9. SITE 414

Shipboard Scientific Party[1]

SITE DATA

Date Occupied: 1830, 1 September 1976

Date Departed: 0300, 2 September 1976

Time on Hole: 8.5 hours

Position: Latitude: 32°03.00′N; Longitude: 27°30.10′W

Water Depth (sea level): 1538 corrected meters, echo sounding

Water Depth (rig floor): 1548 corrected meters, echo sounding

Bottom Felt at: 1548 meters, drill pipe

Penetration: 0 meters

Number of Holes: None

Number of Cores: None

Principal Results: Site 414 is on Cruiser-Irving seamount, at 32°03.00′N, 27°30.10′W, in water about 1500 meters deep. We transferred there from the FAMOUS area because of bad weather in FAMOUS. After a preliminary survey, we dropped the beacon on the eastern ridge of the seamount, where 150 meters of sediment showed on the reflection profile. The pipe was run, but the first spud-in attempt failed because the sediment, possibly limestone, was too hard. After offsetting from the beacon, we planned a further attempt to spud, but the undeviating approach of Hurricane Emmy, fresh from passing over FAMOUS, caused us to abandon the site before carrying out this attempt.

BACKGROUND AND OBJECTIVES

When it became clear that, with two and a half days of drilling time left on Leg 49, the weather was unlikely to permit any more drilling in the FAMOUS area, we had to look around for interesting sites to drill that satisfied the following requirements: (a) they had to be far enough away from the storm center to beat the weather, (b) they had to be near the direct route from FAMOUS to Las Palmas,[2] (c) they had to be in 1000 to 2000 meters of water, shallow enough to reduce the trip time but deep enough to allow accurate positioning over the beacon if the weather were, as seemed likely, still marginal for drilling. This narrowed our choice considerably, and our attention was focused on the seamount province running north from Great Meteor toward the Azores. We considered several seamounts in this chain, but in the end the best choice on all of the above criteria was the joint seamount Cruiser-Irving, variously mapped as a seamount of complex shape with two ridges reaching toward the north, or as a twin-peaked seamount rising from a broad pedestal. We chose a site on the pedestal, away from the steep slopes leading up to the peaks, where one might expect sediment soft enough and thick enough to allow spudding-in.

All these considerations are purely technical. What scientific grounds are there for drilling in this place? Provinces of large seamounts or islands are irregularly scattered through the Atlantic Ocean. Most are volcanic, but in some places, such as in the Horseshoe Seamounts off the coast of Spain, or the Kings Trough region between north Spain and the Mid-Atlantic Ridge, at least some of the seamounts are tectonic, composed apparently of uplifted oceanic crust punched through by serpentinite diapirs. One such seamount (Gorringe Ridge) was drilled on Leg 13 of the Deep Sea Drilling Project. Another appears to have been drilled on Leg 14, when a hole into the top of a diapiric structure penetrated metamorphosed basalt. It is of interest to know whether other large seamounts are tectonic or, as convention has it, volcanoes that did not reach the surface. The distinction is an important one, since the information carried is distinctly different in each case. Tectonic seamounts convey information, not yet clearly interpreted, on past tectonic environments, probably including short-lived plate boundaries resulting from readjustment of plate movements after collisions or continental splitting. Volcanic seamounts, on the other hand, are bringing information about some sort of thermal anomaly in the mantle, a hot-spot or mantle plume or some related phenomenon.

Drilling into seamounts not only enables this important distinction to be made, but allows the age of formation of the seamount to be discovered by looking at the sedimentary record overlying basement. Such information can be found by dredging only in very fortunate circumstances, when a large number of dredge hauls are concentrated into one area.

Because this site was not scheduled on Leg 49, no background information was available on board. The map of Laughton et al. (1975) suggested no systematic survey of Cruiser-Irving (see Figure 1), nor indeed of any seamount within range of our track to Las Palmas.[2] We were not aware of any samples taken from these seamounts, except for limestones from Great Meteor and possibly Atlantis.

