VI. CONTINUOUS SEISMIC REFLECTION PROFILING SURVEY

Kensaku Tamaki, Fumitoshi Murakami and Eiichi Honza

Continuous seismic reflection profiling was carried out along the ship's tracks shown in Fig. I–1. The sound source was a BOLT PAR 1900 B airgun with firing chambers of 120, 80 and 40 cubic inches. A single or double airgun array was used with a total volume of 200, 120 or 40 cubic inches operated at a pressure of 1500 p.s.i. and firing intervals of every 8 seconds. Seismic signals were detected by a Teledyne Exploration Co. Model 24257 hydrostreamer with 50 crystal hydrophones, a GSJ–3–50 hydrostreamer with 50 crystal hydrophones (Geo Space MP17) or a GSJ–4–97 hydrostreamer with 97 crystal hydrophones (Geo Space MP18) towed 150 m behind the ship. The signals were processed by a Teledyne Model 24220 amplifier system or NE–17B amplifier system of Nippon Electric Co., and fed into a Raytheon Universal Graphic Recorder Model 196–B employing a 4-sec sweep rate through filters passing generally 20–98 Hz, and a UGR Model 196–C employing a 2-sec sweep rate through filters passing generally 40–125 Hz. Ship speed was maintained at 10 knots during the survey.

The thickness of sediments is represented by the two-way travel time because of the uncertainty of the sonic velocity of the sediments.

It should be noticed that only preliminary results are presented here and some of them may be revised by further work.

A. West of Kyushu (Line 1–Line 10, Fig. VI–1)

(1) *Tunghai Shelf*

Two sedimentary units and the acoustic basement are discernible in the Tunghai Shelf. The upper sedimentary unit represents an evenly stratified layer without appreciable deformation, and the lower sedimentary unit shows a partly deformed stratified layer which is more reverberant than the upper sedimentary unit.

Two basement highs trending NE are observed beneath the shelf. One is beneath the margin of the shelf and the other is beneath the western margin of the surveyed lines L.1–L.6. The eastern basement high is higher and more prominent than the western one and continues to the Goto Islands through the Danjo Islands. These islands may be exposure of the eastern basement high. If that is the case, the acounstic basement may include Miocene sedimentary rock while occurs widely on the Goto Islands. The acoustic basement has a rough surface. Between these two subbottom ridges of the basement, a synclinal basin of the lower sedimentary unit is observed and the basin also trends NE.

Around the basement high, the deformation of the lower sedimentary unit is distinct, and both of the sedimentary units abut to the eastern basement high whereas the lower sedimentary unit seems to overlap the western basement high. The most plausible explanation for these features is that the eastern basement high acted as a continuous dam that traps western sedimentary units shed from the westward mainland and that the western basement high uplifted after or during the deposition of the lower sedimentary unit.

(2) ***Okinawa Trough (Danjo Basin), its marginal slopes and shelf*** (Fig. VI–1)

Three sedimentary units and the acoustic basement are recognized in the Okinawa Trough and its marginal slopes. The upper sedimentary unit is a densely stratified layer with high frequency reflections which occur only in the Okinawa Trough. The middle sedimentary unit is a stratified layer characterized by low frequency reflections which occur both in the Okinawa Trough and on its marginal slopes. The boundary between the two above mentioned sedimentary units represents a conspicuous disconformity. The lower sedimentary unit, a weakly stratified layer, is observed beneath the trough and its marginal slopes. The boundary between the middle sedimentary unit and the lower one shows an unconformity beneath the slopes and is conformable in the Okinawa Trough.

The sedimentary sequence below the middle unit is moderately deformed whereas the upper sedimentary unit is not appreciably deformed. The maximum thickness of the upper sedimentary unit is 0.3 seconds on Lines 1 and 2. The maximum thickness of the middle sedimentary unit, observed in the trough, is 0.6 seconds, and that of the lower one exceeds 1.2 seconds although the bottom of the unit cannot be detected except in the basement high area. Many basement highs are observable in the trough and its margin. Some of them are abutted and some of them are overlapped by the sedimentary sequence.

B. North of San-in and Northern Kyusyu (Line 13–Line 28, Figs. VI–2, 3)

(1) ***Continental Shelf and Continental Slope off San-in and Northern Kyushu***

Two sedimentary units and the acoustic basement are recognized in the continental shelf. The two sedimentary units are divided into the upper less deformed unit and the lower deformed unit. A conspicuous unconformity is observed between the two units.

The upper unit is a well stratified layer which is observed as deposits in the synclinal basins formed by underlying units and in the margin of the continental shelf. The upper unit in the synclinal basin is evenly stratified in the center, and the stratified layer tilts upwards and is truncated by the sea floor at the margin of the basin. Three synclinal basins are observed in the continental shelf and they trend almost parallel with the coast lines of San-in and northern Kyushu. The largest one is observed on Line 16–20 with a full length of 100 km, and the maximum thickness of the deposits in the basin may exceed 2.0 seconds as is observed on Line 18.

