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How significant is VLP seismicity for determining gas budget at Etna Volcano?

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Whilst eruptions are a natural focus of attention for volcanologists, variations during quiescent periods can yield deep insights into the magma dynamics that can produce eruptive activity. Observations made in quiescent periods can also reveal more subtle changes that can be lost during the 'noise' of an eruption. From December 2005 to January 2006 an anomalous degassing episode was observed at Mt. Etna, well correlated with an increase in volcanic tremor, in the almost complete absence of eruptive activity. The purpose of this paper is to present the results of a comparison between geochemical and geophysical datasets collected during the episode, with a view to improving our understanding of processes producing Very Long Period (VLP) seismic events at Mt. Etna. VLP events commonly observed in volcanic environments represent the elastic response of the conduit's walls to volumetric changes associated with mass (mostly gas) transport processes. Through an automatic detection procedure, applied to the continuous data stream from Etna's broad-band seismic network, more than 10000 VLP events were recognized between 01 October 2005 and 31 January 2006. These events depict a dominant period of about 20 seconds, and rapidly attenuate moving away from the summit craters. Polarization ellipsoids generally depict a radial orientation to the direction pointing to the summit zone, and incidence angles clustering over the 55°-60° interval. Using both semblance method and the particle motion direction, the source of VLP was located beneath the summit craters, at an av-

erage depth of 800-1000 m. Quantitative estimates of the volumetric variations associated with these events are obtained from Moment Tensor Inversion via full-waveform modelling. Assuming that the VLP source mechanism is related to the rapid transit and decompression of a large gas slug at a conduit's geometrical asperity, and using a lithostatic pressure gradient, we may thus constrain the amount of volatiles implied in the VLP-generating process. During this period SO2 fluxes were measured using both traditional traverses and with the automatic FLAME network of scanning ultraviolet spectrometers. High fluxes of up to ˜20,000 t/d were measured in early December, and average fluxes were ˜6,000 t/d throughout the anomaly, compared with background values of ˜1,800 t/d. We use quiescent degassing compositions determined from FTIR measurements and petrological studies to determine the total volume of gas released in this period, thus allowing a direct comparison with the volume of gas estimated through analysis of VLP seismicity. This study allows us to ascertain whether VLP events are a fundamental process controlling degassing, or a second-order process, controlled by a small percentage of the total gas emission.