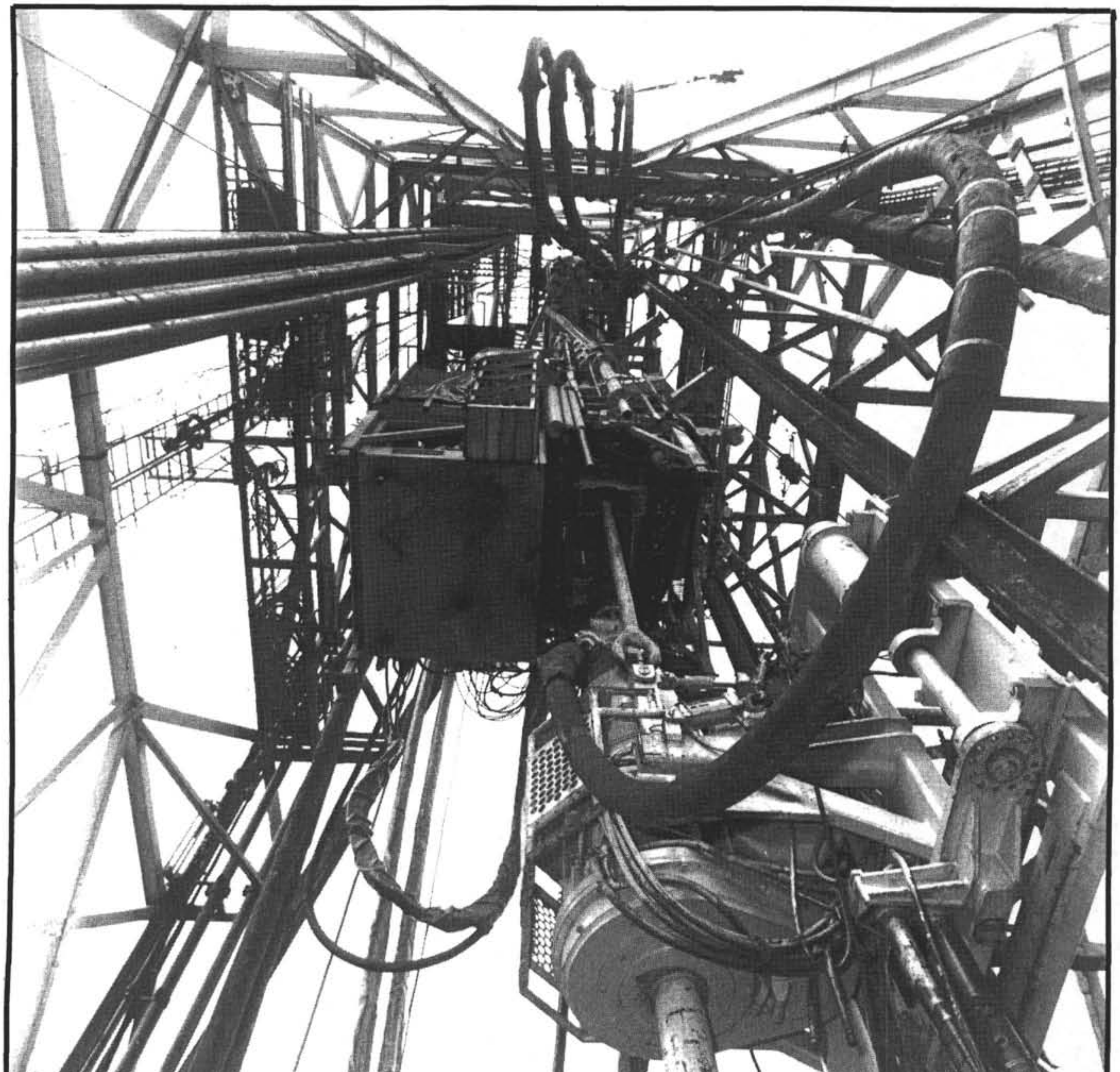
LEG 142 PRELIMINARY REPORT



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EAST PACIFIC RISE
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OCEAN DRILLING PROGRAM

LEG 142 PRELIMINARY REPORT

East Pacific Rise

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ABSTRACT

Leg 142 was devoted primarily to testing and development of new hardware components and techniques needed for drilling at the axes of mid-ocean ridges and other areas with very difficult-to-drill rocks (e.g., interbedded chert-chalk, reefal carbonates, etc.). Operations at Site 864 resulted in drilling of three holes (864A, 864B and 864C). Hole 864A has a guide base and is cased to 13.3 m. Hole 864B was abandoned, while Hole 864C also has a guide base and could be reoccupied and deepened. The new mini Hard Rock Guide bases (HRB) were successfully deployed, moved, and used for extensive drilling operations. They are now operational and can be used routinely. The new nested, Drill-In Bottom Hole Assemblies (DI-BHA) also were used successfully and show great promise for future drilling. Continued development and refinement of bits and cutting structures should extend the depth to which future holes can be cased with multiple DI-BHA casing.

The Diamond Coring System (DCS) platform, the third essential component needed for successful ridge-crest drilling, did not perform as expected on the basis of its previous good performance on Legs 124E and 132. Problems with the secondary heave compensation system on the DCS prevented successful DCS drilling and coring and resulted in destruction of the slim-hole diamond core bits on three bit runs. Clearly, a careful and exhaustive study must be made to identify the reasons for these problems and consider possible solutions.

Drilling, coring, and milling operations on Leg 142 provided glassy to fine-grained, aphyric basalt samples recovered from 0 to 13.3 mbsf from Holes 864A and 864B. These comprise two chemically distinct units of relatively evolved (Mg# of 0.56-0.58), normal depleted mid-ocean-ridge basalt (MORB). These units were likely derived from similar parental melts, differing only slightly in the amount of crystal fractionation they have undergone. Their magnetic properties, mineralogy, and textures are typical of N-MORB. Seismic velocities of the rocks range from 4.1 to 5.1 km/s (wet) and 3.0 to 4.1 km/s (dry).

Leg 142 was a mixed success. While the performance of the DCS secondary heave compensation system was a great disappointment, on balance, the leg represents a significant step forward toward eventual success with ridge-crest drilling.

OPERATIONAL AND DEVELOPMENTAL BACKGROUND

Previous efforts to conduct scientific drilling and coring operations at young crustal spreading centers have historically been fraught with frustration and failure to achieve the desired goals. These included the loss of multiple bottom-hole assemblies, drill bits that would self destruct in a matter of hours, a few meters of hole that would immediately fall in upon removal of the drilling assembly, etc. Undoubtedly, successful drilling and coring at oceanic ridge-crests is one of the most difficult technical problems faced today by engineers of the Ocean Drilling Program. The results of DSDP Leg 54 and ODP Legs 106/109 demonstrated that new technology and new techniques would be required to face and overcome the formidable hurdles encountered in attempting to drill these areas. Based on the results from earlier legs, the ability to drill and recover core at depth from a ridge-crest environment was determined to be dependent upon several developmental capabilities. These include the following:

(1) HARD ROCK GUIDE BASE (HRB) - a relatively small, economic, seafloor structure that could be deployed quickly and efficiently; had the ability to stabilize a drill bit/bottom-hole assembly while attempting to initiate a hole in hard bare rock exposed at the seafloor; could

accept a seafloor slope (or localized surface angle) of up to 25°; allowed for the supporting of one or more casing strings; and preferably incorporated moving or recovery options due to the complexities and time involved with locating an acceptable drill site.

(2) DRILL-IN BOTTOM HOLE ASSEMBLY (DI-BHA) - a reliable means to propagate a borehole in a hostile drilling environment; isolate one or more unstable (rubble) formations penetrated; allow separation from the emplaced drilling assembly without requiring the bit to be pulled off bottom or out of the borehole; provide adequate bit/center bit life to achieve the required stability depth; allow multiple (nested) deployment capability to combat multiple unstable zones; provide large/small diameter drill collars/connections capable of surviving rotation above the seafloor without lateral support; and provide a through bore so that wireline coring systems can ultimately be deployed through the isolation strings allowing continuous coring to the target depth.

(3) DIAMOND CORING SYSTEM (DCS) - a wireline coring system capable of drilling and coring through highly fractured, poorly cemented, crystalline rock; including all supporting wireline systems such as overshots, jars, sinker bars, etc.; provide adequate flexibility in core-catcher selection; provide adequate alternative formation sampling options; determine bit designs able to penetrate and core the desired formations while maintaining an adequate minimum core diameter required for scientific analysis; develop friction reducer and mud programs for diamond drilling in fractured rock; and provide a slim hole drill rod/tubing string capable of fitting within the ODP drill pipe ID, while maintaining adequate annular flow area, and capable of holding up to the rigors of high-speed operation with long, 4500-m plus, pipe lengths.

To accomplish item (3) above, a slim-hole diamond coring system is essential. This in turn dictates the development of a diamond drilling rig equipped with a high-speed top drive, closed loop speed control for constant rpm, fine control of mud pumps for low flow rate requirements; and an active secondary compensation system that allows tagging bottom, drilling through voids, and maintaining constant/low weight-on-bit (WOB) without destroying the very fragile narrow-kerf diamond core bits employed.

All development work had to be undertaken with very few known facts about the targeted drilling environment. Details about physical properties of the rock, the number of unstable zones, the thickness and depth of unstable zones, etc., were unknown.

