33. *DATA REPORT:* VERTICAL SEISMIC PROFILE DATA, HOLE 808E, NANKAI TROUGH[1]

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INTRODUCTION

We acquired a vertical seismic profile (VSP) in Hole 808E during Leg 131. The original intent was to determine the detailed velocity-depth structure of the drilled section, to determine attenuation with depth, and to produce a synthetic seismogram to tie the section drilled at Site 808 to the regional seismic reflection data (see Gal'perin, 1974, and Hardage, 1985, for further explanation of VSP techniques). The strong Kuroshio Current caused excessive banging of the drill pipe during the experiment, however, so the resulting VSP is very noisy and most of the pre-cruise goals could not be attained. This paper reports the results of post-cruise processing and interpretation of the VSP.

DATA ACQUISITION AND PROCESSING

Details of the basic acquisition scheme are described in Taira, Hill, et al. (1991). The energy source was a 400-in.^{3} (6.6 L) water gun. Downgoing and reflected seismic waves were received by a Schlumberger well seismic tool (WST) within the cased section of the hole (76–524 mbsf). At least 10 shots were fired at each recording level in the borehole. The recording interval in the lower part of the hole was 30 ft (9.14 m); this interval was increased to 40 ft (12.2 m) at 515.4 mbsf. Because of poor coupling below the base of the casing, most of the recording levels were unusable. The total length of hole covered by usable VSP data is 76.5–533.7 mbsf. The seismic signals were sampled at 1-ms intervals with the Schlumberger-CSU logging data acquisition system and recorded in LIS format on digital tape. The data were then converted to SEG-Y format for post-cruise processing.

Processing was carried out at the University of Hawaii on an Alliant FX/8 computer using Phoenix Vector software from Seismograph Service. The data were first resampled to 2-ms samples and band-pass filtered at 15-24-124-148 Hz. All shots were then plotted and visually inspected. Shots that were obviously noisy or had poor first arrivals were deleted. The remaining shots for each depth were then summed using a median stack algorithm and displayed (Figs. 1 and 2). First arrival times were then added to each stacked trace and a plot of two-way traveltime vs. depth was produced (Fig. 3).

RESULTS

We picked first-arrival times on a workstation running GeoQuest Systems' Interactive Exploration System (IES) software. Large-scale displays allowed the first arrivals to be picked with a precision of 0.5 ms. The accuracy of the picks was degraded, however, by the excessive noise that contaminated the VSP. The water-gun signal has a precursor positive peak followed by sharp negative and positive peaks. Because the precursor and first negative were somewhat variable from shot to shot, first-arrival times were picked at the mean time of the main positive peak (Table 1). Although this causes inaccuracies in the time-to-depth measurements, consistent picking allows the calculation of accurate interval velocities.

Interval velocities were calculated for each of the major stratigraphic units between the top and bottom of the VSP by running a linear regression on the depth-time pairs for the zone of interest (Table 1; Fig. 4). This procedure yields slightly higher interval velocities than simple division of the depth difference by the time difference for each interval.

Velocities calculated from the VSP data are generally consistent with those determined by downhole logging in the 90–150 m range and by two-ship SSP measurements (Stoffa et al., in press), but are much higher than the velocities determined from core measurements from 250 to 550 mbsf. We attribute this to either excessive rebound in the cores or inappropriate corrections made to the core data.

The interval velocity of the frontal thrust is very high (2382 m/s; Fig. 5). This high-velocity layer is imaged on the seismic reflection data (Moore et al., 1990; 1991). The high velocity indicates that the frontal thrust is a zone of significant porosity reduction.

ACKNOWLEDGMENTS

I am grateful to Bill Mills and Kazushi Kuroki for operating the water gun during the VSP operation; Scott Shannon operated the Schlumberger acquisition system. Pat Cooper reviewed an early draft of the manuscript. Support for the VSP acquisition was provided by USSAC.

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Date of initial receipt: 28 October 1991
Date of acceptance: 25 March 1992
Ms 131SR-140

[1] Hill, I.A., Taira, A., Firth, J.V., et al., 1993. *Proc. ODP, Sci. Results,* 131: College Station, TX (Ocean Drilling Program).