[1]Bruce P. Luyendyk (Co-Chief Scientist), University of California, Santa Barbara, Santa Barbara, California; Joe R. Cann (Co-Chief Scientist), University of East Anglia, Norwich, England; George Sharman, Scripps Institution of Oceanography, La Jolla, California; William P. Roberts, Madison College, Harrisonburg, Virginia; Alexander N. Shor, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts; Wendell A. Duffield, U.S. Geological Survey, Menlo Park, California; Jacques Varet, Dt. Géothermie, B.R.G.M., Orleans, France; Boris P. Zolotarev, Geological Institute of the USSR Academy of Sciences, Moscow, USSR; Richard Z. Poore, U.S. Geological Survey, Menlo Park, California; John C. Steinmetz, University of Miami, Miami, Florida; Angela M. Faller, Leeds University, Leeds, England; Kazuo Kobayashi, University of Tokyo, Nakano, Tokyo, Japan; Walter Vennum, California State College, Sonoma, Rohnert Park, California; David A. Wood, University of London, London, United Kingdom; and Maureen Steiner, University of Wyoming, Laramie, Wyoming.

[2]Final port changed to Funchal, Madeira after this site occupied and drilled.

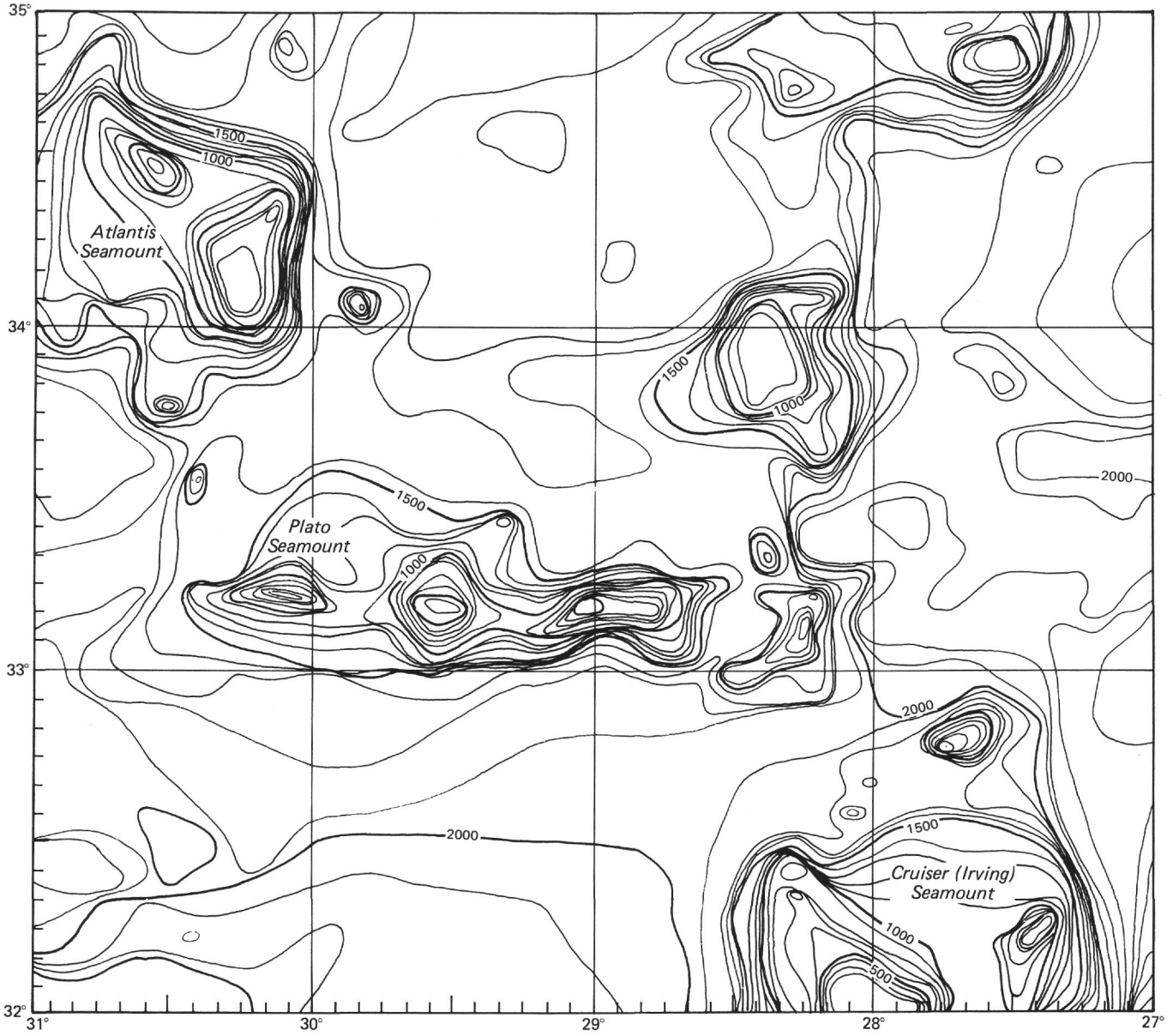

Figure 1. *Topography in the vicinity of Cruiser Seamount (in fathoms). From chart of the northeast Atlantic by Laughton et al. (1975).*

The morphology of Cruiser-Irving on the map of Laughton et al. (1975) indicated a broad pedestal on which two peaks are superimposed. It seemed likely that such a pedestal would be draped with enough appropriate sediment. Our plan was to cross onto the pedestal and there find a site for dropping the beacon.