Leg 142 operations took place at Site 864 (EPR-2) on the East Pacific Rise (EPR) located approximately halfway between Valparaiso, Chile, and Honolulu, Hawaii, the respective ports of call. This leg was the first attempt at drilling/coring on the EPR since new technologies and systems to combat the hostile drilling environment have been under development. It was determined some time ago that certain advances in drilling technology would be required to conduct successful scientific drilling/coring operations at a ridge-crest (Table 1). These included a way to stabilize the unsupported bottom-hole assembly at the seafloor enabling bore holes to be initiated on hard, bare rock; a means to isolate upper unstable "rubble" zones allowing deeper drilling/coring objectives to be reached; and an effective way to drill, core, and recover highly fractured volcanic rock while maintaining adequate bore-hole stability. These developmental systems were put to the test on Leg 142, where drilling conditions are arguably the most difficult encountered to date.

Leg 142 was the third sea-trials test of the 3-component Diamond Coring System (DCS) and its integral platform mounted drilling system (the DCS platform). It was the first sea-trials test of the prototype hex-sided Hard Rock Guide Base (HRB) using a gimballed and counter-balanced 8-ft-diameter reentry cone. It was also the first sea-trials test of the prototype "nested" Drill-In Bottom-hole Assembly (DI-BHA). Although earlier versions of both the HRB and DI-BHA systems had been deployed on Leg 132 with mixed success, neither system had been deployed or tested at sea in its current upgraded/expanded configuration.

Performance of the new HRB system was excellent. Two deployments, one seafloor move, the initiation of 3 bore-holes, and a record 35 reentries into an 8-ft-diameter reentry cone amply demonstrated that the existing HRB technology is now ready for operational use.

The back-off system for the DI-BHA system also performed well in its "nested" configuration. The system was successfully backed off on 3 out of 3 attempts in both 10-3/4-in. and 6-3/4-in." sizes. The 6-3/4-in." inch drill collars utilized with the second stage DI-BHA also functioned well, suffering no failures even after many hours of unsupported, above the seafloor, rotation. The primary weakness of the DI-BHA system is in bit life, both in hours and footage. Progress in this area is still required before an integral DI-BHA system can be considered operational. Promising test data gathered on both carbonado surface set and impregnated diamond bits, however, do give hope in this area. Although the related Diamond Core Barrel (DCB) system had problems circulating/reaming to bottom in "rubble" fill, it also showed promise in trimming a short piece of core out of a large block of rubble wedged several meters off the bottom of the hole. The DCB is designed to drill a 7-1/4-in.-diameter hole while recovering a 2.312-in. core inside a standard ODP Rotary Core Barrel (RCB) wireline system. It is believed that changes in the junk slot (outside flow area) size and configuration can improve the hole-cleaning ability of the bit.

The DCS platform-mounted drill rig, despite apparently having a functional secondary compensation system on two earlier legs (124E and 132) was not able to cut a core successfully at the EPR. The "improved" software code written for Leg 142 did not work. The Leg 132 version of the code was used throughout the leg with mixed success. By leg's end the DCS compensator appeared to be compensating adequately in "standby" mode, using only a velocity signal from an accelerometer installed in the ship's moon pool. When required to go into "approach" mode, the system would not function correctly and in fact on many occasions appeared to amplify the heave problem. Three DCS bit runs ended with three destroyed core bits without obtaining a core. It is believed that several problems contributed to the poor performance. A possible bent forward feed cylinder as well as an erratic load cell caused the introduction of erroneous data into the computer. These false data led to erratic and erroneous string-weight information. String weight is a key component of the secondary compensation system because it is this starting weight that provides the baseline for the computer to sense and modify weight-on-bit (WOB) for the small fragile DCS core bits. Without correct load-cell data, the system will not function appropriately in the "approach" mode. Leg 142 was operating the DCS in deeper water, and under more severe, albeit moderate, sea-state conditions. The higher string loads and larger heave/swell conditions than those experienced during Leg 132 led to higher inertial loads being imposed on the system. It is not certain at this time whether a properly operating system would have been able to handle these conditions or not. This will require further study. What is known is that the DCS must be able to operate in weather and sea-state conditions exceeding those experienced on Leg 142. This may require introducing more hydraulic horsepower into the system or modifying the hydraulic/servo valve design to allow the movement of higher volumes of hydraulic fluid at a faster rate. This too will require further study. Finally, the entire approach to DCS secondary compensation-that is, computer code, hydraulic system, horsepower, and control theory- should be reviewed by other appropriately qualified engineers to ensure that the approach taken with the current system is the correct methodology, not overly complex, and whether the system can be made more predictable and reliable for future deployments.

Unfortunately, no core was cut during Leg 142 operations at the East Pacific Rise, thus compromising a major goal of the leg. It is important to recognize, however, that it was a non-functional secondary heave compensation system that prevented core from being recovered at the EPR, not the hostile operating environment. But the lack of core should not completely overshadow the progress that was made during the leg.

To reiterate, this is one of the toughest areas of the world in which to initiate drilling/coring operations. As indicated in Table 1, the ability to recover scientific cores successfully from this environment requires the development of many new technologies and techniques beyond those of the DCS platform itself. The majority of these are now either proven or well advanced toward operational status.

SCIENTIFIC RESULTS

Introduction

The scientific importance of drilling at spreading ridge-crests has been recognized since the inception of ocean-floor drilling. Indeed, such drilling is still viewed as a very high priority, with 12 additional legs of drilling recommended in the ODP Long Range Plan. DSDP Leg 54 (Rosendahl and Hekinian, 1980) was the first serious attempt to drill at the East Pacific Rise (EPR), but it was unsuccessful because of the serious technological shortcomings of unsupported conventional rotary drilling on, essentially, bare rock. Despite these early problems, COSOD I, COSOD II, and several thematic panels of ODP (notably the Lithosphere, Tectonics, and Sedimentary and Geochemical Processes panels) consistently reaffirmed the great scientific importance of understanding the early origin of oceanic crust by drilling near and at the axes of mid-ocean ridges. ODP Legs 106 and 109 (Detrick, Honnorez, Bryan, Juteau, et al., 1988) at the Mid-Atlantic Ridge convincingly showed that new technological capabilities were essential for spudding into bare rock, for establishing/casing a drill hole, and for coring the hole to the desired depth.

The Diamond Coring System (DCS) was designed and built to overcome some of the initial problems encountered in ridge-crest drilling, especially the problems of poor hole stability and low core recovery. The DCS drills a small diameter (3.96-in.) hole using narrow-kerf diamond drilling, which has been used to drill successfully in fractured rocks on land. The DCS was tested and modified after the two initial engineering legs, 124E (Harding, Storms, et al., 1990) and 132 (Storms, Natland, et al., 1991). ODP Leg 142 was meant not only to continue testing and development, but also to provide the first scientific results from drilling at the EPR. Leg 142 was thus the first leg of a multi-leg drilling program at the EPR, conceived by the East Pacific Rise Working Group (EPRWG) and the East Pacific Rise Detailed Planning Group (EPRDPG) and described in their reports to the Lithosphere Panel and Planning Committee.

The EPRDPG listed five scientific objectives of fundamental importance to understanding the origin of young ocean crust. These objectives address the questions of (1) the structure and composition of "zero-age" crust, (2) fluid-rock interaction above a shallow magma chamber, (3) fluid flow and mineralization, (4) temporal variation of lava chemistry erupted at the ridge axis, and (5) crustal calibration for geophysical remote-sensing studies, such as seismic reflection, refraction, tomography, and others. Further, the EPRDPG recommended several sites in the general area of the EPR at 9°30'N to implement a strategy of segment scale drilling. Initially, Leg 142 was planned to focus on a site 1 km west of the EPR axis (Site EPR-1). However, on the basis of site survey work discussed later, the primary site for the leg was changed to Site EPR-2 (drilled as Site 864), exactly at the axis. Drilling during Leg 142 resulted in the spudding of Holes

864A, 864B, and 864C. The first two are cased to 13.3 and 7.1 m. In addition, Holes 864A and 864C have Hard Rock Guide Bases (HRB) so that they can be reoccupied in the future and deepened. Alternatively, the guide bases could be picked up and moved to another site (e.g., EPR-1) if desired.

General Geology

Site 864 is located at a depth of 2581 m on the axis of the East Pacific Rise at 9°30.85'N, 104°14.66'W (Figure 1). The site is near the mid-point of a 2nd-order ridge segment bounded to the north at 10°10'N by the Clipperton transform fault, and to the south at 9°03'N by an overlapping spreading center (OSC; Macdonald et al., 1984). The full spreading rate along this segment is approximately 11 cm/yr (Klitgord and Mammerickx, 1982). The width of the ridge-crest tapers southward, from a maximum of 4 km near the Clipperton transform to only 2 km at the 9°03'N OSC. This southward narrowing of the ridge is accompanied by a general increase in axial depth, from less than 2600 m on top of an axial high at 9°50'N to 2760 m at the 9°03'N OSC. From 9°51.5'N to 9°26.1'N, the ridge axis is marked by a narrow trough, less than 200 m wide and 5-15 m deep (Fornari et al., 1990; Haymon et al., 1991a). This feature is called an "axial summit caldera" (ASC) by Haymon et al. (1991a) because it has apparently formed primarily from volcanic collapse along the ridge axis following magma drainback.

