OCGC Seminar

Bubble-crystal interactions in magmas: insights from 3D and 4D X-ray microtomography

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Gas bubbles in silicate melts are one of the key drivers of volcanic eruptions as bubble nucleation, growth and potential for attachment to/detachment from other phases can greatly influence eruption explosivity. These bubble kinetics (or interactions) are generally determined from examinations of natural samples and quenched experimental run products – however, both **only provide a view of** the final state, from which the initial conditions of a time-evolving magmatic system must be inferred. In an effort to investigate bubble kinetics prior to volcanic explosions, dynamic, real-time (*in situ*) 4D X-ray microscopy experiments were conducted to induce bubble nucleation and track bubble growth and movement. After tracking these processes with a 0.5 sec temporal resolution (all in 3D), the most important finding was that bubbles readily nucleated on silicate crystals that were previously thought inconsequential to bubble nucleation. The rapid generation of bubbles on plagioclase crystals shows that silicates can affect the timing of degassing in volcanic eruptions. The findings highlight the need to reconsider the role of silicate crystals in magmatic degassing and show possibilities for magma mixing-triggered degassing and potential gas storage at depth.

In a wider effort to study bubble-crystal interactions, but focusing on oxide crystals, 3D scans of experimental products revealed fragile but complex bubble-oxide aggregates. The complexity of 3D bubble-oxide aggregates points to a range of interactions, from continuous generation, detachment and disintegration. Similar natural samples were identified and point to analogous bubble-oxide interactions occurring in a wide range of different geological environments, and offer insights into detailed mechanisms of effective oxide transport in degassing melts.

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