The role of confining pressure in submarine silicic effusive eruptions

Rebecca J Carey, Sharon Allen, Jocelyn McPhie

University of Tasmania, Australia

E-mail: rebecca.carey@utas.edu.au

Our understanding of submarine volcanism is in its infancy with respect to subaerial eruption processes. Two fundamental differences between eruptions in seawater compared to those on land are that (1) eruptions occur at higher confining pressures, and (2) in a seawater medium which has a higher heat capacity, density and viscosity than air.

A vital yet unresolved first-order question is how degassing under conditions of high confining pressure modulates processes of silicic magma degassing during ascent and fragmentation in the conduit. Confining pressure will influence the degassing behaviour, particularly the rates of exsolution of CO2 and H2O- volatile species that that drive volcanic eruptions.

We use clasts collected from two edifices of Sumisu volcanic complex, Izu-Bonin Arc, Japan, where compositionally identical magma was erupted at different water depths. Thee samples were collected from dome carapace at 1300 and 945 meters below sea level. Microtextural analysis has revealed only slight differences between pumice carapace erupted at different depths, however significant variance from subaerial counterparts.

Our results from the deep water domes show i) relatively homogeneous textures with a dominance of round bubbles; iii) highly sheared zones adjacent to highly vesicular expanded zones; iii) bubble number densities equivalent to subaerial sub-plinian eruptions. The dominance of round bubbles, and high porosities and bubble number densities of these deep dome samples vary significantly from subaerial counterparts. Our preliminary observations of pumice microtextures would suggest that confining pressure reduced volatile exsolution to a degree that magma viscosities still allowed for bubble relaxation. Our quantitative data suggest that heterogeneous nucleation could continue to relatively high in the conduit, however, high permeability of the system must have played a dominant role during ascent.