Glacial-to-interglacial changes in nitrate supply and consumption in the subarctic North Pacific from microfossil-bound N isotopes at two trophic levels

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The modern subarctic North Pacific constitutes one of the high-nutrient-low-chlorophyll regions of the modern ocean, where nitrate is perennially abundant at the surface. In a sediment core from the western subarctic North Pacific (SNP), we report the foraminifera-bound $\delta^{15}N$ (FB-$\delta^{15}N$, in *Neogloboquadrina pachyderma* and *Globigerina bulloides*) and diatom-bound $\delta^{15}N$ (DB-$\delta^{15}N$) back to the last glacial maximum (LGM), to infer past changes in the degree of surface nitrate consumption. The $\delta^{15}N$ of all recorders is higher during the LGM, indicating more complete nitrate consumption over the course of the spring-to-summer maximum in phytoplankton growth. *N. pachyderma* FB-$\delta^{15}N$ is similar to DB-$\delta^{15}N$ in the Holocene but 2.3‰ higher than DB-$\delta^{15}N$ during the LGM, a difference that is consistent with reduced wintertime nitrate supply during the LGM. Unlike DB-$\delta^{15}N$, FB-$\delta^{15}N$ does not decrease from the LGM into HS1, which supports the previous suggestion that the HS1 DB-$\delta^{15}N$ drop is due to contamination by sponge spicules. FB-$\delta^{15}N$ decreases in the latter half of the Bolling/Allerod (B/A) warm period, rises weakly during the Younger Dryas (YD) cold period, followed by a decline into the mid-Holocene. The FB-$\delta^{15}N$ records, together with changes in the biogenic flux reconstructed from this site, suggest that the coupling between cold climate and reduced nitrate supply that characterizes the LGM-to-Holocene difference also applied to the deglacial events. The indications for this coupling are strengthened by a correction of the FB- and DB-$\delta^{15}N$ data for denitrification-driven increases in the $\delta^{15}N$ of subsurface nitrate during the B/A and post-YD period.