VIII. SUBSTRATE RECORDS BY A 3.5 kHz SUBBOTTOM PROFILER IN THE GH79-1 AREA

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A subbottom profiling survey was carried out by a 3.5 kHz PDR (subbottom profiler) along all the survey tracks of the GH79–1 area in order to clarify the structure of surficial sediments and make a correlation between manganese nodule distribution and surficial sedimentary sequence. Ship speed in the survey area was about 10 knots in the main survey area and about eight knots in the detailed survey area, respectively. The survey system consisted of nine transducers (TR 75A), a tranceiver (PTR 105A), a correlation processor (CESP II), and a graphic recorder (UGR 196C), which were manufactured by Raytheon Co. Ltd.

Main survey area

Many seamounts and knolls are extensively developed and they complicate the distribution of the substrate layers in the GH79–1 main survey area. Acoustic pattern of the layer as detected on 3.5 kHz records has been classified into three types, i.e. type a, type b, and type c, in the south of the present area by MIZUNO and TAMAKI (1977). The acoustic pattern observed in abyssal basins of the GH79–1 area is mainly type a, which is a transparent pattern underlain by opaque one. Type b and type c are sparsely distributed. They consists of a transparent layer interbedded with irregularly layered opaque parts, and a transparent layer including the horizontally layered opaque part, respectively. A simple opaque pattern, type d (MIZUNO and TAMAKI, 1977), is widely distributed on a top and a steep slope of seamounts and knolls although it is occasionaly recognized in some parts of flat deep-sea floor. In the western marginal area another type which consists of layered semi-opaque pattern is observed. One of a typical profile in main survey area along the N–S track at 170°W is shown in Fig. VIII-1.

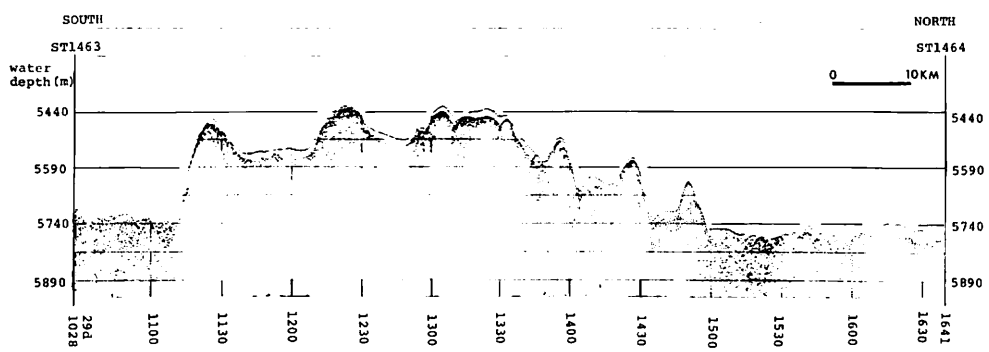

Fig. VIII-1 Typical profile in the main survey area along the N–S track at 170°W, between ST1463 and ST1464.

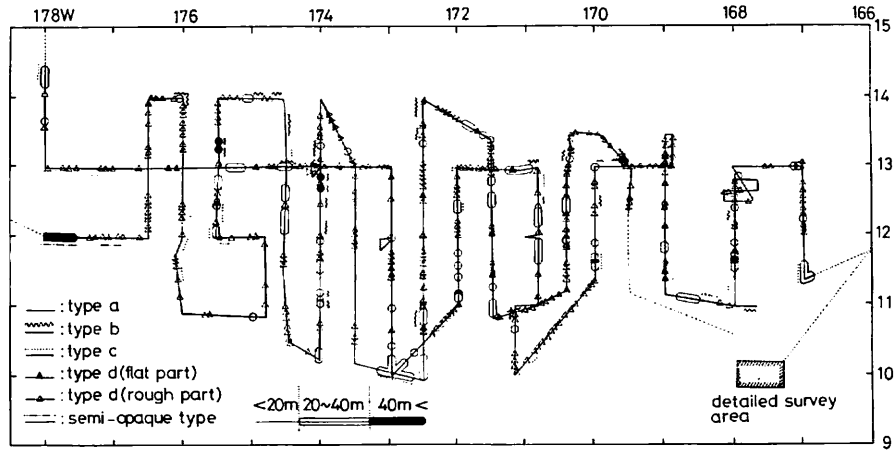

Fig. VIII-2 Distribution map of the thickness and acoustic patterns of the substrate layer overlying the acoustic opaque parts in the main survey area. Thickness is calculated assuming the sound velocity of 1.5 km/sec.

