Isotopically altered wallrock of the hypogene conduits in the Crimean Piedmont, Ukraine

Alexander Klimchouk[1], Yuri Dublyansky[2], Elisaveta Tymokhina[1], Christoph Spötl[2]
[1]*Ukrainian Institute of Speleology and Karstology, Simferopol, Ukraine*
[2]*Leopold-Franzens-Universität, Geology, Innsbruck, Austria*
klim@speleogenesis.info

Keywords: stable isotopes, isotopic alteration, water-rock interaction, hypogene speleogenesis, Crimea

The Crimean Piedmont stretches along the tectonic suture separating the fold-and-thrust structure of the Crimean Mountains from the Scythian Plate. It comprises two cuesta-like ridges whose structural slopes are built up of homoclinal limestone beds of the Paleocene- Eocene (the Inner Range), and the Neogene (the Outer Range) ages. Abundant relicts of the hypogene karst have been identified recently in steep cuesta cliffs of the Piedmont. The hypogene cavities formed in confined to semi-confined hydrological conditions due to interaction of the deep-seated waters, ascending along cross-formational fracture conduits, with the strata-bound lateral filtration flow. The ongoing geomorphological dissection of the stratified structure of the Piedmont commonly follows the pre-formed hypogene conduits, resulting in the development of the pronounced cuesta relief with steep cliffs featuring massive exposure of the hypogene karst conduit paleo-walls with specific morphologies.
Movement of deep-seated fluids through carbonate wallrock may cause isotopic alteration of the later. We have studied isotopic composition of C and O along nine cores drilled into the walls of the cliffs decorated with hypogene solutional features, as well as in two hypogene caves. Data from all cores show the presence of a wide isotopic alteration halo, whose thickness exceeds the core length (max. 40 cm). In this zone, the rock is slightly depleted in $\delta^{18}O$ (ca. 1 -2 ‰) relative to the "pristine", unchanged values of a given rock unit. In most cores the rock is also depleted in ^{13}C but two cores show higher $\delta^{13}C$ values. In addition to this low-gradient alteration, most of the cores also show a narrow (4-50 mm) zone of the high-gradient alteration, across which $\delta^{18}O$ and $\delta^{13}C$ drop by respectively, 2.0–4.9 ‰ and 0.7–4.5 ‰. At three localities, the walls of the hypogene cavities were coated with phreatic calcite. Isotopic composition of this calcite corresponds to the lowermost values of the altered rock. In one core, the rock in the high-gradient alteration zone is depleted in ^{18}O but enriched in ^{13}C. In yet another core the rock is enriched in both ^{18}O and ^{13}C. The results corroborate the hypogenic origin of conduits and suggest that the wallrock was exposed to, and interacted with, geochemically different waters after the main volume of cavities had been created by dissolution.