Between the Clipperton transform and the OSC at 9°03'N, small bends, offsets, and discontinuities of the ASC and the ridge axis partition the ridge-crest into eleven 4th-order segments, 5-15 km in length (Langmuir et al., 1986; Haymon et al., 1991a). These en echelon segments consistently step right along the EPR axial zone south of 9°54'N. Near-bottom images and submersible observations confirm that the youngest lavas in the area are present on the axial high at 9°45'N-51.5'N. In April 1991, divers in the *Alvin* submersible observed evidence of an active eruption in the ASC along this segment (Haymon et al., 1991b, 1991c). On successive 4th-order segments southward from the eruption area, the relative ages of axial lavas increase systematically (Haymon et al., 1991a; Wright and Haymon, 1991), except in the area from 9°21'N to 9°12'N, where older lavas are partially to completely buried by fresh flows. South of this area, the age of lavas along the axial zone continues to increase to the tip of the OSC (Sempere and Macdonald, 1986).

The variations observed along strike in the age of axial lavas and depth to the ridge axis (both increasing away from the axial high at 9°50'N) are spatially correlated with along-strike variations in the compositions of axial lavas and the distribution of hydrothermal vents and deposits. Detailed petrologic study of dredge rock samples collected at ~1.8-km intervals along the ridge axis has shown that the axial basalts of this ridge segment are normal depleted mid-ocean-ridge basalts (N-MORB) derived from a single parent magma (Batiza and Niu, 1992). These lavas exhibit a general increase in degree of fractionation southward from the axial high at 9°50'N to the 9°03'N OSC (Batiza and Niu, 1992). Many hydrothermal vents and mineral deposits were mapped in the ASC along this ridge segment and are known collectively as the Venture Hydrothermal Fields (Haymon et al., 1991a). The hottest and most abundant active vents are found on the actively erupting segment between 9°45'N and 9°51.5'N. The number of active vents decreases, and the number of extinct mineral deposits increases, on successively older 4th-order segments southward from the eruption area to the southern limit of the ASC at ~9°26'N (Haymon et al., 1991a). Except for sparse occurrences of galatheid crabs and hydrothermal staining of basalt, little evidence of past or present vent activity is found on the older axial lavas south of 9°26'N. Nevertheless, one additional active smoker, located at 9°16.8'N, is associated with the area of fresh lava flows at 9°21-12'N.

A robust seismic reflector thought to be the top of an axial magma chamber is present beneath the ridge axis between the Clipperton transform and ~9°09'N (Detrick et al., 1987). The reflector is detected at ~1.5 km beneath the seafloor at 9°45'-50'N, where active eruptions were observed in April 1991. It deepens southward to a depth of ~1.7 km beneath Hole 864A, and drops off sharply south of 9°28'N to ~2.0 km. Seismic data indicate that this apparent deepening of the magma chamber reflector south of 9°28'N may be due to a westward shift in the axis of the magma chamber with respect to the topographic ridge axis (Mutter et al., 1988; Toomey et al., 1990). For the Clipperton-9°N segment as a whole, the apparent southward increase in the depth of the magma chamber reflector along strike has been interpreted to be genetically linked with the observed southward increase in degree of magma fractionation (Batiza and Niu, 1992) and decrease in hydrothermal venting (Haymon et al., 1991a).

Geology at Site 864

Three ODP site surveys were conducted in 1989-1991 to gather detailed information about the EPR segment south of Clipperton and to establish the local geology in the vicinity of Site 864: (1) a near-bottom optical/acoustic study of the axial zone from 9°09'N to 9°54'N using the ARGO camera/sonar sled (Haymon et al., 1991a; Fornari et al., 1990); (2) a near-bottom seismic refraction experiment (the NERO experiment; Purdy et al., 1991; Christeson et al., 1991a,b); and (3) an *Alvin* submersible dive program (the Adventure Program; Haymon et al., 1991b, 1991c).

Site 864 is located approximately 25 km south of the 9°45'N- 9°51.5'N recent-eruption area (Figure 1). At 9°30.8-31'N, the ASC and the seafloor out to 100-200 m away were imaged with ARGO and surveyed on four submersible dives (Haymon and Fornari, in press). The width of the ASC across the top is ~200 m, and it is 8-11 m deep. Outside the ASC to a distance of at least 100-200 m from the rim are sedimented lobate flows pocked with shallow collapse pits 1-2 m deep and 2-3 m across. Inside the ASC is an extensive deposit of collapse rubble consisting of platy pieces 5-20 cm thick. These are the remnant pieces of lobate crusts that were the frozen roofs of lava ponds. When magma drained out from underneath, the lobate crusts collapsed into a chaotic jumble of polygonal plates, or, where the crust was thicker (20-40 cm), into a cracked pavement of larger pieces similar in appearance to a buckled concrete slab. The rim of the ASC is a ragged lip that has formed from roof collapse. Overhangs are present where uncollapsed, pillar-supported roof remnants extend out from the rim over caverns in the ASC walls. The depth of the ASC rim is 2571 m, and the walls bounding the ASC are 5-9 m high. Their 60°-90°slopes are covered with collapse rubble interspersed with lava pillars and uncollapsed, lobate-topped roof remnants. The west wall is ~60 m wide adjacent to Site 864, while the east wall is ~90 m wide. This assymmetry is due to the presence of benches 3-20 m wide on the east wall at depths of 2574 and 2577 m.

The central floor of the ASC lies at a depth of 2581-2583 m. It is flooded by a distinctive flat-to-ropy massive basalt flow (dubbed the "ODP flow") that is ~3.5 m thick and 60 m wide at the drill site. The glassy, sediment-dusted flow is younger than the lobate lavas outside the ASC. The ODP flow extends for at least 260 m along strike and varies in width from 20 to 80 m. Flow striations are oriented subparallel to the strike of the ASC. Submersible observations of contact relationships indicate that the ODP flow traveled along strike and ponded within a preexisting linear collapse or depression along the west margin of the ASC. The ODP flow does not appear to have spilled out of the containing depression, suggesting that the eruption was a small one issuing from a fracture now buried beneath the flow. Fissures and cooling cracks in the flow are up to several meters wide, and may have vertical offsets of up to 1 m near the margin of the flow. Spacing between cracks is spatially variable, from 2-5 m to 8-15 m.

In a 1500-m^2 area approximately 50-100 m north of Hole 864A, diffuse venting of low-temperature (11°-14°C) hydrothermal fluid from fissures in the ODP flow supports a community of mussels, clams, and crabs. Extinct sulfide edifices up to 10 m high are found within 200 m north and south of the drill site. The nearest active high-temperature vents are located in the ASC ~700 m north of Site 864. These active hot vents are barely flowing and appear to be dying. The closest vigorous black smoker is located at 9°33.5'N. Abundant inactive edifices mapped with ARGO are strung out along the ASC south to 9°27'N. Haymon et al. (1991a) propose that the hydrothermal system in this area of the EPR is in a late stage of evolution and is dying from south to north.

Two passive markers were left on the ODP flow, marker 1 at a site where the fissure density was low and the flow surface very flat (9°30.85'N, 104°14.66'W), and marker 2 in the area of diffuse hydrothermal venting and vent biota (9°30.89'N, 104°14.69'W). Marker 1 was located on Leg 142 using the video camera on the drill string, and Hole 864A is sited approximately 20 m northwest of the marker (Fig. 1).

Seismic Studies

One of the primary reasons for interest in scientific ODP drilling at the East Pacific Rise was the identification from multichannel seismics of a coherent reflector marking the top of an axial magma chamber (Herron et al., 1980; Detrick et al., 1987; Mutter et al., 1988). Beneath the axis of the EPR crest, the top of the magma chamber is 1.7 km below the seafloor at the drillsite (Vera et al., 1990), but this apparent depth to the magma chamber lessens to the west. In three-dimensional mapping of the seismic structure of the EPR crest near Site 864, Toomey et al. (1990) found that the magma chamber reaches its shallowest depth of about 1 km below seafloor about 1 km west of the rise axis, beneath crust 20,000 years old. This depth and offset from the axis are right at the limits of resolution of the tomographic inversion used by Toomey et al. (1990), but it is clear that a magma chamber reaching to within 1.5 km of the seafloor exists under the near western flank of the rise. Such a shallow magma chamber is an intriguing target for drilling; it was hoped that experiments in bare-rock drilling on the East Pacific Rise crest would lead to the establishment of drill holes which might eventually be reentered to recover rock from the roof of the magma chamber itself. Two potential sites were chosen: EPR-1 above the shallowest point of the magma chamber as determined by Toomey et al. (1990), and EPR-2 (Site 864) within the axis of the axial summit caldera. The axial low velocity zone is 3-4 km wide (Detrick et al., 1987) and could be reached from either EPR-1 or EPR-2.

To measure the detailed shallow structure of the proposed drill sites, Purdy et al. (1991) carried out seismic refraction experiments using the deep-towed explosive source NOBEL and ocean-bottom hydrophones. By using shots within a few meters of the ocean bottom, this experiment avoided the geometry of traditional seismic experiments in which little energy (and hence little information) is returned from the shallowest seafloor. Purdy et al. (1991) made seismic measurements along ridge-parallel refraction lines at each of the proposed drill sites and at several other sites to make up a cross-ridge transect at 9°30'N. They also made measurements within the ASC at 9°33' and at 12°50'N. Their results show that the structure of the axial summit caldera and the flanks differs markedly (Christeson et al., 1991a,b). A thin (<100 m) slow (2–2.5 km/s) layer forms the top of zero-age crust, and this is underlain by a faster layer with velocities of 5.3 km/s at a depth below the seafloor of 200 m. On the flanks, the surficial low-velocity layer is significantly thicker (130-180 m) and faster (2.4-3.2 km/s). This is underlain by a layer with velocities ranging from 4.2 to 4.7 km/s.