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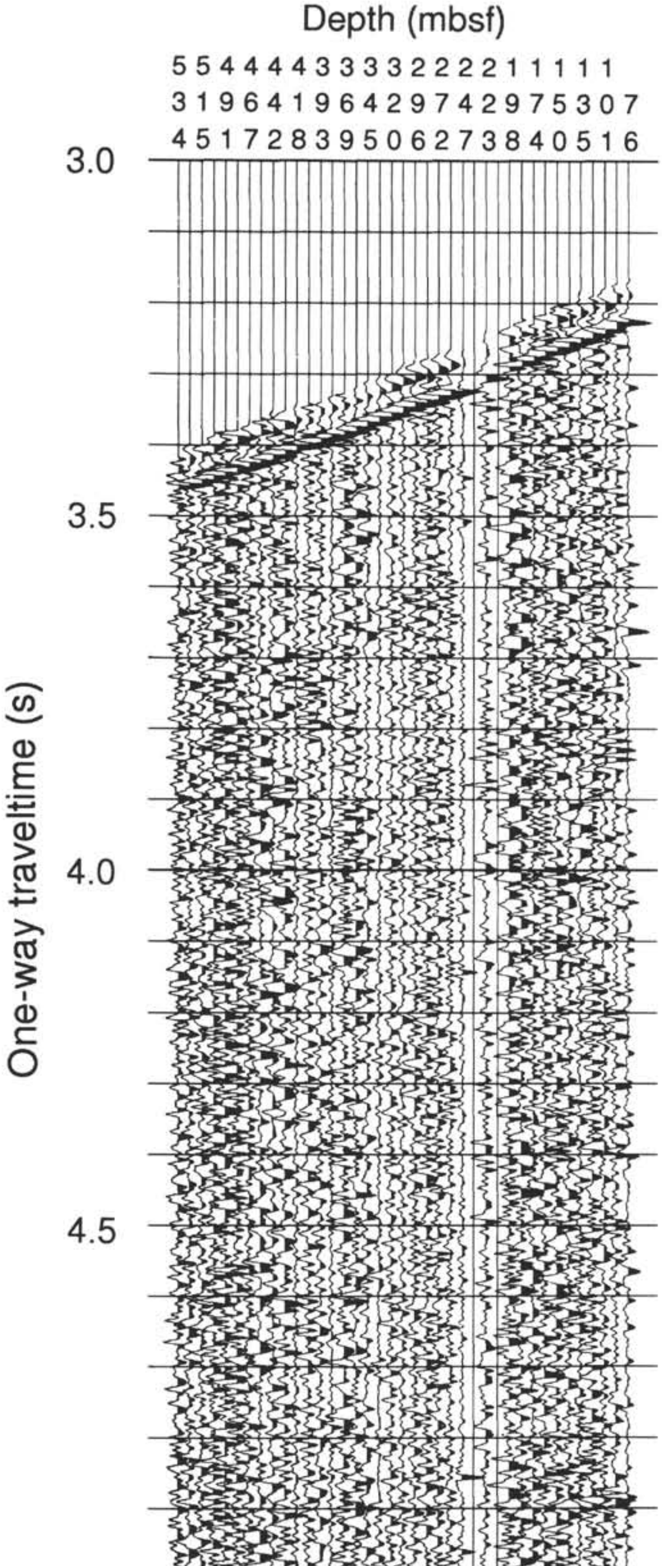

Figure 1. Filtered (15-24-124-148 Hz) and median stacked VSP data.

Table 1. Interval velocity vs. depth determined from Site 808 VSP data.

