Time-dependent volcanic tremor during the 2011 Kamoamoa eruption, Kilauea, Hawai'i

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Volcanic tremor is a ubiquitous feature of active volcanism. However, the use of volcanic tremor as an accurate forecasting tool is still not possible because the underlying physical processes and their variation from one volcanic setting to the next remain opaque.

In order to identify key dynamics of tremor and their relationship to magmatic and tectonic processes, we investigate links between the temporal evolution of tremor properties (e.g. frequency) and other indicators of volcanic unrest (e.g. changes in lava lake height, tilt). A practical hurdle is that appropriately correlated geophysical time series must be available.

We examine seismic data from 8 stations during the 2011 Kamoamoa eruption (05-10 March), Kilauea, Hawai'i. Volcanic tremor persists throughout the eruptive episode with varying amplitudes. The spectra show a broadband signal without clear harmonics. Most of its energy is concentrated below 15 Hz, with a peak between 1 and 2 Hz. For the first time on Kilauea, we detect a systematic temporal variation in the frequency of a spectral peak (frequency gliding). During the gliding episodes, the broadband signal is overprinted by energy linearly shifting up and down between 0.5-5.5 Hz over several hours. These energy shifts roughly coincide with increasing and decreasing tremor intensity. Whereas volcanic activity is high around the time of the first gliding episode, the second energy shift happens during a more quiescent time.

We present a methodology for identifying temporal and spatial correlations of time-dependent tremor properties with other geophysical and geological observables. We also search for gliding during previous episodes of activity at Kilauea in 2007-2008. Our approach can provide critical clues for the tremor source mechanism at Kilauea. Furthermore, we will investigate how the characteristics of tremor at Kilauea compare to other ocean island settings and continental and oceanic arc volcanoes.