Taira, A., Hill, I., Firth, J., et al., 1991
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# 3. UNDERWAY GEOPHYSICS[1]

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## INTRODUCTION

Geophysical data were collected by the *JOIDES Resolution* on Leg 131 while the ship was in transit from Guam to drill in the Nankai Trough. Magnetics and bathymetric data were collected during most of the transit; seismic reflection data were collected only across the Nankai Trough outer slope, trench axis, and lower inner slope during the approach to Site 808.

Site 808 (proposed Site NKT-2) is located on the first ridge of the Nankai Trough landward slope, just landward of the frontal thrust. The location of this site was based on multichannel seismic (MCS) profiles described by Moore et al. (this volume). Positioning the ship to core at the previously chosen location for Site 808 required using a combination of GPS navigation and recognition of bathymetric and structural features such as the seaward-sloping protothrust zone and the tops of the hanging wall anticlines at the base of the slope. The seismic reflection and bathymetric data reported here provided the tie needed to position the ship at the preferred location relative to the MCS lines.

## NAVIGATION DATA

Navigation data were collected both in the underway geophysics lab using a Magnavox MX1107 satellite-navigation system and on the bridge using a Magnavox MX4400 satellite-navigation system. The satellite receiver systems receive fixes from the Global Positioning System (GPS) at 60-s intervals. Positions obtained from GPS were recorded on magnetic tape each minute, and ship's speed and heading were recorded in the header of each shot on the seismic reflection data tapes. The ship's track approaching Site 808 is shown in Figure 1.

## BATHYMETRIC DATA

Bathymetric data were recorded with both 3.5- and 12-kHz echo-sounder systems. The signals were recorded on two Raytheon recorders at sweep speeds of 1 s (750-m scale). Bathymetric data were collected continuously and digitized at 5-min intervals during the transit from Guam to Site 808.

The 3.5-kHz profile from the outer trench slope (Shikoku Basin) across the trench and lowermost trench slope is illustrated in Figure 2. It shows the breaks in slope that define the outer trench slope, the trench floor, the seaward-sloping protothrust zone, and the first anticline at the base of the inner trench slope. The final location of Site 808 was chosen primarily on the basis of this record. The two portions of the 3.5-kHz profile (Fig. 2) indicate that the crossings of the basal thrust ridge were not at the same location. The depth of the

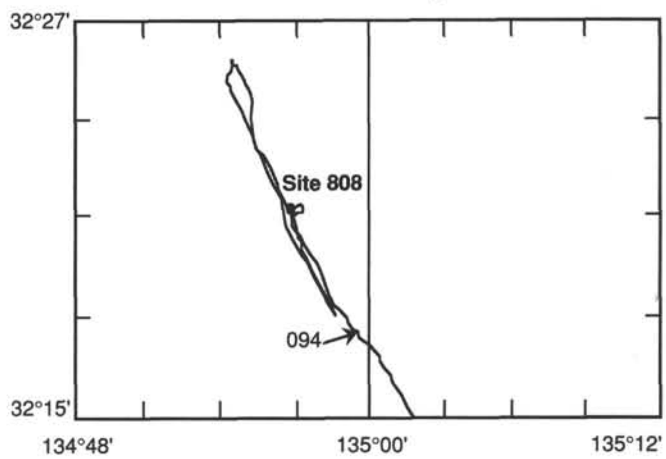


Figure 1. The *JOIDES Resolution* track across Site 808.

ridge crest on the first crossing is 4654 m (4668 corrected m), while the depth on the second crossing is 4647 m (4661 corrected m).

Sub-bottom penetration on the 3.5-kHz profile decreases from about 60 m in the Shikoku Basin hemipelagites seaward of the trench, to approximately 40 m on the outer trench slope, to less than 30 m in the trench. This decrease in penetration probably reflects the increase in grain size of the sediments on the outer trench slope and in the trench axis. The horizontally stratified trench sediments onlap the strata of the outer trench slope at a distinct break in slope (Fig. 2). The trench floor is not completely flat in this area. The seaward portion has a slight landward surface dip, whereas the landward portion has a slight seaward dip. This seaward-dipping region is probably a slump apron of debris shed off the rising protothrust zone. This slump apron is well imaged on the IZANAGI side-scan sonar record (Fig. 6, Geological Background and Objectives chapter, this volume).

