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Velocity changes at Volcán de Colima: Seismic and Experimental observations

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Immediately prior to dome-building eruptions, volcano-seismic swarms are a direct consequence of strain localisation in the ascending 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 monitored geophysical signals prior to lava eruption, will enhance forecasts. Here we present how seismic data from Volcán de Colima, Mexico, is combined with experimental work to give insights into fracturing in and around magma.

Volcán de Colima is a dome-forming volcano that has been almost-continuously erupting since November 1998. We use coda-wave interferometry to quantify small changes in seismic velocity structure between pairs of similar earthquakes, employing waveforms from clusters of repeating earthquakes. The changes in all pairs of events were then used together to create a continuous function of velocity change at all stations within 7 km of the volcano from October to December 1998. We complement our seismic data with acoustic emission data from tensional experiments using samples collected at Volcán de Colima. Decreases in velocity and frequency reflect changes in the sample properties prior to failure. By comparing experimental and seismic observations, we may place constraints on the conditions of the natural seismogenic processes.

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.