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Linking low-frequency events to conduit properties

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Low frequency seismic events have been observed on many volcanoes worldwide and are considered key tools in volcanic monitoring and eruption forecasting. Our model to explain the occurrence of low-frequency events such as those observed on Soufrière Hills Volcano, Montserrat, is conduit resonance, where seismic energy generated by brittle failure of the melt is trapped in a resonating system. The seismic parameters in a volcanic environment are strongly dependent on the properties of the magma, which control the character of this resonance and hence the low frequency seismicity. Crucially therefore, low-frequency events provide one of the few direct links between surface observations and internal magma processes, and this talk presents some applications of this relationship.

We test the effects of varying parameters such as the conduit width, seismic velocity, and magma density in relatively simple numerical models and demonstrate that this can provide volcanologists with useful tools for interpreting changes in the character of the low-frequency seismic signals in terms of changes in either the geometry or magma properties of the conduit system. This is illustrated using the exmaple of the Soufrière Hills volcano on Montserrat, where recent evidence has a suggested a widening of the upper volcanic conduit from 30m to 50m. The effects of this widening on the low-frequency signals were tested using our finite-difference model and the results confirmed the expected shift towards higher resonant frequencies and provide further evidence and validation for the increase in the width of the conduit.