The distribution map of the substrate layer types in the GH79–1 main survey area is presented in Fig. VIII-2. The layer overlying the acoustic opaque parts is dominantly 10 to 30 meters thick, with the maximum thickness up to 60 m. The layer is generally thinner than that in the previously surveyed GH74–5 and GH76–1 areas, south of the area, showing the general tendency of northward thinning as a whole.

According to the results of seismic profiling survey in GH79–1 main survey area, the thickness of Unit IIA is thicker than the previously surveyed area south of the present area, and Unit I, overlying IIA, is thicker in eastern part of the main area in general tendency (TAMAKI and TANAHASHI, this cruise report). The layer detected by a 3.5 kHz PDR is the uppermost part of Unit I. The difference of the thickness distribution pattern of the units and uppermost layer may show the transition of the depositional environment with time.

According to the DSDP result at Site 170 (WINTERER, EWING, *et al.*, 1973), substrate transparent and/or alternation of transparent and opaque layers lying on the opaque parts are regarded as parts of clay and/or ooze formations overlying the Cretaceous to middle Eocene cherty formations.

After the piston coring results in the main survey area (NISHIMURA, this cruise report), siltstone of probably Eocene overlain by soft clay was sampled at St. 1487 (P140), and manganese crust was sampled only in core catcher at St. 1452A (P139). The uppermost layer by a 3.5 kHz PDR is thin (0 to 10 meters thick) at St. 1487 and is not present at St. 1452A. This may show that the disconformity between recent soft clay and older siltstone correspond to the upper surface of strong opaque part on 3.5 kHz records around these sites.

The relationship between the thickness of the uppermost layer by a 3.5 kHz PDR and the occurrence of manganese nodules is not clear because of the rough survey in the main survey area.

Distribution of surficial sediments of the GH79–1 main area are divided into four

provinces based on a lithologic type (NISHIMURA, this cruise report); topographically higher province (dominantly calcareous sediments), western province (dark brown zeolitic or zeolite-rich clay), central province (brown to dark brown siliceous clay), and eastern province (clay). Generally, type a, type b, and type c show little regularity of areal distribution in the main survey area, and also show little correlation with the distribution of surficial sediments.

The calcareous foraminiferal or nanno ooze are restricted to the topographically highs where type d or the layered semi-opaque patterns are observed. Thick-layered (about 100 m) semi-opaque pattern occurs around Sts. 1491 and 1492 on the low rise at the western end of GH79–1 area, from where calcareous nanno ooze was sampled by box corer. The layered semi-opaque and a calcareous nanno ooze cannot be observed out of both the sites, and the acoustic pattern may correspond to a nanno ooze in the topographically higher province.

Detailed survey area

Detailed profiles, under the condition of slower ship speed, were obtained along the meshed survey lines (about 20 km apart each other) in the detailed survey area. The type b acoustic pattern of surficial sediments underlain by strong opaque pattern is predominant in this area. In the southern half, a layer with some weak alternation of transparent and opaque bands is distinguished beneath the strong opaque horizon. The layer, 0.1 sec (ca. 75 m) thick, shows the gentle folding pattern alike to the district around DSDP Site 165.

The uppermost layer of interbedded transparent and opaque beds is mostly 10 to 30 meters thick and thins northwestward in general. This layer disappears in the topographically high areas in the southwestern part and northeastern end. In the northwestern part, strong opaque layer is cropped out, and this area is topographically lower than the area where the type b uppermost layer is observed. The isopach map of the uppermost layer is shown in Fig. VIII-3.

Isopach maps of Unit I and Unit IIA were made, based on the result of detailed profiling by air gun (TAMAKI and TANAHASHI, this cruise report). Both the maps (Figs. VII-5, 6) show the roughly same thickness distribution pattern of northward thickening. A discrepancy of the thickness distribution pattern is present between the 3.5 kHz uppermost layer which represents the uppermost part of seismic reflection Unit I and the main part of Unit I and Unit II. This suggest a peculiar change of sedimentary environments with age similar to that in the main survey area.

According to the piston core data in the area where uppermost layer is lacked and strong opaque layer is cropped out (P137, P138), the latest Pliocene to Quaternary thin (2 to 3 meters thick) clay overlies early Miocene siliceous clay with nannofossil ooze turbidite with remarkable hiatus (NISHIMURA, this cruise report). WINTERER, EWING, *et al.* (1973) have shown that at ransparent layer overlies gently folded older layers around Site 165 with disconformity as detected by 3.5 kHz subbottom profiler. The uppermost part of the older layers was eroded away in places near Site 165. At Site 165 the eroded layers were estimated as the middle Miocene strata by the extrapolation of sedimentation rate for the Oligocene and early Miocene. The unit under the disconformity is about 235 m thick and corresponds to acoustic turbidite facies, most of Unit I in this report.

