Nitrogen cycling in coastal Antarctic sea ice and exchange with the surface ocean

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The west Antarctic Peninsula shelf is a high productivity region of the Antarctic sea ice zone, where sea ice dynamics play a key role in modulating surface ocean phytoplankton blooms. Primary production can also be pronounced within the ice matrix itself, accompanied by intense biogeochemical cycling of carbon, nitrogen and other elements.

Here we use the nitrogen isotopic composition of nitrate ($\delta^{15}N_{NO3}$) and particulate nitrogen ($\delta^{15}N_{PN}$) and ancillary biogeochemical data to examine nitrogen cycling processes in landfast sea ice and surface waters in Ryder Bay, west Antarctic Peninsula, between 2004 and 2006. Concurrent surface water measurements were taken to examine the exchange of nutrients and organic matter between sea ice and the underlying surface ocean.

High $\delta^{15}N_{PN}$ and low $\delta^{15}N_{NO3}$ in sea ice indicate intense nitrogen recycling within the semi-closed ice matrix. *In situ* remineralisation of organic matter was extensive and ammonium-based production played a significant role alongside algal uptake of nitrate supplied from underlying waters. We also found evidence for nitrification as an important source of regenerated nitrate. The implications of such nitrogen recycling for production of the greenhouse gas nitrous oxide and its potential release to the atmosphere, and for surface ocean biogeochemistry and ice-ocean exchanges will be discussed.

This study adds to a growing body of evidence for intense nitrogen cycling in Antarctic sea ice and its effects on large-scale biogeochemical cycles. These findings improve our understanding of the complex role of sea ice within Earth's climate system and must be incorporated into biogeochemical models predicting future ice-ocean-atmosphere interactions in a changing climate.