EGU21-8282, updated on 12 May 2021
https://doi.org/10.5194/egusphere-egu21-8282
EGU General Assembly 2021

A numerical approach for modeling thermo-poro-elastic deformation sources in volcanic and hydrothermal regions.

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The Thermo-Poro-Elastic (TPE) inclusions contribute to deformation and stress in volcanic and hydrothermal areas. Differently from other deformation source models (e.g. magma chambers), the TPE sources effects are due to pore-pressure and temperature changes of the fluid within the inclusion. So that the TPE inclusions can allow large deformations even in those volcanic environments in which there is no evidence of a shallow magmatic body. This kind of sources also provides large deviatoric stresses, promoting different types of focal mechanisms both inside and around them. With respect to a previous work, we propose a numerical model that allows for a more realistic representation of TPE sources: we can represent inclusions with an arbitrary geometry and we take into account the elastic stratification of the crust, thanks to a modified version of the EDGRN/EDCMP code. We can also represent the case of a depth dependent distribution of pore pressure and temperature changes within inclusions, as expected during the transient stage of fluid propagation and temperature diffusion. We found that elastic layering and transient changes of the TPE source can promote both normal and thrust earthquakes in its interior. For the 1982-84 unrest episode at Campi Flegrei the inversion of geodetic data leads to a lower misfit between modeled and measured deformation data, with respect to a homogeneous medium and the retrieved geometry and location of the thermo-poro-elastic are in good agreement with the observed distribution of seismicity.