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Hydrothermal activity in a lava dome detected by combined seismic and muon monitoring

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Characterizing volcano-hydrothermal activity is crucial for understanding the dynamics of volcanos and the relation between surface observations and deep magmatic activity. It may be also relevant for detecting precursors to magmatic and phreatic eruptions. Traditional monitoring tools such as seismicity and deformation are not always sensitive to hydrothermal activity, therefore it is important to explore new tools that can provide complementary information about the system.

Muon imaging is increasingly used as a novel tool to complement standard geophysical methods in volcanology, allowing to image large volumes of a geological body from a single observation point. Continuous measurements of the muon flux enable to infer density changes in the system. In volcanic hydrothermal systems, this approach helps to characterize processes of steam formation, condensation, water infiltration and storage. Here we present the results of a combined study in the La Soufrière de Guadeloupe volcano (West Indies, France) where continuous measurements of muon tomography were acquired simultaneously to seismic noise. The combination of these two methods helps to characterize a short-term, shallow hydrothermal event, its localization, and the involved volumes in the volcano. The deployment of networks of various sensors including temperature probes, seismic antennas and cosmic muon telescopes around volcanoes could valuably contribute to detect precursors to more hazardous hydrothermal events.