SPOTLIGHT 10 | Northwest Rota-1 Seamount

14°36.048'N, 144°46.519'E

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Northwest Rota-1 Seamount is the first place on Earth where a submarine volcanic eruption was witnessed in 2004, and, remarkably, it appears that the volcano has been erupting continuously ever since. NW Rota-1 is located ~ 100 km north of Guam in the western Pacific, within the newly designated Mariana Trench Marine National Monument (http://www.fws.gov/marianastrenchmarinemonument/). With a summit depth of 520 m, it is a symmetrical cone of basaltic andesite composition (Figure 1) formed in the subduction zone setting of the Mariana volcanic arc. It was identified as a site of particular interest in 2003 when sampling of its overlying hydrothermal plume showed very high magmatic volatile input (Resing et al., 2007). Consequently, it was one of several seamounts targeted for dives with a remotely operated vehicle the following year. During these dives, an actively erupting vent was discovered at a depth of 550 m; lava, fluid, and gas samples were collected; and colonies of shrimp, limpets, and crabs (some of them new species) were found living in the volcano summit's harsh conditions (Embley et al., 2006; Limén et al., 2006).

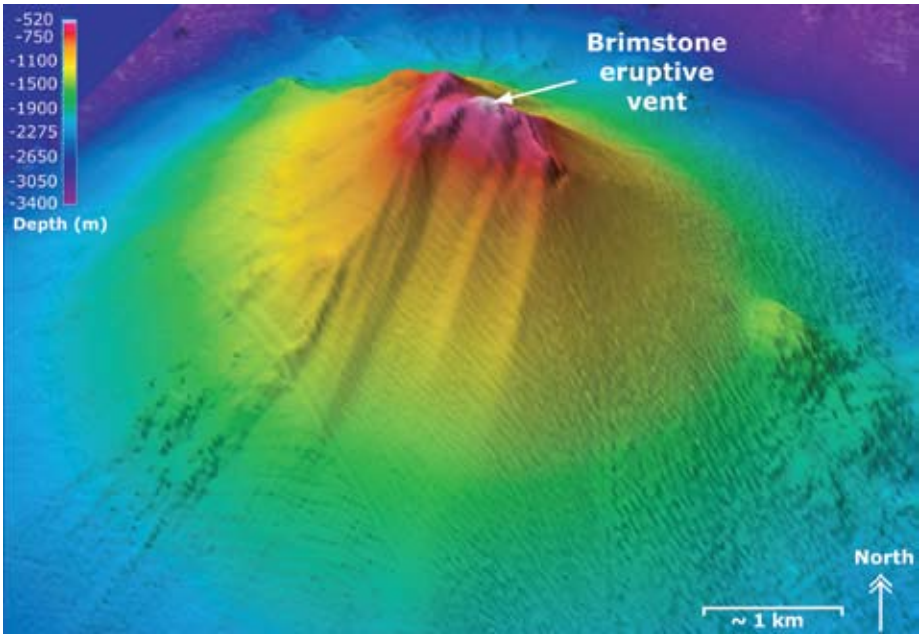

Figure 1. Oblique three-dimensional view of NW Rota-1 Seamount, looking to the north. The active eruptive vent is located just south of the summit, and despite ashfall and acidic conditions, a chemosynthetic biological community is thriving at diffuse hydrothermal vents along the summit ridge.

Subsequent expeditions visited the site in 2005, 2006, 2008, and 2009 and found the volcano erupting on every visit. The activity has varied from slow lava extrusion to vigorous explosive bursts (Figure 2) driven primarily by magmatic degassing (Butterfield et al., 2009). Acoustic recordings (Figure 3) show that the activity occurs as cyclic bursts every few minutes, separated by shorter pauses (Chadwick et al., 2008). In addition, morphologic changes have been documented from year to year and water column surveys have found turbid plumes full of volcanic glass shards around the lower flanks of the volcano, apparently caused by land-sliding, eruption-fed gravity flows, or both (Walker et al., 2008). These observations suggest that long-term activity is characterized by the buildup and collapse of a cinder cone at the vent.

The chemosynthetic biological

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community at NW Rota-1 has responded to the volcano's ongoing activity with significant population increases and recruitment of new species. Monitoring data from a hydrophone and eruption-plume sensor moored at the site during 2008–2009 show that the volcano was continuously active during the entire year, though with varying character and intensity. This continuous activity is unusual, even for volcanoes on land, and makes NW Rota-1 an outstanding natural laboratory for the study of submarine eruption processes.

