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Physical properties of Campi Flegrei tuff from variable depths

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A number of measurements on physical properties of volcanic tuff from different volcanic Italian districts (Campi Flegrei, Colli Albani, Lago di Vico) has been performed in the recent years.
Petrophysical investigations carried out at increasing/decreasing effective pressure (Vinciguerra et al., 2005; 2008) revealed how, within the same lithology, the different degree of lithification and presence of clasts can affect significantly physical property values. Microstructural analyses revealed that the pressurization and depressurization cycles generate inelastic crack damage/pore collapse and permanent reduction of voids space.
When cores from boreholes were investigated, significant variations of physical properties have been found even within the same tuff lithologies (Vinciguerra et al., 2008), which significantly influence the modelling of the overall physics and mechanics, as well as the input parameters for ground deformation and seismicity modelling.
In this study we analysed the physical properties of Campi Flegrei tuff (12ka) cores from depths down to 100m, which is the most abundant and widely distributed lithology in the caldera (Rosi and Sbrana, 1987). CF tuff is a strongly heterogeneous pyroclastic flow material, which include cavities, pumice and crystals of sanidine, pyroxene and biotite (Vanorio et al., 2002; Vinciguerra et al., 2005).
Total porosity was measured, after drying samples at 80°C for 24 hours, throughout a helium pycnometer (AccuPyc II 1340, Micromeritics Company) with $\pm$0.01% accuracy. Initial total porosity of 52% was found for cores coming from 30m of depth. Total porosity decreases to 46% , when cores from 100m depth are considered.
Bench measurements of P-wave and S-wave velocities carried out in dry conditions are of 1.8 and 1.2 km/s respectively for the 30m depth cores and increase up to 2.1 km/s and 1.35 km/s at depth of 100m.
Taken together, the measurements of porosity and seismic velocities of P and S wave velocities revealed a significant compaction occurring even at such shallow depths. This observation suggests that pore collapse is a pervasive mechanism affecting such weak lithologies and can be activated even from very modest increase of effective pressure (1-10MPa).
In order to proof this we aim to carry out simultaneous seismic velocity and permeability under increasing effective pressure, which simulate the lithostatic increasing load. The results obtained from laboratory measurements and their comparison with field determinations, such as sonic logs, provide crucial information for the interpretation of the inner volcanic district structure, and in turn suggest if/how mechanical and thermal stress can significantly change the rheology and permeability tuffs, opening new perspectives for the interpretation of the caldera dynamics.