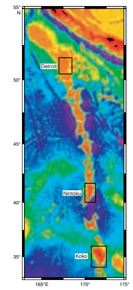
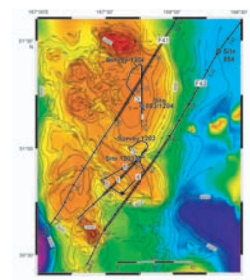
Duncan, R.A., Tarduno, J.A., Davies, T.A., and Scholl, D.W. (Eds.)
*Proceedings of the Ocean Drilling Program, Scientific Results* Volume 197

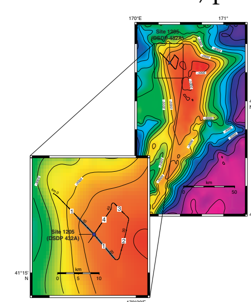
**F1.** Regional bathymetry of the Emperor Seamount chain, p. 6.



**F2.** Detroit Seamount, p. 7.



**F3.** Nintoku Seamount, p. 8.



# 6. Data Report: Seismic Reflection Surveys of the Emperor Seamounts: ODP Leg 197[1]

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## ABSTRACT

This report presents the digital seismic data used to locate and characterize the sites drilled during Ocean Drilling Program Leg 197 along the Emperor Seamount chain. Four new drill sites were surveyed over three seamounts: Detroit Seamount, Nintoku Seamount, and Koko Seamount. The main goal of these surveys was to collect site survey data required for drill site location and to provide a detailed seismic stratigraphic record of the sites. This report documents seismic reflection data acquisition, processing, display, and location information collected during Leg 197, along with data from two tracklines collected by the U.S. Geological Survey over Detroit Seamount in 1987.

## INTRODUCTION

The Emperor Seamounts are a north-northwest–striking chain (~2500 km long) of undersea volcanoes that are widely thought to record the movement of the Pacific plate relative to the Hawaiian hotspot during the Late Cretaceous and early Tertiary (Fig. **F1**); seamount ages increase from south to north. We have collected and processed high-resolution single-channel seismic data from surveys conducted by the *JOIDES Resolution* over Detroit Seamount (Fig. **F2**), Nintoku Seamount (Fig. **F3**), and Koko Seamount (Fig. **F4**) and processed U.S. Geological Survey (USGS) data collected over Detroit Seamount.

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[1] Kerr, B.C., Scholl, D.W., and Klemperer, S.L., 2006. Data report: Seismic reflection surveys of the Emperor Seamounts: ODP Leg 197. *In* Duncan, R.A., Tarduno, J.A., Davies, T.A., and Scholl, D.W. (Eds.), *Proc. ODP, Sci. Results*, 197, 1–17 [Online]. Available from World Wide Web: <http://www-odp.tamu.edu/publications/197_SR/VOLUME/CHAPTERS/006.PDF>. [Cited YYYY-MM-DD]

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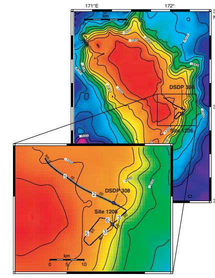
This report documents the acquisition and processing of these data and serves as a reference to those wishing to download and inspect the profiles in detail. We partitioned the data discussion into three sections, one for each seamount. Within each section, we discuss the processing details unique to the survey, display a sample of the data, and provide location information to orient drill holes and line crossings relative to the seismic profiles. Kerr et al. (2005) provide a separate geological interpretation of seismic data over Detroit Seamount and discuss the deposition of the Meiji Drift during Oligocene to Miocene time.

F4. Koko Seamount, p. 9.



# METHODS AND MATERIALS

## Acquisition and Processing

The source for the seismic reflection data collected during Leg 197 was an 80-in$^3$ Seismographic Services Inc. water gun. These data were received by a single-channel streamer and collected at slow survey speeds that resulted in shot intervals of 15–20 m. The high-frequency content of the water gun, coupled with the small shot spacing, provided high vertical and lateral resolution in the data.

USGS data employed an 80-in$^3$ conventional air gun source and was received by a two-channel streamer with shot intervals between 40 and 50 m. The active sections of the streamer were towed 400 m behind the air gun (S. Dadisman, pers. comm., 2005; see **walrus.wr.usgs.gov/infobank/f/f287aa/html/f-2-87-aa.meta.html**).

All data were processed using Landmark Graphics ProMAX 3D software on a 750-MHz Sun Blade 1000 workstation. Source-signature deconvolution (discussed below) was performed on an 866-MHz Pentium III using Parallel Geoscience SPW software. The processing sequence for all data sets included a –100-ms static shift, normal moveout (NMO) corrections, deconvolution, bandpass filtering, true amplitude recovery, water column mute, trace kill, and Stolt F-K migration. Refer to Table T1 for a detailed description of processing parameters for each survey. A constant velocity of 1500 m/s was used for NMO, true amplitude correction, and migration.

T1. Survey parameters, p. 16.

# DISCUSSION

## Detroit Seamount

Two different cruises provided the seismic reflection data for Detroit Seamount: Ocean Drilling Program (ODP) Leg 197 (*JOIDES Resolution*) and the USGS GLORIA Mapping Program cruise F-2-87-AA (*Farnella*) (USGS, 1987) (Fig. F2). Leg 197 data were collected in two separate surveys, referred to as Survey 1203 (around ODP Site 1203) and Survey 1204 (around ODP Sites 883/1204). Lines 1203-1, 1203-3, and 1203-6 intersect at Site 1203; Lines 1204-1 and 1204-3 intersect at Site 883, ~500 m northwest of Site 1204. The two F-2-87-AA lines (Lines F41 and F43) are subparallel, separated by ~25 km. Line F41 intersects Lines 1204-1 and 1204-3, and Line F43 passes within 1 km of Lines 1203-3 and 1203-4, allowing limited correlation with these data sets (Fig. F2).

