Supplementary Material:

What Feeds the Benthos in the Arctic Basins? Assembling a Carbon Budget for the Deep Arctic Ocean

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Details on Data Compilation:

Literature data compiled in this work originate from studies in the Arctic Ocean (AO) basins with > 1000 m water depth.

Benthic Carbon Demand

Abundance and biomass were estimated for bacteria, meiofauna (retained on 32-64 µm mesh and passing through 0.5-1 mm mesh, depending on study), macrofauna (retained on a 300-500 µm mesh), and megafauna (visible in imagery and/or caught in trawls, ≥ ca. 0.5-1 cm). Where given in gram wet weight, benthic biomass was converted to carbon using the conversion proposed by Rowe (1983; 4.3 % of wet weight is carbon). Meiofaunal biomass given as dry weight was converted to carbon using the conversion proposed by De Bovée and Labat (1993; 4.6 % of dry weight is carbon), and that given as ash-free dry weight was converted to carbon by diving by two. Though our focus was on AO basins > 1000 m, Figure 1 includes macrobenthic biomass ≥ 500 m to illustrate the difference between interior basin and upper slope values. Carbon demand in the studies compiled was mostly measured indirectly through benthic community oxygen consumption and was often, but not always, measured in mmol O_2 m^{-2} d^{-1}, determined through incubations of sediment cores *in situ* or more often *ex situ* (described for example by Renaud *et al.*, 2007). Such incubations include the entire benthic community, though megafauna is underrepresented due to their low densities. Where literature data were given as mmol O_2 m^{-2} d^{-1} or in other units they were converted to carbon demand in mmol C m^{-2} d^{-1} using the respiration quotient, here 0.77 (Boetius & Damm, 1998). Quotients commonly used may range between 0.77, 0.85 and 1 (Graf *et al.*, 1995; Ritzrau *et al.*, 2001; Rowe *et al.*, 1994). Carbon demand in mmol C m^{-2} d^{-1} was then converted to g C m^{-2} d^{-1} by multiplying by 12 (from mol to mg) and dividing by 1000 (from mg to g). Resulting values were multiplied by 365 to arrive at annual estimates given as g C m^{-2} yr^{-1} (Table 1). Note that only the subset of literature values deeper than 1000 m are referenced and converted. In addition we estimated carbon demand, though for macrofauna only, based on benthic production values from (Degen *et al.*, 2018) assuming 80 % respiration (and 20 % production) (Brey, 2001).

Nitrate and New Primary Production

The World Ocean Database 2018 (https://www.nodc.noaa.gov/OC5/WOD/pr_wod.html) was used to access nitrate data. The stations with a bottom depth > 1000 m were extracted using the extraction tool in the program Ocean Data View, and then all available data were plotted to get a rough overview on the nutrient situation in the deep AO basins as well as adjacent shallower areas. The overall annual new primary production was estimated based on taking the mean of the observations compiled in Table 2.

Zooplankton Carbon Demand

In the sources listed, carbon demand was assessed with different methods, such as community respiration of water samples followed by a conversion to estimate the carbon demand or modelling and compiled in Table 3. If the annual carbon demand was not given in literature, we estimated it based on the growth season assumed in the literature. If no estimate was given for the duration of the seasons, we assumed 120 days of growth season for bacteria and active phase of ice-associated grazers, similar to the growth season assumed for primary production by Wheeler *et al.* (1996). For mesozooplankton grazing, only 60 days were assumed which corresponds to the time that *Calanus* spp. spends in the upper water column.

Vertical Carbon Export

The annual vertical carbon export was estimated based on the observations presented in Table 4. We used a mean to estimate the overall annual vertical carbon export for estimates of the export at around 200 m depth (mean of results from sediment traps deployed at 150-285 m) and at greater depth (1500-3100 m).

References:

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