IV. PRELIMINARY RESULTS

IV. 1 Submarine topography

by Kouji Onodera, Kaichi Ishibashi and Masafumi Inoue

The general feature of the submarine topography of the surveyed area is shown in Figure 2. The bathymetric lines in the figure are based on the depth records in the charts of No. 180 and No. 302 published by the Hydrographic Office, Maritime Safety Agency.

The topographic profiles obtained through these cruises are illustrated in Figures 9 and 10. The following are the brief description of some characteristic features of topography, based on the profiles.

1) Five submarine terraces at different depths of water are distinguished. They are found at 45 to 55, 75 to 85, 90 to 100, 110 to 120 and 200m below sea level. Among them, the terraces at 45 to 55, 90 to 100 and 200m are extensively distributed in the surveyed area. Besides, the terraces of 45 to 55, 75 to 100 and 120m level may be correlated with those of the D, E and F terraces which H. Yake and R. Tayama (1934) had recognized in the continental shelves around Japan.

The surface of the terrace of 45 to 55m depth shows somewhat irregular profiles (see L 105, 108, 119, 121 and 123 in Figure 9-B and 10). This irregularity of

Sediments	Remarks	Area
shell c. Sand	Almost rocky bottom	South and west of Fukue
shell c.～v. c. Sand	ditto	West of Fukue
light brown m.～c. Sand	Well sorted	ditto
brown m.～c. Sand		ditto
grey brown m.～c. Sand	Fall SM in the sea	ditto
grey brown c. Sand		
brown c.～v. c. Sand		West of Nomo
dark grey green f. Sand	Well sorted	ditto
dark green f. Sand		North of Nomo
dark grey mud		Between Takashima and Iōjima

the surface infers that recent sediments scarcely cover rocky bottom and the surface preserves erosional evidences.

2) There is a shallow depression trending NE-SW along the channel between Tsushima and Iki. The depression shows irregular topographic feature and becomes extremely narrower towerd southwest (L 102, 123 and 131B). A small valley runs at the bottom of the depression. The east margin of the depression forms cliff of about 15m height (L 102). In the shelf southwestern side of the depression there is a distinctive submarine valley runing at NE-SW (L 111,131B and 132). The valley extends to the head of the Goto Canyon southerly and joins the depression or a deep trough west of Tsushima. These submarine valleys appear to have been formed along weak tectonic lines on land and being buried by sediments since they have been submarged.

3) The profile of the upper part of the Goto Canyon is shown in L 104. The figure of L 104 shows that the bottom of the upper part of the canyon is irregular. The canyon is separated from the shelf by a small prominent ridge. The bottom surface of the shelf at the west of the canyon inclines gently toward the east and is not very smooth, as shown in the west half of L 104. It is considered that the rough surface is due to wave action at the time when sea level was lowered.

4) The Goto Shelf lies between Goto Islands and Kyushu, inclining southward very gently. The edge of the shelf lies at the depths between 115 and 125m (see L 105, 113, 116 and 127). The slope between the Goto Shelf and the Danjyo Basin indicates irregular in profiles and a shallow submarine valley is recognized on the slope (see L 133). A broad U-shaped depression is shown in the profile of L 127: the bottom of the depression is at 200m in depth, 40km wide, flat and smooth. Both flanks of the depression incline at 4° and are 70 to 100m heigh. It suggests that the depression was the upper part of the submarine valley shown in the profile of L 133 and that some small upper drainages of the valley were buried during later sedimentation.

5) The east and west flanks of the Ajisone Shoal, which is located on the eastern part of the slope, form steep cliffs of 200m high from the slope surface. Topogra-

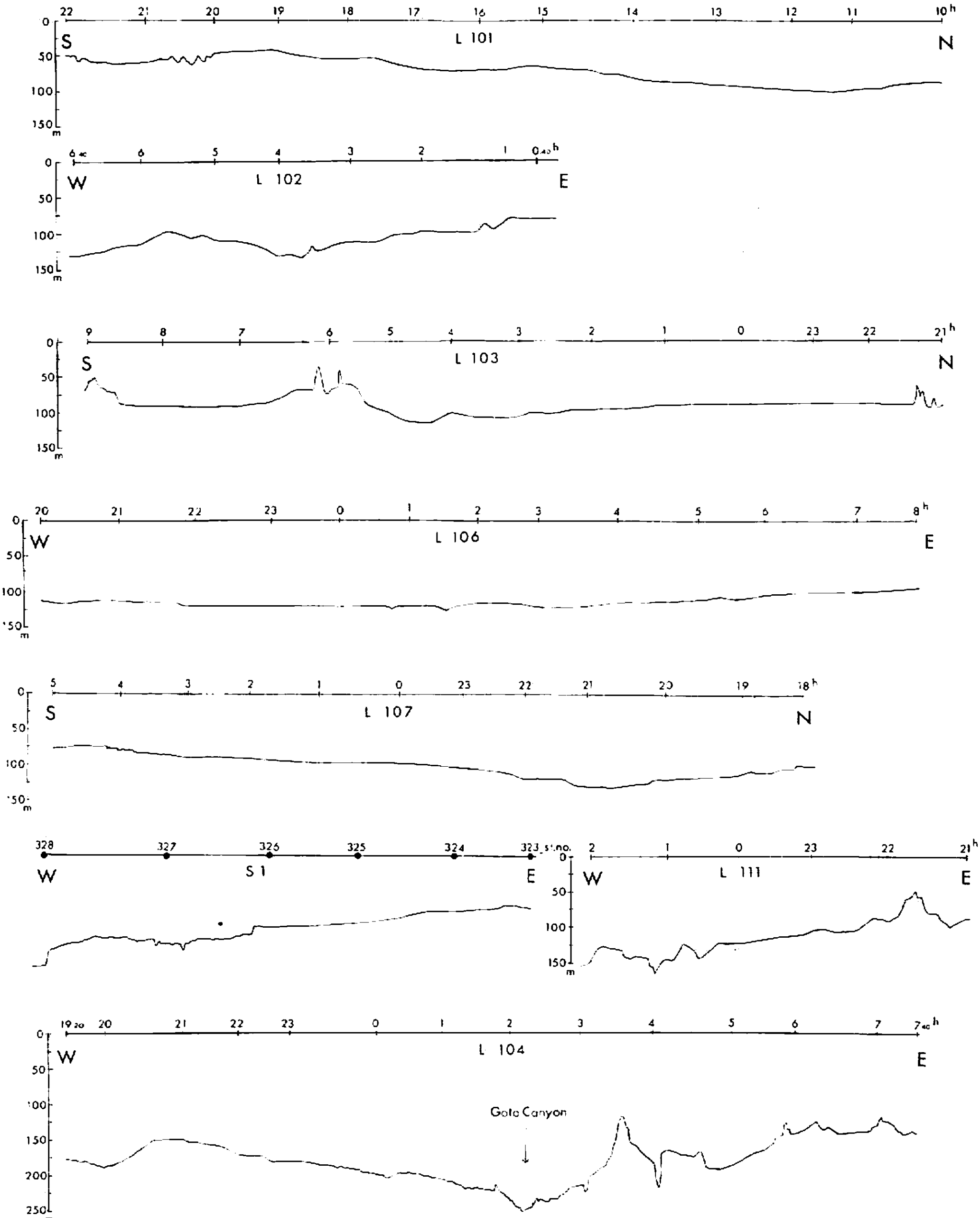

Fig. 9-A. Bathymetric profiles in the Tsushima Strait. The records was obtained in the 1972 cruise.

