Anatomy of a fumarolic system inferred from a multiphysics approach

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Abstract

Fumaroles are a fundamental manifestation of volcanic activity that are associated with large emissions of gases into the atmosphere. These gases originate from the magma, and they can provide indirect and unique insights into magmatic processes. During their ascent, the magmatic gases interact with the rock and hydrothermal fluids, which modify their geochemical compositions. These interactions can complicate our understanding of the real volcanic dynamics and remain poorly considered. Here, we present the first imagery of a fumarolic plumbing system at Solfatara crater (Campi Flegrei Caldera, Italy), using three-dimensional electrical resistivity tomography and acoustic noise localization. Using this results we performed a thermodynamic model revealing that near-surface mixing between gas and condensed steam explains the distinct geochemical compositions of fumaroles that originate from the same source.

Keywords: Fumarole, Hydrothermal system, Electrical Resistivity Tomography, Multiphase Flow Modelling, Acoustic noise localization, Campi Flegrei caldera.