The influence of regional-scale sea-ice and meteorological condition on d-excess in ice core in northwestern Greenland

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The deuterium excess (d-escess), which was defined by hydrogen and oxygen isotopes in water, reflect ocean surface conditions in moisture source regions for precipitation (Merlivat and Jouzel, 1979). The sea-ice variability affects the origin of moisture for precipitation (Jouzel et al., 2007). Therefore, the d-excess in ice cores obtained from coastal region helps to understand regional climate and sea-ice variability in the past (Osterberg et al., 2015). During spring 2017, ice core drilling was conducted on the SIGMA-A site (78°03′06″N, 67°37′42″W, 1490 m a.s.l.), which is located on the northwestern Greenland Ice Sheet (Matoba et al., 2018). Here we measured temporal variation of stable isotope of water and d-excess and elucidate the relationship between the variations of d-excess in the ice core and regional-scale sea-ice and meteorological conditions in the northwestern Greenland.

One of the sections of the ice core cut along the vertical axis of the ice cores beforehand was horizontally cut into every 25 mm long sections for analyses of stable isotope of water in a cold room at the Institute of Low Temperature Science (ILTS), Hokkaido University. The samples were placed into a clean polyethylene bags, melted at ambient temperature, and decantated into glass bottles. The stable oxygen and hydrogen isotope composition of water was measured using a water isotope analyzer (L2130-i, Picarro lnc.) with an evaporating device (A0212, Picarro lnc.) at the ILTS. The analysis precision of $\delta^{18}O$ and δD was 0.08, 0.8 ‰ respectively. We estimated age of the ice core by counting of negative peaks of $\delta^{18}O$ corresponding to winter layers of the ice core and a tritium peak at 29.58 to 29.94 m as a reference horizon of 1963 caused by H-bomb test in atmosphere (Clausen and Hammer, 1988). Seasonality of $\delta^{18}O$ above 6.06 m were not clear because of influence of melt water. Therefore, we used data from 6.06 to 21.45 m of the ice core corresponding to AD 2005-1979 for discussion about the relationship between temporal variation of d-excess and environmental changes extracted from ERA-interim reanalysis data set (Dee et al., 2011).

In 1979-2005, annually averaged d-excess in summer in the ice core were negatively correlated with sea-ice concentration in Baffin Bay on March-May significantly. Increase in d-excess of water vapor is caused by strong temperature contrasts between surface air temperature (cold) and sea surface temperature (warm) (e.g. Gat and Carmi, 1970). d-excess of snowfall at SIGMA-A site increased when cold polar air mass was transported to SIGMA-A site via the Baffin Bay (Kurosaki et al., submitted). We suggest that low sea-ice concentration in the Baffin Bay caused the temperature contrast between air temperature and sea surface temperature becomes strong and d-excess of the water over the sea water increases.

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