

Interactive comment on “Clay mineralogy, strontium and neodymium isotope ratios in the sediments of two High Arctic catchments (Svalbard)” by Ruth S. Hindshaw et al.

Anonymous Referee #2

Received and published: 21 November 2017

The present study investigates the major-trace element, strontium-neodymium isotope composition and mineralogy of rocks and river sediments from two small high-Arctic catchments from Svalbard. The authors find that the Sr-Nd isotope composition of suspended sediments is quite variable between these two catchments ($\epsilon_{Nd0} = -24.2$ to -11.9 ; $87Sr/86Sr = 0.72449$ to 0.75243), between different grain sizes (lower $87Sr/86Sr$ and higher ϵ_{Nd0} in the clay fraction), between different time of the melting season and between leachable and non-leachable fractions. They show that the whole range of Sr-Nd isotope composition of the sediments can be explain by a mixture between two distinct lithological sources and not by modern weathering processes. The contribution of each of these two erosion sources being a function of the glacial cover, they argue

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that climatic variations (e.g. glacial-interglacial cycles) can result in a change of the Svalbard end-member Sr-Nd isotope composition over time with important implications for paleo-marine reconstructions.

In general, the manuscript is well-written and the data are discussed in great detail so that in my opinion, the conclusions of the study are relevant and convincing. I suggest this manuscript to be published in Earth Surface Dynamics with minor revisions. The few minor points that should be clarified in order to improve the manuscript are discussed below. The authors use these data to address 4 different questions:

(i) Characterization of the Svalbard source for paleo-oceanic reconstructions: so far, there are no available data on detrital sediments from Svalbard despite the importance of Svalbard location in regard with ocean circulation (as stated in the introduction by the authors). Hence, these new data are very important for interpreting Arctic sediment paleo Sr-Nd isotope composition with implications on paleo-climatic and oceanic reconstruction of the Arctic ocean. However, it is not clear in the current manuscript how representative these data are of the whole Svalbard area. Indeed, the total area of these two catchments corresponds to 0.01% of the total Svalbard surface (61 022 km²), which is very small. In what extent the data from these two catchments can be considered as representative or not of the Svalbard source region for paleo-erosion source-mixing reconstruction?

(ii) Control of the heterogeneity of the Sr-Nd isotope composition of Svalbard river sediments: the authors show that there is a large variation in the $^{87}\text{Sr}/^{86}\text{Sr}$ and eNd0 composition of bulk sediments from these two catchments (inherited from the mixture of sediments derived from the Siberian traps and Archean rocks). However, in the absence of any information about fluxes, it is difficult to conclude about the integrated contribution of these two catchments and hence whether there is indeed a significant difference between the contribution of glacial and non-glacial areas in Svalbard (as claimed by the authors in lines 30 to 33).

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(iii) Influence of the grain-size on the isotope composition of sediments in the Arctic: the authors show that the clay mineral fractions have higher ϵNd and lower $^{87}\text{Sr}/^{86}\text{Sr}$ compared to bulk sediments. The implication of this result, which is not discussed in the paper, is that the Sr-Nd isotope composition of detrital sediments is a function of grain-size. This grain-size control is important to take into account for interpretation of Arctic ocean marine sediments paleo-record.

(iv) Characterization of the leachable phase of Arctic river sediments: the authors do not give any justification for why they have conducted leaching experiment on these sediments (in section 5.3). Does the presence of an acid-leach labile phase isotopically distinct from the bulk silicate sediments have any implication for studies looking at the isotope composition of the marine authigenic phase (carbonate and oxides fractions recording the marine isotope composition) of marine sediments? In other words, is it possible that part of the signal extracted by leaching methods (the classical Hydroxylamine Hydrochlorid (HH) in Acetic Acid solution extraction) is inherited rather than authigenic (marine)?

Finally, the authors should provide more information about the samples other than just “samples were collected at different times during the melt season” in the main text in section 3. How many times during the melt season? How much different was the runoff between the different sampling dates? What are the suspended sediment concentration? Is there any available information about the fluxes (water and sediments) for these two catchments?

Interactive comment on Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2017-55>, 2017.

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