VI. CONTINUOUS SEISMIC REFLECTION PROFILING SURVEY IN THE GH78-1 AREA

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Introduction

A continuous seismic reflection survey was carried out along the ship's tracks shown in Figs. I-4 and 5. The energy source was a BOLT PAR 1900B air gun with a firing chamber of 120 cubic inch (1966 cm^3) operated at a pressure of 1500 p.s.i. (105 kg/cm^2) with firing intervals of every 12 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 sygnals were fed into the Universal graphic recorders (Model 196-B) of Raytheon Co. employing 4-sec. sweep rate with band pass filter passing 30–110 Hz. The ship's speed was maintained in 8–10 knots.

Results

Typical exsample of the seismic reflection record and its interpretation are shown in Fig. VI-1. The interpretation of the seismic record is shown in Fig. VI-5 (1)–(5), and its original record in Fig. VI-6 (1)–(15).

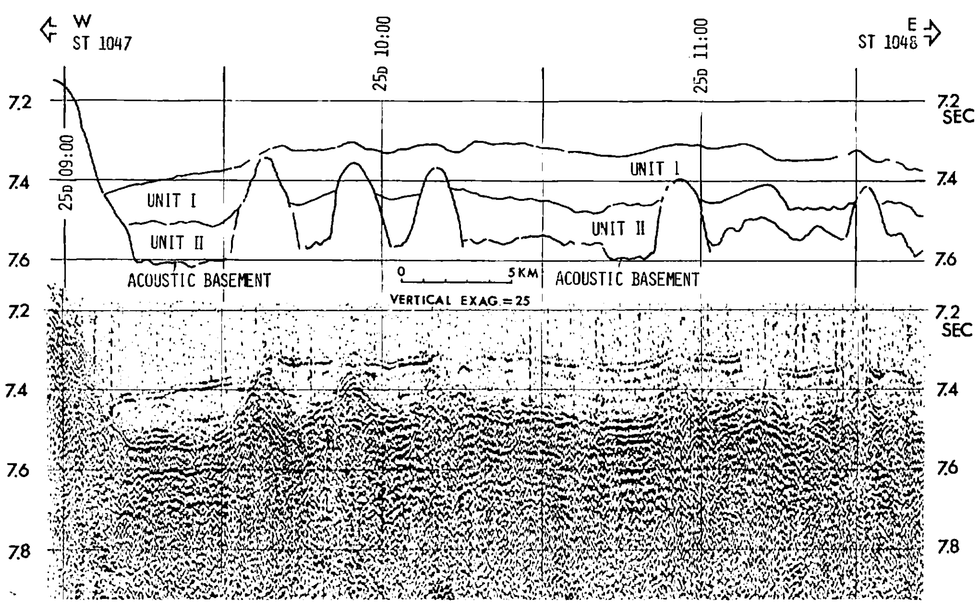


Fig. VI-1 Typical example of the seismic reflection record and its interpretation.

Acoustic sequence is divided into two layers, Layer 1 (sedimentary strata) and Layer 2 (acoustic basement). Layer 1 is subdivided into Unit I (upper "transparent" layer) and Unit II (lower semiopaque layer). Unit I is classified into three types according to its acoustic features mostly following the classification by TAMAKI (1977), as below.

Type A: completely transparent.

Type B: transparent, with reflective part.

Type C: coherent reflections.

A variation of Type A, i.e. Type A′ characterized by rather intense reflectivity of the sea bottom surface was newly recognized, while Type B was not observed in the present survey area.

Topographically, the survey area is divided into southwest and northeast mountainous area, central to east predominant troughs and hills area with their WNW-ESE trend bounded to the north and south by both the above-mentioned mountainous areas, and northwest abyssal plain area at the depth of 5,500–6,000 m.

Distribution and characteristic features of each layer and unit are described below.

Unit I: Unit I is assumed to be unconsolidated sedimentary strata with about 1.5 km/sec. acoustic velocity, according to the DSDP results (WINTERER, EWING *et al.*, 1973). Distribution of the three types of Unit I, i.e. A, A′ and C, is shown in Fig. VI-2 together with the isopach of the Unit I. Thickness of Unit I tends to be thicker in southern part, and it is less than 50 m in the central and abyssal plain areas.

Type A—Typical transparent features of this type layer are shown in Fig. VI-3a. Type A develops widely in the survey area. In the northwest abyssal plain area, Unit I is very thin, and Type A of the unit overlies Unit II in rather uniform thickness. Type A buries basin part between hills in the central hilly area with variable thickness. However, it becomes thicker southward from around the latitude 10°N. Particularly Type A becomes thickest (110 m) along the track part between Sts. 1046 and 1047.

Type A′—The characteristic features of Type A′ is the presence of intense reflectivity on the sea bottom surface as well as the general transparency within the whole layer as shown in Fig. VI-3b. The intense bottom reflectivity of Type A′ seems to be caused not by instrumental results from the effect of condition of sound source and/or receiving system, but by the presence of some particular sediments with acoustic velocity different from that of Type A, because the 3.5 kHz PDR record shows also the similar bottom surface reflection.

The distribution of Type A′ is localized in the northeast mountainous area and the northwest abyssal plain area, as shown in Fig. VI-2. In the northeast mountainous area, Type A′ is accumulated in a trough along the northern foot of the mountain. Here, Type A′ is 0.05 sec. (about 37 m) thick, accumulating concordantly on the relief of Unit II. On the other hand, in the northwest abyssal plain (between Sts. 1040 and 1041), the thickness of Unit I is thin as about 18 m (0.02 sec.), and its structure is not clear.

Type C—This type is characterized by a coherent stratified structure with relatively transparent appearance on seismic (air-gun) profile as shown in Fig.

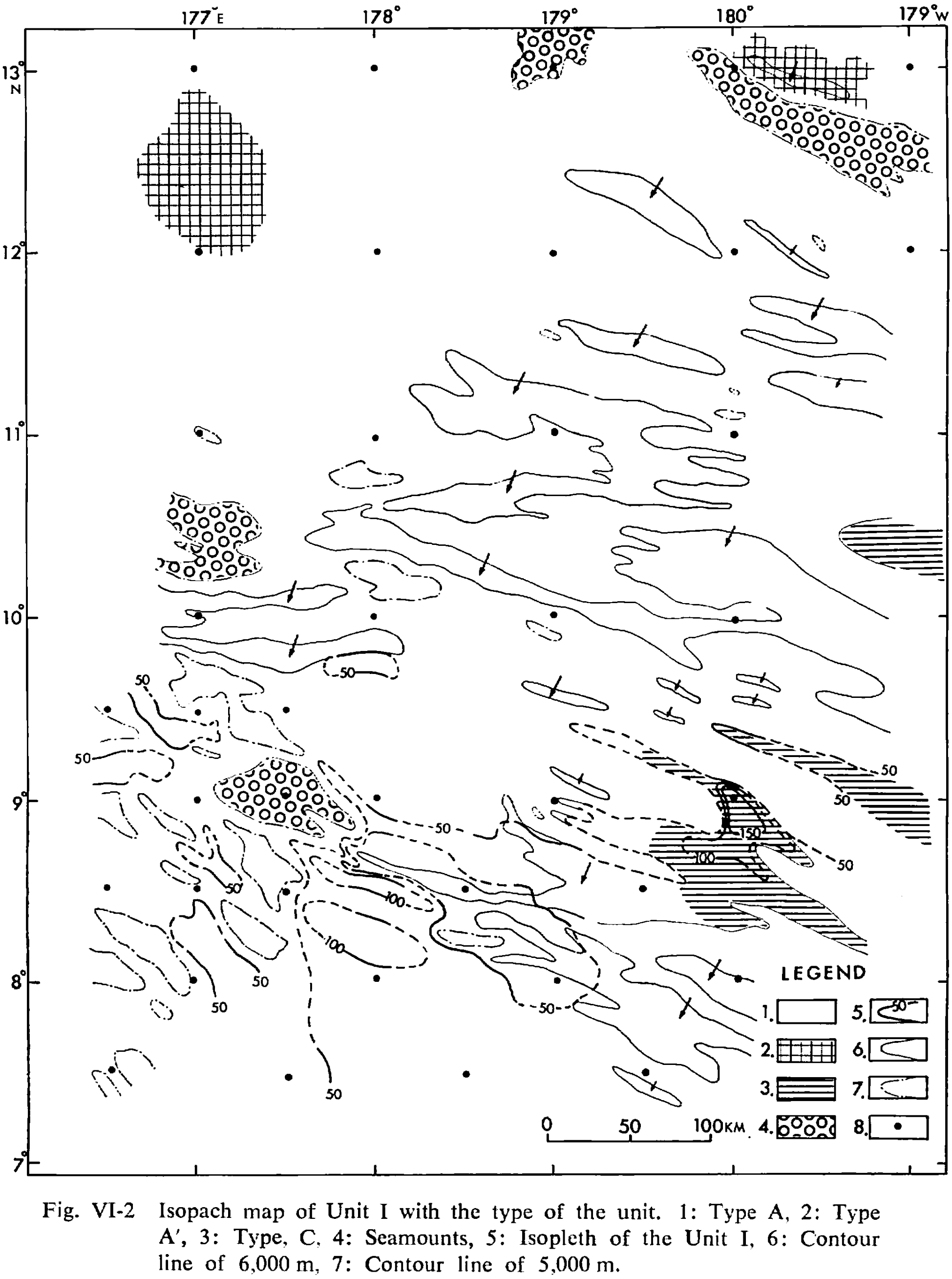


Fig. VI-2 Isopach map of Unit I with the type of the unit. 1: Type A, 2: Type A′, 3: Type, C, 4: Seamounts, 5: Isopleth of the Unit I, 6: Contour line of 6,000 m, 7: Contour line of 5,000 m.

