Collot, J.-Y., Greene, H. G., Stokking, L. B., et al., 1992
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5. UNDERWAY GEOPHYSICS[1]

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INTRODUCTION

Seismic reflection data used during Leg 134 include multichannel data collected before the cruise as well as single-channel records collected during the cruise to select the location for offset holes. In this chapter the collection and processing of single-channel data are described; the preliminary interpretation of these data together with multichannel seismic data is contained in the individual site summaries.

Single-channel seismic reflection, magnetic, and bathymetric data can be collected aboard the *JOIDES Resolution*. Because data collected before Leg 134 included detailed Seabeam bathymetric and magnetic data, the decision was made to collect only single-channel seismic data over each site. During Leg 134, magnetic and bathymetric data were collected on transits of more than 12 hours. Navigation information as well as bathymetric and magnetic data are routinely processed at the Geological Data Center (GDC) at Scripps Institution of Oceanography. Digital data and microfilm copies of original analog records are available from the Data Librarian at Ocean Drilling Program (ODP) headquarters at College Station, Texas, the Site Survey Data Bank at Lamont-Doherty Geological Observatory, and the National Geophysical Data Center at Boulder, Colorado.

NAVIGATION

Satellite navigation, based on the satellite constellation of the Global Positioning System (GPS), was the main method used to determine the ship's position during Leg 134. Recent additions to the satellite constellation provided nearly continuous GPS positioning. Transit-satellite data were available at infrequent intervals and were used only to check positions derived from GPS. A Magnavox MX 1107 satellite navigator collected the primary navigation data. All calculated positions as well as course and speed data were recorded by a Masscomp 561 computer in the underway geophysics laboratory at a 5-min sampling interval. The GPS receiver was operated in the on-site mode to determine the location of the drill sites.

Owing to problems in obtaining copies of and in reducing navigation data, shotpoint maps are presented in this report for only a few seismic lines. Maps for the other lines are contained in the appropriate site chapter.

GEOPHYSICAL DATA COLLECTED DURING TRANSITS

Geophysical instruments that were operated during long transits, like those between ports and the study area, included 3.5- and 12-kHz precision echo sounders and a total-intensity magnetometer. Bathymetric data were acquired with a 3.5-kHz system, which used a Raytheon PTRIOSB transceiver and 12 Raytheon transducers, and a 12-kHz system, which used a Raytheon PTRIOSB transceiver driving an EDO 323B transducer. All bathymetric data were processed through CESP-III correlators and then displayed with Raytheon 1807M LSR Line Scan recorders. These displays were made with a 1-second (s) sweep.

Magnetic data were collected using a Geometrics 801 proton-precession magnetometer that was towed about 400 m behind the ship. Measurements were made at 3-s intervals with a sensitivity of about 1 nT. These data were displayed on a strip-chart recorder. Magnetic data were processed later by the GDC to remove values calculated from the International Geomagnetic Reference Field.

GEOPHYSICAL DATA COLLECTED OVER DRILL SITES

Only single-channel seismic reflection data were collected over the drill sites. The survey speed was typically 6 knots. The Teledyne single-channel streamer had an active section that was 100 m long and contained 60 hydrophones, and the streamer was towed 200–300 m behind the ship. The seismic source consisted of two 80-$in.^3$ water guns that operated at an air pressure of about 2000 lb/in^2. The guns were towed 25 m behind the ship at a water depth of about 10 m. The interval between shots was 9 s; this time could not be further reduced because of the time needed for the Masscomp computer to store the information. Analog seismic data were amplified and filtered to between 25 to 150 Hz, and two seismic sections having different time scales were displayed on Raytheon LSR recorders. Seismic reflection data were also recorded by a Masscomp 561-based acquisition system using the HIGHRES software. Data were filtered to between 5 and 250 Hz and then recorded on tape in SEG-Y format and displayed in real time on a Printronix graphics printer.

ONBOARD PROCESSING

Seismic reflection data were processed aboard ship using the SIOSEIS software package that ran on one of the Masscomp 561 computers. This software package contains numerous faults that required considerable time to circumvent; nevertheless, a basic processing scheme eventually evolved that seemed to be stable and to produce reliable results. A typical processing flow included spiking deconvolution, bandpass filtering, typically to between 15 and 55 Hz, and automatic gain control (AGC) with a 0.25-s operator. The efficiency of the deconvolution and filtering operations were checked by comparing the processed and original outgoing pulse that was recorded along one of the seismic lines. All of the sections shown in this report were processed aboard ship.

SINGLE-CHANNEL SEISMIC REFLECTION DATA

Sites 827 and 829 are close together in the forearc area of the New Hebrides Island Arc (Fig. 1); they were designed to investigate the geologic consequences of collision between the island arc and the north ridge of the aseismic d'Entrecasteaux Zone. Multichannel seismic data from near these sites show that a reflection from the top of the colliding north ridge can be traced

[1] Collot, J.-Y., Greene, H. G., Stokking, L. B., et al., 1992. *Proc. ODP, Init. Repts.*, 134: College Station, TX (Ocean Drilling Program).