One-way traveltime (s)	Depth (mbsf)	Interval velocity (m/s)
3.2260	76.5	
3.2340	88.7	1762
3.2400	100.9	
3.2470	113.1	
3.2530	125.2	
3.2600	137.4	
3.2660	149.6	
3.2710	161.8	
3.2780	174.0	1795
3.2850	186.2	
3.2920	198.4	
3.3060	222.8	
3.3280	259.4	
3.3340	271.5	
3.3410	283.7	
3.3450	295.9	
3.3500	308.1	1949
3.3570	320.3	
3.3640	332.5	
3.3710	344.7	
3.3780	356.9	
3.3840	369.1	
3.3885	381.3	2564
3.3935	393.5	
3.4000	405.7	
3.4050	417.9	
3.4110	430.0	
3.4170	442.2	
3.4235	454.4	
3.4295	466.6	2101
3.4350	478.8	
3.4410	491.0	
3.4460	503.2	
3.4520	515.4	
3.4565	524.5	
3.4600	533.7	

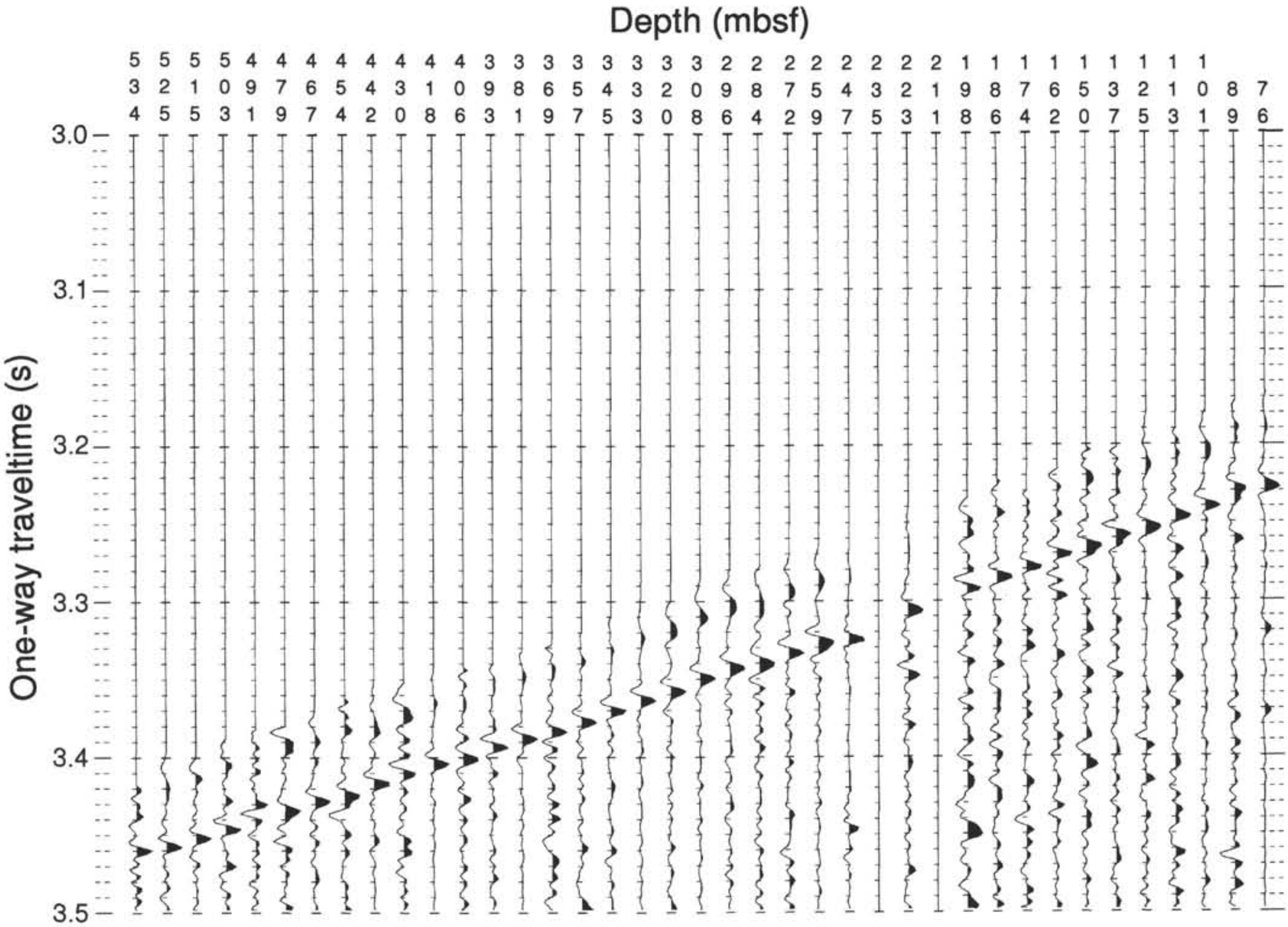

Figure 2. Detailed view of first arrivals of stacked VSP data. Traces at 211 and 235 mbsf were zeroed because of excessive noise.

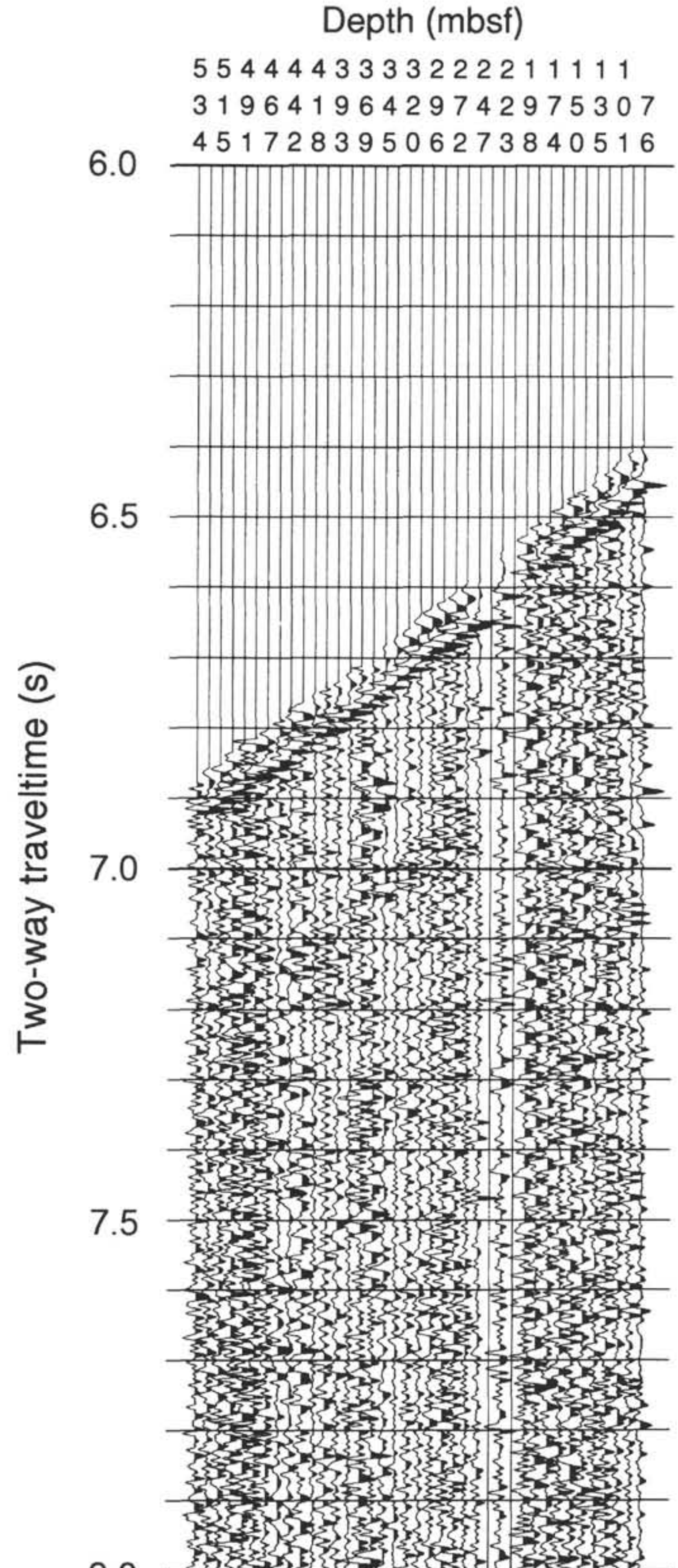

Figure 3. VSP data converted to two-way traveltime for comparison to seismic reflection data.

