Scientists discover new eruption at undersea volcano, after successfully forecasting the event

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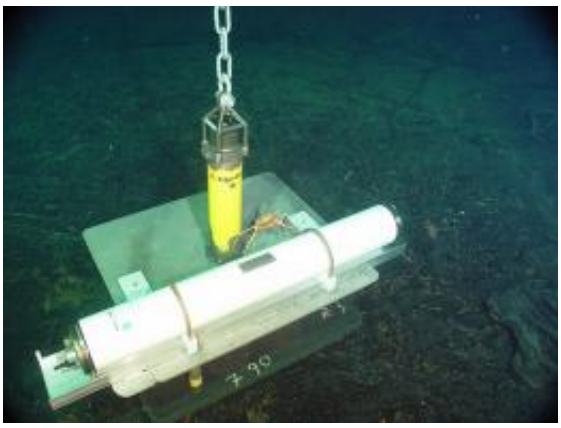

photo credit: Bill Chadwick, Oregon State University

A team of scientists just discovered a new eruption of Axial Seamount, an undersea volcano located about 250 miles off the Oregon coast – and one of the most active and intensely studied seamounts in the world.

What makes the event so intriguing is that the scientists had forecast the eruption starting five years ago – the first successful forecast of an undersea volcano.

Bill Chadwick, an Oregon State University geologist, and Scott Nooner, of Columbia University, have been monitoring Axial Seamount for more

than a decade, and in 2006 published a paper in the *Journal of Volcanology and Geothermal Research* in which they forecast that Axial would erupt before the year 2014. Their forecast was based on a series of seafloor pressure measurements that indicated the volcano was inflating.

"Volcanoes are notoriously difficult to forecast and much less is known about undersea volcanoes than those on land, so the ability to monitor Axial Seamount, and determine that it was on a path toward an impending eruption is pretty exciting," said Chadwick, who was chief scientist on the recent expedition, which was jointly funded by the National Oceanic and Atmospheric Administration and the National Science Foundation.

photo credit: Bill Chadwick, Oregon State University

Axial last erupted in 1998 and Chadwick, Nooner and colleagues have monitored it ever since. They used precise bottom pressure sensors – the

same instruments used to detect tsunamis in the deep ocean – to measure vertical movements of the floor of the caldera much like scientists would use GPS on land to measure movements of the ground. They discovered that the volcano was gradually inflating at the rate of 15 centimeters (six inches) a year, indicating that magma was rising and accumulating under the volcano summit.

When Axial erupted in 1998, the floor of the caldera suddenly subsided or deflated by 3.2 meters (10.5 feet) as magma was removed from underground to erupt at the surface. The scientists estimated that the volcano would be ready to erupt again when re-inflation pushed the caldera floor back up to its 1998 level.

"Forecasting the eruption of most land volcanoes is normally very difficult at best and the behavior of most is complex and variable," said Nooner, who is affiliated with the Lamont-Doherty Earth Observatory. "We now have evidence, however, that Axial Seamount behaves in a more predictable way than many other volcanoes – likely due to its robust magma supply coupled with its thin crust, and its location on a mid-ocean ridge spreading center.

"It is now the only volcano on the seafloor whose surface deformation has been continuously monitored throughout an entire eruption cycle," Nooner added.

The discovery of the new eruption came on July 28, when Chadwick, Nooner and University of Washington colleagues Dave Butterfield and Marvin Lilley led an expedition to Axial aboard the R/V Atlantis, operated by the Woods Hole Oceanographic Institution. Using Jason, a remotely operated robotic vehicle (ROV), they discovered a new lava flow on the seafloor that was not present a year ago.

"It's funny," Chadwick said. "When we first arrived on the seafloor, we

thought we were in the wrong place because it looked so completely different. We couldn't find our markers or monitoring instruments or other distinctive features on the bottom. Once we figured out that an eruption had happened, we were pretty excited.

"When eruptions like this occur, a huge amount of heat comes out of the seafloor, the chemistry of seafloor hot springs is changed, and pre-existing vent biological communities are destroyed and new ones form," Chadwick added. "Some species are only found right after eruptions, so it is a unique opportunity to study them."

The first Jason ROV dive of the expedition targeted a field of "black smoker" hot springs on the western side of the caldera, beyond the reach of the new lava flows. Butterfield has been tracking the chemistry and microbiology of hot springs around the caldera since the 1998 eruption.

"The hot springs on the west side did not appear to be significantly disturbed, but the seawater within the caldera was much murkier than usual," Butterfield said, "and that meant something unusual was happening. When we saw the 'Snowblower' vents blasting out huge volumes of white floc and cloudy water on the next ROV dive, it was clear that the after-effects of the eruption were still going strong. This increased output seems to be associated with cooling of the lava flows and may last for a few months or up to a year."

The scientists will examine the chemistry of the vent water and work with Julie Huber of the Marine Biological Laboratory to analyze DNA and RNA of the microbes in the samples.

The scientists recovered seafloor instruments, including two bottom pressure recorders and two ocean-bottom hydrophones, which showed that the eruption took place on April 6 of this year. A third hydrophone was found buried in the new lava flows.

"So far, it is hard to tell the full scope of the eruption because we discovered it near the end of the expedition," said Chadwick, who works out of OSU's Hatfield Marine Science Center in Newport. "But it looks like it might be at least three times bigger than the 1998 eruption."

The lava flow from the 2011 eruptions was at least two kilometers (1.2 miles) wide, the scientists noted.

"Five years ago, these scientists forecast this eruption, which has resulted in millions of square meters of new lava flows on the seafloor," said Barbara Ransom, program director in the National Science Foundation's Division of Ocean Sciences. "The technological advances that allow this research to happen will lead to a new understanding of submarine volcanoes, and of any related hazards."

The bottom-anchored instruments documented hundreds of tiny earthquakes during the volcanic eruption, but land-based seismic monitors and the Sound Surveillance System (SOSUS) hydrophone array operated by the U.S. Navy only detected a handful of them on the day of the eruption because many components of the hydrophone system are offline.

"Because the earthquakes detected back in April at a distance from the volcano were so few and relatively small, we did not believe there was an eruption," said Bob Dziak, an OSU marine geologist who monitors the SOSUS array. "That is why discovering the eruption at sea last week was such a surprise." Both Dziak and Chadwick are affiliated with the Cooperative Institute for Marine Resource Studies – a joint NOAA/Oregon State University institute.

This latest Axial eruption caused the caldera floor to subside by more than two meters (six feet). The scientists will be measuring the rate of magma inflation over the next few years to see if they can successfully

forecast the next event.

"The acid test in science – whether or not you understand a process in nature – is to try to predict what will happen based on your observations," Chadwick said. "We have done this and it is extremely satisfying that we were successful. Now we can build on that knowledge and look to apply it to other undersea volcanoes – and perhaps even volcanoes on land."

Provided by Oregon State University