

Understanding bioaccumulation of metals by aquatic organisms in streams of different bedrock geology using Sr and Mg isotopes

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In stream ecosystems, dissolved metals play important roles in biological production. Ultimately, dissolved metals in streams mainly derive from chemical weathering of bedrocks in the catchment representing potential sources to stream biota. We use Mg and Sr isotopes of stream biota to test whether the bedrock type is reflected in the isotopic composition of aquatic organisms. In November 2017, we sampled aquatic organisms of different trophic level from eight tributaries to Lake Biwa (central Japan), which have natural, forested catchments. Four of these streams have limestone in their watersheds (18–38 %) and four streams lack of limestone (“non-limestone streams”). We measured metal concentrations, $\delta^{26}\text{Mg}$ and $^{87}\text{Sr}/^{86}\text{Sr}$ of aquatic insects, bones of goby (*Cottus pollux*), shells of crayfish (*Geothelphusa dehaani*) as of stream water and rock cobbles. Mayflies (*Baetis*), cranefly (*Tipulidae*) and caddisfly (*Hydropsychidae*) from limestone streams were enriched in Mg and Ca indicating that dissolved Ca and Mg from stream water contributed more to insects of lower trophic positions. We found stream organisms from limestone streams to have often lower $\delta^{26}\text{Mg}$ values compared to the same organisms from non-limestone streams pointing to limestone contributions. Stream insects showed an offset in $\delta^{26}\text{Mg}$ to higher values compared to stream water indicative for Mg fractionation during Mg incorporation. Differences in $\delta^{26}\text{Mg}$ with trophic level, which are not the same between limestone vs. non-limestone streams, may arise from organism-dependent seasonal variations in $\delta^{26}\text{Mg}$ of metal sources. We expect similar findings for $^{87}\text{Sr}/^{86}\text{Sr}$, i.e. low $^{87}\text{Sr}/^{86}\text{Sr}$ in limestone stream organisms indicate limestone contributions. We conclude that stream organisms may serve as proxies for the bedrock type in the catchment.

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