

Behavior of Beryllium in the weathering environment and its delivery to the oceans

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Chemical weathering of silicate rocks is one of the major long-term sinks of atmospheric CO₂. Any change in the rate of this process as a function of climate has important implications for climate sensitivity. While several radiogenic isotope systems (e.g. Nd, Pb, Os) in the authigenic component of recent marine sediments show temporal patterns that could be interpreted in terms of fluctuations in chemical weathering rate over glacial cycles, recent work using beryllium isotopes suggests little such variation. However, our knowledge of the sources of ⁷Be to the oceans is incomplete.

Here, we address some of the gaps in knowledge with new data on Be in Croatian and Scottish rivers and estuaries, as well as with mixing experiments between Amazon tributaries and ocean water. The new data, combined with data from the literature, confirm that riverine Be is only marginally affected by carbonate weathering, which only accounts for 0.4-1.5% of dissolved riverine Be fluxes. The behavior of Be in estuaries is highly variable, with some estuaries showing removal and others addition. Based on the available data, about 60% of dissolved riverine Be is removed in estuaries, with complexation by both organic vs. inorganic ligands appearing to exert a strong control on the specific behavior in a given estuary. Beryllium complexation with organic material facilitates transport across estuaries, whereas the presence of inorganic complexants results in loss. Presence of both colloidal ligand types may lead to stronger non-conservative removal compared to only one type being present. Coupling different estimates of the dissolved riverine Be flux with estimated estuarine removal, we calculate that 70-89% of the marine ⁷Be input is derived from sources other than riverine dissolved loads, including desorption from particulate matter and release from shelf sediments. Although this finding is similar as for other elements that do show variation over glacial cycles (e.g. Nd), it should be taken into account when inferring weathering rates from Be isotopes in marine sediments.