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Integrated geological and geophisycal methods for the evaluation of the ceiling collapse hazard of the Poesia Cave in the Salento peninsula (southern Italy)

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Abstract
According to the Protection Civil Department database, Apulia is the fourth region in Italy affected by sinkholes, due to collapse of natural or man-made cavities. The southern part of the region (the Salento peninsula) had hosted in the last twenty years at least fifteen events of sinkholes, the greatest part of which occurred inside “soft” carbonate rocks (calcarenites).
The most catastrophic sinkhole, due to the presence of underground quarries, occurred at Gallipoli on 29 March 2007, when a collapse created a 12 x 18 m sinkhole which involved two 3 floors buildings. and 140 people were evacuated. In these cases, the usual approach of investigation of the area consist of geological survey supported by geophysical prospecting aimed to evaluate the real size of sinkhole crater and to predict its development over the time.
In spite of the importance on the civil protection, the prediction of the sinkhole events is currently an hard issue, especially if they are related to caves of cultural interest as the case at hand, where are summarised questions of safety of people and cultural heritage.
The “Poesia Piccola” cave, located at the Salento area of the Puglia region (southern Italy), has such features and it is the case study of this paper.
The cave is an outstanding example of hypogean archaeological site morphologically in evolution and potentially dangerous for humans. It belongs to a karst system formed by dome-shaped caves, minor cavities and galleries. The system, named “Grotte della Poesia”, is joined to the ground through vertical and horizontal entrances, respectively placed on a coastal plateau and along the contiguous cliff.
This paper provides a new methodological approach on the evaluation of sinkhole hazard in such “soft” carbonate rocks combing geological, geophysical and mine engineering complementary methods, such as: geological analysis of outcrops and boreholes, aerophotogrammetric interpretation of aerial photos, electrical resistivity tomography (ERT), ground penetrating radar (GPR), seismic tomography, stability models to evaluation of ceiling caves.
The research allows to define the geometrical caves shape (span, length and thickness of the crown pillars) which related to the geological features and physics properties of the rocks, determine the instability of the ceiling caves and, as a consequence, the sinkhole hazard.