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Detailed analysis of amplitude and recurrence times of LP activity at Mt. Etna Volcano, Italy.

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Long-Period (LP) events recorded on many volcanoes worldwide are thought to be associated with conduit resonance triggered by fluid flow instabilities throughout the volcano plumbing system. The rate of Long-Period activity, however, varies greatly depending on the particular volcano taken into account. At Piton de la Fournaise, for instance, LP event rate is on the order of 10 events /year, while at Mt. Etna it is not unusual to observe several thousands of events per month.

This work is aimed at improving our understanding of the LP source mechanism through a statistical analysis of detailed LP catalogues. The behaviour of LP activity is compared with the empirical laws governing earthquakes recurrence (e.g., Gutenberg-Richter [GR] and Omori's laws), in order to understand what relationships, if any, exist between these two apparently different earthquake classes.

In particular, we investigated the amplitude and the recurrence time of LP activity on Mt. Etna, Italy, using data from a temporary network (inter-station distance ∼5km) and a small-aperture array (inter-station distance ∼50m) deployed in 2005.

Some 13,000 LP events were detected in August 2005 through a short-term average/long-term average (STA/LTA) method. Directional properties of these events were obtained by applying a Plane Wave Fitting (PWF) method to data from the small array. The different directions of propagation measured for such events suggest that at least two different sources are active. From PWF alone we were not able to isolate the contribution of individual sources without ambiguity. LP signals, however, exhibit a high degree of waveform similarity, thus providing a criterion for classification / source separation. Using correlation analysis, we then grouped the events into families containing comparable waveforms.

By waveforms stacking, we obtained a representative, template event for each family. These template signals were then used for a Matched-Filtering of the continuous data streams, in order to discriminate small-amplitude events previously undetected by the STA/LTA triggering method. This procedure allowed for a significant enrichment of the catalogues, from which we retrieved amplitudes and inter-event times associated with individual families. The retrieved amplitude distributions differ significantly from the GR law, and there is no clear relationship between events amplitude and recurrence times. Comparison with data from both lab experiments and numerical simulations of (i) brittle-fracturing of high-viscosity materials, and (ii) fluid flow under different regimes, are needed in order to better understand the physics governing the observed distributions. Hopefully, these steps will lead to an improved understanding of LP activity, in turn clarifying their significance in terms of eruption forecasting.