Geophysical Research Abstracts,
Vol. 11, EGU2009-9162, 2009
EGU General Assembly 2009


# Deformation patterns associated with an eruption at Mount Etna volcano: a combined study of the 2001 episode using geodesy and analogue modelling.

N. LE CORVEC (1), T. R. WALTER (1), G. PUGLISI (2), and A. BONFORTE (2)

(1) Dept. Physics of the Earth, GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany, email: lecorvec(at)gfz-potsdam.de, (2) Istituto Nazionale di Geofisica e Vulcanologia – Sezione di Catania, Piazza Roma, 2, 95125 Catania, Italy.

Ground deformation studies of volcanoes have provided much information on the pattern of flank movements. Mount Etna volcano, situated on the eastern coast of Sicily has grown in the vicinity the Malta escarpment probably linked on shore to the Timpe Fault System (TFS) dissecting the volcano's eastern flank. The eastern flank is, in addition to this regional faulting, subjected to gravitational spreading, as seaward horizontal displacements are constrained by geodetic studies. Therefore, the question arises how tectonic faulting and gravitational spreading of the Mount Etna eastern flank are related and how this complex deformation is associated with eruptive activity. Here we investigate the 2001 eruptive period in an attempt to elaborate the mutual influence of tectonic faulting, spreading and intrusion. Associated with this eruption, GPS and InSAR data revealed that the eastern flank has been affected by significant ground deformation, moreover the pattern of geodetically-detected ground displacements abruptly changed before, during and after the eruption. The pre-eruptive deformation (January to July 2001) is characterized by the displacement and subsidence of the lower part of the eastern flank affecting the TFS's footwall and hangingwall. The co-eruptive deformation (July to September 2001) is characterized by movement of the entire flank with stronger displacements at higher altitudes, and the post-eruptive deformation (September to October 2001) shows a similar displacement as during the pre-eruptive period, but with stronger displacements at lower altitudes.

To better understand this changing behaviour, we reproduced Mount Etna volcano in a sandbox model and recorded its internal deformation with a digital image correlation technique. We considered the volcano morphology as a half ridge, and (1) defined an underlying weak decollement surface (silicone) to simulate gravitational spreading, (2) defined displacement of the Malta escarpment and hence of the TFS using a motor-controlled normal fault originating in the solid basement, and (3) forcefully intruded dikes along the axis of symmetry (N-S) that intend to push the eastern flank. Thus gravitational spreading and tectonic faulting were simulated concurrently with intermittent intrusions. Two main sets have been tested, first gravitational deformation (non-intruding period) followed by a period of intrusion together with normal faulting; and second an intrusion period followed by gravitational deformation together with normal faulting. The experiments showed that intrusive activity at Etna volcano change the intensity of spreading and affect displacement at the TFS. For instance, horizontal velocities at either side of the TFS are strongly affected by periods of shallow magmatic activity.

Our experiments may help to explain the horizontal displacement changes found by the geodetic data associated with the 2001 eruptive cycle, including the pre-eruptive spreading, the dike intrusion event and the following eastern flank movements.