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58. *DATA REPORT:* UNDERWAY AND SITE-SURVEY GEOPHYSICS, LEG 133[1]

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ABSTRACT

Site-survey geophysical data collected prior to Leg 133 and underway geophysical data collected during Leg 133 were indispensable parts of the Ocean Drilling Program (ODP) drilling process off northeastern Australia. During 1987, BMR's vessel *Rig Seismic* collected 1400 km of multichannel, water-gun seismic reflection data and associated bathymetric, gravity, and magnetic data throughout the region to be drilled, and this formed the site-survey data set that was used to refine the scientific objectives and to select the final drill sites. During Leg 133, the *JOIDES Resolution* seismic crew collected 3222 nmi (5971 km) of underway geophysical data on transits to and between sites and over the sites themselves. These data were mainly bathymetric and magnetic data, but also included 154 nmi (285 km) of single-channel water-gun seismic reflection data over the sites to confirm their positions prior to drilling. Together, these data sets play an important part in our understanding of the regional significance of the drilling results.

INTRODUCTION

Geophysical data, particularly seismic data, form an important and integral part of the ODP process. These data fall into two categories: "site-survey" data collected prior to the drilling leg and used for defining the scientific problems to be addressed, pre-leg planning, and selection of final drill sites; and "underway geophysics" data collected on board *JOIDES Resolution* during the actual drilling leg on transits to and between sites, and around and over the sites themselves. Underway geophysics data collected over the sites are used to confirm the positions of the selected sites prior to drilling, to provide further information on the nature of the sites, and to tie between the sites and other data sets in the area. Both site-survey and underway geophysical data are vital for regional interpretation and extrapolation of the drilling results.

The main purpose of this study is to describe the equipment, methods, and data collected on board *JOIDES Resolution* during the Leg 133 shipboard underway geophysics program. However, because the site-survey data acquired over and between the proposed Leg 133 sites in 1987 by the Bureau of Mineral Resources, Australia (BMR), is often referred to and figured in both the Leg 133 *Initial Reports* volume (Davies, McKenzie, Palmer-Julson, et al., 1991) and this volume, a brief description of the methods, equipment, and seismic acquisition parameters used during that survey also is included here. Specific geophysical data used in the selection, description, and interpretation of each site are discussed in more detail in individual site chapters (see "Site Geophysics" and "Seismic Stratigraphy" sections, site chapters) in Davies, McKenzie, Palmer-Julson, et al. (1991). The "Site Geophysics" sections of the site reports in Davies, McKenzie, Palmer-Julson, et al., (1991) contain track charts showing the distribution of both *JOIDES Resolution* site-location surveys and BMR 1987 *Rig Seismic* site-surveys, and regional seismic data around the Leg 133 sites, as well as figures illustrating portions of *JOIDES Resolution* and BMR *Rig Seismic* seismic data over the sites; these are not repeated here. Interpretations and discussions of regional seismic data tied to the drill sites will be addressed in various chapters within this volume.

BMR SITE-SURVEY DATA

During September/October 1987, BMR used its research vessel *Rig Seismic* to collect site-survey data over and between 14 sites proposed for drilling during ODP Leg 133 off northeastern Australia (Symonds and Davies, 1988). During this cruise, about 1400 km of multichannel, water-gun seismic reflection data and associated bathymetric, gravity, and magnetic data were collected throughout the region to be drilled (Fig. 1), and gravity and piston cores were obtained at each proposed site. Navigation during the cruise was by Magnavox T-set global positioning system (GPS), supplemented by Decca HI-FIX-6 radio navigation, and Magnavox 1107RS and 1142RS transit satellite receivers with sonar-doppler, speed logs, and gyro-compass. A list of the main equipment, acquisition parameters, and the seismic processing sequence for data collected during the BMR cruise is given in Tables 1 and 2.

The Leg 133 sites form two transects across the northeastern Australian continental margin—an east/west transect from the Great Barrier Reef east of Cairns, across the Queensland Trough to the Queensland Plateau near Holmes Reef; and a north/south transect from the Queensland Plateau, southwest of the Tregrosse Reefs, across the western Townsville Trough to the northeastern Marion Plateau (Figs. 1 and 5). More than one-half of the site-surveys consist of relatively dense, roughly orthogonal grids of between 6 and 10 seismic lines, which vary in length from about 6 to 11 km and are spaced from 0.5 to 1.8 km apart. The remaining site-surveys consist of at least two orthogonal crossings of the site with linking line segments (Feary et al., 1990; see "Site Geophysics" section, site chapters, in Davies, McKenzie, Palmer-Julson, et al., 1991). GPS navigation was available during 11 of the 14 surveys over the proposed sites. As well as the detailed site-surveys, linking seismic lines were recorded between some sites—Lines 75/38, 40, 42, 44, and 47 tying Sites 811/825, 824, 823, and 819/820/821 on the Queensland Trough transect; and Line 75/28 tying Sites 815/816/826 and proposed Site NEA12 on the southern end of the Townsville Trough transect (Fig. 1).

Many of the sites that were not linked during the 1987 BMR site-survey are tied through a variety of other regional seismic data that are available throughout the area (Figs. 1, 2, and 3). This regional data set is listed in Table 3, and track charts showing the distribution of these data in the area around the sites are given in the "Site Geophysics" sections of the site reports in Davies, McKenzie, Palmer-Julson, et al. (1991).

[1] McKenzie, J.A., Davies, P.J., Palmer-Julson, A., et al., 1993. *Proc. ODP, Sci. Results,* 133: College Station, TX (Ocean Drilling Program).

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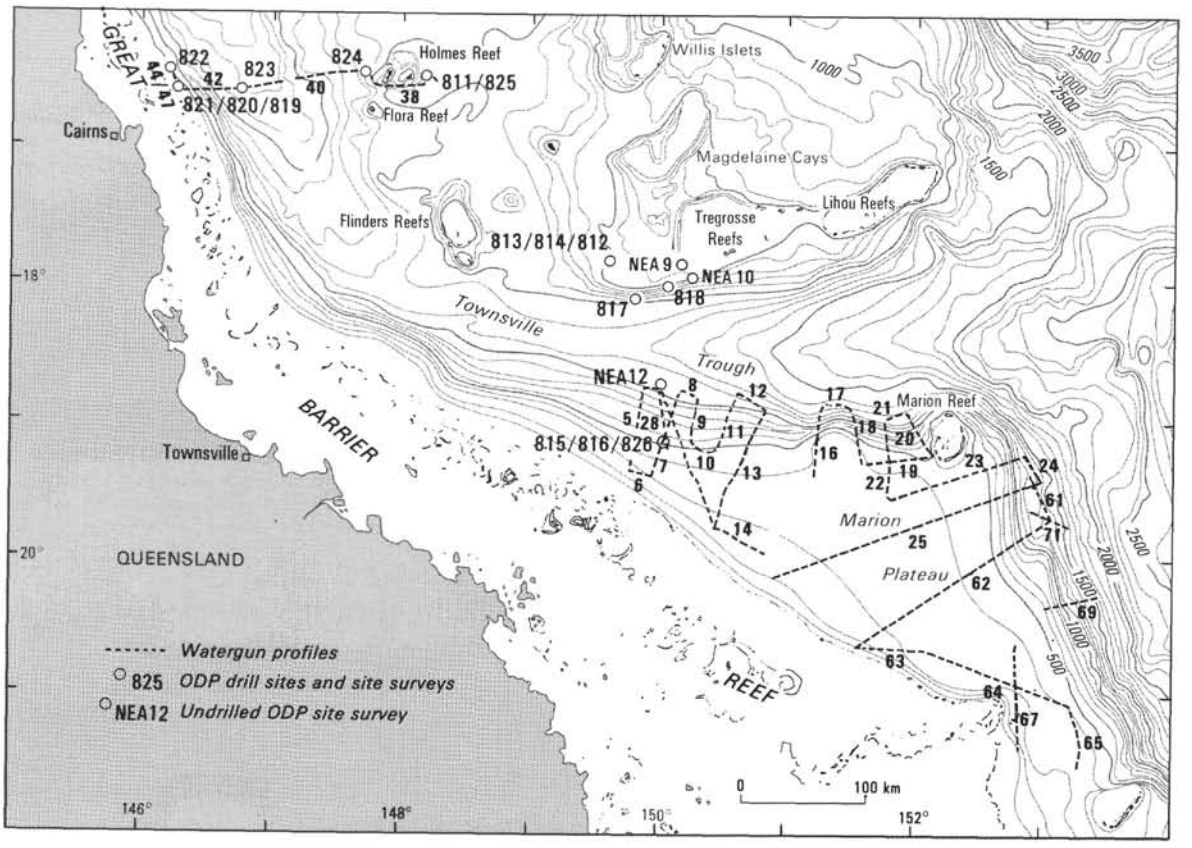

Figure 1. Location of water-gun seismic lines collected by *Rig Seismic* during the 1987 BMR site survey (survey 75) off northeastern Australia. Locations of detailed site-survey data over the drilled Leg 133 sites and undrilled proposed Sites NEA 9, 10, and 12 are shown. Water-gun seismic lines linking some of the sites also are shown. Line numbers are indicated as follows: 40 is BMR Line 75/40.

Table 1. Equipment and seismic acquisition parameters for the 1987 BMR site-survey.

Vessel		*Rig Seismic*
Seismic Streamer		450 m Teledyne 178 (small diameter) Active sections—12 × 12.5 m (front) and 12 × 25 m (rear) Near trace offset—193 m behind stern
	Energy source:	1.31 L (80-in.^{3}) Seismic Systems Inc. S.80 water gun
	Recording parameters:	24-channel, 24-fold recording Shot point interval—12.5 m Sample rate—1 ms Record length—2.5 s Amplifiers—gain 512 or 1024 dB filters low-cut 12 Hz; high-cut 256 Hz
		Tape format—BMR SEG-Y, 1600 BPI tape
Bathymetry	Raytheon 3.5- and 12-kHz depth recorders with 2 kW maximum output	
Gravity	Bodenseewerk Geosystems KSS-31 marine gravity meter	
Magnetics	Geometrics G801/803 proton precession magnetometers	
Geological sampling	Gravity and piston cores, chain-bag, and pipe dredge	
Navigation	Magnavox T-set GPS, Decca HIFIX-6 radio navigation, Magnavox 1107RS, and 1142RS transit satellite receivers with sonar-doppler, speed logs, and gyro-compass	

JOIDES RESOLUTION UNDERWAY GEOPHYSICAL DATA

JOIDES Resolution departed from Port Apra, Agana, Guam, at JD 221/0355 universal time coordinated (UTC) on 9 August 1990, to commence the 2017-nmi, 7-day transit to Site 811, the first site to be drilled during Leg 133. Leg 133 ended at Townsville, Australia, at JD 283/2000 on 10 October 1990, after traveling a total distance of 3242 nmi at an average speed of 10.8 kt, occupying 16 sites, and drilling 36 holes. Leg 133 was 67.5 days in duration, including the 4.8 days (7.1% of leg) in port at Agana, Guam, and was made up of 11.8 days (17.5%) underway and 50.9 days (75.4%) on site. The track of *JOIDES Resolution* for the whole of Leg 133 is shown in Figure 4. This track chart was generated from the MGD77 formatted tape prepared by the Geological Data Center (GDC), Scripps Institution of Oceanography, following processing of Leg 133 underway data.

Table 2. Seismic processing sequence for the 1987 BMR site-survey data.

Geometry definition, Reformat to DISCO internal format.
Resample to 2 ms.
Static correction for start of data; spherical divergence correction; velocity analyses at selected points; remove spikes greater than 1E6.
CDP sort 24-fold.
Near-trace mute over multiple.
Normal move-out correction.
24-fold median stack.
Bandpass filtering - 25 to 100 Hz.
F-K filter +/– 13° dip.
F-K migration with velocity of 1.5 km/s.
Time-gated bandpass filter: water bottom + 300-ms - 50 to 120 Hz; water bottom + 600-ms to end - 30 to 120 Hz

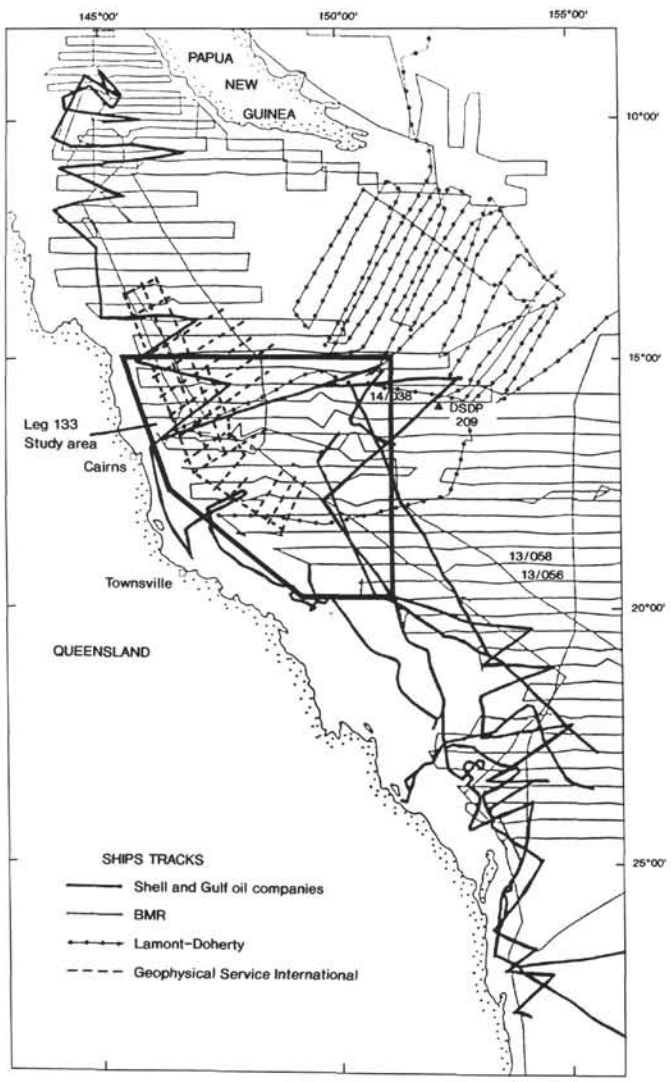

Figure 2. Distribution of pre-1984 regional seismic data in the western Coral Sea by BMR, Shell Development (Australia), Australian Gulf Oil, Geophysical Service International, and Lamont-Doherty Earth Observatory.

JOIDES Resolution is capable of collecting, displaying, and processing a variety of underway geophysical information, including navigation, bathymetric, magnetic, seismic reflection, and sonobuoy data. The equipment used for this purpose is located in the Underway Geophysics Laboratory (UGL) and on the adjacent poop deck. The instruments were maintained and operated by ODP marine technicians. A total of 3222 nmi of underway data were collected during Leg 133, including 3020 nmi of bathymetric data, 2877 nmi of magnetic data, and 154 nmi of seismic reflection data. A brief description of the underway equipment and methods used is given below, followed by a discussion of the data collected during Leg 133.

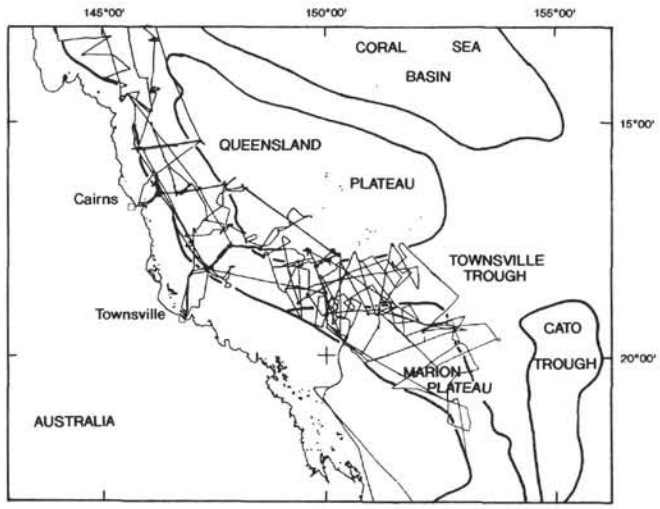

Figure 3. Distribution of post-1984 BMR *Rig Seismic* tracks in the Leg 133 study area.

Two types of underway geophysics data were collected during Leg 133:

1. Transit data, generally consisting of only bathymetric and magnetic data, collected on the long transit from Guam to the northeastern Australia study area, and on transits between sites and groups of sites.
2. Site location data, consisting of seismic, bathymetric, and magnetic data collected during site-surveys that were run to confirm the seismic character and position of the proposed sites that had been selected on the basis of the *Rig Seismic* site-survey data.

Following the leg, the navigation, bathymetry, and magnetic data were further processed by GDC in the standard manner under contract to ODP. The final data produced by GDC were submitted to ODP in the following formats:

1. Navigation listing of times and positions of course and speed changes, fixes, and drift velocity.
2. On magnetic tape: separate time series files of fixes, course and speed changes, water depth, and magnetics in SIO "uwts" format, navigation list file; merged file of navigation, water depth, and magnetics in MGD77 Exchange format.
3. On 35-mm microfilm, index track charts, navigation listing; fast and slow seismic profiler records; 12- and 3.5-kHz echo-sounder records; and magnetometer records (on one or more 100-ft rolls).