To assist detailed analysis of Detroit's stratigraphic record and effectively correlate sediment horizons from one data set to another, we attempted to process both the Leg 197 and the F-2-87-AA data sets equivalently. The different source signatures of the Leg 197 and F-2-87-AA data sets (nonminimum phase water gun vs. minimum phase air gun, respectively) and different frequency contents (Leg 197 peaks between 40 and 45 Hz and F-2-87-AA data peaks at 22 and 44 Hz with a 30-Hz notch) limited the degree to which the processing results could be matched. We attempted a source-signature deconvolution during both Leg 197 surveys (in order to convert the data to minimum phase) prior to predictive deconvolution. The lack of a true far-field source-signature recording of the water gun source and a significant loss of signal-to-noise ratio due to source-signature deconvolution artifacts rendered source-signature deconvolution impractical for Survey 1204 data. A persistent receiver ghost, prominent just below the seafloor in the Survey 1203 data, required a signature deconvolution for which we simulated the far-field source-receiver signature using the water-bottom reflection by stacking 40 traces from a thick (~ 800 ms two-way traveltime [TWT]) part of the sediment cap.

Further discussion of the seismic data from Detroit Seamount is reported and discussed in Kerr et al. (2005). Seismic sections from Lines 1203-1, 1204-1, F41, and F43 are shown in Figures F5, F6, F7, and F8, respectively. Acquisition parameters and data processing flows for Surveys 1203, 1204, and F-2-87-AA are listed in Table T1. See Table T2 for drill site locations and line crossing information from these seismic surveys.

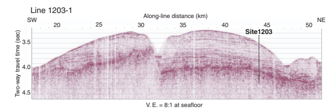
## Nintoku Seamount

Tarduno, Duncan, Scholl, et al. (2002) report that two different types of acoustic basement are present in the vicinity of Site 1205 that produce distinctly different seismic signatures (Fig. F9). The first type appears as laterally coherent, low-frequency, west-dipping reflections near Site 1205. These reflections coincide with a sequence of dominantly alkalic basalt lava flow units interbedded with soil layers (Fig. F9). Locally, this section continues nearly to the bottom of Hole 1205A. The second type appears more massive, lacks laterally coherent internal reflections, and gently slopes upward to the southeast. The strongly reflective sequence of lava flows and interbedded soils thins to the southeast. Below 203 mbsf, which roughly corresponds to 1.88 s TWT, laterally coherent reflections cease to occur at Site 1205. Acquisition parameters and the data processing flow for Survey 1205 are listed in Table T1. See Table T2 for drill site and line crossing locations from Survey 1205.

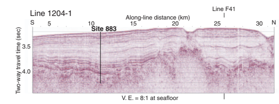
## Koko Seamount

Figure F10 shows the most prominent feature on Koko Seamount: a 200-m-thick sediment drift (assuming a sediment velocity of 1700 m/s). On the southeastern flank, a series of wavy reflections is present in the upper part of the sediment cap. The right side of Figure F10 also shows sediment horizons onlapping onto basement in a westerly direction. Kerr et al. (2005) discuss the possible origin of these features. Acquisition parameters and the data processing flow for Survey 1206 are listed in Table T1. See Table T2 for drill site and line crossing locations from the Survey 1206.

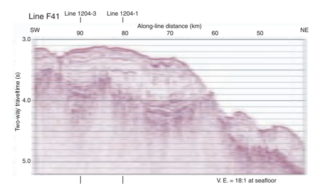
**F5.** Line 1203-1, p. 10.



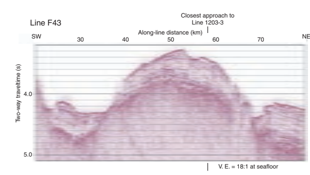
**F6.** Line 1204-1, p. 11.



**F7.** Line F41, p. 12.

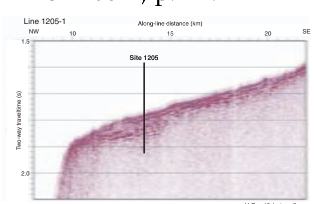


**F8.** Line F43, p. 13.

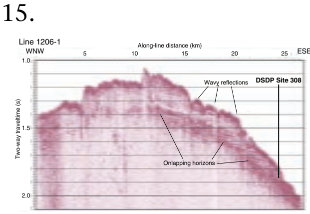


**T2.** Drill sites and line crossings, p. 17.

**F9.** Line 1205-1, p. 14.



**F10.** Lines 1206-1 and 1206-2, p. 15.



# ACKNOWLEDGMENTS

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Rea, D.K., Basov, I.A., Janecek, T.R., Palmer-Julson, A., et al., 1993. *Proc. ODP, Init. Repts.,* 145: College Station, TX (Ocean Drilling Program).

Smith, W.H.F., and Sandwell, D.T., 1997. Global seafloor topography from satellite altimetry and ship depth soundings. *Science,* 277:1956B1962. **doi:10.1126/science.277.5334.1956**

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United States Geological Survey, Coastal and Marine Geology (CMG) 20030428, 1987. Aleutian arc marine geology and geophysics from field activity: F-2-87-AA (bathymetry, gravity, magnetics, seismic). Available from World Wide Web: <**http://walrus.wr.usgs.gov/infobank/f/f287aa/html/f-2-87-aa.meta.html**>.

**Figure F1.** Regional bathymetry of the Emperor Seamount chain. Black boxes show the location trackline maps over Detroit Seamount (Fig. F2, p. 7), Nintoku Seamount (Fig. F3, p. 8), and Koko Seamount (Fig. F4, p. 9).

