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

I. Futó, Zs. Szántó, É. Svingor, M. Molnár, L. Palcsu, L. Rinyu
Institute of Nuclear Research of the HAS, Laboratory of Environmental Studies, Debrecen

Since Roman times several spas have been known in Pannonia. The first thermal wells were drilled in Hungary around the natural thermal springs during the last century.

Medium deep aquifers (up to 2.5 km depth) of the Pannonian Basin, which is characterized by a thin crust and resulting high heat flux, are tapped by numerous water wells and produce an important volume of water hotter than 65°C (the regional threshold of thermal gas generation). Some of them contain large volumes of carbon dioxide and/or hydrocarbon gas as well as dissolved organic carbon consisting of aromatic hydrocarbons, heteroaromatics and in some cases phenols (Kárpáti et al, 1999). They also contain NH₄.

Most of the waters are dominated by bacterial methane produced during early burial and the contribution of thermogenic methane is also significant (2-3). In a part of the waters deep, hot acetate fermentation took place (2-6).

Parallel with methane formation amino acids decomposed and NH₄⁺ was released as a fluid component (6-7). There is a correlation between salinity and dissolved-NH₄ (7, 10).

In the acetate fermentation phase ammonium starts to break down, nitrogen being released as N₂ (7, 9), and the δ¹⁵N of the residual ammonium becomes more positive. There is an anti-correlation between the ammonium content and the δ¹⁵N values (7-8).

The four waters containing „thermogenic” methane (2, 3, 5) are in three different places far from each other (1), but in the same depth (4-10). They are high salinity waters (10), their outflow temperature is 59-60°C (4). Three of them carry rather high amount of CH₄ (6), and all of them contain 40-50 ppm of NH₄ (7) with extremely positive δ¹⁵N values (+25 - +63‰, 1, 8).

These high salinity waters may contain NH₄ dissolved from micas, in which the δ¹⁵N maybe as positive as +19‰ (Boyd & Philippot, 1998). If NH₄ has been partly released, the residual ammonium may became enriched in ¹⁵N. They also contain more N₂, than the other waters, so the break-down of ammonium may have a role in the enrichment of ¹⁵N.

The NH₄ and CH₄ should be formatted in situ, or they should have less positive, even negative δ¹⁵N and more negative δ¹³C values because of the fractionation during the diffusion.

References
Vető, L, Futó, L, 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