Groundwater geochemistry as a tool to understand hypogene karst systems – Study of Mariovo thermal karst springs (North Macedonia)

Dr. Marjan Temovski

(Isotope Climatology and Environmental Research Centre, Institute for Nuclear Research, Hungarian Academy of Sciences)

Hypogene karstification is a relatively recent scientific paradigm in the understanding of the formation of karst systems. It addresses karst systems that develop due to dissolution by groundwater that recharges the karst rock formation from below. Contrary to the much more widespread epigene karst where the chemical capacity to dissolve the bedrock is dominantly due to dissolved CO2 obtained from the surface, more diverse genetic mechanisms are present in hypogene karst systems due a variety of geochemical processes. As hypogene karst systems generally become accessible only after being intercepted by surface erosional processes, the most common approach to study them is by studying cave morphology and deposits in fossil cave systems. Rare is the possibility to study active hypogene karst systems, and this is usually constrained only to their output parts. A complementary approach is to study the geochemical properties of groundwater associated with hypogene karst systems. This allows us to gain insight in to the processes operating within the system, and help better understand the properties of the hypogene karst.

Mariovo hypogene karst systems are relatively small but an important example where hydrothermal speleogenesis was locally coupled with additional processes/mechanisms (i.e. sulfuric acid speleogenesis and ghost-rock weathering) due to geological or lithological control. The conceptual genetic model of Mariovo hypogene karst systems was based on previous morphological, mineralogical and geochemical studies on caves and cave deposits.

A set of geochemical analyses on the low-temperature karst springs associated with these systems were carried out to test and complement our understanding of the hypogene karst development in the area. Chemical composition as well as environmental isotopes and noble gasses were used to confirm previous assumptions of deep groundwater flow with increased temperatures related to the nearby Neogene-Quaternary volcanism.

Dipartimento di Scienze della Terra

Via S. Maria, 53 Pisa Aula C

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