Factors influencing $\delta^{13}C$ of suspended and sinking organic matter in the coastal antarctic sea ice environment

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This study presents the first high-resolution time series analysis of the $\delta^{13}C$ of dissolved inorganic carbon (DIC), suspended and sinking particulate organic carbon and diatom assemblages in the near shore Antarctic sea ice environment, Ryder Bay, Antarctica. The study spans a period of two growing seasons from 2004 to 2006. Our results show on average higher $\delta^{13}C_{POC}$ in sea ice samples compared to surface waters, possibly brought on by post-production decomposition processes. In addition a very large ~10 ‰ negative shift in surface water $\delta^{13}C_{POC}$ is observed during the growing seasons, which was not accompanied by a similar change in $[CO_{2(aq)}]$ or $\delta^{13}C\text{-}CO_2$. Analysis of diatom assemblages shows distinct changes accompanying the negative $\delta^{13}C_{POC}$ shifts towards collective diatom assemblages with increasing SA:V ratios and thus a higher ε_p. Other processes involving internal cell biochemistry would also have contributed to changes in ε_p, but these processes are not well constrained for most diatom species and cannot be fully investigated in this study. Sinking $\delta^{13}C_{org}$ in sediment traps show that the surface water signal is transferred to depth, with negative $\delta^{13}C$ shifts consistent with surface waters clearly observed in the sediment traps located in Ryder Bay. These findings weaken the utility of using diatom-based $\delta^{13}C$ in reconstructing paleo-pCO_2 as $[CO_{2(aq)}]$ is not a major control on surface suspended $\delta^{13}C_{POC}$ and also highlight the biogeochemical processes that can affect $\delta^{13}C_{POC}$ in sea ice.

Particulate Barium transformations and fluxes in the continental shelf, Antarctic sea ice environment

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The clear relationship between excess barium and organic carbon flux to the seafloor has made the use of marine sedimentary excess barite a popular tracer for paleoproductivity in recent decades. There are still, however, large gaps in the understanding of seasonal controls on particulate barium and barite formation in surface waters and at mesopelagic depths. This study presents high-resolution time-series measurements of barium in sea ice, surface waters, sediment traps and surface sediments, to highlight the processes that govern the seasonal flux of excess particulate barium and carbon to the seafloor. High concentrations of excess particulate barium are seen in sea ice, brought on by the continuous recycling of organic matter in the sea ice matrix, which is then released into the water column during sea ice decay and melting. There is then a clear seasonal cycle in the surface water production of particulate barium, with the excess barium pool dominated by “labile” particulate barium during new production. It is during the decay of organic matter during mid-season lags in primary productivity and at the end of the season when production declines that the particulate barium pool becomes dominated by barite. Although this material is a relatively small proportion of the total flux of particulate barium, it does give insight to the processes that eventually lead to the high Ba:C ratio of sinking material, produced as a result of organic carbon degradation and barite supersaturation at mesopelagic depths. The overall flux of excess particulate barium and carbon in sediment traps in this study is consistent with preliminary algorithms produced in previous studies, but we are able to produce a detailed conceptual model of the seasonal progression of particulate barium formation and transformations in the Antarctic sea ice environment.