OPERATIONS

Cruiser-Irving seamount was shown by our surveys taken before and after occupying the site to be a twin-peaked seamount, of which the eastern peak is called Cruiser and the western Irving in the Woods Hole Atlas of the Atlantic Ocean. We approached from the northwest on a course of 135°, heading for the saddle between the peaks. The track on our approach and departure is shown in Figure 2, and the corresponding seismic profiles appear in Figures 3, 4.

After a step up from the surrounding ocean floor onto the pedestal from which the peaks rise, the sedimentary sequence thickened rapidly to at least 800 ms two-way travel time, and continued at about this thickness as we moved over the pedestal ascent toward the saddle between the peaks. Such a thickness was too great for us to attempt drilling in the time available, so we turned east, to reach a ridge running south from the eastern peak, Cruiser. The west side of this ridge is a cliff, and, once over it, we came over a plateau with little sediment visible. Crossing this and a steep-sided peak perched on its center, we moved across the steep downward slope of the eastern side, looking for a sediment-covered ledge. None appeared, so we turned west again, on a course south of the previous one, over the plateau again, where now we got good penetration, reaching 150 ms, which suggested suitable sites for drilling.

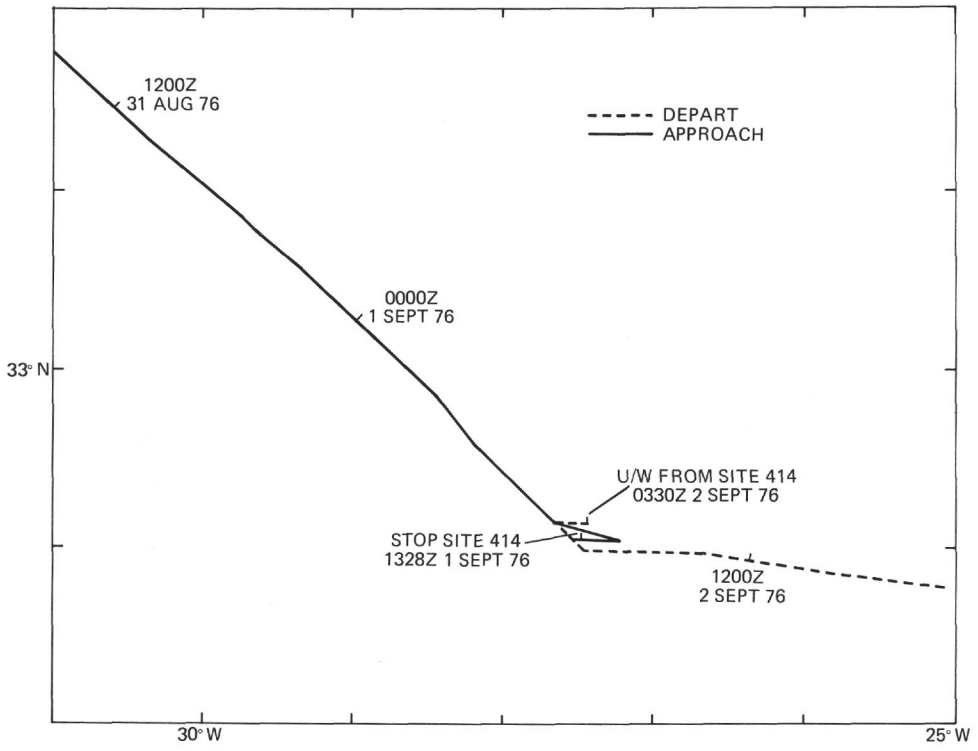

Figure 2. *Track chart of D/V* Glomar Challenger, *showing approach to and departure from Site 414.*

Encouraged by this, we turned back and dropped the beacon at 1328 on 1 September. The pipe was run, and spud-in attempted. But the surface was very hard. Repeated washing brought penetration of 6 meters, but at that point we encountered a harder layer and abandoned the attempt. It seemed to us that we might have unluckily hit a basement high, or that the sediment was indurated limestone. In case we had happened to strike a basement high, we offset 3000 feet to the east to try again, having pulled enough pipe to be sure of clearing any obstacles on the way. As we were running the pipe again, a fierce squall blew us off station, and suspended operations. During this time it became clear that Hurricane Emmy, having just come across the FAMOUS area, was going to pass close enough to us to cause conditions severe enough to stop us drilling by late in the night. Because the available time was short, it was clear that we would gain nothing by staying on the site and waiting for the weather to clear, so we pulled the string and were underway in worsening weather by 0600.

