MONITORING OF MEDITERRANEAN VOLCANOES ACTIVITY THROUGH SEAFLOOR MULTIPARAMETRIC MEASUREMENTS

G. Giovanetti [1], S. Monna [1], N. Lo Bue [1], D. Embriaco [1], F. Frugoni [1], G. Marinaro [1], M. De Caro [1], T. Sgroi [1], C. Montuori [1], A. De Santis [1], G. Cianchini [1], L. Beranzoli [1]* and P. Favali [1]
[1] Istituto Nazionale di Geofisica e Vulcanologia - laura.beranzoli@ingv.it

Abstract
The presence of a wide variety of volcanoes in the central Mediterranean Sea is such that this is considered a particularly active and dangerous area. The objects of this study are three main volcano systems in this area: Etna , Stromboli and Marsili Seamount. The first two are sub-aerial volcanoes but have significant parts of their structures under the sea, while the Marsili Seamount is completely submerged. This work presents an overview that shows how multiparametric measurements performed through seafloor observatories of EMSO, can bring a real benefit volcano hazard assessment.

Keywords: Geohazards, Mediterranean Sea

Seafloor fixed-point multidisciplinary observatories offer new possibilities in the detection of signals associated with volcanos on different time-scales. They allow for extensive and long-term synchronous measurements of signals from different sensors (multi-parameter), including instruments that are less commonly used for volcano monitoring, such as gravimeters, magnetometers, and Acoustic Doppler Current Profilers (ADCPs). Gravimetric on-land volcano monitoring is not routinely performed and is even more rare at the seafloor due to the technological challenges related to the marine environment. Nevertheless, density variations inferred from gravity observations can be used to better understand processes such as magma and fluid mass redistribution within the volcano apparatus [1]. Gravity signal variations can also be linked to degassing processes in hydrothermal systems [2] and, together with seismological and magnetometric data, provide helpful information on these systems. Magnetic measurements give important information on sub-seafloor magnetic and electrical properties, in terms of magnetization and conductivity. The resistivity structure underneath the observation area can be deduced from the observed geomagnetic field. Magnetic field variations can be caused by transport of conductive fluids in a hydrothermal system [3]. Oceanographic parameters, such as the echo intensity measured by ADCP, can supply information on volcanic ash dynamics in seawater. Actually, this data is mostly used to monitor sediment and turbidity fluxes in rivers and coastal areas [4], but it was applied to the detection of ash fallout in seawater during the 2013 Etna explosive activity. Thanks to a multiparameter approach we were able to document the whole chain of events, from the explosion, the ash emission, to the fallout in the water column, and finally to its sedimentation at the benthic layer. In cases where the volcanoes have part of their structure under the sea, observation from the seafloor is necessary to complement land and satellite observations, as in the case of Stromboli and Etna volcanoes. By contrast, remote sensing from the seafloor is an obvious necessity in the case of a submerged volcano that has activity undetected from land, such as the Marsili Seamount. Seismological and gravimetric data acquired by seafloor observatory, suggested that the Marsili Seamount shows signals that are typically associated to hydrothermal activity. In particular, Short Duration Events were observed during a variation in gravity and an increase of high frequency seismic noise. Although these gravimetric variations have been observed only a few times at Marsili during the recording period, similar signals have been detected at other volcanoes, including Etna and Stromboli, and have been linked to mass rearrangement within the volcano.

References

1 - Battaglia, M.; Gottsmann, J.; Carbone, D.; Fernández, J. 4D volcano gravimetry. Geophysics 2008, 73, WA3–WA18.
Gottsmann, J.; Carniel, R.; Coppo, N.; Wooller, L.; Hautmann, S.; Rymer, H. Oscillations in hydrothermal systems as a source of periodic unrest at caldera volcanoes: Multiparameter insights from Nisyros, Greece. Geophysical Research Letters 2007, 34. Johnston, M.J. Volcano-Electromagnetic Effects. In Encyclopedia of Geomagnetism and Paleomagnetism; Springer, 2007; pp. 984–987. Gostiaux, L.; Van Haren, H. Extracting meaningful information from uncalibrated backscattered echo intensity data. Journal of Atmospheric and Oceanic Technology 2010, 27, 943–949.