Effects of the dissolution of trace calcites on silicate weathering

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Silicate weathering has significant influence on the global carbon cycle and climate change. However, the amount of CO_2 consumed by global silicate weathering remains controversial, some Ca and HCO_3 in silicate catchments may be from rapid dissolution of trace calcite.

For discuss the influence of trace calcite, some small granitic and basaltic catchments in different climate zones in China were selected. We use chemical analyses of river waters together with carbonate leachates and silicate residues from the riverbed sediments and bedrocks to model the relative fractions of Sr, Mg and Ca derived from carbonate and silicate weathering. Moreover, we also try to use a high-precision Ca isotope MC-ICPMS method ($\delta^{44/40}Ca$) to trace sources of Ca in these silicate rivers.

The preliminary results showed that in tropical Hainan small basaltic watersheds, the $^{87}Sr/^{86}Sr$ ratios were 0.705418–0.709096, 0.704871–0.708660 and 0.707879–0.712263 in stream water, ground water and rain water, respectively. In the leaching experiments of basalt bedrock and sediment, the $^{87}Sr/^{86}Sr$ of acetic acid leachate (0.704238–0.707788) was higher than that of silicate residues (0.703385–0.706765), which indicates that the dissolution of trace carbonate minerals in the bedrock will increase the $^{87}Sr/^{86}Sr$ values of river water. $^{87}Sr/^{86}Sr$ of river water in mono-lithological basaltic watershed is slightly higher than that of bedrock, acetic acid leachate and groundwater. Therefore, there is still an unknown source that affects the hydrochemistry of rivers to be solved.

On the contrary, in the catchments dominated by granite where the $^{87}Sr/^{86}Sr$ of river water was >0.709, the $^{87}Sr/^{86}Sr$ in silicate residues (0.711325–0.737871) of the sediments was higher than those in the acetic acid leachate (0.709732–0.724503). The $^{87}Sr/^{86}Sr$ of this leachate is much higher than that of the common carbonate endmember (about 0.709). The possibility that calcite may also have a high $^{87}Sr/^{86}Sr$ ratio by exchange with silicate minerals during metamorphism makes it more difficult to use Sr isotopes to discriminate the fractions of cations derived from silicate and carbonate sources in rivers. We are taking the time to analyze the $\delta^{44/40}Ca$ data, and then combine with Sr isotope and leaching experiment to better explore the contribution of trace calcite to silicate weathering.