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Is hot fluid migration the source of deformation in the Campi Flegrei Caldera?

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Campi Flegrei is an active volcanic caldera, 12-14 km in diameter, immediately west of Naples, Southern Italy. Geological and historical records indicate that Campi Flegrei has been the site of intense uplift and subsidence phenomena. A historical period of uplift has occurred in Campi Flegrei from mid-1982 to 1984. Peak surface deformation reached about 1.8 m and the caldera experienced significant seismic activity. Since January 1985, the caldera floor is slowly sinking. Several mechanisms have been proposed to explain the caldera unrest: hot fluid migration, intense magma degassing, or the intrusion of a magma body followed by fluid removal. Given the significant density difference between silicate melts ($\sim$ 2500 kg/m^3) and hydrothermal fluids ($\sim$ 1000 kg/m^3) we can use density estimates from the joint inversion of gravity and geodetic data to distinguish between these two possible sources of caldera unrest. In this work, we determine first the location and geometry of the inflation source inverting leveling and trilateration measurements collected between 1980 and 1983. Then we determine the density of the intrusion by inverting leveling and gravity data gathered between 1982 and 1984. Finally, we use bootstrap to compute 95% bounds on the source parameters. The source that best fit the geodetic and gravity data is a penny shape crack, 1.25 to 4.25 km deep beneath the town of Pozzuoli, radius between 1.25 and 5.25 km, volume 0.035 to 0.075 km^3, mass 0.025 to 0.075 MU, and density 600 to 1100 kg/m^3. We estimate the location and geometry of the deflation source inverting leveling and trilateration measurements collected between 1990 and 1995. The source that best fit the geodetic data is now a vertical prolate ellipsoid, 2.3 km beneath Pozzuoli and with an aspect ratio of 0.49. These preliminary results support the hypothesis that hot fluid migration is the source of deformation in the Campi Flegrei caldera.