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Insights into high temperature tensional fracturing in silicic magma

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During dome-forming eruptions, the rapid transition from effusive to explosive activity is a direct consequence of strain localisation in magma. A deformation mechanism map of magma subjected to strain localisation will help develop accurate numerical models, which, coupled to an understanding of the mechanics driving the monitored geophysical signals precursor to failure, will enhance eruption forecasts. Here we present our work where seismic data is combined with experimental work to give insights into high temperature tensional fracturing in magma.

The seismic data is derived from multiple recent dome-forming eruptions including Unzen (Japan), Volcán de Colima (Mexico) and Mt. St. Helens (USA). For the analysis we implemented various methods to study temporal variations in seismicity, such as: automatic event detection, statistical analysis of time-series, waveform correlation, and singular value decomposition. Preliminary results have highlighted various processes during dome formation such as: sub-weekly cycles, clusters during spine extrusion, and variations in precursors to dome extrusion. In our experiments, samples from the above volcanoes were placed under tensional conditions at high temperatures and acoustic emissions were recorded. The data is analysed and compared to the natural seismic data so that constraints may be placed on the conditions of the natural seismogenic sources.

Using a combination of field and experimental data promises a greater understanding of the processes affecting the rise of magma during an eruption. This will help with the challenge of forecasting and hazard mitigation during dome-forming eruptions worldwide.