SPOTLIGHT 1 | Axial Seamount

45°57.00'N, 130°00.00'W

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Axial Seamount is a hotspot volcano superimposed on the Juan de Fuca Ridge (JdFR) in the Northeast Pacific Ocean. Due to its robust magma supply, it rises ~ 800 m above the rest of JdFR and has a large elongate summit caldera with two rift zones that parallel and overlap with adjacent segments of the spreading center (Figure 1). Submersible dives at Axial in 1983–1984 discovered the first active black smoker vents in the Northeast Pacific (Chase et al., 1985). The New Millennium Observatory (NeMO; http://www.pmel.noaa.gov/vents/nemo/) was established at Axial in 1996 to study volcanic events and the perturbations they cause to hydrothermal and biological systems. As if on cue, Axial erupted in January 1998 and was the first seafloor eruption detected remotely and monitored by in situ instruments (Embley et al., 1999). In fact, one instrument caught in a 1998 lava flow was later recovered with data intact, providing new insight into the emplacement of submarine lavas (Chadwick, 2003). Initially, research focused on mapping, sampling, and documenting the impact of the eruption on the hydrothermal vents and biological communities (Figure 2). The emphasis has gradually shifted to long-term geophysical, geochemical, and biological monitoring of the volcano in anticipation of its next eruption.

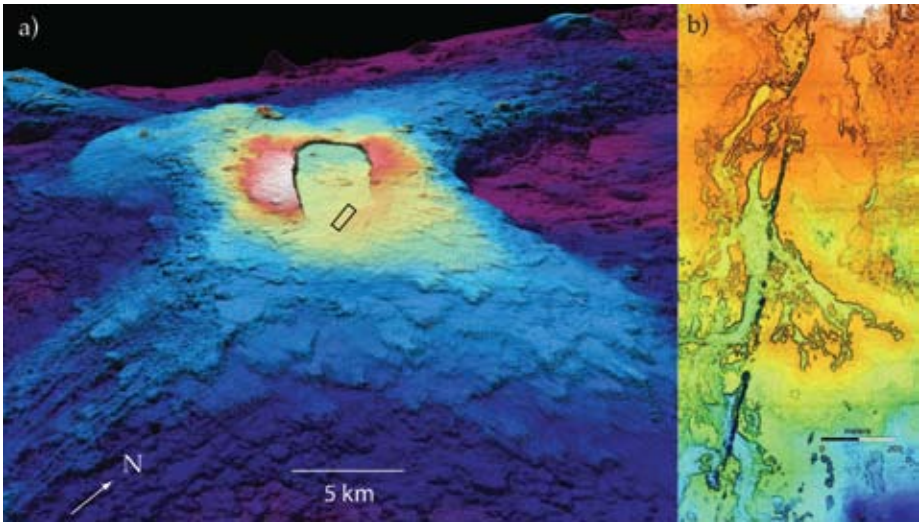

Figure 1. (a) Oblique three-dimensional view of Axial Seamount, looking NNW, showing its summit caldera (8 km x 3 km wide and up to 100-m deep). Black box shows location of Figure 1b. (b) High-resolution bathymetry (1-m grid) acquired by Monterey Bay Aquarium Research Institute autonomous underwater vehicle *D. Allan B.* reveals an eruptive fissure and sinuous lava flow channels on the caldera floor and upper south rift zone.

Biological colonization and succession have been observed at vents on the new lava flows (Marcus et al., 2009), and the diversity and changing populations of the subseafloor microbial biosphere have been studied in concert with the chemical evolution of vent fluid compositions (Butterfield et al., 2004; Huber et al., 2007). Geophysical studies at Axial have included active-source seismic experiments and multichannel seismic surveys, both revealing a large shallow reservoir of magma beneath the summit caldera, as well as long-term monitoring with US Navy hydrophone arrays (SOSUS) and deployments of ocean-bottom seismometers and hydrophones. A time series of precise pressure measurements make Axial the only site in the world where volcanic inflation is being monitored on the seafloor, constraining estimates of the magma supply rate and providing the basis for a forecast of the next eruption by 2020 (Nooner and Chadwick, 2009). Recent mapping of Axial caldera by the Monterey Bay Aquarium Research Institute autonomous underwater vehicle *D. Allan B.* produced new bathymetry with stunning resolution (1-m grids), illuminating lava flow morphology and

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Axial's recent geologic history. Axial has been chosen as one of the nodes on the Ocean Observatory Initiative's (http://www.ooi.washington.edu/) regional cabled observatory in the Northeast Pacific, and so will continue to be a focus for creative multidisciplinary research in the dynamic setting of a volcanically active seamount.