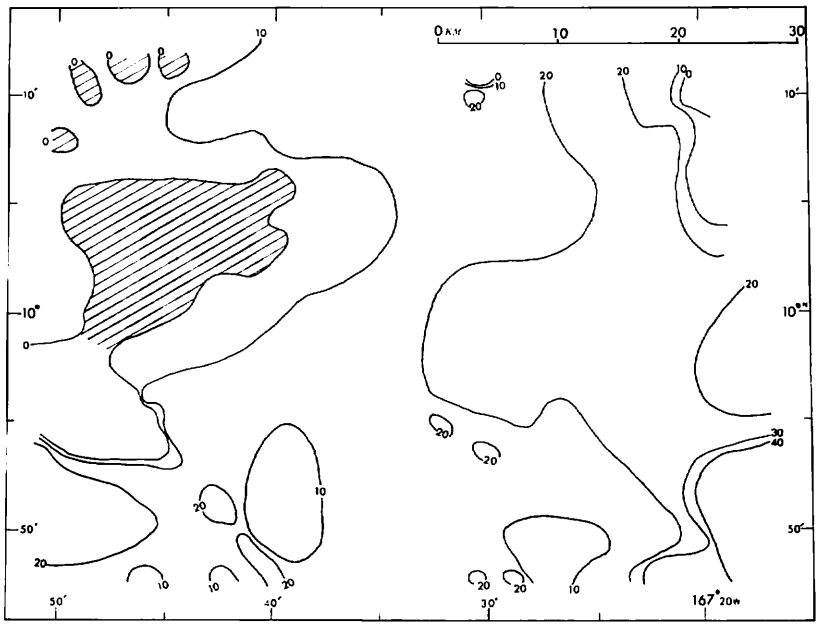

Fig. VIII-3 Distribution map of the thickness of the uppermost continuous layers overlying the continuous opaque parts in the detailed survey area. Thickness (in meter) is calculated assuming the sound velocity of 1.5 km/sec. Shaded parts are the topographic smooth sea floor where type b layer is not present. See the topographic map (Fig. I-6).

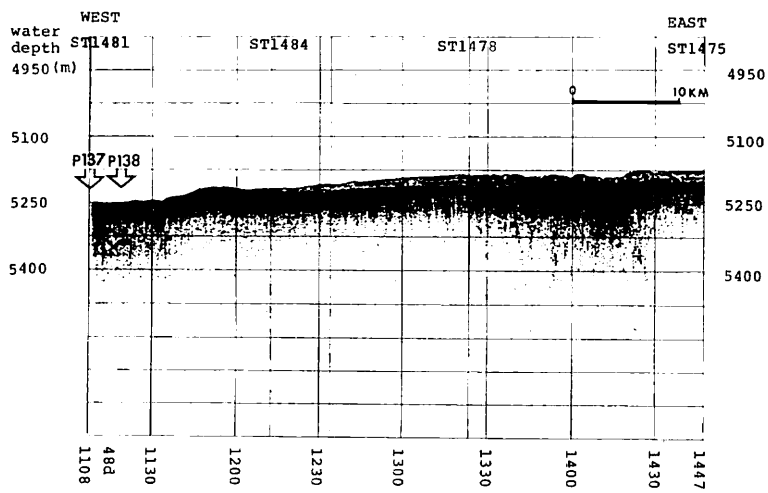

Fig. VIII-4 Typical profile in the detailed survey area, along the E–W track at 10°00'N, between ST1481 and ST1475. Two arrows show the approximate position of sampling by piston corer. See the track line map Fig. I-7.

They comprise the middle Eocene to lowest Miocene soft radiolarian and nannofossil-foram ooze with remarkable development of turbidite.

Similar acoustic features and subbottom structures can be recognized in the GH79–1 detailed survey area. It is concluded that the strong opaque part of the detailed survey area is correlated to the sediments including the early Miocene ooze and turbidite at P137 and P138 and DSDP Site 165, and the uppermost layer represents the post Miocene sediment.

According to NISHIMURA (this cruise report), the eastern half with type b thicker than 15 m belongs to siliceous ooze to siliceous clay surface sediment area, and the northwestern part with type b thinner than 15 m belongs to brown clay area. This condition is closely related to the distribution of the manganese nodules; the manganese nodules are abundant in the thin type b area, although this relationship is not shown clearly in the GH79–1 main survey area.

References

MIZUNO, A. and TAMAKI, K. (1977) Substrate profiles by 3.5 kHz PDR. *In* MIZUNO, A. and MORITANI, T., (*eds.*), *Geol. Surv. Japan, Cruise Rept.*, no. 8, p. 38–43.

WINTERER, E. L., EWING, J. I., *et al.* (1973) *Initial Reports of the Deep Sea Drilling Project*, vol. 17, Washington (U.S. Government Printing Office), xx + 930p.