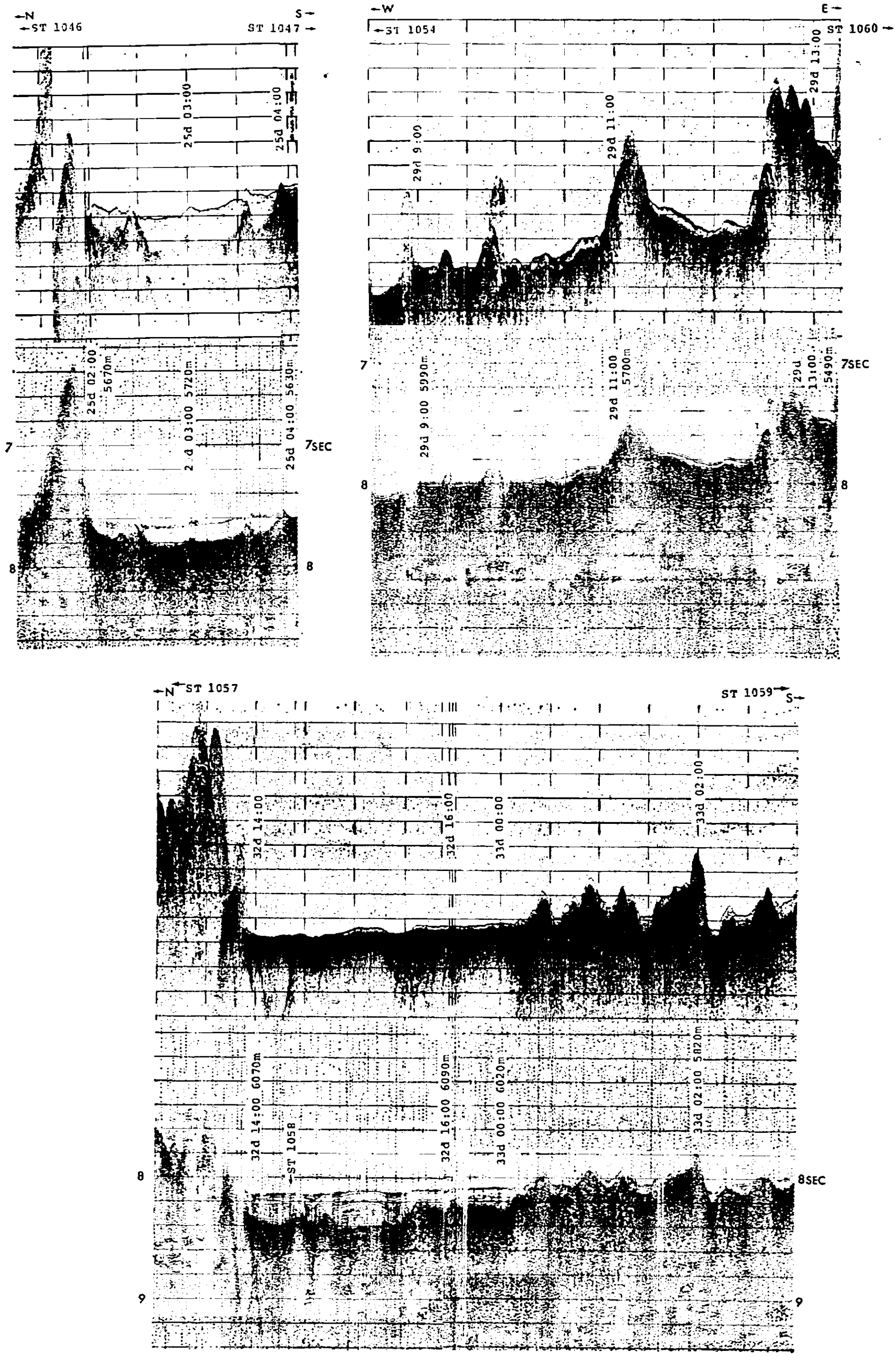


Fig. VI-3 Comparison of the records by 3.5 kHz PDR and seismic (air-gun) reflection.

VI-3c. However the type has opaque nature and also upper transparent layer on the 3.5 kHz PDR record, contrary to the absence of clear upper transparent layer on seismic record.

Unit I of Type C is distributed only in the southeastern part of the survey area (northwest of the Magellan Rise), burying troughs underlain by Unit II and forming rather flat sea bottom surface. The thickness of Unit I of this type varies from 0.07–0.28 sec. (50 m–210 m) attaining the maximum thickness of Unit I in the whole survey area.

