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Ground deformation at the Panarea volcano (Aeolian island, Italy) during 2002-2006 measured by gps and structural analysis

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In November 2002 a submarine gas eruption started offshore 3 Km east of Panarea island (Aeolian Island) on top of a shallow rise of 2.3 km^2 surrounded by islets forming a small archipelago. This event has posed new concern on a volcano generally considered extinct. Panarea island and its archipelago ($\sim$3.3 km^2) are the emergent portion of submarine stratovolcano more than 2000 m high and 20 Km across; exhalative activity due to a shallow hydrothermal system is well known since historical times. To monitor and study ground deformation associated with anomalous gas emission, a local GPS network (PANAREA) was designed, set up and measured during time span December 2002 - October 2006. The network consists of nine sites (six constructed after 2002) located on Panarea and on the islets. GPS data analysis was performed combining episodic campaigns of Panarea and other local networks located in the Aeolian area, carried out between 1995 and 2006, and data of continuous European and Italian sites. The results show at Panarea volcano two distinct crustal domains characterized by different kinematics and styles of deformation. Extension is recognized between Panarea island and its archipelago. Shortening WNW-trending of the order of 10-6, is present in the islets area. The time series of all sites in the Panarea network show presently a general subsidence; the site of PANA shows an uplift of 4.2$\pm$0.5 cm in correspondence of gas eruption event, apparently not affecting the general subsidence

pattern before and after December 2002. Moreover continuous measurements at site LI3D on Panarea Island has allowed to observe an aseismic displacement in June 2005 of 12.1$\pm$0.7 mm towards SE, not yet explained. The GPS results were integrated with bathymetric data represented by gas vent distribution, morphological and structural underwater features. In particular the gas vents were analysed by use of specific algorithm (Tosi et al., 1994) and the direction of the best alignments of this parameter were found. The NNE and NW trends are the principal alignments recognised. The merging of GPS and structural data suggest the relationship among gas vent distribution, submarine volcanological structures and ground deformations. The actual distribution of the estimated strain-rate is consistent with the structural setting.The general subsidence and shortening in the islets area can be interpreted as the response of the surface to the variation of the hydrothermal system reservoir which is progressively reducing its pressure after the gas eruption. The geochemical composition of the hydrothermal fluid changed during the 2002 gas emission. To evaluate the coupled thermo-hydro-mechanical processes going on in Panarea, a two-step model will be implemented. The model first involves the simulation of pore pressure and temperature changes due to fluid circulation. Then the mechanical response of the porous rock is calculated based on the linear theory of poro-elasticity.