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Hydrothermal activity and subsurface soil complexity: implication for outgassing processes at Solfatara crater, Campi Flegrei caldera

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The Solfatara area and its fumaroles are the main surface phenomena of the vigorous hydrothermal activity within the active Campi Flegrei caldera system. The existing fault system appears to have a major control on outgassing which in turn leads to a strong alteration of the volcanic products. Moreover the maar-nature of the crater, and its filling by more recent volcanic deposits, resulted in a complex fractured and multilayered cap to the rising gases. As a consequence the hydrothermal alteration differently affects the rocks within the crater, including pyroclastic fallout ash beds, pyroclastic density current deposits, breccias and lavas. The induced changes in both original microstructure and physical and mechanical properties of the rocks control the outgassing behavior.
Here, we report results from a measurement survey conducted in July 2015, and aimed to characterize the in-situ physical (temperature, humidity) and mechanical (permeability, strength, stiffness) properties. The survey also included a mapping of the surficial hydrothermal features and their distributions. Chemical analyses and laboratory measurements (porosity, granulometry) of selected samples were additionally performed.
Results show that the crater floor area comprises very different kinds of soils, from fine grained, thin laminated deposits around the two bubbling Fangaia mud pools, to crusted hummock formations along the SE and NE border of the crater. Dry and solid alunite-rich deposits are present in the western and southern part. Furthermore we observed evidences of a beginning of crust formation within the central part of the crater. A large range of surface temperatures, from boiling point to ambient temperature, were measured throughout the surveyed area.
Outgassing occurs mainly along the crack system, which has also generated the crusted hummocks. Elsewhere the fluid circulation in the subsoil is favored by the presence of coarse and highly porous sulfur-hardened levels, whereas their surfacing is hindered by compacted fine-grained, low permeability layers.