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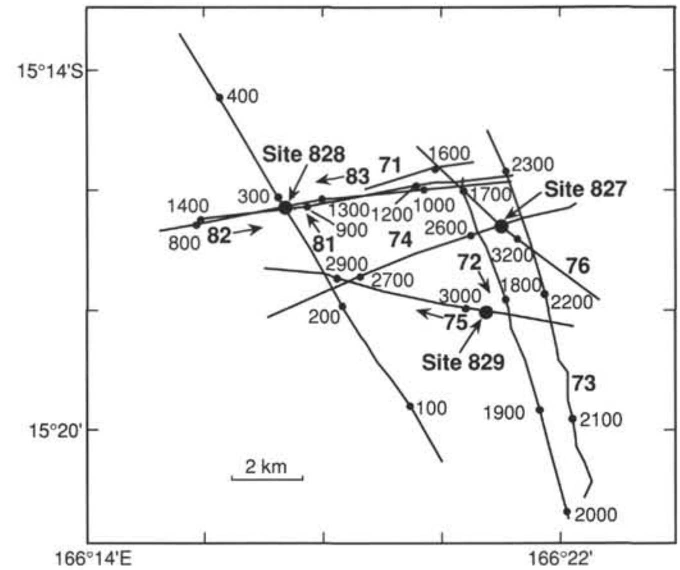

Figure 1. Shotpoint map for single-channel seismic lines collected near Sites 827, 828, and 829.

beneath the arc's lower slope. Under the arc slope this reflection may be from the subducted top of sediment that covers the ridge or from the contact between this sediment and the underlying igneous basement. In either case, this reflection most likely correlates with the interplate décollement. A single-channel seismic reflection survey was conducted before drilling to locate flat areas that were covered by soft sediment so that drilling could begin. Line 72 (Fig. 2A) shows a strong reflection at a traveltime of about 4.5 s below the drill site that also can be traced on other seismic lines; this reflection most likely correlates with the interplate décollement. This reflector was the main target of drilling at this site but was not penetrated.

Seismic line 75 crosses over Site 829, and seismic line 72 crosses line 75 just west of this site (Figs. 1 and 2A, -B). Together with one multichannel seismic section, these two single-channel lines indicate that the reflector presumed to be the interplate décollement underlies the site at a sub-bottom time of about 0.62 s. The drill did not reach this reflector either.

Site 828 is located along the crest of the North d'Entrecasteaux Ridge and was proposed to provide a reference hole to help interpret the origin of rocks below Sites 827 and 829 and to clarify the origin of the ridge. Seismic reflection data indicate that this ridge is covered by a thin (about 100–200 m) sediment layer and that reflections from rocks below the layer are discontinuous, of generally poor quality, and have variable east and west apparent dips (Fig. 2C).

Site 830 is located just east of where the Bougainville Guyot collides with the slope of the New Hebrides Island Arc. Seismic reflection data outline structures caused by this collision, such as a large antiform along the interplate boundary just east of the Bougainville Guyot. In addition, east-dipping reflections suggest imbricated thrust faults. Site 830 lies just south of the intersection of seismic lines 1 and 2. Unfortunately, strong noise of undetermined origin affected seismic section 2 just over the drill site, but line 1 is unaffected. Seismic section 1 (Fig. 3) shows that one of the east-dipping reflections lies at about 0.25 s below the seafloor. The interface that causes this reflection lies at the top of a rock unit that returns parallel reflections for about 0.4 s. Rocks within the forearc area are not usually so reflective, thick, or coherently bedded.

Site 831 penetrates the broad, planar, carbonate cap of the Bougainville Guyot. Seismic lines 11 and 13 cross just west of this site (Figs. 4 and 5). Parallel reflections from within the cap vary little in amplitude, spacing, or frequency content, and they are more discontinuous than are the reflections in multichannel seismic data, suggesting that cap rocks are mainly homogeneous and that layering is only faintly expressed. The discontinuous reflections may result from the lagoon and reef environments of deposition of the cap rocks. Poorly reflective rocks below the cap have been shown by drilling to be andesite breccia.

Site 832 is located near the western margin of the intra-arc Aoba Basin. The main goal of drilling is the unconformity evident at a traveltime of about 4.8 s. The seafloor over the western margin of the basin has locally irregular morphology that may have been caused by mass wasting. Single-channel seismic lines 21 and 22 cross over Site 832 and show substantially similar acoustic images of the basin fill. Single-channel seismic section 21 (Fig. 6) shows parallel, consistent, acoustic layering within 0.5 s of the seafloor. Reflections within the next 0.1 s are poorly reflective, and still-deeper rocks return strong discontinuous reflections.