Christeson et al. (1991a,b) interpret the low-velocity surface layer to be fractured and brecciated basalt, with the increase in velocity explained by modest cementation or difference in morphology. The ASC lavas are predominantly sheet and lobate flows, whereas the flanks have pillows erupted over lobated flows (*Alvin* submersible observations by R. Batiza and others during February and March 1992, on Dives 2489 and 2491). More difficult to explain is the apparent decrease in velocity of the material beneath the low-velocity layer in going from the axis to the flanks. Christeson et al. (1991a,b) offer two explanations: (1) the 5.4 km/s on the zero-age lines represents fairly massive, low-porosity basalt which is fractured tectonically, reducing its velocity to the 4.2-4.7-km/s seen on the flanks; and (2) the 5.4-km/s material of the zero-age lines is mostly dikes, while the flank 4.2-4.7 km/s material is fractured flows. Drilling could help to distinguish between these possibilities. Of all lines run in the Purdy et al. (1991) experiment, the thinnest surficial low-velocity layer detected was at site EPR-2 within the ASC, where the thickness was only 50 m. Everywhere else the layer was thicker. In particular, at EPR-1, the original primary choice for an EPR site, the layer is 165 m thick. Because of the difficulty in drilling through thick sequences of fractured rock, the primary location for drilling was switched to EPR-2 (Purdy et al., 1991), drilled as Site 864.

Petrologic Studies

Langmuir et al. (1986) described samples dredged from the EPR between 8°N and 15°N. A detailed study of the axis in the area of the seismic tomography experiment (the area of Site 864) was conducted by Batiza and Niu (1992) using dredges spaced about every 1.8 km along the axis. Additional samples on the axis and on the flanks of the EPR were collected by Perfit et al. (1991). So far, these studies show that the axial lavas are primarily normal depleted mid-ocean-ridge basalt (N-MORB), with rare, more enriched E-MORB occurring at some 4th-order discontinuities along axis and at other places on the flanks, off axis. Batiza and Niu (1992) showed that there is a correlation between axial depth and chemistry between 9°17'N and ~9°50'N, with shallow areas of the axis having more primitive lavas (higher MgO contents and MgO/FeO) and deeper areas having more fractionated lavas. Furthermore, since there is a correlation between axial depth and depth of the seismic magma chamber, there is also a correlation between the chemistry of axial lavas and axial magma chamber (AMC) depth. Chemical differences among the samples of N-MORB can all be explained by crystal fractionation involving a single parental melt. Batiza and Niu (1992) invoked a magma chamber that has compositional zoning along axis to explain the observed along-axis chemical variation in the vicinity of Site 864.

Site 864 Summary

Site 864 was located on a flat, relatively unfissured lava flow flooring the axial summit caldera of the East Pacific Rise (EPR) at about 9°30' N (Fig. 1). Three holes were drilled, and two (Holes 864A and 864B) yielded samples in the form of angular fragments recovered by the Diamond Coring System (DCS), miscellaneous junk-basket and bit-recovery samples, and a cylindrical wash core cut by the Diamond Core Barrel (DCB). On the basis of geochemical and petrographic results, two lithologic units have been identified (Fig. 2). Unit 1 consists of massive glassy to fine-grained aphyric basalt. Recovered fragments commonly show thin (< 1 cm thick) glassy margins grading into micro crystalline interiors; some angular fragments consist entirely of pure glass, whereas others are entirely crystalline. Drilling conditions and the nature and chemistry of the recovered material indicate that Unit 1 consists of a 2- to 3-m-thick massive flow, underlain by several meters of glassy lobate or sheet flows (Fig. 2), all likely emplaced during a single eruptive event. An additional massive flow of unknown thickness, possibly sampled by the junk basket, may underlie the lobate and sheet flows; the total thickness of Unit 1 is unknown but is likely less than 6.6 m. Phenocrysts in Unit 1 samples are sparse (< 1%) and consist of euhedral, prismatic plagioclase (up to1.5 mm in length) and rare clinopyroxene. The groundmass consists of varying proportions of glass, cryptocrystalline mesostasis, microcrystalline to fine-grained plagioclase, olivine, clinopyroxene, titanomagnetite, and small (5-10 microns) Fe-sulfide globules. Groundmass textures are consistent with differing rates of quench crystallization and cover a complete spectrum from glassy and spherulitic to microlitic to fine-grained intergranular, some with subophitic intergrowths of plagioclase and clinopyroxene. Vesicularity is low (0 to 5%). In general, samples are quite fresh, but microcracks and fracture surfaces of some fragments exhibit thin coatings of secondary precipitates, including opaline silica and cryptocrystalline quartz, Fe-oxyhydroxide minerals, minor pyrite and chalcopyrite, Cu-sulfate(?), and possible clay minerals.

Unit 2 is a massive, microcrystalline to fine-grained, aphyric to slightly plagioclase phyric basalt. It is separated from Unit 1 by an interval of no recovery during drilling and washing (Fig. 2), and represents a thick, jointed lava flow or dike of unknown thickness recovered from an interval from 11.8 to 15.0 mbsf. One recovered fragment displays well-developed polygonal jointing. Phenocrysts are sparse (up to 2%) and consist of euhedral, tabular to prismatic plagioclase crystals (<2.1 mm) and rare olivine. Scattered, large (up to 1 cm diameter), coarse-grained crystal clots of euhedral, prismatic clinopyroxene and plagioclase are present. Groundmass mineralogy and textures are identical to Unit 1. Vesicularity is low but is generally higher than in Unit 1 (0 to 6%). All samples are fresh but traces of hydrothermal alteration are found as thin coatings of opaline silica, cryptocrystalline quartz, and Fe-oxyhydroxide minerals. Rust-colored clay minerals rarely occur as partial vesicle fillings.

Representative whole rock and picked glass samples from Unit 1 (n=13) and whole rock samples from Unit 2 (n=2) were analyzed for major and trace elements by X-ray fluorescence. Within each unit, samples yielded identical values within analytical precision (Table 2). Unit 1 and Unit 2 are compositionally very similar, relatively evolved N-type MORB (Fig. 3), with average $Mg/(Mg+Fe^{2+})$ of 0.58 and 0.56, respectively. Compared to Unit 1, Unit 2 is characterized by slightly higher TiO_2 (1.78% vs. 1.64%), Na_2O (2.63% vs. 2.55%), Y (40 vs. 36 ppm), and V (369 vs. 355 ppm), and by slightly lower Al_2O_3 (14.03% vs. 14.30%), CaO (11.45% vs. 11.71%), and Cr (188 vs. 238 ppm). Nb, K_2O, and P_2O_5 are low in both units (3 ppm, 0.14%, 0.11%-0.12%, respectively), and CO_2 and H_2O contents of glass from Unit 1 ranged from 0.01% to 0.04% and 0.13% to 0.23%, respectively. Units 1 and 2 were derived from parental lavas similar to those which produced other N-type MORBs from this portion of the EPR, with the minor differences between the two Leg 142 units consistent with Unit 2 having undergone slightly more low-pressure fractionation of olivine, plagioclase, and clinopyroxene than Unit 1.

Grain densities of Leg 142 basalt samples ranged from 2.99 to 3.02 g/cm^3, with wet bulk densities of 2.94 to 2.99 g/cm^3 indicating porosities of 1.8% to 2.1%. Compressional wave velocities of these basalts were low for basalts, ranging between 4.1 to 5.1 km/s (seawater-saturated) and 3.0 to 4.1 km/s (dry). The large differences between wet and dry velocities exhibited by most samples tested imply that a significant part of the rock porosity consists of microcracks. The mean magnetic susceptibility of the basalts (0.015 SI units) is comparable to that of other ocean-ridge basalts, and shows a great range (0.00066 to 0.033 SI units). The natural remanent magnetization (NRM) of the samples is also broad (0.17 to 0.49 A/M), with the lowest values measured from glassy samples. Magnetic and thermal coercivities of the samples are low, consistent with multidomain Ti-rich magnetite being the dominant carrier of the NRM.

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Figure Captions

Figure 1. Location and geologic map of Site 864 and vicinity. The hard rock guide bases for Holes 864A and 864B are shown by the solid hexagons; the southern hexagon represents Hole 864A.

Figure 2. Inferred stratigraphy at Site 864 from drilling parameters and petrological observations. Unit and lithological boundaries are highly uncertain.

Figure 3. Average compositions of Units 1 and 2 normalized to standard N-MORB composition (Sun and McDonough, 1989). Leg 142 units are typical N-MORB in composition.

