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Amplitude and Recurrence Time of LP activity at Mt. Etna, Italy

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The manifestation of Long-Period (LP) activity is attested on many volcanoes worldwide and is thought to be associated with the resonant oscillations of subsurface, fluid-filled, cracks and conduits. Nonetheless the actual source mechanism that originates the resonance is still unclear. Different models have been proposed so far, including (i) fluid flow instabilities as periodic degassing and (ii) brittle failure in viscous magmas. Since LP activity usually precedes and accompanies volcanic eruption, the understanding of these sources is crucial for the hazard assessment and eruption early warning.
The work is aimed at improving the 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 Gamma-law distributions), in order to understand what relationships, if any, exist between these two apparently different earthquake classes.

In particular, about 13000 events were detected on Mount Etna in August 2005 through a STA/LTA method. For this given period, the volcano does not present particular sign of unrest. The manifestation of the LP events is sustained in time over all the period of analysis.
From the analysis of the directional properties, it turns out that the events of this first catalog propagate from 2 distinct sources . Furthermore, the events exhibit a high degree of waveform similarity, and provide a criterion for classification/source separation. The events were then grouped into families of comparable waveforms, resulting also in a separation for their source locations. We then used template signals of each family 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. The retrieved amplitude distributions, similar for both families, differ instead significantly from the Gutenberg-Richter law, and the inter-event times distributions don't follow a typical Gamma-law.
In order to compare these results with a catalogue for which the source mechanism is well-established, we applied the same analysis procedure to a dataset from Stromboli Volcano, where LP activity is closely related to VLP (Very-Long-Period) pulses, in turn associated with the summit explosions. Again, catalogues of thousands of LP events were achieved over one month of seismic records (July 2011). Our results indicate a similar behaviour in terms of both amplitude and inter-event time distributions, with respect to what observed at Mt. Etna.
This suggests that the Etna's LP data are likely related with a degassing process occurring at depth. Nonetheless, further studies are needed in order to quantify the time recurrence and amplitude distribution of brittle failure in viscous, stressed magmas.
Hopefully, these steps will lead to an improved understanding of LP activity in different volcanic contexts, in turn clarifying its significance in terms of eruption forecasting.