Unmanned submersible sheds light on an undersea volcano

December 6 2005

Rock samples collected last year show surprising variation in the chemistry of an undersea volcano on the Juan de Fuca Ridge near Seattle. The variation comes from the mantle, the source of the magma that erupted from the volcano to form the rocks, and may influence the microbial communities that now inhabit the volcano, said James Gill, professor of Earth sciences at the University of California, Santa Cruz.

"By terrestrial standards this is a piddly little volcano, but we're finding more chemical variation per unit area than has been found before in a seafloor volcano," Gill said.

Gill will present his group's findings this week at the Fall Meeting of the American Geophysical Union in San Francisco (session T31A, poster #483, on Wednesday, December 7, at 8 a.m.).

A remote-controlled submersible called Tiburon collected the rock samples that Gill and others are using to study the volcano. The submersible, owned by the Monterey Bay Aquarium Research Institute (MBARI), is connected to the research ship Western Flyer by a fiber-optic cable and controlled by a joystick while it dives to depths of more than 2,000 meters. The ability to collect fragile samples, to know their location within meters, and to see their geological context was essential to the mission, Gill said.

"The submersible allows us to pinpoint the location of samples and document surrounding rock formations in a way that's impossible with

manned submersibles," he said.

In addition to rock samples, Tiburon also collected hours of high-definition video footage from the ridge site, allowing scientists to view the undersea environment in exquisite detail while sitting safely on the surface. The video footage shows bulging lava formations called pillow basalt and towering mineral chimneys that grow around undersea hydrothermal vents. The vents provide heat and minerals that support an entire food chain of strange undersea creatures.

The global mid-ocean ridge system is the largest single volcanic feature on Earth and is responsible for the continual renewal of the Earth's crust. Scientists know that the mantle rises and melts in ridge areas, forming magma that ultimately forms new oceanic crust. But exactly where the magma comes from and how it forms the crust remain unclear.

Gill and his co-workers, including UCSC graduate students Jenni Kela and Jason Woodcock, hope that the rock samples collected by Tiburon will help them answer these questions. Preliminary analysis of the more than 250 rock samples collected by Tiburon shows some surprising results.

"The volcano looks symmetrical, but we're finding that the basalt rock on the east flank of the volcano cannot have formed from the same magma as the rock on the west flank," Gill said.

The two sides of the volcano probably formed at different times when the underlying magma had different characteristics, he said. Further analysis will help researchers determine when the rocks formed to draw a clearer picture of how the volcano has acted in the past.

"We hope to use the chemistry of the rocks and the chronology of when they formed to develop a geologic model of volcano activity," Gill said.

"This may help us understand why the mantle delivers so much chemical diversity here, but not in other volcanoes."

The researchers speculate that the volcano's chemical diversity contributes to the differences in their active hydrothermal vents, and that these differences extend to the biological systems the vents support. This research was conducted as part of a project sponsored by the National Science Foundation that focuses on the geology and biology of oceanic ridge spreading systems. The project, called Ridge 2000, includes scientists from a wide range of disciplines who study everything "from mantle to microbes" to understand how the interior of the Earth ultimately affects life in this novel environment, Gill said.

Source: University of California, Santa Cruz