Field investigation on capturing of lake water salts within surface ice on ice-covered saline lakes in Mongolia: Implications for icy shell compositions of Solar System icy bodies.

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Geologically-active icy bodies in the Solar System, such as Europa, Enceladus, and Ceres, possess (or possessed) subsurface oceans under the icy crusts. These icy crusts may contain salts through trapping of oceanic water. If salts are contained, they could affect the rheology of the icy crust, surface material evolution, and internal evolution. Subsurface oceanic water could be trapped within ice grains at the interface between the ocean and icy crust as same as sea ice on the Earth (Spaun and Head., 2001). Intrusion of oceanic water into cracks and fractures in the icy crust is also suggested (Pappalardo and Barr., 2004). However, no field investigations have been conducted to evaluate both of these salt trapping processes.

Here, we report results of field survey to ice-covered lakes, the Orog and Olgoy lakes, in Mongolia to investigate water capturing within ice upon freezing. These lakes are saline closed-basin lakes. The surface is completely covered with ice in winter. Upon freezing, surface ice can be pressurized due to volume expansion of the ice, possibly forming cracks and fractures within the ice.

We performed field surveys to these lakes in February 2019 and January 2020. We collected the ices and underlying lake water at different locations of the lakes. The obtained vertical profile of salt contents and their mineral compositions from the ice samples are compared with our calculation results of brine capturing model coupled with low-temperature aqueous geochemical model. From the comparison, salt contents at the bottom are several times higher than calculation of brine captured model. We discuss about possibilities which can produce this variation of vertical profiles about salt contents (e.g. crack formation). We also argue the effect of trapped salt within icy crust to surface and interior evolution in icy bodies.

Keywords: Icy bodies, Surface evolution, Interior evolution