An informal report summarizing these data was also produced by GDC and sent to ODP.

Navigation

Equipment and Methods

During Leg 133, navigation data were collected using a Magnavox MX 1107 GPS combined transit and GPS satellite navigator located in the UGL. Additional back-up navigation equipment was located on the bridge and consisted of a Magnavox MX4400 GPS receiver, a Magnavox MX 702A transit receiver, and Decca and Loran C positioning systems; the latter two systems were not used within the Leg

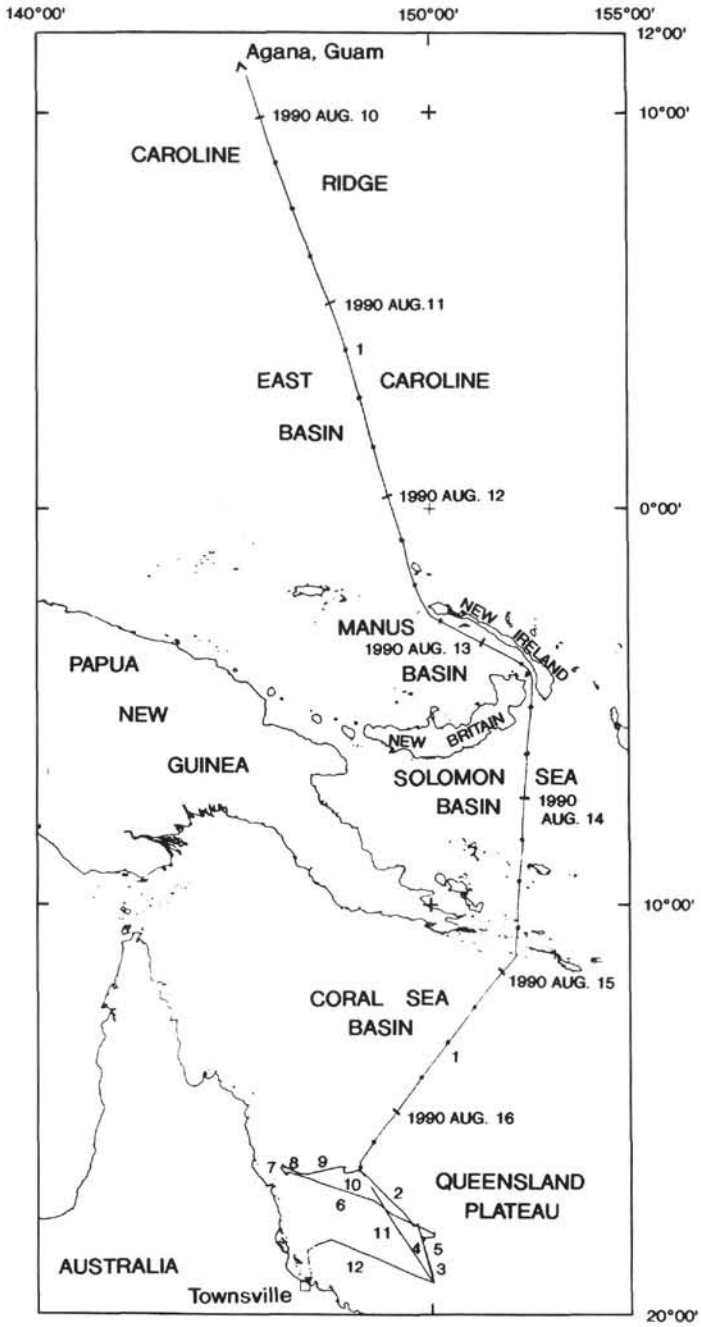

Figure 4. Track chart of *JOIDES Resolution* for Leg 133 from Agana, Guam, to Townsville, Australia.

133 study area. GPS fixes were available for about 90% of the time off northeastern Australia, while transit satellite fixes were available at various times throughout the day — good fixes about every 1 to 2 hr. The system calculated dead reckoning (DR) positions between satellite fixes. All fixes, plus ship's course and speed, were recorded in a "Navlog" file at selected time intervals using a Masscomp 561 super microcomputer system, usually every 15 to 30 min during nonseismic transits, and every 1 min while approaching the site and shooting seismic data. A continuous print-out was available of all transit fixes, and GPS and DR fixes every 30 min. Fixes collected on site were averaged, and a single accurate fix was determined as the official location for that site. The generalized track of *JOIDES Resolution* during Leg 133 from Agana, Guam, to Townsville, Australia, is shown in Figure 4. A more detailed *JOIDES Resolution* track chart in the study area off northeastern Australia is given in Figure 5 and shows simplified bathymetry, Leg 133 drill sites, and the underway geophysics line numbers.

Transit Data

Bathymetric and magnetic data were recorded on the transit from Guam to Site 811, and on most major transits between sites. On Line 7 between Site 821 and 822, and on Line 9 between Site 823 and 824 (Fig. 5), no magnetic data were recorded because of malfunction of the magnetometer. The only transit seismic data recorded during Leg 133 was on Line 7 between Sites 821 and 822. The locations of the transit lines between various groups of sites are given in Figure 5. Transits between closely spaced sites, such as Sites 812, 813 and 814, Sites 815 and 816, and Sites 819, 820 and 821, were included within the respective *JOIDES Resolution* site confirmation surveys covering each group of sites.

Site Location Data

JOIDES Resolution site location surveys were performed during Leg 133 to confirm the seismic character and position of the proposed sites selected using the BMR *Rig Seismic* site-survey data. Apart from the first survey at Site 811, all of the following site location surveys were conducted in a similar manner. Track charts showing the *JOIDES Resolution* site location surveys over the sites are given in Figures 6 to 14. During some site location surveys, particularly those covering groups of closely spaced sites, such as Sites 812 to 814, Sites 815 and 816, and Sites 819 to 821, extra seismic lines were shot to provide better site definition and to directly tie the sites.

At Site 811, the site location survey (Fig. 6) was designed (1) to give the seismic technicians enough time to test the seismic system before crossing the proposed site, (2) to develop procedures for locating Leg 133 sites as efficiently as possible, and (3) to compare the site location determined from the *Rig Seismic* navigation system with that from the *JOIDES Resolution* GPS. Seismic data were recorded along a *Rig Seismic* track over the site, and the seismic character and position of the site were confirmed. A beacon was dropped on the basis of seismic data recorded during a second crossing of the site on a reciprocal course.

Following the excellent correlation between *Rig Seismic* and *JOIDES Resolution* data at Site 811, a different procedure was adopted at the following sites. *JOIDES Resolution* crossed the proposed site generally in two directions, and at least one crossing was directly along a *Rig Seismic* site-survey line. Following confirmation of the seismic character and GPS coordinates of the site, *JOIDES Resolution* was maneuvered onto location using its dynamic positioning system. This method allowed the vessel's moon-pool to be positioned accurately over the site—an important factor for many of the Leg 133 drilling targets, which were small in area, in relatively shallow water, and were often covered by stringent drilling requirements imposed by the JOIDES Pollution Prevention and Safety Panel. This approach was favored over the more normal hit-and-miss approach, where a beacon is dropped while collecting seismic data, which is used in an attempt to predict the site location more than 200 m ahead of the displayed seismic record.

Bathymetry

Bathymetric data were collected during both the transits and site location surveys using 3.5- and 12-kHz precision depth recorder (PDR) systems and were displayed on two Raytheon LSR 1807M recorders at a 1-s sweep speed. The 3.5-kHz system uses a Raytheon PTR105B transceiver and 12 transducers, while the 12-kHz system has a PTR105B transceiver and an EDO 323B transducer. Both systems normally operate with CESP-III correlators, giving about a

Table 3. Regional seismic data off northeastern Australia relevant to Leg 133.

Survey	Year	Area	Seismic	
			Source	Fold
BMR Continental Margins Surveys 13 and 14	1971/1972	Northeastern Australia region	120 kJ sparker	6
Gulf Research and Development Co. and Australian Gulf Oil Co.	1973	Queensland Plateau and Trough; Townsville Trough; Great Barrier Reef south of Townsville	Aquapulse	24
Shell Development (Australia) Pty. Ltd.	1973/1974	Queensland Trough and Plateau; Townsville Trough; Marion Plateau	Air gun	24
Geophysical Service International (GSI)	1979	Queensland Trough and Plateau	Air gun	48
BMR Survey 41	1982	Central Great Barrier Reef and adjacent slope	9 kJ sparker	6 and 12
BMR Survey 42	1983	Great Barrier Reef and adjacent slope between Townsville and Bowen	9 kJ sparker	12 and 18
BMR *Rig Seismic* Surveys 50 and 51	1985	Northeastern Australia region	Air gun; 9 kJ sparker	24 and 18
BMR *Rig Seismic* Survey 75	1987	Queensland and Townsville troughs; Marion Plateau	80-in.^{3} water gun	24
BMR *Rig Seismic* Survey 76	1987	Townsville and Cato troughs; Marion Plateau	2 x 26 L air gun array	24

20-dB signal-to-noise improvement over the standard systems. Because of its higher frequency, and thus sharper seafloor imaging, the 12-kHz system was used to determine water depth.

Reasonable quality records were obtained throughout Leg 133, as would be expected with the relatively shallow water and calm seas experienced off northeastern Australia. Bathymetric data were obtained during our crossing of the nearly 9000-m-deep Mariana Trench south of Guam, but the seafloor was not imaged during our crossing of the nearly 7500-m-deep New Britain Trench. Good sub-bottom penetration on the 3.5-kHz records was not common during Leg 133; however, at a few locations, penetration of up to about 40 m was obtained. The 3.5-kHz records were particularly good during the transit from Site 817 to Site 818 along the southwestern slope of the Queensland Plateau, where up to 40 m of penetration was obtained. An example of this record is given in Figure 6 in the "Site Geophysics" section, "Site 818" chapter, in Davies, McKenzie, Palmer-Julson, et al. (1991). Profiles of bathymetry along track are given in Figures 15 to 27, and a list of the echo-sounder records collected is given in Table 4.

Magnetics

Total magnetic intensity was measured during Leg 133 using a Geometrics 801 proton precession magnetometer, with the sensor towed approximately 300 m astern. Measurements were performed at 3-s intervals, with 1 nT sensitivity, and the data were recorded digitally in the seismic tape header on the Masscomp computer every 1 min during nonseismic transits and once per shot during seismic surveys. The data were also displayed continuously in real time in analog form on a strip chart recorder, and values were recorded manually every 30 min in the UGL. These magnetic data were processed by GDC and reduced to magnetic anomaly values by removal of the 1985 International Geomagnetic Reference Field.

Magnetic data were obtained on all transit lines and site location surveys except during Line 7, between Sites 821 and 822, and Line 9, between Sites 823 and 824 (Fig. 5), when the magnetometer malfunctioned. Profiles of magnetic anomaly along track are given in Figures 15 to 27, and a list of the magnetic records collected is given in Table 5.

Seismic Reflection Data

Single-fold seismic reflection data were collected on board *JOIDES Resolution* during all site location surveys and on the transit from Sites 821 to 822 (Line 7). An important requirement of the site location surveys was that the seismic records obtained on board *JOIDES Resolution* should be as close as possible in appearance to those collected by the BMR during the 1987 *Rig Seismic* site surveys. The aim was to reduce ambiguity during site definition and when comparing seismic stratigraphy from the two data sets. This necessitated some changes to the *JOIDES Resolution* streamer and 80-in.^{3} water-gun deployment systems to ensure that the frequency, content, and display parameters of the two data sets were similar. A summary of the seismic equipment and acquisition parameters used during the *JOIDES Resolution* site surveys is given in Table 6.

The seismic source used during Leg 133 seismic surveys was two 80-in.^{3} Seismic Systems Inc. water guns fired simultaneously at 1700 to 2000 psi, and towed about 14 m apart (using the starboard and port davits) about 25 m behind the ship at a depth of about 3 m. This towing depth was considerably shallower than that normally used on board *JOIDES Resolution* and was achieved by suspending the water guns 3 m below the sea surface from Norwegian buoys. A Teledyne "high-speed" streamer was used that consisted of a 100-m-long active section containing 60 hydrophones and a 50-m-long stretch section. The streamer was towed about 220 m behind the ship, generally on the

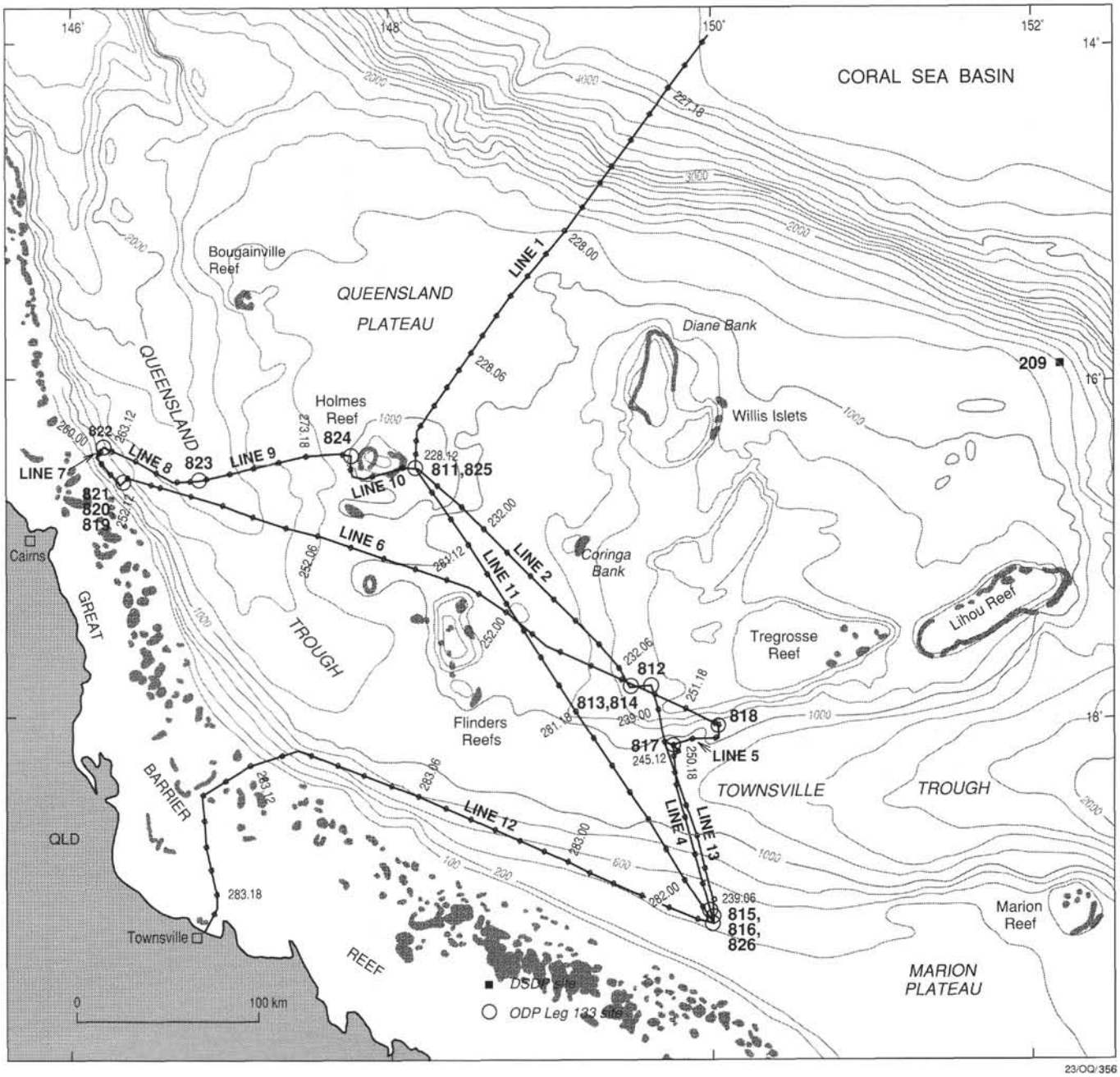

Figure 5. Track chart of *JOIDES Resolution* in the Leg 133 study area off northeastern Australia. Shows the general bathymetry of the area; the locations of Sites 811 to 826 occupied during Leg 133; DSDP Site 209; and the underway geophysics line numbers.

port side, at a proposed depth of 5 m. In an effort to try to tow the streamer at this depth, which is considerably shallower than that normally used on board *JOIDES Resolution*, the hydrophone array was stripped of lead at the eel head and filled with oil. Even with these modifications, the streamer was generally much deeper than the nominal 5 m, commonly about 10 m.

Seismic data were digitally recorded on 9-track magnetic tape using a Masscomp 561 super microcomputer system and then displayed in real time on a 15-in.-wide Printronix high-resolution graphic printer (160 dots/in.). The raw data were filtered at 25 to 250 Hz and recorded on 1600 bpi magnetic tape in SEG-Y format at a 1-ms sample rate and with a 5-s record length. The water guns were fired every 9 s, the fastest rate allowed by the seismic acquisition software, with a ship's speed of between 5 and 6 kt. A shot rate of about 5 s (12.5 m shot interval at 5 kt) would have been preferred, as this was the coverage obtained during the BMR site-survey, and it would also have resulted in a less compressed analog display. The tape header file for each shot contains information, such as first file ID number, shot point number, field time break delay, date, time, wind speed and direction, ship's speed (pit log), ship's gyro heading, cumulative distance traveled, streamer and gun depths, information about timing of gun firing, as well as the magnetic data discussed above.