Site 833 penetrates rocks along the eastern flank of the Aoba Basin. The unconformity drilled at Site 832 is also present below Site 833, where nearly all thinning of rocks onto the eastern flank of the basin occurs above the unconformity. The main objective at Site 833 was to investigate the older rock section that underlies the unconformity. This feature produces a strong, continuous reflection. Seismic section 33 (Fig. 7) was collected obliquely across small anticlines that strike nearly north-south; this obliquity may explain why rock layering below this line appears different from layering below crossing line 32. Another difference between the images along these seismic sections is that along section 33, the upper part of the basin fill seems to be more sharply divided into layers than does the equivalent fill below line 32.

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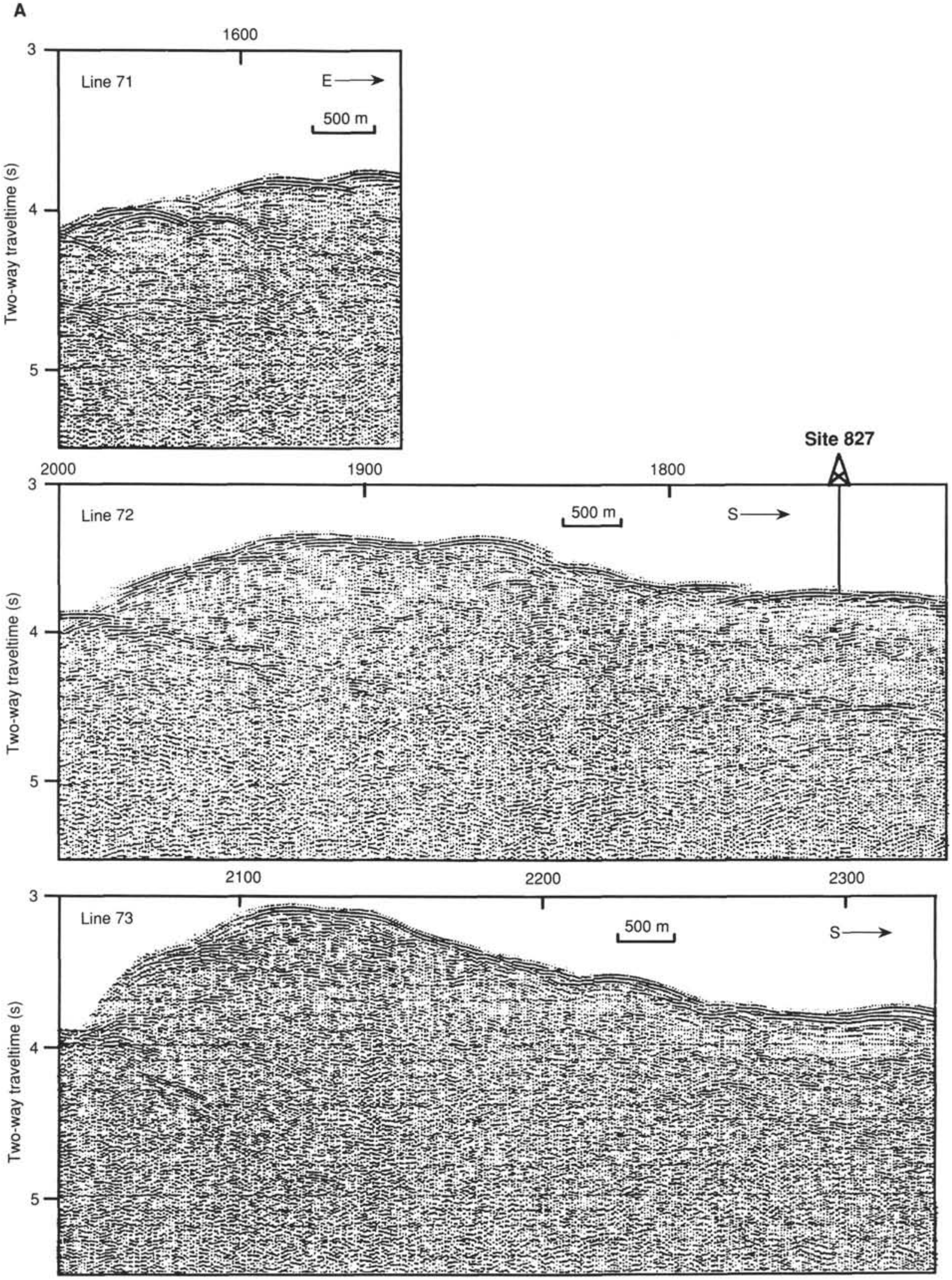
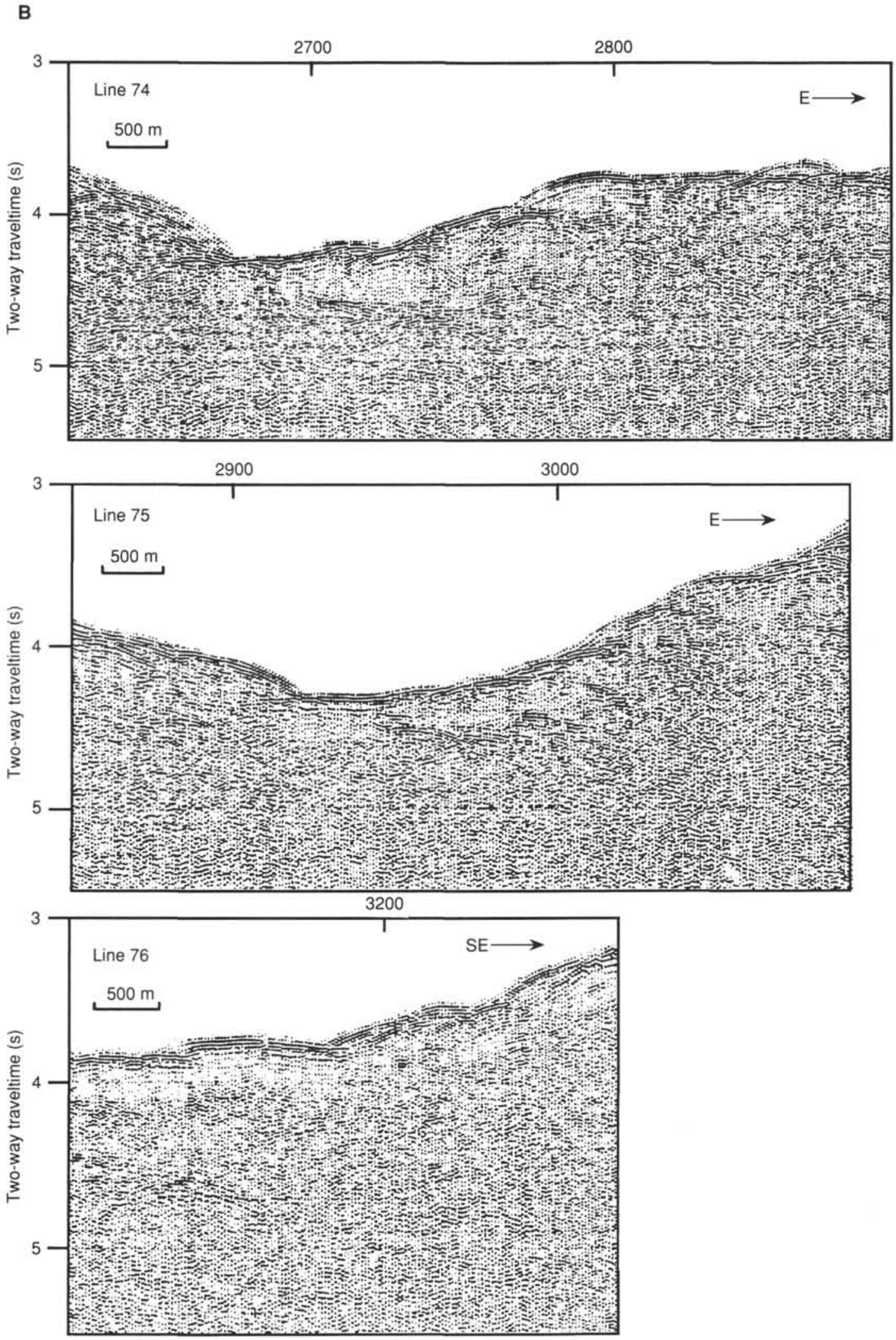