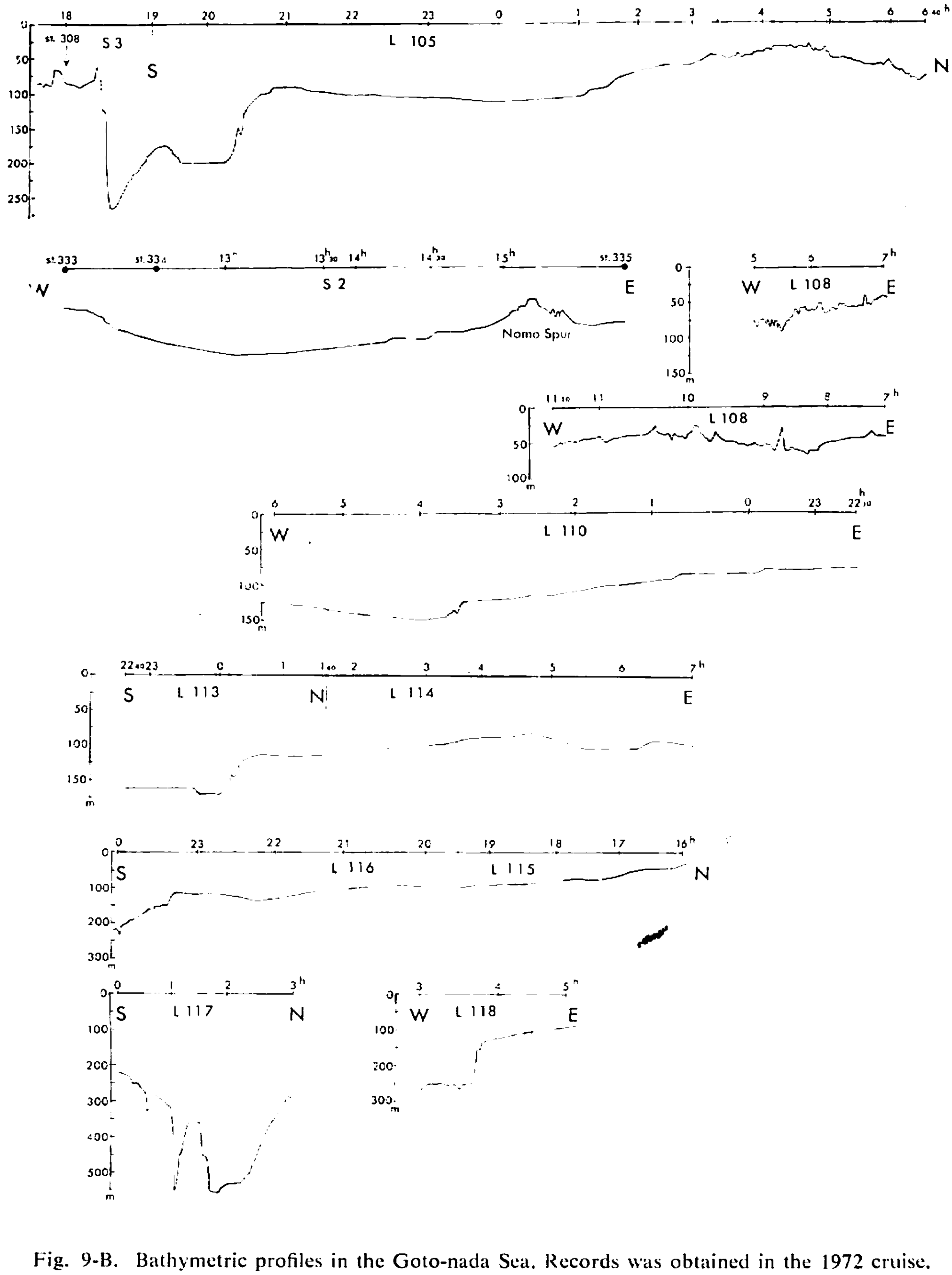

Fig. 9-B. Bathymetric profiles in the Goto-nada Sea. Records was obtained in the 1972 cruise.

