

## Leg 203

### Ocean Drilling Creates "Telescope" to the Inner Earth: Seafloor Observatories

**May 2002** A new Ocean Drilling Program (ODP) project is building observatories equipped with instruments, including seismometers, deep below the seabed that will allow scientists to continuously monitor and record information and gain long-term understanding of geological hazards, such as tsunamis and major earthquakes.

These observatories fill an important void in scientific monitoring. On land, the Global Seismic Network (GSN) provides adequate earthquake monitoring capabilities for most continental regions and islands, but large areas of the ocean floor remain unmonitored until now. "The US Global Seismic Network and its international affiliate, the Federation of Digital Seismic Networks, operate nearly 200 seismic stations. However, even though nearly every island has a modern seismic observatory, enormous gaps in the coverage exist limiting scientific and operational coverage for seismic studies of sources and the deep interior of the Earth." said Co-Chief Scientist on the D/V *JOIDES Resolution* John Orcutt, Scripps Institution of Oceanography.

An ODP expedition on the research ship *JOIDES Resolution* (Leg 203) next month will drill a hole in the western equatorial Pacific that will serve as the location of a future observatory.

The observatory will contain several types of seismometers and other instrumentation that will connect to the Internet through a satellite communications telemetry link. The site is more than 1200 miles from another seismic observatory and will provide important information on earthquakes affecting Central and South America. Orcutt explained, "While South and Central America are well-equipped with seismic instrumentation and a GSN station exists on the Galapagos, large earthquakes common along the western boundaries can be studied and quantified only from one side the continents. This station and other future installations at sea will greatly enhance the coverage for these

particularly threatening earthquakes."

The expedition will be the second ODP cruise this year to create observatories deep below the seafloor in boreholes.

During ODP Leg 200 (December 2001-January 2002), also on the *JOIDES Resolution*, scientists and engineers successfully drilled a borehole at the Hawaii-2 Observatory, a permanent, continuously-operating seafloor observatory more than 16,000 feet below the surface of the water, about half-way between Hawaii and California. The observatory utilizes the Hawaii-2 submarine cable system, which is a retired AT&T transoceanic telephone cable that originally ran from San Luis Obispo, California to Makaha on Oahu, Hawaii. It was installed in 1999 by scientists from Incorporated Research Institutions for Seismology, the University of Hawaii, and Woods Hole Oceanographic Institution. The equipment on the seafloor allows power to be sent to instruments in the observatory and data to be retrieved from the seafloor in real-time and relayed to any laboratory in the world through the Internet.

Currently, sensors at the Hawaii-2 observatory sit on the seafloor. Leg 200 Co-Chief Scientist Ralph Stephen, Woods Hole Oceanographic Institution (USA), who led the expedition along with Co-Chief Junzo Kasahara, Earthquake Research Institute, University of Tokyo (Japan), remarked, "Scientists have known for many years that broadband seismic installations, the equipment used to detect vibrations from earthquakes and man-made explosions, give better quality results if the sensors are placed in boreholes, away from the noise generated by wind and ocean currents."

The Leg 200 expedition will enable a deep-sea observatory to be established in a borehole in the ocean crust. The borehole can be used for future seismic and other geophysical, geochemical and microbiological monitoring.

"The two ocean observatories provide scientists with an opportunity to measure many oceanographic variables in addition to the obvious seismic ones. For example, the depth of the ocean can be monitored with great accuracy to both record tsunamis which pass overhead, but have an expression on the

surface of only fractions of an inch, and quantify the rate of increase in sea level in a mid-ocean environment over the course of years and decades. Presently, such observations are made only near continents and islands where the measurements are biased by shallow water phenomena." said Orcutt.

The Ocean Drilling Program (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.

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