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

The vast shelf areas, which comprise about 1/3 of the total Arctic Ocean area (see Fig. 1), are free of sea-ice during summer. Meltwater and huge amounts of river water are released here in summer, while sea-ice and brine waters are produced during winter. Halocline waters 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 ($^{18}O/^{16}O$; usually expressed as $\delta^{18}O$ values, which is the ‰ deviation relative to a sea water standard SMOW) in conjunction with hydrological data are an excellent tool to investigate the contribution of the different water masses from the shelf regions.

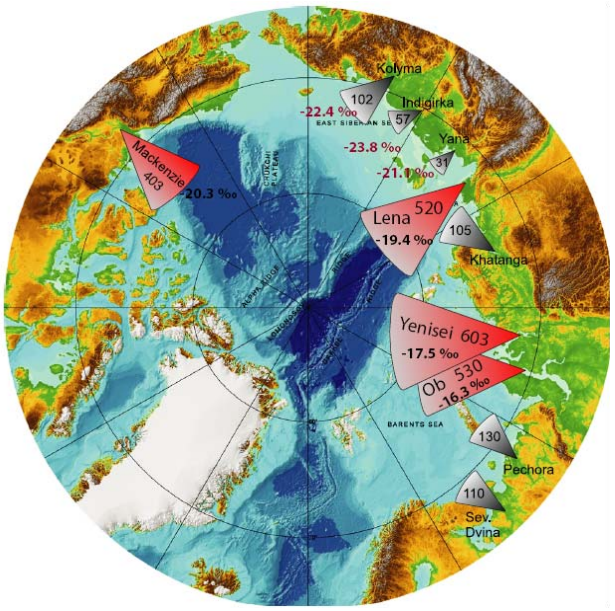

Fig. 1 Geographic map of the Arctic Ocean. The numers represents the amount of runoff in km^3/yr for the 10 largest rivers and the mean $\delta^{18}O$ values is given (Ekwurzel et al., 2001).

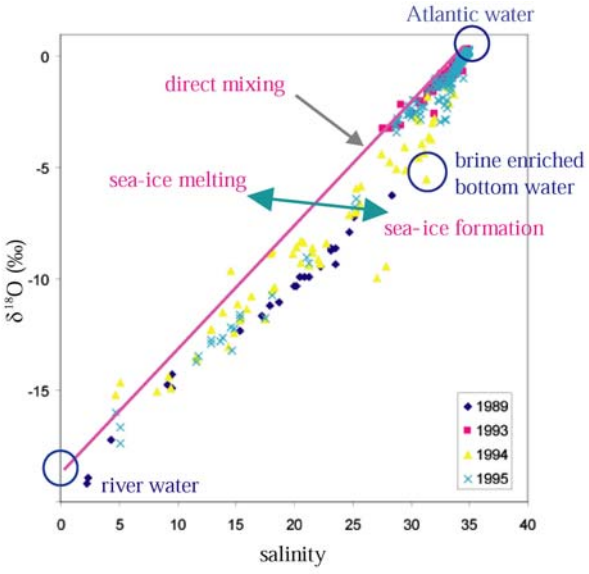

Fig. 2: $\delta^{18}O$ versus salinity from the Laptev Sea shelf (1989 and 1994 data) and shelf break (1993 and 1995 data). Figure modified from Bauch et al. (2005).

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 as well as brine waters, formed predominantly on the shelves 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).

By distinguishing these different freshwater and brine-water contributions to the Arctic Halocline the impact and processes of the Arctic shelf regions are better understood which are maintaining the Arctic Ocean halocline and transforming the Atlantic-derived waters in the Arctic Ocean. These different mixing processes show considerable inter-annual variations in dependence of the general atmospheric setting (Guay et al. 2001; Dmitrenko et al., 2005) and are prone to change with the ongoing climate change, i.e. changes in Sea-ice conditions in the Arctic.

References

Bauch, D., Schlosser, P. and Fairbanks, R.F., 1995. Freshwater balance and the sources of deep and bottom waters in the Arctic Ocean inferred from the distribution of $H_2{}^{18}O$. Progress in Oceanography, 35: 53-80.

Bauch, D., Erlenkeuser, H. and Andersen, N., 2005. Water mass processes on Arctic shelves as revealed from $\delta^{18}O$ of H_2O. Global and Planetary Change, 48: 165–174. doi:10.1016/j.gloplacha.2004.12.011.

Dmitrenko, I.A., Kirillov, S.A., Eicken, H. and Markova, N., 2005. Wind-driven summer surface hydrography of the eastern Siberian shelf. Geophysical Research Letters, 32: L14613, doi:10.1029/2005GL023022.

Ekwurzel, B., Schlosser, P., Mortlock, R. and Fairbanks, R., 2001. River runoff, sea ice meltwater, and Pacific water distribution and mean residence times in the Arctic Ocean. Journal of Geophysical Research, 106(C5): 9075-9092.

Guay, C.K., Falkner, K.K., Muench, R.D., Mensch, M., Frank, M. and Bayer, R., 2001. Wind-driven transport pathways for Eurasian Arctic river discharge. Journal of Geophysical Research, 106(C6): 11,469-11,480.