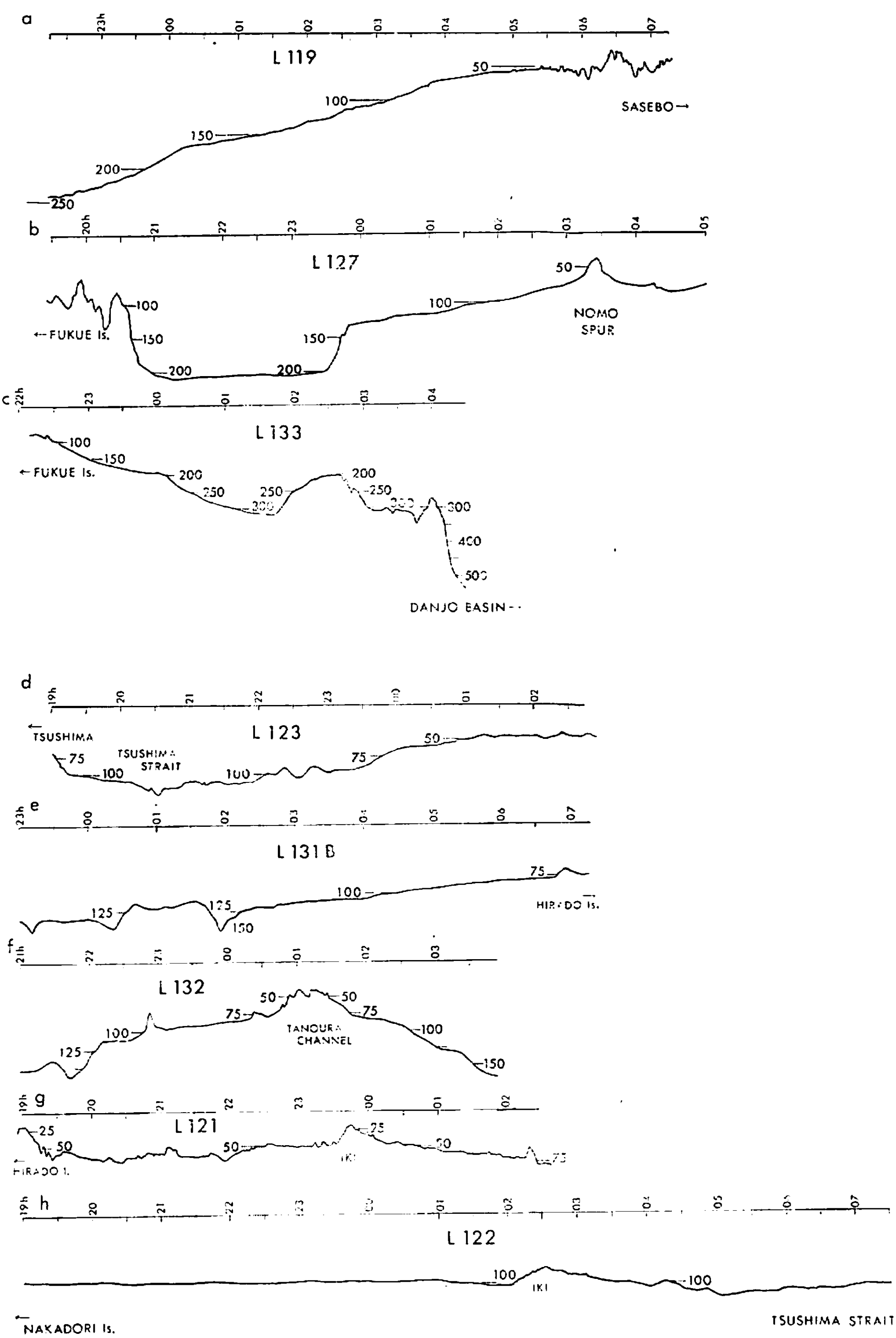

Fig. 10. Bathymetric profiles obtained in the 1973 cruise.

phically the shoal continues to the Nomo Peninsula.

6) The bottom of the Danjyo Basin is not flat, but rather irregular, as if the bottom was incised by small channels.

IV. 2 Undersea beds and geological structures

by Masaaki Kimura, Toshio Hiroshima and Yoshihisa Okuda

The net of geophysical traverse lines has roughly covered the surveyed area about 30,000km^2 in all. Analysis of the geophysical data is incomplete at the time of writing, so, only preliminary results of the 200- and 3,000-joule sparker survey, which provides the information of the undersea beds of about 400m beneath sea bottom, are available.

Undersea beds

1) Tsushima Strait sub-area

In the sub-area the strata on the acoustic basements are acoustically divided into four layers, namely, A,B,C and D layers in order from above. The A layer has relatively strong and widely contineous reflective interfaces. The thickness of the layer is about 100m at the northeast of Nakadori Island, but it decreases east- and northwards so that the layer is 30 to 50m in thickness at the west of Ikitsuki Island and becomes 20 to 0m in thickness between Tsushima and Iki. The A layer is presumably correlated to upper Pleistocene to recent sediments.

The B layer is distributed in the northwest of Goto and in the west of Tsushima with overlapping the Iki-Tsushima Barrier, which is developed in a NW-SE direction and composed of the older layers and acoustic basement. The B layer has cross-bedding reflective interfaces at the outer margin of the barrier, but becomes to have contineous reflective interfaces toward the center of the sedimentary basin of the B layer. The maximum thickness of the B layer is more than 170m at the north-west of Goto, and the thickness decreases toward the margin of the basin. The B layer is presumably correlated to Pliocene to Pleistocene.

The C layer lies beneath the B layer, of which the reflective interfaces are clearer than those of the C layer. The layer is distributed widely in the surveyed area. It is tentatively correlated with upper Pliocene. The C layer is uplifted toward the margin of the sedimentary basin, and the barrier between Tsushima and Iki is composed of the C layer mainly.

The D layer, of which reflective interfaces fairly incline, is overlain by the C layer with clino-unconformity. The D layer is typically distributed between Tsushi-ma and Iki, in the northwest of Goto, in the west of Ikitsuki and south of Tsushima. The D layer between Tsushima and Iki is presumably correlated to the Katsumoto Formation of Miocene flysh, because the D layer is traced from the north of Iki. Judging from the distribution, the D layer at the west of Ikitsuki Island is prob-ablly correlated to the Hirado Formation. The D layer observed locally on the profiles of the L 111 and 131B between Tsushima and Goto is anticlinally folded

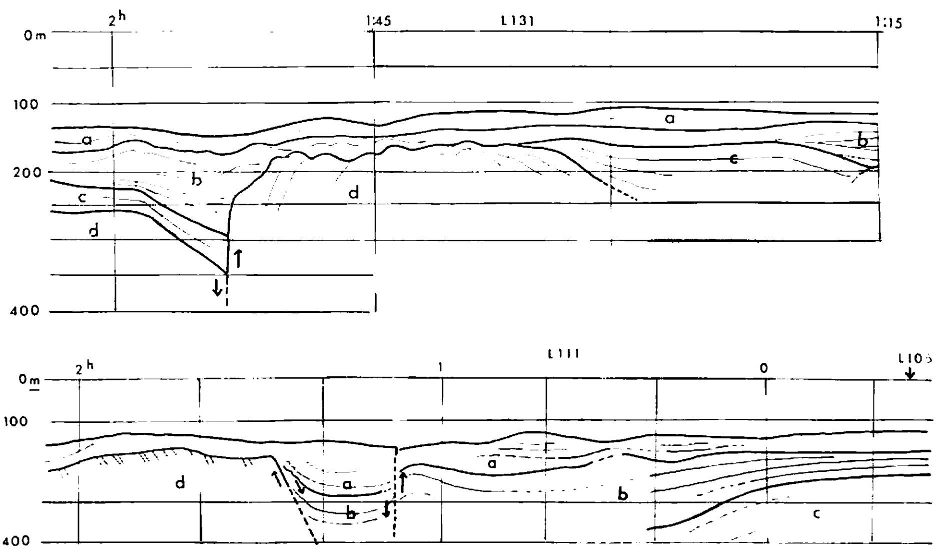

Fig. 11. Interpretative seismic profiles showing distinct faults, a=west part of traverse line L 131B south-southwest of Tsushima, and b=western part of traverse line L 111 north of Nakadori Island.

and the western part of the layer is cut by a distinct fault as shown in Figure 11. It is presumably correlated to the Hirado Formation or a little older strata than the formation, judging from the acoustic pattern. The D layer is also distributed off the coast of Fukuoka and probable igneous rock is distributed south of it. The acoustic basement having very weak reflective stratification is distributed around Tsushima, and is assumed to be the Taishu Group of Miocene. The intrusion of igneous rocks into the strata is suggested by the patterns of the acoustic records. Around Iki the acoustic basement of featureless at low signal record intersecting the B and the C layers, is distributed. It may be volcanic rocks of Iki. West of Goto, acoustic basement having indistinct reflective stratification is located. It is assumed to be the Goto Group.

