Three new auxiliary chemical geothermometers for hot brines from geothermal reservoirs

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Since the 1960s, several classical geothermometers such as Na-K, Na-K-Ca, K-Mg, SiO_2, $\delta^{18}O(H_2O)$-$\delta^{18}O(SO_4)$ are commonly available in geothermal exploration to estimate the reservoir temperature from chemical and isotopic analyses of fluids collected either from wells or thermal springs. Unfortunately, these estimates are not always concordant, especially at low and medium temperature (≤ 150°C). The absence of equilibrium reactions between water and minerals occurring in the geothermal reservoirs, the mixing of the deep geothermal fluids with surface waters or their cooling and the associated precipitation/dissolution processes during their rising to the surface can be responsible of these discordances.

The Na-Li auxiliary geothermometer which is less accurate than the previous geothermometers, but is often more reliable due to the low Li reactivity during the ascent of the geothermal waters up to the surface, can be very useful for geothermal exploration [1], [2]. So, within the framework of the FP7 EU IMAGE project, we identified and tested several thermometric relationships for dilute geothermal waters from European granite reservoirs [3], after an exhausted literature review about the use of potential auxiliary geothermometers. We also developed three new Na-Rb, Na-Cs and K-Sr thermometric relationships from 20 hot natural brines collected from granite and sedimentary reservoirs [4] whose the majority is located in the Rhine Graben (France and Germany), apart two which are at Salton Sea (USA), and are the hottest reservoirs (300-320°C). The existence of different thermometric relationships for a given geothermometer suggests that the latter not only depends on temperature, but also on other factors such as the nature of the rock, its degree of alteration, the water-rock ratio or the fluid composition and salinity.

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