NUTRIENTS IN MELT PONDS AND SNOWS ON ARCTIC SEA ICE DURING 2014 SEA ICE CAMP

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ABSTRACT

Melt ponds are the most distinctive summertime feature of Arctic sea ice, which are formed by melting snow and surface sea ice due to surface melt driven by increased short-wave radiation absorption in summer. Although considerable effort has been devoted to investigate physical processes and feedbacks of melt ponds, relatively little is known about biogeochemical properties of melt ponds. To examine chemical components of nutrients (NH₄, NO₂⁺NO₃, PO₄ and SiO₂) in different types of melt ponds (i.e., closed and opened ponds) and differences of nutrients in between melt ponds and snows near melt ponds, a total of 36 melt ponds and snow samples were collected at two different sea ice stations located in northern part of the Chukchi Sea during the ARA05B cruise aboard Korean icebreaker Araon. In the closed melt ponds (salinity ≈ zero), NH₄ and NO₂⁺NO₃ showed high concentrations, whereas PO₄ concentrations were low and SiO₂ was not detected. In contrast, in the opened ponds (salinity ≈ surface seawater), both nitrogen species were depleted as those in surface seawater, while PO₄ and SiO₂ concentrations were as high as those in surface seawater. In snow samples, mean NH₄ concentration was about 9 times higher than that of NO₂⁺NO₃, probably due to NO₂ and NO₃ losses in snows by photolysis. Likewise SiO₂ in the closed ponds, SiO₂ in snow samples was not detected. From these results, it was suggested that not only salinity, but also nitrogen species, especially NH₄ and SiO₂ can be used as an indicator to distinguish between the closed and opened ponds, and that high NH₄ concentrations in the closed ponds were derived from snows. In addition, all nutrients species concentrations in surface and deep waters of the opend ponds showed large differences, suggesting that the melt pond waters were strongly stratified. Although no statistically significant relationships were found between chlorophyll a and nutrients variation trends, chlorophyll a concentrations in both types of melt ponds were higher than those in surface seawater, implying that additional nutrients supplied to the melt ponds from snows might contribute to more high biological activities in the melt ponds. Considering that the Arctic Ocean is currently experiencing rapid environmental change, such as warming and decreases in sea ice concentration and thickness, the role of melt ponds could be important. Further studies on biogeochemical cycles in the melt ponds therefore are required to improve understanding of the Arctic marine ecosystem more clearly.