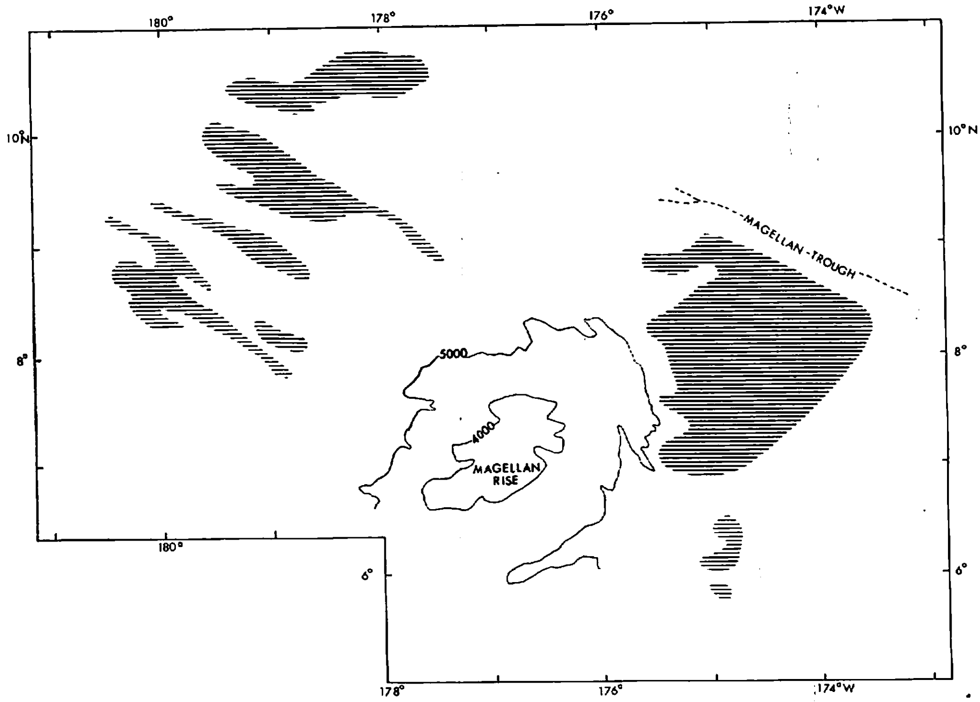


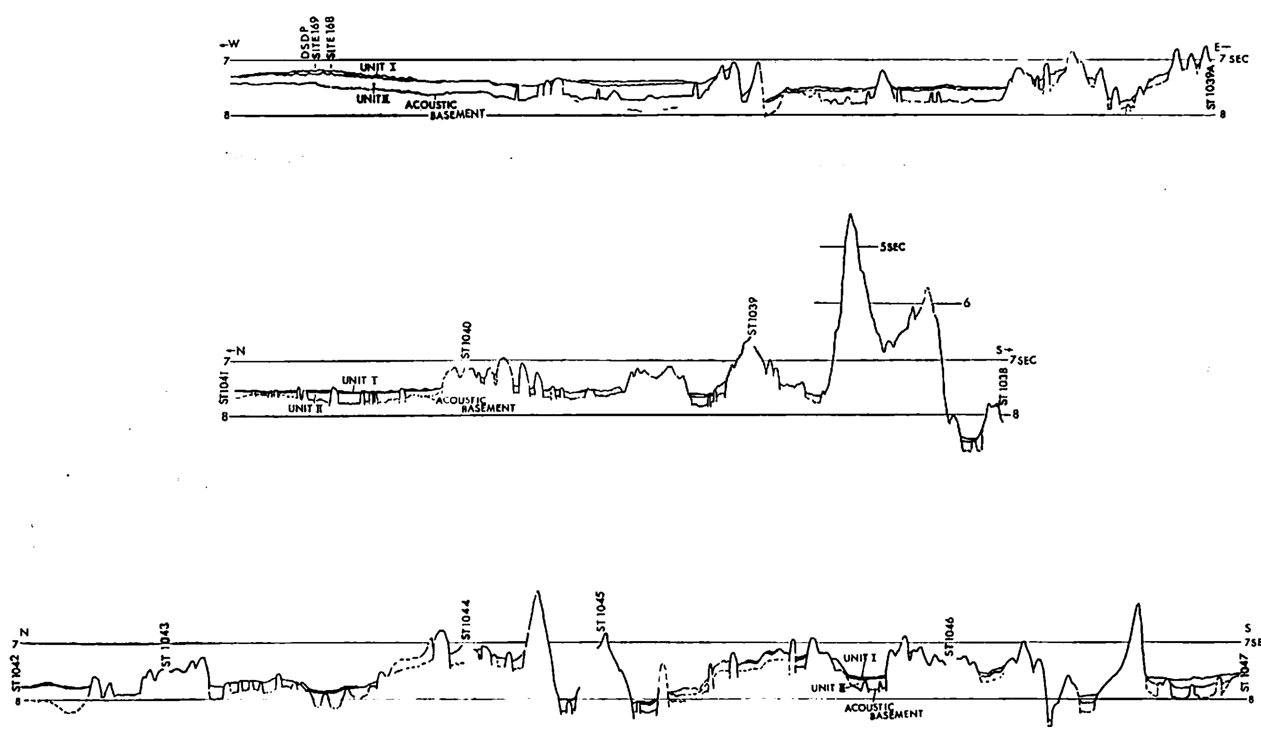
Fig. VI-4 Compiled map of the distribution of Type C of Unit I in the areas of GH78-1, GH77-1 and GH76-1 cruises.

Type C has been recognized in the previous cruises, i.e. GH76-1 (Tamaki, 1978) and GH77-1 (Murakami *et al.*, 1979). Together with the present and these results, the distribution of Type C is delineated in Fig. VI-4. As shown in the figure it is restricted in northwest and northeast of Magellan Rise, within the distance of about 240 miles from the Rise and at the depth of about 6,000 m.

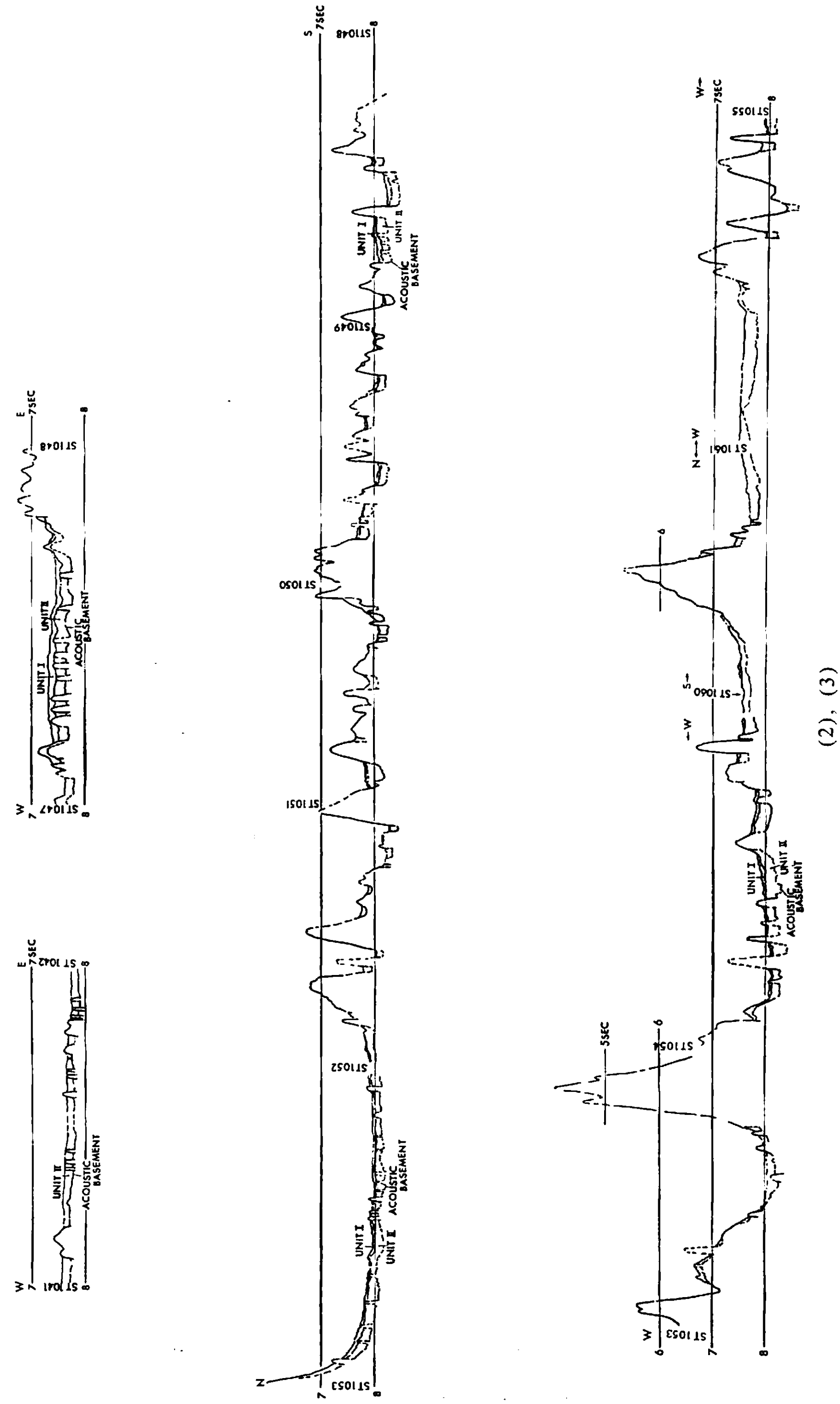
Acoustic features and distribution of Type C suggest that the sediments composing Unit I of Type C derived from the Rise sediments.

Unit II: Unit II is a semiopaque layer and presumably a consolidated sedimentary layer, according to the data of DSDP, Site 170. The feature of this unit shows local variation, and a strong reflector exists in some cases. Thickness

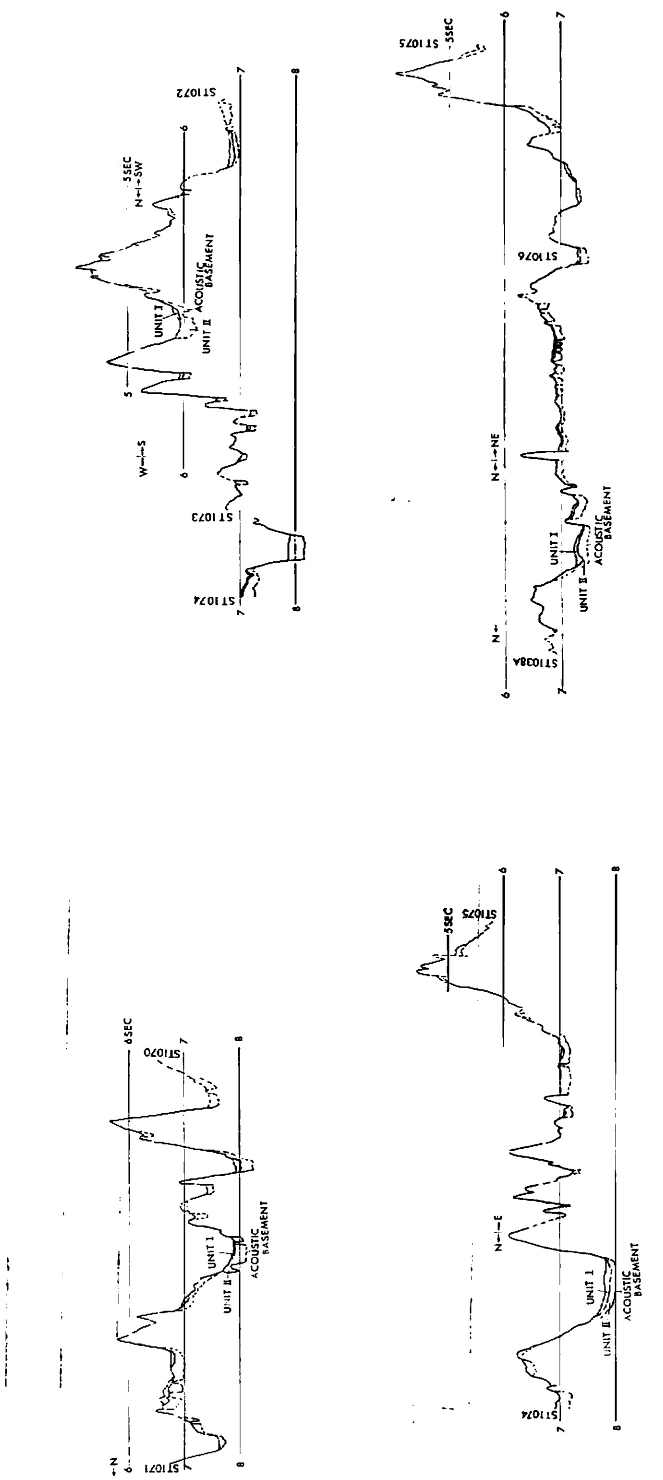
Fig. VI-5 (1)-(5) Diagram of seismic record along the ship's track.



