Lithium and boron isotopes for a new coupled geothermometer.

MYLENE MOMBRU[1*], DAMIEN LEMARCHAND[1], SOPHIE RIHS[1]. SEBASTIEN HAFFEN[2]

[1]LHyGeS/CNRS, Univ. Strasbourg, France.
[2] Teranov, ENSG, Vandoeuvre-les-Nancy, France.
[*]Correspondance : mylene.mombru@etu.unistra.fr

Before building new geothermal power plants, the estimation of the temperature in deep hydrothermal fields is essential to evaluate the potential geothermal resources. The analysis of surface hydrothermal springs, supposed linked to the geothermal reservoir, can help for the determination of the deep temperature. Several methods based on major/trace chemical ratio, such as, Na/Li ratio were previously used as a proxy for the temperature acting in the reservoir. But these chemical methods remain dependent on the mineralogy and chemistry of both the rocks and the fluids that interact in the hydrothermal systems of interest. Here, a new approach is proposed coupling lithium and boron isotopes to minimize the influence of the mineralogy and deep water chemistry and therefore provide a more reliable geothermometer.

The isotopic imprint of water/rock interaction on deep fluids is related to the temperature at which reactions occur, which allows us to use lithium and boron isotopes as thermometers. Because the fractionation of lithium and boron is different for a given temperature, coupling these isotopes allow to reduce the number of parameters and test wether equilibrium conditions are reached in the reservoir. This fractionation was investigated through fluid/rock interaction experiment conducted at different pH (3-8) and temperatures (50-200°C) in diluted seawater. Three minerals – albite, K-feldspar and biotite – and two rock samples – andesite and granite – were used in these experiments to represent volcanic (Guadeloupe, GEOTREF) and continental (Soultz-sous-Fôrets) hydrothermal context.

Experimental results show that concentrations and isotopic ratios of both elements are clearly dependent on temperature. A decrease of franctionation with temperature is systematically observed. Boron and lithium isotope primarily result from a mixing between the diluted sewater and the lithium and boron realeased from solids. The temperature dependence of the isotopic fractionation during secondary minerals precipitation appears of second order. These results show that coupling lithium and boron isotopes in hydrothermal fluids allows to remove parameters such as weathering intensity leading to a relationship only dependent on temperature.