Background Information on Methods:
Arctic Shelf Areas and Stable Oxygen Isotopes ($\delta^{18}O$) in the Water Column

The vast shelf areas comprise more than 1/3 of the total Arctic Ocean area (see Fig. 1) and are free of sea-ice during summer. Sea-ice meltwater and huge amounts of river water are released here in summer, while brine waters formed during sea-ice formation are produced during winter. Halocline waters in the central Arctic Ocean Basin are maintained by waters from the shelves. And warm intermediate Atlantic-derived waters are influenced by waters from the shelves.

Arctic rivers are strongly depleted in heavy oxygen isotopes (^{18}O) relative to marine waters (see Fig. 1, 2). Sea-ice processes on the other hand also strongly influence *the* salinity of the water, but have little influence on the oxygen isotope composition of the water column. Therefore oxygen isotope ratios ($^{18}O/^{16}O$; expressed as $\delta^{18}O$ values, the ‰ deviation relative to a sea water standard) in conjunction with hydrological data are an excellent tool to investigate the contribution of the different water masses from the shelf regions.

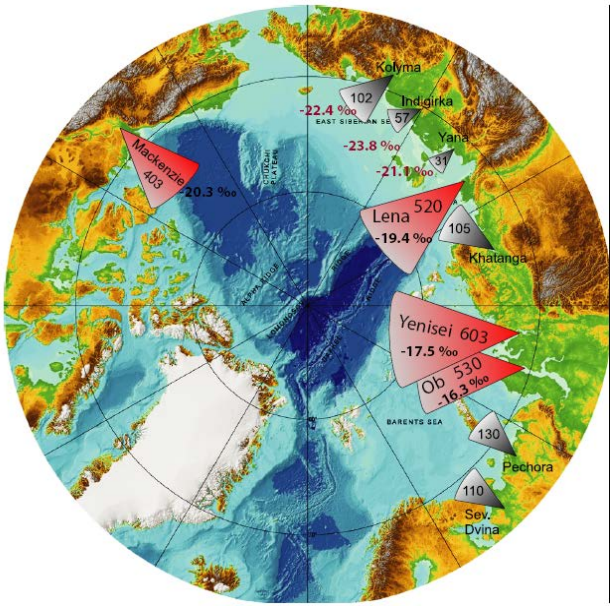

Fig. 1 Geographic map of the Arctic Ocean. The numbers represents the amount of runoff in km^3/yr for the 10 largest rivers and the mean $\delta^{18}O$ values is given (Ekwurzel et al., 2001).

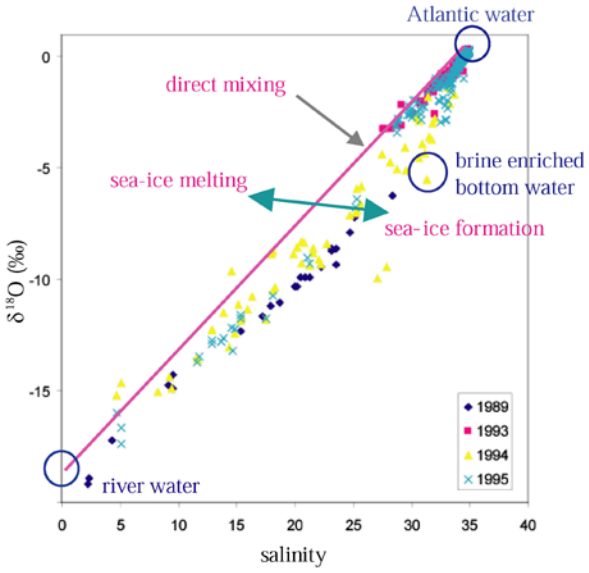

Fig. 2: $\delta^{18}O$ versus salinity from the Laptev Sea shelf (1989 and 1994 data) and shelf break (1993 and 1995 data). Figure modified from Bauch et al. (2005).

Salinity and temperature data can help to determine changes in water masses and $\delta^{18}O$ analysis gives important additional information about freshwater sources such as river water or sea-ice meltwater and brine waters formed during sea-ice formation. Based on mass balance calculations the fractions of the different components forming a certain water mass can be quantified (e.g. Bauch et al., 1995 and 2011).

By distinguishing these different freshwater and brine-water contributions to the Arctic Halocline the impact of sea-ice processes and river water released from the Arctic shelf regions are better understood. The contributions from the shelves shows considerable inter-annual variations in dependence of the general atmospheric and are prone to further change with the ongoing changes e.g. in sea-ice coverage in the Arctic.

References

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Bauch, D., M. Rutgers van der Loeff, N. Andersen, S. Torres-Valdes, K. Bakker, and E. P. Abrahamsen (2011), Origin of freshwater and polynya water in the Arctic Ocean halocline in summer 2007, Progress in Oceanography, 482-495, doi:410.1016/j.pocean.2011.1007.1017

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