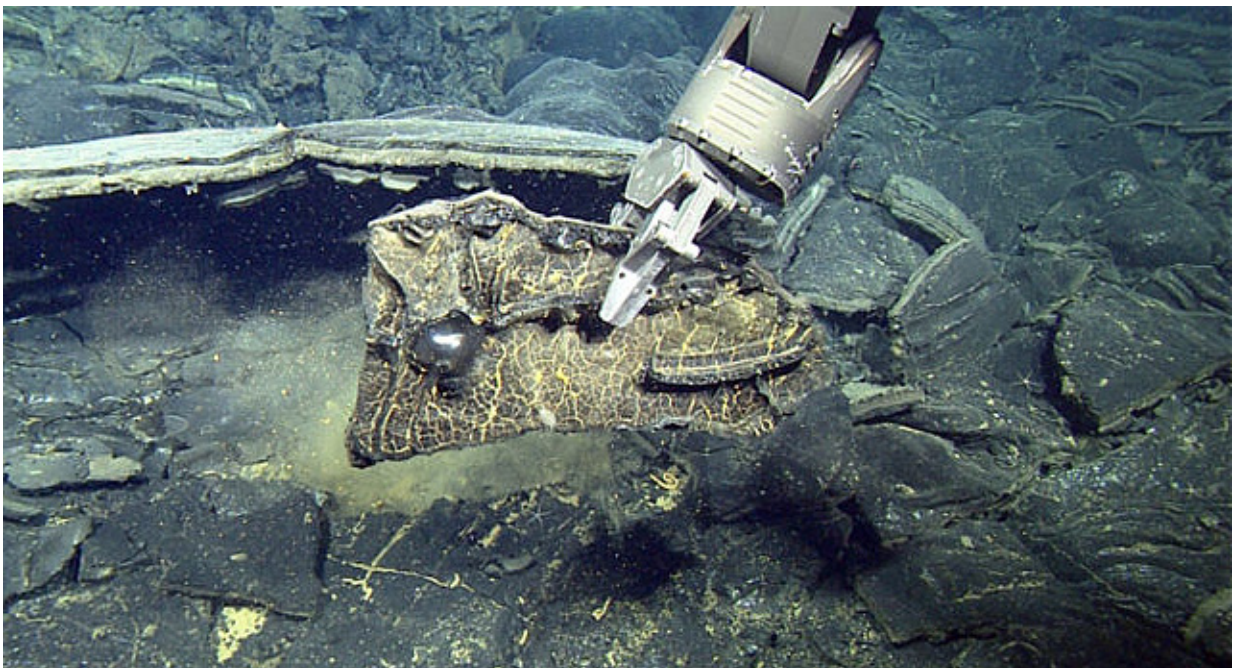


# MBARI's seafloor maps provide new information about 2015 eruption at Axial Seamount

December 15 2016

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Collecting a fragment of lava from the 2015 eruption of Axial Seamount. Credit: MBARI

Axial Seamount, a large underwater volcano about 470 kilometers (290 miles) offshore of the Oregon coast, is one of the most active volcanoes in the world-and one of the most intensively studied. Three research papers, to be published this week, describe a large eruption on Axial

Seamount that occurred in April 2015.

At the 2016 meeting of the American Geophysical Union (AGU), researchers from the Monterey Bay Aquarium Research Institute (MBARI) will be presenting a new seafloor map that complements these research papers, showing the results of detailed underwater surveys conducted in August 2016, after the papers were written. This map reveals a number of previously undocumented flows from the 2015 eruption.

By comparing the new map with survey data before the 2015 eruption, researchers were able to precisely estimate the volume of lava emitted during the 2015 eruption. The new data indicate that the eruption consisted of 14 separate lava flows containing almost 156 million cubic meters of lava.

The new map also allowed geologists to locate precisely where the lava was disgorged from the seafloor. During the 2015 eruption, a series of "eruptive fissures" extended from the north end of the Axial crater (caldera) and far up the north rift zone—a total distance of 19 kilometers.