A second break in slope defines the boundary between the flat-lying trench strata and the seaward-dipping protothrust zone. Penetration decreases to less than 20 m in the protothrust zone. The shallowest point in the proto-thrust zone is about 60 m above the trench floor. Site 808 is located at the top of the diffraction hyperbola defining the first thrust ridge landward of the protothrust zone.

## MAGNETIC DATA

Total-intensity measurements of the earth's magnetic field were obtained with a Geometrics 801 proton precession magnetometer. The sensor was towed approximately 500 m astern during the transit from Guam to Site 808. Measurements were made at 3-s intervals with 1-nT sensitivity. The data were recorded in analog format on a graphics recorder, in digital format on SEG-Y seismic tapes (1 reading every 12 s during the seismic survey; 1 reading per min during the nonseismic transit), and manually every 5 min in the under-

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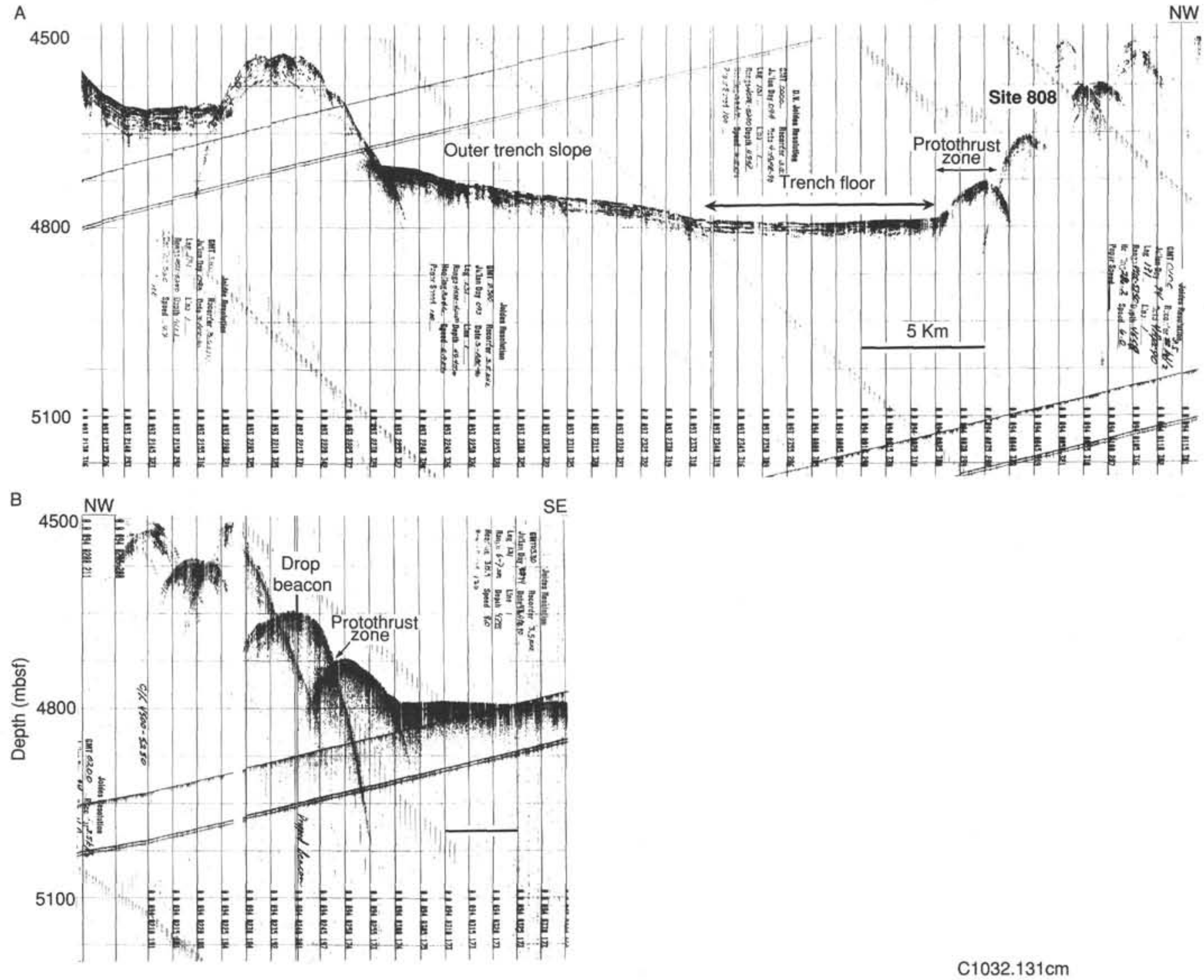


