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Dissolved gases monitoring to disclose regional hydrogeochemical interactions processes involved in mineral water genesis in non-active zone: the case of Corsica Island

MARGAUX DUPUY[1], EMILIE GAREL[1], THIERRY LABASQUE[2], DR. ELIOT CHATTON[3], VIRGINIE VERGNAUD[2], LUC AQUILINA[2], SEBASTIEN SANTONI[1], ALEXANDRA MATTEI[1] AND FRÉDÉRIC HUNEAU[1]

[1]Univ. of Corsica, CNRS, UMR 6134
[2]Univ. Rennes, CNRS, UMS 3343
[3]CNRS UMR6118

Presenting Author: dupuy_m@univ-corse.fr

In complex geological context, not seismically active, deep water-rock interactions associated with transit time and geological disparities can generate singular mineralisation associated to significant gaseous content. Widely used as tracers in seismically – and tectonically– active regions, the gaseous emission monitoring is underused to discriminate regional from local groundwater flow patterns. In this study the dissolved gas monitoring in groundwater has proven to be an innovative tool for reconstructing interactions involved in regional flows, and responsible for the genesis of highly diversified mineral water-types.

The oriental plain of Corsica (France) has been investigated as an area with a wide variety of mineral waters (22 springs) emerging at the interface of magmatic, metamorphic and sedimentary rocks. Dissolved reactive (N_2, CO_2, CH_4, H_2S, H_2, O_2) and noble gases (Ne, Ar, He) on 9 springs have been quarterly sampled, and analysed by gas chromatography (µGC). The first results highlight 3 very contrasted gas abundances:

- N_2-rich thermal waters (54 °C), poorly mineralised, with noble gas occurrence as cortege gases, highlighting the influence of deep flow with a long groundwater residence time.
- CO_2-rich cold waters (<20 °C), low to highly mineralised, with N_2 as cortege gase, highlighting the occurrence of deep flow interacting during upflow through metacarbonates.
- CH_4-rich cold waters (<20 °C), highly mineralised, with H_2S and CO_2 as cortege gases, showing biotic anaerobic activity involvement in the gases composition of waters.

Then, based on the observed abundance of noble gases, theoretical recharge conditions were computed to defined recharge temperature, air- and He-excess. Computation results have stressed out the common origin of these three gas, depending on flow paths, reservoir conditions, biotic and abiotic interaction involvement. The circulation within magmatic reservoir is responsible for the deep N_2-rich flow, which shows during his up-flow abiotic interactions with metamorphised carbonates rocks, increasing the CO_2 content in water. Then under anoxic geological confinement in deep sedimentary layers, the CO_2 is reduced into CH_4 and N_2 into NH_4. In the shallowest sedimentary layers, the formed CH_4 is degraded, due to the occurrence of rich-organic matter lithology, by biotic activity into H_2S.