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Isotope Investigations of thermal waters in the Pannonian Basin, (SE) Hungary

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The Pannonian basin is located in eastern Central Europe encircled by the Eastern Alps to the west, the Western Carpathians to the north, the Apuseni Mountains to the east and the Dinarides to the south. Its formation began in the early to mid-Miocene accompanied by intense volcanism, E-W crustal extension, and local block faulting. In the basin, which still exhibits heat-flow anomalies, there are a lot of thermal springs containing large volumes of carbon dioxide and/or hydrocarbon gas.

H and O isotope ratios and H and C isotope ratios of methane as well as the abundances of some major and minor dissolved components were measured earlier (Vető et al, 2004) in 26 subsurface waters from SE Hungary, produced from late Neogene aquifers within the upper two kilometers in depth. From the isotope data Vető et al. concluded that about two thirds of the waters are dominated bacterial methane produced during early burial. In the corresponding aquifers methanogens started to operate immediately after the sulfate content dropped below 0.1 mmol/l due to bacterial sulfate reduction. In about one third of the waters bacterial sulfate reduction was inhibited by some unknown mechanism and, with continuing burial, the corresponding aquifers became sites of intensive bacterial acetogenesis and subsequent fermentation of the acetate to methane in the depth interval of about 600–1000 m at temperatures of about 40–60 ^{o}C (Vető et al, 2004).

For the better understanding of the governing mechanism the former isotope studies were completed with $\delta^{13}C$ measurements of dissolved inorganic carbon (DIC) and of the co-existing CO_2 gas, as well as $\delta^{15}N$ study of the dissolved ammonia. On the basis of parallel $\delta^{13}C$ (CO_2) and $\delta^{13}C$ (CH_4) data we could identify gases originating from saline carbonate reduction or methyl fermentation. These isotope investigations help to interpret the water isotope data ($\delta^{18}O$ and δD) and understand the origin of waters.

References

Vető, I., Futó, I., Horváth, I., Szántó, Zs., 2004. Late and deep fermentative methanogenesis as reflected in the H-C-O-S isotopy of the methane-water system in deep aquifers of the Pannonian Basin (SE Hungary). Organic Geochemistry 35, 6, 713-723.