HETEROGENEOUS BUBBLE NUCLEATION ON MAFIC CRYSTALS IN RHYOLITE MAGMA

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ABSTRACT

The nucleation of H_20 bubbles within magma plays a significant role in how volcanic eruptions occur and how magmas evolve through time. Recent studies propose that bubbles that nucleate heterogeneously on crystals within a magma may account for most if not all bubbles that form during an eruption. To better constrain the conditions under which heterogeneous bubble nucleation may occur on common minerals found in magmas, we ran decompression experiments on high silica rhyolite magma with crystals of augite and hornblende to observe the kinetics of bubble nucleation. Our experiments show that bubbles can nucleate on both augite and hornblende at H_20 supersaturations as low as 10 MPa. The average number of bubbles that nucleated on 20-45μm crystals increased by a factor of ~3 between 20 and 50 MPa of supersaturation for both augite and hornblende. At a given supersaturation, larger crystals consistently have more bubbles attached to their surfaces. The number of bubbles on flat surfaces are consistently an order magnitude greater than those on non-flat ones (i.e., corners, divets, or points) at all tested supersaturations. These observations show that augite and hornblende are effective sites for bubble nucleation at low supersaturations in rhyolite magma, consistent with previous work that found magnetite is similarly effective. This behavior is in contrast to quartz or plagioclase, which have been shown to be inefficient sites for bubble nucleation. As such, the size, amount, and types of crystals within magma can have large impacts on how magmas degas during an eruption.

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