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Shaft speleogenesis in Picos de Europa (North Spain): contribution of cave geomorphological mapping and U-Th dating techniques

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Picos de Europa Mountains are located in the North of Spain, showing more than 2,000 m thickness of Carboniferous limestone, in which the 14 % of the deepest shafts of the world are developed. This work concerns with a speleogenetical research carried out in two shafts (Torca Teyera and La Texa), using geomorphological maps and U-Th dating. The spatial distribution of cave geomorphological processes is established by the elaboration of geomorphological maps at a 1:500 scale, using genetical criteria for the classification of cave features. Cave temporal evolution is established from relative chronology between cave features and deposits and absolute dating of eight selected samples with U-series disintegration (234U/230Th). Torca Teyera Shaft (4º 52' 56.9" W 43º 16' 33.1" N) is a multilevel cave 4,438 m long and 738 m deep with three cave levels located at 1,300, 800-900 and 615 m.a.s.l. Cave levels are formed by phreatic and epiphreatic tubes strongly modified by vadose stream incision and breakdown processes. Fluvial and slackwater deposits, frequently covering breakdown deposits, are preserved up to 70 m over the active level and reach thickness of 3 m, appearing sometimes interbedded with flowstone. Flowstone levels usually fossilize fluvial deposits, being covered by other speleothems, as stalagmites and pool deposits. La Texa shaft (4º 58'1.3" W 43º 15'45.2" N), 2,231 m long and 215 m deep, presents only one cave level at 1,300 m a.s.l. formed by phreatic and epiphreatic tubes modified by vadose incision. Flowstones and dripstones are often covering fluvial (slackwater deposits) and gravity deposits, being the last the most frequently feature in shaft bottom. Eight speleothem samples from the two shafts were dated using the U-series disintegration method. Two flowstones from the middle cave level of Torca Teyera yielded ages of 185 and 238 ka, respectively. The age of a pool deposit sample and of a flowstone from the upper level exceeded 300 ka. On the other hand, three flowstone samples from Torca La Texa were dated between 156 and 181 ka, whereas the third sample is out of range of the U-Th method. Finally, one sample of a pool deposit found over flowstones is dated at 65 ka. These ages allowed us to establish a preliminary chronology of the speleogenetic events. The development of Torca Teyera and La Texa began at least during the Mid Pleistocene and in both cases it was controlled by the dropping of the base level. Fluvial activity and the grow of speleothems started prior 300 ka and both processes have been continuous up to at least 185 ka, at the middle level of Torca Teyera, and up to 156 ka at Torca La Texa. The most important flowstone of Torca La Texa precipitated at about 65 ka ago. These results are consistent to validate the previous speleogenetical models in the area, in which new shafts and canyons began to develop downwards cutting the old cave levels that remained perched during Alpine uplift.