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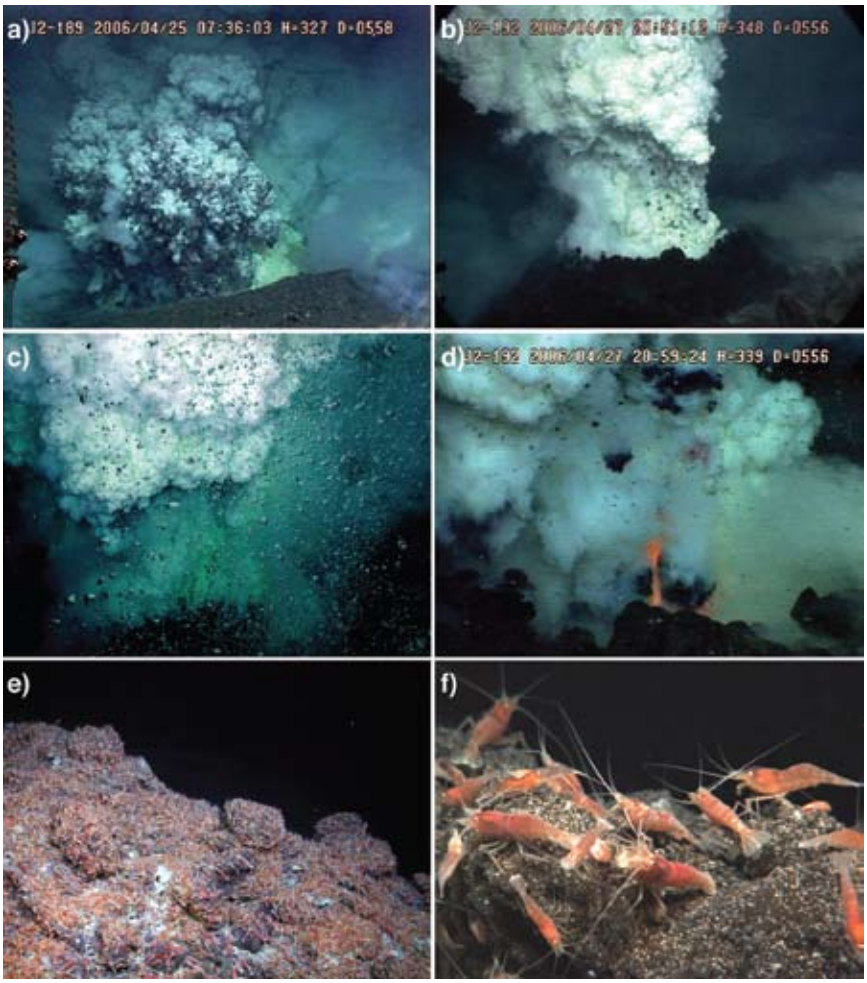

Figure 2. Images of eruptive activity at NW Rota-1 Volcano, including: (a) ash and bombs thrown out of the vent during an explosive burst, (b) a billowing sulfur-rich particle plume, (c) clear CO_2 bubbles rising from the vent, and (d) red glow from hot lava. (e–f) Dense communities of shrimp and limpets live nearby.

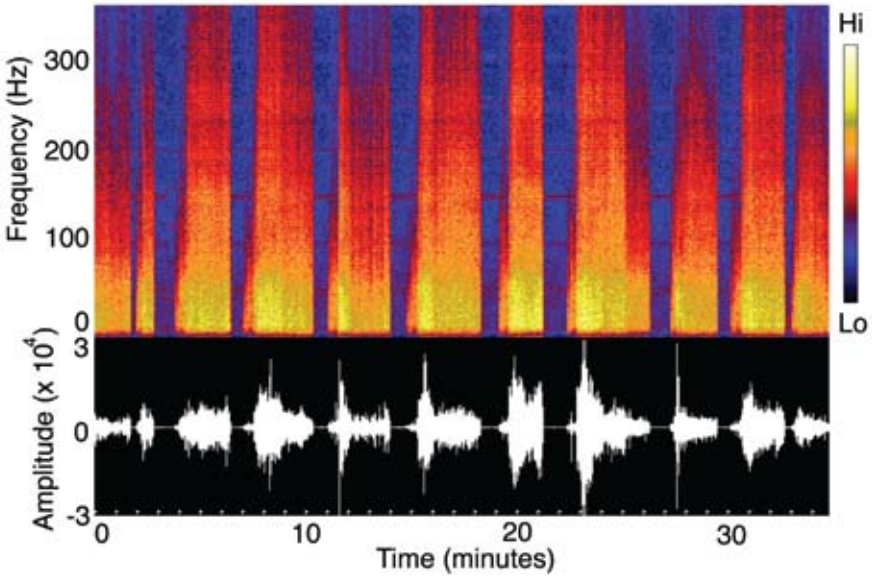

Figure 3. Hydrophone data collected from NW Rota-1 in 2006, showing cyclic explosive bursts every two to five minutes separated by shorter quiet intervals (Chadwick et al., 2008). (Bottom) Time series of acoustic amplitude over 35 minutes. (Top) A spectrogram of the sound showing the bursts are broadband with the highest amplitudes at low frequencies.