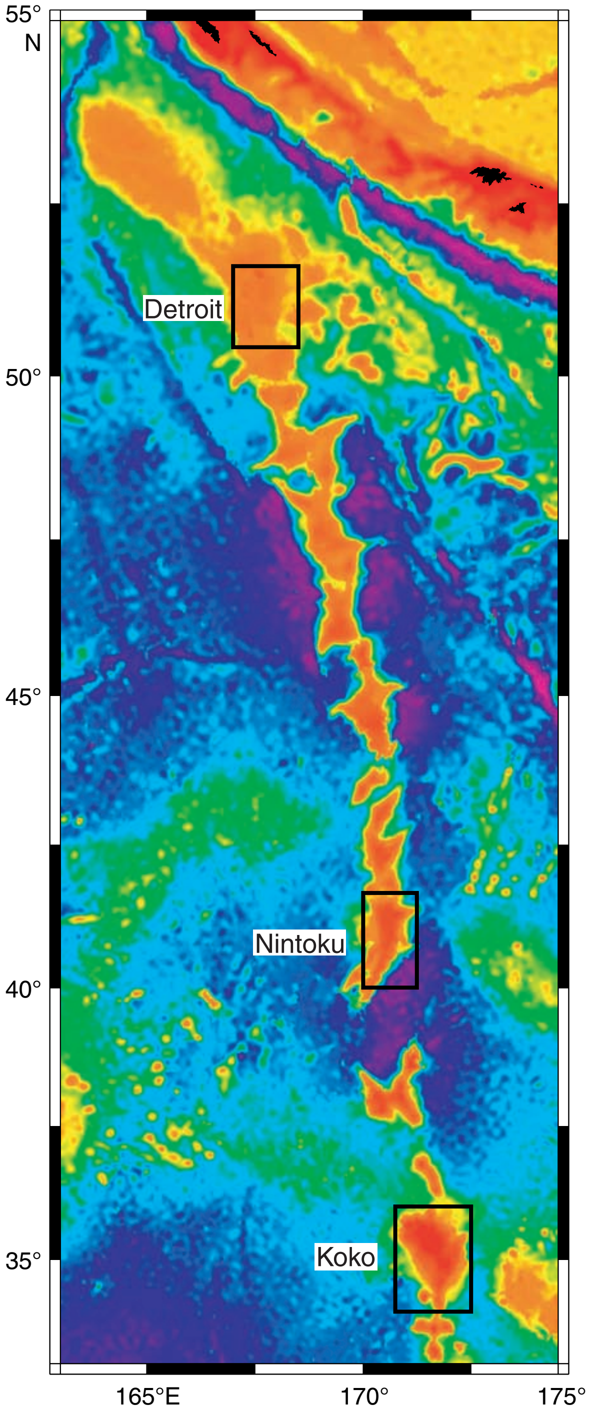

**Figure F2.** Map of Detroit Seamount with seismic lines from Leg 197 and F-2-87-AA. Tick marks indicate along-line distance in 10-km intervals from the beginning of the lines (F41 and F43) or from the beginning of the survey (Surveys 1203 and 1204). Thick gray bars show locations of seismic sections in Figures F5, p. 10, F6, p. 11, F7, p. 12, and F8, p. 13. Blue dots show locations of drill sites. Single-digit numbers in white boxes show line numbers for each survey. Contour map from Rea, Basov, Janecek, Palmer-Julson, et al. (1993). Color map from Smith and Sandwell (1997). Contour interval = 100 m, and contour labels are in meters.

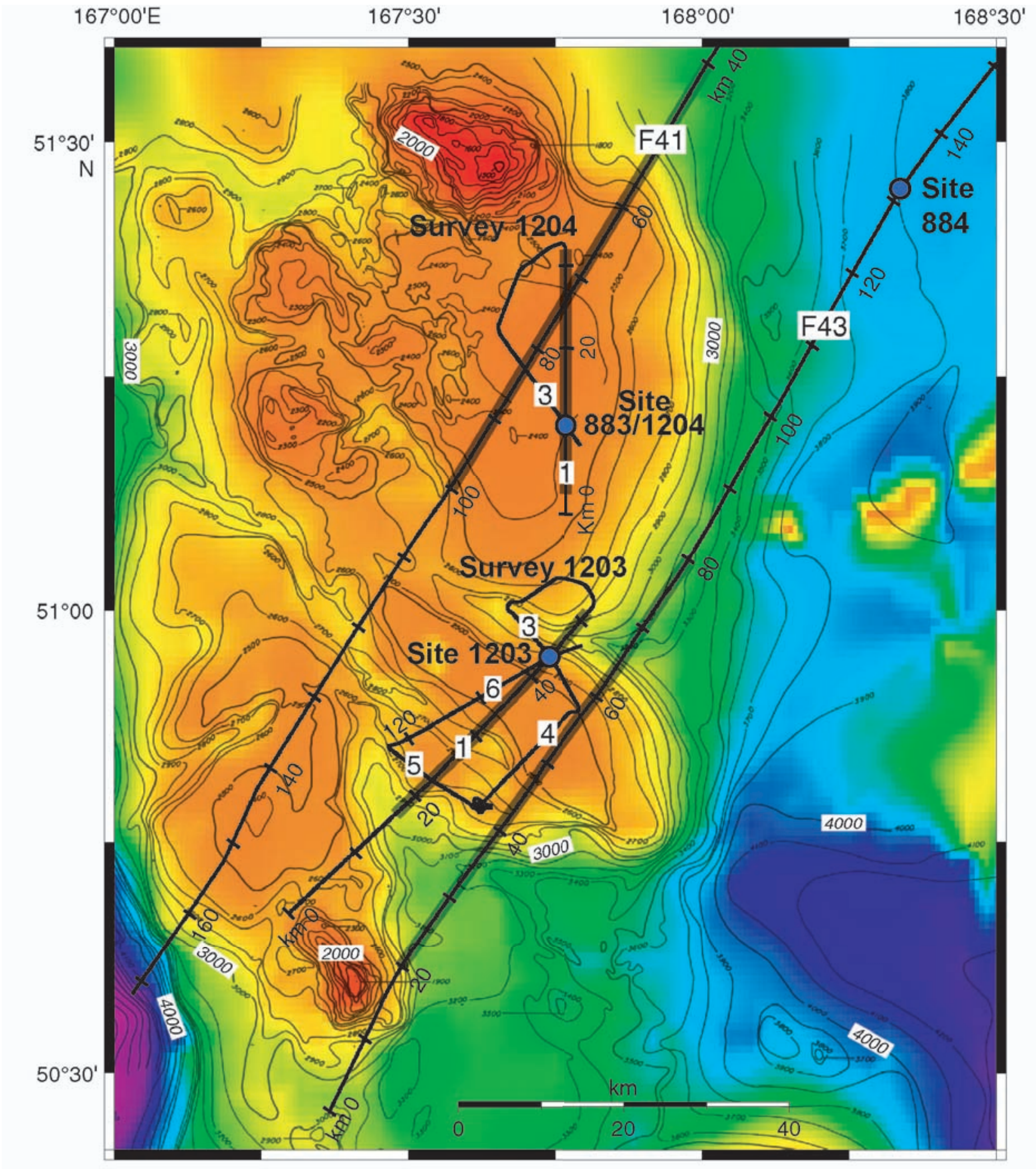

**Figure F3.** Map of Nintoku Seamount with seismic lines from Leg 197. Inset: Area immediately surrounding Survey 1205. Tick marks indicate along-line distance in 5-km intervals from the beginning of the survey. Thick gray bar shows locations of seismic sections in Figure F9, p. 14. Blue dot shows location of drill site. Single-digit numbers in white boxes show line numbers for this survey. Contour map interpolated from and color map from Smith and Sandwell (1997). Contour interval = 500 m.

