# The influence of source waters on the Holocene nutrient cycle in the Labrador Sea: A multiproxy approach of stable isotopes

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In the Labrador Sea, hydrographic and biogeochemical conditions are sensitive to climate variability. Accelerated warming and melting of sea ice today reduce the seasonal sea ice cover and increase primary productivity (Chan et al., 2017). The amount of productivity is closely coupled to nitrate and dissolved silicic acid (dSi) delivery to the area (Harrison et al., 2013). High nitrate, compared to dSi, is delivered from the North Atlantic via the Irminger Sea, while Pacific waters delivered via the Canadian Archipelago are higher in dSi than nitrate (Torres-Valdés et al., 2013) and have distinctively heavier isotope signatures (Giesbrecht et al., 2022).

To investigate how primary productivity was influenced during the Holocene, we analyzed nitrogen isotopes ($\delta^{15}N$) of sediments and silicon isotope ($\delta^{30}Si$) compositions of diatoms. Based on an extensive data set from surface sediments of the entire Labrador Sea record, influences of the water mass signatures or nutrient utilization on the recorded isotope composition were studied. The $\delta^{15}N$ signatures closely mirror the water column signal, as nitrate utilization is complete, suggesting that sediments can be used to trace changes in the source signature of nitrate and the admixture of the source waters. Additionally, two downcore records were studied, from the NE Labrador Sea, in the pathway of Atlantic waters, and from the NW Labrador Sea, where Pacific and Atlantic waters are mixed. These records indicate similar $\delta^{15}N$ values of 7‰ before 7 kyr BP, followed by a decrease to 4.5‰ in the NE and a much slighter decrease to 6.5‰ in the NW over the mid and late Holocene. The $\delta^{30}Si$ values of diatoms ($\delta^{30}Si_{diatom}$) are only available from surface sediments of the Labrador Shelf and a core from the NW Labrador Shelf. Here, dSi is also nearly entirely used by summer (>90%), reflecting the differences in the $\delta^{30}Si$ of source waters. Our downcore record from the NE Labrador Shelf indicates a decrease of $\delta^{30}Si_{diatom}$ that reflects either an increase of light Atlantic-derived waters or a lighter Pacific-derived source.

## References

Chan, P., Halfar, J., Adey, W., Hetzinger, S., Zack, T., Moore, G.W.K., Wortmann, U.G., Williams, B., Hou, A., 2017. Multicentennial record of Labrador Sea primary productivity and sea-ice variability archived in coralline algal barium. *Nature Communications* 8, 1–10. https://doi.org/10.1038/ncomms15543

Giesbrecht, K.E., Varela, D.E., Souza, G.F., Maden, C., 2022. Natural variations in dissolved silicon isotopes across the Arctic Ocean from the Pacific to the Atlantic. *Global Biogeochem Cycles, 36, e2021GB007107.* https://doi.org/10.1029/2021gb007107

Harrison, W.G., Børsheim, K.Y., Li, W.K.W., Maillet, G.L., Pepin, P., Sakshaug, E., Skogen, M.D., Yeats, P.A., 2013. Phytoplankton production and growth regulation in the Subarctic North Atlantic: A comparative study of the Labrador Sea-Labrador/Newfoundland shelves and Barents/Norwegian/Greenland seas and shelves. *Progress in Oceanography* 114, 26–45. https://doi.org/10.1016/j.pocean.2013.05.003

Torres-Valdés, S., Tsubouchi, T., Bacon, S., Naveira-Garabato, A.C., Sanders, R., McLaughlin, F.A., Petrie, B., Kattner, G., Azetsu-Scott, K., Whitledge, T.E., 2013. Export of nutrients from the Arctic Ocean. *J Geophys Res Oceans* 118, 1625–1644. https://doi.org/10.1002/jgrc.20063