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Magmatic processes evidenced by borehole dilatometer data at Campi Flegrei, Italy.

Bellina Di Lieto (1), Pierdomenico Romano (1), Roberto Scarpa (2), and Massimo Orazi (1)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Napoli - Oservatorio Vesuviano, Naples, Italy(bellina.dilieto@ingv.it), (2) Università di Salerno, Dipartimento di Fisica "E.R. Caianiello", Salerno, Italy

Since spring 2004 a joint research project (AMRA, UniSa, INGV) has been developed in Italy to install borehole strainmeters aimed at enhanced INGV monitoring systems. Six Sacks-Evertson dilatometers were installed around Campi Flegrei and Vesuvius during 2004-2005, and in 2008 these were supplemented by two arrays of long-baseline underground water tube tiltmeters. Renewed activity started since 2004-2005, characterized by a low rate of vertical displacement, amounting initially to a few cm/year. Recent deformation in the Campi Flegrei caldera is dominated by aseismic inflation, interrupted by minor transient aseismic reversals in rate. These are typically below the noise level or are poorly sampled by the low sampling frequency of most geodetic techniques, but can be quantified relatively easily using high sensitivity strainmeters and tiltmeters. These instruments provide coherent views of deformation at several different time scales capturing reversals in rate with periods from minutes to months. Monotonic uplift episodes have been recorded with durations of several weeks to a few years. During the summer of 2006 a long term strain episode related to an increase of CO_2 emission, evidenced by borehole tiltmeters and continuous GPS sensors, has been observed by the borehole dilatometers array. This strain episode preceded caldera microseismic activity by few months, as was also observed during the 1982 period of unrest. Other aseismic slip episodes were recorded in October 2006 and in March 2010, several minutes before the most significant seismic swarms (VT and/or LP events) occurred after the 1982-1984 uplift. The time scale of these transient strain events lasted less than one hour, putting further constraints on the origin of ground uplifts at Campi Flegrei. Their locations are compatible with the source inferred from long term deformation signals, at about 4 km depth beneath Pozzuoli. The current array provides us with a glimpse of the potential utility of a dense array of strainmeters and tiltmeters surrounding the Campi Flegrei region. An expanded array of tiltmeters and strainmeters operating continuously would permit the details of magma-transfer and the underlying cause of subsequent seismic activity to be monitored. Despite the small number of sensors, a preliminary mechanism model for aseismic strain episodes can be defined, correlating these episodes with magma growth in reservoirs with occasional pressure relief associated with the leakage of gas.