Figure 2. The 3.5-kHz record across Nankai Trough in the Leg 131 drilling area. Location is shown in Figure 1. **A.** Crossing from southeast to northwest. Note sharp bathymetric breaks at the seaward margin of the trench and at the deformation front. **B.** Crossing from northwest to southeast. The beacon drop position is shown.

way geophysical log. Magnetics data have not been reduced, but copies of the field data are available from ODP.

## SEISMIC REFLECTION DATA

Single-channel seismic-reflection data were collected across the trench during the approach to Site 808. The seismic source was two 200 $in.^3$ (3.3 L) water guns operating at 1800–2000 psi (124–138 bar) and towed about 14 m apart and 50 m behind the ship. The water guns were fired at a 12-s repetition rate. Reflections were received by a Teledyne streamer that included a 100-m- long active section containing 60 hydrophones. The head of the streamer was about 500 m behind the ship. The source and receivers were intended to have been towed at depths of 8–10 m, but because of heavy following seas, they were probably much shallower.

The seismic signals were passed through an analog bandpass filter (25–250 Hz) before being sent to a Masscomp 561 computer, that recorded the seismic data on magnetic tape. Five seconds of data were recorded at a 1-ms sample rate in SEG-Y format at 1600 bpi. The data were also displayed in analog form on two Raytheon recorders at sweep rates of 5 and 8 s, with filter settings of 30–150 Hz.

### Seismic Processing

The seismic-reflection line was processed on board during drilling of Site 808, using the SIOSEIS processing package on the Masscomp computer. Reprocessing, using the parameters shown in Table 1, was completed at the University of Hawaii.

**Table 1. Processing and display parameters of the Leg 131 seismic line.**

1. Bandpass filter (24-32-72-96 Hz)
2. Resample from 1 ms to 2 ms
3. Trace mix (3 traces with 1-3-1 weighting)
4. Mute to water bottom
5. Finite-difference migration
6. Mute to water bottom
7. Automatic gain control (AGC) (500-ms window length)
8. Plot (22-in. Versatec)

