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### Isotopic composition of dissolved Mg in Himalayan river waters

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The isotopic composition of a dissolved element is controlled by the isotopic composition of its source rock and any mass dependent fractionation occurring during dissolution. Analyses of Mg-isotopic compositions therefore have the potential application to help determine the relative proportions of Mg derived from carbonate and silicate sources and the extent to which incongruent dissolution govern its concentrations. This is of particular interest for the Himalayan-Tibetan region where there is debate about the amount of silicate weathering and where the  $^{87}\text{Sr}/^{86}\text{Sr}$  is not a straightforward proxy of the silicate contribution.

We have measured the  $\delta^{26}\text{Mg}$  from 13 tributaries of the Marsyandi watershed and the Langtang in the Nepal Himalaya by a Nu instruments MC ICPMS. The samples chosen for analysis represent a range of chemical compositions thought to correspond to tributaries which are dominated by either a silicate input or a carbonate input with a view to identifying a carbonate end-member and a silicate end-member for  $\delta^{26}\text{Mg}$ . A 1.1‰ range in isotopic compositions is observed with waters in the range -0.7‰ to -1.8‰ relative to the DSM3 standard. The water is, therefore, 2.2 to 3.8 ‰ heavier than the Himalayan limestone [1]. Based on the  $\delta^{26}\text{Mg}$  of loess, a proxy for silicates [2], Himalayan tributaries have  $\delta^{26}\text{Mg}$  close to the silicate rock. There seems to be little or no correlation between the  $\delta^{26}\text{Mg}$  and the major cation chemistry of the tributary making silicate and carbonate end-members difficult to identify. Even in the most carbonate-like tributaries (where Mg is <2% of the bedrock), the Mg isotope budget is likely to be controlled by small amounts of silicate present in the bedrock dominating the even smaller amounts of Mg present in low Mg calcite. Similar discrepancies between the isotopic composition of low-Mg lithology and corresponding dissolved Mg have been previously reported [1].

#### References

- [1] Galy A., Bar-Mathews M., et al. (2002) *Earth and Planetary Science Letters* **201**, 105-115.
- [2] Young E.D. and Galy A. (In Press) *Rev. Mineral. Geochem.*

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### Utility of lithium isotopes as tracers of continental weathering processes

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We have conducted a systematic survey of  $\delta^7\text{Li}$  and elemental concentrations of dissolved load, suspended load and bed sediments from river catchments in the Nepalese Himalayas both before and after the monsoon. Locations were chosen in order to cover catchments with (i) silicate and (ii) carbonate lithologies, in two different weathering regimes: (a) high altitude (2500-4000m) with low weathering intensity versus (b) low altitude (800-1000m) with high weathering intensity.

Rivers draining silicates are identified by low molar Ca/Na ratios (0.25 to 3.0), whereas rivers draining carbonates have high molar Ca/Na ratios (4.9 to 41). Although the  $\delta^7\text{Li}$  values of both the bed sediments and the suspended load from carbonate catchments are usually higher and thus distinct than those of silicate catchments, there is considerable overlap in the  $\delta^7\text{Li}$  values of the dissolved load between the different lithologies (+6 to +27‰). The Li isotope composition of the dissolved load is always heavier than the suspended load, which demonstrates that the light isotope is preferentially retained in the solid phase during weathering.

The fractionation factor ( $\alpha$ ) between the dissolved load and the suspended load is highest for silicate catchments at high altitude (0.975 to 0.977), followed by silicate catchments at low altitude (0.979 to 0.986), followed by the carbonate catchments (0.982 to 0.991). These data demonstrate that  $\alpha$  is a proxy for weathering intensity; if weathering is rapid and superficial,  $^7\text{Li}$  is released preferentially, whereas in transport-limited regions where reaction is slow but complete even the light fraction is being solubilized. Our data also show that rivers draining silicate catchments in the Himalayas have lower  $\delta^7\text{Li}$  values after the monsoon, by 2.0 to 4.4‰. This demonstrates that weathering of silicates is more intense during the monsoon, both at high and low altitude. The  $\delta^7\text{Li}$  value of rivers draining carbonates is not changed significantly by the monsoon, confirming that weathering of carbonates in the Himalayas is essentially complete.

Based on these data, we conclude that Li isotopes are an effective tracer of weathering intensity in the Nepalese Himalaya. However, Li isotope analysis of the dissolved load cannot be used to distinguish weathering of carbonates from weathering of silicates.