4. UNDERWAY GEOPHYSICS[1]

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INTRODUCTION

Underway geophysical data form an important element of the Ocean Drilling Program (ODP) insofar as these data provide the basis for (1) defining the scientific problems to be addressed by drilling; (2) site selection; and (3) interpretation of the drilling results within regional structural and stratigraphic contexts. This chapter describes the acquisition and display of the underway geophysical data collected aboard the JOIDES Resolution during Leg 141. Other geophysical data, primarily the multichannel seismic reflection profiles and SeaBeam swath bathymetric data used for site selection and regional stratigraphic and structural analyses, are discussed by Bangs et al. (this volume). Detailed discussions and interpretations of the regional geophysical data in the context of the drilling results will be presented in the Scientific Results volume for Leg 141.

SHIPBOARD UNDERWAY GEOPHYSICS

The JOIDES Resolution is equipped to acquire, display, and process a variety of geophysical data, including underway navigation, bathymetric, magnetic, single-channel seismic reflection, and sonobuoy refraction/wide-angle reflection data. Digital logging of most of these data facilitate post-cruise processing. Navigation data, bathymetry, and magnetics data are routinely edited and corrected by the Geological Data Center (GDC) at the Scripps Institution of Oceanography under contract to ODP. Merged digital data are produced in MGD77 Exchange format and made available, together with microfilm copies of all original analog records, to the ODP Data Bank at Lamont-Doherty Geological Observatory, Palisades, NY and to the National Geophysical Data Center, Boulder, CO. The following sections briefly describe the equipment and methods used for acquiring underway geophysical data aboard the JOIDES Resolution, and discuss the data collected during Leg 141.

NAVIGATION

Equipment and Methods

Primary navigation data were acquired during Leg 141 by a Magnavox Transit/Global Positioning System (GPS) Satellite Navigator, Model MX 1107 GPS, which is located in the Underway Geophysics Laboratory. Additional navigational equipment is located on the bridge of the vessel, including a Magnavox MX 4400 GPS receiver, a Magnavox MX 702A transit satellite receiver, as well as Decca and Loran-C radio positioning systems. GPS position fixes were available on an essentially continuous basis. Transit satellite fixes, although available at various times throughout the day, were not used. The satellite receiver automatically calculated dead reckoning (DR) positions between satellite fixes while operating in the transit mode. All fixes, together with course and speed information, were recorded digitally in a computer file at selected time intervals (typically every 15–30 min during nonseismic transit segments and every 2 min while acquiring seismic data) using a Masscomp 561 super-microcomputer system. These data were used to produce plots of the ship's position as a function of time. Fixes collected while on the site were averaged to produce the location for that site. A navigation plot of the ship's track between Panama, Valparaiso, and the operations area for Leg 141 is shown in Figure 1.

Transit Between Sites

Leg 141 acquired underway geophysical data only for limited times during transits and approaches to the drill sites. Table 1 tabulates the times during which underway geophysical data were acquired during Leg 141. During portions of this time, the following underway data were acquired:

1. 3.5- and 12-kHz precision echo-sounder profiles;
2. Single-channel seismic reflection profiles;
3. Total field magnetic intensity measurements; and
4. Underway navigation data.

The instruments used to collect these data were maintained and operated by ODP marine technicians, in cooperation with the scientific party and the officers and crew of SEDCO-FOREX,Inc.

Following a high-speed transit from Panama to Valparaiso, where a personnel transfer occurred,the *JOIDES Resolution* proceeded southward to the operations area near a latitude of 46°S.

Because proposed Sites SC-1, SC-2, and SC-3 (Sites 861, 860, and 859, respectively) were located along a single common depth point (CDP) line, Conrad Line 745, a single site survey was conducted by the *JOIDES Resolution* for all three sites. The seismic reflection gear was deployed near the eastern (landward) end of Line 745, and the drill ship surveyed westward along the line, while acoustic beacons were deployed as each site was identified. Following deployment of the beacon at Site SC-3, the seismic reflection gear was retrieved and the ship occupied what became Site 859. No additional survey operations were required prior to the occupation of Sites 860 and 861 (see the Operations and Site Summary sections of each site chapter for the arrival and departure times from each site).

