



Modeling the hydrothermal system of Piton de la Fournaise (Reunion Island) using self-potential and electromagnetic measurements.

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The geoelectrical structure of the central part of the Piton de la Fournaise has been studied using direct electrical current (DC), transient electromagnetic (TEM) soundings and spontaneous potentials (SP) data. A multi-scale analysis and electrical tomography of SP data has been carried out. Beneath the active summit area, low-resistivity zones rise to within a few hundred meters of the surface, forming a bulge that coincides with a 2000-mV SP anomaly. These features strongly support the hypothesis of a well-developed hydrothermal system, above a shallow magma reservoir inferred to exist between 1 and 2.5km beneath the summit. Repeated SP surveys (1981-2005 period) show that some anomalies persist over time while others are transient. The permanent SP features emphasize the geometry of the hydrothermal system, whereas the transient anomalies are related to the volcanic activity. For example, the formation of the December 2002 pit crater induced an important decrease (-300mV) of a large positive permanent SP anomaly. The pit crater event has induced a relaxation of the hydrothermal system characterized by the appearance of fumaroles emissions, a drastic decrease of fluid pressure and, consequently, a decrease of the SP anomaly.

A 2D SP/elevation horizontal gradient approach has been tested on the high-resolution summit SP-map. It allows to better differentiate hydrogeological and hydrothermal

zones. Major SP/elevation horizontal gradient anomalies are clearly superimposed on and linked to preferential fracture zones or conspicuous structural features (rims, pit craters and collapse features, radial fractures, ...).

Complex continuous wavelet transforms (CWT) have also been applied to the temporal SP data. CWT of the SP signal allows for 3D determination of hydrothermal fluid displacement through the time and is a promising new technique for improved forecasting of changes in eruptive activity.