Constraints on the incongruent weathering of Hf isotopes in the Leverett and Russell catchments, west Greenland

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Hafnium isotopes released during weathering are more radiogenic than the compositions in weathered source rocks. This incongruency reflects differential weathering of rock forming minerals characterized by variable Lu/Hf ratios and Hf isotope compositions. Our understanding of the parameters, which could reduce or increase the incongruency is limited and not well substantiated by observations in the weathering environment. Here, we report on dissolved and particulate Hf and Nd isotope compositions from glacial and non-glacial rivers and streams of the neighbouring Leverett and Russell Glaciers in West Greenland, complemented by measurements of catchment sediments, bulk rocks and mineral separates. The catchment largely consists of amphibolite facies gneisses and granites, but layers and lenses of metabasite also occur. Due to the Archean age weathering contributions from specific minerals should be detectable.

Most of the Nd data is isotopically quite uniform, between εNd = -43 and -38. Hafnium isotopes, however, show large variations, becoming increasingly more radiogenic from felsic bulk rocks (εHf = -60 to -55) to catchment sediments (-55 to -47), riverine suspension (-46 to -35) and dissolved Hf (-18 to -7 in glacial, +16 to +46 in nonglacial rivers). The variation in Hf isotope compositions of the different solid samples can be explained by mineral sorting and decreasing abundances of zircons. The large difference between riverine suspension and dissolved Hf, however, has to reflect the preferential weathering of radigogenic minerals. Although titanite in the gneisses (εHf = +21, +177) is likely to contribute to the radiogenic dissolved Hf, an even larger effect arises from the weathering of metabasite-hosted garnet (εHf = +1308) and epidote (+123).

Although the strongly incongruent weathering in both catchments suggests that glacial grinding is not very effective in promoting the release of unradiogenic Hf from zircons, an indication of such an effect still arises from the comparison of glacial and non-glacial streams, which are more radiogenic by several tens of epsilon units.