The raw seismic data were also displayed in real time in analog form on two Raytheon LSR 1807M recorders via an Ithaco amplifier set at about 80 dB, and a Krohn-Hite filter generally set at 30 to 170 Hz. The Raytheon recorders were set at two different scales, generally one at a 1-s sweep with a paper speed of 12 in./hr. and one at a 2-s sweep with a paper speed of 50 lines/in.

About 154 nmi of seismic reflection data were recorded during Leg 133. In general, the seismic equipment operated well and good

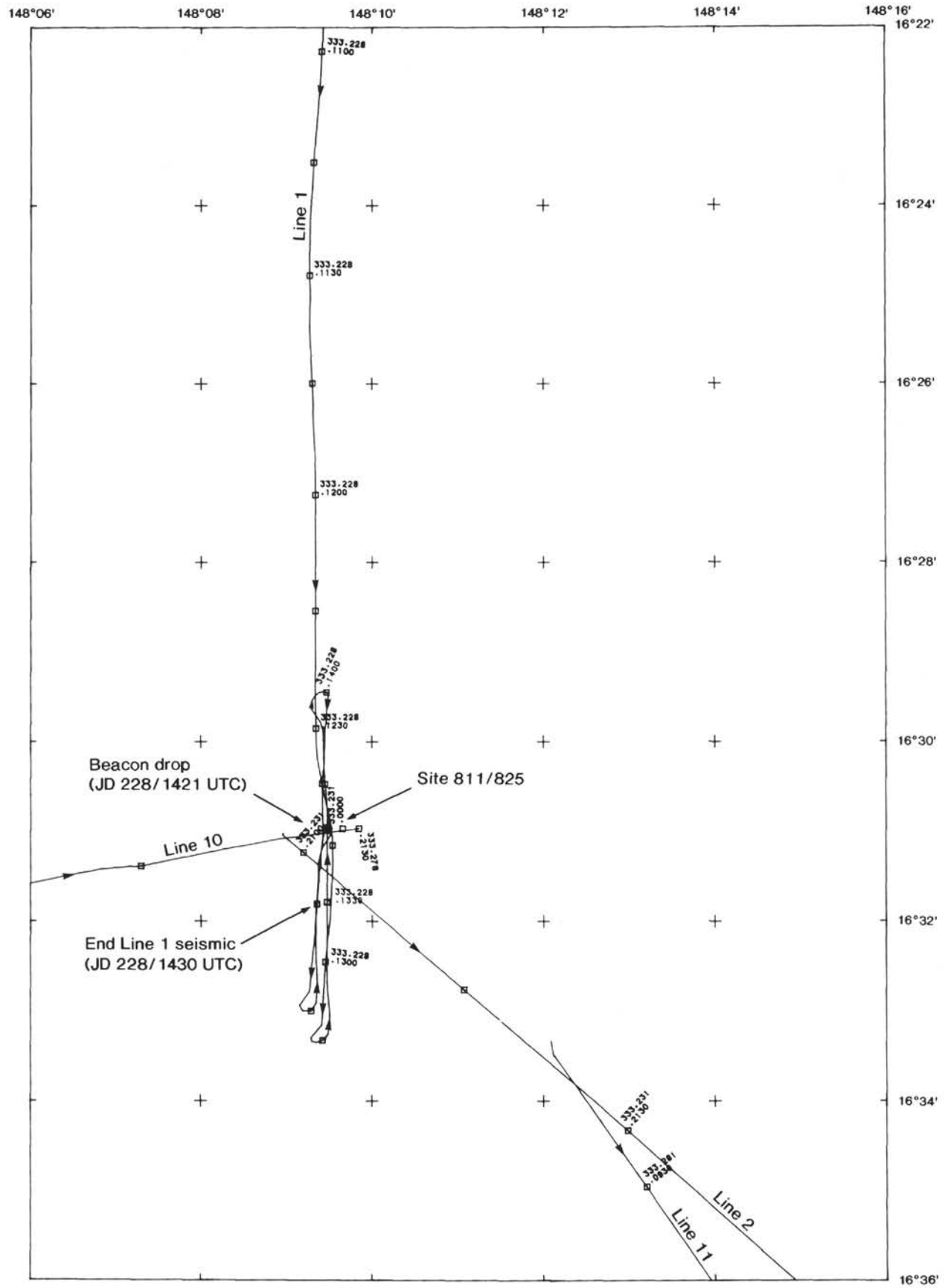

Figure 6. *JOIDES Resolution* site location survey over Sites 811 and 825.

Table 4. Log of 3.5- and 12-kHz echo sounder records collected during Leg 133.

Line number	Start time (UTC)	Stop time (UTC)	Start Lat. (°S)	Start Long. (°E)	Stop Lat. (°S)	Stop Long. (°E)
1	0800 9/08/90	1435 16/08/90	12 44.1	144 44.9	16 32.2	148 09.3
2	2100 19/08/90	1105 20/08/90	16 31.2	148 09.1	17 48.8	149 36.4
3	2310 26/08/90	1100 27/08/90	17 48.8	149 36.3	19 08.9	149 59.4
4	0615 2/09/90	1545 2/09/90	19 12.1	150 00.2	18 09.6	149 45.2
5	1715 7/09/90	2050 7/09/90	18 09.5	149 45.4	18 03.5	150 02.5
6	1650 8/09/90	1520 9/09/90	18 03.3	150 02.2	16 37.5	146 19.5
7	2020 16/09/90	0240 17/09/90	16 25.3	146 12.8	16 23.8	146 11.5
8	1055 20/09/90	1710 20/09/90	16 26.2	146 13.8	16 36.9	146 47.0
9	1340 30/09/90	2130 30/09/90	16 37.7	146 48.1	16 26.7	147 45.4
10	1830 5/10/90	2130 5/10/90	16 26.8	147 46.0	16 30.9	148 09.8
11	0920 8/10/90	0135 9/10/90	16 33.4	148 12.1	19 13.3	150 00.8
12	2045 9/10/90	1100 10/10/90	19 04.2	149 36.1	18 13.6	147 18.7

Table 5. Log of magnetic records collected during Leg 133.

Line number	Start time (UTC)	Stop time (UTC)	Start Lat. (°S)	Start Long. (°E)	Stop Lat. (°S)	Stop Long. (°E)
1	0800 9/08/90	1425 16/08/90	12° 44.1′	144° 44.9′	16° 31.3′	148° 09.3′
2	2100 19/08/90	1024 20/08/90	16 31.2	148 09.1	17 48.8	149 37.4
3	2310 26/08/90	0955 27/08/90	17 48.8	149 36.3	19 12.9	150 01.0
4	0651 2/09/90	1448 2/09/90	19 11.6	150 00.0	18 11.2	149 47.2
5	1730 7/09/90	2015 7/09/90	18 09.1	149 47.0	18 01.3	150 02.4
6	1705 8/09/90	1445 9/09/90	18 02.6	150 00.5	16 34.9	146 21.0
No magnetic data recorded on Line 7						
8	1210 20/09/90	1630 20/09/90	16 26.8	146 15.0	16 36.9	146 48.1
No magnetic data recorded on Line 9						
10	1845 5/10/90	2110 5/10/90	16 29.2	147 45.6	16 31.5	148 06.4
11	0930 8/10/90	0100 9/10/90	16 34.9	148 13.1	19 08.3	149 56.8
12	2130 9/10/90	1045 10/10/90	19 00.8	149 28.3	18 12.5	147 21.6

quality shipboard analog records were obtained in a variety of sea states from Beaufort Scale force 2 to 6. The most common acquisition problems were the streamer towing depth, which was commonly about 10 m, rather than the nominal 5 m, and occasional gun firing and synchronization problems. It was not possible to produce a good quality analog record on board *JOIDES Resolution* with the same scale as the available BMR *Rig Seismic* site-survey profiles. This was mainly due to the compressed nature of the *JOIDES Resolution* records related to the minimum 9-s shot interval, which resulted in a trace spacing about twice that on the BMR site-survey data. Despite this difference in horizontal scale, excellent correlation was seen at most sites between the *Rig Seismic* and *JOIDES Resolution* seismic profiles. Figures comparing these two data sets are contained in each of the "Site Geophysics" sections in the site reports in Davies, McKenzie, Palmer-Julson, et al. (1991). Specific acquisition problems experienced during the various site location surveys are also discussed in these "Site Geophysics" sections. Shipboard processing of the *JOIDES Resolution* seismic data was not conducted because it formed such a small component of the seismic data available over the sites, and because time and manpower were limited during the very intensive Leg 133 drilling program. Shipboard analog seismic profiles obtained during Leg 133 are shown in Figures 28 to 36, and a list of the seismic profiles recorded is given in Table 7.

Table 6. Seismic equipment and acquisition parameters used for the *JOIDES Resolution* surveys during Leg 133.

Streamer	100 m Teledyne (high speed) Active section—1 × 100 m (60 hydrophones) Offset—220 m behind stern Towing—generally port side
Energy source	2 × 1.31 L (80-in.^{3}) Seismic Systems Inc. S.80 water guns Towing—one port and one starboard
Recording parameters Digital	Single-channel recording Shot point interval—23 m Sample rate—1 ms Record length—5 s Filters—low-cut 25 Hz, high-cut 250 Hz Tape format—SEG-Y, 1600 BPI tape
Analogue	Recorders—Raytheon LSR 1807M Recorder settings: recorder 1: sweep - 1 s paper speed-12 in./hour recorder 2: sweep-2 s paper speed-50 lines/in. Amplifier—Ithaco; 80–85 dB Filters—Krohn-Hite—settings generally low-cut 30 Hz, high-cut 170 Hz

UNDERWAY GEOPHYSICAL PROFILES

As mentioned previously, the underway magnetic and bathymetric profiles are shown in Figures 15 to 27, and the seismic profiles in Figures 28 to 36.

Transit from Guam to Site 811

During the long regional transit (Line 1) from Agana, Guam, to Site 811 on the Queensland Plateau, continuous bathymetric and magnetic data were collected and are displayed as profiles in Figures 15 and 16. This line crossed many significant tectonic features within the complex zone of interaction between the Philippine, Australia-India and Pacific plates, such as the Mariana Trench, Caroline Ridge, East Caroline Basin, West Melanesian Trench, Manus Basin, New Britain Trench, Solomon Sea Basin, Woodlark Basin, Coral Sea Basin, and Queensland Plateau.

Transit from Site 821 to Site 822

Seismic data were not normally recorded during transits between the sites, except within the site confirmation surveys of closely spaced

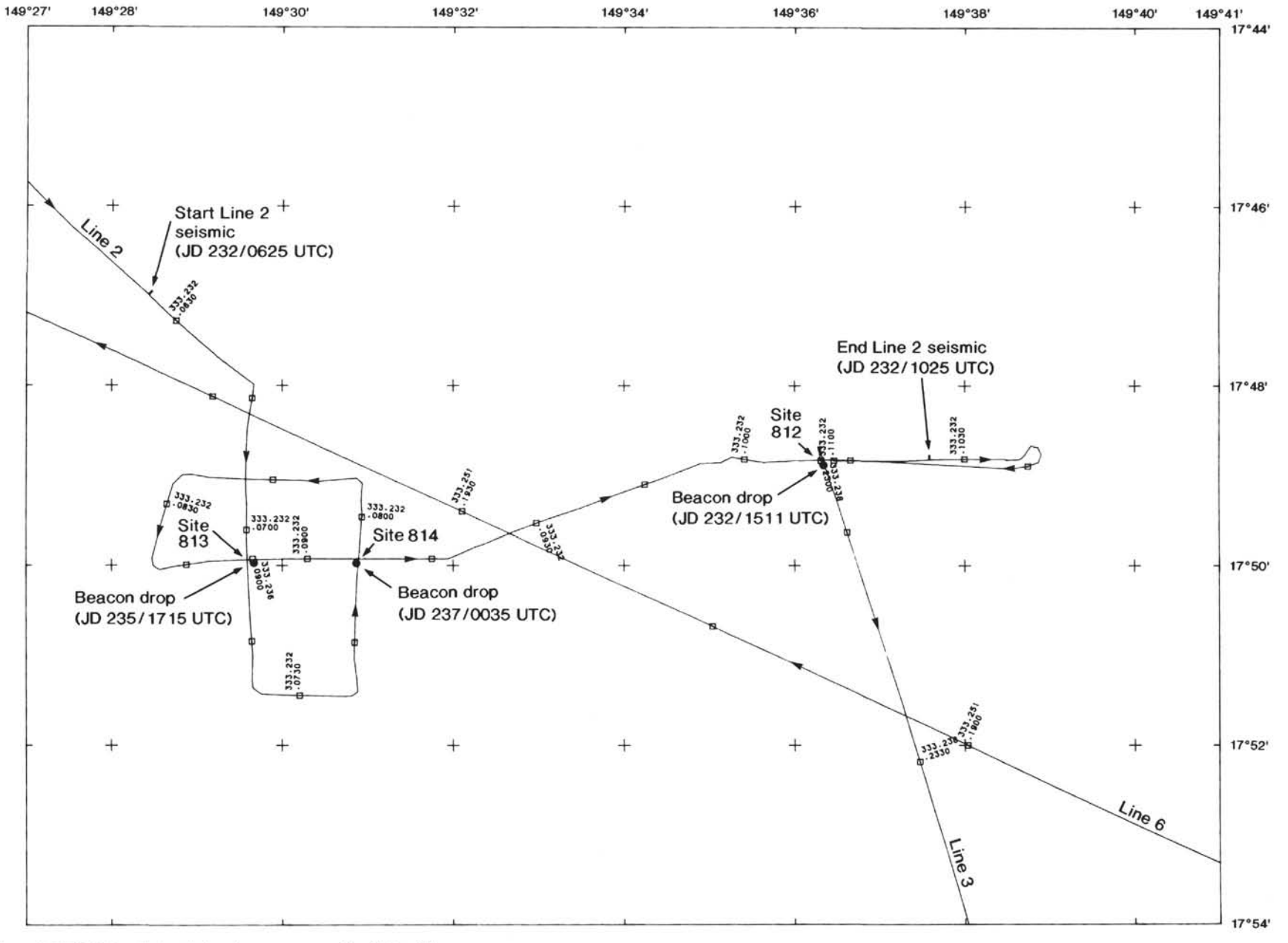

Figure 7. *JOIDES Resolution* site location survey over Sites 812 to 814.

sites. However, the Shipboard Scientific Party decided to collect seismic data during the transit between Sites 821 and 822 (Line 7) in an attempt to achieve a good, unambiguous seismic tie that would allow us to compare the two areas. A previous attempt to do this during the *Rig Seismic* site surveys was thwarted by canyons that dissect the lower slope between the sites. Unfortunately, during the *JOIDES Resolution* transit, the tie was also affected by upper slope canyons (Figs. 22 and 34).

Composite Bathymetric Profiles

Three composite bathymetric profiles are shown in Figure 37 that place the Leg 133 drilling sites within a regional perspective. The profile in Figure 37A is composed of Lines 1, 2, and 3, and defines the north/south Queensland Plateau-Townsville Trough-Marion Plateau drilling transect. The profile in Figure 37C is composed of Lines 7, 8, 9, and 10, and defines the west/east Great Barrier Reef-Queensland Trough-Queensland Plateau drilling transect. The profile in Figure 37B is composed of Lines 3, 5, and 6 and forms a diagonal tie between the two drilling transects.

ACKNOWLEDGMENTS

The author acknowledges the help of Laura Bagwell, ODP Data Librarian, in providing copies of various Leg 133 processed geophysical data tapes; Jeremy Bishop, John Mowat, and Ray Tracy of BMR, who helped with data transfer and manipulation, and plotting of the various track charts; and the AGSO Cartographic Services Unit for drafting the figures. Symonds publishes with permission of the Executive Director, Australian Geological Survey Organisation.

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Symonds, P.A., and Davies, P.J., 1988. Structure, stratigraphy, evolution and regional framework of the Townsville Trough and Marion Plateau region—research cruise proposal. *Bur. Miner. Res., Geol. Geophys.*, 1988/48.

*Abbreviations for names of organizations and publication titles in ODP reference lists follow the style given in *Chemical Abstracts Service Source Index* (published by American Chemical Society).

Date of initial receipt: 30 January 1992
Date of acceptance: 19 January 1993
Ms 133SR-277

Table 7. Log of seismic reflection records collected during Leg 133.

