南極沿岸多年定着氷内に取り込まれる物質とその後の分解過程

野村大樹[1]、青木茂[2]、清水大輔[3]、豊田威信[2]、牛尾収輝[3]、直木和弘[4]、田村岳史[3]

[1]北大院水産、[2]北大低温研、[3]国立極地研、[4]東海大

Incorporation and degradation processes of biogeochemical compounds within Antarctic multi-year land-fast sea ice

Daiki Nomura[1], Shigeru Aoki[2], Daisuke Simizu[3], Takenobu Toyota[2], Shuki Ushio[3], Kazuhiro Naoki[4], Takeshi Tamura[3]

[1]*Faculty of Fisheries Sciences, Hokkaido University,* [2]*Institute of Low Temperature Science, Hokkaido University,* [3]*National Institute of Polar Research*, [4]*Tokai University*

Antarctic multi-year land-fast sea ice was examined to assess the incorporation and the degradation processes of biogeochemical compounds within sea ice. For the incorporation, both processes from the downward growth as columnar ice formation and the upward growth as snow-ice formation were related. Columnar ice formation provided the biogeochemical components from seawater and ice algae at the bottom of sea ice, and this process was dominated for the thin and relatively young land-fast ice. On the other hand, snow-ice formation provided the biogeochemical components from flooded water at snow and ice interface when sufficient snow had been deposited on the sea ice, and this process was dominated for the thick and old land-fast ice in areas of significant snow accumulation. In addition, incorporation process of flooded water was promoted by the sea ice crack formation. The water inside the crack and proximate ice were characterized by an intense brown color, an indication that a massive phytoplankton bloom had occurred within the crack water. Our results suggest that sea ice crack formation provides conditions favorable for phytoplankton blooms by directly exposing the crack water to sunlight. Subsequently, components of the crack water modified by biological activity were transported into the upper layer of the sea ice. Incorporated biogeochemical components and algae were preserved in the multi-year ice column and their concentrations were modified by the photosynthesis and the remineralization process. In the future, the melting of sea ice will strongly affect the output of biogeochemical components trapped within sea ice and their use in primary and secondary production within surface oceans. In the case of multi-year land-fast ice, biogeochemical components that accumulate within the ice would be discharged abruptly to ocean surface waters when the multi-year ice breaks up.

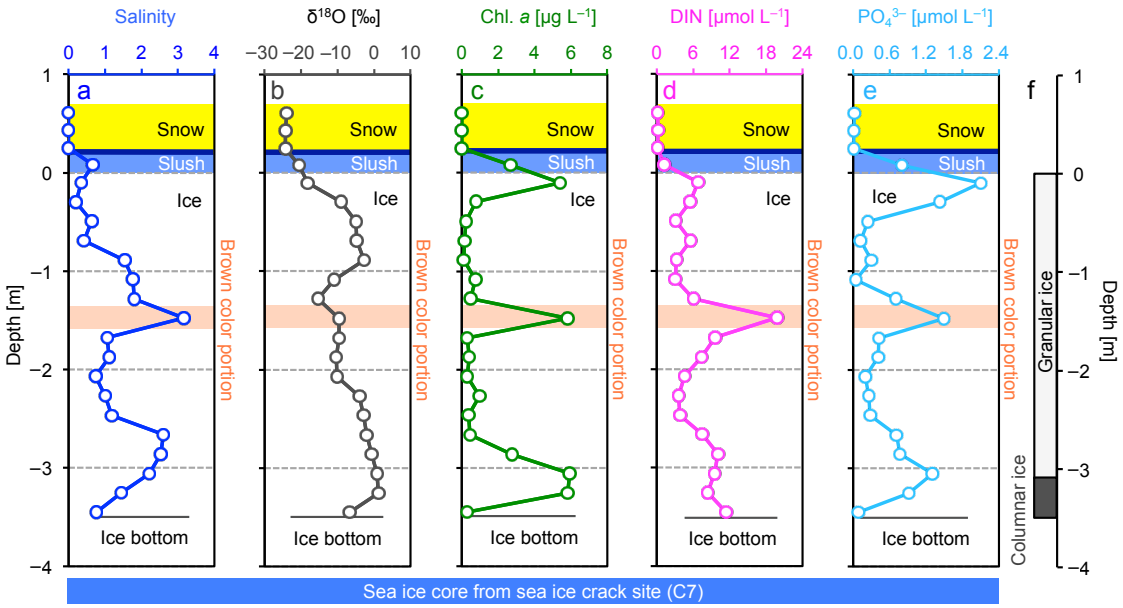

Figure 1. Depth profiles of salinity (a), $\delta^{18}O$ (b), chl-a concentration (c), DIN concentration (d), PO_4^{3-} concentration (e), and sea-ice structure (f) at thick snow and multi-year ice near Syowa station, Antarctica. The yellow, blue, light blue, and brown shading indicate the snow, ice overlying the slush, slush, and brown portions of the sea ice, respectively.