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Lithium isotopes systematics in Geothermal systems

ROMAIN MILLOT^{1*}, PHILIPPE NÉGREL², AND BERNARD SANJUAN³

¹BRGM, Metrology Monitoring Analysis Department, Orléans, France, r.millot@brgm.fr (* presenting author)

²BRGM, Metrology Monitoring Analysis Department, Orléans, France, p.negrel@brgm.fr

³BRGM, Department of Geothermal Energy, Orléans, France, b.sanjuan@brgm.fr

Assessing the origin and behaviour of lithium and the distribution of Li isotopes in geothermal systems is of major importance in order to increase our knowledge of the lithium cycling in the Earth's crust. Lithium is a fluid-mobile element and due to the large relative mass difference between its two stable isotopes, it is subject to significant low and high temperature mass fractionation which provides key information on the nature of water/rock interaction processes. The main objective of the present work is to constrain the behaviour of Li and its isotopes in geothermal systems both for geothermal water samples representing deep circulation in the crust and by using an experimental approach.

The behaviour of Li and its isotopes ($\delta^7\text{Li}$) have been characterized in geothermal systems located in volcanic island arc areas: Guadeloupe, Martinique islands [1] and in New Zealand [2]. Moreover, one particularly important aspect of this work was to establish the nature, extent and mechanism of Li isotope fractionation as a function of temperature during water/rock interaction.

And, we also report results of Li isotope exchange experiments during seawater/basalt interaction (from 25 to 250°C). These results confirm that Li isotopic exchange is strongly temperature dependent, and demonstrate the importance of Li isotopic fractionation during the formation of Li-bearing secondary minerals and allow us to determine the following empirical relationship between isotopic fractionation and temperature: $\Delta_{\text{solution} - \text{solid}} = 7847 / T - 8.093$.

This work shows that the fractionation of Li isotopes is dependent upon the extent of water/rock interaction in terms of intensity (i.e. temperature that control primary mineral dissolution and secondary mineral formation in geothermal systems). Altogether, this study highlights that the use of Li isotopic systematics is a powerful tool for characterizing the origin of geothermal waters as well as the nature of their reservoir rocks.

[1] Millot *et al.* (2010) *Geochim. Cosmochim. Acta* **74**, 1852-1871.

[2] Millot *et al.* (2012) *Applied Geochem.*

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