南極海の海氷から大気へのブロモホルム放出

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Bromoform emission over the Antarctic sea ice

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Bromoform is one of the volatile organic compounds emitted from the ocean surface to the atmosphere, and it is believed to affect ozone depletion in the atmosphere through photochemical reactions. While estimates of air−sea flux of bromoform are well examined in open ocean areas, fluxes have rarely been estimated in ice-covered seas, and so far, no observations have been made to evaluate the bromoform flux between the sea ice surface and atmosphere. Here, we present the first direct measurements of the air−sea ice bromoform flux obtained from first-year sea ice off east Antarctica. Measurements were made in early austral spring (September to November 2012) as part of the Sea Ice Physics and Ecosystem Experiment II (SIPEX-2). Vertical profiles of bromoform concentrations in snow and sea ice indicated that high concentrations were mainly found in the bottom of the snow and the surface layers of the sea ice (Figure 1) (including slush and brine) ranging from 281−1360 pM. Sea ice–atmosphere bromoform fluxes measured by the chamber method ranged from +0.3 to +7.5 nmol $CHBr_3$ m^{-2} day^{-1} (positive value indicates the emission of the bromoform from ice surface to the atmosphere), and flux values increased with increasing bromoform concentrations at the surface layers (Figure 2). The mean flux estimate (+2.4 nmol $CHBr_3$ m^{-2} day^{-1}) obtained in this study was consistent with the flux estimate for the ice-free part of the Southern Ocean (+2.6 nmol $CHBr_3$ m^{-2} day^{-1}; Quack and Wallace, 2003). Our results suggest that the bromoform emitted from the sea ice surface to the atmosphere may account for an important fraction of the global bromine budget.

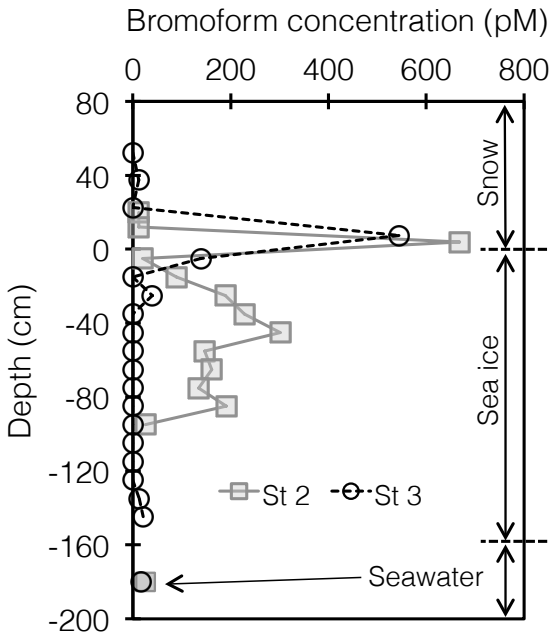

Figure 1. Depth profiles of bromoform concentration in snow, sea ice and seawater.

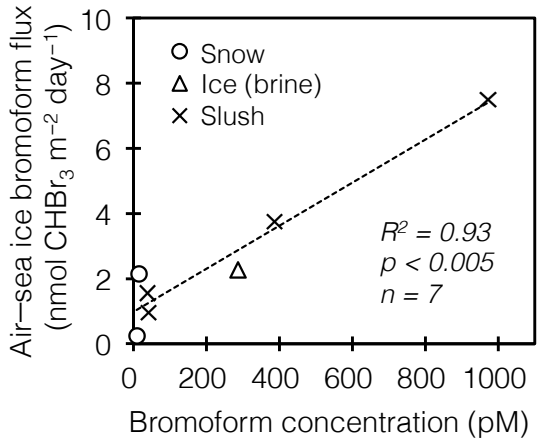

Figure 2. Relationship between air-sea ice bromoform flux and concentration for snow, sea ice (brine) and slush.

References

Quack, B. and D. W. R. Wallace, Air-sea flux of bromoform: Controls, rates, and implications, Global Biogeochemical Cycles, 17, 1023, doi:10.102 9/2002GB001890, 2003.