The Pernicana and Trecastagni faults: the most active structures dissecting Mt. Etna volcano (Sicily) studied by multidisciplinary ground deformation measurements

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The complex interaction between regional stress, gravity forces and dike-induced rifting, seems to have a role in the eastward movement of the Mt. Etna eastern flank. In this context the Pernicana and the Trecastagni-Tremestieri Fault systems seem to identify the northern and southern boundaries of the unstable sector.

The Pernicana fault system forms a left-lateral shear zone that dissects the north-eastern flank of Etna. The kinematics of this system is related to shallow seismic crises (M $\approx$ 4.0) occurring along the western segment. The eastern segment, ESE trending, is only affected by aseismic creep with purely left-lateral displacement.

The Trecastagni fault is a NNW-SSE tectonic structure on the lower southern flank, characterized by evident morphological scarps and normal and right-lateral movements damaging roads and buildings. This fault is affected by continuous dynamics with episodic accelerations accompanied with shallow seismicity.

The dynamics of these faults has been analysed by a multi-disciplinary approach with terrestrial (levelling across both faults and extensometers record on the Trecastagni fault) and satellite (InSAR data and GPS surveys) ground deformation data.

The levelling route on Mt Etna is 150 km long and consists of 200 benchmarks. Part of the levelling route crosses the Pernicana fault, at an altitude of 1400 m asl. A new levelling network has been installed across the Trecastagni fault and it showed a mean vertical slip rate of about 1 cm/y and episodic acceleration on short segments of the fault, with displacements of almost 3 cm.

The monitoring of the Trecastagni fault is also performed by two continuous wire extensometers and a system for periodic direct measurements across the fault in its central and north-central sectors. The two stations measure the relative displacements perpendicular to the fracture, evidencing an opening of about 2-3 mm/y.

Both faults show clear traces on SAR interferograms and time series. InSAR data allows tracking the path of the Pernicana fault with a rate of about 2-3 cm/y. The Trecastagni fault shows a main vertical kinematics, at a rate of about 4 mm/y, with a minor E-W component.

The dense GPS network is measured periodically and has more than seventy benchmarks. Two GPS sub-networks lie across the eastern segment of the Pernicana fault. The first one was installed in April 1997; the second one was measured for the first time in July 2002 upgrading an EDM network. The aim of these networks is to detail the structural framework and displacements along the aseismic sector of the fault.

Integration of this wide spectrum of geodetic data allows strongly constrained ground deformation pattern to be defined and modeled. Furthermore, the very long time series available on the Pernicana fault, allows its behavior to be investigated in time and its role and relationships in the framework of flank instability and eruptive activity to better understood.