Figure 2. **A.** Single-channel seismic lines 71, 72, and 73. For location see Figure 1. **B.** Single-channel seismic lines 74, 75, and 76. For location see Figure 1. **C.** Single-channel seismic lines 81, 82, and 83. For location see Figure 1.



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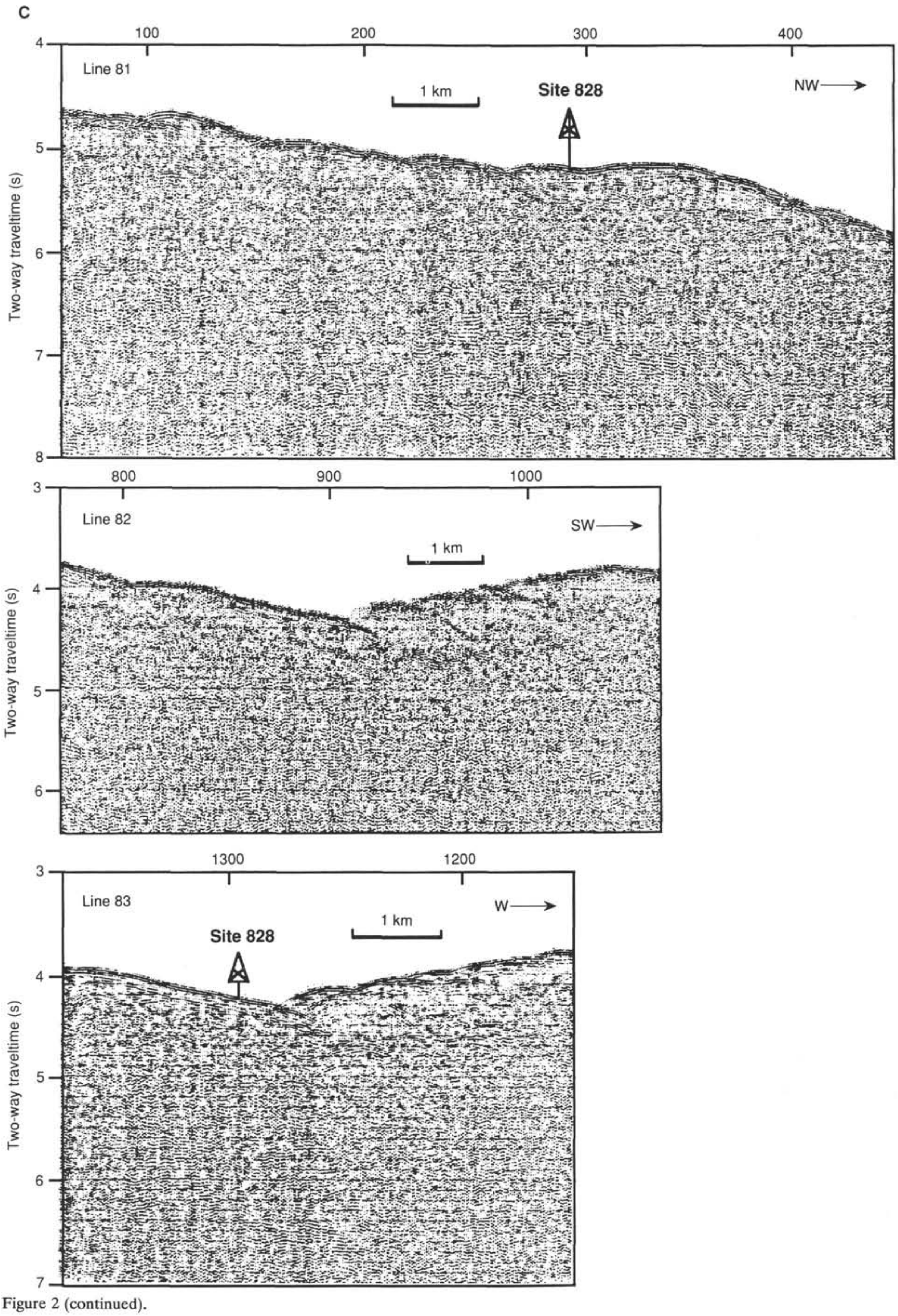

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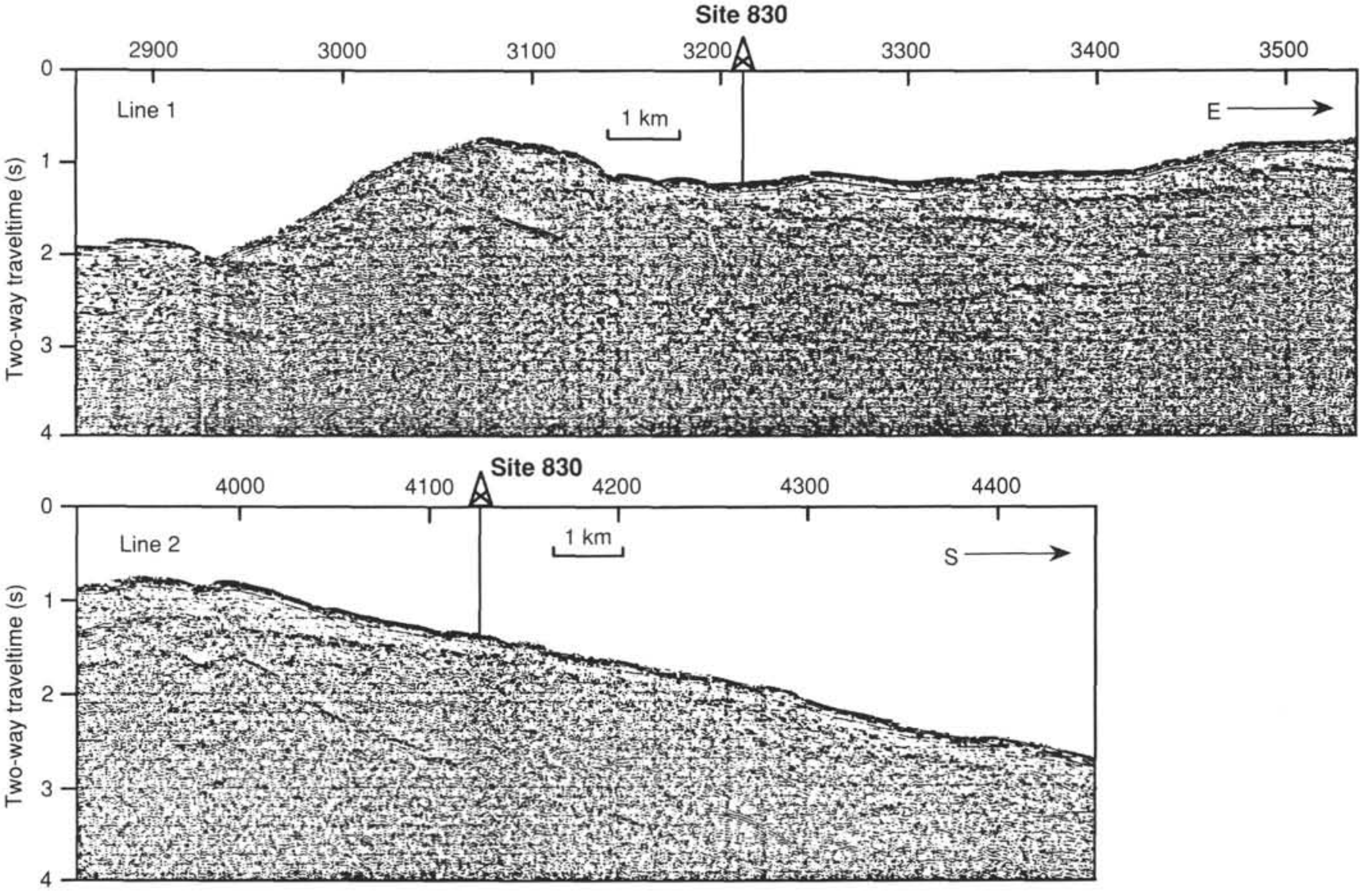

