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BRIEFING: OCEAN DRILLING PROGRAM LEG 168

The scientific objective of Ocean Drilling Program Leg 168 was to explore the sediments, rock, and water deep within the ocean crust on the eastern flank of the Juan de Fuca Ridge, about 200 km off the coast of Oregon, Washington, and British Columbia.

A team of 23 scientists from eight countries returned today from a two-month expedition to study the flow of hot water within the seafloor, and their findings are surprising: **the water flowing within the crust in this region is much younger, and moving more quickly, than previously believed.**

Taking advantage of the tremendous lifting capacity of the drillship, **scientists installed massive sub-seafloor observatories within four deep holes.** These instruments will record pressures and temperatures, and collect fluid samples continuously, over the next three years. The first data will be collected in one year, using a remotely operated robotic vehicle, JASON. These data will provide more information about the forces that drive fluid flow deep within the crust, and about natural variations in this flow that may be linked to other geologic processes such as crustal motions and earthquakes.

Sea water percolates through cracks in the sea floor and reacts with the rocks of the oceanic crust, extracting heat and chemicals in a process called "hydrothermal circulation." This process is known to be particularly vigorous at seafloor spreading centers like the Juan de Fuca Ridge, where "black-smoker" vents spew water at temperatures as great at 400 deg C (750 deg F) into the cold ocean depths.

Scientists now believe that the most important means of extracting heat and chemicals from earth's interior occurs in older seafloor, many kilometers from spreading ridges. Water circulates over enormous distances within the crust, beneath the thick sediments that have filled the ocean basins over millions of years. Within these undersea aquifers, some chemicals are leached out of the ocean crust, while others are removed from sea water and deposited in the rocks. The mixture of rock + water + heat works much like a giant pressure cooker, deep within the Earth, and the waters that eventually emerge are chemically very different from sea water.

In some ways the seafloor hydrothermal cycle may be as important to the chemistry of the ocean as the flow of river water from the continents. Relatively little is known about the sub-seafloor hydrology because most of the ocean bottom is remote and difficult to sample. Scientists collected samples from beneath 600 m (1900 ft) of sediment and rock, in as much as 2500 m (8100 ft) of water.

Prior to ODP Leg 168, scientists estimated that the circulation of hydrothermal seawater through the seafloor was rapid enough so as to cycle a volume equivalent to the world's oceans in several million years. **The chemistry of water samples extracted from the deep sediments during this expedition, and of a sample of pristine "basement" water, collected for the first time in the history of ocean drilling during their leg, indicates that the cycling may take substantially less time than previously thought.** Additional shorebased studies will enable scientists to define the extent to which similar changes occur in other ocean basins, which may result in an accurate estimate of the importance of these processes on a global scale.

Measurements of fluid pressures during aquifer tests in volcanic rocks below the thick sediments indicate that the hydrothermal aquifer in the upper oceanic crust is present throughout the study area. One hole turned into a hot spring after drilling, indicating that the fluids in the crust at the site are pressurized.

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