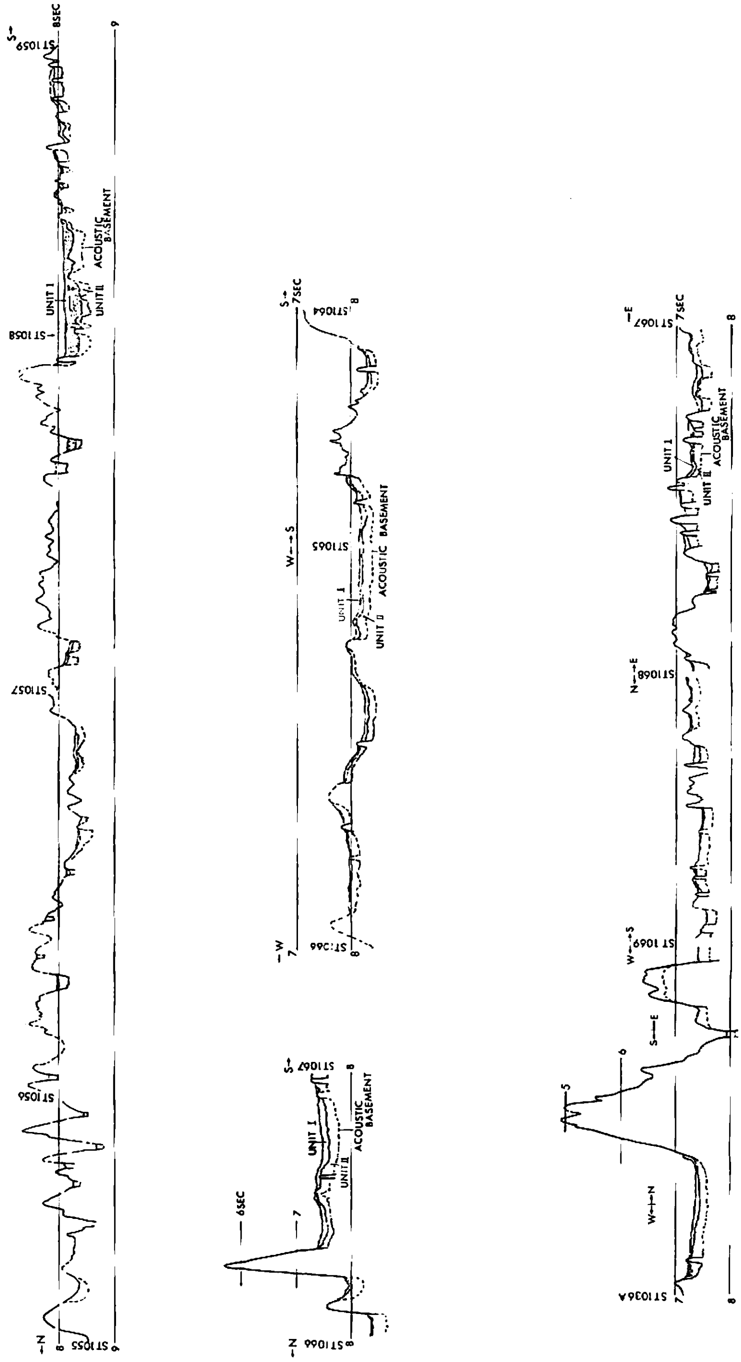
(1)


W
E
7SEC
ST1041
ST1042
ST1047
ST1048
UNIT I
UNIT II
ACOUSTIC BASEMENT
S
N
ST1049
ST1050
ST1051
ST1052
ST1053
ST1054
ST1055
ST1060
ST1061
5SEC

(2), (3)

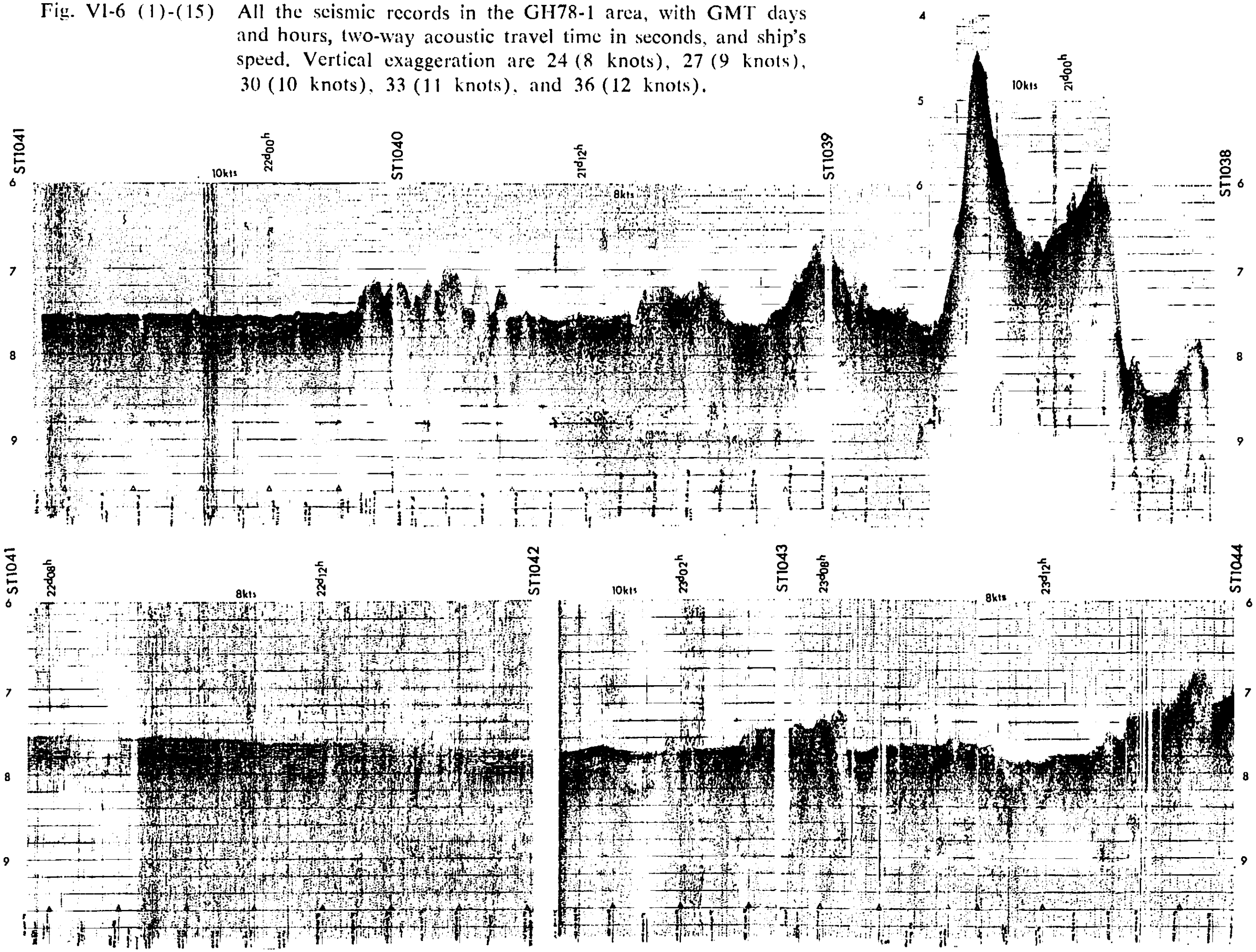

ST1071
ST1070
6SEC
UNIT I
UNIT II
ACOUSTIC BASEMENT
N←I→E
ST1074
ST1075
5SEC
W←I→S
N←I→SW
ST1073
ST1072
ST1076
ST1038A
N←I→NE

