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Stalagmites' reactions to ground motion studied using modified Raspberry Shake and nodal sensors

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Karstic zones are numerous on Earth and offer a particular field of study to evaluate the ground motion levels that occurred in the past in support of regional seismic hazard assessment. Indeed, some fine and slender candlestick stalagmites are intact and therefore indicate that a certain level of ground motion has not been exceeded since they exist. Many parameters must be considered in the behaviour of stalagmites to earthquakes such as their shape, their mechanical properties and their natural frequency. A good way to better understand and characterize the reaction of these stalagmites to earthquakes is to study their reaction to the current permanent ground motion. To do this, a study based on the measurement of ambient seismic noise is underway in the cave of Han-sur-Lesse (Ardenne, Belgium). The ambient seismic noise is measured both at the surface (above the limestone massif and in the nearest village), on the floor of the cave and on the stalagmites themselves. Different three-component seismic sensors are used in parallel: three SmartSolo IGU-16HR 3C and two Raspberry Shake 3D Personal Seismographs, one of which has been adapted to be easily attached to the stalagmites. This parallel configuration during two-week recording periods made it possible to determine the eigenfrequencies and the polarization of the associated movements of 16 stalagmites. In addition, daily and weekly variations in ambient noise and transient events are measured such as earthquakes, quarry explosions or flooding in the cave. The presence of sensors in different places over the same period also makes it possible to study the possible impact of the cave's local characteristics on these measurements.