Geophysical Research Abstracts, Vol. 9, 11121, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11121

A new uplift episode at Campi Flegrei caldera: implications for unrest interpretation and eruption warning

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Campi Flegrei (Southern Italy) is the area with the longest historically documented ground deformation, and one of the most densely populated, making crucial eruption forecast. The background long-term deformation in the area is subsidence, occurring at a rate of 1.5-1.7 cm/year, with episodes of intense uplift (up to 7 m in 50-60 years). The last one before present occurred at the end of XV century, culminating with the 1538 Mt. Nuovo eruption, the only historic eruption. The last period of uplift started in 1969, with two main episodes occurring at peak rate of 1 m/year, respectively in 1969-1972 and 1982-1984. As a consequence, the town of Pozzuoli, where uplift was maximum, was evacuated two times, in 1970 and 1984. In 1985, a subsidence phase started, with some episodic small and fast uplifts superimposed. The data used in this paper to analyze the on-going deformation are of two kinds: precision leveling and continuous GPS data (CGPS), taken from the monitoring networks of INGV in the area. The recent data clearly indicate that, since November 2004, the subsidence lasting since 1985 is definitively stopped and a new uplift phase has started. In this paper we use these data to constrain the kind of source producing the recent unrest at Campi Flegrei. We show that, using a simple method based on continuous GPS measurements to compare the ratio between maximum horizontal to vertical displacements, the present episode enlightens both the common origin of small and large unrests, and the conditions to generate large unrests. Results show that both small and large unrests are due to overpressure in a deeper source of fluids of magmatic origin which, when overcoming rock strength, involves shallower aquifers and generates large uplifts. This work also shows that the continuos monitoring of maximum horizontal to vertical displacement ratios with CGPS represents a very effective way to detect in-

trusive processes which give rise to eruptions.