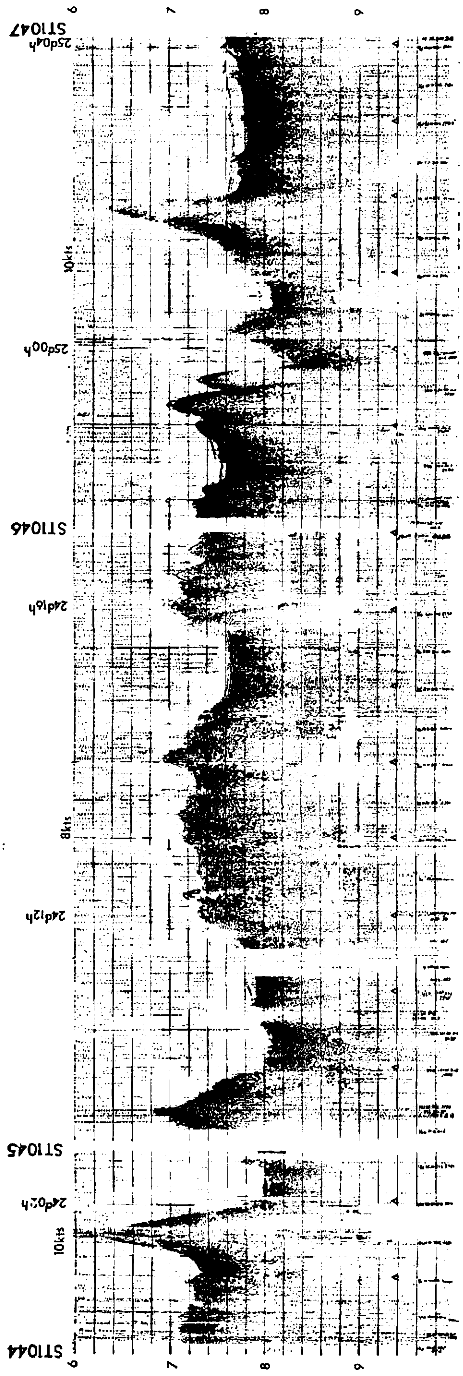
(4)


N
ST1055
ST1056
ST1057
ST1058
ST1059
S
8SEC
9
8
UNIT I
UNIT II
ACOUSTIC BASEMENT
ST1066
N
6SEC
7
ST1067
S
W
ST1064
ST1065
W—S
7SEC
ST1036A
W—N
5
6
S—E
W—S
ST1069
N—E
ST1068
E

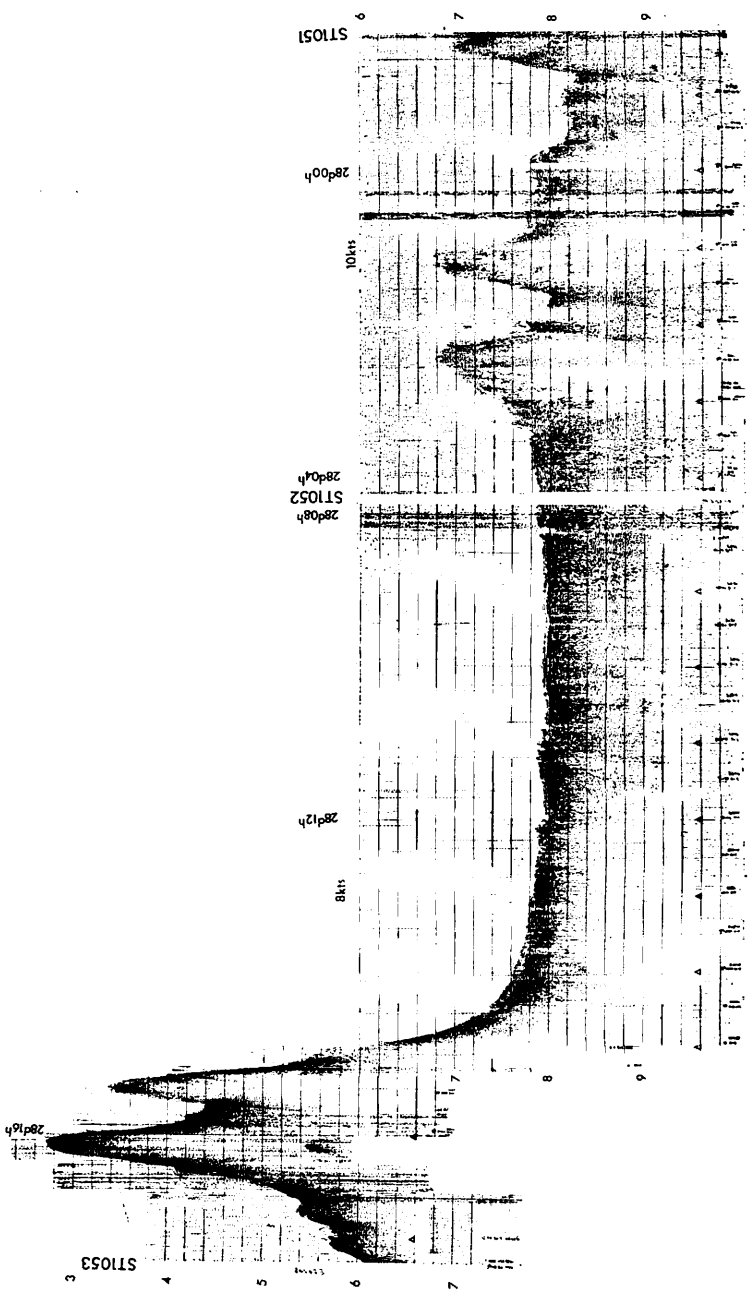
(5)

Fig. VI-6 (1)-(15) All the seismic records in the GH78-1 area, with GMT days and hours, two-way acoustic travel time in seconds, and ship's speed. Vertical exaggeration are 24 (8 knots), 27 (9 knots), 30 (10 knots), 33 (11 knots), and 36 (12 knots).

