Utility of Li and Li isotopes as tracers of silicate weathering

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It is now well established that changes in rates of silicate weathering have the potential to regulate levels of atmospheric carbon dioxide, the principal greenhouse gas. Thus far information on past changes in silicate weathering rates largely relies on studies of the temporal record of the Sr isotopic composition of the oceans. However, in recent years the utility of this proxy has been questioned, because shifts in Sr isotopes may reflect changes in the composition of the continental source rather than a simple change in weathering flux. To better constrain the links between weathering and climate, it is therefore imperative to find new proxies for continental weathering processes. Here, we discuss the potential of lithium and its isotopes.

We have conducted systematic surveys of lithium and its isotopes in the dissolved load and suspended and bed sediments of rivers in the Himalaya, Iceland and the Azores. Locations were chosen in order to cover catchments of differing lithology, altitude and vegetative and glacial cover. Our data indicate that most of the dissolved Li (>90%) in Himalayan rivers is derived from silicates even in carbonate-dominated catchments. The main control on the Li isotopic composition of the dissolved load is fractionation during weathering; the δ^7Li value of the dissolved load decreases with increasing silica, alkalinity and saturation state of secondary minerals in Icelandic rivers. Finally, we show that both Li and δ^7Li are conservative during estuarine mixing.

As rivers presently contribute ~50% of the Li input to the oceans, we suggest that past variations in seawater Li concentrations and δ^7Li are likely to reflect changes in silicate weathering processes. To this end, we have produced multi-species records of the Li/Ca ratio and Li isotopic composition of planktonic foraminifera from the Atlantic and Pacific oceans for the past 18 Ma. The results of this study will also be discussed.