Line number	Start time (UTC)	Stop time (UTC)	Start		Stop	
			Lat. (°S)	Long. (°E)	Lat. (°S)	Long. (°E)
1	1055 16/08/90	1430 16/08/90	16° 21.8′	148° 09.4′	16° 31.8′	148° 09.3′
2	0625 20/08/90	1025 20/08/90	17 46.8	149 28.2	17 48.8	149 37.5
3	0610 27/08/90	0955 27/08/90	19 06.1	150 00.5	19 12.9	150 01.0
4	1210 2/09/90	1450 2/09/90	18 13.2	149 45.5	18 11.4	149 47.4
5	1900 7/09/90	2005 7/09/90	18 07.0	150 01.3	18 02.2	150 02.5
6	1200 9/09/90	1440 9/09/90	16 35.4	146 22.7	16 35.0	146 20.6
7	2030 16/09/90	0230 17/09/90	16 39.0	146 18.5	16 23.6	146 11.3
8	1500 20/09/90	1632 20/09/90	16 36.9	146 40.1	16 36.9	146 48.3
9	1920 30/09/90	2055 30/09/90	16 26.6	147 38.8	16 26.7	147 47.5

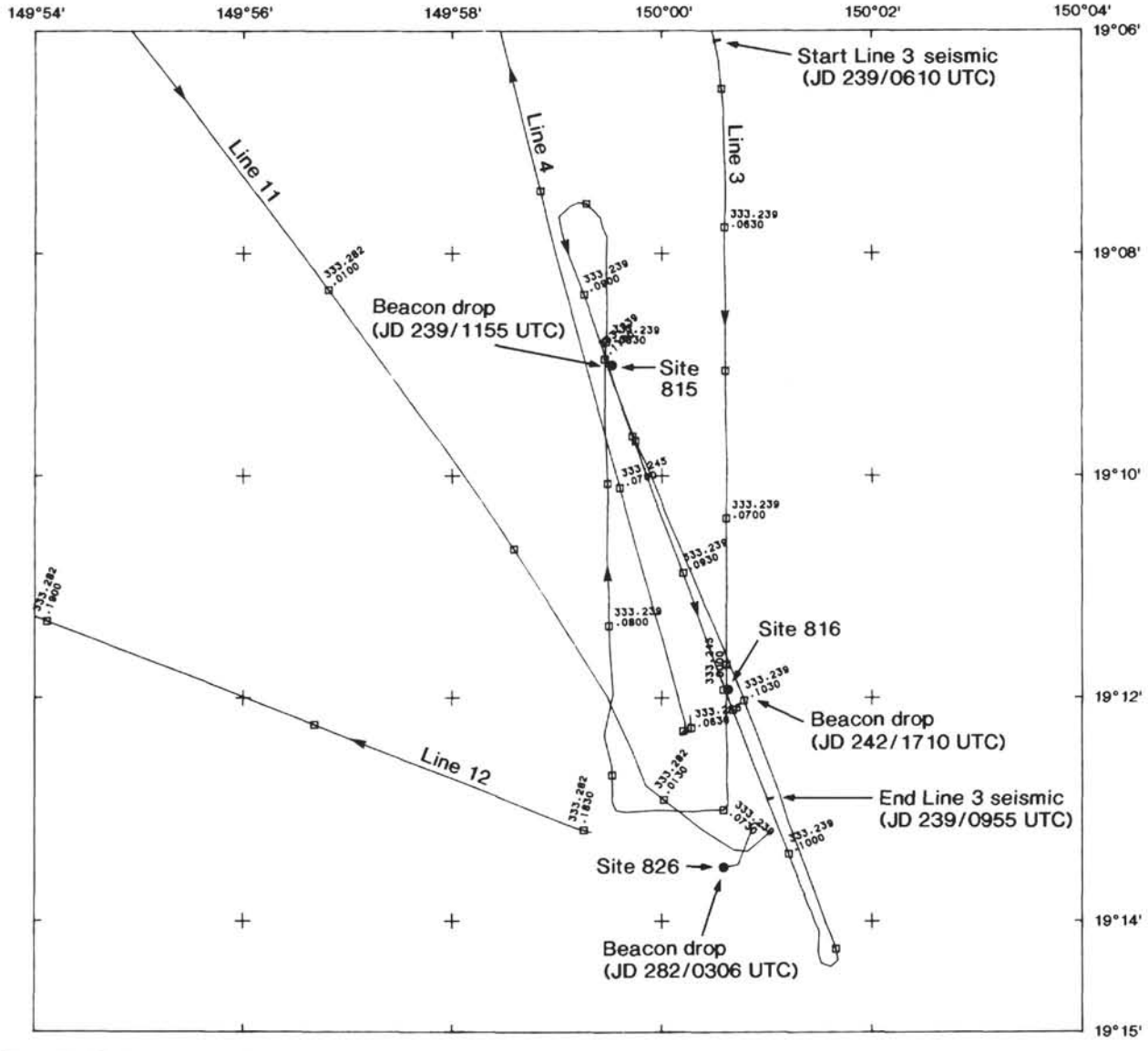

Figure 8. *JOIDES Resolution* site location survey over Sites 815, 816, and 826.

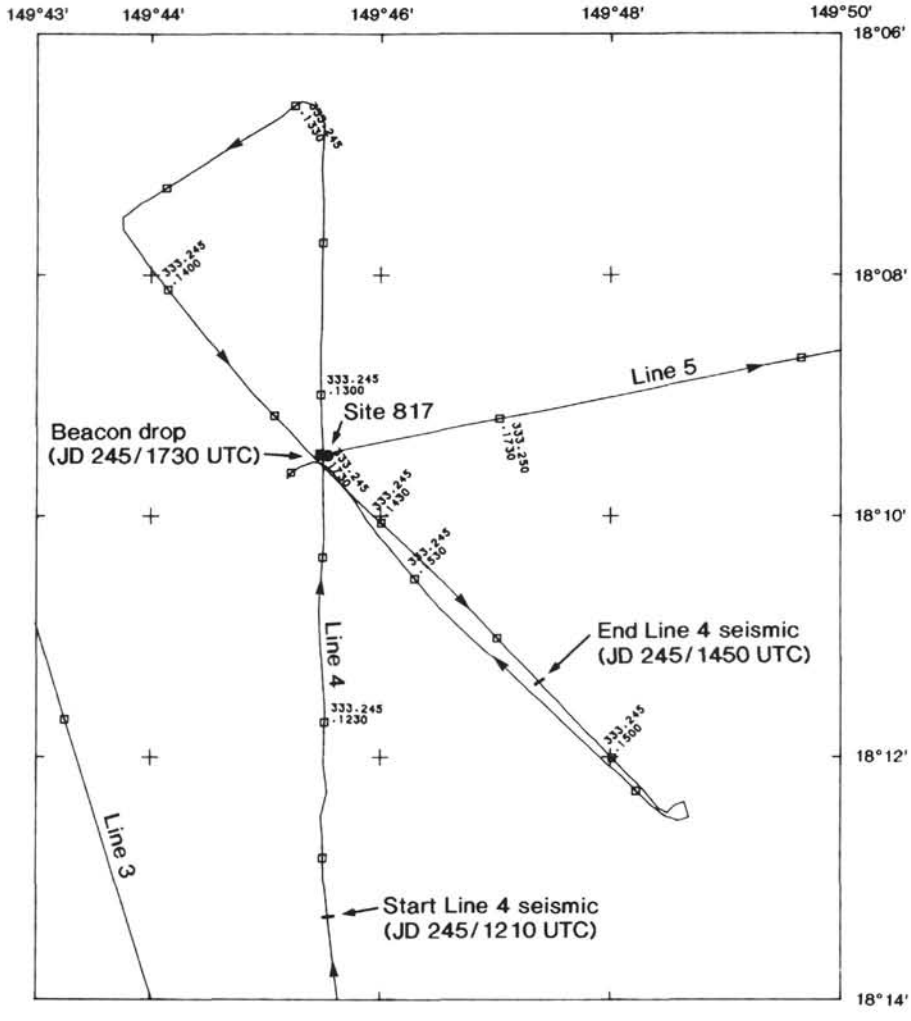

Figure 9. *JOIDES Resolution* site location survey over Site 817.

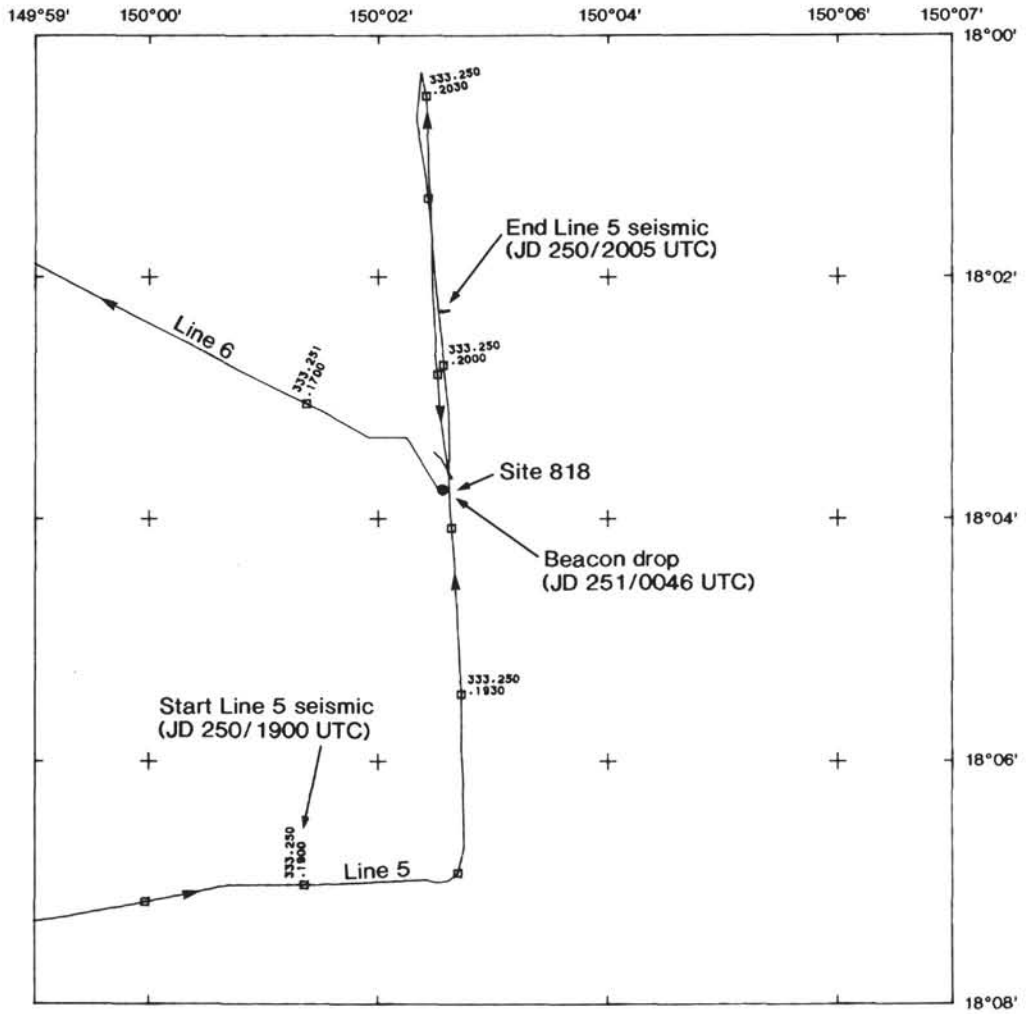

Figure 10. *JOIDES Resolution* site location survey over Site 818.

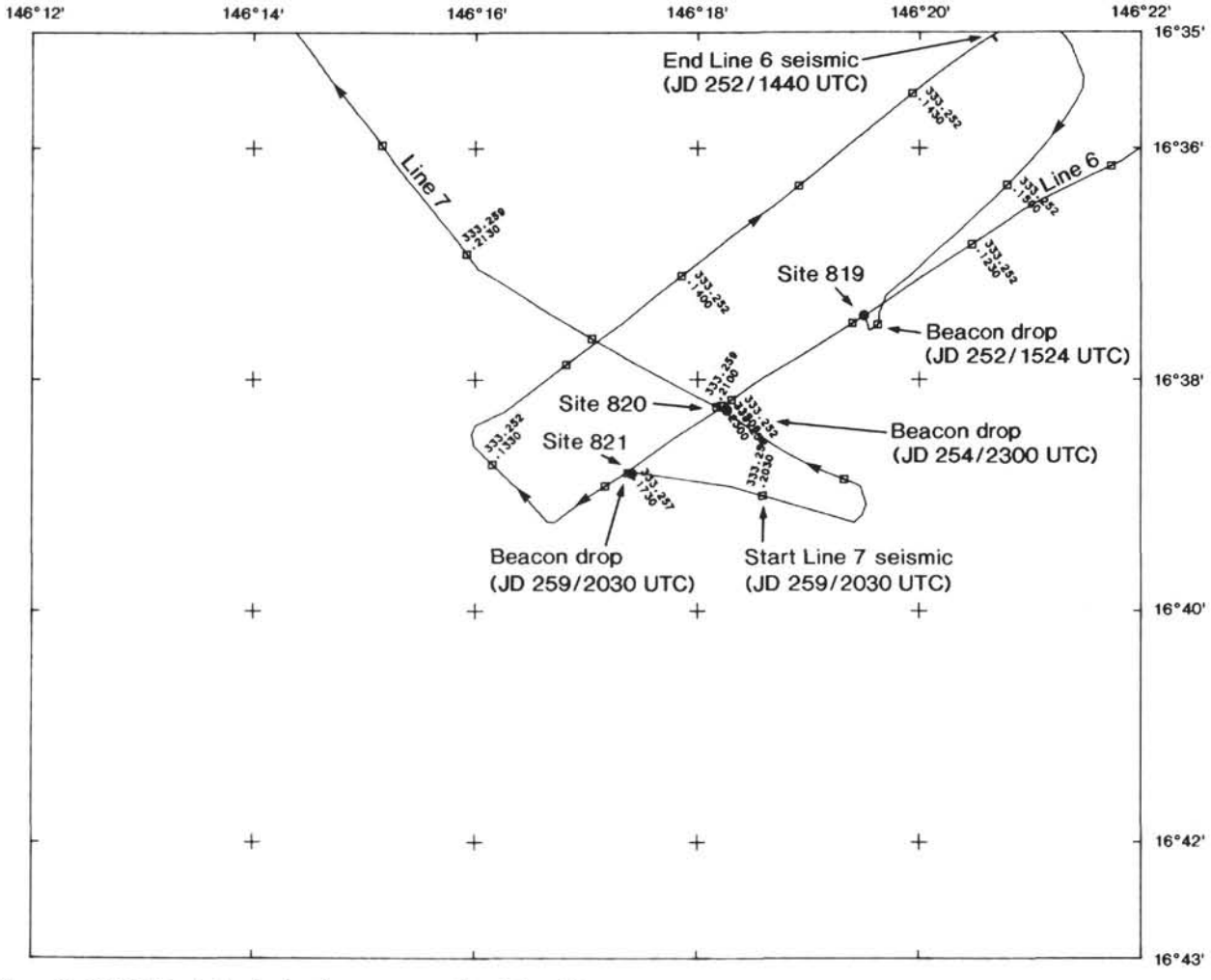

Figure 11. *JOIDES Resolution* site location survey over Sites 819 to 821.

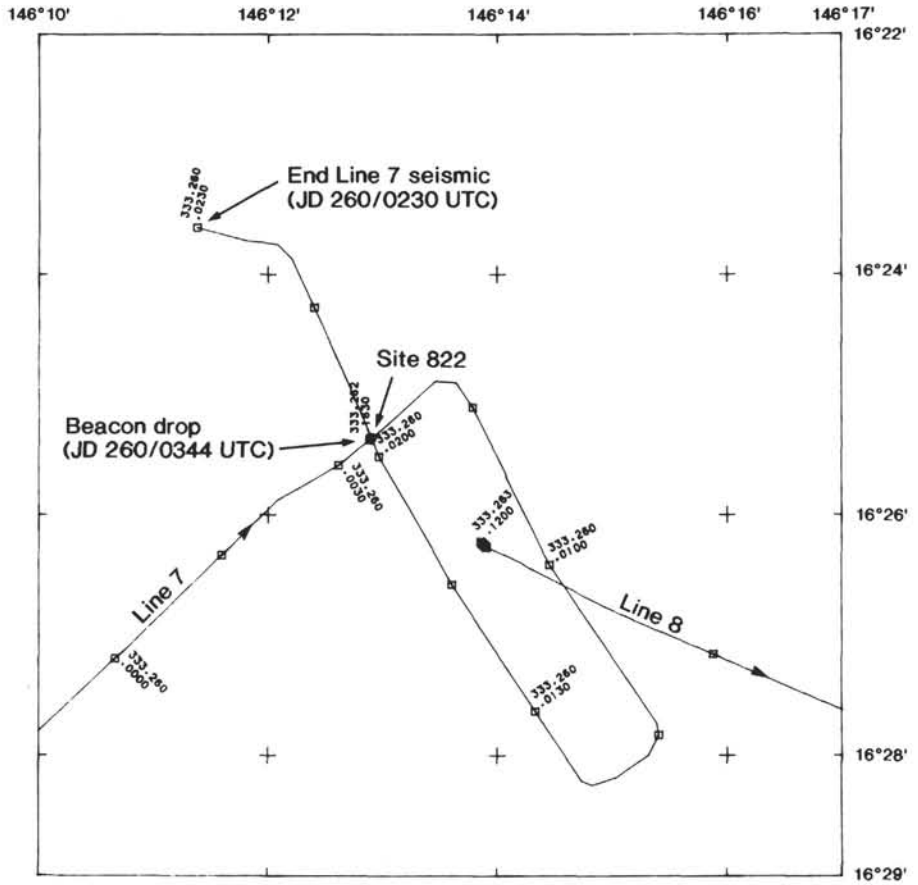

Figure 12. *JOIDES Resolution* site location survey over Site 822.

