EGU24-9520, updated on 03 May 2024
https://doi.org/10.5194/egusphere-egu24-9520
EGU General Assembly 2024

Imaging hydrothermal alteration with electrical resistivity tomography in La Soufrière de Guadeloupe volcano

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Hydrothermal alteration plays a major role in volcanic instability. Improving techniques that allow us to better understand the timescales of alteration in active volcanoes is thus paramount. Since the reactivation of the fumarolic field at the top of the dome of La Soufrière de Guadeloupe (Guadeloupe, France) in 1992 and the expansion of its surface area in recent years, the area of study is subjected to prolonged variable alteration that has promoted past flank collapses and can also influence permeability and thus shallow depth overpressurization. During a field campaign in May 2022 we performed 25 electrical resistivity tomography (ERT) profiles in the summit of La Soufrière, next to active fumaroles and acid boiling ponds. These ERT profiles were inverted using the open-source code pyGIMLi. Thanks to the ERT profiles we are able to roughly map the altered areas to a depth of about 20 m in this zone of La Soufrière. Some of the byproducts of alteration that have been identified in La Soufrière are clays, sulfates and pyrite. Thus, we infer that the low electrical resistivity zones (<20 Ωm) correspond to alteration and high electrical resistivity (>1500 Ωm) corresponds to unaltered rock. Low electrical resistivity anomalies are observed north of the Breislack fault, near the fumaroles. The explored north-most region is characterized by higher values of electrical resistivity. We take into account ground temperature and spatial variability to interpret the electrical conductivity anomalies and we use this first high-resolution resistivity model to plan a repetition of our experiment. This time-lapse experiment will allow us to estimate the evolution of hydrothermal alteration in the volcano's summit over a 2-year period in the context of the current ongoing multiparameter unrest.