Geochemical characterization of dissolved noble gases in thermal springs in the Betic Cordillera (Spain)

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The Betic Cordillera (Spain) is a tectonically active zone corresponding to the European western part of the Alpine peri Mediterranean orogenic belt. Several occurrences of thermal springs are known in the Betic Cordillera with moderate temperatures comprised between 23 and 50°C. The location of these thermal springs are closely related to major faults, including the Cadix-Alicante Fault and strike-slip fault bordering the southern part of the Nevado-Filábride Complex. The concentrations of dissolved gases and the isotopic compositions of helium and neon in these waters have been analyzed in order to identify the origin of these fluids. The helium concentrations are comprised between $9.08*10^{-4}$ and $5.34*10^{-3}$ $cc.l^{-1}$, with values exceeding $1.46*10^{-3}$ $cc.l^{-1}$ for thermal waters with temperature exceeding 30°C. Those values are two orders of magnitude higher than those measured in air saturated water suggesting gas-water interaction processes with volatile-rich fluids. The helium isotopic data (R/Ra ratios) range from 0.06 to 1.03 whereas the measured $^4He/^{20}Ne$ values span between 0.4 and 32.87. These preliminary results seem to show that the crustal radiogenic contribution of helium is predominant for the thermal springs and the mantle-derived contribution is almost negligible. Hence, no mantelic fluid circulations through the major faults structuring the cordillera could have been evidenced. One thermal spring at the border of the metamorphic complex of Nevado-Filábride shows bubbling gases with high concentration in CO_2 (70% vol.), whereas its $^4He/^{20}Ne$ and R/Ra ratios are close to that of air. This gas phase could be interpreted as a mixture of atmospheric gases and pure CO_2 produced by metamorphic reactions of carbonates.