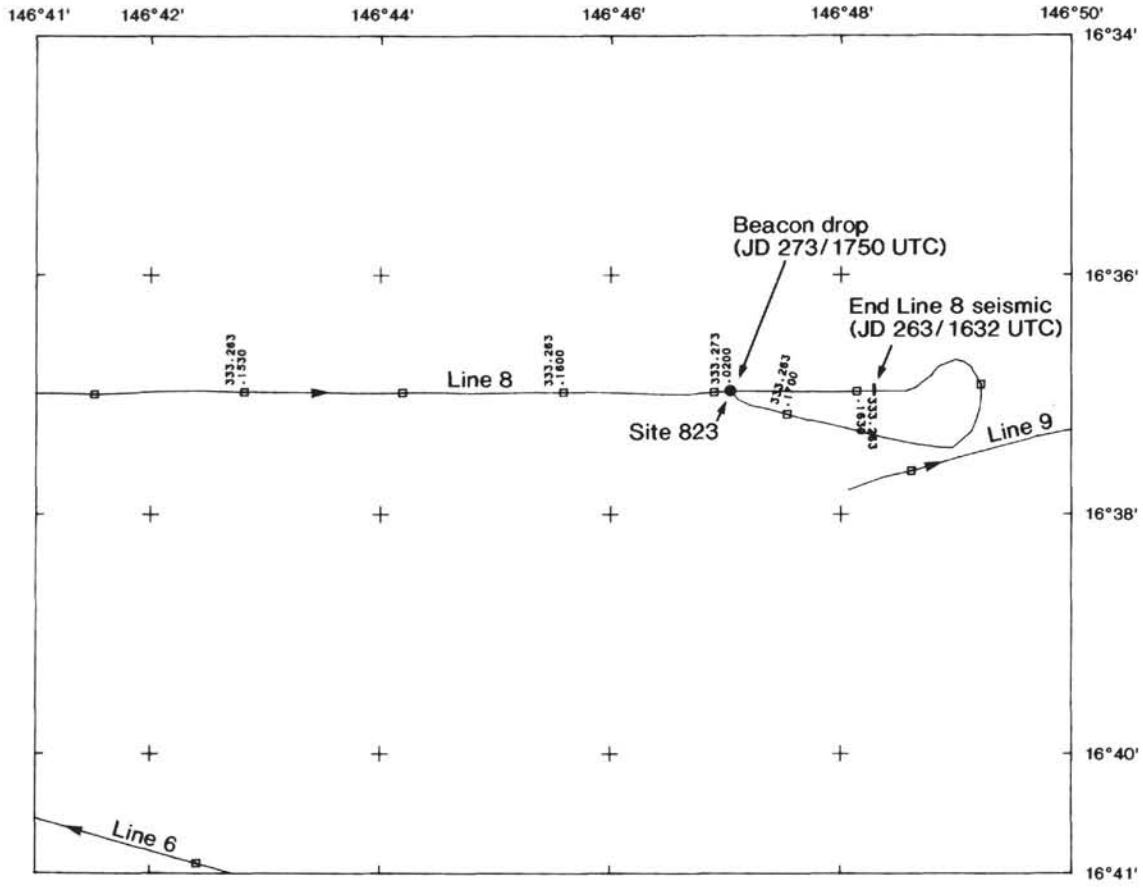

Figure 13. *JOIDES Resolution* site location survey over Site 823.

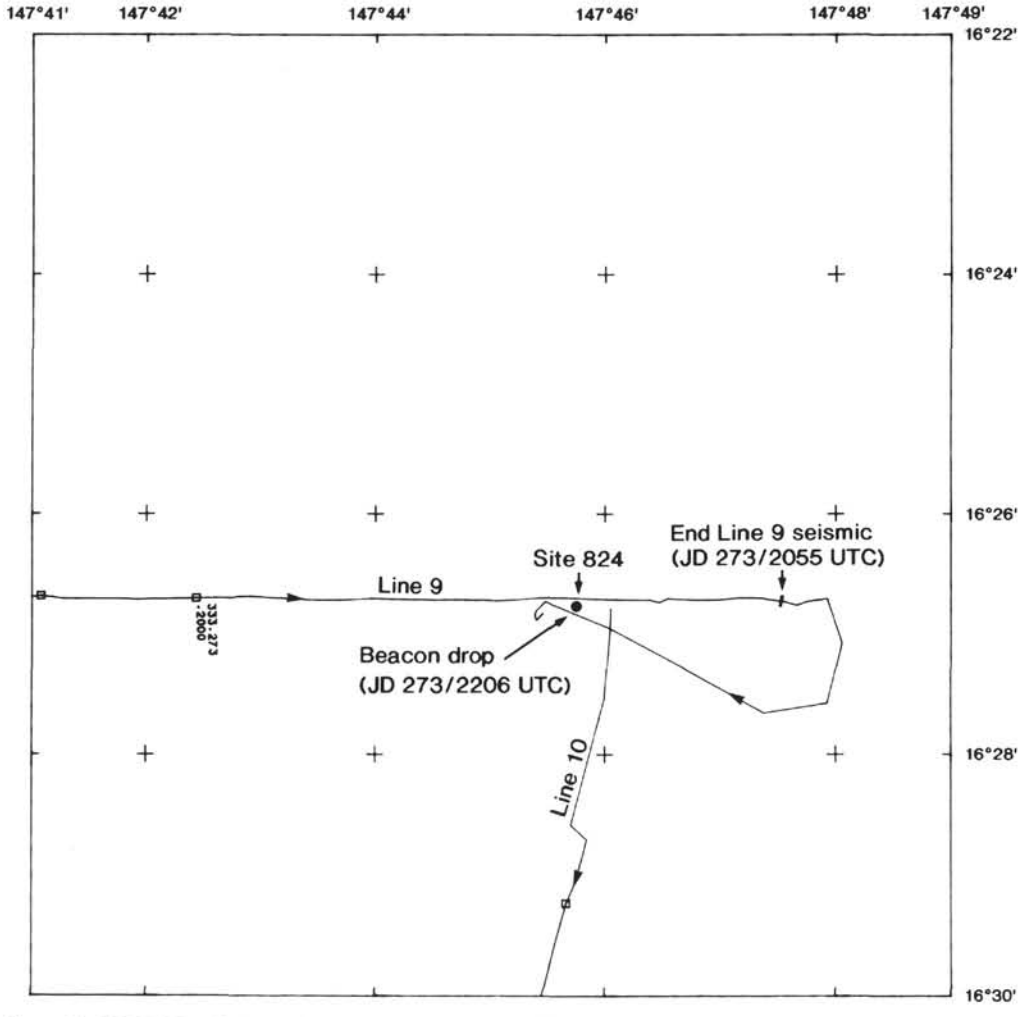

Figure 14. *JOIDES Resolution* site location survey over Site 824.

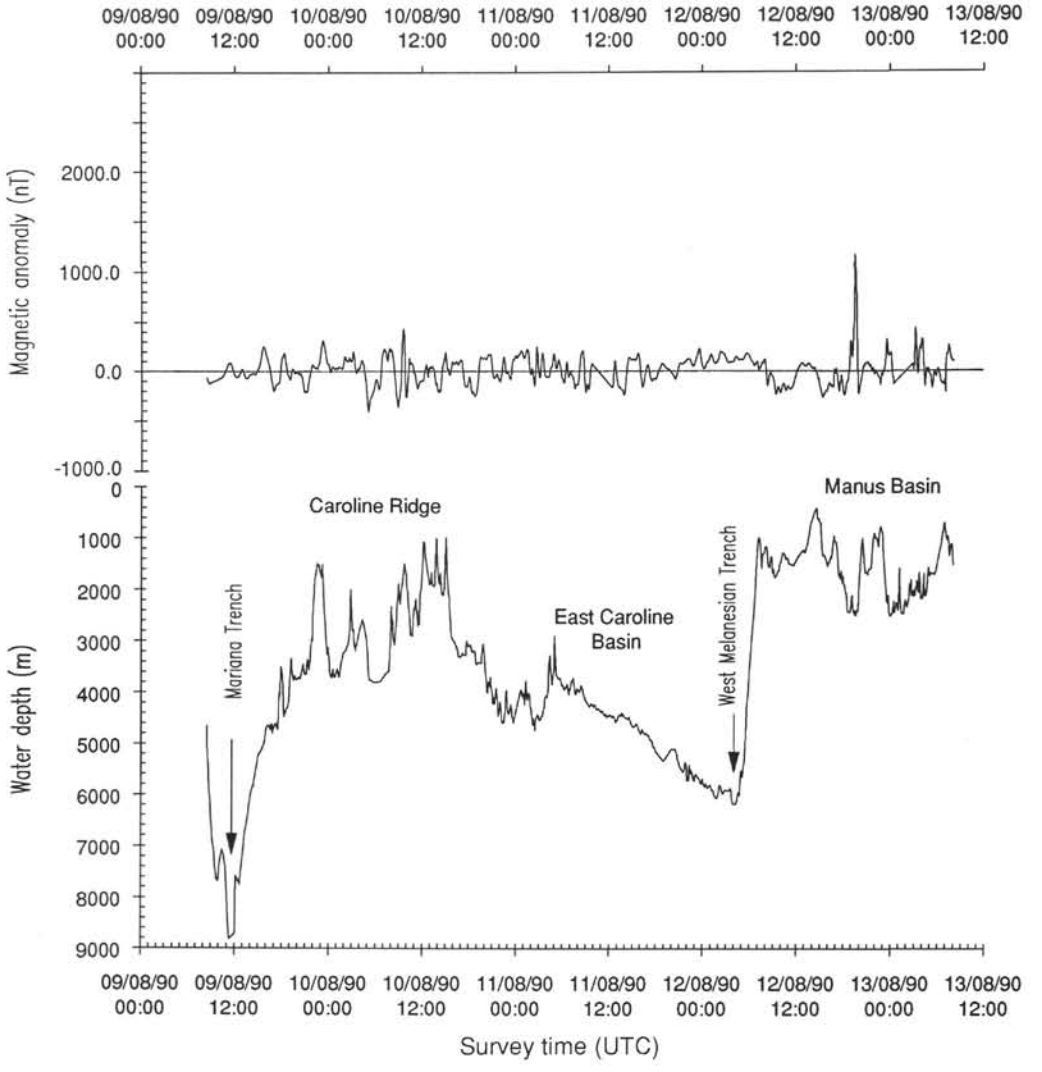

Figure 15. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 1 of Leg 133 and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figure 4.

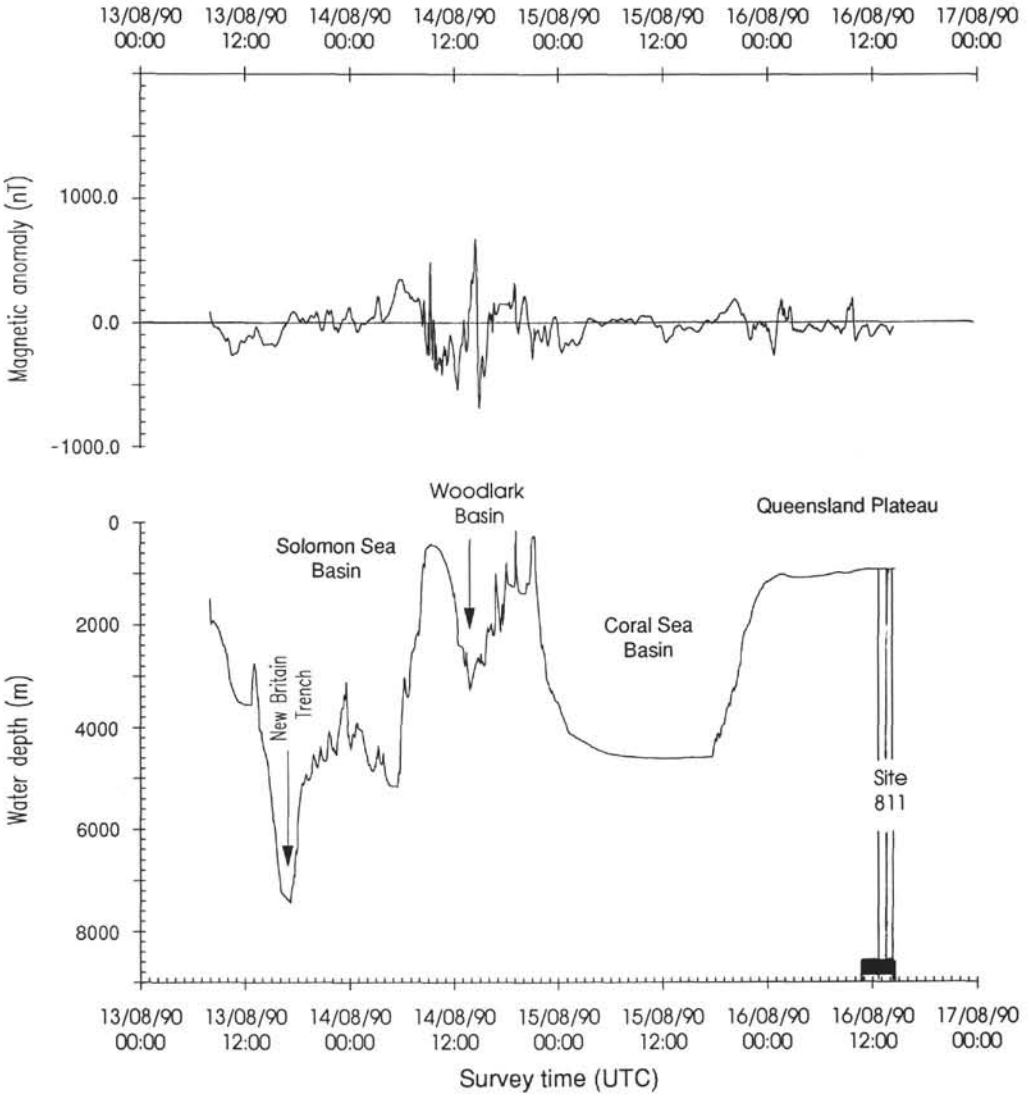

Figure 16. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 1 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figure 4. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

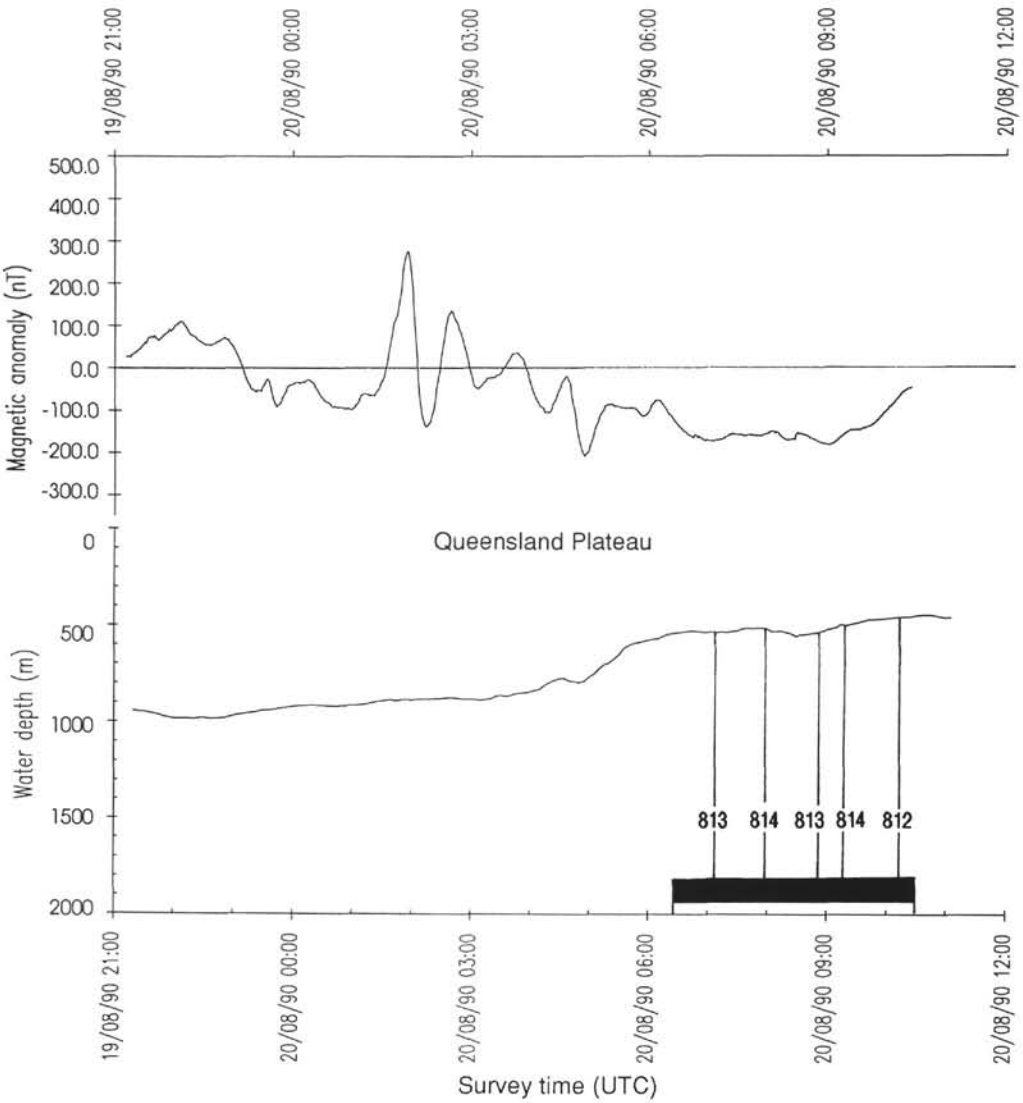

Figure 17. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 2 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

