A new interpretation of the 1982-84 unrest episode at Campi Flegrei Caldera (Italy) by numerical inversion

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HETEROGENEOUS MEDIUM

The 1982-84 unrest episode at Campi Flegrei was characterized by huge deformation (1.8 m uplift) located inside the caldera. We combine microseismic source mechanisms (plates and focal solutions) to generate main stress sources such as a sphere, an ellipsoid or a sill. The models are realized by Finite Element and the medium is characterized by elastic heterogeneities consistent with seismic tomography. We study the deformation detected by leveling and EDM. The best-fitting source is located beneath Pozzuoli at about 5 km b.s.l. and undergoes to horizontal compression and vertical dilatation.

MODEL

The deformation is modelled by a polygonal-solid medium. The geometry is characterised by a source volume. Depending on the principal stresses, the kind of source they represent either a sphere, an ellipsoid, a fault, or a sill.

METHOD

The FE grid is made of 150,000 brick elements. The potential domain is constrained by a volume of 4x4x4 km or for each stress component. The resulting surface displacement is the superposition of the 6 elementary sources depicted on the left.

ELASTIC STRUCTURE

We consider 2 different classes of rocks:

1. HOF: homogeneous medium with rigidity \( \mu = 1 \) GPa and density \( \rho = 2500 \) kg/m³.
2. HEF: heterogeneous medium with elastic structure computed from the seismic tomography. A finite element representation is illustrated in the panel (right).

CONCLUSIONS

All the inversions performed show evidence of a deformation source located near Pozzuoli at about 4.5 km b.s.l.

The source stress tensors indicate horizontal compression and vertical dilatation (sill-like model) which can be interpreted as shear sliding along ring faults bordering the caldera.

Elastic heterogeneities may influence in modifying the source depth and volume variations.

New inversions are in progress using also gravity data observed at CF. The gravity variations observed at CF should be interpreted as due to the deformation induced in the medium by the sliding mechanism described above, without noticeable variation of the source volume.