

## **Is fluid injection the predominant source of Campi Flegrei (Italy) unrests? Clues from the comparison of inflations and deflations.**

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The Campi Flegrei (CF) caldera is a high-risk volcanic area located West of Naples (Italy). CF is generally uplifting since a few years, after a 20-year-long subsidence started at the end of the recent 1982-84 unrest (maximum uplift about 180 cm). Few mini-uplifts with subsequent total or partial recoveries are superimposed on the multiannual trend. While mini-uplifts are usually ascribed to changes in the sub-surface hydrothermal system or injections of magmatic fluids, a long-standing controversy characterizes the interpretation of the 1982-1984 uplift episode, both in the source geometry and unrest cause (intrusion of magma, injection of magmatic fluids, or instability of the hydrothermal system).

As regards the 1982-1984 uplift, deformation data (obtained from leveling and triangulation surveys) seem consistent with different source models, like pressurized ellipsoidal cavities, mixed-mode faults, fluid injection. As a consequence, deformation data seem unable to resolve the above-mentioned controversy. However, numerical models of fluid injection indicate strong time variations in the surficial deformation pattern during inflation and even more between inflation and deflation.

Here we compare surficial deformation patterns of the major mini-uplifts and subsequent recoveries, the 1995-2000 subsidence, and the 1982-1984 unrest. We use SAR data (ENVISAT ascending and descending orbits, courtesy of IREA/CNR, Naples, Italy) between 1995-2010, and leveling and triangulation (EDM and angular) data for the 1982-1984 unrest. Horizontal displacements from triangulations are given with respect to a local not-fixed coordinate system whose origin coincides with a reference triangulation monument and whose y-axis points toward a second one. Since the overall deformation pattern is always nearly axial, we have searched for a roto-translation capable to make the 1982-1984 horizontal displacements radial, thus transforming displacements with respect to the local coordinate system to absolute displacements.

We find that all the overall deformation patterns, both uplifts and subsidences, coincide within errors and noise until 2007. The only evident difference between the 1982-1984 unrest and the subsidence phase relates to a small area (Solfatara) rich of fumaroles. Although we cannot reject fluid injections, the distinct constancy of the surficial deformation pattern may rule out their predominant role as source of deformation at CF, maybe apart from Solfatara. After 2007 the deformation pattern seems to consist of the "usual" pattern and an "anomalous" side uplift, whose origin is under investigation.