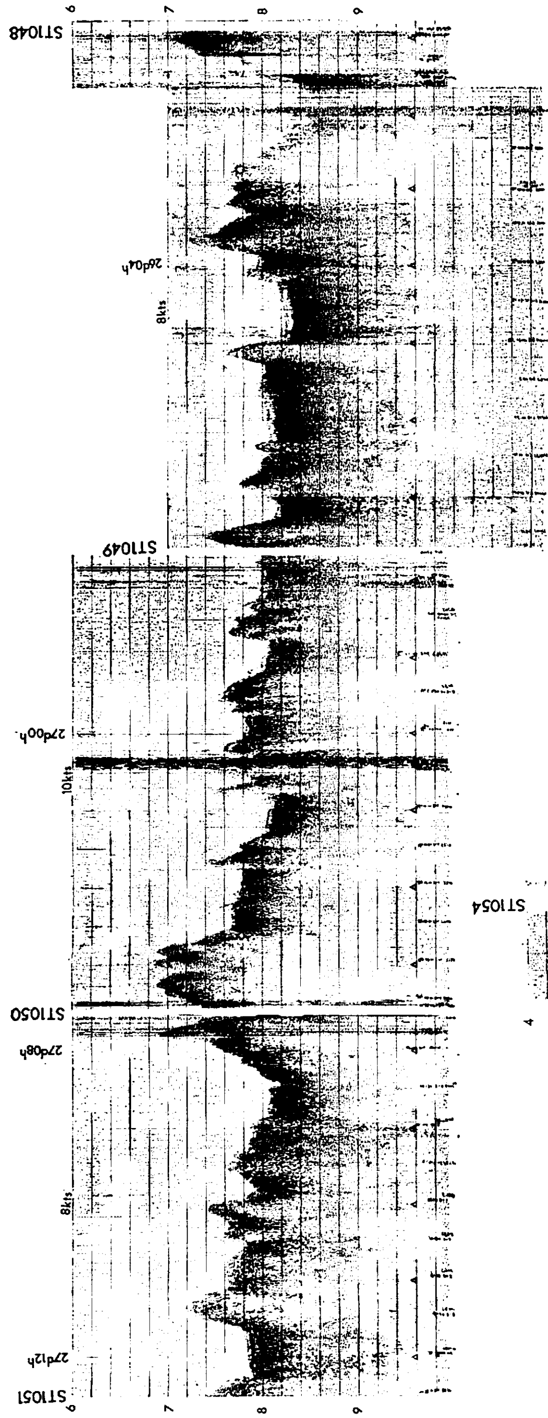



ST1044
ST1045
ST1046
ST1047
24d02h
24d12h
24d16h
25d00h
25d04h
10kts
8kts

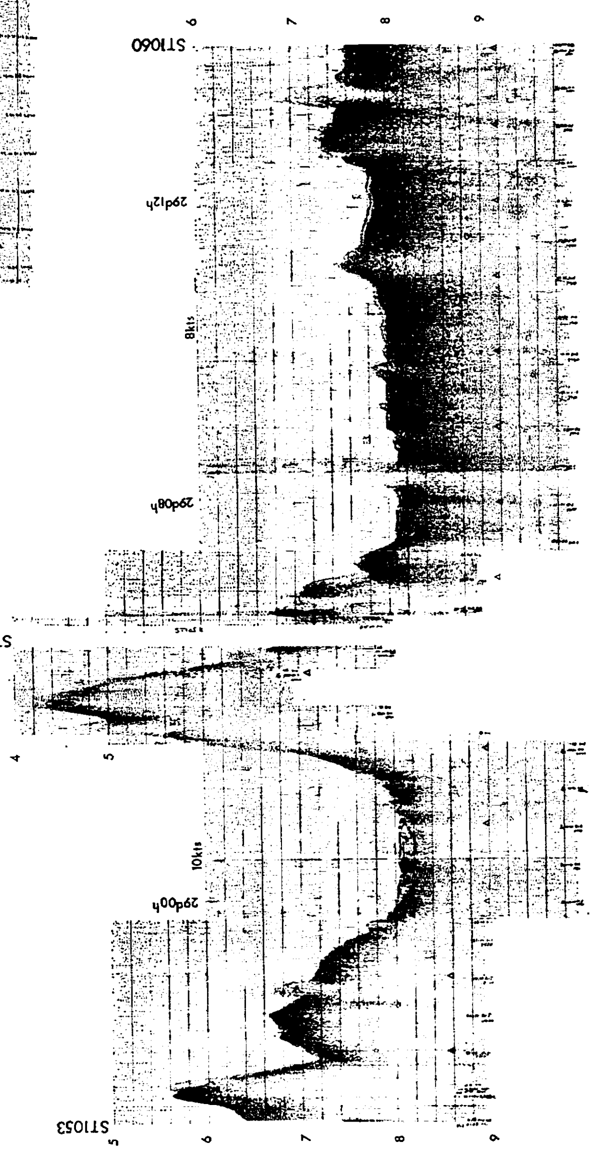
(3)


ST1051
ST1052
ST1053
28d00h
28d04h
28d08h
28d12h
28d16h
10kts
8kts

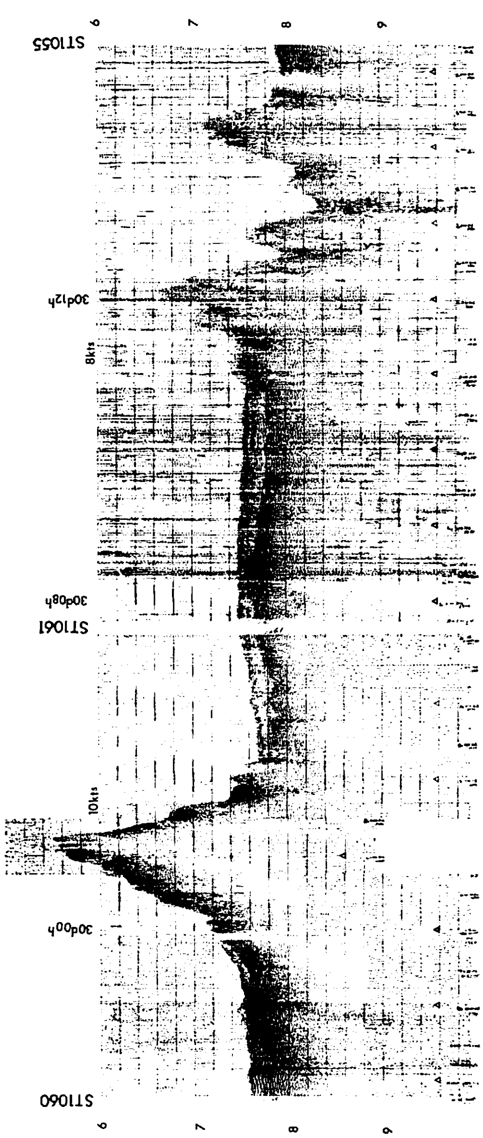
(4)


ST1048
ST1049
ST1050
ST1051
26d04h
27d00h
27d08h
27d12h
8kts
10kts
6
7
8
9

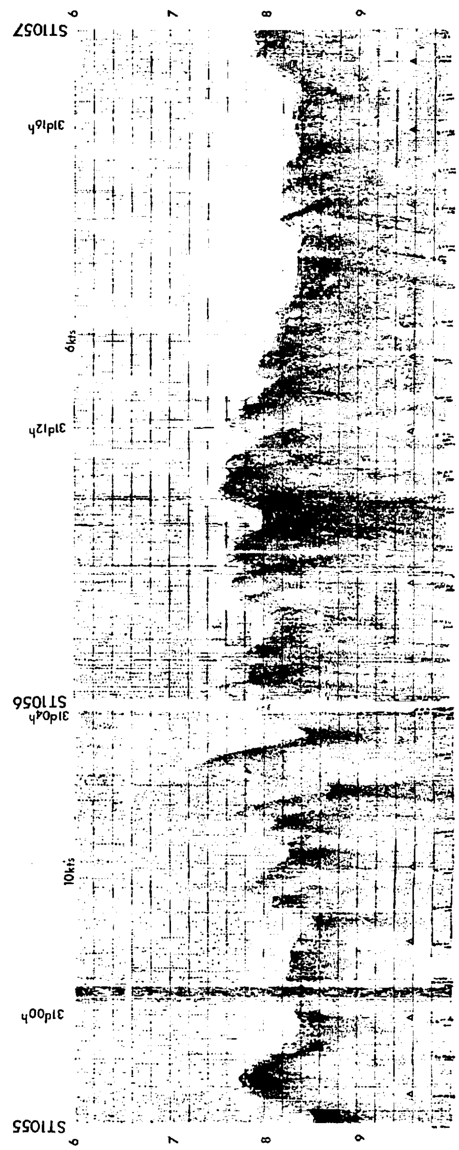
(5)


ST1053
ST1054
ST1060
29d00h
29d08h
29d12h
8kts
10kts
4
5
6
7
8
9

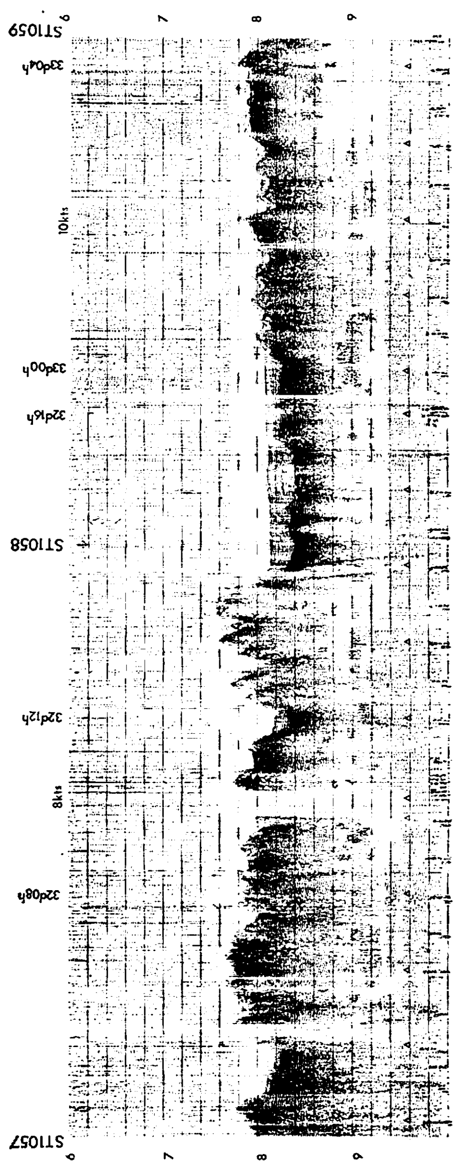
(6)


ST1055
ST1061
ST1060
30d12h
30d08h
30d00h
8kts
10kts
6
7
8
9

(7)