Seismic reflection data were also acquired in the process of locating Sites 862 and 863.

BATHYMETRY

Equipment and Methods

Bathymetric data were acquired using both 3.5- and 12-kHz systems. Data for both 3.5- and 12-kHz systems were displayed using the Raytheon Model 1807M line scan recorders (LSR) operated at a sweep rate of 1 s. The 3.5-kHz system utilized an EDO 248C transceiver, while the 12-kHz system used a Raytheon PTR105B transceiver to drive an EDO 323B transducer. The 12-kHz system normally operates with a CESP-III correlator.

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[1] Behrmann, J.H., Lewis, S.D., Musgrave, R.J., et al., 1992. *Proc. ODP, Init. Repts.*, 141: College Station, TX (Ocean Drilling Program).

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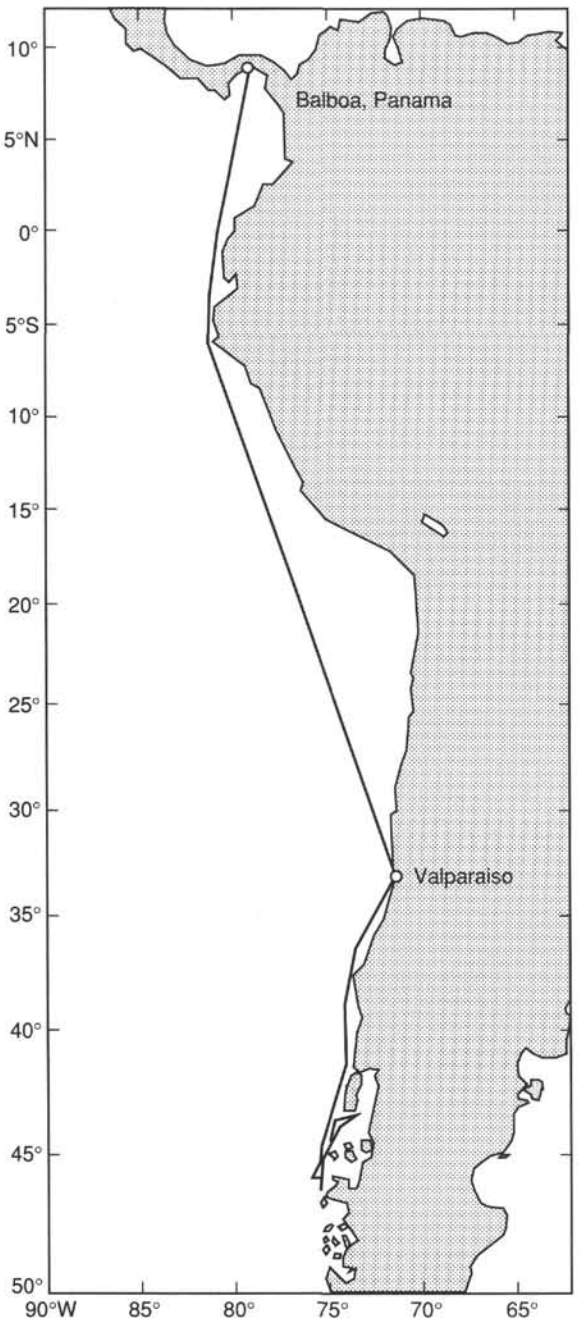

Figure 1. Track of the *JOIDES Resolution* during Leg 141.

Transducers for both systems are mounted in a sonar dome for improved noise conditions at high ship speeds and in rough weather conditions. On-site water depths were determined using the high-frequency 12-kHz system. Depth readings were recorded manually every 5 min for later processing and display. The 3.5-kHz system provided information regarding sub-bottom acoustic stratigraphy, generally providing penetration of up to 50 to 100 m. In Table 1, we show the time intervals during which bathymetric data were acquired during Leg 141.

