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New physical, textural and mineralogical data on rock samples cored in 1981-1985 geothermal deep wells at Campi Flegrei caldera

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Density and porosity determination on rocks under overburden pressure is an important goal to map properties closely related to rock permeability, fluids movements and hence the heat transport processes through the crust. Furthermore, values of density, porosity and permeability are generally used as input to reservoir simulation models. Finally, the determination of such properties is crucial for the interpretation of unrest phenomena at this area, as pointed out by several recent studies. Such information is also crucial to investigate some key questions, such as the relationships between the physical properties of the drilled rocks and the hydrothermal alteration, not yet adequately known. In this work we analyse new and literature data on samples from deep wells drilled in the ‘80s by the Agip Oil Company at Campi Flegrei caldera (Italy), which are used to infer values of density and porosity versus depth of burial and compaction of different types of sediments. We also describe the different sample lithologies and perform macroscopic and microscopic analyses, so that relationships among texture, mineralogy, physical properties and depth location of the cored rocks can be inferred. The obtained patterns show results consistent with pyroclastic deposits-filling volcanic caldera and sedimentary basins, suggesting the fundamental role of compaction over the other parameters. The found relationships and the mineral distribution at depth, indicate that porosity increment can occurs only in fractured zones, at least down to the thermo-metamorphic horizon. This has implication on the permeability which, for comparable volcanological setting, depth and rock porosity, increases as a consequence of pre-existing or stress-induced fracturing. These results significantly improve our understanding of the behaviour of rock physical properties at depth in Campi Flegrei caldera and provide the basis to estimate and evaluate density and porosity at other sites within the caldera. Interestingly, results found here on deep-drilled samples are significantly different from those inferred by studies on surface samples brought at high pressures.