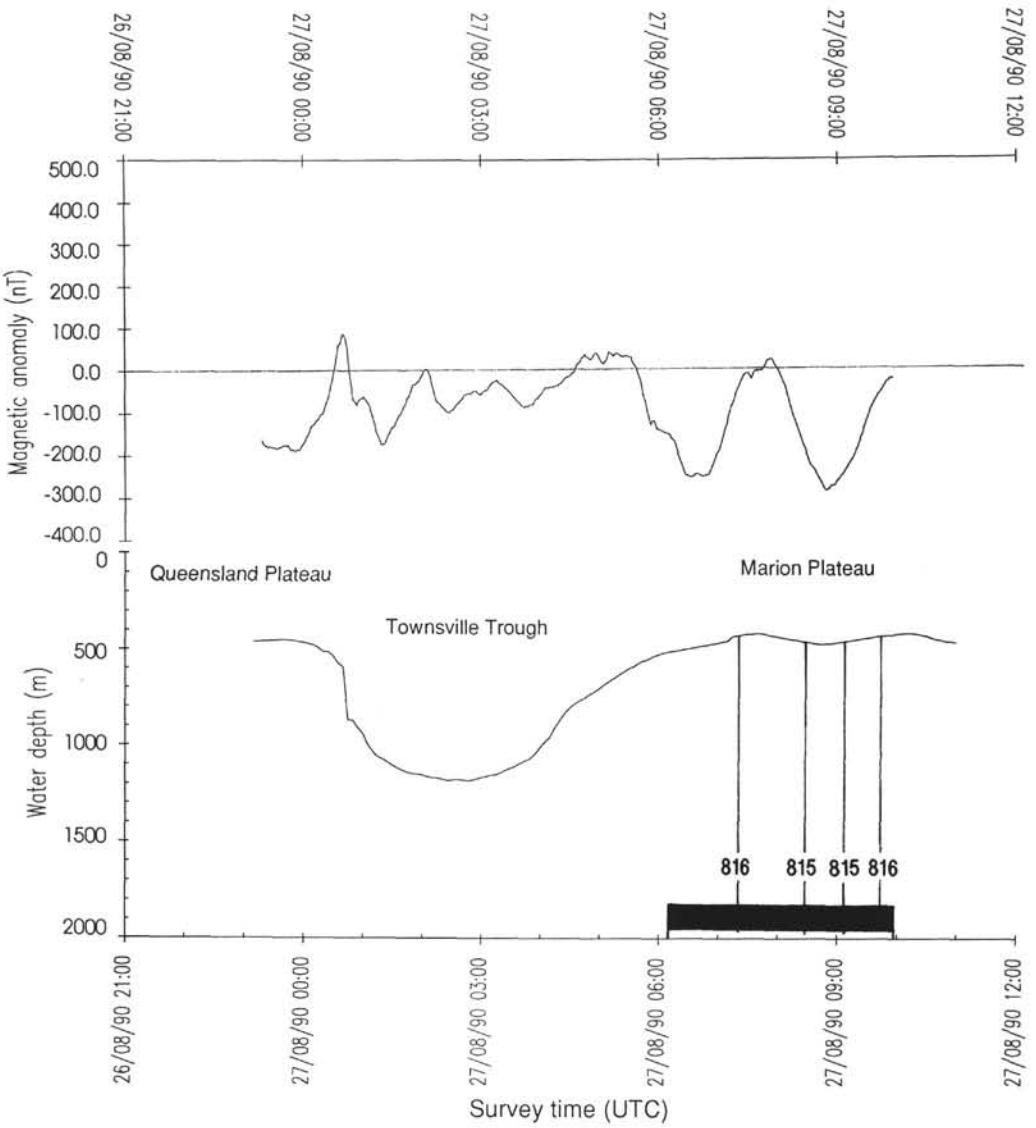

Figure 18. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 3 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

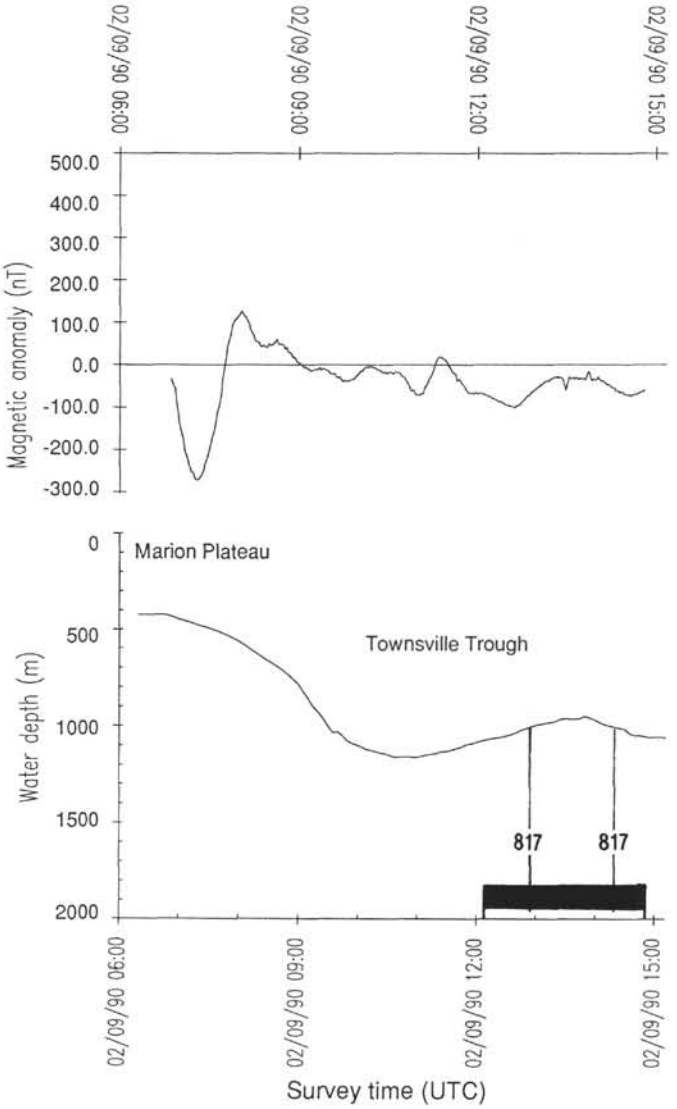

Figure 19. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 4 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown on Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

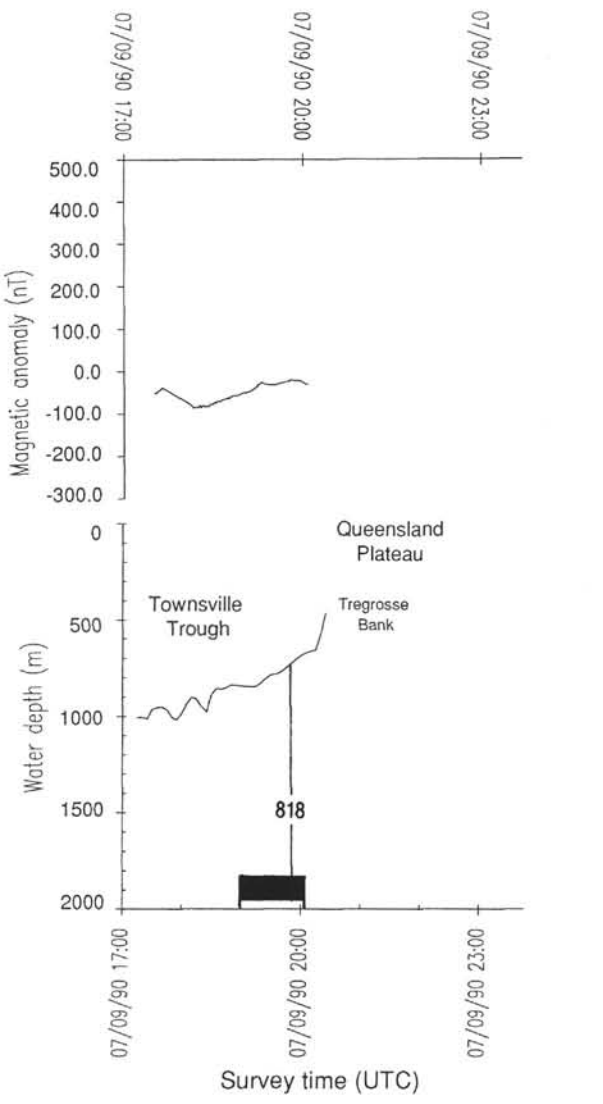

Figure 20. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 5 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

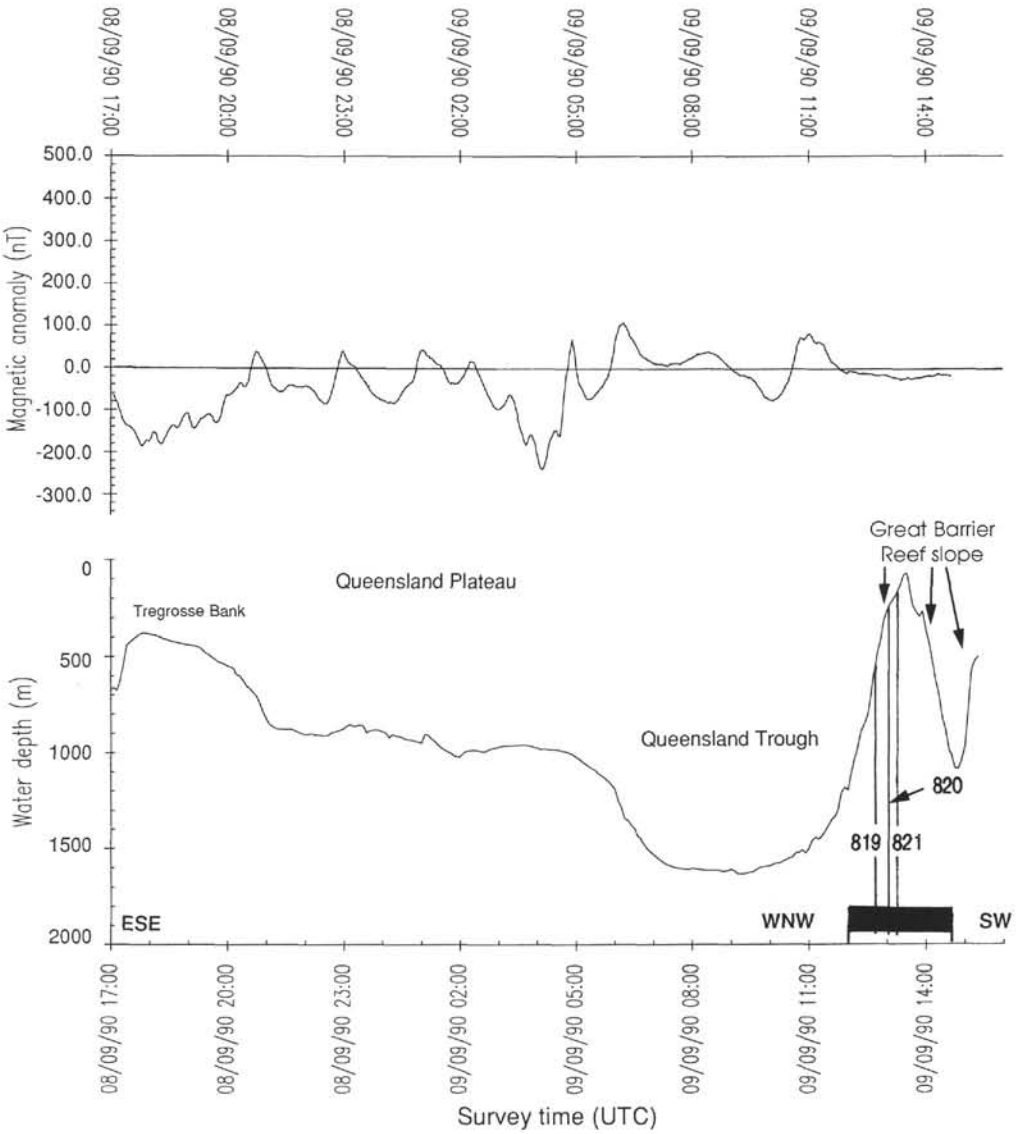

Figure 21. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 6 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

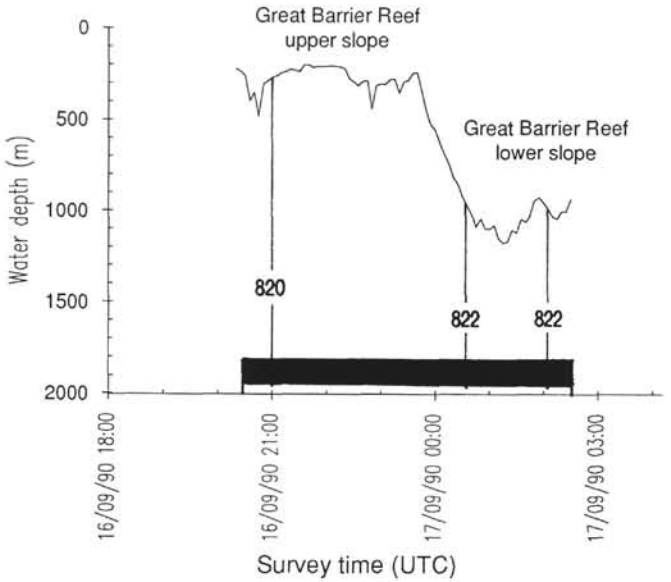

Figure 22. Profile bathymetric data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 7 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profile is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

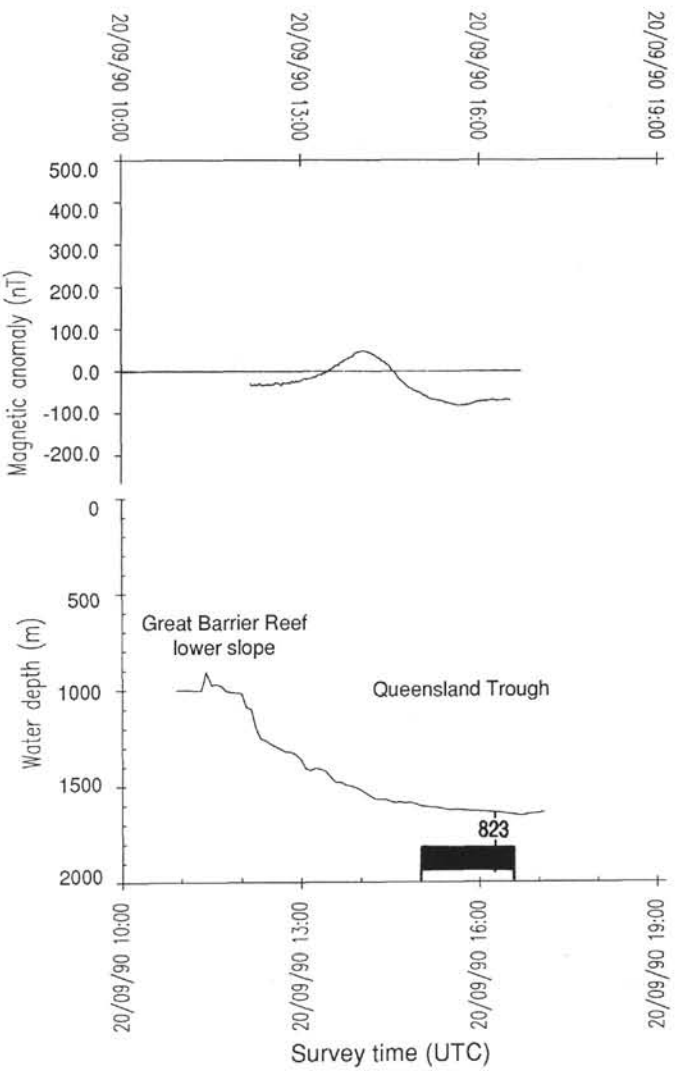

Figure 23. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 8 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

