Seismic Imaging of the Uppermost Magmatic System and Strombolian Eruptive Variability Associated with Conduit Changes at Erebus Volcano, Antarctica

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Mount Erebus is a large polygenic volcano that forms the summit of Ross Island, Antarctica. The volcano has hosted a persistent convecting phonolite lava lake for over 40 years, which hosts small (VEI 0-1) Strombolian eruptions. Analysis of sparse (10-station) long-term and dense (> 100-station) short-term deployments of seismographs in the summit region during the past 12 years have yielded new observations of the Strombolian eruptive process and images of the sub-lava lake plumbing system. Complementary coda interferometric and tomographic seismic methods, using seismic illumination arising from both lava lake explosions and artificial sources, have been integrated into new images of the upper structure. These images show that the principal storage region of magma in the uppermost few hundred meters of the volcano is offset by several hundred m from the lava lake, and more towards the geometric center of the uppermost volcano. Detailed analysis of eruptive seismograms from near-repeating lava lake eruptions show systematic days-to-weeks long variations in the delay between short-period explosion and conduit system-associated very-long-period signal components that indicate variable response/communication times between the surface and the deeper conduit system. We suggest that this variation arises from changes in the uppermost conduit system geometry that affect elastodynamic communication within the system, and that these changes may be observable with seismic coda interferometric imagery. This work further suggests that background images obtained from dense temporary seismographic experiments can subsequently be leveraged for longer-term monitoring for temporal changes made at a smaller number of long-term stations.