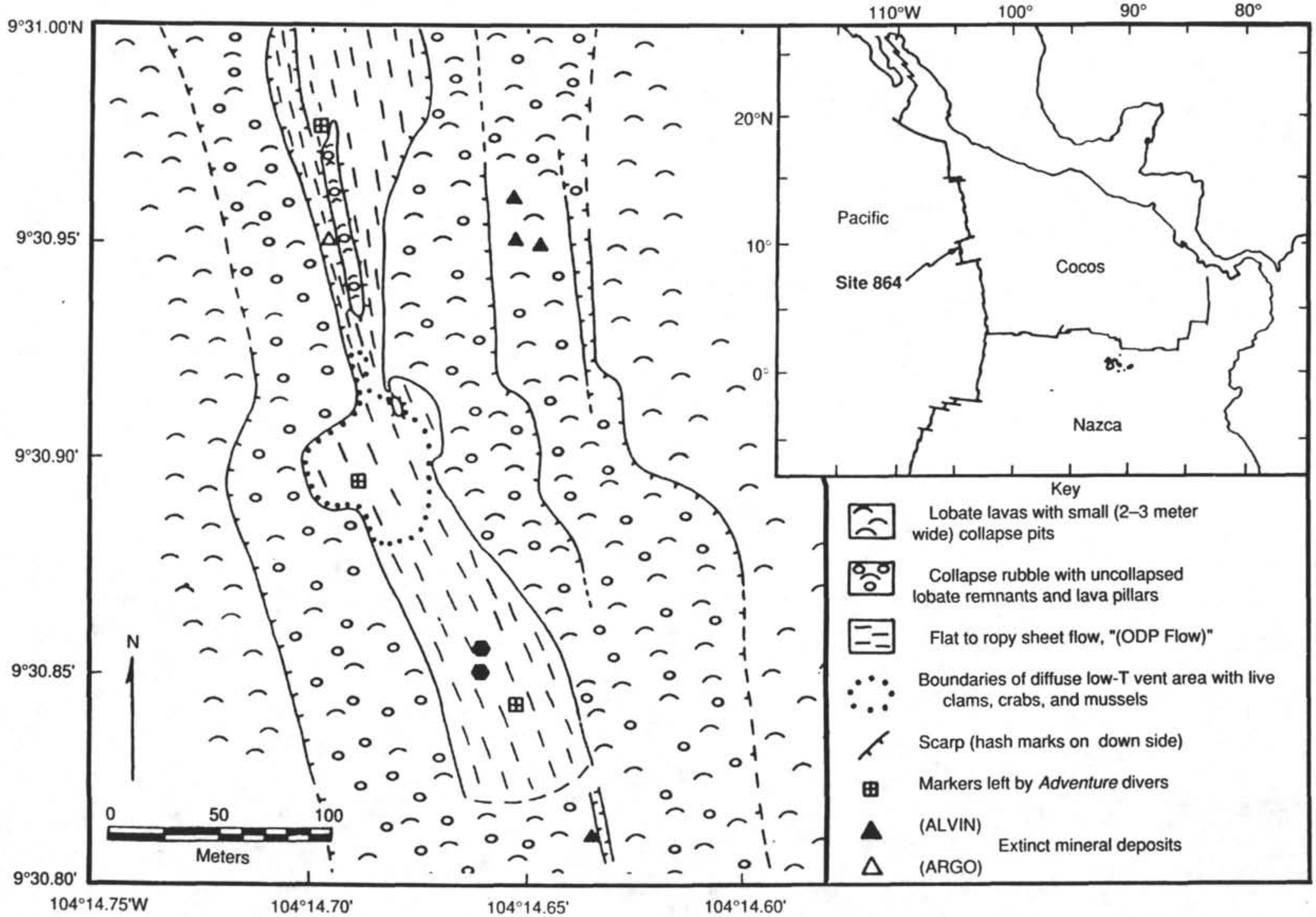
9°31.00'N
9°30.95'
9°30.90'
9°30.85'
9°30.80'
104°14.75'W
104°14.70'
104°14.65'
104°14.60'
N
0
50
100
Meters
110°W
100°
90°
80°
20°N
10°
0°
Pacific
Site 864
Cocos
Nazca
Key
Lobate lavas with small (2–3 meter wide) collapse pits
Collapse rubble with uncollapsed lobate remnants and lava pillars
Flat to ropy sheet flow, "(ODP Flow)"
Boundaries of diffuse low-T vent area with live clams, crabs, and mussels
Scarp (hash marks on down side)
Markers left by Adventure divers
(ALVIN)
Extinct mineral deposits
(ARGO)

Figure 1

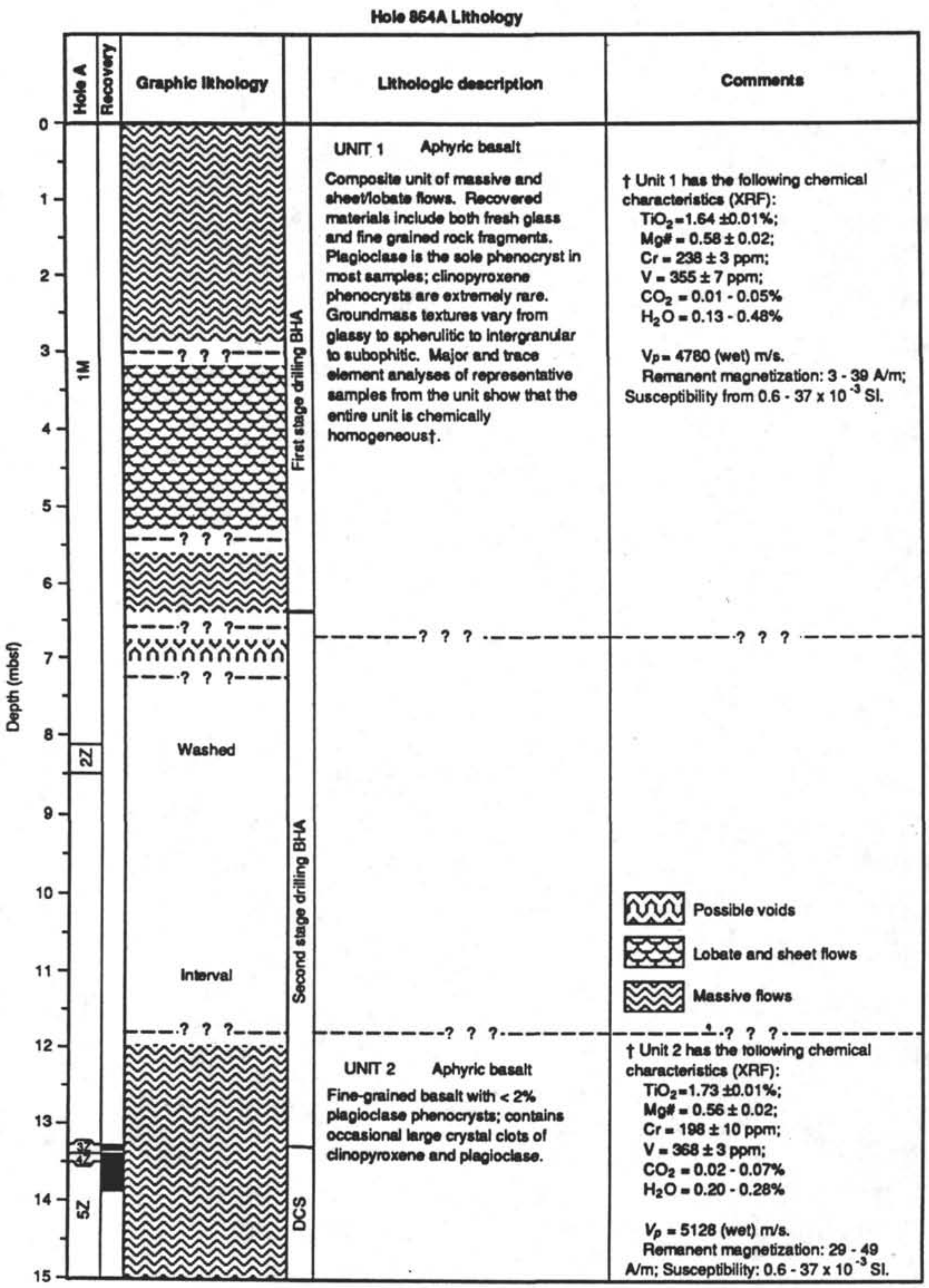
Hole 864A Lithology
Hole A
Recovery
Graphic lithology
Lithologic description
Comments
Depth (mbsf)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
1M
2Z
3Z
4Z
5Z
First stage drilling BHA
Second stage drilling BHA
DCS
? ? ?
Washed
Interval
UNIT 1 Aphyric basalt
Composite unit of massive and sheet/lobate flows. Recovered materials include both fresh glass and fine grained rock fragments. Plagioclase is the sole phenocryst in most samples; clinopyroxene phenocrysts are extremely rare. Groundmass textures vary from glassy to spherulitic to intergranular to subophitic. Major and trace element analyses of representative samples from the unit show that the entire unit is chemically homogeneous†.
† Unit 1 has the following chemical characteristics (XRF):
TiO2=1.64 ±0.01%;
Mg# = 0.58 ± 0.02;
Cr = 238 ± 3 ppm;
V = 355 ± 7 ppm;
CO2 = 0.01 - 0.05%
H2O = 0.13 - 0.48%
Vp = 4780 (wet) m/s.
Remanent magnetization: 3 - 39 A/m;
Susceptibility from 0.6 - 37 x 10-3 SI.
Possible voids
Lobate and sheet flows
Massive flows
UNIT 2 Aphyric basalt
Fine-grained basalt with < 2% plagioclase phenocrysts; contains occasional large crystal clots of clinopyroxene and plagioclase.
† Unit 2 has the following chemical characteristics (XRF):
TiO2=1.73 ±0.01%;
Mg# = 0.56 ± 0.02;
Cr = 198 ± 10 ppm;
V = 368 ± 3 ppm;
CO2 = 0.02 - 0.07%
H2O = 0.20 - 0.28%
Vp = 5128 (wet) m/s.
Remanent magnetization: 29 - 49 A/m; Susceptibility: 0.6 - 37 x 10-3 SI.