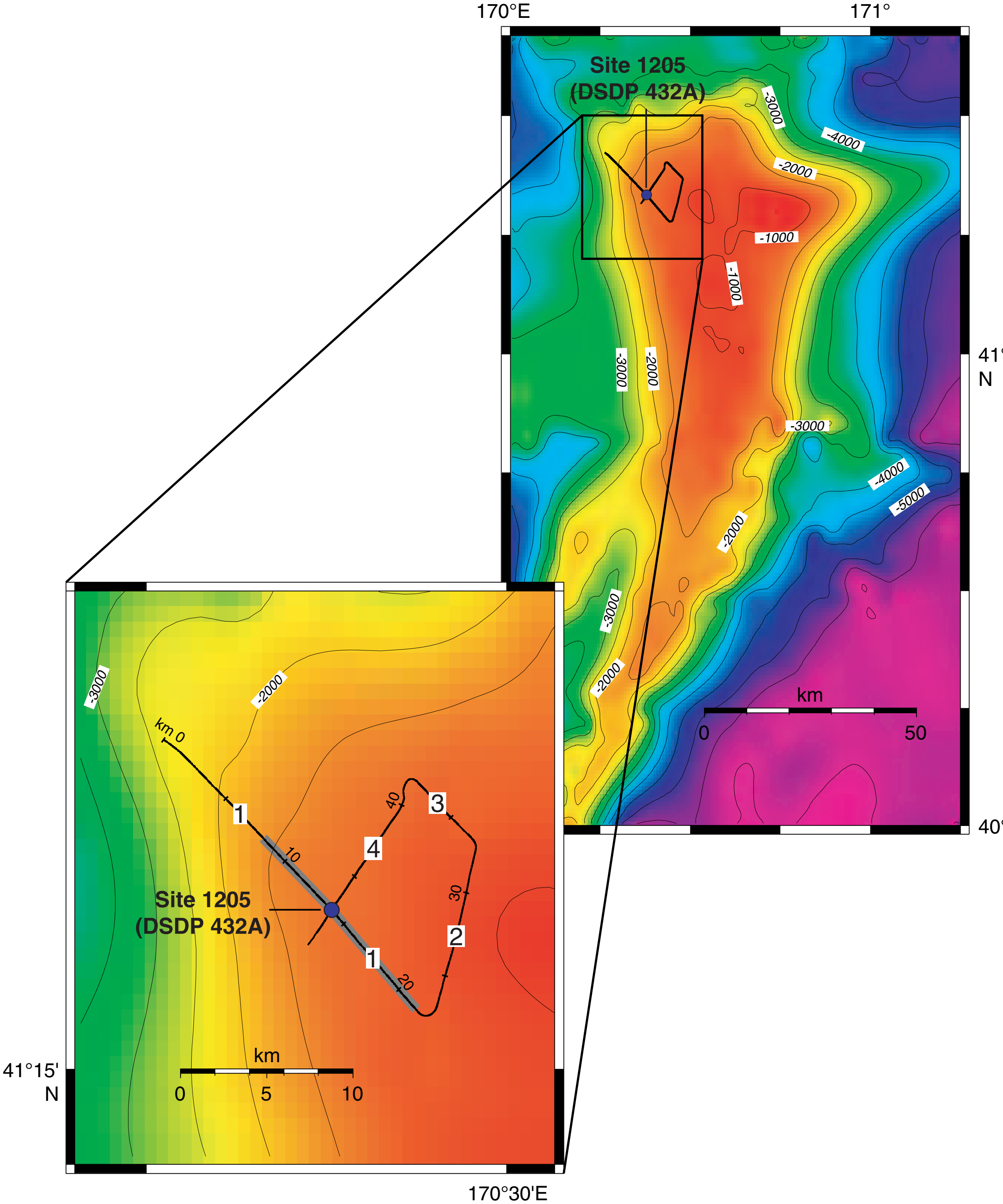

**Figure F4.** Map of Koko Seamount with seismic lines from Leg 197. Inset: Area immediately surrounding Survey 1206. Tick marks indicate along-line distance in 5-km intervals from the beginning of the survey. Thick gray bar shows the locations of seismic sections in Figure F10, p. 15. Blue dots shows locations of drill sites. Single-digit numbers in white boxes show line numbers for this survey. Contour map interpolated from and color map from Smith and Sandwell (1997). Contour interval = 500 m.

