Oomurodashi volcano: Past effusive and phreatomagmatic activity revealed by submarine and subaerial deposits

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Oomurodashi is a recently discovered active, shallow (~140 mbsl), silicic submarine volcano in the northern Izu-Bonin arc, only 60 km from the entrance to Tokyo Bay. Past activity at Oomurodashi spans a wide range of eruption styles and includes small lava effusions, submarine pumice, and subaerial tephra deposits on nearby Izu-Oshima and Toshima islands. Here we present volatile and textural data that reveal contrasting degassing, quench and fragmentation processes occurring in the shallow conduit and overlying water column.

H_2O data for pumiceous pyroclasts and lavas were obtained using new Fourier Transform Infrared spectroscopy (FTIR) analytical techniques for vesicular and hydrated glasses. Although the Oomurodashi glasses are extensively hydrated, the interconversion of H_2O species (i.e. molecular water, H_2O_m, and hydroxyl groups, OH) stops at the glass transition temperature, and low temperature hydration occurs via diffusive addition of H_2O_m only, leaving OH contents unchanged. OH data can therefore be interpreted according to the known pressure-dependence of H_2O solubility and temperature dependence of H_2O speciation.

Pumice clasts within the subaerial tephra layer have OH contents that are consistent with quench fragmentation at depths of ~60 –150 m depth within the shallow edifice. Moreover, the majority of this tephra deposit consists of ‘mosslike’ particles formed by annealing of extremely fine-grained material, which are typically formed by explosive phreatomagmatic activity. We therefore propose that this tephra represents the distal deposits from the explosive formation of the shallow (~100 m depth) summit crater by a shallow submarine, phreatomagmatic maar-type eruption.

By contrast, two in situ submarine lavas have lower OH contents than expected for their current water depths. Comparison with past sea level variation suggests that these effusive eruptions occurred at ~8-9 and ~12 ka during times of lower sea level. Loose submarine pumice also sampled from the edifice has a range of OH contents and vesicularities, reflecting different quench depths and dispersal histories within the water column.

Keywords: Submarine volcanism, FTIR, Volatiles, Magma fragmentation