Figure 3. Single-channel seismic lines 1 and 2. A shotpoint map for these lines is presented in Figure 2 in the "Site 830" chapter (this volume).

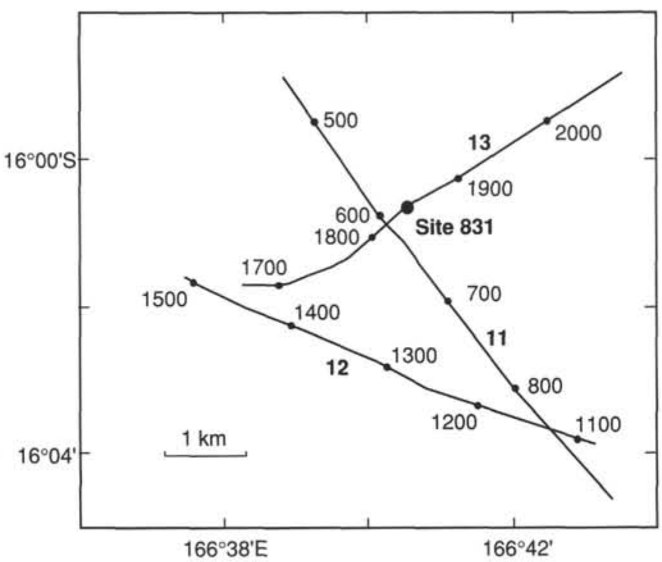

Figure 4. Shotpoint map for single-channel seismic lines collected near Site 831.

