Geodetic and photogrammetric survey of mud volcano in Santa Barbara village (Caltanissetta): implication of active tectonics.

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The Santa Barbara mud volcano field is located in central Sicily, along the accretionary wedge forming the Sicilian-Maghrebian fold-and-thrust belt. It is constituted by Neogene-Early Pleistocene deposits that were progressively shortened and displaced during the late Miocene to Pleistocene.

The "Maccalube" of Santa Barbara focus of attention after the paroxysm event occurred in August 2008, (Madonia et al. 2011). The paroxysm was preceded by an intense ground fracturing, with displacement spanning from few centimetres up to one meter, which involved many residential building.

With the aim of understand what trigger paroxysm event (crustal and/or superficial stress field, overpressure of fluids) and to set up a valid geological model able to reduce the geological risk of the urban area, a multidisciplinary study was performed. Workflow has included studies on active (morphometry) and ground deformation, (IGM 95 geodetic benchmark) seismic profiles, and epicentres of earthquakes occurred in central Sicily. Since October 2016, we started monitoring the evolution of Santa Barbara active mud volcano through the installation of a GNSS network along the borders of the area covered by the materials ejected during the paroxysm of 2008. Geodetic measurements were also accompanied by photogrammetric surveys through an Unmanned Aerial Vehicle (UAV) to monitoring the most dangerous area. Photogrammetric data and GNSS measuring were acquired during seven measurement campaigns (October 2016 - April 2018) and after compared each other to achieve information about ground motion and get the best 3D model of the mud volcano.

The GNSS results show as expected that the mud volcano is affected by a radial movement in the order of one centimetre. Moreover, the outcome of photogrammetric surveys showed a more important vertical deformation in the vent area characterized by one order of magnitude more than the GNSS data. In particular, we observe a constant upward movement in the central and northern sector of the vent area, that has been interpreted as a first and fast inflection phase, followed by a slower phase of inflection.

This study can contribute to evaluate if mud volcano activity along the Sicilian-Maghrebian fold-and-thrust belt (e.g. Aragona, S. Barbara and S. Biagio) are just related to independent overpressure fluids phenomena and/or by NNW-SSE compressive regional stress field (Bonini, 2012).

Reference

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