2) Goto-nada Sea sub-area

The layers in the sub-area have not been precisely correlated to those in the Tsushima Strait sub-area up to date, because analysis of the profiles is in process now. So, the authors preliminarily describe the profiles in the Goto-nada subarea independently in no relation to those in the Tsushima sub-area. Therefore, even if layer names are not exactly compared with those of the Tsushima sub-area. Generally speaking, the layers above the acoustic basement in the Goto-nada sub-area are acoustically divided into three layers; that is, A,B and C layers in decending order. The thickness of each layer becomes thicker southwards.

The A layer is widely distributed in the sub-area and shows relatively strong and continuous reflective interfaces, except the northern part of the Goto-nada sub-area. Near Odate islet, the A layer is restricted to small area burying the depressions of the surface of basement rocks. In the light of the sampling evidence, the layer consists of coarse grained arkose. The A layer becomes thicker towards the southwestern part of the layer is 70m.

The strata having reflective interfaces of distinctive cross-bedding exist beneath the A layer. The strata can be divided into two layers. The upper layer is named B layer and the lower is named C layer, and the latter unconformably overlies the acoustic basement. There is a sedimentary basin in the southeastern part of the Goto-nada sub-area. The basin is filled mainly with both the layers. The total thickness of the B and the C layers in the center of the basin is more than 300m. The inclinations of those layers in the western part of the basin are less than in the eastern part. Those layer might be presumed to be the Kuchinotsu Formation.

The acoustic basement shows the patterns of three types. The first type of the patterns has no reflective stratification, the second has less reflective stratification and the last sometimes has very weak reflective interfaces. Judging from the distribution of each pattern, the first distributed around Odate islet is assumed to be the pre-Tertiary granitic rocks of Odate and Enoshima islets, the second distributed around Ainoshima and south of Odate islets is presumably correlated to the Ainoshima metamorphic rocks and the sedimentary rocks of Paleogene. The last distributed southeast of Goto may be correlated to the Goto Group.

Geological structure

1) In the surveyed area, three main sedimentary basins exist; they are distributed east of Iki, between Tsushima and Goto, and in the southeastern part of the Goto-nada. All of them are filled with sediments probably younger than Miocene. The basins east of Iki and between Tsushima and Goto are separated from each other by a ridge, which runs from north Kyushu to Tsushima through Iki in a NW-SE direction, and the basin of the Goto-nada is separated from another ridge running from Goto to northwestern Kyushu in a NE-SW direction. It is presumable that these basins had been roughly constructed before the B layer deposited in the Tsushima sub-area, because the B layer in the Tsushima sub-area overlaps those ridges.

2) Two major faults are recognized in the sparker records in the area between Tsushima and Goto islands. One of the faults is found at the almost intermediate point between the islands as shown as the profile of the line 131B (Figure 11-b). The southeastern side of the fault throws down. The other is located 24km south-southwest of the fault above mentioned (Figure 11-a). The dip direction of the strata is changed by the fault. It is not decided whether these faults occupy parts of a fault or two different ones, however, the former interpretation is more probable. If it is so, a great fault must be NE-SW trending along the narrow submarine valley, but it is obscure that the estimated fault connects with the depression between Tsushima and Iki. Southerly, the estimated fault meets the NW-SE trending fault runing along the Goto Canyon, at almost right angle.

3) Previous studies of geology on land have indicated that a large fault is estimated between Nakadori Island, Hirashima and Ainoshima islets from the distribution of the Tertiary sedimentary rocks, granites and metamorphic rocks. The

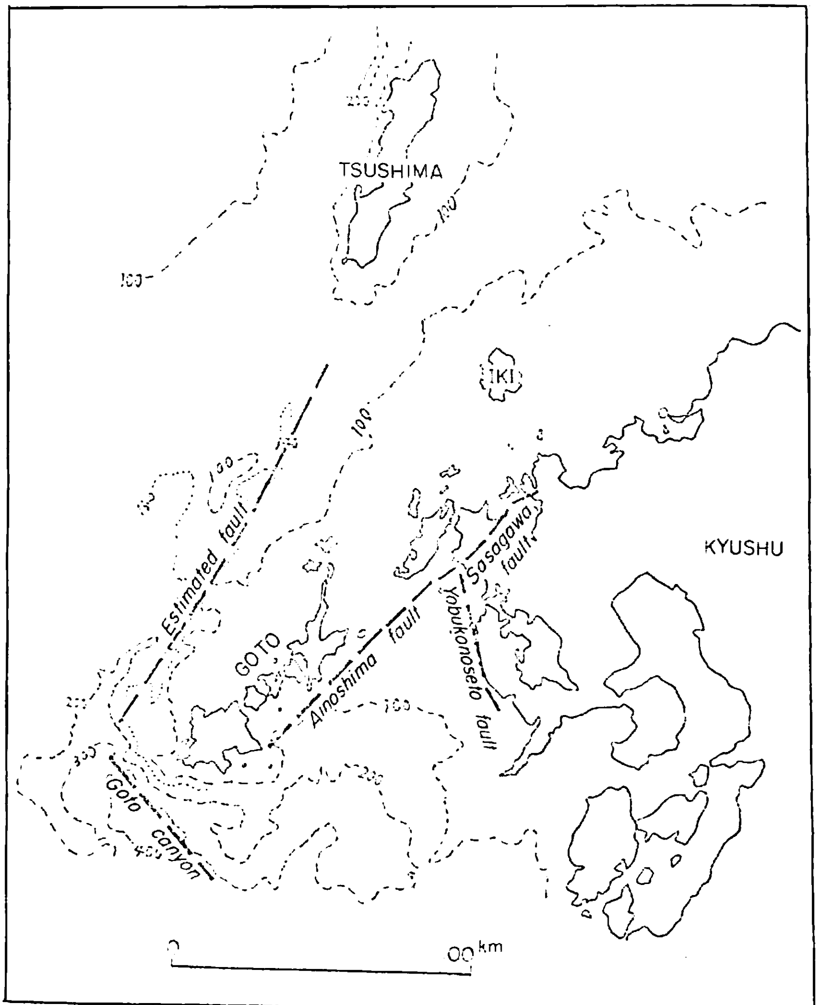

Fig. 12. Main faults in the Goto-nada and the Tsushima Strait. Numbers indicate water depths in metre.

fault is called the "Ainoshima Fault" by H. Isomi and others (1969). Namely, thick Neogene strata such as the Goto and the Nojima Groups are only distributed on the western side of the fault and the granites, the Mesozoic altered sediments and Paleogene formation are distributed on the other side.

The Ainoshima fault has been recognized in the seismic records of geophysical surveys of the cruises. The fault runs along the eastern coast of Goto trending NE-SW, and changes its trend to N-S near Fukue Island. The northward extention of the fault may be connected with the Sasagawa Thrust, which runs across the central part of the Sasebo Coalfield. And also, the Ainoshima Fault may be diversed to NNE-SSW trending branch fault at the south of Hirado, according to the seismic records.