The upper unit in the margin of the continental shelf shows a forward dipping layer which is truncated by the sea floor on the continental shelf and is over 2.5 seconds in maximum thickness. The unit, gently folded in parts, is obviously continuous with the sedimentary sequence of the Tsushima Basin through the continental slope as shown in Fig. VI–3. A strong deformation zone in the unit is observed along the foot of the continental slope with irregular topography, which is thought to be caused by anomalous sedimentation such as major gravitational sliding.

The lower deformed unit is overlain by the less deformed unit or crops out on the seafloor of the continental shelf. A wide distribution of the unit on the continental shelf is observed. Some acoustic basement exposure is seen on the continental shelf off San-in and around the Tsushima Islands and the Oki Islands.

(2) *Tsushima Basin*

The Tsushima Basin has a smooth floor gently tilting up toward the south. The basement cannot be detected except around the Korea Continental Borderland where the basement is shallow. The deepest reflector observed is 2.2 seconds below the sea floor on the foot of the continental slope off San-in.

The sedimentary sequence is divided into three units. The upper unit is a non-deformed stratified layer with high frequency reflection and it forms a small abyssal plain south of Ullung Island. This unit is presumably mainly turbidites. The maximum observed thickness of the unit is 0.3 second.

The middle unit is a stratified and highly reverberant layer which is weakly deformed in the basin and strongly deformed on the foot of continental slope. The acoustic nature of this basin is strongly resembles that in the Hidaka Trough off the Pacific coast of Hokkaido (TAMAKI *et al.*, 1976). The middle unit is overlain slightly disconformably by the upper unit. The thickness of the unit increases southwards and the maximum thickness observed is 1.4seconds on the foot of the continental slope off San-in. This southward thickening of the middle unit causes the southward tilting up of the sea floor. The middle unit is continuous southwards through the continental slope to the upper sedimentary unit of the continental shelf off San-in whereas, northwards, it abuts onto the basement of the South Korea Rise.

The lower unit is a transparent layer with weak reflectors which are almost evenly deposited. The boundary between the middle unit and the lower unit is slightly disconformable. The thickness may exceed 1.0 seconds although the bottom of the unit cannot be detected. The lower unit might also be continuous with the lower sedimentary unit whereas it abuts onto the South Korea Rise.

C. **Korea Continental Borderland and Genzan Trough** (Line 25–Line 28, Fig. VI–4)

Two major rises (north Korea Rise and South Korea Rise) which represent basement highs covered by some amount of sediments are recognized on Line 27 and Line 28. A sedimentary sequence of 1.1 seconds in maximum thickness is observed on the rises. The sedimentary sequence is divided into three units bounded by disconformities. The upper unit is a transparent or weakly stratified layer with a thickness of less than 0.1 second and is occasionally absent. The middle unit with a maximum thickness of 0.6 second forms the main part of the sedimentary sequence. The upper part of the unit is stratified and its lower part is transparent or very weakly stratified.

The lower unit of the sedimentary sequence is partly observed in the basement depressions on the rises and it is composed of an upper stratified layer and a lower transparent layer which is absent where the unit is thin. The maximum thickness of the unit is 0.6 seconds.

The middle and lower units are slightly deformed and the upper unit represents sedimentary cover overlying the middle unit. The thickness of the sedimentary sequence is generally thick on the basement depression and on the basement terrace.

The basement topography of the rises is rugged and some basement highs crop out on the sea floor.

A deep sea basin is observed between the two rises on Line 28. This basin is the margin of the Japan Basin and represents a feature like an abyssal plain although slight irregularity of the floor is sometimes seen. The sedimentary sequence in the basin is a transparent layer which includes two reflective parts—the upper and the middle one, and its thickness is 0.7–1.1 seconds.

The basement morphology in the basin is generally flat with minor irregularities. The flat basement feature in the basin shows marked contrast to the irregular basement features of the rises. This fact suggests that the basement of the rises is different from that of the Japan Basin in origin.

The sedimentary sequence in the basin seems to continue with that on the rises, although its acoustic nature gradually decreases in transparency upwards.

The sedimentary sequence with thickness ranging from 0.5 to 1.4 seconds is observed in the Genzan Trough. The northern basement topography is rugged in contrast with the flatness of the southern basement, and the northern basement decreases its depth northwards. The northern sedimentary sequence is highly reflective in comparison with the southern sedimentary sequence. These features suggest that the northern part of the Genzan Trough on Line 28 composes the foot of the continental slope and that the terriginous sediments which are derived from the north form the northern reflective sedimentary sequence. They suggest also that the basement at the foot of the continental slope is dissimilar in origin to the Japan Basin. A prominent channel is observed on the foot of the continental slope and its features imply that the channel is a very active one.

The upper half of the sedimentary sequence in the Genzan Trough is a well stratified layer with slight deformation whereas the lower half is transparent. Most of the sequence seems to be continuous with the sedimentary sequence on the North Korea Rise.

Reference Cited

TAMAKI, K. (1977) Continuous seismic reflection profiling survey. Honza, E. *ed.*, *Cruise Report No. 7, Geological investigation of Japan and southern Kuril Trench and slope areas*, Geol. Surv. Japan, p. 50–71.