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## Lava dome rock strength estimation using 3-D muography at La Soufriere de Guadeloupe

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The intense hydrothermal activity occurring at La Soufrière de Guadeloupe, French Lesser Antilles, is a major concern for volcanologists at the Volcanological and Seismological Observatory of Guadeloupe and for the local population living nearby. Partly hosted within the andesitic lava dome, this hydrothermal system, continuously fueled with meteoric waters, is indeed responsible for both violent phreatic eruptions (the last major event occurred in 1976-1977), and fast rock alteration due to hot and acid fluid circulation, which worsens the risk of a partial volcano flank collapse.

Since the early 2010s, the deployment of scintillator-based muon telescopes built in IP2I, Lyon, to perform imaging of the lava dome structure has allowed increasing the knowledge of the hydrothermal system dynamics.

Here we will present the preliminary results of muon data analysis recorded in four detectors around the lava dome between 2015 and 2019 ( $3.10^7$  events in total). The muography data were processed using a RANSAC method that mitigates the impact of random noise and contamination from secondary particles while improving the muon reconstruction efficiency compared to previous processing.

For this analysis, we have also attached importance to the estimation of the irreducible low-energy muons (so-called “soft” muons) background on the obtained density estimates using dedicated GEANT4 simulation. This uncertainty estimation constitutes a precious input to muography data inversion, allowing better-constrained estimates of the lava dome density. We highlight that this is the first time that such an amount of muography data is inverted at La Soufrière. The result of this three-dimensional density modeling of the lava dome is then interpreted in terms of rock strength, using an empirical rock strength-bulk density law obtained from laboratory measurements on hydrothermally-altered samples. This modeling of the dome highlights the low-strength zone in the southern zone, consistent with the current state of knowledge acquired through geophysical surveys (e.g electrical tomography) on the hydrothermal activity at La Soufriere.

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