IV. 3 Test of seismic refraction survey with sonobuoy system

by Kosuke Ito and Toshio Hiroshima

Using the sonobuoy system the refraction surveys of the sea bed were experimentally undertaken in Tachibana Bay of the depth of about 40m and in Kagoshima Bay of the depth of 100m, in order to measure the speed of the undersea bed. In Tachibana Bay, the refraction survey using 200-joule sparkarry source scarecely succeeded. Although clear signal of direct and reflected waves was obtained from the sonobuoy at the distance of 4km far from the ship, it was difficult to distinguish the refracted wave from other waves. This is mainly due to the low acoustic energy.

In Kagoshima Bay, another refraction survey was carried out using 30,000-joule acoustic energy. As the result, the unsatisfied record was obtained; this is mainly owing to the bad condition of the transmitter unit.

IV. 4 Sea bottom sediments

by Kazuo Oshima, Seizo Nakao, Hiromi Mitsushio, Makoto Yuasa and Kei Kuroda

Through the cruises 194 samples of the sea bottom sediments and rocks from the sea beds were obtained. They are mud, sandy mud, fine to very coarse sands, gravel and rock fragments. The distribution of these sediments, as determined by preliminary visual observation, is shown in Figure 13. In general terms, the surveyed area is mostly covered by medium to very coarse sand with gravels, and the distribution of mud is rather restricted. Around the coast of Goto, Hirado, Iki, Tsushima and Kyushu, solid rocks such as Cretaceous granites, Tertiary sedimentary rocks and Quaternary basaltic lavas are somewhat broadly exposed on the sea bottom.

The relationship between the depth of water and the size fraction of the sediments in the surveyed area, as shown in Figure 14, is not clear; that is, most sands occur from 30m to more than 200m in depth, while coarse silt is found at depths of less than 70m. Geographically speaking, fine to coarse sand is mainly distributed at the depths of 90 to 140m in the Tsushima Strait and at the depths of 60 to 140m in the central part of the Goto Shelf. Although mud covers on the slope of the Danjyo Basin at the depth of greater than 100m(it is also found between Iki and Hirado islands, and in the bays of Karatsu, Imari and Tachibana, where are in depths of less than 70m but somewhat stagnant environments. Such distribution of the sediments in the surveyed area seems to be primarily controlled by the effect of tidal currents more than by the depth of water.

Temperature in the sediments has close relation with the depth: for instance, the temperature is above 20°C where the depth is less than 120m. The maximum temperature is 24°C in both the bays of Karatsu and Tachibana (stations 343 and 346), while the minimum is 12°C at station 345 southwest of Nomo Cape, where the depth is 209m.

Mud: Mud from Tachibana and Karatsu Bays and the off-shore of the Nishi-

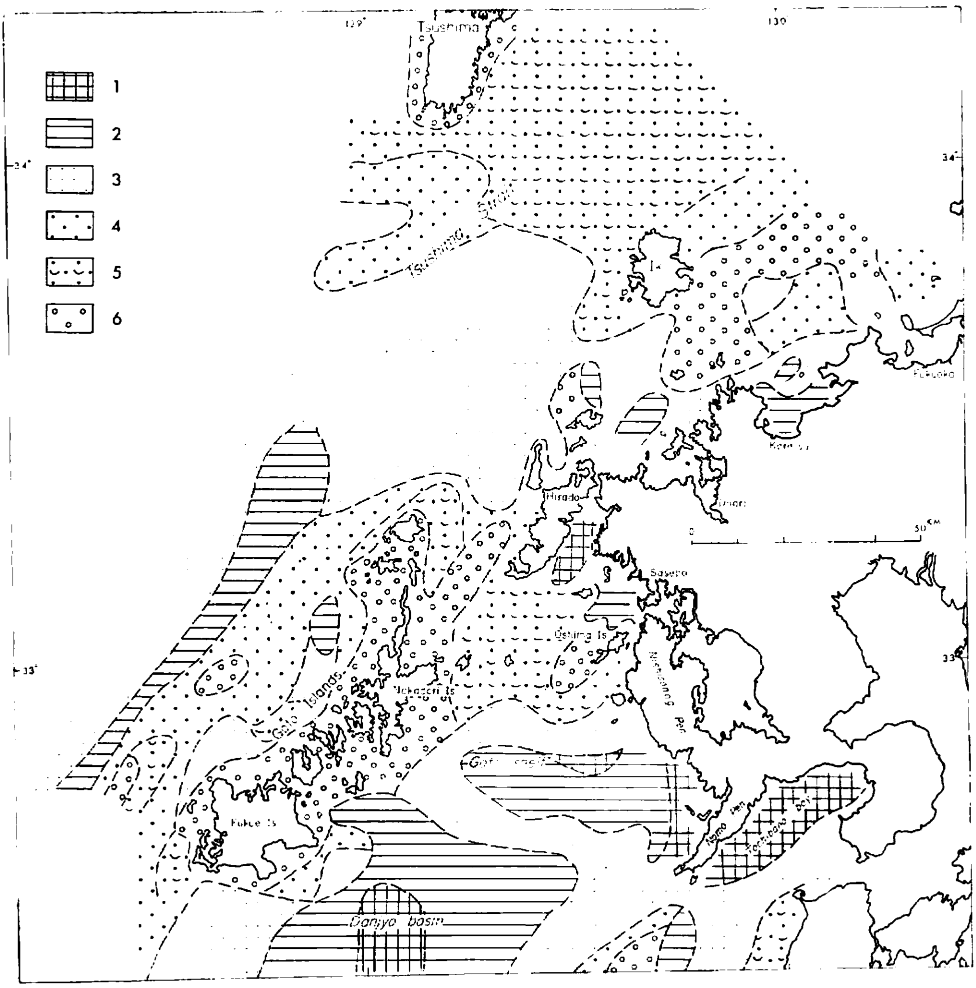

Fig. 13. Distribution of sediments on the continental shelf in the Goto-nada and the Tsushima Strait, 1=mud, 2=sandy mud and muddy sand, 3=fine to medium sand, 4= coarse to very coarse sand. 5=shell sand, and 6=gravel or rock exposure.