MAGNETICS

Measurements of total magnetic field intensity were collected along the ship's track by a Geometrics 801 proton-precession magnetometer. The sensor was towed approximately 400 m behind the ship. Measurements were performed at 3-s intervals with a sensitivity of about 1 nT. Values were digitally recorded in the header of the seismic reflection data on the Masscomp computer every 99 s during nonseismic transit periods and once per shot while acquiring seismic reflection data. The magnetics data were recorded in real time, with manual log entries of magnetic field intensity made every 5 min. Magnetics data over 1399 nmi were collected during Leg 141. These magnetics data were later processed by GDC to remove the regional field (1985 IGRF). In Table 1, we present tabulated time intervals when magnetics data were acquired during Leg 141.

SEISMIC REFLECTION PROFILING

Equipment and Methods

Single-channel seismic reflection data were collected over all drill sites occupied during Leg 141. These data were acquired as follows.

Seismic Source

The seismic sources used for underway reflection profiling during Leg 141 consisted of two Seismic Systems, Inc. (SSC) 80-in^3 water guns fired at approximately 2000 psi. The guns were towed approximately 14 m apart, roughly 25 m behind the ship in special towing frames engineered by ODP. The guns were towed at depths of about 13 m at the ship's speed used for the surveys (typically 6 kt). Repetition rates between shots were typically 12 to 14 s.

Hydrophone Streamer

One 100-m Teledyne Model 178 hydrophone streamer was towed from the fantail during Leg 141. The streamer was towed approximately 500 m behind the vessel at a depth of between 15 and 20 m. The output signals of the 60 active hydrophone elements of the streamer were summed to produce a single seismic signal.

Recording Seismic Data

Real-time analog seismic reflection data were displayed on two Raytheon Model 1807M LSR recorders. The seismic signal from the hydrophone streamer was amplified and band-pass filtered at 30 to 150 Hz before its display. The seismic reflection data also were simultaneously recorded in digital format by a Masscomp 561-based acquisition system using the HIGHRES software package. Data were filtered (25–250 Hz) and displayed in real time on a 15-in. Printronix high-resolution graphics printer capable of a resolution of 160 dots per inch (DPI). Filtered seismic data were recorded on Cipher tape drives in SEG-Y format at a density of 1600 bytes/in. (BPI). In Table 1, we have tabulated the times when seismic reflection data were acquired during Leg 141.

No underway geophysical data were acquired during the high-speed transit from Site 863 to Valparaiso at the end of Leg 141.

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Table 1. Status of underway geophysical data collected during Leg 141 transits and site surveys.

Date (1991)	Time (UTC)	Latitude (S)	Longitude (W)	PDR	Magnetics	Seismics	Comments
16 Nov	1700	4°58.5′N	79°56.8′	On	On		Depart Panama
18 Nov	0200	1°43.6′	81°17.9′		Off		
19 Nov	0200	5°31.15′	81°32.8′		On		
25 Nov	0700	32°41.0′	71°44.6′	Off	Off		Arrive Valparaiso end Line 1.
25 Nov	2100	33°19.2′	71°56.1′	On	On		Depart Valparaiso begin transit to Site 859; start Line 2.
26 Nov	1550				Off		
26 Nov	1650				On		
27 Nov	2030	41°43.8′	74°27.9′		Off		
27 Nov	2320				On		
28 Nov	0300	42°51.2′	74°50.3′		Off		
28 Nov	0500	43°19.5′	74°58.1′		On		
28 Nov	0515				Off		
28 Nov	0715				On		
28 Nov	1740				Off		
28 Nov	1840					On	Begin survey for Sites 859
28 Nov	2130	45°52.6′	75°57.2′	Off		Off	End survey.
24 Dec	1500			On		On	Begin Line 3 survey for Site 862.
24 Dec	2000	46°31.5′	75°48.3′	Off		Off	End Line 3.
28 Dec	2100			On			Begin transit to Quellon and Site 863.
29 Dec	0400	46°10.1′	75°37.5′			On	Begin Line 4 survey for Site 863.
29 Dec	0600	46°14.4′	75°47.7′	Off		Off	End Line 4.