Chemical weathering of granitic rock: experiments and Pb-Li isotopes tracing

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In a recent study (Négrel et al. 2010, Chem. Geol. Vol. 274) focusing on the lead geochemistry and Pb-isotope ratios of groundwaters along a small (53 km^2) endoreic granitic catchment in India (Masheshwaram, Andhra Pradesh), we have shown that most of the lead in the groundwaters is of geogenic origin. Combining a weathering model and field observations, we were able to define a two-step weathering process that includes a control on the Pb-isotope ratios by accessory phases and by the main minerals from the granite in a second step of weathering.

In order to go further and to better characterize water/rock interactions, we performed laboratory experiments with the two main granite bedrocks from this site. The aim of the present work is to better constrain the processes of water/rock interactions both in terms of source (dissolution of different primary minerals) and extent of weathering, by measuring Pb isotope signatures in addition with Li isotope signatures.

Laboratory experiments consisted in measuring the evolution through time of major and trace elements, as well as Pb and Li isotopic compositions of a rainwater solution in equilibrium with a granite powder. Experiments were carried out at 25°C with a solution/powder mass ratio of 10 considering 15 mL of reference solution TMRAIN-95 and 1.5 g of powdered granite placed in screw-top Teflon® PFA beakers. The beakers were kept in a temperature-controlled oven, which temperature was maintained within 5% of target temperature over the total duration of the experiments. Aliquots of the solution (after filtration at 0.2 µm) in contact with the granite powder were periodically sampled (from weeks up to 2 years) and analyzed for lead and lithium isotopic compositions.

The results show that a radiogenic contribution of lead is observed during the experiments, in agreement with the field observations, and that the light lithium isotope (6Li) is preferentially retained during uptake of Li into secondary minerals.

The results of these experiments will be discussed in the frame of the relative proportion of granite weathering (dissolution of primary minerals) to secondary mineral formation.