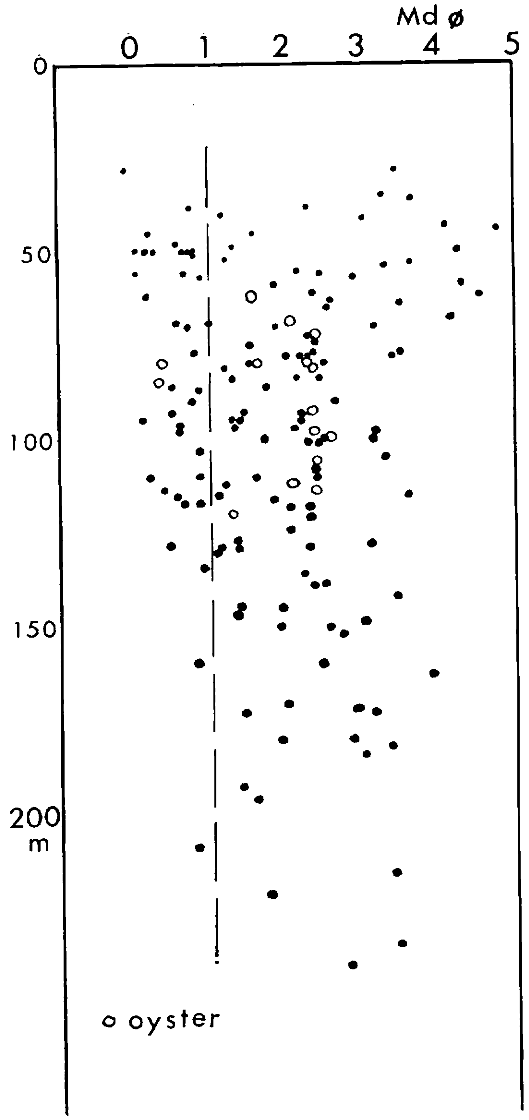

Fig. 14. Relationship between the water depth and the grain size of the sediments.

sonogi Peninsula is greenish grey to dark grey in colour. This seems to be modern sediments. Well-sorted mud of Tachibana Bay contains abundant pipy Polychaeta, while that of Karatsu Bay is ill-sorted and no pipy Polychaeta. This mud smells odor of sapropel.

Muddy sand: There are two types of muddy sand; that is, one is modern sediments and another is relict sediments of Pleistocene to Recent. The latter occurs south of Sasebo, south of Hirado Island, between the Nomo Peninsula and the margin of the Goto Shelf. This sediment is greenish grey, ill-sorted, and contains semiconsolidated mud balls. The relict muddy sand sediments occuring at depth of 60m off Sasebo (station 375) and south of Hirado Island (station 348) include peat and many plant fossil fragments, of which yield *Qurcus serrata* Thunb and *Q. glauca* Thunb. identified by Tohoru Onoe of Geological Survey. The sediments are interpreted to have been deposited in a lagoon environment when the terrace of 45 to 50m depth was formed at low sea level. Muddy sand occuring at station 374 of the depth of 72m off the Nishisonogi Peninsula and station 383 of the depth of 109m at the margin of the Goto Shelf yields fossil *Crassostrea gigas*, and then, the muddy sand seems to be relict sediments.

Fine to medium sand: Fine and medium sand is distributed at various depths between Tsushima and Goto. the central part of the Goto shelf, the bay mouths of Tachibana and Karatsu, and north of Hirado. The sand is generally well-sorted and grey or greenish grey coloured. The sand contains stained quartz grains in many places. Most of the sediments are considered to be removed by the strong tidal currents, and so, modern and relict sediments are mixed within the fine to medium sand.

Coarse sand or pebble-bearing sand: The sand is mainly distributed between Tsushima, Iki and Fukuoka, around Goto and Tsushima, and the Nomo-Ajisone Spur. Such distribution of coarse or pebbly sand coincides with the area of strong tidal currents of more than 2kt. The sand is light brown coloured, ill-sorted and contains abundant shell fragments.

Most of the sand are relict sediments in Pleistocene age, which is proposed by H. Niino and K.O. Emery (1961) in the East China Sea including the surveyed area, because the sand is characterized by brown coloured and stained quartz grains and abundant fossil shells.

Shell sand: Coarser sand with many shell debris or shell sand occurs between Nakadori Island, Hirado and the Nishisonogi Peninsula, between Tsushima and Iki, and near the coast of Fukue Island. The percentage of $CaCo_3$ content in shell sand is more than 70% and the maximum attains more than 90% in the coarse sand sample from station 355 off Fukue, 78m in depth. The shell sand consists of shell debris of more than 50%, echinoid and briozoa of 20%, quartz grains of 15–20% and rock fragments. Shell sand is divided into two types from its shell assemblages. A type of shell sand mostly contains recent shell assemblages and occurs at depths of less than 70m. The other type contains shell fossil assemblages of tidal elements including *Crassostrea gigas* together with recent assemblages, and occurs at the depths of more than 70m. The latter seems to be the Pleistocene sediments.

Gravel and rocky bottom: Gravel and rocky bottom are mostly found around the coasts of Tsushima and Goto, and between Hirado, Nakadori and Nishisonogi, where are affected by the strong tidal currents and at the depths of less than 80m. These are described next. Between Nakadori and Hirado, very coarse sand with gravels and large shell debris is residual deposit lying on the surface of rocky bottom.

Appendix—Bottom sediments in Kagoshima Bay

In Kagoshima Bay, sampling of bottom sediments was carried out with the Aoki-type dredge and a piston-corer at station K 1 and K 2 on 25th of September in 1972. The sediment of station K 1 is dark grey coloured muddy sand with thin film of oxides, containing nesting Polychaeta. At station K 2, sampling of the piston-corer was tried twice, but was in fail. Only a few samples of mud and pumice fragments were collected.

IV. 5 Gravel and rock fragment

by Makoto Yuasa

Gravels and rock fragments, larger than pebble size, were obtained from 30 stations in the surveyed area by the dredge. Rock fragments were mostly obtained from rock exposures on the sea bottom near Hirado and Nakadori Islands, between Iki and Fukuoka, and around Tsushima. These are listed in Table 8.

1) Granitic rocks

Granitic rocks were obtained from St. 337, 333, 357, 371 and 379. Among them the sample obtained at St. 357 is rich in alkali-feldspar and probably correlated with the San'in-type granite. Muscovite granite fragments from St. 337 and 379 are correlated with the granite which is distributed on and around Odate islet and Oshima Island. According to the geological data of the Oshima coal mine the granitic rock is widely exposed on the sea floor of this area. Granodiorite from St. 371, of which mafic minerals are mostly green hornblendes, is rather difficult to be correlated with the land rocks. The sample from St. 376 is gravel of conglomeratic rock. At St. 333, east of Nakadori Island, granitic rock fragments were found. It is not sure whether the fragments are of Tertiary intrusive rocks or Cretaceous granites.

2) Volcanic rocks

Basalt and rhyolite from St. 360 are correlated with those which are distributed on Iki, and the basalt from St. 404 and 407 may be derived from the basalt lava of Hirado and the nearby islets respectively. Basaltic fragment at St. 357 has the trachytic texture and is alkalic.

The rhyolitic rock from at St. 331 seems to be Tertiary intrusive rock of Tsushima. The rock fragments dredged at St. 291, on the steep flank of a small submarine hill off Fukue Island are porphyrite together with sandstone.