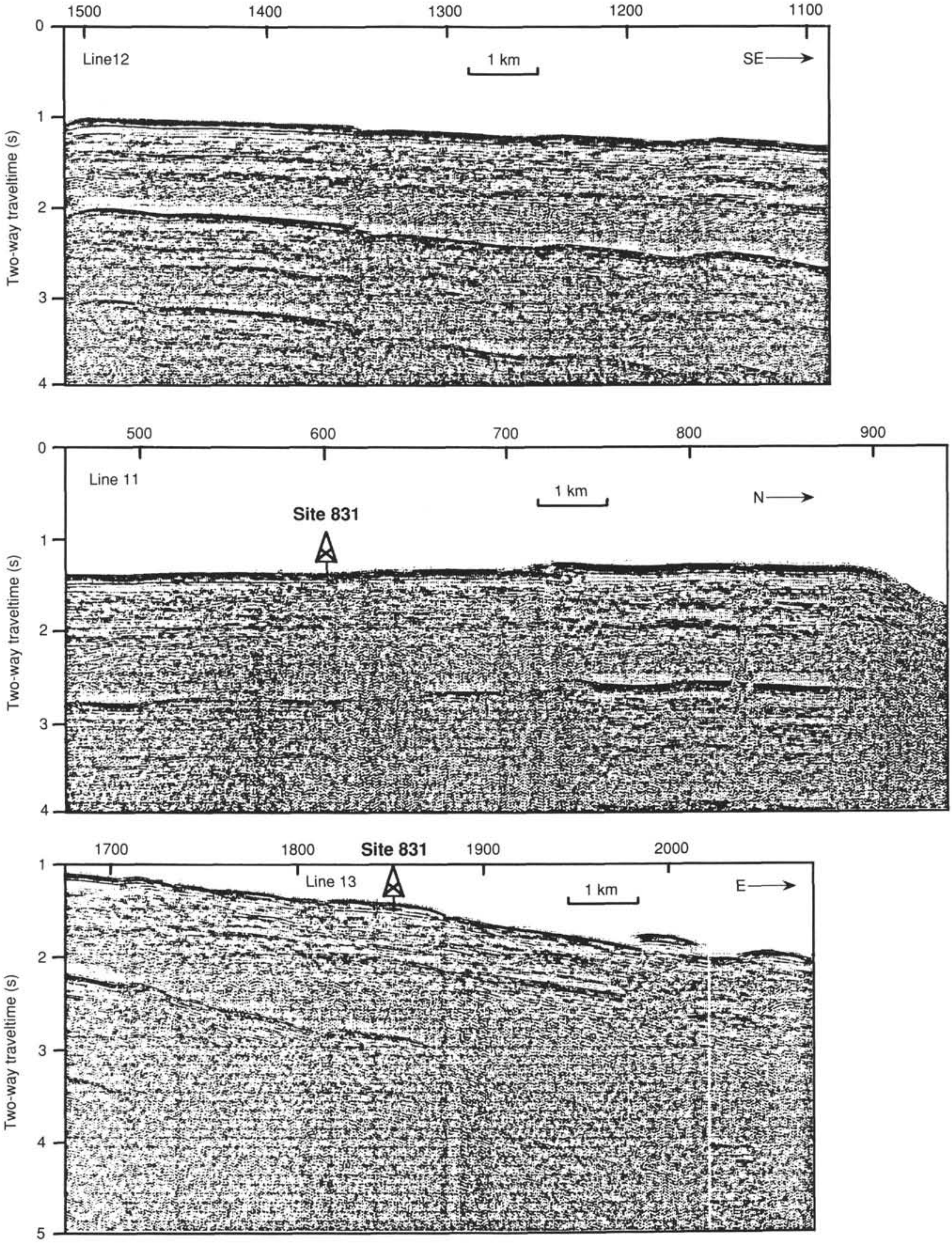

Figure 5. Single-channel seismic lines 11, 12, and 13. For location see Figure 4.

