High-resolution imaging of the Nisyros hydrothermal system.

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Context

Nisyros is a Quaternary volcanic island located in the Dodecanese in the Easternmost part of the Aegean, Greece. The subaerial edifice is sub-circular in shape with an average diameter of 8 km. The top of the volcanic system is characterised by a caldera structure with a diameter of about 4 km marked by the presence of a resurgent dome. The largest eruption occurred in Nysiros (Kos tuff dates some 160'000 yrs BP) devastated the entire Dodecanese islands while the most recent eruptive activity dated back at least 25'000 vrs BP. However, vigorous hydrothermal circulation is still largely present [*Caliro et al.*, 2005; *Gottsmann et al.*, 2007].
Large magnitude earthquakes and phreatic explosions occurred during hydrothermal eruptions in 1871-73 and in 1887. The hydrothermal craters are still visible today and are visited by thousands of tourists every year. The latest tectonic activity took place in 1997 when a M5.5 earthquake affected the local villages. The seismic events created fracture zones towards the NNW part of the caldera rim causing the enhancement of the hydrothermal activity and the emplacement of mud and hydrothermal pools steaming high-temperature CO_2 and H_2S.
However, the structure of the shallow hydrothermal system is still largely unknown and accurate geophysical prospections are very much required to mitigate risk.

Objectives and Methods

The GEneva geoPhysical Pool (GEPPO) recently included an IRIS Fullwaver system (more info about the instrumentation here) for the acquisition of Deep Electrical Resistivity Tomography (DERT). Compared to classical geoelectrical methods DERT is able to reach about 1000 m depth and perform 3D surveys. Resistive methods are particularly sensitive to detect hydrothermal fluids and to investigate magmatic environments.
The project includes a field survey to acquire 2D and 3D resistive data. The goal of the survey will be to map the geometry of the hydrothermal system and to infer how local tectonics may drive fluid flow. The candidate will use ERTLab for the inversion of resistivity and chargeability data. The acquired geophysical information will be key for the development of fluid flow models to understand how heat sources affect hydrothermal circulation at depth. Aspects of hazard assessment, exposure and vulnerability of the island will also be investigated in order to evaluate the overall risk.

Literature

Caliro, S., G. Chiodini, D. Galluzzo, D. Granieri, M. La Rocca, G. Saccorotti, and G. Ventura (2005), Recent activity of Nisyros volcano (Greece) inferred from structural, geochemical and seismological data, *Bull. Volcanol.*, *67*(4), 358–369, doi:10.1007/s00445-004-0381-7.

Gottsmann, J., R. Carniel, N. Coppo, L. Wooller, S. Hautmann, and H. Rymer (2007), Oscillations in hydrothermal systems as a source of periodic unrest at caldera volcanoes: Multiparameter insights from Nisyros, Greece, *Geophys. Res. Lett.*, *34*(7), L07307, doi:10.1029/2007GL029594.

Aerial view of the island of Nisyros showing the Caldera and the resurgent dome.

Sites WEB

http://www.unige.ch/sciences/terre/en/research/crustal-deformation-and-fluid-flow/

http://cms.unige.ch/sciences/terre/research/Groups/physical_volcanology/physical%20volcanology.php

Choice of orientation :

RGEOL and GATO