

Hydraulic and geochemical characterization of the Villány thermal karst area (Hungary)

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Considerable part of Hungary's thermal water resources is hosted by carbonate rocks. Owing to the favourable geological and geothermal conditions many of these reservoirs are characterized by natural thermal water discharge, usually at the boundary of outcropping carbonates and adjacent sedimentary basins. These regional discharge areas are favourable sites for the development of hypogenic caves as well.

The Villány thermal karst area is situated in the southern part of Hungary. The karst aquifer is build-up of Mesozoic carbonates. The outcropping carbonates and their subsurface continuation covered by young sediments in the adjacent basin basement form a thick (up to 1700 m) karst reservoir. The groundwater flow system in the Villány area is a gravity and temperature (density)-difference driven flow system (Liebe and Lorberer, 1981), where on the surface of bare carbonates infiltrating meteoric waters circulate and discharge in karst springs with different temperatures. Majority of the springs is characterized by lukewarm waters (20-26°C) with 712-930 mg/l TDS in the area. Natural thermal water discharge (52-62°C, 1100 mg/l TDS) occurred only in Harkány, as a marshland. According to Liebe & Lorberer (1981) in the Villány Hills infiltrating meteoric waters can maintain only the lukewarm springs' discharge, i.e. there might be other water components (especially in case of the sulphuric thermal waters in Harkány). Based on trace element measurements, Scheuer (2012) suggested that active tectonics-induced mantle fluid contribution may play a role in the geochemical composition of thermal waters.

Some caves in the area, discovered by human activity (quarrying), are characterized by phenomena related to thermal waters: tectonically controlled maze-like pattern, morphological features such as spherical niches, and typical minerals such as huntite, aragonite and typical forms of calcite such as cave popcorns (Takács-Bolner, 1985; Takács-Bolner in Székely, 2003; Vigassy et al., 2010). Some of the caves are connected to thermal waters even today (e.g. Beremend crystal cave (Takács-Bolner, 1985). Scheuer (2012) connected these caves and their mineral association to hydrothermal activity induced by Neogene basaltic volcanism. According to his opinion, the chemical characteristic of the sulphuric Harkány thermal waters is shaped by these deep fluids and he raised the possibility of the sulphuric speleogenesis. This is supported by the microbial investigations by Miseta et al. (2012), since he found that majority of the clones belonged to different sulphur-oxidizing or sulphur/sulphate-reducing Proteobacteria. However, Takács-Bolner (1985) and Vigassy et al. (2010) suggested the "classical" mixing corrosion as cave forming process in the area.

The thermal waters and the caves were hitherto investigated separately. However, all these phenomena belong to one single system, a hypogenic karst system and they can be evaluated only if their context is understood, i.e. if their common cause is revealed: the pattern of groundwater flow and its thermal and geochemical characteristics. The aims of the present study in the Villány thermal karst area are 1) to evaluate the groundwater flow system based on measured hydraulic data, 2) to characterize the geochemical composition of the waters, using natural tracers (chemical components) to identify different fluid components, and 3) to evaluate the cave forming processes.

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References

- Liebe, P., Lorberer, Á. (1981) A baranyai termális karsztrendszer hidrológiai és termodinamikai jellemzői. A Magyar Hidrológiai Társaság II. Országos Vándorgyűlése II. kötet: 74-82.
- Miseta, R., Palatinszky, M., Makk, J., Márialigeti, K., Borsodi, A. K. (2012) Phylogenetic diversity of bacterial communities associated with sulfurous karstic well waters of a Hungarian spa Geomicrobiology Journal 29:(2) pp. 101-113.
- Scheuer, Gy. (2012) A hazai egyes lemez-tektonikai szerkezeti egységek karsztos hévizeinek előzetes összehasonlító nyomelem vizsgálata. Hidrológiai Közlöny, 92/1: 1-12.
- Takács-Bolner, K. (1985) A Beremendi-kristálybarlang. Karszt és Barlang, I-II: 3-12.
- Takács-Bolner, K. (2003) A Beremendi-kristálybarlang. In Székely, K. (szerk.): Magyarország fokozottan védett barlangjai. Mezőgazda Kiadó, 399-407.
- Vigassy, T., Leél-Őssy, Sz., Demény, A. (2010) A Nagyharsányi- és a Beremendi-kristálybarlang és képződményeik genetikai vizsgálata. Földtani Közlöny 140/1:73-88.