Air-ice CO_2 fluxes in the Arctic coastal area (Amundsen Gulf).

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Sea ice covers about 7% of the Earth surface at its maximum seasonal extent. For decades sea ice was assumed to be an impermeable and inert barrier for air – sea exchange of CO_2 so that global climate models do not include CO_2 exchange between the oceans and the atmosphere in the polar regions. However, uptake of atmospheric CO_2 by sea ice cover was recently reported raising the need to further investigate pCO_2 dynamics in the marine cryosphere realm and related air-ice CO_2 fluxes. In addition, budget of CO_2 fluxes are poorly constrained in high latitudes continental shelves [*Borges et al.*, 2006]. We report measurements of air-ice CO_2 fluxes above the Canadian continental shelf and compare them to previous measurements carried out in Antarctica.

We carried out measurements of pCO_2 within brines and bulk ice, and related air-ice CO_2 fluxes (chamber method) in Antarctic first year pack ice ("Sea Ice Mass Balance in Antarctica – SIMBA" drifting station experiment September – October 2007) and in Arctic first year land fast ice ("Circumpolar Flaw Lead" – CFL, April – June 2008). These 2 experiments were carried out in contrasted sites. SIMBA was carried out on sea ice in early spring while CFL was carried out in from the middle of the winter to the late spring while sea ice was melting.

Both in Arctic and Antarctic, no air-ice CO_2 fluxes were detected when sea ice interface was below -10°C. Slightly above -10°C, fluxes toward the atmosphere were observed. In contrast, at -7°C fluxes from the atmosphere to the ice were significant. The pCO_2 of the brine exhibits a same trend in both hemispheres with a strong decrease of the pCO_2 anti-correlated with the increase of sea ice temperature. The pCO_2 shifted from a large over-saturation at low temperature to a marked under-saturation at high temperature. These air-ice CO_2 fluxes are partly controlled by the permeability of the air-ice interface, which depends of the temperature of this one. Moreover, air-ice CO_2 fluxes are driven by the air-ice pCO_2 gradient. Hence, while the temperature is a leading factor in controlling magnitude of air-ice CO_2 fluxes, pCO_2 of the ice controls both magnitude and direction of fluxes.

For a same temperature, pCO_2 in Arctic is significantly higher than in Antarctica. This potentially decreases air-ice CO_2 fluxes in Arctic compare to Antarctica. Unfortunately this difference is still an open question. However, the impact of the coastal processes should not be excluded. Air-ice CO_2 should be taken into account budgets of CO_2 fluxes in the coastal zone of the Arctic Ocean.

REFERENCES

Borges, A. V., et al. (2006), Carbon dioxide in European coastal waters, *Estuar. Coast. Shelf Sci.*, *70*(3), 375-387.

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