# V. CONTINUOUS SEISMIC REFLECTION PROFILING SURVEY

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Continuous seismic reflection measurements were carried out along the ship's tracks shown in Fig. I–1. The energy source was an array of two BOLT PAR 1900B air guns with a total firing chamber of 240-cubic inches (3960 $cm^3$) operated at a pressure of 1600 p.s.i. (approximately 112 $kg/cm^3$) with firing intervals of every 9 seconds. Seismic signals were detected by a GSJ–4–97 Hydrostreamer with 97 crystal hydrophones (Geo Space MP18) towed 150 m behind the ship. The signals were processed by a NE–17B linear amplifier system of Nippon Electric Co. of Japan. The processed signals were fed into two Raytheon Universal Graphic Recorders (Model 196–B) employing 4-sec and 8-sec sweep rates with filters passing 30–90 Hz (4-sec range) and 28–80 Hz or 20–60 Hz (8-sec range). The ship's speed was generally maintained at 10-knots.

The thickness of the sediments is represented by the two-way acoustic travel time when the sonic velocity of the sediments is uncertain. Physiographic provinces in the survey area are shown in Fig. II–1.

It should be noted that only preliminary results are presented here; some of these may be revised in further work.

Five selected profiles with interpretations are presented in Figs. V-1 (S2–K2), V–2 (K5), V–3 (S2–J2), V–4 (J6) and V–5 (J8).

## A. Okhotsk Sea (Fig. V–1 and 2)

### (1) *Kuril Basin*

The sea floor of the Kuril Basin is flat and smooth in general although some minor irregularities are observed around the foot of the continental slope. The main part of the basin is floored by an abyssal plain.

The thickness of the whole sedimentary sequence was difficult to detect during the ordinary profiling survey with the ship cruising at 10 knots. However, the acoustic basement could be detected at 2.8 seconds below the sea floor in the reflection data at sonobuoy station SB5, because the ship's speed in this case was maintained at 6 knots.

The sedimentary sequence in the basin is stratified in its upper part, and transparent or less reflective in its lower part. The upper part is 0.8–1.2 seconds in thickness and its surficial sediments of about 0.3 seconds in thickness covers the underlying slightly deformed sediments and forms the smooth sea floor. The thickness of the lower part is inferred to be about 2.0 seconds.

### (2) *Continental slope*

Two different features are distinguished in the continental slope. One is the development of a sedimentary basin formed by the mid-slope high as shown in Fig. V–1. Three sedimentary units are observed in the continental slope of this type. The upper unit is well stratified and shows a maximum thickness of more than 1.5 seconds. The middle and lower sedimentary units are part of the mid-slope high which trends NNE–SSW.

The middle unit is disconformably overlain by the upper sedimentary unit. The maximum thickness of the middle unit exceeds 1.0 second.

The other feature of the continental slope is the sedimentary apron off Abashiri as shown in Fig. V–2. Two canyons, the Abashiri Canyon and the Shiretoko Canyon, cut through the sedimentary apron. A rugged acoustic basement is observed in the lower part of the slope (Fig. V–2, 6.23–21, 22). The sedimentary sequence is stratified in its upper part and transparent in its lower part. The thickness of the sedimentary unit is generally 1.5 seconds.

(*3*) ***Continental shelf***

Two sedimentary units and an acoustic basement are recognized in the continental shelf. The uplift of the basement and the lower sedimentary unit is observed beneath the margin of the continental shelf as shown in Fig. V–1 (6.18–5, 6). This uplift is elongate NS and may continue to the Nakashiretoko Peninsula of Sakhalin. A large sedimentary basin of the upper sedimentary unit is formed behind this uplift. The maximum thickness of the basin sediments exceeds 2.0 seconds. The basin trends NS through K1 to K3 and NW–SE through K4 to K5 along the coast line.

The Kitami–Yamato Bank is composed of a folded lower sedimentary unit as shown in Fig. V–2, and an upper sedimentary unit is trapped behind a ridge formed by the lower unit.

The lower sedimentary unit and the acoustic basement crop out along the coast. Some basement exposures are associated with short range magnetic anomalies, and these are inferred from the onshore geology to be Tertiary volcanic rocks. The lower sedimentary unit is disconformably overlain by the upper sedimentary unit along the margin of the basin, but the two units are conformable in the center of the basin.