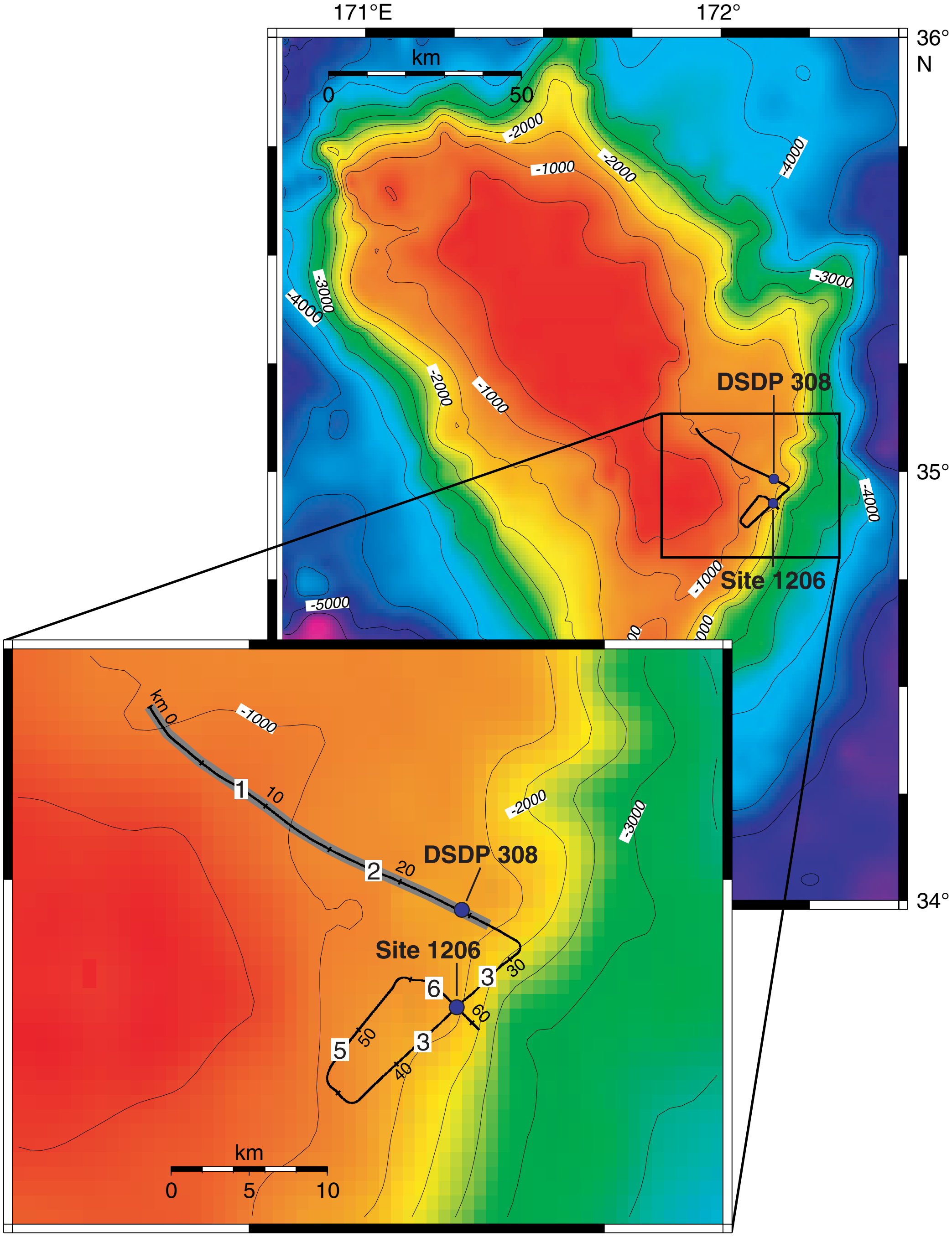

**Figure F5.** Seismic section from Line 1203-1 showing location and depth of penetration at Site 1203. Vertical exaggeration at the seafloor = 8:1.

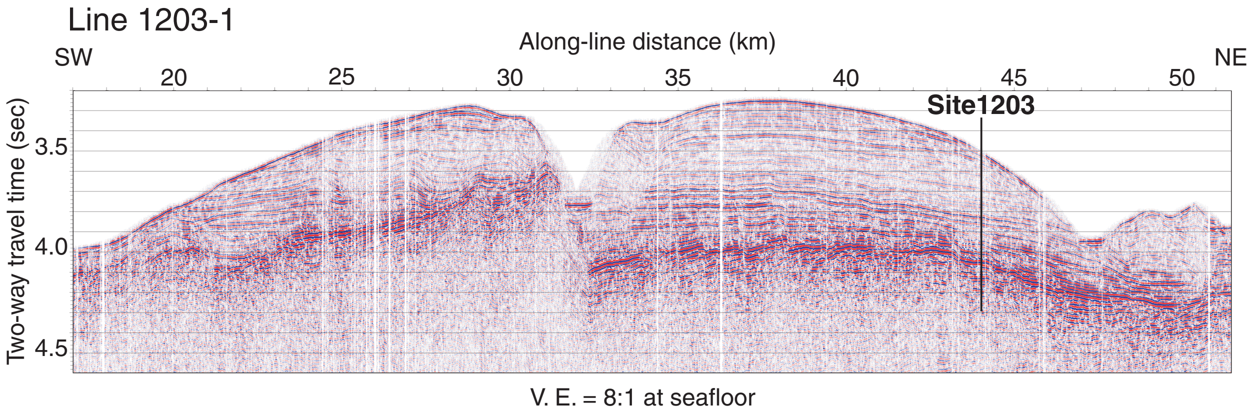

**Figure F6.** Seismic section from Line 1204-1 showing location and depth of penetration at Site 883. Vertical lines above and below the seismic section shows the location where Line F41 crosses Line 1204-1. Vertical exaggeration at the seafloor = 8:1.

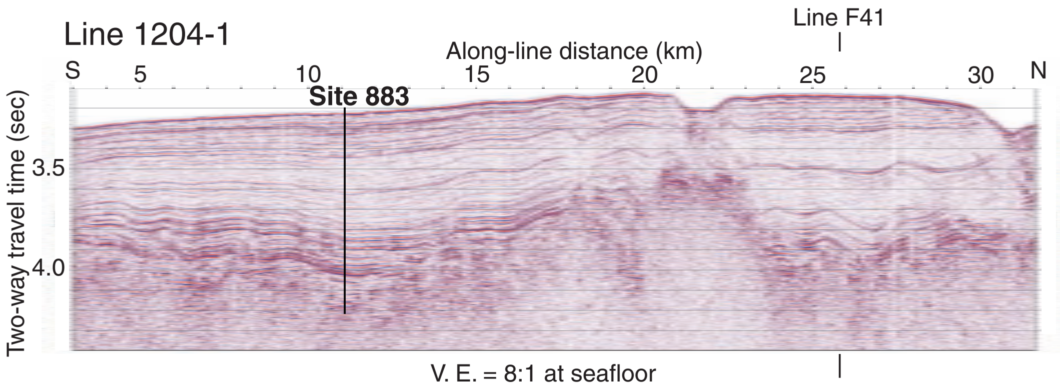

**Figure F7.** Seismic section from Line F41 with vertical lines above and below the seismic section showing the location where Lines 1204-1 and 1204-3 cross Line F41. Vertical exaggeration at the seafloor = 18:1.