Figure 2

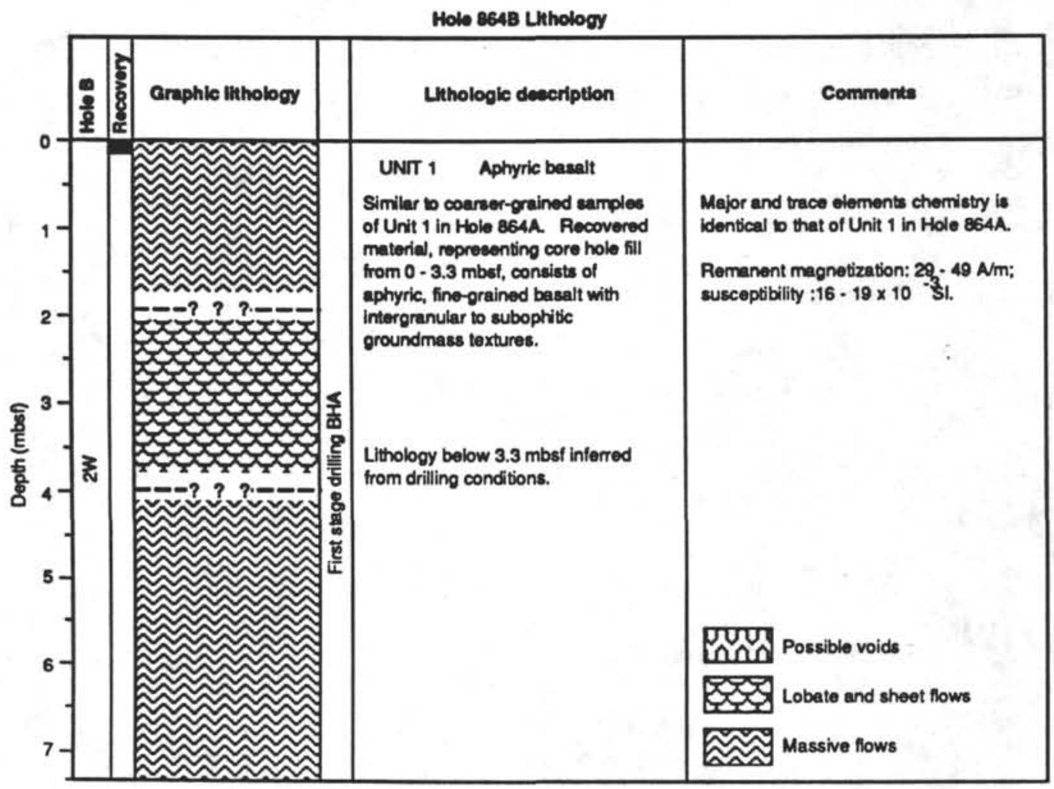

Figure 2 continued

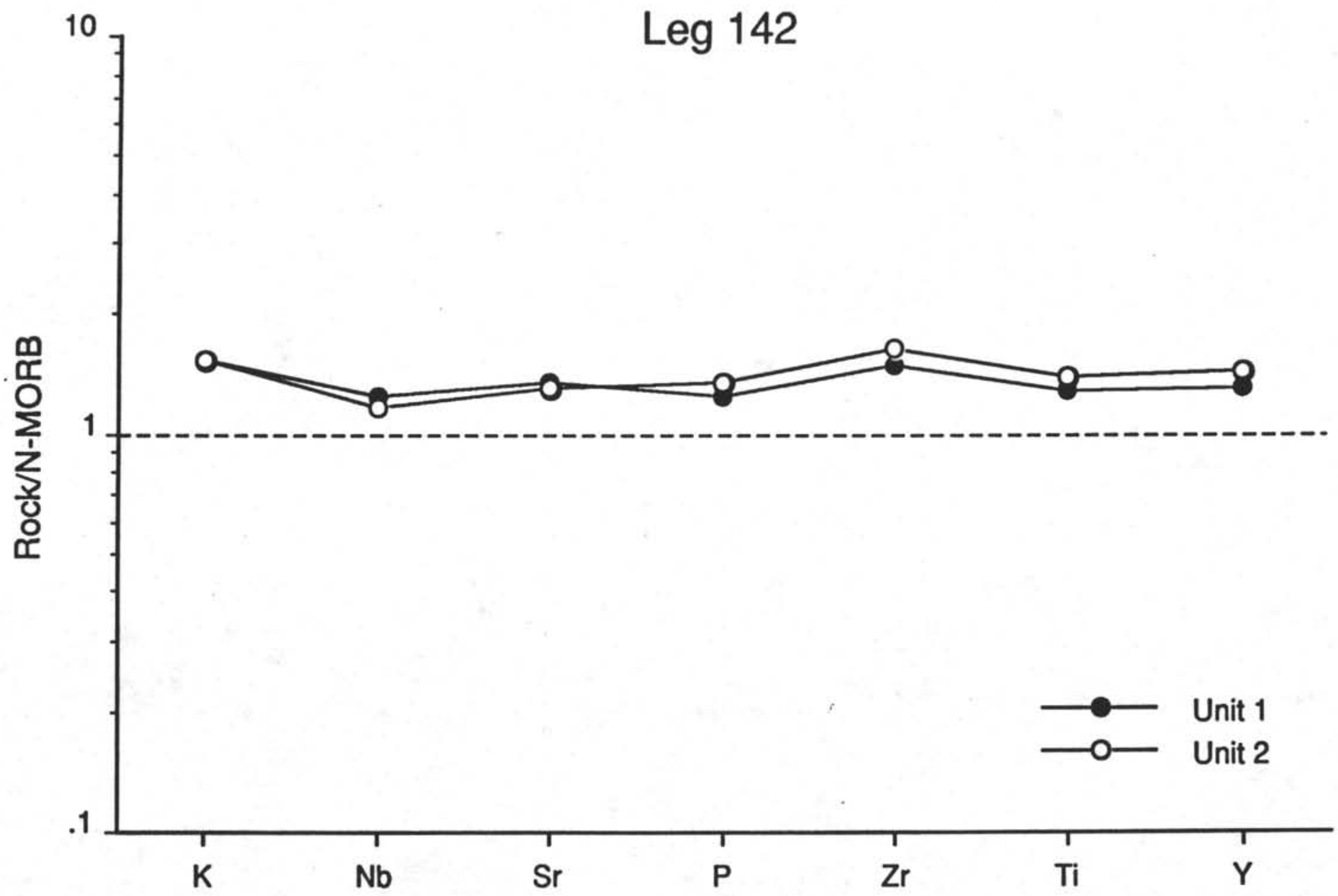

Figure 3

Table 1. Capabilities required for ridge-crest drilling on East Pacific Rise.

REQUIRED/DESIRED CAPABILITY	LEG 54	LEG 106	LEG 109	LEG 124E	LEG 132	LEG 142
HARD ROCK GUIDE BASE		X	X		X	X
* PROVIDE SEA FLOOR STABILITY		X	X		X	X
* HANDLE 25 DEGREE SLOPES					X	X
* HRB TILT INDICATOR (MECH OR ELEC)		X	X		X	X
* SMALL/ECONOMICAL					X	X
* EFFICIENT ASBLY/DEPLOYMENT						X
* MULTIPLE CASING STRINGS						X
* MOVABLE AT SEA FLOOR					X	X
* RECOVERABLE ABOARD SHIP					X	X
DRILL-IN BOTTOM HOLE ASSEMBLY					X	X
* PROVIDE 4 INCH DCS THROUGH BORE					X	X
* ISOLATE ONE UNSTABLE ZONE					X	X
* DETACH FROM DRILL STRING					X	X
* ADEQUATE BIT/CENTER BIT LIFE						
* MULTIPLE UNSTABLE ZONES						X
* OPTION TO SPUD WITH SMALL DIA BIT						X
* SMALL COLLARS/CONNECTIONS						X
* OPTIONAL 7-1/4 DIA CORE BARREL						X
DIAMOND CORING SYSTEM				X	X	X
* SLIM HOLE CORING SYSTEM				X	X	X
* RUGGED WIRELINE COMPONENTS					X	X
* DRILL ROD/TUBING - 2000 M				X	X	X
* DRILL ROD/TUBING - 4500 M					X	X
* OPTIONAL/MULTIPLE CORE CATCHERS						X
* SAMPLER OPTIONS FOR C'BBL						X
* FRICTION REDUCER/DRILLING MUD					X	X
* SLIM HOLE BIT DESIGNS				X	X	X
DIAMOND DRILLING RIG				X	X	X
* HIGH SPEED TOP DRIVE				X	X	X
* CONSTANT RPM SPEED CONTROL					X	X
* FINE /LOW FLOW PUMP CONTROL					X	X
* ACTIVE SECONDARY COMPENSATION				X	X	

NOTE: The HRB and DI-BHA back-off assemblies were considerably more refined on Leg 142 although the design concepts were proven on Leg 132.

Table 2

	Unit 1 Average	Unit 1 1σ	Unit 2 Average	Unit 2 1σ
SiO_2	49.91	0.12	49.71	0.10
TiO_2	1.64	0.01	1.78	0.04
Al_2O_3	14.30	0.08	14.03	0.09
Fe_2O_3	11.61	0.05	12.09	0.18
MnO	0.20	0.01	0.21	0.00
MgO	7.30	0.11	7.15	0.18
CaO	11.72	0.05	11.45	0.06
Na_2O	2.55	0.03	2.63	0.02
K_2O	0.14	0.02	0.14	0.00
P_2O_5	0.11	0.01	0.12	0.01
Total	99.49		99.30	
L.O.I.				
CO_2				
H_2O				
Mg#	0.581	0.003	0.565	0.010
V	353	9	369	3
Cr	237	6	188	18
Ni	73	4	69	5
Cu	77	11	70	1
Zn	92	6	93	2
Sr	122	1	119	2
Y	36.4	0.6	40.3	1.1
Zr	111	1	122	2
Nb	2.9	0.2	2.7	0.6
Zr/Y	3.06	0.04	3.02	0.04
Nb/Zr	0.026	0.002	0.022	0.005
Ti/Zr	88.3	0.8	87.4	0.6
Or	0.85	0.13	0.95	0.11
Ab	21.90	0.33	22.35	0.47
An	27.38	0.41	26.73	0.36
Di	25.10	0.19	25.37	0.42
Hy	16.44	0.51	15.68	0.36
Ol	2.78	0.46	3.20	0.72
Mt	1.71	0.02	1.73	0.04
Ilm	3.17	0.09	3.27	0.13
Ap	0.24	0.02	0.25	0.01

Note: Rb, Ba, and Ce are below detection limits and are not reported. Mg# refers to $Mg/(Mg+Fe^{2+})$ where Fe^{2+} is assumed to be 0.9 times Fe^{Total}; L.O.I. = loss on ignition.

