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Spatial and temporal variations in the detrital and authigenic neodymium isotopic compositions of Svalbard fjord sediments

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Detrital and authigenic neodymium isotopes (143Nd/144Nd; εNd) have been demonstrated to be useful tracers for sediment provenance and water mass composition because of their limited incongruent weathering and short oceanic residence time. As the sediment transport and hydrology of fjord systems in Svalbard are mainly governed by glacier retreat and advance, tracing of sediment provenance and water mass composition using these two proxies is essential to understand the environmental change in Svalbard fjords. Surface sediments obtained from various fjords on Svalbard, i.e. Dicksonfjorden, Hornsund, Isfjorden, Van Mijenfjorden, Wijdefjorden and Woodfjorden, were analysed with regard to detrital and authigenic neodymium isotope ratios with the purpose of tracing spatial variation in sediment provenance and water mass composition, as well as to test their potential application in palaeoclimatic and paleoceanographic studies of fjord sediments.

Detrital and authigenic εNd values are spatially variable, ranging from -25 (-15) to -10 (-9), and they correlate generally well (r = 0.62, n = 45). We attribute the fluctuation in εNd to various types and ages of bedrocks in the drainage area. The fluctuation in εNd is the largest in Hornsund (-25 to -10 for detrital εNd and -14 to -9 for authigenic εNd) where the eroded rocks include pre-Devonian metamorphic rocks and various younger sedimentary rocks (e.g. limestones, sandstones, shales). The similar spatial patterns between detrital and authigenic εNd indicate that local water circulation generally exerts influence of the sediment provenance, as well as the water mass composition in Hornsund. On the other hand, εNd values in Dicksonfjorden and the Woodfjorden vary from -14 (-12) to -13 (-11), indicating that similar bedrocks, i.e. Devonian red sandstone (εNd = -13.6), occur in the drainage areas of both fjords.

In addition to surface samples, we investigated two sediment cores from Dicksonfjorden (HH16-1202) and the Woodfjorden (HH12-964), respectively, to reconstruct temporal variations in lithological sediment provenance and water-mass composition through time. Minor temporal variations in detrital and authigenic εNd measured on two sediment cores shows that the Devonian red sandstone has also been the dominant bedrock in meltwater drainage area during the Holocene. However, the overall decreasing εNd trend in Dicksonfjorden may result from the change in meltwater drainage by landward glacier retreat. The temporal variation in authigenic εNd does not well correspond to detrital εNd, in particular in Woodfjorden, reflecting that the water mass composition in Woodfjorden has been also affected variations in external input, such as the inflow of Atlantic Water and/or changes in local meltwater discharge from surrounding glaciers.