The preliminary estimation of the ages of the sedimentary sequence and the acoustic basement from correlation with the onshore geology of Hokkaido and Sakhalin is as follows. The upper sedimentary unit is a Plio-Pleistocene formation, and the lower sedimentary unit is a Neogene and late Paleogene formation. The acoustic basement may be a pre-Tertiary formation including some intrusive rocks; some acoustic basement along the coast, however, may be correlated with Tertiary volcanic rocks.

**B. Japan Sea** (Fig. V–3, 4 and 5)

(*1*) ***Continental shelf***

Two sedimentary units and acoustic basement are recognized in the continental shelf. The lower sedimentary unit is folded strongly, with the fold axes being traceable into the onshore geological structure, especially around Wakkanai (Fig. V–3, 6.17–21 to 220). On the basis of the correlation with the coastal geology, it is inferred that the lower sedimentary unit corresponds to a Tertiary formation. The maximum thickness of the lower sedimentary unit could not be determined in the present survey, but the deep drilling data onshore by Japan Petroleum Development Corporation indicate that this thickness is more than 4.5 km (J.P.D.C., 1974).

A few synclinal sedimentary basins filled by the upper undeformed sedimentary unit are observed on the continental shelf. The largest one is located between Wakkanai and Rebun Island, and the maximum thickness of the upper sedimentary unit may exceed 1.6 seconds (Fig. V–3, 6.17–20).

A NNW trending acoustic basement exposure on the sea floor was observed in the Soya Strait (Fig. V–3, 6.17–23), and the basement here may be correlated with a Cretaceous formations which are distributed in the adjacent coast of Hokkaido and Sakhalin. Other minor exposures of acoustic basement with short-range magnetic anomalies are observed on the continental shelf.

The general structural trend of the sedimentary sequence on the continental shelf is NNE–SSW, N–S or NNW–SSE.

(2) ***Continental Slope Area***

The continental slope area off Hokkaido in the Japan Sea is one of the most complicated slopes in offshore area of Japan. There are many physiographic features on the continental slope; two major ones of them being the Musashi Bank and the Okushiri Ridge.

Two sedimentary units and the acoustic basement are found on the Musashi Bank. The lower deformed sedimentary unit, which may correspond to the lower sedimentary unit on the continental shelf, is distributed in the southeastern part of the bank (Fig. V–4, 7.3–22). The upper sedimentary unit along the northwestern margin of the bank has a maximum thickness of 0.6 second.

Acoustic basement which often shows appreciable acoustic penetration without layering, is observed widely in the central part of the bank. The distribution of this acoustic basement is consistent with the short-range magnetic anomalies, and this indicates that almost all of the acoustic basement on the Musashi Bank may be the product of volcanic activity.

Deformed sediments more than 1.0 second thick are underlain by an acoustic basement in the Okushiri Ridge as shown in Fig. V–4 and 5. The features of the ridge suggest that it was deformed by uplifting after the deposition of the sediments and is composed of two subridges which trend approximately N–S.

Horst and graben structures of the acoustic basement are present along the western margin of the continental slope, along the Tartary Trough as shown in Fig. V–3. This character may be analogous to that of the lower continental slope of the Atlantic Ocean (DINGLE and SCHRUTTON, 1977), and it is inferred to be foundered continental crust which was rifted by the initial generation of oceanic crust within the continent (MONTADERT, *et al.*, 1977).

A NS trending trough was observed west of Rebun Island. A prominent fault is recognized along the eastern margin of this trough (Fig. V–3, 6.17–18), and the vertical basement displacement exceeding 1.0 second. This fault may have controlled the formation of this trough.

(3) ***Tartary Trough***

The sedimentary sequence of the Tartary Trough is highly reflective in the upper part and its maximum thickness exceeds 2.3 seconds in the northern part of the trough where the acoustic basement could not be detected (Fig. V–3). The middle part of the sedimentary sequence of the trough is continuous into the eastern continental slope.

The basement is shallower in the southern part of the Tartary Trough, and the depositional features of the sedimentary sequence in this area are irregular. There is also the prominent development of the Tartary Canyon (Fig. V–4 and 5).

The sedimentary sequence in the Japan Basin is generally divided into an upper stratified unit and a lower transparent unit with a total thickness exceeding 2.0 seconds in the southeastern area of the Bogolov Seamount. The sea floor is nearly flat and smooth regardless of the ruggedness of the basement. The J8 profile (Fig. V–5) shows the marginal feature of the Japan Basin, where the sedimentary sequence is more transparent than that of the Japan Basin proper and the basement ruggedness controls the sea floor topography.

**References Cited**

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