3) Sedimentary rocks

Sandstones from St. 291, 436 and 438 have many quartz and are probably correlated with the sandstone of the Goto Group. Sandstone from St. 436 has acidic

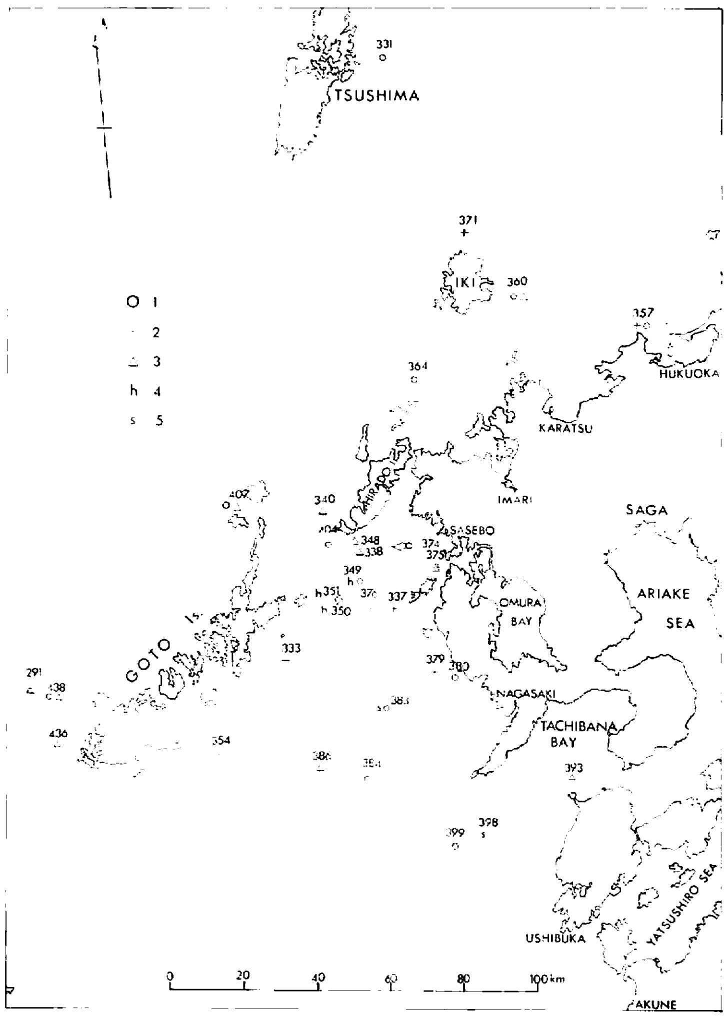

Fig. 15. Sampling localities of rock and gravel in the Goto-nada and the Tsushima Strait, 1=volcanic rocks, 2=plutonic rocks, 3=sedimentary rocks, 4=hornfels, and 5=schist.

volcanic rock fragments. Subangular pebbles from St. 340 are arkose, which is similar to the sandstone of the Sasebo Group. Off the east coast of Tsushima, a shale fragment of the Taishu Group was obtained. Mudstone fragments taken from St. 338 are compared with the sedimentary rocks of the Nojima Group. Pebbles of red shale at St. 291 are identified to the Paleogene basal formation. Chert fragments were obtained from St. 360. Coquinites were obtained from St. 354, 376 and 407.

4) Metamorphic rocks

Gravels of hornfels derived from the Ainoshima metamorphic formation and of schist derived from the Nishisonogi metamorphic rocks were dredged. The schists from St. 383, 393 and 398 are quartz-muscovite schists.

Table 8. Properties of gravel and rock fragments obtained from the Goto-nada and the Tsushima Strait.

Igneous Rocks

St. -Samp. No.	Name	Round-ness	Size (cm)	Remarks
349–3	Px-andesite	SR	5.5×3×2	px→montmollilonite
357–1	mus-bi-granite	SR	2.6×1.8×1.5	alkali feldspar very rich, alkali feldspar>plagioclase, typical granite
2	ol-px-basalt	SR	1.9×1.5×1.3	fresh, trachyte texture
360–1	ol-px-dolerite	A	23×19×15	fresh, qz-xenocryst
2	ol-px-basalt	SA	8×6.5×2	altered, qz-xenocryst
4	qz-ol-px-basalt	A	4.5×4×3	altered and weathered
5	bi-rhyolite	R	3.5×3.5×2	weathered
404–1	hld-rhyolite	SA	8.0×3.5×2	weathered, montmollilonite
2	bi-dacite	SR	5.5×4.2×3.5	
3	ol-px-basalt	SR	4.0×3.0×2.0	
407–2	ol-px-basalt	R	6.0×3.5×1.5	weathered
3	px-basalt	SA	7.0×6.0×2.0	weathered, vesicular

Sedimentary Rocks

360–3	chert	SR	4.5×4.0×3.0	
407–1	coquinite	SR	4.5×2.5×0.7	oolitic

Metamorphic Rocks

St. -Samp. No.	Original rock name	Metamorphic rock name	Round-ness	Size (cm)	Alte-red	Metamor-phosed	Altered or weathered
349–1	felsic tuff	bi-hornfels	SR	5×2.5×2		bi, chl	
2	felsic tuff (?)		SA	6.0×3.0×2.0	?	chl, epi	
4	felsic tuff	hld-hornfels	SR	3.5×2.5×2.5		needle hld	weathered limonite(?)
350	porphyrite or tuff(?)	bi-hornfels	SA	7.5×7.0×3.0		bi, Fe ore	
351–1	porphyrite (?)	hld-hornfels	SR	8.4×4.9×2.0		hld	
2	andesitic tuff	hld-hornfels	SR	6.5×5.5×3.7		hld, epi	pilotaxitic texture
3	felsic tuff	epi-hornfels	SR	9.0×6.0×4.0		epi, tourmaline	

4	silt stone	epi-hornfels	SR	6.5×5.5×3.7		epi, (mus or bi)	
5	andesitic tuff	hld-hornfels	SR	7.0×5.0×3.0		hld, epi	
6	volcanic-conglo-merate	bi-hornfels etc.	SA	16×7.6×3.6		bi etc.	
7	fine grained sandstone	bi-hornfels	SR	7.0×4.0×3.0		bi	weathered

* bi; biotite chl; chlorite epi; epidote hld; hornblende mus; muscovite ol; olivine px; pyroxene qz; quartz.

Between the Nishisonogi Peninsula and Goto Islands there are sediments including a large quantity of mica. The mica has been derived from land or rocky bottom; that is, muscovite is dominant in the sediments near the Nishisonogi, and biotite increases in the area near Goto.

IV. 6 Biological results

by Katsura Ouyama

1) Biological note in 1972 cruise

Biocoenosis: With the exception of micro-lives, most of biocoenosis in the surveyed area consist of various kinds of polychaets and ophiuroids and the other animals are rather rare. Living mollusks are not rich in spite of the abundance of their remains.