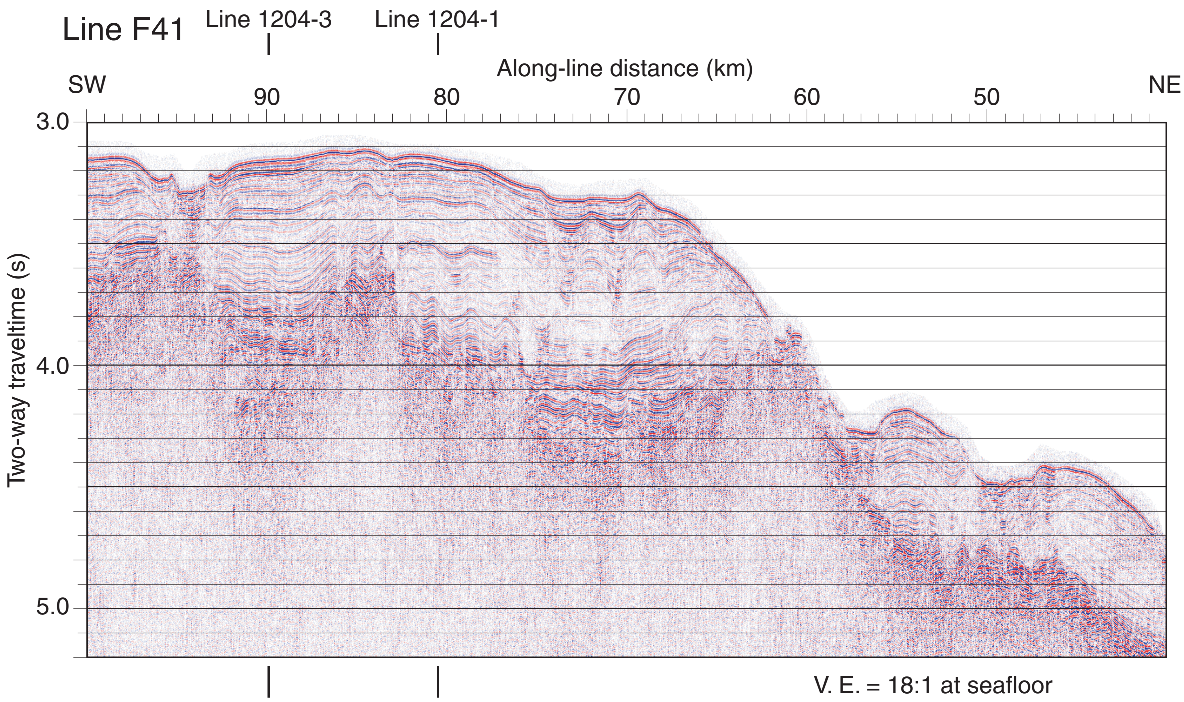

**Figure F8.** Seismic section from Line F43 with the vertical line above and below the seismic section showing the closest approach of Line 1203-3 to Line F43. Vertical exaggeration at the seafloor = 18:1.

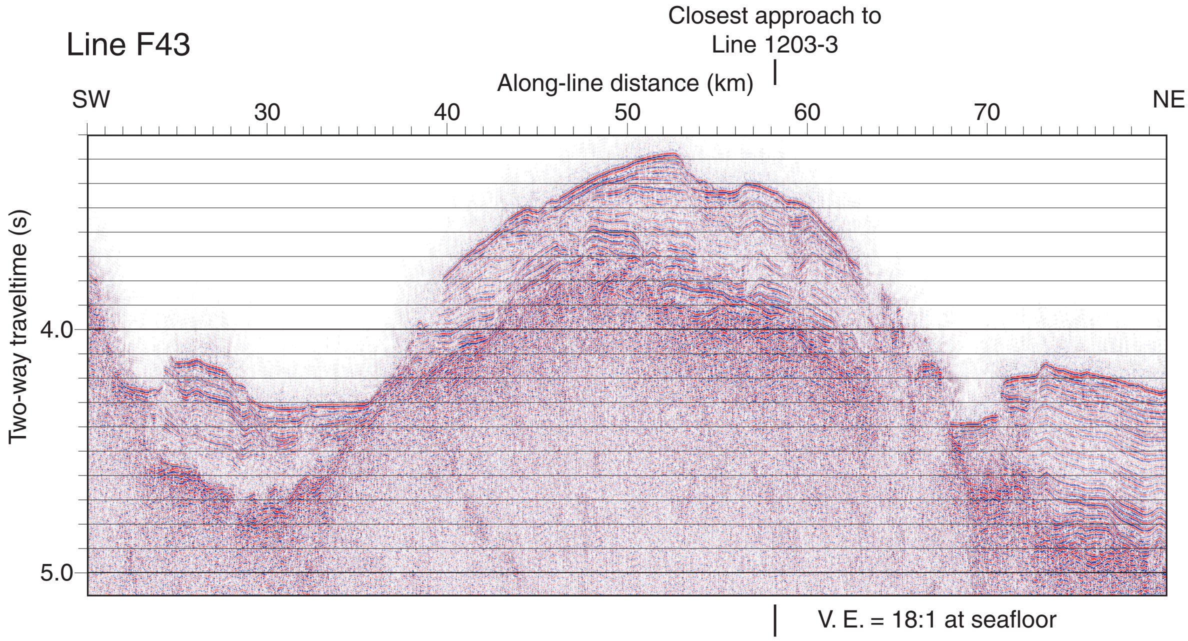

**Figure F9.** Seismic section from Line 1205-1 showing location and depth of penetration at Site 1205. Vertical exaggeration at the seafloor = 18:1.

