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Microstructural evidences of instability at Stromboli volcano: new insights from physical properties

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The December 2002 slump episode at Stromboli volcano, causing severe damage in the island, but not casualties, involved volumes of the order of $10^6 m^3$(Pino et al., 2004). However Stromboli experienced four large sector collapses in the past 13 ka, which involved volumes larger of at least 3-4 order of magnitudes (Tibaldi et al., 2001). The collapse would trigger a tsunami able to induce major destruction to human settlements along Southern Italy.

The 2002 eruption also evidenced the propagation of a dike within the unstable sector (Bonaccorso et al., 2003), validating field structural studies (Tibaldi et al., 2003) and analogue experiments (Acocella and Tibaldi, 2005) inferring that tectonic strain field interplayed with dyking along weakness zones promotes instability processes. Previous studies on physical properties of a very close volcanic district, i.e. Mt. Etna volcano showed that microcrack orientation in extruded lava flows is isotropic and related to rapid thermal cooling (Vinciguerra et al., 2001). We analysed the 3D fabric of Stromboli's rock samples from extruded lava flows, in order to assess the presence of anisotropy due to preferential microcrack orientations, which would reflect the tectonic strain field acting on the volcano. Such orientation can play a crucial role when enhancing the formation of slip surfaces which can lead to sector collapses of volcanic edifices.

In order to do this we combined 3D velocity measurements to the anisotropy of magnetic susceptibility (AMS) of both the rock matrix (mAMS) and the void space after

saturation of samples with a magnetic ferrofluid. The AMS is then re-measured, with the matrix susceptibility values subtracted from these readings to yield the average 3-D pore space shape, size and orientation (pAMS).

A weak, but clear anisotropy of 4.7% and 3.0% (P-wave and S-wave velocity) has been found, which support the hypothesis that the microcrack network is not only related to the rapid cooling of the lava flows, but also to the active tectonics acting on Stromboli. Further work will focus on comparison with in situ directions and on the micromechanics of faulting along preferential directions.