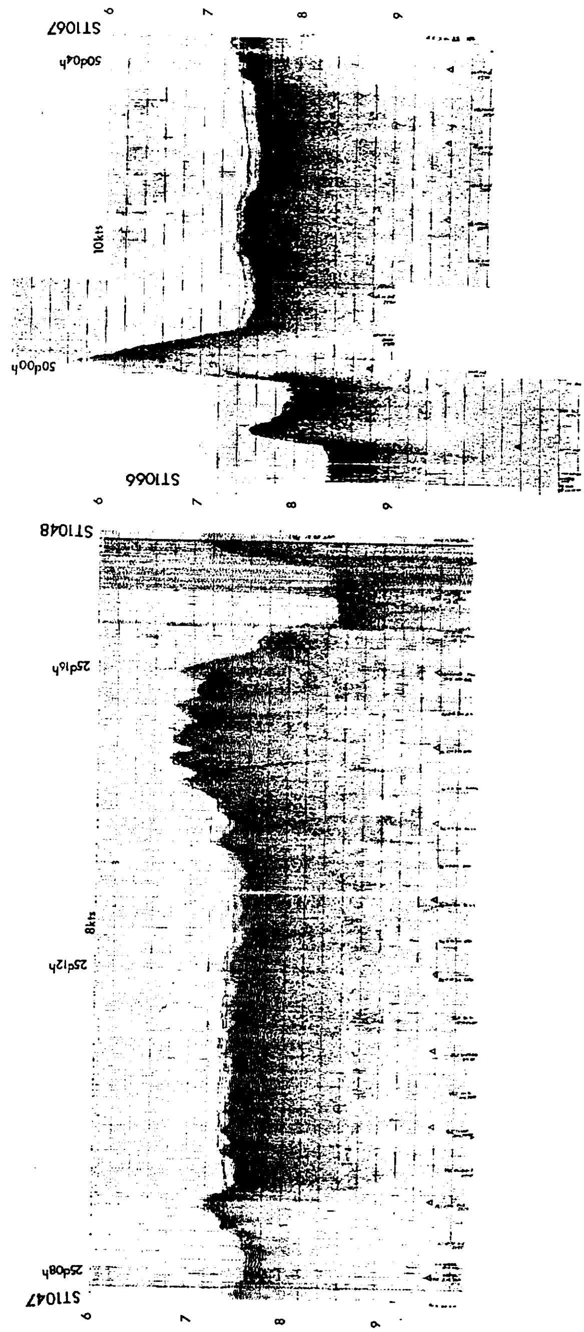

ST1057
ST1056
ST1055
31d16h
31d12h
31d04h
31d00h
6kts
10kts
6
7
8
9

(8)



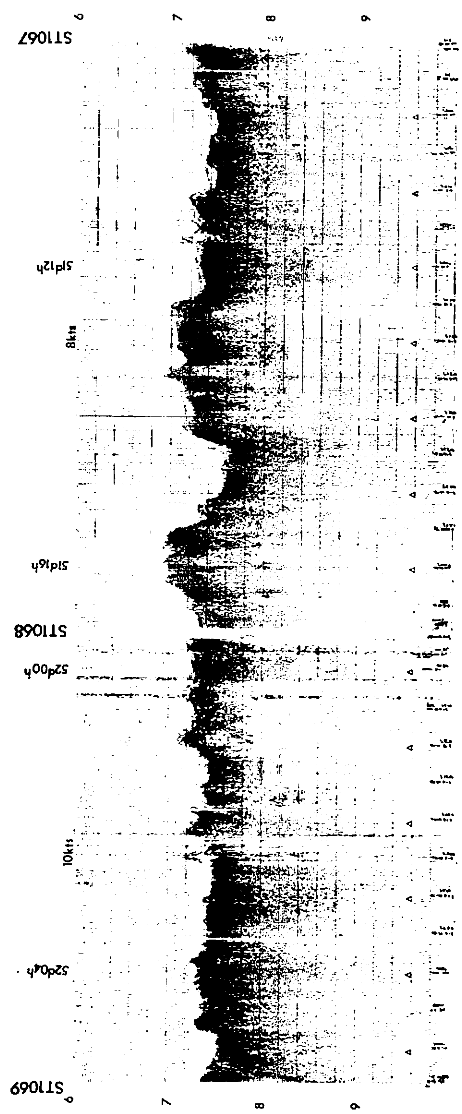
ST1057
32d08h
8kts
32d12h
ST1058
32d16h
33d00h
10kts
33d04h
ST1059

(9)



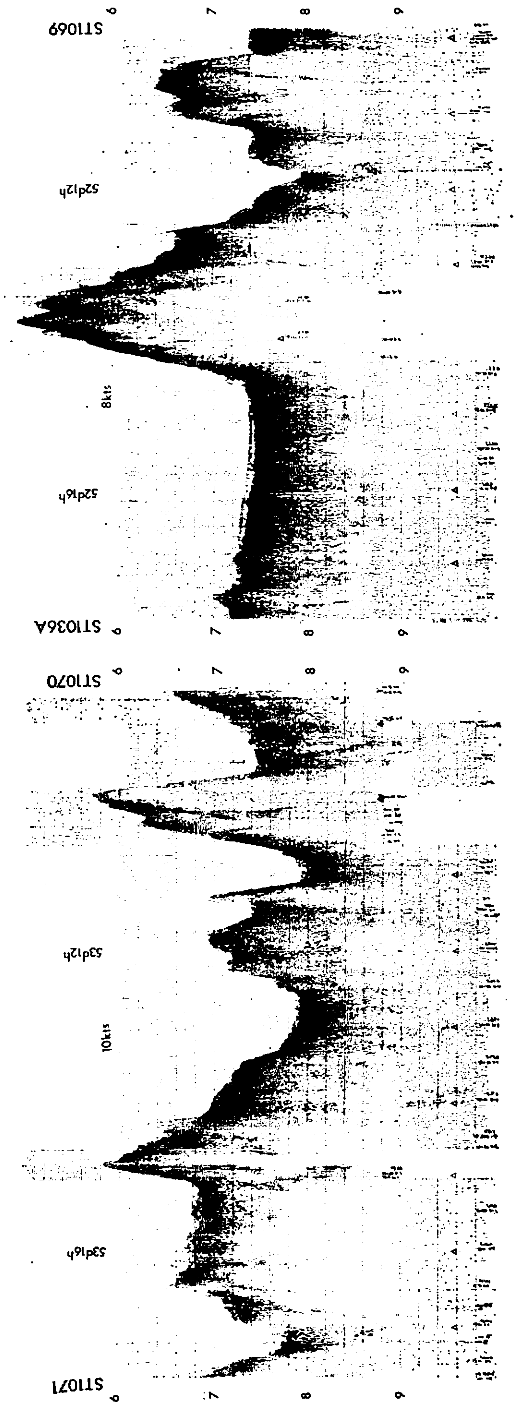
ST1047
25d08h
25d12h
8kts
25d16h
ST1048
ST1066
50d00h
10kts
50d04h
ST1067

(10)



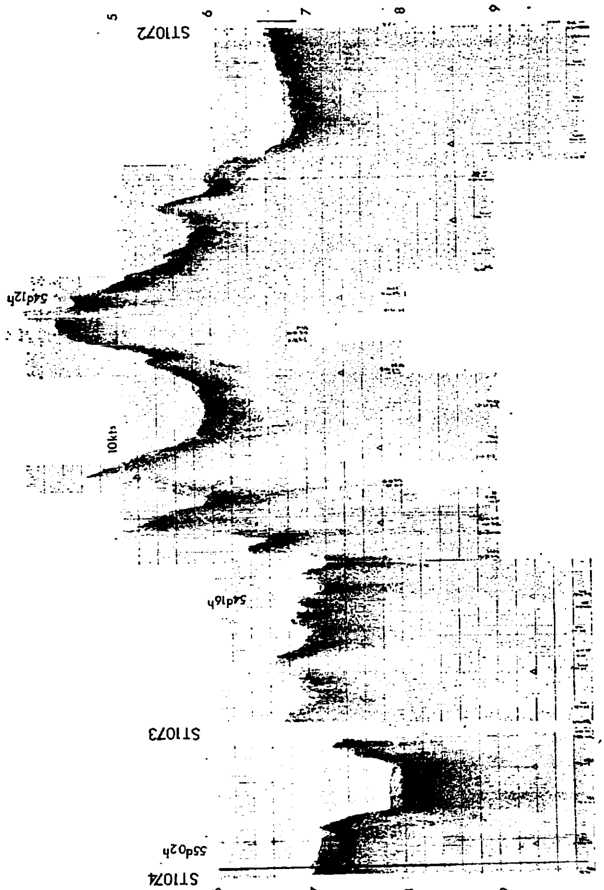
ST1069
52d04h
10kts
52d00h
ST1068
51d16h
8kts
51d12h
ST1067
6
7
8
9

