

Contribution to the estimation of long return period seismic hazard of Beirut area from speleothem studies

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In the framework of the LIBRIS project (Contribution to seismic risk assessment in Lebanon), a work package was devoted to the use of broken or unbroken speleothems (stalagmites and stalactites) to better characterize the local seismic hazard. This kind of study is particularly interesting in the long return period range, where historical information is far from being sufficient. The proposed approach is based on a previous study by Lacave et al. (2004).

Two pilot caves, located north of Beirut, along or close to a major fault, were first selected. Then, in situ measurements of speleothems were done using a 3D laser scan. The data were processed to obtain a detailed sampling of the broken and unbroken speleothem population (number, precise shape), in order to attribute a vulnerability class, with uncertainty, to each speleothem. These data were then used to compute, in a statistical approach, the probability of exceeding, or non exceeding, of a certain level of seismic acceleration in the study area. The combined data of both caves are complementary and bring the following results:

- a remarkable decay of the probability of occurrence for events with high PGA (5 to 20 m/s²), due to the presence of long intact speleothems;
- the confirmation of the fact that earthquakes with PGA between 2 and 6 m/s² are clearly possible in the region (contribution of broken speleothems).
- this pilot study finally leads to the conclusion that the maximum probably reached acceleration in this area is of the order of 6 to 8 m/s².