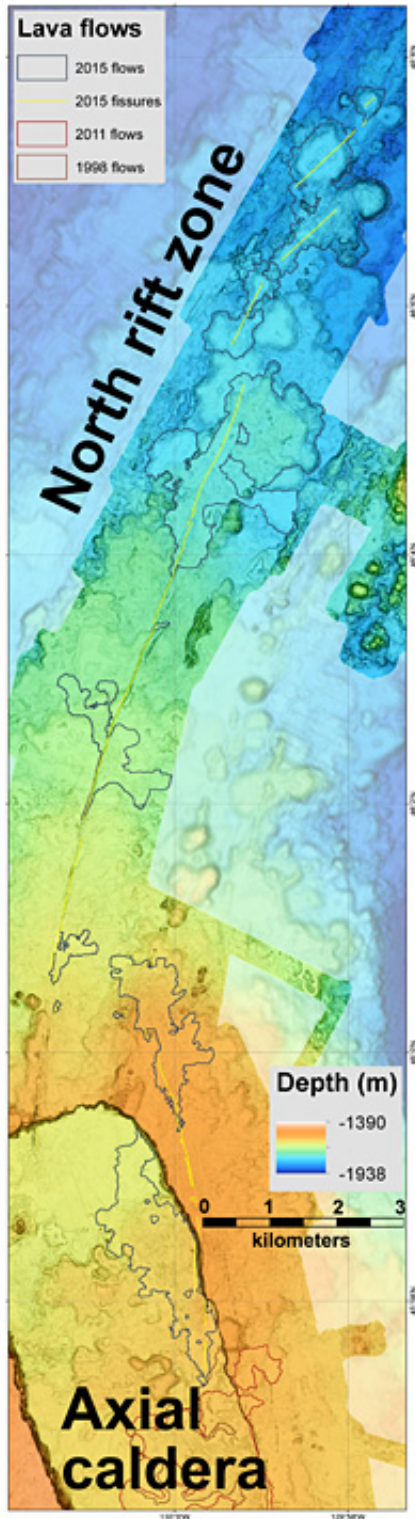
The new map doesn't just show the lava that erupted during 2015. It covers the entire Axial caldera, as well as the north and south rift zones. Thus it will serve as a useful benchmark for geologists the next time the volcano erupts.

Since 2006, MBARI researchers have been mapping the seafloor at Axial using sonar systems mounted on autonomous underwater vehicles (AUVs). For this map, researchers combined data from MBARI's seafloor mapping AUVs with data from Sentry, an AUV operated by Woods Hole Oceanographic Institution. Because these AUVs fly just 50 to 75 meters above the seafloor, they reveal details such as thin lava

flows that are invisible to sonar from surface ships.

Seafloor pressure recorders such as those deployed on the Ocean Observatories Initiative (OOI) Cabled Array at Axial Seamount can record very small changes in seafloor depth (deformation). But they only provide point measurements. To show deformation over a larger area, MBARI researchers ran identical sets of AUV survey lines across the entire Axial caldera in 2011, 2014, 2015, and 2016.

These repeated surveys showed that the center of the caldera bulged up as much 1.8 meters between 2011 and 2014 (after the 2011 eruption), then subsided more than one meter between 2014 and 2015 (during the 2015 eruption). Between 2015 and 2016, the caldera floor uplifted about one half of a meter, which suggests that that magma is building up below the caldera in advance of the next eruption



Part of the new map of Axial Seamount produced by MBARI researchers. Black outlines show lava flows from 2015 eruption. Image (c) 2016 MBARI Credit: (c) 2016 MBARI

In addition to running AUV surveys, over the past 10 years MBARI researchers have conducted about 40 dives on Axial Seamount using remotely operated vehicles (ROVs). Their latest dives, in 2016, revealed fascinating details about the 2015 flow. For example, on one fresh lava flow, the researchers discovered a field of tiny (30- to 50-centimeter-tall) hydrothermal chimneys, complete with tubeworms and other vent animals.

The 2016 ROV dives also revealed hundreds of lava "pillows" that exploded during the 2015 eruption, in parts of the new flows not explored in 2015 during ROV Jason dives. Tens of thousands of gunshot-like sounds were documented by seafloor seismometers on the OOI Cabled Array, as described in one of the research papers published in *Science* this week. Geologists suspect that these sounds were produced when seawater became trapped beneath fingers of hot lava, suddenly turned to steam, and exploded.

Much larger explosions apparently occurred earlier in the history of Axial Seamount, according to research conducted by former MBARI postdoctoral fellow Ryan Portner. These explosions scattered huge volumes of pulverized [lava](#) over wide areas of seafloor. Portner analyzed layers of fine-grained sediment that collected on the rims of the summit caldera, and used the shells of foraminifera (tiny marine animals) to determine how long ago these sediment layers were deposited. His research suggests the main caldera at Axial Seamount formed between 700 and 1,200 years ago, answering a question that has been perplexing geologists since they started studying Axial Seamount in the early 1980s.

Geologists know that Axial Volcano erupted in 1998, 2011, and 2015, and dozens of times in the preceeding 350 years. Thus it is likely that the next [eruption](#) will occur some time within the next decade. When that



happens, MBARI's newly created bathymetric map will provide essential information for geologists trying to figure out the extent and volume of the latest flow from this amazingly active underwater volcano.

**More information:** S. L. Nooner et al. Inflation-predictable behavior and co-eruption deformation at Axial Seamount, *Science* (2016). [DOI: 10.1126/science.aah4666](https://doi.org/10.1126/science.aah4666)

W. S. D. Wilcock et al. Seismic constraints on caldera dynamics from the 2015 Axial Seamount eruption, *Science* (2016). [DOI: 10.1126/science.aah5563](https://doi.org/10.1126/science.aah5563)

Provided by Monterey Bay Aquarium Research Institute

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