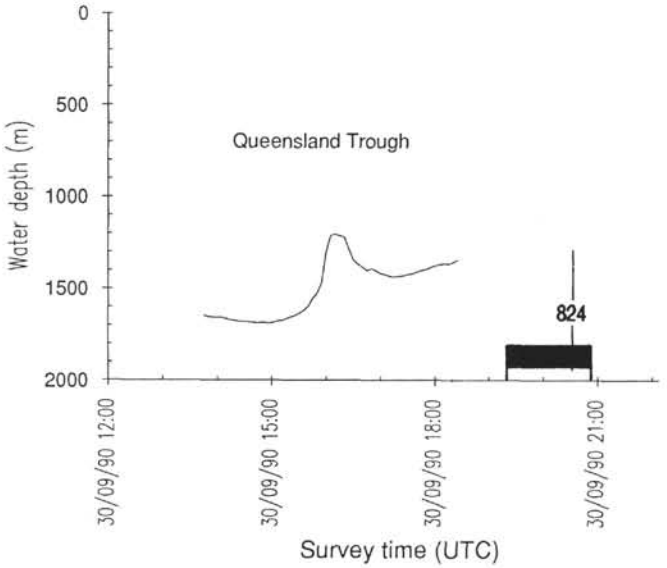

Figure 24. Profiles of bathymetric data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 9 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profile is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

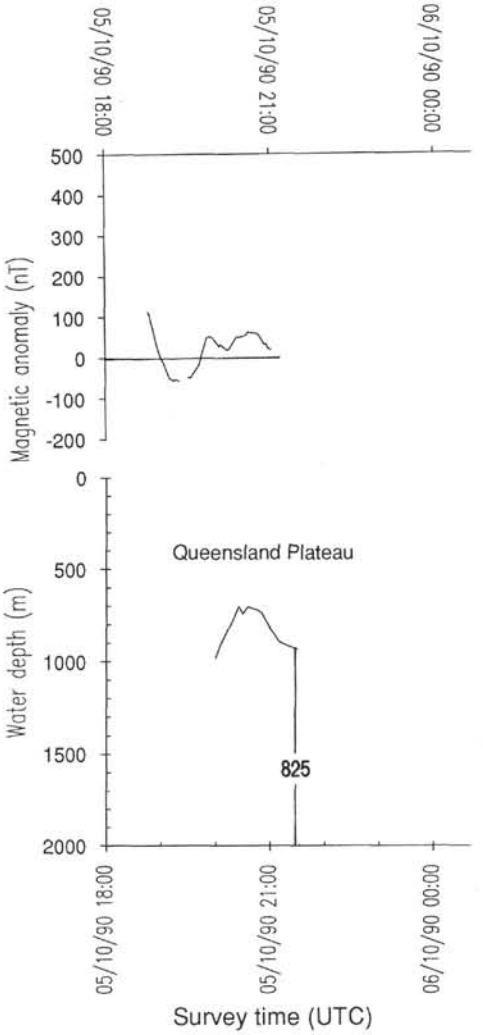

Figure 25. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 10 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

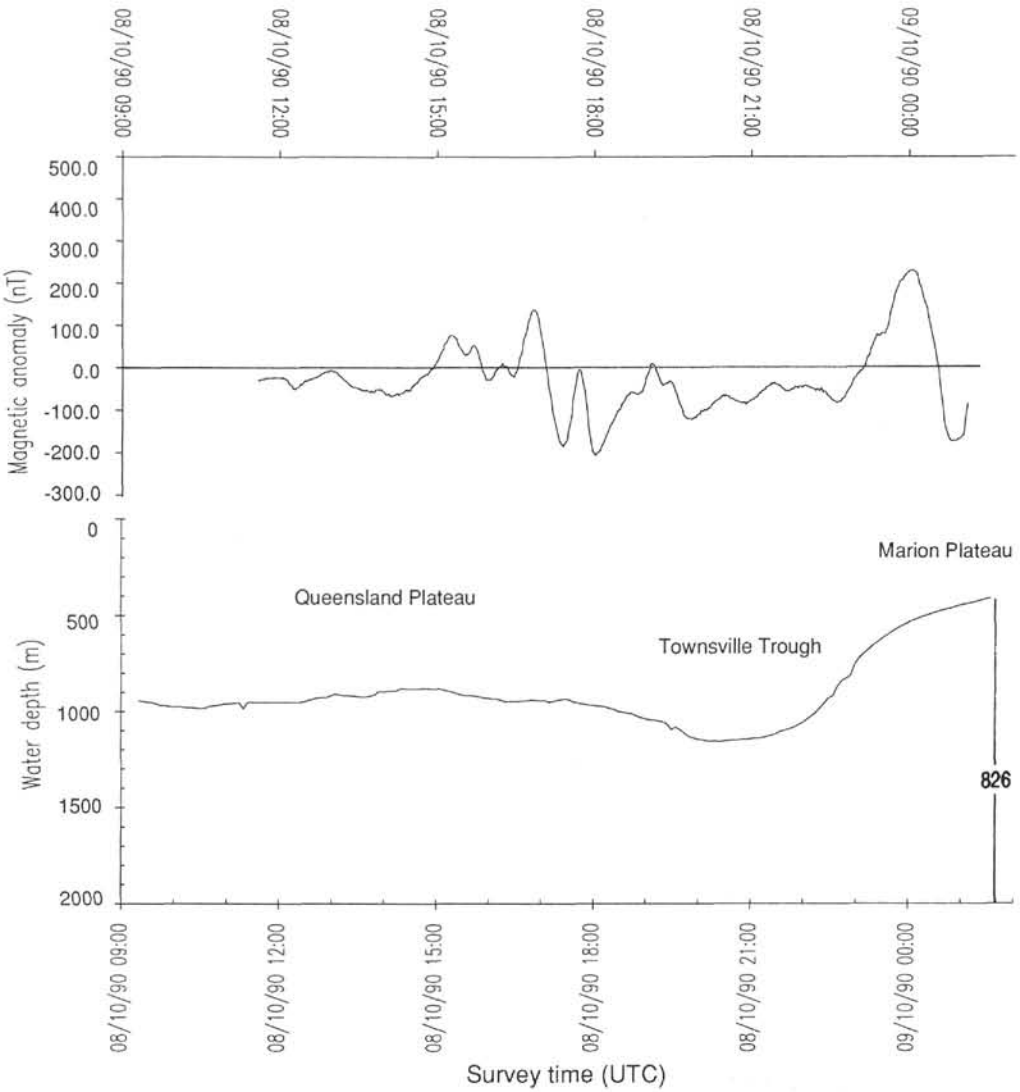

Figure 26. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 11 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

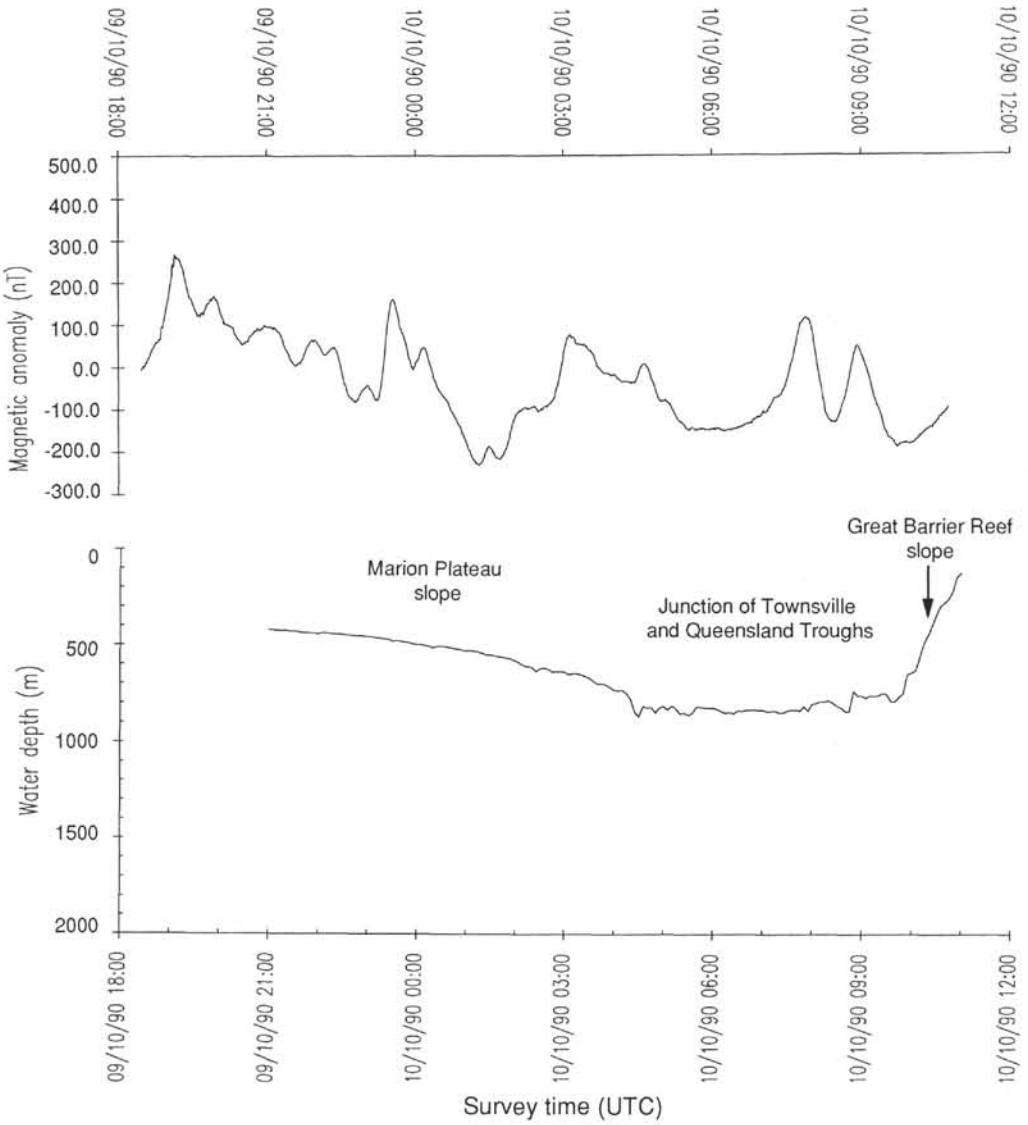

Figure 27. Profiles of magnetics (upper) and bathymetric (lower) data as a function of survey time (UTC) collected on board *JOIDES Resolution* on Line 12 of Leg 133, and processed by the Geological Data Center, Scripps Institution of Oceanography. The location of the profiles is shown in Figures 4 and 5. The locations of seismic lines shot are shown by the black bars at the bottom of the profiles, and the positions of the Leg 133 drill sites are indicated.

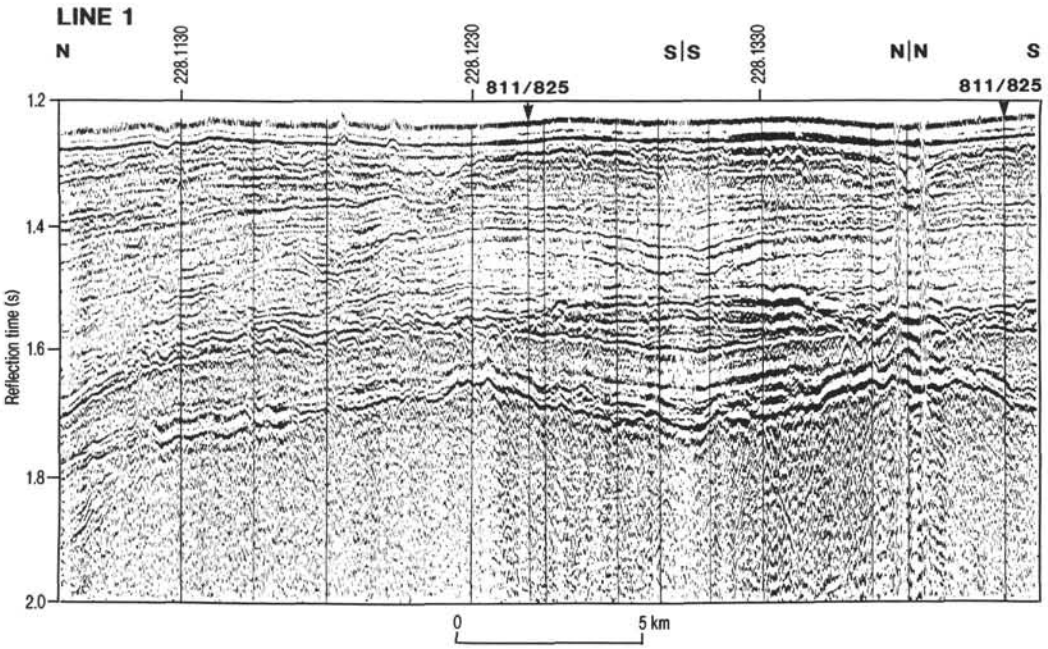

Figure 28. *JOIDES Resolution* water-gun seismic profile around Sites 811/825.

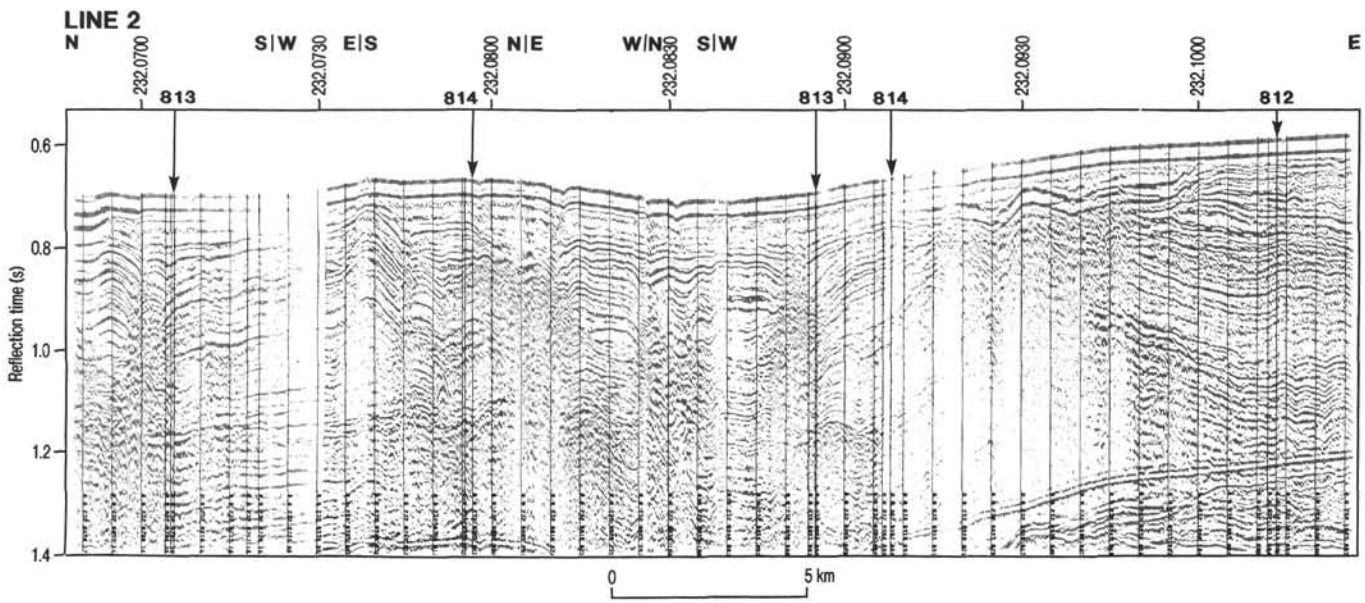

Figure 29. *JOIDES Resolution* water-gun seismic profile around Sites 812 to 814.

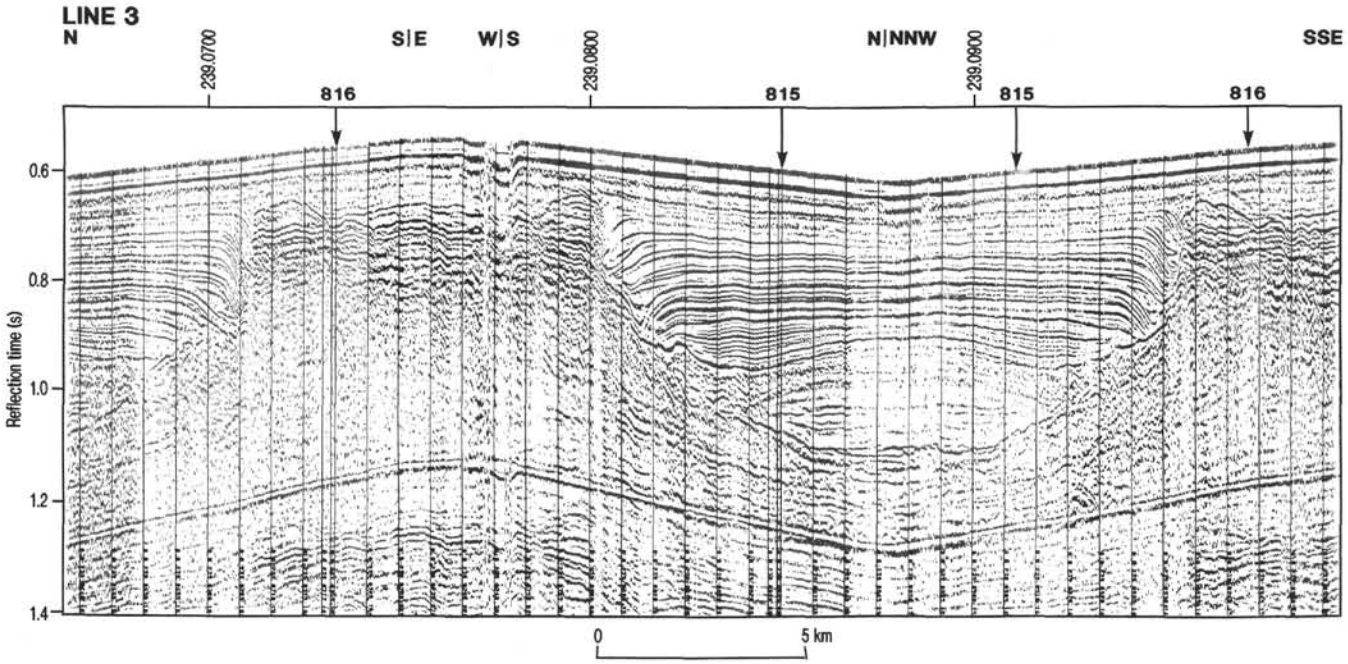

Figure 30. *JOIDES Resolution* water-gun seismic profile around Sites 815, 816, and 826.