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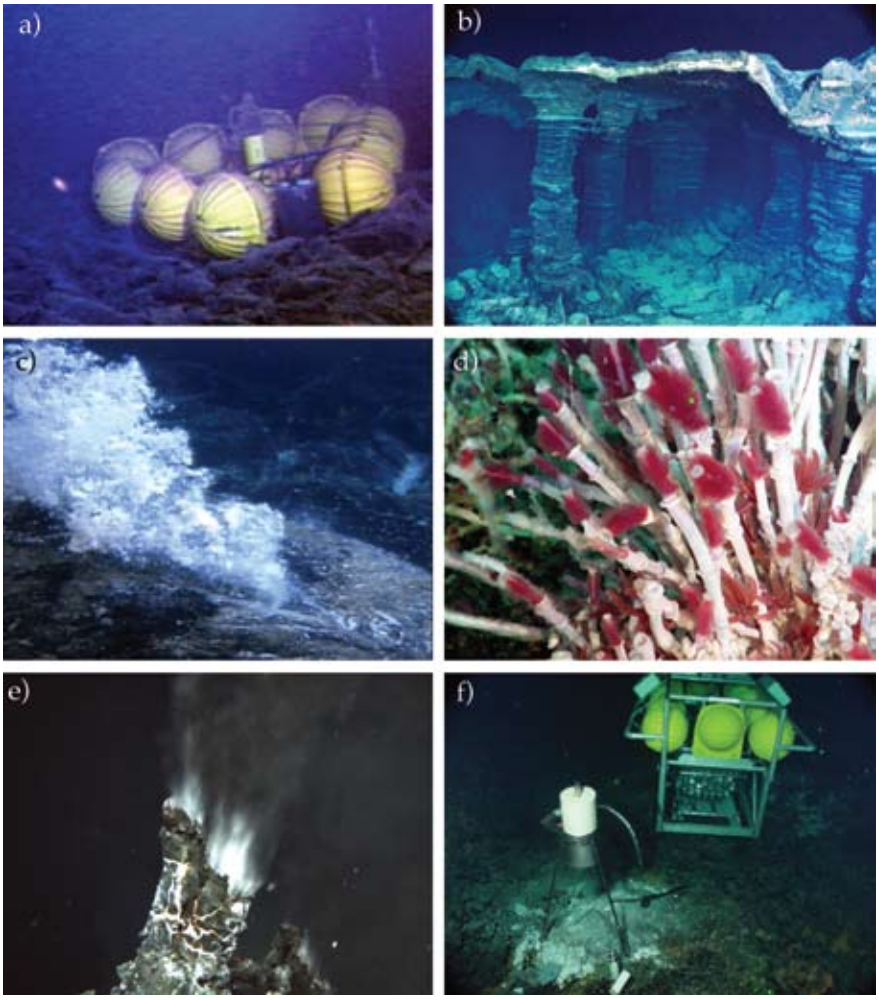

Figure 2. Views of 1998 lava flow at Axial Seamount: (a) instrument caught in lava, (b) lava pillars, (c) snowblower vent expelling microbial floc, (d) hydrothermal vent recolonized with tubeworms (*Ridgeia piscesae*). High-temperature vents: (e) El Guapo sulfide chimney venting at the boiling point, and (f) long-term water sampler at Virgin anhydrite chimney in the vent field known as ASHES (for Axial Seamount Hydrothermal Emissions Study).

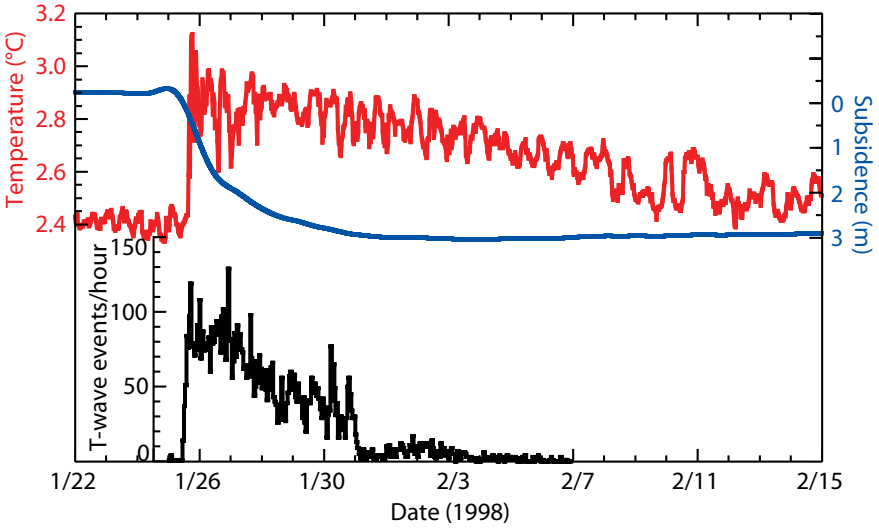

Figure 3. Covariation of seafloor monitoring data recorded during the 1998 eruption at Axial Seamount. Histogram of detected earthquakes per hour (black), subsidence of the caldera measured by a pressure gauge (blue), and temperature measured by a sensor moored above the bottom near the eruption site (Baker et al., 1999; Dziak and Fox, 1999; Fox, 1999).