Global inputs of dissolved silica from submarine groundwater discharge

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In the marine silica budget, riverine fluxes of dissolved silica (DSi), 7.3 – 8.1 Tmol/y, to the global ocean remain the most documented, whereas the magnitudes and uncertainties of other input fluxes are largely unconstrained. In particular, inputs via submarine groundwater discharge (SGD) are given a cursory treatment when constructing marine budgets of silica and silicate weathering products. Here, we report DSi concentrations in the subterranean estuary (STE) from ten new sites. Augmenting this data with an extensive literature search, we established terrestrial and marine DSi end – member concentrations by major lithology (carbonate, shale, sandstone, igneous extrusive, shield, and "complex"). Shale and sandstone aquifers have similar terrestrial SGD concentrations (160 – 180µM), whereas aquifers composed of shield and "complex" lithology have [DSi] of ~290 – 330 µM. Sufficient evidence of non-conservative DSi enrichment, resulting from mineral dissolution in recirculated marine groundwater, was available to constrain extrusive igneous (56µM) and "complex" (50µM) marine SGD [DSi] end – members.

Using the terrestrial DSi groundwater concentrations from multiple endmember aquifer lithologies and a global terrestrial SGD model, we calculate DSi fluxes to the ocean equal 0.7±0.1 Tmol/y [1]. Based on a total (terrestrial+marine) SGD-driven DSi flux of 3.8±1.0 Tmol/y [2], we estimate that marine SGD supplies an additional DSi flux of ~3Tmol/y. Total SGD DSi fluxes are ~5X greater than previous estimates and are ~60% of the global riverine DSi flux. These findings indicate the residence time of oceanic Si is ~25-30% lower than the current estimate of 10ka, and impacts the mass balances of silicate weathering products.

[1] Rahman et al. (2019) *Mar. Chem.* **208** 29-42. [2] Cho et al. (2018) *Nature* **8**, 4-10.