Tracing the contribution from weathering to a glacial stream in Antarctica

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In high latitude environments, silicon is supplied to river waters by both glacial and non-glacial chemical weathering. The signal of these two end-members is often obscured by biological uptake and/or groundwater input in the river catchment. McMurdo Dry Valleys, characterised by extensive permafrost, has no deep groundwater input and no surface vegetation cover, so provides a simplified system for us to constrain the supply of dissolved silicon (DSi) to rivers from chemical weathering. Here we report Si concentrations and Si isotope values ($\delta^{30}Si$) in Crescent Stream in McMurdo Dry Valleys from the 2014 – 2017 austral seasons. The DSi concentrations are higher than reported in sub- and supra- glacial meltwaters, with highest DSi concentrations in January coinciding with peak stream flow. This shows that Si concentrations increase during transient water storage in the hyporheic zone. The $\delta^{30}Si$ composition ranges from +0.91 ‰ to +1.39 ‰ between 2015 and 2017 and show no seasonal variation. The $\delta^{30}Si$ values are higher than $\delta^{30}Si$ values reported in sub-glacial waters showing that Si isotope fractionation, likely via clay mineral formation and amorphous silica precipitation, occurs during transport of glacial waters through the hyporheic zone. We show that silicon isotopes provide a way to track the relative contribution from chemical weathering in the hyporheic zone and glacial water to DSi in rivers. This is important in the context of the ongoing retreat of dry-based glaciers and the exposure of more land surface to chemical weathering.

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