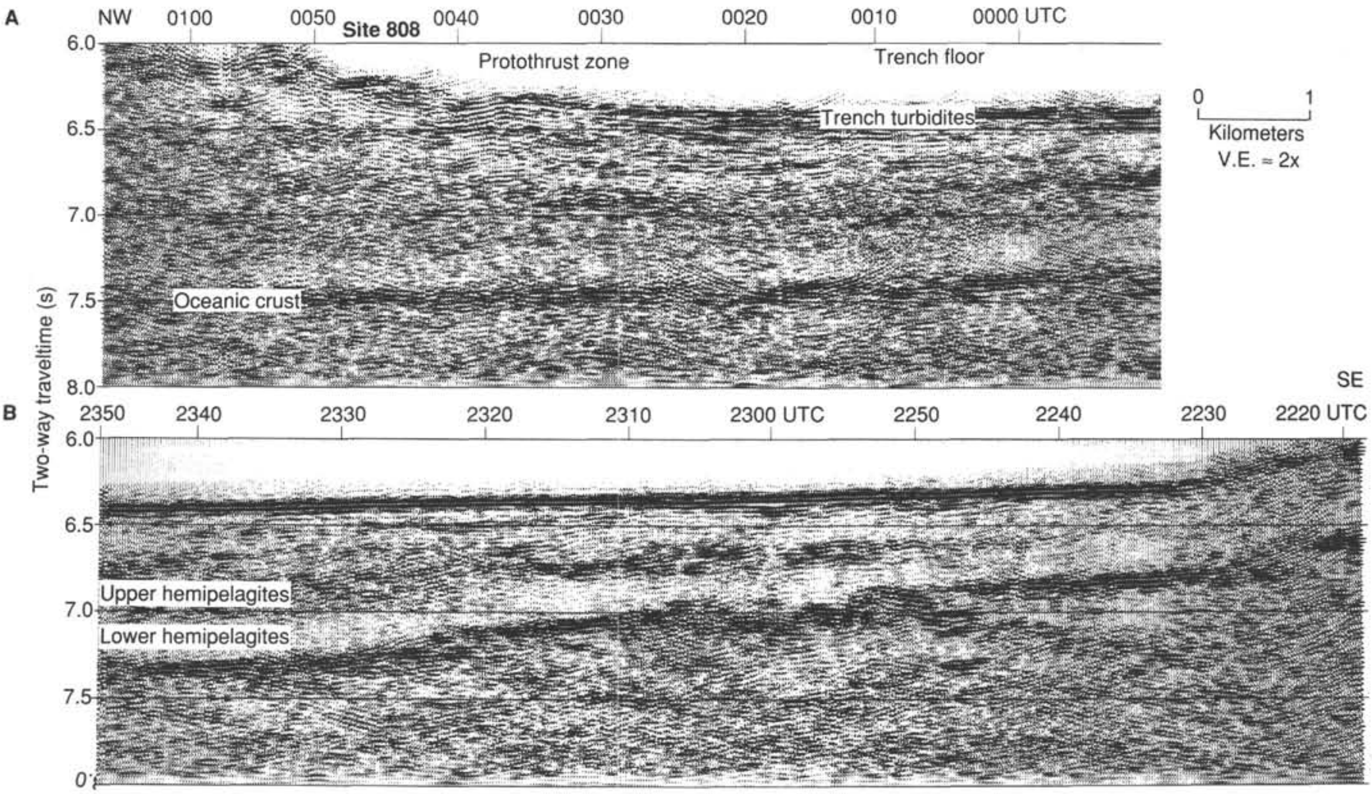


Figure 3. Water-gun seismic reflection record across the Nankai Trough collected during the predrilling survey of Site 808.

## Data Description

Due to the heavy following seas and the likelihood of poor gun synchronization, the seismic line is relatively noisy, but shows the important features of the Nankai Trough (Fig. 3). The seaward boundary of the trench floor is defined by the subtle break in both surface and subsurface slope near the center of the profile. The protothrust zone is bounded by a break in slope at its seaward margin and a diffraction hyperbola at its landward margin. Strata within the protothrust zone dip moderately seaward. Site 808 is located near the seaward edge of the lowermost thrust anticline (Fig. 3). The décollement is not imaged as a continuous reflection as it is on the MCS line through this area.

Three major seismic stratigraphic units overlie oceanic crust. A trench turbidite wedge overlies a stratified upper hemipelagic unit, which in turn overlies an acoustically transparent lower hemipelagic unit (Fig. 3). The base of the wedge is defined by a change in dip of the internal wedge reflections from seaward within the wedge to landward below the wedge. The sedimentary section thickens from 550 ms (approx. 500 m) at the seaward margin of the trench to over 1000 ms (approx. 975 m) beneath the deformation front.

### REFERENCES

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