Geophysical Research Abstracts
Vol. 14, EGU2012-11421-2, 2012
EGU General Assembly 2012

Air-cooled volcanoes ? New insights on convective airflow process within Miyakejima and Piton de la Fournaise volcanoes

R. Antoine (1,2), N. Geshi (3), K. Kurita (1), Y. Aoki (1), M. Ichihara (1), T. Staudacher (4), and P. Bachelery (5)

(1) Earthquake Research Institute, The University of Tokyo, Tokyo, Japan, (2) Centre d'Études Techniques de l'Équipement, Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux, France (raphael.antoine@developpement-durable.gouv.fr), (3) Geological Survey of Japan, AIST, Tsukuba, Japan, (4) Observatoire Volcanologique du Piton de la Fournaise, IPGP, La Plaine des Cafres, Ile de la Réunion, (5) Observatoire de Physique du Globe, Aubière, France

Subsurface airflow in the unsaturated zone of the soil has been extensively investigated in a variety of disciplines such as mining, nuclear waste or agriculture science. In volcanology, the recent discovery of subsurface airflow close to the terminal cone of Piton de La Fournaise volcano (La Réunion Island, France) provides for the first time insights into the convective behavior of air within the unsaturated layer [1]. The characteristics of the aerothermal system, its occurrence in other volcanoes, its ability to transport heat during quiescent periods and the perturbation of this system before eruptions are the key questions we want to address following this discovery.
In this study, we present observations of subsurface convective airflow within opened fractures located at the summit of Miyakejima and Piton de la Fournaise volcanoes from anemometric and temperature data. Two anemometers and thermocouples were placed at the surface and at the center of the fracture at two-meter depth during a diurnal cycle. Six thermocouples also measured the temperature at 1 meter-depth, on a profile set perpendicularly to the fracture. Finally, a thermal camera was used to make punctual measurements of the surface temperature of the fracture. At Miyakejima, two surveys were realized in winter 2010 and summer 2011. During the winter, mild air exit was detected from the fracture with a central vertical velocity of 20 to 50 cm/s. The temperature of the site was constant during the diurnal cycle ($\sim 22°C$), leading to a maximum temperature contrast of 15°C between the fracture and the atmosphere just before sunrise. During summer, a different hydrodynamic behavior was observed: Air inflow was detected during the whole diurnal cycle with a mean velocity of 20 cm/s. The temperature of the fracture followed the temperature of the atmosphere at 2 meters-depth.
In the case of Piton de la Fournaise volcano, the same convective behavior was observed at two different fractures during winter 2008 and summer 2010. Moreover, the velocities and temperature contrast between the fracture and the atmosphere were close to the ones recorded at Miyakejima.
Finally, the temperature profiles realized across the fractures and confirmed by the infrared thermography data allowed us to define the convective patterns. This study represents the first detection and characterization of air convection at a seasonal scale within fractures on volcanoes. It constitutes a preliminary step to further investigations dedicated to the understanding of the perturbation of such systems before eruptions.

[1] Antoine R., Baratoux D., Rabinowicz M., Fontaine F.J., Bachèlery P., Staudacher T., Saracco G., Finizola A., Thermal infrared images analysis of a quiescent cone on Piton de La Fournaise volcano: Evidence for convective air flow within an unconsolidated soil, Journal of Volcanology and Geothermal Research, Volume 183, Issues 3-4, 2009, Pages 228-244.