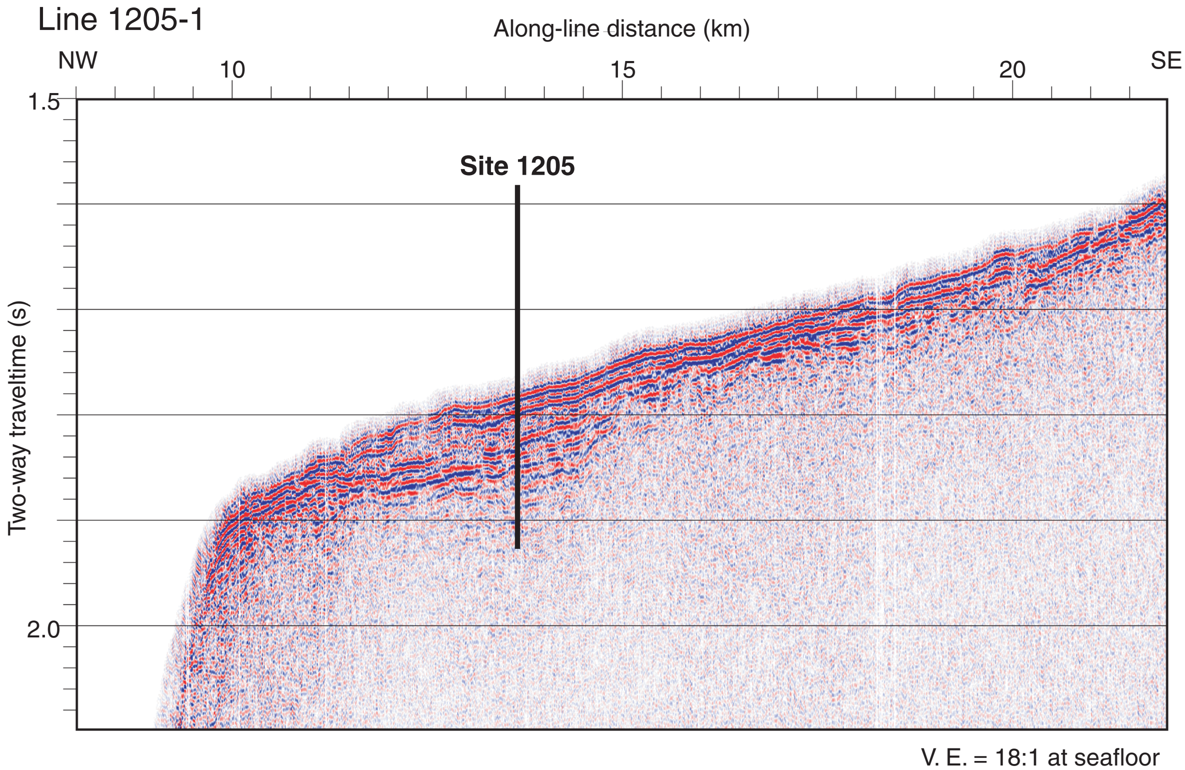

**Figure F10.** Seismic section from Lines 1206-1 and 1206-2 showing location and depth of penetration at DSDP Site 308. Vertical exaggeration at the seafloor = 18:1.