On our outward track, we ran west over the saddle between the peaks, and turned southeast to show that they were separated from one another, before running of the seamount toward the east. On this track we located a highly favorable spud-in site which should be noted for future reference.

REFERENCE

Laughton, A.S., Roberts, D.G., and Graves, R., 1975. Mid-Atlantic Ridge to Southwest Europe, sheet 3 of "Bathymetry of the Northeast Atlantic," Institute of Oceanographic Sciences.

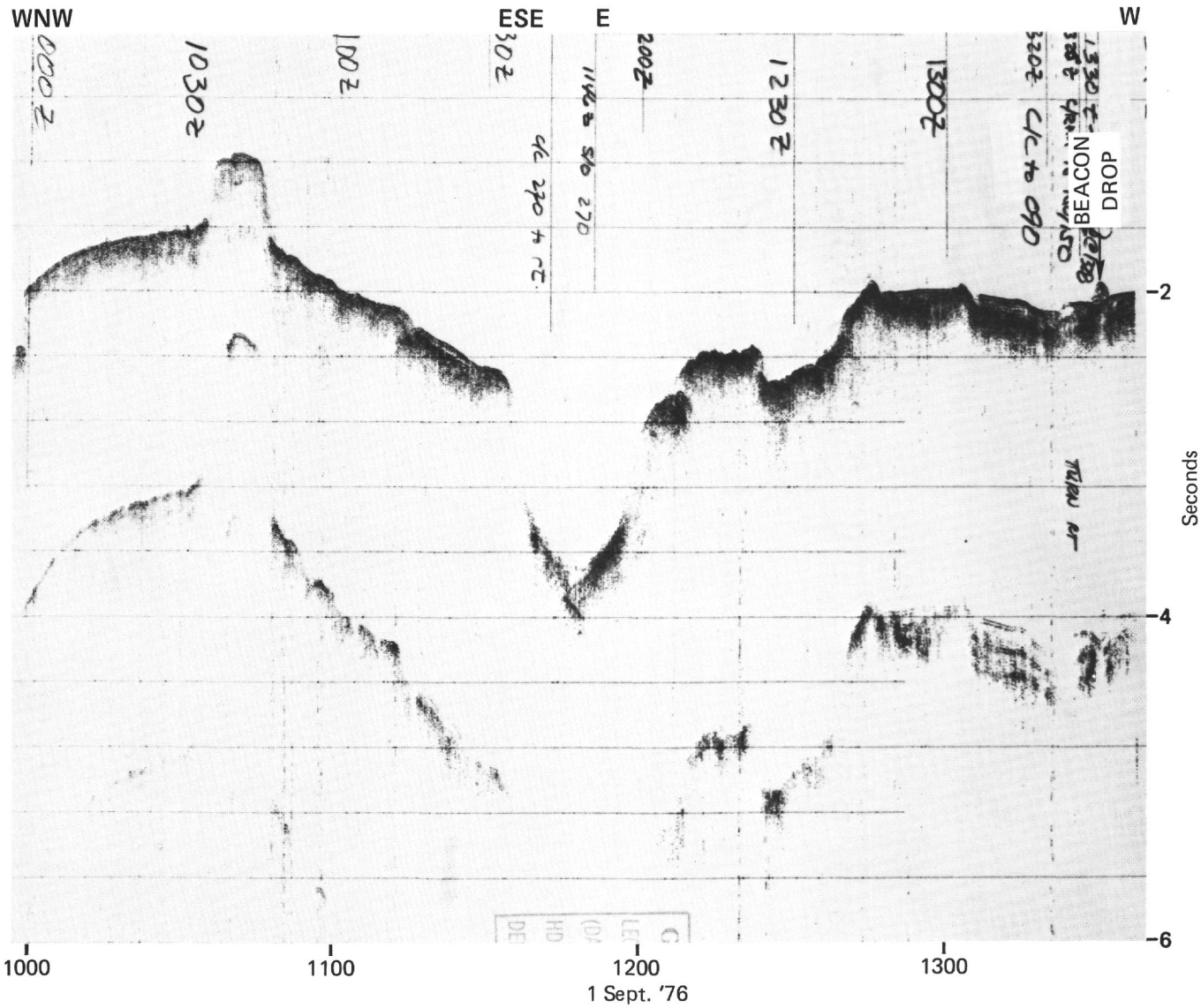

Figure 3. *Seismic profiles from* Glomar Challenger *showing approach to Site 414.*

