Geophysical Research Abstracts, Vol. 7, 03693, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03693

Dynamics of the eastern flank of Mt. Etna investigated by a dense GPS network

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Mount Etna has developed at the intersection of two regional tectonic lineaments, the NNW-SSE trending Hybleo-Maltese escarpment and the NE-SW Messina - Fiumefreddo fault. The first separates the thick inland continental crust of the African platform from the Ionian mesozoic oceanic crust underthrusting the Calabrian arc; the latter marks a rift zone between South Calabria and north-eastern Sicily, extending as far as the Mt.Etna area. All tectonic features affect, with outstanding surface evidences, the eastern side of the volcano. The eastern flank of the volcano is affected by a long-term motion toward ESE, probably resulting from the interaction between gravity, thermal effects, regional tectonics and dyke intrusions. In 1997, in order to increase the detail of the ground deformation pattern on the lower eastern flank of Mt. Etna, a new GPS network, the “Ionica” network, was installed on this sector of the volcano. This GPS network consists of 24 stations and covers the lower eastern flank of the volcano from the town of Catania to Taormina and from the coastline up to an altitude of about 1300 m. All the new stations consist of self-centring benchmarks; this kind of benchmark allows all station set-up errors (on centring and instrumental height determination) to be avoided. After the benchmarks installation (in 1997) and before the merging of the Ionica network to the frame of the global GPS network of Mt. Etna (June 2001), three surveys were carried out on this network: in September 1997, August 1998 and January 2001. From the ground deformation pattern, it is possible to distinguish two different sectors, showing different deformation characteristics. The southern part of the network shows a more uniform distribution of the vertical motion with a mean SE-ward horizontal component, while the northern one shows an heterogeneous vertical motion with a ESE-ward horizontal component. The model resulting from data inversions defines a wide sliding plane beneath the entire eastern flank of the

volcano with a low dip angle. The expected station velocities, calculated for the new geometry, well fit the observed ones, even if the measured velocities are still rather higher than expected at the lowermost stations. The vertical inclination of the velocity vectors measured during the 1998-2001 period, gradually decreases from West to East suggesting a sort of rotational movement of the south-eastern flank, interrupted by some anomalous vectors on the lower part, that show higher vertical velocities. These anomalies, being located on a wedge defined by the intersection of the main NNW-SSE and NE-SW fault systems and near the Timpe faults, are probably due to the activity of the vertical faults cutting the lower eastern flank of Mt. Etna. Stations lying on the hangingwall and on the footwall of the Timpe fault system are affected by similar horizontal displacements, indicating that these structures are moving eastwards together with the sliding flank; this evidence suggests that the Timpe faults are probably second order structures, with respect to the detachment surface. These results depict a structural framework of the eastern flank of Mt. Etna in which the low angle dislocation can be considered as a first order approximation of an actual listric plane and the current active part of the Timpe fault system is confined above the detachment surface.