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3D geophysical imagery of an active volcano by airborne eletromagnetism. (Piton de La Fournaise, La Reunion Island)

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Basaltic volcanoes result from several eruptive and dismantling phases leading to complex interior structure. This pattern significantly influence the volcanic activity, hydrothermal system and flank destabilization. During the last decades, shallow and deep structures were imaged with geophysical methods. However, rough steep surface of active volcanoes restricts the density and the coverage of ground geophysical measurements. Thus, they hardly provide an interpretable image of either the entire cone with low resolution or a restricted area with high resolution. For the first time, a high-resolution airborne electromagnetic survey, conducted in 2014, provides an image of an active basaltic volcano, the Piton de la Fournaise (La Reunion Island).

Recently, airborne electromagnetic surveys have been exponentially used in environmental studies. However, in the case of an active basaltic volcano, the subsurface is composed by dry recent lava flows which are generally too resistant to be imaged with this method. A fine-tuned specific processing was therefore applied allowing us retaining enough time domain electromagnetic soundings (up to 7 000) to carry out a quasi-3D spatially-constrained inversion.

The obtained resistivity model provides information on the geometry and the spatial extension of the hydrothermal system and inherited structures. In the former case, airborne electromagnetism images an upwelling of the hydrothermal system below the volcano summit. In addition, as shown with self-potential measurements, it also shows higher activity of the hydrothermal system below rift-zone axes. The latter case, the resistivity model provides an extensive imagery of an ancient collapse structure. This geometry, consistent with magnetic and seismic data, improves the understanding of past flank destabilization and weakness area for future events.