Thanatocoenosis: The thanatocoenosis of the surveyed area are not essentially different from those of the Koshiki-jima area surveyed during previous three years. The molluscan shells collected from the bottom sediments in this year are listed up as shown in Appendix. There are 329 species in all; that is, 199 species of Pelecypoda, 116 species of Gastropoda and 6 species of Scaphopoda. Among them, the widely distributed species are listed below;

Turritella fascialis Menke
Saccella gordonis (Yokoyama)
Limopsis crenata Adams
L. forskalii Adams
L. cumingii Adams
Glycymeris rotunda (Dunker)
G. pilsbryi (Yokoyama)
Aequipecten vesiculosus (Dunker)
Pecten albicans (Schröter)

For the ecological study of these molluscs, three environmental factors are adopted; that is, bottom character, the depth of water and the temperature of bottom sediments. The bottom character related to the size fraction of sediments is divided into seven categories; that is, gravel, gravel and very coarse sand, coarse sand, medium sand, fine sand, muddy sand and sandy mud.

The bathymetrical zoning has been done in every 25m from 25 to 225m; for instance, 25–50m zone etc. The temperature of bottom material is separated in every 2.5°C from 12.5° to 25°C. It is interested that the remains of the shells appear to be closely related to the temperature of bottom sediments.

***Turritella fascialis* Menke:** The frequency of the occurrence of this form is highest in sandy mud (3 of whole 4 stations), next in very coarse sand bottom and none was found in muddy sand bottom. However, it has been known that the living shell of this species is commonly available in fine sand or muddy sand bottom. It is, therefore, considered that the remains in muddy sand must have been transported to other place.

Bathymetrically, more than half of the *Turritella* individuals were found in 50–75m zone. None occurs at the depth of greater than 125m, and only a specimen was obtained from 200–225m zone. This was probably transported from shallower zone.

Concerning the bottom temperature, the *Turritella* was mostly found in the stations of temperature of 22.5° to 25°C, next in temperature of 20° to 22.5°C, rare in temperature of 17.5° to 20°C, none from 15° to 17.5°C, and only a specimen was exceptionally obtained in the bottom of 12.5° to 15°C. The result indicates that this species is the dweller in warm water.

***Saccella gordonis* (Yokoyama):** The occurrence of this species is rather similar to that of *Turritella fascialis* Menke. Three-quarter of the individuals of this form occurred at sandy mud bottoms and the remains were found at muddy fine sand and fine to coarse sand bottoms. No individual occured at gravel or gravel bearing coarse sand bottoms.

The main occurrence of the *Saccella* bathymetrically ranges from 75 to 150m; 50–75m and 150–175m zones contain each sole specimen. The other zones, namely 25–50m zone and deeper zones than 175m did not yield any specimen of the *Saccella*.

The tendency for bottom temperature is also distinct. The coolest (12.5°–15°C) and the warmest (22.5°–25°C) zones contain no shell. The richest appearences of the *Saccella* were at 5 stations of total 13 in 17.5°–20°C, and 6 stations of total 14 in 20°–22.5°C and rare in 15°–17.5°C.

Three species of *Limopsis* : *Limopsis crenata* Adams, *L. forskalii* Adams and *L. cumingii* Adams have similar tendency to two previous species. The present forms are rich in coarser material and also occur from sandy mud, but rare or none in fine sand and muddy sand. Such tendency is quite parallel to *Turritella fascialis*, and the bottom character of the *Limopsis* has almost same problem as the *Turritella*. Generally speaking, *L. forskalii* occurs in shallower bottom, while *L. crenata* can be observed from the deeper bottom. The pattern of the bathymetrical range of *L. cumingii* is different from two former species; that is, *L. cumingii* is mostly found at 75–100m zone containing the living shells, although each zone of 25–50m, 50–75m, 125–150m and 150–175m yielded one specimen of this species, which was not found in deeper zone than 175m.

Concerning the bottom temperature, *L. forskalii* of the shallow element was found from warm bottoms and *L. crenata* of the deep element occurred between 12.5° and 25°C, though 17.5°–20°C zone was richest in this species.

Glycymeris rotunda **(Dunker) and *G. pilsbryi* (Yokoyama):** In the bottom characters of these species, *G. pilsbryi* occurs in medium sand to gravel bottoms much more than another species, which occurs in fine materials only. The bathymetrical ranges of these species are rather similar to each other, although *G. rotunda* was collected in deeper zones; that is, each single sample was found in 150–175m and 175–200m zones.

Their tendencies in bottom temperature are also similar; they were rich in 17.5°–20°C, but *G. rotunda* was also found in 15°–17.5°C as rich as 17.5°–20°C. Both the species occured very rarely in other ranges.

Aequipecten vesiculosus **(Dunker):** This form has been known from coarse bottom sediments. In the surveyed area the occurrence of the species does not conflict with the previous records. Namely, the species occured mostly in coarse and medium sands and was only a few in very coarse sand. This form is also well known by its bathymetrical range of 50–200m. All the stations of the 125–150m zone and most stations of the 100–125m zone contained this species, on the other hand, the species was only a few at stations of 50–75m, 75–100m and 150–175m zones and rare at 25–50m zone. In the bottom temperature, the distribution of the species is almost restricted in 15°–20°C; few individuals occur in 20°–25°C and none in 12.5°–15°C.

Pecten albicans **(Schröter):** The bottom character of the species is almost similar to that of *Aequipecten vesiculosus*. Most shells of the present species were obtained from coarse material, and very few of the species were found in fine sediments exceptionally.

The bathymetrical range of the species is quite characteristic. Most stations of 25–50m and 50–75m zones contained the remains of this species. The stations of 75–100m and 100–125m zones, commonly yielded the remains of this form and there is no shell at deeper stations than 125m. The bottom temperature also indicates noteworthy tendency. The stations of 17.5°–25°C in bottom temperature contained abundant individuals of the species, while no remain could be found at stations where the bottom temperature is less than 17.5°C.

2) Biological note in 1973 cruise

The biological samples from bottom material, in general, are not so much differs from the former years. In this year as well as last four years, there is the same problem which is to be solved. It is difficult to separate either "fossil" or a remain of a recent material for a not fresh autochthonous samples, if there is no extinct species included. For example, those forms which have been reported from the interior of bays may live in the bottoms of open sea where mud develops. Then an embayment fauna from moderate depth of open sea bottom is difficult to distinguish either actually living there, or mixed "fossil". The characteristic examples of embayment fauna can be shown in this survey.

The one case is characterized by the presence of several specimens of *Theora lubrica* Gould found alive from the station 444 with 50m in depth. This species has been considered to live in shallower bottoms.

The remains of the other case are considered to be a fossil example from Quaternary deposit. The remains from the station 375 contain *Batillaria multiformis* (Lischke), a tidal element. The specimen of this form is never fresh at all associating with *Theora lubrica* and other characteristic embayment fauna. Then an exposure of a Quaternary or late Neogene deposit is supposed by this fact.

The species names are listed in the following list in Appendix. The specimen found alive, remains, fossils and fragments, are separately indicated in the list. The station with living material is underlined. The presence of fossil is indicated by "f", and "f?" does the case if supposed to be fossil. The mark X is used for those stations where fragments are found only.