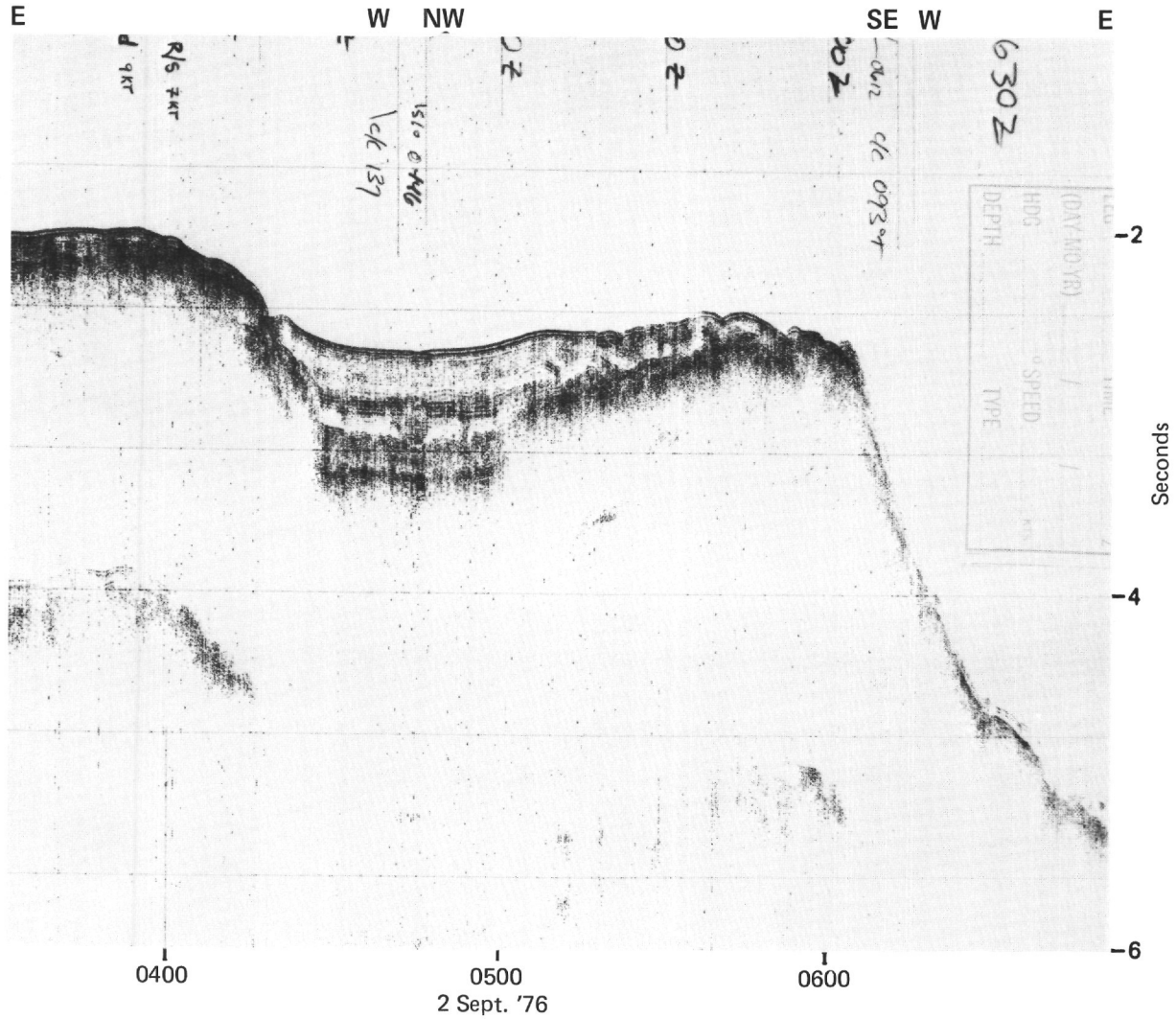

Figure 4. *Seismic profiles from* Glomar Challenger *showing departure from Site 414.*