Geophysical Research Abstracts
Vol. 18, EGU2016-13859, 2016
EGU General Assembly 2016

The Evolution of the Campi Flegrei caldera (Italy): High- and low-frequency multichannel 2.5D seismic surveying for an amphibian IODP/ICDP drilling approach

Lena Steinmann (1), Volkhard Spiess (1), Marco Sacchi (2), and the CAFE_2016 Scientific Team

(1) Department of Geosciences, University of Bremen, Bremen, Germany (lena.steinmann@uni-bremen.de), (2) Institute for Coastal Marine Environment (IAMC), Italian Research Council (CNR), Napoli, Italy

Caldera-forming eruptions are considered as one of the most catastrophic natural events to affect the Earth's surface and human society. The half-submerged Campi Flegrei caldera, located in southern Italy, belongs to the world's most active calderas and, thus, has received particular attention in scientific communities and governmental institutions. Therefore, it has also become subject to a joint approach in the IODP and ICDP programmes.
Despite ample research, no scientific consensus regarding the formation history of the Campi Flegrei caldera has been reached yet. So far, it is still under debate whether the Campi Flegrei caldera was formed by only one ignimbritic eruption, namely the Neapolitan Yellow Tuff (NYT) eruption at 15 ka or, if it is a nested-caldera system related to the NYT and the Campanian Ignimbrite (CI) eruption at 39 ka. In the last decades, the Campi Flegrei caldera has been characterized by short-term episodes of unrest involving considerable ground deformation (uplift and subsidence of several meters), seismicity and increased temperature at fumaroles. Furthermore, long-term deformation can be observed in the central part of the caldera with uplift rates of several tens of meters within a few thousand years. Recently, it has been proposed that the long-term deformation may be related to caldera resurgence, while short-term uplift episodes are probably triggered by the injection of magmatic fluids into a shallow hydrothermal system at ∼2 km depth. However, both long-term and short term uplift could be interpreted as eruption precursor, thereby posing high-concern for a future eruption, which would expose more than 1.5 million people living in the surroundings of the volcanic district to extreme volcanic risks.
During a joint Italian-German research expedition in 2008, a semi-3D grid (100-150 m profile spacing) of high-frequency (up to 1000 Hz) multichannel seismic data were acquired to support both the ongoing onshore ICDP and a proposed offshore IODP drilling campaign. These data are of outstanding quality and high vertical resolution (∼1 m), however, limited by their low signal penetration of ∼200 m below seafloor. Hence, only the shallow structures of the Campi Flegrei caldera could be imaged and, consequently, the interpretation was mainly focused on the evolution of the Campi Flegrei caldera since the NYT eruption at 15 ka. Nonetheless, the data also show first evidence for a collapse prior the NYT eruption, supporting the existence of a nested-caldera system formed by collapses related to both the CI and NYT eruptions.
Detailed imaging of the upper 2 km - target of the IODP/ICDP drilling campaigns - will be provided through an additional semi-3D (50 m profile spacing) low-frequency (20–200 Hz) multichannel seismic survey collected in February 2016. Preliminary results from a combination of both low- and high-frequency seismic surveys will be presented on (1) deeper-seated collapse structures related to the CI eruption, (2) the extent of the caldera fill, and (3) the hypothesized shallow hydrothermal system.