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The contribution of speleotectonics on active faults investigation in the Central Apennines (Italy)

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In highly seismic active regions characterized by karst environments, speleoseismology may represents a potential tool to better constrain the seismogenic sources, their kinematics and related hazard. We performed a speleotectonic study in the easternmost sector of the Central Apennine chain, an area representing the boundary between the active extensional domain, to the west, and the compressional one, to the east. The Cavallone Cave is located in correspondence of the Maiella ridge, the outermost outcropping carbonate anticline of the Central Apennines, where the occurrence of "silent normal faults", to the east, and blind thrust, to the west, raises critical questions about the identification of the true seismogenic structures of this area. The most hazardous adjacent seismogenic structures are the Sulmona and the Palena-western Porrara normal faults. Whereas, a lower seismicity is probably associated to the buried Apennine thrust fronts which characterize the frontal sector of the chain.
Many structures recognized in the Cavallone Cave can be resembled to "seismothems" (i.e. speleothems potentially broken, or deformed, by a seismic event), even more so radiocarbon dating and comparison with other paleoseismological and geological data collected in surrounding areas, outside the cave, provide important constraints for the individuation of a paleoearthquake during Holocene times. The age of the seismothem (a stalagmite broken along a sub-horizontal cut plane with the upper part lying on the floor close to their base, accompanied with a new-growing stalagmite covering the rupture surface of the stump) found in the Cavallone Cave, in fact, matches with the dating obtained from both a trench performed along the Sulmona fault and the analysis of earthquake-induced secondary effects in neighboring areas.
Moreover, although controversies exist about the correlation between spleotectonic observations and quantitative modeling, the matching of these different field data suggest the reliability of speleoseismological studies in discovering past earthquakes.