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Analysis of the source of the LP sequence recorded before the 2004 Mt. Etna eruption

I. Lokmer (1), C. J. Bean (2) and G. Saccorotti (2)

(1) Seismology and Computational Rock Physics Lab, Geophysics Group, School of Geological Sciences, University College Dublin, Belfield, Dublin 4, Ireland, (2) Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Vesuviano, Via Diocleziano 328, 80124 Napoli, Italy (ivan.lokmer@ucd.ie)

Broad-band seismic network was installed at the Mt. Etna in November 2003. Within the subsequent ten months, more than 40,000 long-period events (LP) with a dominant period of about 2 s were recorded. Although different in number and size, a large number of these events exhibit similar records, thus indicating the action of a non-destructive, repeatable source process. The similarity of the signals gives us an opportunity to stack them and thus build the dataset with enhanced signal-to-noise ratio. From such a dataset we are able to extract more information on the source than would be possible from noise contaminated single records. The events were located using methods based on the cross-correlation analysis. The spectral and particle-motion analyses imply that the source is most likely related to the resonance of a fluid-filled buried cavity. Considering the significant amount of shear observed during polarisation analysis, a crack is a likely candidate for the geometry of the source. A fluid-related seismic source can be seen as an oscillating system - it has its eigenfrequencies and corresponding damping factors (Q-factors hereinafter). An alternative approach to the standard spectral analysis (FFT) of such systems is the SOMPI method based on the autoregressive models of linear systems. A signal is assumed to be a sum of a number of decaying (or growing) harmonic signals. Thus, in addition to the dominant frequencies of a signal we also obtain source Q-factors at those frequencies. They can tell us about the time evolution of the physical properties of the fluid driving the source process. In our dataset, the most energetic part of signal consists of two eigenfrequencies, spanning the interval 0.5 - 0.8 Hz. Although the absolute value of the source Q-factors is contaminated by the path Q-factor, we observed there was no significant

change in their relative values throughout the considered time period. The same holds for the observed eigenfrequencies. It tells us there was likely no significant change in the type of fluid or amount of gas involved in the source processes. It seems to suggest that the LP-generating process was not related to the renewal of effusive activity at the Mt. Etna in September 2004. In future work we aim to put quantitative constraints on this interpretation based on modelling of the source through complete waveform inversion.