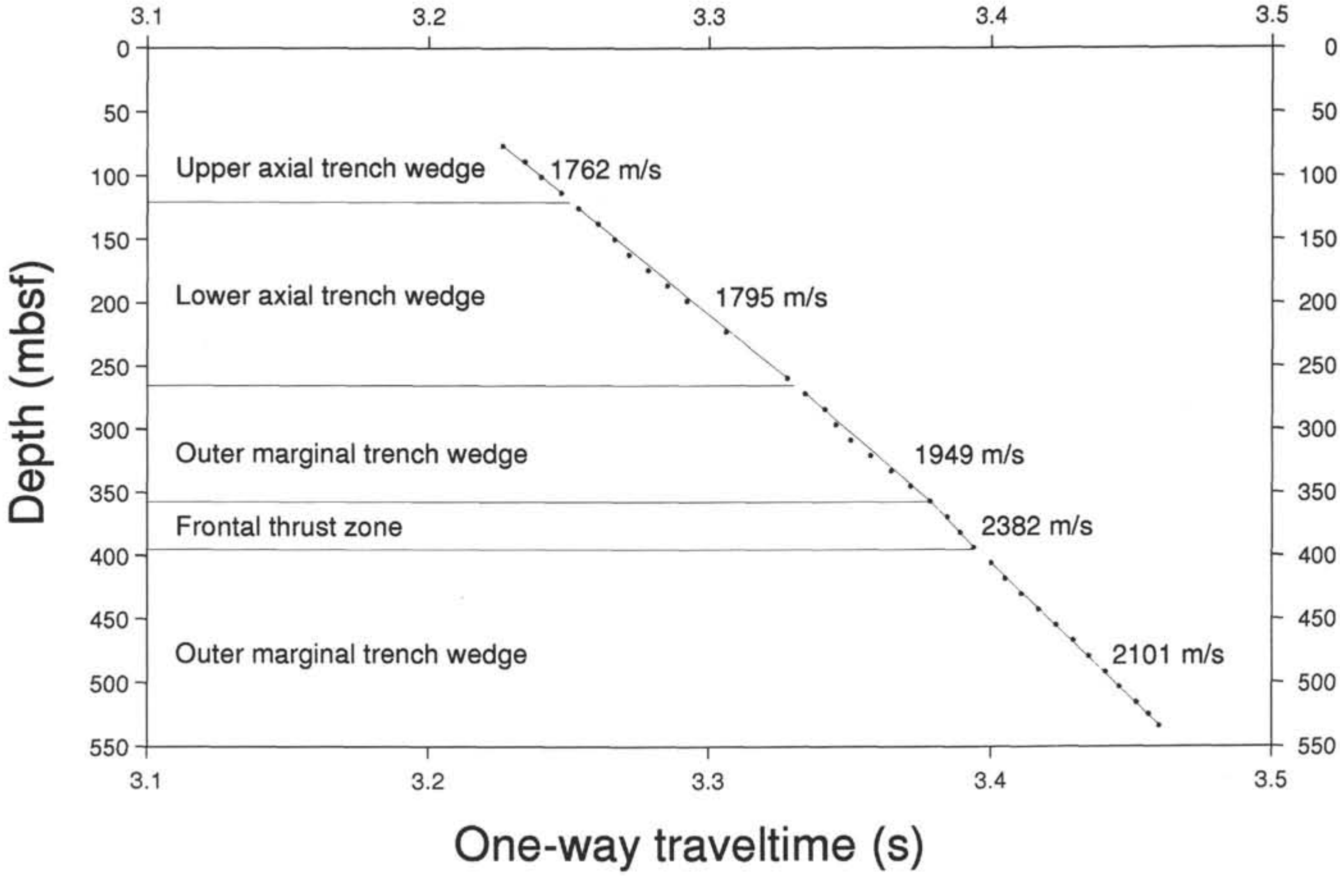

Figure 4. Plot of one-way traveltime vs. depth for VSP first arrivals. Velocities were determined by linear regression of indicated segments.