TECHNICAL REPORT

The following ODP Technical and Logistics personnel were aboard *JOIDES Resolution* for Leg 142 of the Ocean Drilling Program:

Laboratory Officer:	Burney Hamlin
Assistant Laboratory Officer:	Wendy Autio
Marine Laboratory Specialist/Yeoperson:	Jo Claesgens
Marine Computer Specialists/System Managers:	John Eastlund Dan Bontempo
Marine Electronics Specialist:	Eric Meissner Mark Watson
Marine Laboratory Specialist/Photography:	Mark Gilmore
Marine Laboratory Specialist/Chemistry:	Dennis Graham
Marine Laboratory Specialist/Curatorial:	Erin McCarty
Marine Specialists:	Tim Bronk Brad Cook "Kuro" Kuroki Jon Lloyd Stacey Lyle

Introduction

With the holidays and vacations behind them, the technical staff arrived in Santiago, Chile and Vina Del Mar near Valparaiso to begin Leg 142. The flight for most, to Santiago via Dallas and Miami 12-13 January, worked out well. SEDCO's agent had buses with enough room to convey all of us from the Chilean capital's airport down across the stepped valleys to the coast and Vina Del Mar. The relatively minor time change was easy on everyone, as was making the transition from winter to summer!

The *JOIDES Resolution* arrived at Valparaiso on the evening of the 12th, allowing the tired off-going crew to enjoy an evening on the town before freight and crossover activities began the next day.

Port Call

After crossover, the Marine Specialists focused on the core lab modifications proposed for the leg. The ODP engineers and the SEDCO crew handled all of the 11 flats/containers of equipment supporting the Diamond Coring System (DCS) operations planned for the leg. The off-going technical crew had cleaned out and stored materials from the drawers in the effected core lab areas, unfastened benches, and gave us the head start which allowed the cryogenic magnetometer to be moved in port. With help the first day from two of the off-going crew and Lab Officer Bill Mills, who stayed during several days of the port call, the effort began. The walls separating the old paleomagnetics area from the physical properties area in the core lab were removed. The magnetometer was moved to its new location adjacent to the photo area on the 14th. Cores and the surface freight, too, were off-loaded; a very full day. All ship power was off from midnight on the 15th to 0400 to allow electrical components of the DCS to be connected to ship's power. All lab equipment was turned off, and most things powered up again normally the next morning. Some sticky Apple internal disk drives required efforts from the computer specialists to get them going.

The technical staff anticipated sailing at midnight on the 16th, so most took off a few hours in the afternoon for last-minute shopping and looking, and then dinner. A sailing reprieve was announced when the engineers found they needed an EPROM burner to customize some heave compensator control chips. One unit from Western Gear Corporation was hand carried down only to have it discovered faulty. The *JOIDES Resolution* went to anchor on the 17th while another one of the devices was located and carried to the ship. The regulated power on the Foc'sle deck failed twice; a 150-amp. circuit breaker was exchanged. With the successful delivery of the second EPROM burner, the anchor was pulled at 19:15 hr on the 18th, and the ship sailed for Site 864.

Underway

Navigation tapes were initiated immediately and underway watches began as soon as we passed through the harbor traffic. A security sign-in sheet was posted for visitors. The magnetometer sensor was deployed, and both 12- and 3.5 kHz depth recorders turned on. No response could be detected from the 3.5 system until the aft transducer was connected. The return was very dirty and mostly unusable. The failure of the dome-mounted 3.5 transducer was investigated, and those ashore alerted to locate a replacement. The magnetometer record quality was irregular, leading to sensor swaps and decane replacement. The deck electronics seemed to handle range crossovers poorly, resulting in "wall to wall" records until the trace emerged into the middle of the analog records. Running along the East Pacific Rise resulted in many range crossovers. An alignment procedure was completed on site, but the deck unit was within tolerances.

The 12-day transit to Honolulu provided an opportunity to work on acquiring some seismic records at transit speeds, mostly at 10-11 knots, and testing several suggestions to improve the results.

There is a 23-hr hiatus in the navigation records, 9-10 March, when the salt water piping was off aft for pipe exchange. AC was lost for this interval, and the lab was secured to limit heat damage.

The two HAMCO 200-in.^{3} water guns were used on two occasions and are large enough to overcome much of the past problem of amplifying noise. Filtering the signal below 80-100 Hz resulted in an analog bottom record on a light background, partly fuzzy but discernible. The region we transited was not particularly appropriate for the tests, as there was little or no sediment blanket to discern. The last few minutes of the record showed promise, with some ponding recorded. The digital tape will be processed at ODP as a training exercise for our underway specialist.

The majority of the hose fittings, NICCO press fittings and shackles were moved from our storage cabinets in the lower sack area to the drawer system in the subsea shop.

A day was gained on the transit, and permission was given to dock a day early.

Core Lab Modifications

The 11.5-day transit to Site 864 became routine and afforded time for many of the Marine Specialists to contribute to the core lab changes and refurbishment, particularly the all-hands efforts. With everyone switching to their shifts, the various specialists starting work in their areas and the technical staff sailing with three fewer techs than on most legs, we found we had a quite limited team to support the minutiae of the day.

After the lab furniture groups were positioned, the plumbing effort proceeded. The technical staff managed the pipe fitting, 1/2-in. copper tubing, and PVC but depended on the SEDCO staff to solder the 2-in. copper drain lines from two sink locations. Cold potable water service was run to the sinks, teeing off an emergency shower installation over the drinking fountain. The effort had to be made after discovering that the cold potable water we had used for most sampling equipment previously was really hot water, as many had correctly guessed, seeing steam occasionally at the saw stations! The ship electricians changed circuits, added receptacles, and moved ISODUCT and track lights to support the changed roles in the various core lab areas. New Bar Top epoxy was poured on the wet bench surfaces, and polyurethane painted on the rest. Fresh Dex-O-Tex floor epoxy was rolled out in the sampling area to complete the modifications for this part of the lab in time for the scientists to move into their work areas, calibrate instruments, and finally describe junk-basket collections of basalt/glass cuttings recovered during attempts to drill at the site.

On Site

As drilling continued, various enhancements continued in the core lab, and other projects and cross-training were initiated.

Areas that core recovery would impact immediately were finished to a level that would support scientific effort. This included the remodeled sampling area, core-description area and discrete sample paleomagnetics. The repositioned drawers in the moved cabinets were sorted out and hardware was added which makes them less likely to roll out with ship motion; this permitted much of the functional but aesthetically displeasing Velcro tape to be removed. While the discrete sample part of the paleomagnetics lab was ready for samples and the refrigeration was connected to the cryogenic magnetometer, construction of cabinets and bookshelves in a UNISTRUT frame over the instrument continued. Wall shelving and cabinets were also constructed. Progress was slow as these items were designed and constructed in steps to address problems as they were identified. The fact that nothing is level or square in this type of construction slows things also.

Curation

The very low recovery, the non-standard recovery means, and indefinite sub-bottom depths led to some organization by decree. Problems associated with the use of reduced-diameter DCS core liners were investigated, and agreement was found with the suggestions made on Leg 132. Shims were made for the core cutter so the reduced diameter liner could be split.

Junk-basket samples were washed with hexane to remove any petroleum-product contamination, and then they were sieved; electromagnets removed potential milling fragments.

Extensive work was done in rewriting and updating the Curatorial Cookbook. A database was created to organize residues.

Core Lab

After the dust of renovation was cleared from the physical properties lab, calibration of the ThermCon needles progressed, and remounting the Hamilton Frame transducers was done. The effort highlighted a need for more standards and transducers, which were ordered. Measurements with the pycnometer of saturated hard-rock samples were questioned, though the instrument was operating well.

Much of the leg was spent organizing the volumes of scanned old documents supporting the physical properties lab, rewriting, and doing drawings, photos, and schematics to support a new edition of the physical properties manual. The effort was mostly complete with work still outstanding on support of the MST.

The spinner magnetometer for discrete samples was installed early in the construction of the new lab. A few samples were eventually measured and studied. The design and construction of the paleomagnetics area and the nearly complete rewiring was a time-consuming effort, done mostly as a solo effort. Initial measurements with the new fore and aft layout of the instrument indicate a reduced helium boil-off rate. The problem of using chill water that is too cold for use in the cryocooler will be eliminated with the installation of another HASKRIS intercooler. It will permit a larger flow of cooling water through the unit and make it less sensitive to small changes in chill water volume or temperature.

Chemistry Lab

Activity in the chemistry lab was limited, but several of the instruments were used. Sulfate determinations from some Alvin vent samples were made using the DIONEX ion analyzer. The cookbook was updated by a shipboard scientist, and maintenance was performed. The CHNS instrument was used to perform hydrogen and CO_2 analysis on the XRF powders to determine water content and combustion losses. Gas chromatographs were tested but were not needed. The AA and spectrophotometer devices were also exercised and appeared to work, though no samples were run. As this was the chemist's first leg, much of the time available to him was spent reading the manuals and working with the scientists in the lab. IAPSO standards were run on the alkalinity apparatus for familiarity. Some small changes were made in the program to move the system away from IAPSO and to keep from losing data if too few data points were recorded in a specific range.

