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The isotopic composition of Sr and Nd in Arctic Ocean ice rafted sediments: Implications for provenance and transport

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A large fraction of the sea ice in the Arctic Ocean is formed on the surrounding continental shelves. Sediments and other particulates are entrained in the sea ice and the ice drift transports and redistributes these sediments. This ice rafting is an important contributor to the sedimentary archives and interpretations of climatically induced changes in sediment provenance require knowledge about trajectories and sedimentary source regions. Although trajectories of drifting ice have been used to study transport of ice-rafted sediments (IRS) before, sedimentary sources and mixing are not well understood and the use of coupled radiogenic isotopes adds important new constraints on the sedimentary source regions.

Fine grained IRS were sampled in the Beaufort Sea in 2000 and during the Swedish Arctic Ocean 2001 expedition, stretching from Svalbard to the North Pole Area. The IRS where characterized for Sr- and Nd-isotopic composition as well as major- and rare earth element patterns. There is a large span in the isotopic compositions of the IRS samples with ε_{Nd} ranging from –7.2 to –14.5 and $^{87}Sr/^{86}Sr$ from 0.7121 to 0.7297. The data display a general mixing relationship between Sr- and Nd- isotopes in that high $^{87}Sr/^{86}Sr$ ratios correspond to the most negative ε_{Nd}. This suggests two major mixing end members, isotopically distinguishable, defining the modern sources for the IRS. Likely, these end members themselves constitutes mixtures of several crustal sources.

However, within the overall mixing relationship significant differences between different groups of IRS are found. This shows that Arctic Ocean IRS is not a well-mixed population and that particular source regions, such as Laptev and Kara Sea can be traced. The data will be interpreted utilizing the known isotopic composition of Sr and Nd in the Siberian shelf- and coastal-sediments and possibly trace the pathways of IRS. The results will also be discussed in terms of the importance of the IRS in controlling the isotopic and trace element composition of Arctic Ocean surface waters.

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Carbon and hydrogen isotopic compositions of sterols in riverine-marine sediments

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Estimation of relative source (marine algae, terrestrial C3 and C4 plants) contribution into sediments from riverine to marine environments is important for the better understanding of burial and mixing processes of organic matter at marine environment.

In this study, the source variation of relative contribution into surface sediments from Ohtsuchi river in Iwate Prefecture, Japan to Northwestern Pacific Ocean is estimated using carbon ($\delta^{13}C$) and hydrogen isotopic compositions (δD) of various sterols.

Results and discussion

Algal sterols such as brassicasterol ($28\Delta^{5,22}$) in marine sediments have $\delta^{13}C$ values of –22.7±0.4‰ and δD values of –292±3‰ (Fig. 1). Multiple source sterols such as campesterol ($28\Delta^{5}$) and β-sitosterol ($29\Delta^{5}$) are gradually more enriched in ^{13}C by 6.1-8.4‰ from riverine (–30.7‰ and –30.5‰, respectively) to marine sediments (–22.3‰ and –24.4‰, respectively), but showing little δD variation (–262±1‰) from riverine to marine sediments. These isotopic signatures suggest that the multiple source sterols should be atributed to C3 plants (~90%) and C4 plants (~10%) in riverine sediment, and marine algae (~30%), C3 (~30%) and C4 plants (~40%) in open marine sediment. Thus, the contribution of C3 plants decreases while that of marine algae and C4 plants increases from riverine to marine sediments.

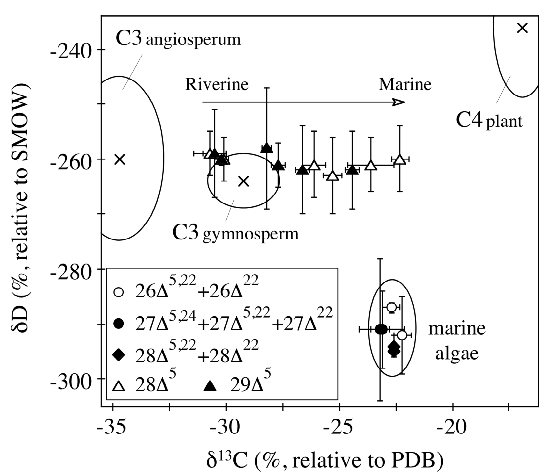

Fig. 1. $\delta^{13}C$- δD cross plot of various sterols in riverine-marine sediments, with putative $\delta^{13}C$ and δD values of sterols for the potential sources.