Subsidence Hazard in Limestone Cavities: The Case of “Grutas da Moeda” (Fátima, Central Portugal)

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Abstract

“*Grutas da Moeda*” are natural touristic caves, located in the plateau of São Mamede, near Sanctuary of Fátima, in Portugal. They have been opened to the public since 1974, and receives about 75,000 visitors per year, from 76 nationalities. They are located in the “*Maciço Calcário Estremenho*”, composed by limestone deposits of the Middle Jurassic (Bathonian), corresponding to the Serra de Aire formation. The geological risk assessment is fundamental to guarantee the safety of its visitors and staff; therefore, it is intended to develop geotechnical monitoring methodologies in order to collect data to understand the risks that may be associated with this natural cavity and to identify critical areas of collapse. There are four main alignments (faults/joints), which assume parallelism with the development of the caves. The trend of the layers in the cave is approximately N30ºE; 17ºSE. In the year 2015, a geophysical study was carried out, using the 3D electrical resistivity method and, for one of the areas in particular, the georadar method. The georadar method allowed to map the anomalies corresponding

to empty spaces that have been identified with the 3D electrical resistivity technique. This paper presents the results obtained, as well as proposals for geotechnical measures to mitigate the risk of collapse subsidence.

Keywords

Subsidence risk Limestone cavities Geological hazards Geophysical methods Geotechnical monitoring

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