X-Ray Lab

This was a training leg for an experienced ODP technician who was new to the X-ray lab. Wendy Autio provided assistance when needed.

XRD - The Philips XRD analyzer was repaired during port call, when new detector arm was installed and the goniometer aligned. The instrument was not used during this leg other than running standards to understand its operation and exploring the software available.

XRF - The lengthy task of calibrating the XRF analyzer for major and minor elements was requested by our Staff Scientist, as the transit afforded the time and he wanted the best analyses possible. 15 basalt samples, recovered during coring, drilling, and hole cleanout operations, were powdered and analyzed. Basalt specimens recovered by the *Alvin* submarine with our Chief Scientist, and ancillary to the drill site, were also prepared and analyzed under way to Hawaii. Scientists participated by helping with sample preparation. The added 31 major and 36 trace analyses afforded the X-ray specialist practice and the experience of working with several investigators who could guide him. His careful work resulted in exceptional calibration numbers.

Contamination tests were made, comparing the results of basalt samples prepared with agate, alumina ceramic, and tungsten carbide grinders. The results were identical within the range of instrument error.

One of the goniometer's was limited to major analyses when the X-ray intensity was found to shift over time. A pre-amplifier was changed after the samples were analyzed to correct the problem.

Thin Section Lab

Thirty polished basalt thin sections were prepared for the petrologists. No problems were encountered, though the pace of the recovered material was never enough to use time preparing them efficiently.

Computer Service

This was the first leg with two computer specialists to provide 24-hour coverage of the computer systems. While there were little data to stress the software or system, there were numerous projects to pursue.

Six new MAC ci's installed throughout the labs were provided by Science Operations. It was curious to note that during this leg the majority of the users were PC-oriented, skewed by the number of engineers on this leg.

Several projects included Jaxbase software inventory updates and converting them to Excel for utility and as an Excel exercise. Introductory presentations and class outlines for Word Perfect, Excel and Kaleidagraph were updated, expanded, and enhanced. Most of a new System Manager Guide was completed and is ready for review.

A few problems were experienced, associated with new systems/networks and software. The new thin-line ethernet revealed its sensitivity by crashing the network when new lines were plugged into the net.

There were problems with Word Perfect installed in Windows causing damaged files. In two cases a change was attempted through the server to change a terminal's Vax port, resulting in the loss of all the port names. Re-identifying all the ports is a tedious renaming process done manually.

An interruption in chill water for service caused concern as humidity and temperatures rose. A new strip of Isoduct with added regulated and ship-power receptacles was added to the system managers' office and other changes were made in the machine room.

A Silicon Graphics workstation was brought aboard by one of the scientists and set up. Its impressive 3-D graphics capabilities were demonstrated, though there was little its capabilities could be applied toward. Missing files prevented hooking it to the network. Potentially useful image-grabbing capabilities were demonstrated.

Photo Lab

The "round the clock" photo demands of an engineering leg had been anticipated, and one of our marine specialists, Brad Cook, was scheduled to work opposite our photographer, Mark Gilmore, to cover requests. A large volume of engineering photos was expected, and an order for seven copies of 180 views was received near cruise end.

Extensive testing was performed to determine correct exposures for close-ups, as film emulsions had been changed, and to clarify some confusion as to the power of some of the strobes being used. Some drift was noticed in the density of the reference control film, and steps were taken to explain it. Other than a backed-up drain, there were few problems noted in the lab or with the equipment.

A Macintosh was installed in the photo lab and will eventually be connected to the ship's network, easing communication between the lab and the rest of the ship.

Microscopes

Brad Cook also assumed responsibility for making minor repairs and cleaning the lab microscopes. There was little use of the microscopes other than the Axioscopes, which are configured for petrographic work. Staff Scientist Jamie Allan introduced the photographers and scientists to these optical instruments from the point of view of a familiar and professional user of the Axioscope series.

User-defined problems with these Axioscopes were to have been presented to the Zeiss repairman in port for attention. Problems taking photomicrographs with these microscopes, too, were to have been discussed. The microscope inventory was updated and completed.

Electronics Shop

The usual wide range of support was given to people with problems, mechanical or electrical. The photocopying machines that are being replaced in Hawaii were kept serviceable throughout the leg. Assistance was given in the paleomagnetics area, with rewiring and start-up problems.

Considerable time was devoted to improving stabilizing circuits at the weighing stations to improve accuracy. A failed 3.5 kHz transducer and nearly 3 weeks of underway time generated an ongoing list of problems to investigate in the underway lab. Most were routine, and were soon fixed.

Time was spent determining why the fiber optics link failed to work with the streamer seismic signal. Performance data and oscilloscope photos were taken, with plans to discuss the problems with the distributor.

A Xerox database was incorporated into the rest of the ET's database. Enhancements such as menus were added with an assortment of viewing and printing options.

Storekeeping

The volume of material shipped to and from a DCS deployment stretches the shipping program to the limit, occasionally requiring help from the computer specialists. An attempt was made to import the entire DCS shipment into S2S with hopes of deleting items expended. Few other problems were encountered.

Special Projects

The fantail hoses and winch/boom controls associated with the handling of the seismic gear were replaced. As several of the fittings broke during the exchange the effort was not too soon. The 80-in.^{3} SSI water guns and depressors were stored, and the 200-in.^{3} HAMCO water guns readied for deployment. Other service included exchanging the port magnetometer cable and reheading the sensor, adding a weighted streamer section to the port hydrophone array that Teledyne had strengthened for ODP, and adding oil. The test rigging for towing the eel from the outer port side of the helideck was installed. The rigging for the 200-in.^{3} water guns had not been used for a year and was refurbished to a level that would support our efforts.

A fiber optics link from the eel winch slip rings into the electronics lab was tested. The device worked well on the bench but not in service. There was some evidence that the system was not fast enough to transmit/receive a seismic signal, resulting in noise. Other tests suggested that the signal level from the streamer was too low for the link to operate. This link was to ensure that the usual noise observed over 7-8 kts is not electrical noise induced by the thyrig room located under the underway lab.

The ship welders constructed a base to mount a level wind aft of the starboard hydrographic winch.

Air-line fittings and marine hardware were moved from the lower sack storage area to the new cabinets in the subsea shop.

Several more attempts were made to lower the Doppler sonar stem into the sea chest past the gate valve. Measurements indicated that the assembly was passing the gate valve before hanging up on what we supposed was marine growth. Further efforts determined that the spiral flukes on the transducer housing were engaging some projections on the gate valve. Some sketches and ideas have been assembled in a report left on the ship to overcome the problem. It will require the disassembly of the transducer from the stem and the transducer housing so the fluke pattern can be modified.

Diver service was requested, in conjunction with a hull survey, to clear the sea chest of marine growth to free the deployment of the Doppler sonar transducer and to change the impedance transformer on the dome 3.5-kHz transducer.

The new air-conditioning system added to the core lab roof in San Diego performed well on this leg. There was a nuisance condensate leak in the stairwell from the air intake that has been studied and determined to be the result of an insulation problem at the unit. More insulation was added around an exposed section of ducting. Several weeks passed with no drips in the stairwell.

The five chemical hood vent blowers on the downhole lab were inspected by the Captain, Chief Engineer, and Electrician. This out-of-the-way area has received little maintenance and is in need of fastener refitting, vibration mount replacement and new weather covers for the electric motors. Materials were ordered through ODP from SEDCO to initiate refurbishment, possibly on Leg 144.

Safety

The topic of shop and particularly table-saw safety was discussed at one of SEDCO's first safety meetings. During last leg a keyed lock was placed on the table saw to ensure that the Lab Officer was aware of who was using the tool. This step, of course, doesn't ensure that a skilled person using the saw, even with permission, won't have an accident. As another step to keep safety foremost in the users' minds, users on this leg were instructed to keep the blade and kickback safety device on the saw. If the sawing operation demanded that the guard be removed, it was to be replaced when the saw was secured. Two pages of typical shop hazards users can encounter with the equipment in the shop was listed for the technical staff to review.

The pneumatic nail gun was returned to ODP with the intention of replacing it with a model with current safety features.

There was one accident noted during this leg, when a tall individual hit the top of his head on the upper 'tween landing leaving the gym. The accident was the result of a hasty descent down the three steps, unmindful of the landing.

A five-person METS team participated in the weekly fire drills.

LEG 142 STATISTICS

GENERAL:

Sites:	1
Holes:	3
Meters Drilled:	29.0
Meters Cored:	2.0
Meters Recovered:	0.5
Number of Pipe Trips:	38
Number of Samples:	132

Analysis:

Magnetics Lab:
- Discrete measurements: 5 samples (measured repeatedly and in every possible way)

Physical Properties:
- Index Properties: 7
- Velocity: 4

Chemistry:
- CHNS: 15

X-ray Lab:
- XRF: 60 Major elements; 65 Trace elements

Thin Sections: 30

Underway Geophysics:

Total Transit Nautical miles:	6570
Bathymetry:	6570
Magnetics:	6170
Seismics:	~216

Final Positions for Leg 142

Site 864A:	09°30.85' N, 104°14.66 W
Site 864B:	09°30.85' N, 104°14.66 W
Site 864C:	09°30.85' N, 104°14.66 W