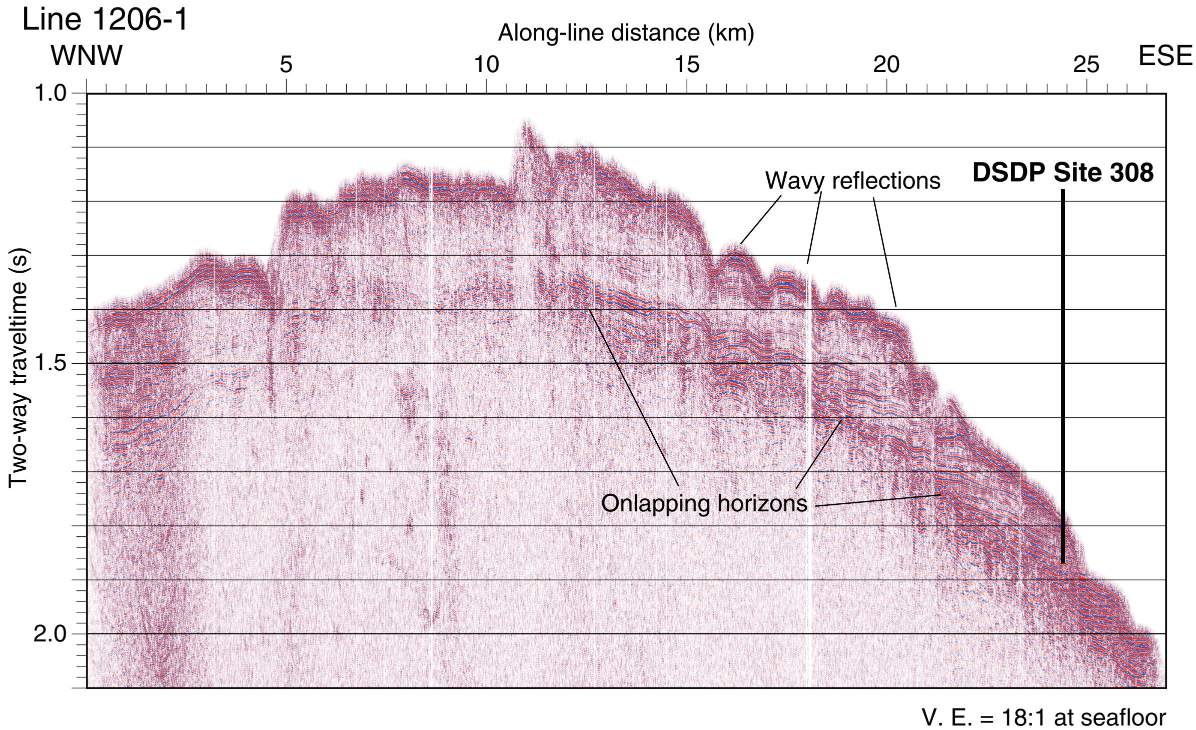

**Table T1.** Acquisition and processing parameters.

| Parameter | Survey 1203 | Survey 1204 | Survey F-2-87-AA | Survey 1205 | Survey 1206 |
|---|---|---|---|---|---|
| Acquisition parameters: | | | | | |
| Sample interval (ms): | 1 | 1 | 4 | 1 | 1 |
| Record length (s): | 5 | 5 | 10 | 3 | 3 |
| Source: | 80-in$^3$ water gun | 80-in$^3$ water gun | 80-in$^3$ water gun | 80-in$^3$ water gun | 80-in$^3$ water gun |
| Source depth (m): | 6 | 6 | Unknown | 5 | 5 |
| Receiver depth (m): | 15 | 15 | Unknown | 15 | 15 |
| Source-receiver offset (m): | 450 | 218 | 400 | 218 | 218 |
| Source interval (s; constant): | 6 | 6 | 10 | 4 | 4 |
| Source spacing (m; depends on ship speed): | 15–20 | 15–20 | 40–50 | 10–15 | 10–15 |
| Processing flow: | | | | | |
| Source signature deconvolution: | | | | | |
| Operator length (ms): | 150 | — | — | — | — |
| Signature length (ms): | 4999 | — | — | — | — |
| Time shift for output (ms): | 0 | — | — | — | — |
| White-noise level (%): | 0.1 | — | — | — | — |
| Channel stack | No | No | Yes | No | No |
| Static shift (ms): | –100 | –100 | –100 | –100 | –100 |
| NMO correction (m/s): | 1500 | 1500 | 1500 | 1500 | 1500 |
| Minimum phase deconvolution: | | | | | |
| Operator length (ms): | 90 | — | — | — | — |
| Prediction distance (ms): | 3 | — | — | — | — |
| Design window (ms above seafloor reflection): | ~1200 | — | — | — | — |
| White-noise level (%): | 0.1 | — | — | — | — |
| Minimum phase deconvolution: | | | | | |
| Operator length (ms): | 90 | 220 | 160 | — | — |
| Prediction distance (ms): | 3 | 3 | 8 | — | — |
| Design window (ms below seafloor reflection): | ~1000 | ~1200 | ~1500 | — | — |
| White-noise level (%): | 0.1 | 0.1 | 0.1 | — | — |
| Spiking deconvolution: | | | | | |
| Operator length (ms): | — | — | — | 300 | 3 |
| Design window (ms below seafloor reflection): | — | — | — | ~800 | ~300 |
| White-noise level (%): | — | — | — | 0.1 | 0.1 |
| Butterworth bandpass filter: | | | | | |
| Phase: | Zero | Zero | Zero | Zero | Zero |
| Pass-band (Hz): | 40–80 | 40–120 | 40–120 | 65–170 | 60–170 |
| Low roll-off (dB/octave): | 18 | 18 | 18 | 18 | 18 |
| High roll-off (dB/octave): | 72 | 36 | 72 | 36 | 36 |
| True amplitude recovery: | | | | | |
| Basis: | Spherical spreading (1/t·v2) | Spherical spreading (1/t·v2) | Spherical spreading (1/t·v2) | Spherical spreading (1/t·v2) | Spherical spreading (1/t·v2) |
| Velocity model: | Constant at 1500 m/s | Constant at 1500 m/s | Constant at 1500 m/s | Constant at 1500 m/s | Constant at 1500 m/s |
| Water column mute | Yes | Yes | Yes | Yes | Yes |
| Trace kill | Yes | Yes | Yes | Yes | Yes |
| F-K migration: | | | | | |
| Stolt stretch factor: | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Velocity model: | Constant at 1500 m/s | Constant at 1500 m/s | Constant at 1500 m/s | Constant at 1500 m/s | Constant at 1500 m/s |

Notes: For Survey 1203, the first break of source signature occurs at t = 40 ms. — = no value.

**Table T2.** Locations of drill sites and line crossings from seismic surveys over Detroit, Nintoku, and Koko Seamounts.

| | Trace number | Northing (m) | Easting (m) | Distance (m) |
|---|---|---|---|---|
| Survey 1203: | | | | |
| Line 1203-1 | | | | |
| Line 1203-5 intersection | 1,305 | –42,210 | –15808 | 23,498 |
| Site 1203 (closest trace) | 2,380 | –27,458 | –1690 | 43,959 |
| Line 1203-3 intersection | 2,384 | –27,398 | –1636 | 44,040 |
| Line 1203-6 intersection | 2,385 | –27,384 | –1622 | 44,059 |
| Line 1230-3 | | | | |
| Site 1203 (closest trace) | 4,037 | –27,795 | –1716 | 73,177 |
| Line 1203-1 intersection | 4,042 | –27,866 | –1667 | 73,264 |
| Line 1203-6 intersection | 4,042 | –27,866 | –1667 | 73,264 |
| Line F43 (closest trace) | 4,454 | –28,087 | –1542 | 80,205 |
| Line 1203-5 | | | | |
| Line 1203-1 intersection | 6,268 | –42,255 | –16288 | 111,330 |
| Line 1203-6 | | | | |
| Site 1203 (closest trace) | 7,766 | –27,553 | –1714 | 139,980 |
| Line 1203-3 intersection | 7,772 | –27,512 | –1610 | 139,816 |
| Line 1203-1 intersection | 7,773 | –27,506 | –1592 | 139,834 |
| Survey 1204: | | | | |
| Line 1204-1 | | | | |
| Line 1204-3 intersection | 610 | 178 | 25 | 11,096 |
| Site 883F (closest trace) | 610 | 178 | 25 | 11,096 |
| Line F41 intersection | 1,406 | 14,932 | 19 | 25,853 |
| Line 1204-3 | | | | |
| Line F41 intersection | 3,014 | 6,529 | –4740 | 52,041 |
| Site 883F (closest trace) | 3,519 | –160 | 131 | 60,324 |
| Line 1204-1 intersection | 3,520 | –174 | 140 | 60,341 |
| Site 1204A (closest trace) | 3,550 | –570 | 443 | 60,840 |
| Site 1204B (closest trace) | 3,557 | –659 | 510 | 60,951 |
| Farnella data: | | | | |
| Line 41 | | | | |
| Line 1204-1 intersection | 1,813 | 14,494 | –120 | 80,511 |
| Line 1204-3 intersection | 2,023 | 6,440 | –4,985 | 89,921 |
| Line 43 | | | | |
| Line 1203-3 (closest trace) | 1,337 | –33604 | 2,703 | 58,162 |
| Site 884 (closest trace) | 3,063 | 28,296 | 39,712 | 130,534 |
| Survey 1205: | | | | |
| Line 1205-1 | | | | |
| Site 1205 (closest trace) | 854 | –130 | 146 | 13,711 |
| Line 1205-4 intersection | 855 | –137 | 151 | 13,720 |
| Line 1205-4 | | | | |
| Site 1205 (closest trace) | 3,825 | –1 | 7 | 47,125 |
| Line 1205-1 intersection | 3,825 | –1 | 7 | 47,125 |
| Survey 1206: | | | | |
| Line 1206-2 | | | | |
| DSDP Site 308 (closest trace) | 2,178 | 6,296 | 67 | 24,182 |
| Line 1206-3 | | | | |
| Line 1206-6 intersection | 3,022 | –136 | –131 | 34,648 |
| Site 1206 (closest trace) | 3,022 | –136 | –131 | 34,648 |
| Line 1206-6 | | | | |
| Line 1206-3 intersection | 4,947 | –133 | 139 | 58,511 |
| Site 1206 (closest trace) | 4,947 | –133 | 139 | 58,511 |

Notes: Trace number is that given in the SEG-Y data trace headers; all distances refer to source-receiver midpoint locations. Northing and Easting is the distance north and east, respectively, from Site 883F (Surveys 1203 and 1204, Farnella data; 51.1984°N, 167.7681°E), Site 1205 (Survey 1205; 41.33332°N, 170.37833°E), and Site 1206 (Survey 1206; 34.92580°N, 172.14588°E). Distance refers to along-line distance from the start of survey.