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Geochemistry of free and dissolved gases in the Amik basin area (Turkey) and its relationships with the tectonic setting

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Twenty-two gas samples were collected in August 2012 in the area of Amik basin (Turkey). Two samples were collected from gas seeps, one was a bubbling gas in a thermal spring, while the remaining were dissolved gases from cold and thermal groundwaters (T 16-43 °C). All gases were analysed for their chemical composition (He, H_2, O_2, N_2, CH_4 and CO_2) and for their He isotopic composition. Dissolved gases were also analysed for the carbon isotopic composition of the total dissolved carbon (TDC), while free gases also for their higher hydrocarbon (C_1 – C_5) content and for δD of H_2 and CH_4, δ^{13}C of CH_4

Basing on their chemical composition, the gases can be roughly subdivided in three groups. Most of the dissolved gases (16) belonging to the first group were collected from springs or shallow wells (< 150 m depth). All these samples contain mainly atmospheric gasses with very limited H_2 (< 80 ppm) and CH_4 (1 – 2700 ppm) contents and minor concentrations of CO_2 (0.5 – 11.2 %). The isotopic composition of TDC evidences an almost organic contribution. The only exception is represented by the CO_2-richest sample where a small but significant mantle contribution is found. Such contribution can also be evidenced in its ^{3}He rich isotopic composition. Further three samples of this group evidence a small mantle contribution. These samples were collected in the northern part of the basin along the main tectonic structures delimiting the basin and close to areas with quaternary volcanic activity.

A second group is composed by two dissolved gases collected from deep boreholes (> 1200 m depth). Their composition is typical of hydrocarbon reservoirs being very rich in CH_4 (> 78 %) and N_2 (> 13%). Also the water composition is typical of saline connate waters (Cl- and B-rich, SO_4-poor). C-isotopic composition of methane ($\delta^{13}C \sim$ -65%¸) points to a biogenic origin while He-isotopic composition indicates a prevailing crustal signature for one (R/Ra 0.16) of the sites and small mantle contribution for the other (R/Ra 0.98).

To the last group belong four gas samples taken at two sites within the ophiolitic basement that crops out west of the basin. These gases have the characteristic composition of gas generated by low temperature serpentinisation processes with high hydrogen (37 – 50 %) and methane (10 – 61 %) concentrations. While all gases show an almost identical δD-H_2 of $\sim$ -750‰ those of one of the two sites display an isotopic composition of methane ($\delta^{13}C \sim$ -5‰ $\delta D \sim$ -105%¸) and a $C_1/[C_2+C_3]$ ($\sim$100) ratio typical of abiogenic hydrocarbons and mantle-type helium (R/Ra: 1.33), while those of the other site evidence a contribution of a crustal (thermogenic) component ($\delta^{13}C$-CH_4 $\sim$ -30‰ $\delta D \sim$ -325‰ $C_1/[C_2+C_3] \sim$ 3000). Such crustal contribution is also supported by higher N_2 contents (40% instead of 2%) and lower He-isotopic composition (R/Ra 0.07).

The preliminary results highlight contributions of mantle-derived volatiles to the fluids vented along the Amik Basin. The main tectonic structure of the area, the Death Sea Fault, and other parallel structures crossing the basin seem to be the responsible for deep-originated volatiles drainage towards shallow levels.