Lake Ice Formation Process at Lake Abashiri, Hokkaido, Japan
- The Lake Ice Structure and Thickness Evolution-
（網走湖における湖氷形成過程―湖氷構造と氷厚推移―）

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Formation processes on both sea and lake ice have been studied intensively. However, ice structure from low saline lake water has seldom been investigated. The purpose of this study is therefore to clarify the ice formation process in the low salinity water.

Lake Abashiri has low saline (about 1psu) upper water layer. From November 2012 to March 2013, 7 observational points, from the upper to the lower sides, were installed. The observation includes measuring lake water salinity and temperature by CTD, and samplings of lake water, ice and snow. In addition, ice internal temperatures were recorded continuously by thermistor loggers at the center of the lake. At laboratory, thick/thin-section analysis of ice as well as salinity and stable isotope ratio measurements of the samples were executed.

The lake ice was composed mainly of two structures, *i.e.*, transparent and white layers. The transparent layer was thicker at the upper sites, while the white layer was thicker at the lowest site. Based on $\delta^{18}O$ profiles, we recognized that the former and the latter layers were congelation ice and snow ice, respectively. Thick/thin-section analysis of ice showed that snow ice was underlain by macro grain congelation ice at the upper and the central sites. This structure is the same as that observed in fresh water lakes. While, the snow ice was underlain by frazil ice, congelation ice with transitional layer and columnar ice at the lower sites. It is a typical structure in sea ice without ridging or rafting in the past. The ice salinity was low (ave. 0.02) in the congelation ice and relatively high (ave. 0.04) in the snow ice. At the lowest site, the deposited snow was the highest in January, but it was constant until February, indicating much snow was consumed for snow ice formation. Comparison between ice internal temperature and Abashiri meteorological observatory data showed that snowfall as well as air temperature had important influence on lake ice evolution.

One of the factors diversifying the ice structure and thickness can be spatial variability in nocturnal air temperature in the lake area, where it was warmer at the lowest site. The other factor can be the higher ratio of snow accumulation to ice thickness at the lowest site, for it prefers more snow ice formation through lake water flooding. Change in surface water current direction with time at the lower sites can be another factor, since it provides non calm ice growth environment.

This study concludes that low salinity lake has both structures of typical sea ice and fresh water lake ice. Heat budget of lake ice and initial ice growth condition should be investigated to further clarify the mechanisms in the formation processes.