Cave wall-rock alteration as an indicator of hypogene speleogenesis

Christoph Spötl¹, Yuri Dublyanky¹, Gabriella Koltai¹, and Lukas Plan²

¹University of Innsbruck, Inst. Geology, Innsbruck, Austria (christoph.spoetl@uibk.ac.at)
²Natural History Museum Vienna, Vienna, Austria

Recent years have seen an increasing number of studies suggesting that hypogene processes are more important in the origin of cave systems than previously thought. Recognizing such hypogene caves has important implications for e.g. paleohydrology and has been primarily based on morphological criteria, which to some degree are subjective and difficult to quantify. Apart from caves containing coarsely crystalline spar backed by evidence of elevated paleotemperatures based on isotopes and/or fluid-inclusion data, there are no well-established physico-chemical tools to validate a hypogene model for a given cave.

In a systematic approach we have studied a number of cave systems showing morphological features diagnostic of upwelling fluids, and examined the composition of the rock immediately behind the cave wall using small-diameter drill cores. We commonly observed two features in this wall rock: (1) an increase in porosity (partly later occluded by carbonate cement) and (2) a change in the rock colour (bleaching of initially grey rock, or reddening). We also identified dedolomitisation of the dolomite host rock, which may locally lead to the formation of boxwork. The most diagnostic feature, however, is a systematic shift in the carbon and/or oxygen isotopic composition along wall rock drill cores. None of these petrographic and geochemical features were observed in wall-rock cores of epigene caves, opening the door to use this approach in order to identify, and in some cases quantify, paleo-water-rock interactions associated with hypogene speleogenesis.