Total alkalinity contained in sea ice and the impact of its release on total carbon contents at the East Siberian Sea

AHRA MO[1], TAE-WOOK KIM[1,2]*

[1] Division of Environmental Science and Ecological Engineering, Korea University, Seoul 02841, Republic of Korea (*correspondence: twktw@korea.ac.kr)

[2] O-Jeong Eco-Resilience Institute (OJERI), Korea University, Seoul 02841, Republic of Korea

We predicted variations in the total carbon content caused by sea ice melting and associated changes in seawater carbonate chemistry and air-sea flux of CO_2 in the East Siberian Sea. Sea ice samples were collected from two ice camps (77.60°N, 179.32°E at ICE CAMP1; IC1 and 75.37°N, 176.24°E at ICE CAMP2; IC2) in August 2017 at the East Siberian Sea (ESS). The average salinity was 1.39, 0.36, and 29.37 at the IC1, IC2, and ESS, respectively. The average total alkalinity (TA) was 109, 31, and 2037 μmol kg^{-1} at the IC1, IC2, and ESS, respectively. The excess alkalinity relative to ESS water was approximately 13 and 6 μmol kg^{-1} in ice melting waters of the IC1 and IC2, respectively. They may be introduced through non-biological $CaCO_3$ formation (i. e., ikaite) or simply these sea ices were formed in a sea with higher TA compared to the ESS. The effect of sea ice melting and release of TA contained in sea ice was examined with and without the excess TA. During the progress of Arctic ice-melting, the salinity of the East Siberian Sea has decreased from 29.37 to 28.52, but its total carbon content has increased if assuming air-sea equilibrium of CO_2. The total carbon content with the excess TA varied from 595.82 to 600.93 Tg C in the mixed layer depth of the ESS, whereas the total carbon content without the excess TA varied from 595.82 to 600.51 Tg C. In conclusion, the total carbon content could increase up to approximately 8.3% because of the excess TA. The result highlights the necessity of further investigations on TA included in sea ice and its formation mechanism to more accurate estimate oceanic uptake of CO_2 in the Arctic Ocean