(11)

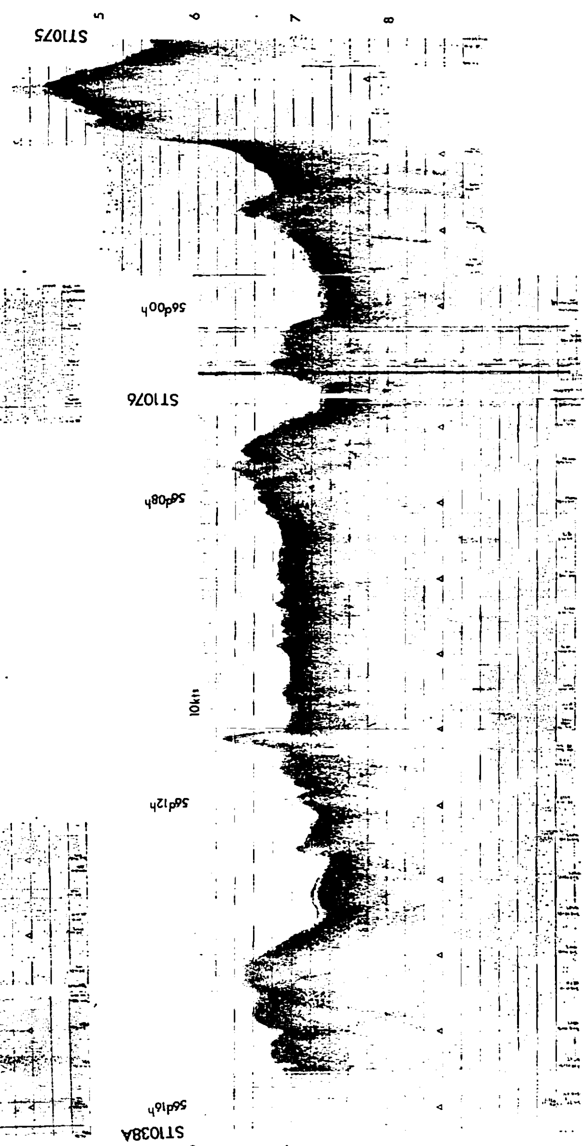


ST1071
53d16h
10kts
53d12h
ST1070
ST1036A
52d16h
8kts
52d12h
ST1069
6
7
8
9

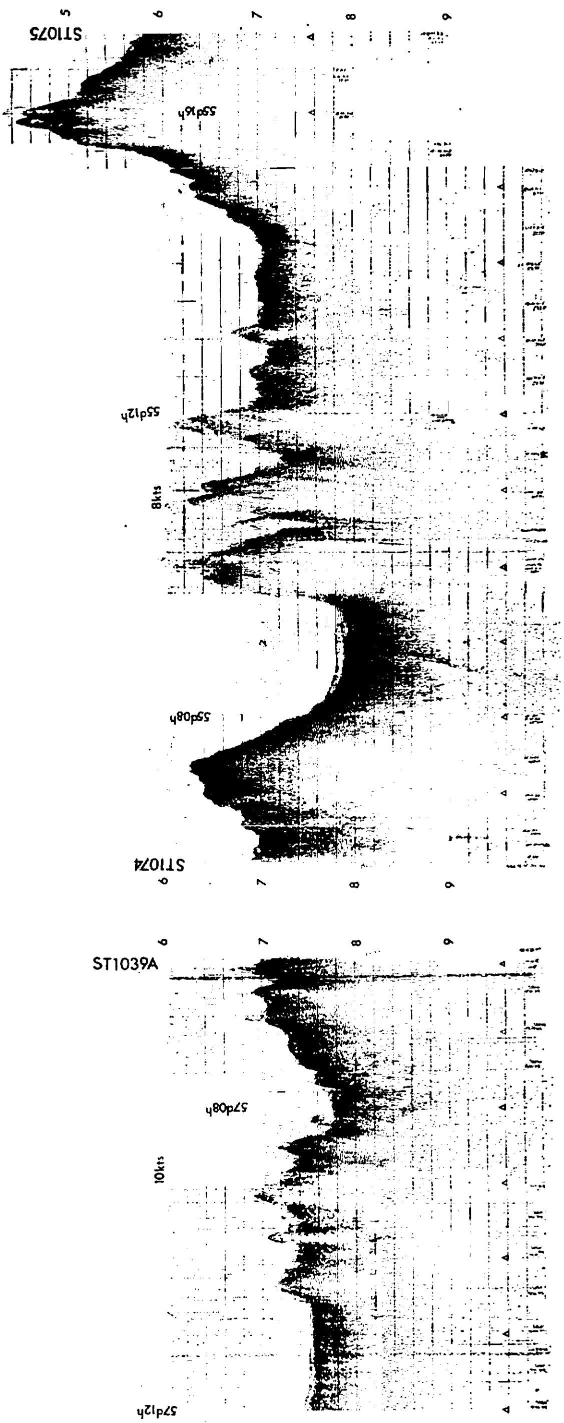
(12)


ST1072
54d12h
10kts
54d16h
ST1073
55d02h
ST1074

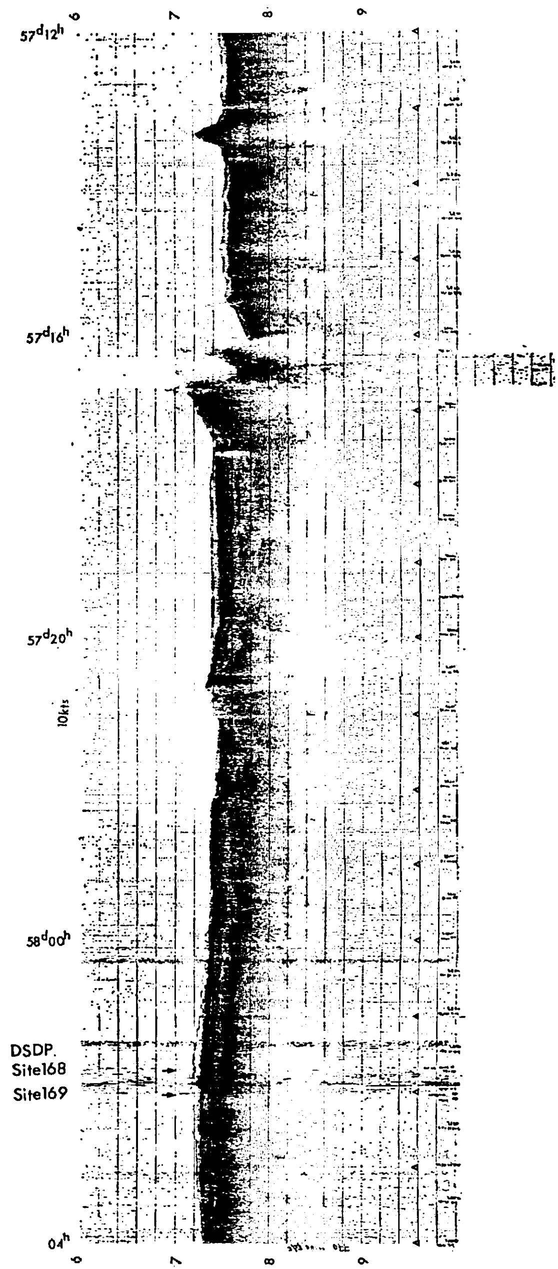
(13-1)


ST1075
56d00h
ST1076
56d08h
10kts
56d12h
56d16h
ST1038A

(13-2)


ST1075
55d16h
55d12h
8kts
55d08h
ST1074
ST1039A
57d08h
10kts
57d12h

(14)


57d12h
57d16h
57d20h
10kts
58d00h
DSDP.
Site168
Site169
04h

(15)

of the layer varies from 0.05 to 0.25 sec. (50–250 m, assuming the acoustic velocity of 2.0 km/sec), though it does not show any areal or systematic tendency.

Acoustic basement: The DSDP data suggest that the acoustic basement of this area consists mainly of basalt. The surface of basement rolls all over the survey area, and some projections of the basement exist in the Unit I or even on the sea floor. The boundary between the basement and Unit II is obvious in the northeastern abyssal plain area, but usually not clear in the rest of the survey area.

References

MURAKAMI, F. and MORITANI, T. (1979) Continuous seismic reflection profiling survey. *In* T. MORITANI (*ed.*), *Geol. Surv. Japan Cruise Rept.*, no. 12, p. 74–102.

TAMAKI, K. (1977) Study on substrate stratigraphy and structure by continuous seismic reflection profiling survey. *In* A. MIZUNO and T. MORITANI (*eds.*), *Geol. Surv. Japan Cruise Rept.*, no. 8, p. 51–62.

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.