Leg 205

Ocean Drilling Expedition Installs Two Long-term Observatories in the Seafloor off Costa Rica

November 2002 A team of scientists from seven nations has just finished a two-month expedition in the Pacific Ocean off Costa Rica where they installed long-term observatories deep into the Earth's crust. The instruments in the observatory will collect vital data over the next decade to better understand the processes that control and are associated with earthquakes and tsunamis in the region.

Co-chief scientist on the cruise, Julie Morris (Washington Univ., St. Louis, USA), explained the science behind the cruise: "The incoming plate subducting at the margin off Costa Rica and the processes affecting it as it sinks into the deep mantle of the earth may play a major role in the nature and extent of hazardous seismicity, as well as the magnitude of volcanism and the chemistry of lavas produced in the overlying volcanic arc of Central America. The fate of incoming sediments and ocean crust and of their associated fluids and gases has profound effects on the behavior of the zone, in which most of the world's destructive earthquakes and tsunamis are produced."

The cruise, therefore, had two primary objectives. The first was to determine the history of the uppermost part of the downgoing oceanic plate by drilling the deepest part of the trench, just before the plate is subducted. The second was sampling subsurface fluid flow along faults by installing long-term observatories in boreholes.

To accomplish these goals, the Ocean Drilling Program (ODP) drillship *JOIDES Resolution* left Victoria, Canada in early September and returned to shore in Panama in early November. Co-chiefs Morris and Heinrich Villinger (Univ. Bremen, Bremen, Germany) and staff scientist Adam Klaus (Texas A&M University, USA) led the shipboard scientific party on this venture, referred to as Leg 205.

Onboard, scientists cored sediments and basement and installed

long-term observatories, known as CORKs, at two sites: one in the trench and the other about 500 m away on the continental margin. The installation of observatories in deep boreholes in the ocean floor will help to better understand variations of processes in the subsurface of the ocean floor and also allow insight into the integral physical properties of the sediments and the oceanic crust.

The CORKs will sample fluids and gases and monitor temperature and pressure in the subsurface over a period of two years. A CORK consists of two parts: instruments installed in the sealed part of the borehole itself and a data logger sitting on the seafloor. These instruments consist of long-term fluid samplers, which have no moving parts, no electronics and therefore do not need any batteries – making them ideal for long-term sampling. At the seafloor of a CORK installation, a data logger collects pressure and temperature data. These data can be downloaded during a visit to the site with a manned submersible or a ROV (Remote Operated Vehicle) by hooking up a computer to the data logger via an underwater connector. In 1-2 years, scientists will return to Costa Rica to recover the recorded data and the fluid samplers.

Villinger explained the importance of the leg: "For the first time we successfully installed long-term monitoring fluid samplers together with pressure monitors in an area with a high level of seismicity."

He continued, "The installation of the two long-term observatories in an uncased borehole was a true success, which can only be envisioned if one keeps in mind that every instrument has to fit through a 5 inch inner diameter drillstring for deployment and has to survive a long, rough and more than 4 km long trip down the pipe. On top of that all instruments have to withstand the high ambient pressures in the borehole. "

In addition to installing the CORKs, scientists studied the cores recovered from drilling. Coring results in the trench off Costa Rica surprised the science party because instead of finding well-altered and quite porous oceanic crust, they drilled about 170 m of a fresh gabbroic unit – a very different type of rock than expected. Coring at the prism site revealed the pathways used

by fluids to escape partially from the subducted sediments. They mainly migrate along faults, planes where rock units move against each other and due to the movement, crush rock and create pathways for fluid and gas migration. The chemical analyses of the small quantities of pore water extracted from the rock by squeezing them under high pressure, reveals that they originate from depths of >4 km, as they contain components which require temperatures around 100 C.

ODP is an international partnership of scientists and research institutions organized to study the evolution and structure of the Earth. It is funded principally by the US National Science Foundation, with substantial contributions from its international partners. The Joint Oceanographic Institutions manages the program. Texas A & M University is responsible for science operations, and Lamont-Doherty Earth Observatory of Columbia University is responsible for logging services.

Photographs from Leg 205, including CORK installation, are available on the web at http://www-odp.tamu.edu/public/life/leg205.html.

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