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Simulating the effects of seismic shaking on bubbles within magma through analogue experiments

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Shaking a tank containing bubbles within a viscoelastic magma analogue material provides insight into how seismic shaking affects magma bodies. Volcanic eruptions following earthquakes have been recorded in literature since 1840 (Darwin) and have been the focus of many studies since. Both anecdotal evidence and numerical modelling suggest that both near-field and far-field earthquakes may trigger volcanic activity. However, little experimental work has been done to further constrain the interaction between the seismic trigger and the bubbly magma. We injected bubbles of various sizes into homogenous, viscoelastic silicon oil in a sealed tank and then subjected them to shaking using a Geo-SIG GSK-166 shake table. The viscosity of the fluids tested are 2,000 Pa•s, 10,000 Pa•s, and 30,000 Pa•s, simulating a range of magmas. The duration, displacement, and frequency of shaking were varied and we measure the rate of bubble rise and recorded bubble deformation. Experiments were filmed and converted to one image per second. Changes were then tracked before, during, and after shaking using ImageJ. Preliminary results indicate that bubbles are affected by shaking which exceeds accelerations of over approximately 0.5 g. Bubble rise may also increase more associated with shaking of longer displacements. Additionally changes in behavior occur for the duration of shaking and bubbles return to their normal state when shaking ceases, although some experiments show a slight attenuation period following cessation of shaking. Changes in bubble behavior during shaking occur throughout the range of fluid viscosities tested. The changes occur throughout the range of bubble sizes tested. Oscillation of the bubbles during shaking is likely the mechanism for increased rate of rise. Our measured increase in rise of bubbles has implications for advective pressure increases in magma during earthquakes.