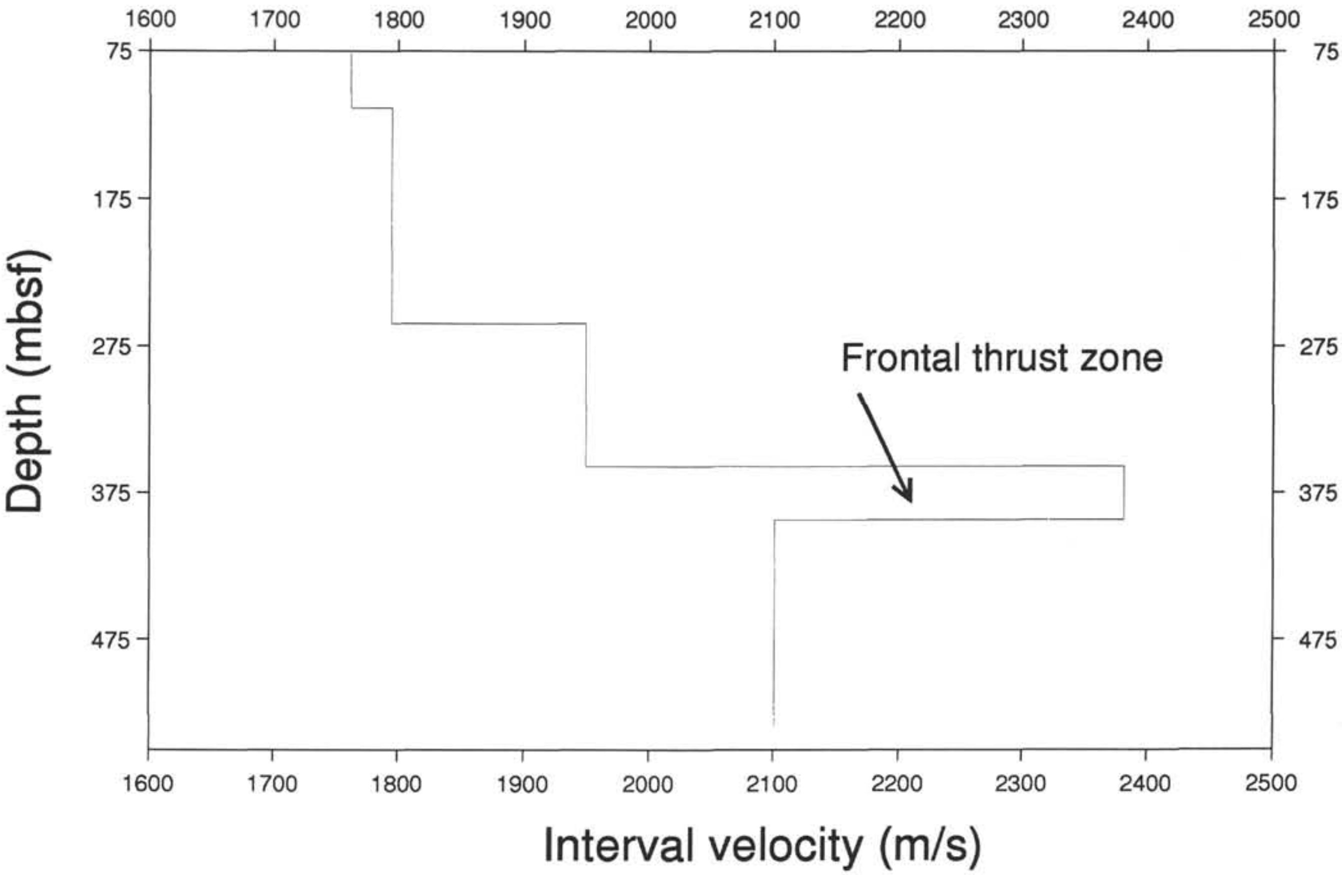

Figure 5. Interval velocity plot of VSP data.