240. The conglomerate is probably upper Miocene in age as deduced from the molluscan fossil. Many gravels of siliceous siltstone were obtained from D241. These seem to be nearly in situ because of abundant and less variety of the kind. No bed rock was sampled from D242.

ii) Northern Japan Sea

Uneven topography, characterised by the distribution of the Musashi Bank and others, and by the northern extension of the Okushiri Ridge, is dominant in this area. The western edge of such topography is bounded by Tartary Trough.

It is interesting in this area to distinguish where the greentuff region of northeast Japan extends and by what the region is bounded. As shown below, in situ volcanic rocks occur more in this area as compared with the rocks from the area of the Sea of Okhotsk mentioned earlier. So it seems to be important to explain the difference of the geologic development between the two areas.

This area is divided into five domains on the bases of bottom topographic features and kinks of sampled rocks.

a) *Continental shelf around the Soya Strait*

The continental shelf developed around the Soya Strait is cut by a fault northwest off Rebun Island (seismic profile J1). From the cliff of this fault, greenish-colored and laminated sandstone (in situ) was obtained. The site seems to correspond to the northern extension of the Rebun massif on the basis of the seismic profiling.

b) *Highs around Musashi Bank*

Musashi Bank itself coincides nearly with the area enclosed by the 200 m depth contour; however, this domain involves the northern and southern extended highs.

A relatively fresh block of hypersthene-augite andesite and pebbles were obtained from D243. The andesite may be in situ. No bed rocks forming the Rebun Bank was sampled.

Sampling in the neighborhood of the Musashi Bank was carried out on the gentle slope near the shallowest part of the Bank (D249 and D250), "Tengu no Hana"* (D248). Teuri Bank (D253 and RC20), "Tengu no Ago"* (D254) and Otaru Bank (D255 and RC21). It is characteristic that acid volcanics were conspicuously obtained

from this domain. However minor intermediate–basic volcanics were found together with them.

From D249 and D250 near the shallowest part of the Musashi Bank, biotite-quartz dacitic welded tuff with a mineralogy comprising quartz, plagioclase and biotite (altered to sphene+clay minerals) as phenocrysts was obtained. No potassium feldspar is present. Hornfelsed welded tuff was found in the haul of D250. Minor amounts of olivine-orthopyroxene-clinopyroxene andesite were sampled.

Welded tuff was found also in the haul from “Tengu no Hana”. This is biotite-green hornblende-pyroxene andesitic tuff and different from that of Musashi Bank. Besides, hornblende-pyroxene dacite and clinopyroxene andesite were sampled.

Dredge (D253) and rock-coring (RC20) were carried out at the Teuri Bank west of Teuri Island. A 20 cm length of core of ill-sorted and pebble-bearing sand was obtained in RC20 and the core did not reach the hard bed rock layer. However, angular cobbles of sandstone, and olivine basaltic volcanic breccia were sampled by dredge. These rocks are considered to be nearly in situ because of the abundance of the same rock type. No welded tuff was sampled from this station.

Angular boulders of siliceous siltstone (Mas. 22×17×11 cm) and gravels of acid-intermediate volcanic rocks (dg. hornblende-biotite dacite, biotite-clinopyroxene-orthopyroxene andesite and so on) were obtained from “Tengu no Ago”. No rocks having welded phenomena are found in this site.

The Otaru Bank is located west-northwest off Rumoi. Here, sandstone, siliceous siltstone and pumiceous sandstone were dredged, and orthopyroxene-clinopyroxene-green hornblende dacite (sometimes quartz-bearing) was also found in the same haul. Welded phenomena were not found in these volcanics.

Generally, acid volcanics are conspicuous but those showing welded phenomena are restricted to the central part of the Musashi Bank.

c) Northern extension of Okushiri Ridge

Three samples were taken along the line of seismic profile J6. RC19, D251 and D252 aimed to sample the sedimentary layer developing on the flat top of, at the western lower slope of, and at the eastern upper slope of the Ridge, respectively.

Sedimentary rock cropping out on the top was composed of sandstone (RC19). Pebble-bearing calcareous sandstone and siltstone, both in situ, were obtained from the upper slope. Hornblende-quartz dacitic welded tuff (with no potassium feldspar present), rhyolitic tuff and olivine andesite were obtained. However, it is not clear whether these are in situ or not. From the lower slope, apparent in situ rock was not sampled but angular cobbles of diorite (mostly altered) may represent the rock forming a part of this Ridge.

d) Knolls off Shakotan Peninsula

Two dredge hauls were made here (D257 and D258). Complicated uneven topographic features are found. However, elongations of the highs are divided broadly into three directions; N–S, NE–SW and NW–SW. The proton magnetometer measured

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- * “Tengu no Hana” and “Tengu no Ago” are marginal parts of the Musashi Bank. They mean the nose and chin respectively, of a long-nosed God. As shown in the bathymetrical map (chapter II, Fig. II-1.), they show the figures of the nose and chin of a man.

high anomalous amplitudes on the NW–SE trending high, but on the other hand, low ones in the NE–SW direction. Such anomalies were not observed in the N–S trending high. On the basis of the above observations, we consider that the NW–SE trending high was derived from the same Neogene volcanic activity as that occurring in the Shakotan Peninsula and that the N–S trending high was derived from sedimentary rocks. To test this hypothesis, sampling sites were planned for each high.

D258 is the site on the N–S trending high. Sandstone and pumice-bearing siltstone were obtained here. These appear to be in situ rocks from the appearance and abundance of the samples. Minor fragments of basaltic rocks were sampled with the sedimentary rocks. Therefore, the main constituent of the high seems to be sedimentary rocks.

The D257 hole was selected for sampling from the higher magnetic anomalous high elongating NW–SE. Volcanic breccia and tuff breccia including porous clinopyroxene basaltic rubble were obtained.

Almost part of the Okushiri Ridge and the area off the Shakotan Peninsula are involved in next year's cruise.

e) Three sites were dredged at the western part of the surveyed area. They are the Vitiaz Rise (D256), its neighbor (D259) and the northeastern elongated high (D247).

No rock fragments were obtained from D259. From D247 and D256, pebbles of acid volcanic rocks with minor acid plutonic rocks were sampled and angular rubble consisting of biotite rhyolitic tuff breccia which had altered to become greenish-colored was obtained from D247.