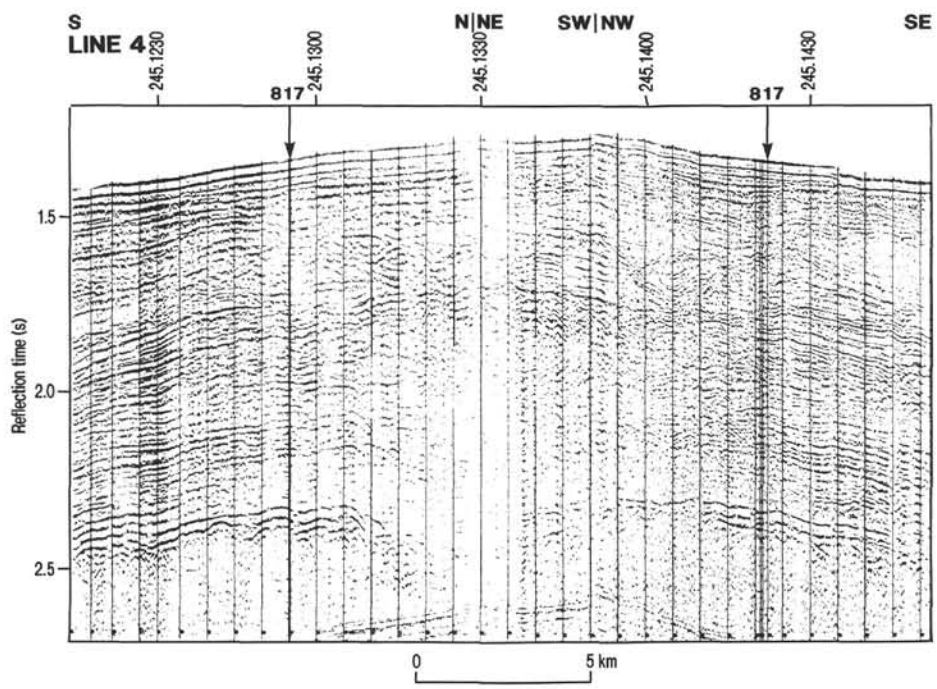

Figure 31. *JOIDES Resolution* water-gun seismic profile around Site 817.

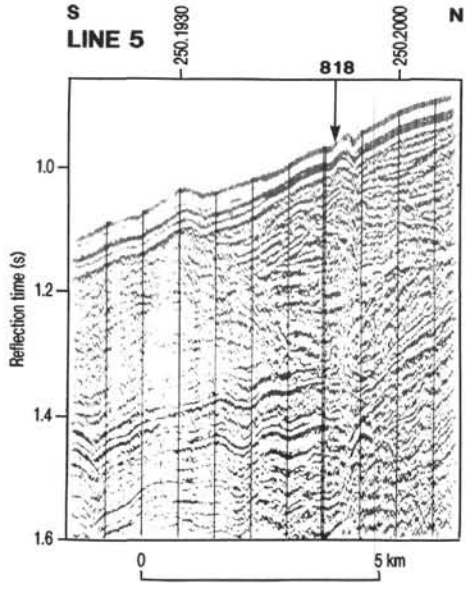

Figure 32. *JOIDES Resolution* water-gun seismic profile around Site 818.

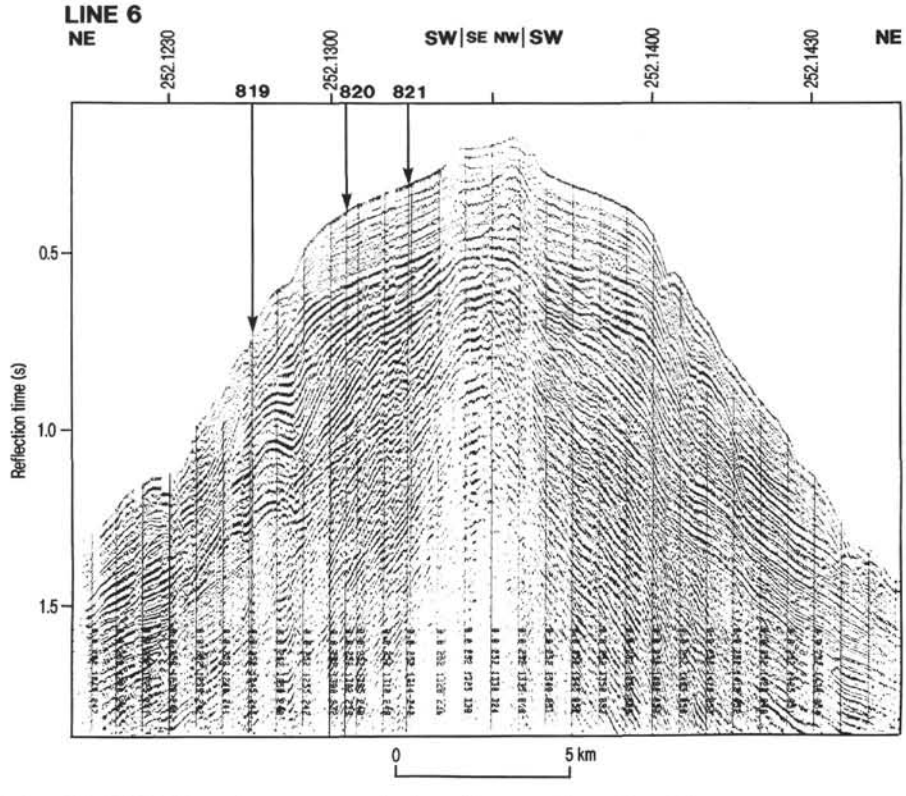

Figure 33. *JOIDES Resolution* water-gun seismic profile around Sites 819 to 821.

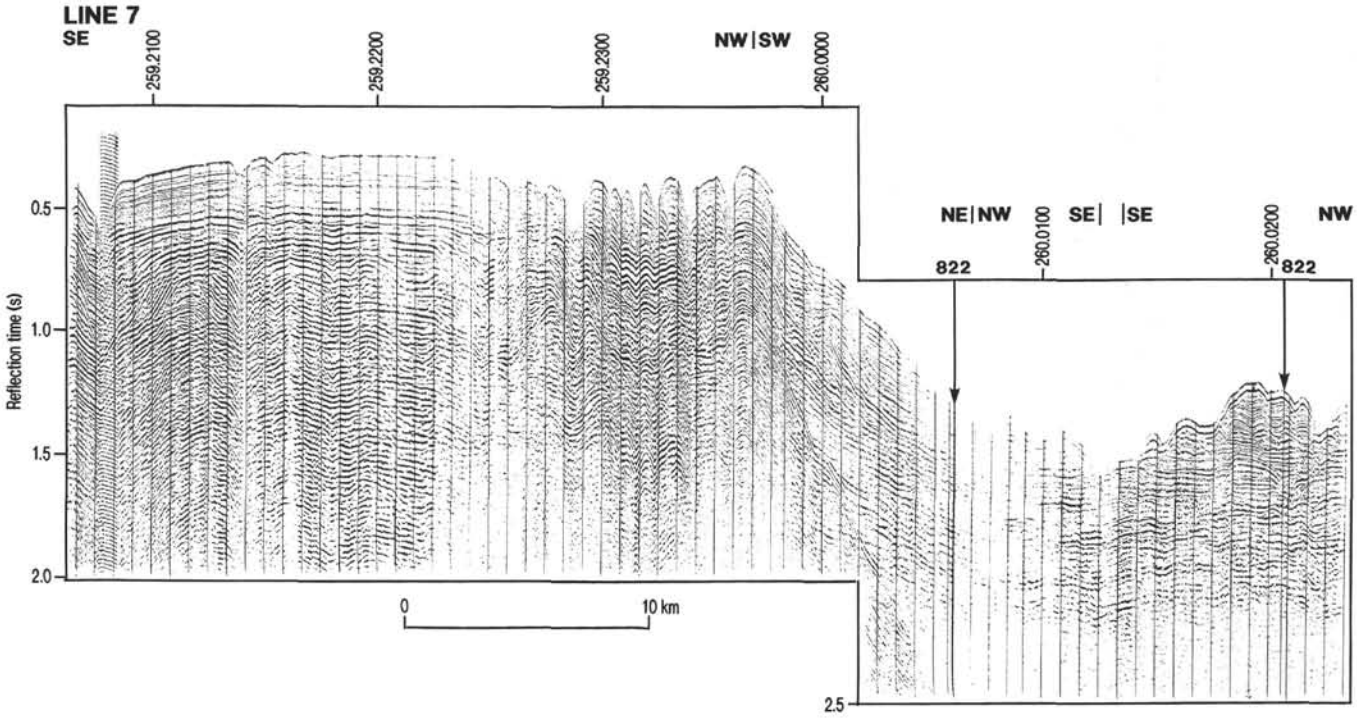

Figure 34. *JOIDES Resolution* water-gun seismic profile around Site 822.

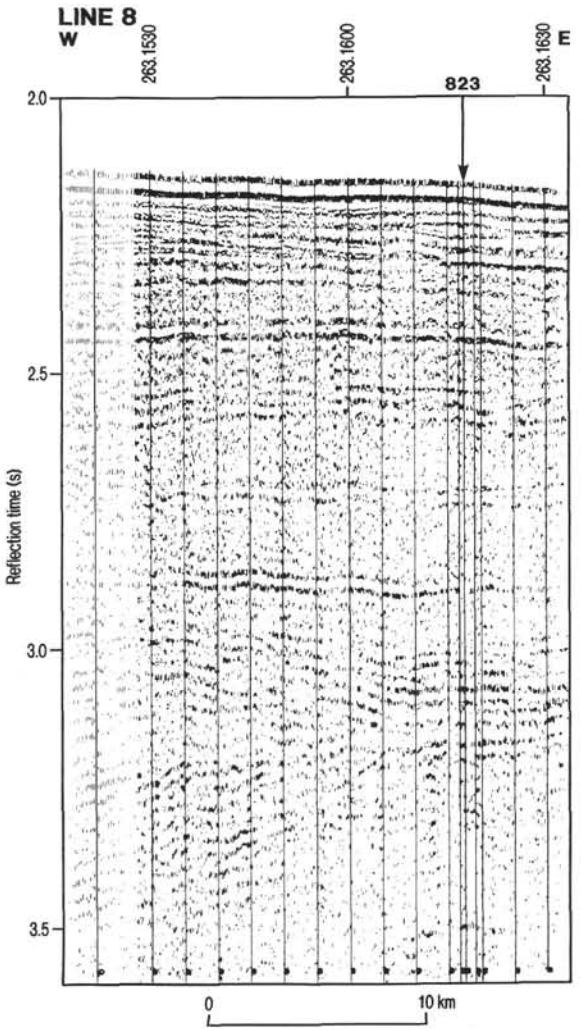

Figure 35. *JOIDES Resolution* water-gun seismic profile around Site 823.

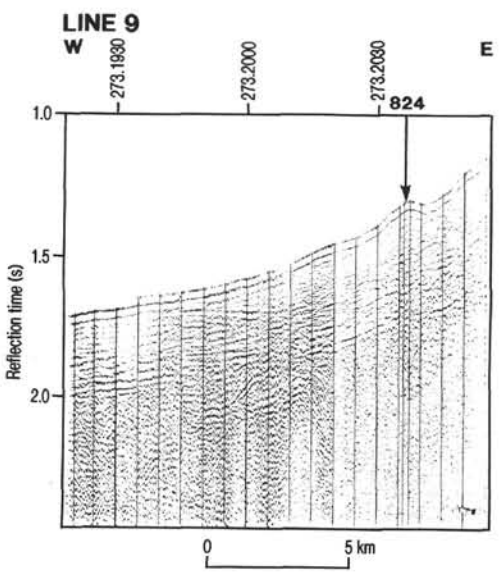

Figure 36. *JOIDES Resolution* water-gun seismic profile around Site 824.

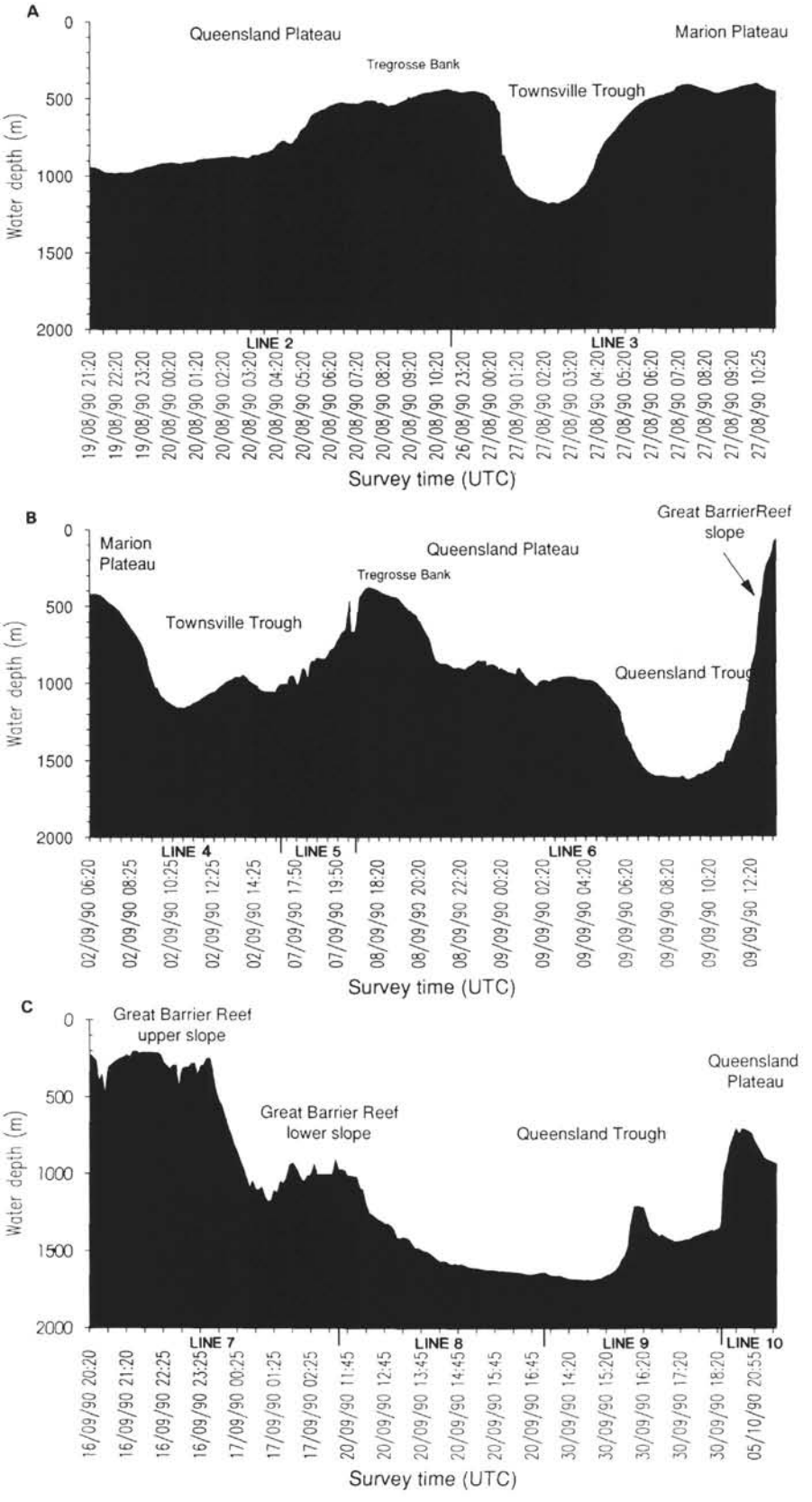

Figure 37. Composite bathymetric profiles from the Leg 133 study area. **A.** North-south bathymetric profile from the Queensland Plateau to the Marion Plateau incorporating *JOIDES Resolution* Lines 2 and 3. **B.** Southeast-northwest bathymetric profile from the Marion Plateau to the Great Barrier Reef incorporating *JOIDES Resolution* Lines 4, 5, and 6. **C.** West-east bathymetric profile from the Great Barrier Reef to the Queensland Plateau incorporating *JOIDES Resolution* Lines 7, 8, 9, and 10.