

by harassment, of several species of marine mammals incidental to conducting a seismic survey program. As presently scheduled, two seismic surveys will be conducted in the Mid-Atlantic Ocean. The Trans-Atlantic Geotransect (TAG) cruise will be centered at 26°N and 45°W in the Mid-Atlantic Ocean during late October 2003, for a total of six days of seismic surveying. The Atlantic Deep Western Boundary Current (ADWBC) cruise will occur between 39° and 42°N and between 45° and 52.5°W, during July and August of 2004 for a total of approximately 20 days of surveying. These operations will take place in international waters.

The seismic survey work conducted during the TAG cruise is part of a multi-disciplinary experiment, taking place in the TAG Active Mound area over a period of nine months. The TAG active mound (26°N on the Mid-Atlantic Ridge), which is one of the largest hydrothermal deposits found to date on the seafloor, is a large, focused mineral deposit on a slow-spreading ridge. The purpose of the TAG cruise is to delineate the nature, position, and size of any heat sources (low-velocity zones) that might drive convection at the TAG active mound, and more generally, to provide an understanding of crustal architecture in the TAG region. More specifically, the TAG experiment will address key issues at the TAG site: (1) the nature of the heat source driving circulation, (2) the relationship between faulting on the eastern flank and fluid flow at the mound, (3) the possible existence of a low-velocity zone beneath the rise axis, and (4) the hydraulic connectivity of the shallow TAG mound.

The ADWBC cruise will determine the configuration, age, and paleoceanographic significance of the sedimentary sequences on J Anomaly Ridge and Southeast Newfoundland Ridge, which may show evidence for strong boundary currents dating to the early Paleocene. Proposed tracklines for the seismic survey were chosen with four primary objectives in mind: (1) to map the main reflection sequences across the full extent of the ridges and onto the edges of adjacent abyssal plains, (2) to obtain continuity in tracing sequences by profiling around major interruptions (seamounts) and optimizing track crossings, (3) to provide abundant crossing lines in areas where existing seismic and bathymetric data suggest that there are outcrops of pre-Neogene strata, and (4) to take advantage of good-quality seismic data, where they exist (e.g., Conrad 2510

MCS), in order to make loop correlations between tracks.

Description of the Activity

The TAG seismic survey will involve a single vessel which will conduct the seismic work, the *R/V Maurice Ewing*, operated by LDEO under a cooperative agreement with the U.S. National Science Foundation (NSF), owner of the vessel. The *Maurice Ewing* will deploy an array of 20 airguns as an energy source, and will deploy and retrieve Ocean Bottom Hydrophones (OBHs). A hydrophone streamer will not be towed during the TAG cruise. The energy to the airgun array is compressed air supplied by compressors on board the source vessel. As the airgun array is towed along the survey lines, the OBHs and Ocean Bottom Seismometers (OBSs) will receive the reflected signals and transfer the data to the onboard processing system. All planned geophysical data acquisition activities will be conducted by LDEO scientists with onboard assistance by the scientists who proposed the study. The TAG program will consist of 185 km (100 n.mi.) of survey lines. There will be a total of three seismic lines, two along- and one across-axis of the TAG. Water depths in the area will vary from 1500 to 4500 m (4921–14,764 ft).

The ADWBC cruise will involve the oceanographic research vessel *R/V Knorr*, a U.S. Navy-owned ship operated by the Woods Hole Oceanographic Institution (WHOI), and will use a portable LDEO seismic system to conduct the seismic survey. The vessel will deploy 2 General Injector (GI)-guns as an energy source plus a towed streamer containing hydrophones to receive the returning acoustic signals. The hydrophone array will consist of a 600-m (1969 ft) solid state streamer with a 200-m (656 ft) tow leader. The energy to the airgun array is compressed air supplied by compressors on board the source vessel. As the 2 GI-guns are towed along the survey line, the hydrophone array will receive the returning signals and transfer the data to the onboard processing system. All planned geophysical activities will be conducted by the scientists who have proposed the study, while LDEO will provide the portable high-resolution seismic system that will support the seismic surveys for the proposed study. The ADWBC program will consist of 4334 km (2340 n.mi.) of seismic profiles that will be shot over a period of 20 days. The most detailed grids of seismic lines are proposed for the southern end of J Anomaly Ridge and for moats around seamounts on the crest of the Southeast Newfoundland Ridge - both

are areas where there appear to be extensive pre-Neogene outcrops. Water depths in the area will vary from 4000 – 5000 m (13,124–16,405 ft).

The procedures to be used for the two seismic studies will be similar to those used during previous seismic surveys by LDEO, e.g., in the equatorial Pacific Ocean (Carbotte *et al.*, 1998, 2000). The proposed seismic surveys will use conventional seismic methodology with a towed airgun array as the energy source, and either a towed hydrophone streamer or OBH and OBS receivers placed on the bottom to receive the reflected signals. For the TAG survey, eighteen OBHs will be deployed (and recovered) by the *Maurice Ewing* - eight along each of the long axis lines and two on the across axis line. After the seismic lines are shot, the data will be downloaded and the OBSs will be retrieved during an, as of yet, unscheduled cruise in the summer of 2004 (during which no seismic sound sources will be used). Along three selected seismic lines, 13 OBS receivers will be placed in the proposed study area by the *R/V Alvin* from 7–24 June 2003, before the arrival of the *Maurice Ewing*. In addition, a multi-beam bathymetric sonar will be operated from the source vessel continuously throughout both cruises, and a lower-energy sub-bottom profiler will also be operated during most of both surveys. During the ADWBC study, coring of numerous sedimentary outcrops known to exist on the ridges will also take place. During both cruises, there will be additional operations associated with equipment testing, startup, line changes, and repeat coverage of any areas where initial data quality is sub-standard.

The *R/V Maurice Ewing* will be used as the source vessel during the TAG cruise, and the *R/V Knorr* will be used as the source vessel during the ADWBC cruise. Both vessels will tow airgun arrays along predetermined lines, and will also serve as platforms from which vessel-based marine mammal observers will watch for marine mammals before and during airgun operations.

During TAG-study airgun operations, the vessel will travel at 7.4–9.3 km/hr (4–5 knots), and seismic pulses will be emitted at intervals of 60–90 seconds (OBS lines during the TAG cruise). The 60–90 sec. spacing along OBS lines is to minimize reverberation from previous shot noise during OBS data acquisition, and the exact spacing will depend on water depth. The airgun array to be used will consist of 20 2000-psi Bolt airguns, towed at a depth of 7.5 m (24.5 ft). The 20-gun array will include airguns ranging in chamber volume from 80 to 850 in³, with a total volume of 8,575 in³.