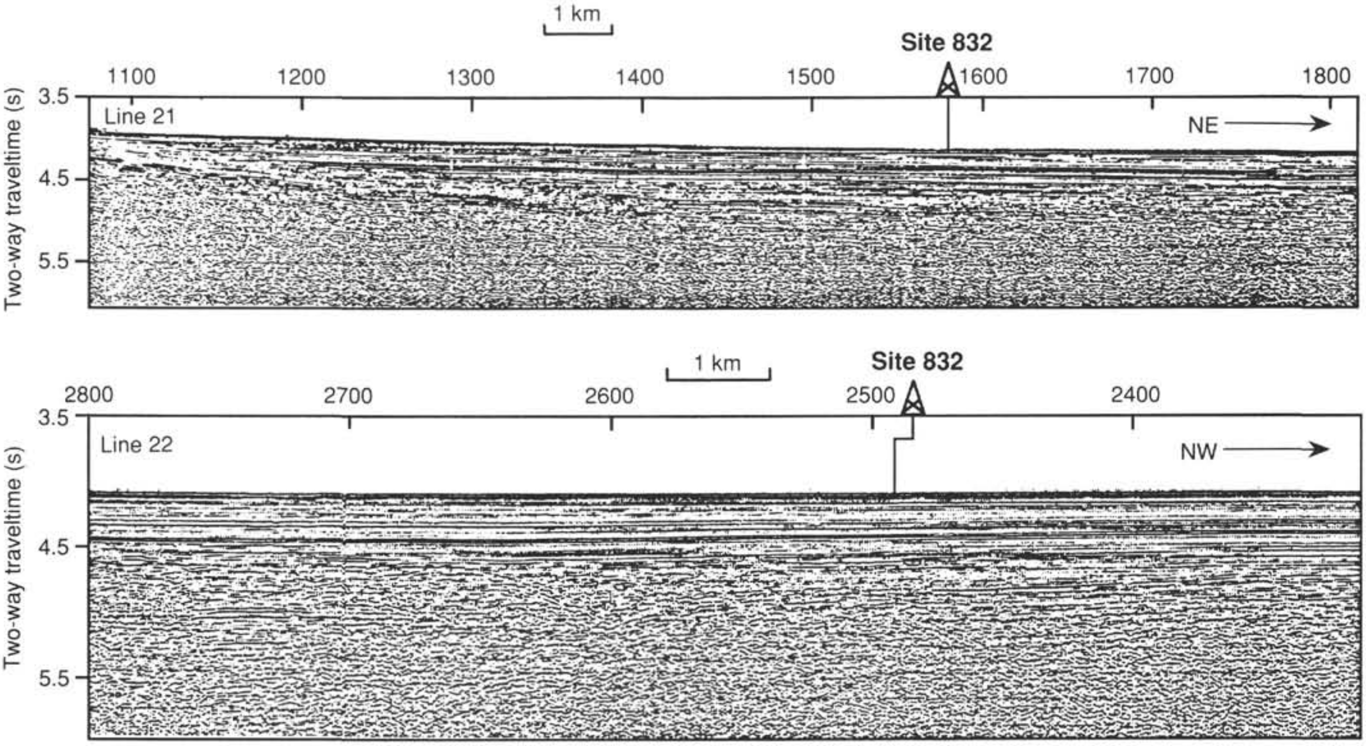

Figure 6. Single-channel seismic lines 21 and 22. A shotpoint map for these lines is presented in Figure 5 in the "Site 832" chapter (this volume).

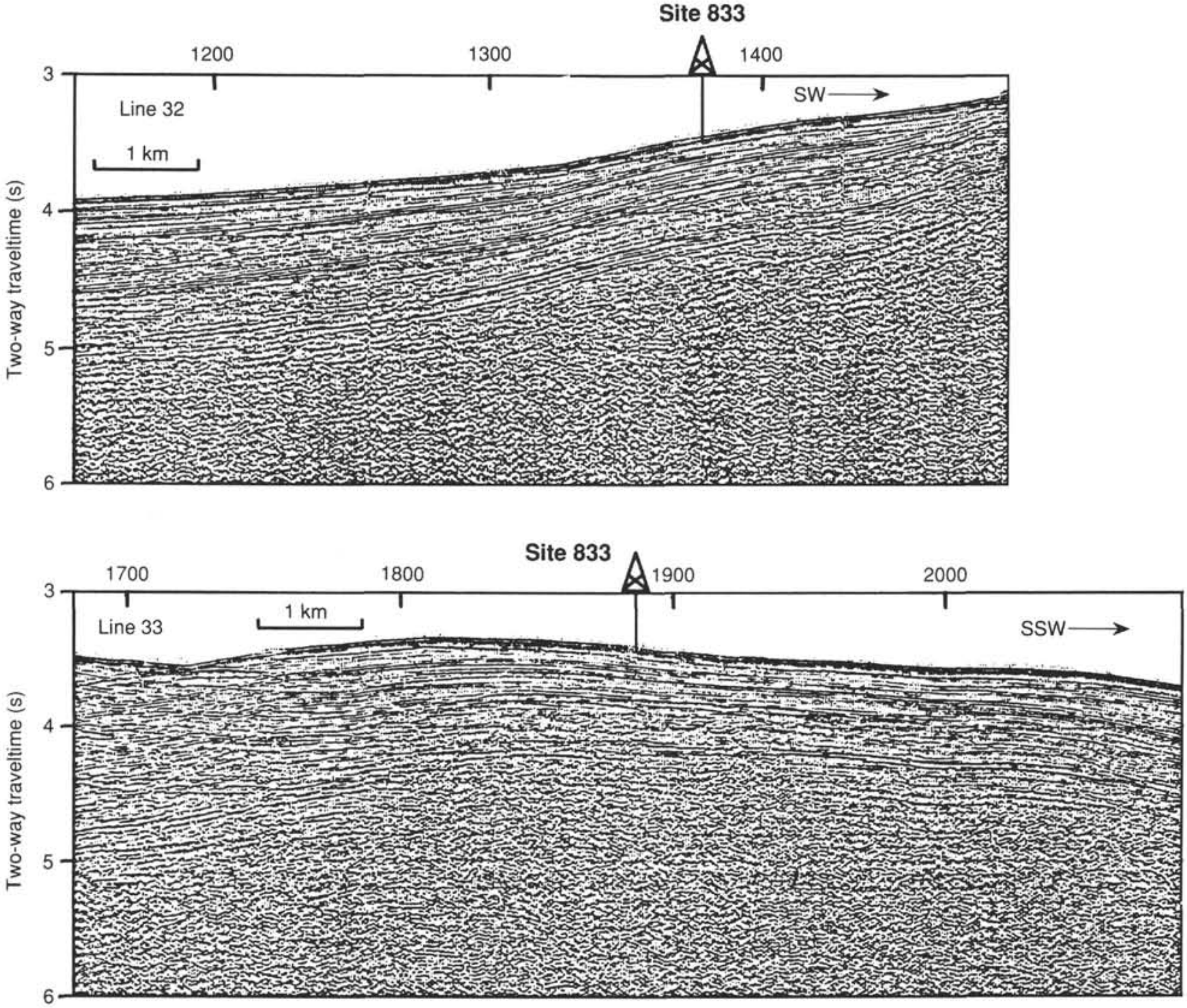

Figure 7. Single-channel seismic lines 32 and 33. A shotpoint map for these lines is presented in Figure 3 in the "Site 833" chapter (this volume).