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East Greenland's rising impact on the marine silicon cycle constrained by silicon isotopes

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The Greenland Ice Sheet is experiencing significant mass loss due to surface melting and ice runoff from glacier fronts. This melting is accompanied by accelerating nutrient inputs into the North Atlantic but how exactly these Greenland-sourced inputs affect nutrient cycling and primary productivity in the North Atlantic remains contested. Of particular interest are the supply, distribution and fate of Greenland-sourced silicon (Si), given that Si is an essential macronutrient for diatoms that account for up to 40 % of global marine primary production. The export of Greenland-sourced Si is controlled by regional hydrography and multiple biogeochemical processes occurring in fjords and along the Greenland shelves. To assess the combined effects of these processes, we studied stable Si isotope (δ^{30}Si) compositions along the entire East Greenland Shelf using samples recovered in 2016 (PS100, GEOTRACES GN05) and 2019 (MSM85, GROCE Project). Systematic variations of δ^{30}Si linked to dissolved Si concentration ([DSi]), salinity, and water depth are attributed to Si inputs from Greenland and the Arctic and Atlantic oceans as well as utilization by diatoms and spatially variable remineralization and release from sediments. The uptake of Si by diatoms at the surface is clearly reflected by heavier δ^{30}Si signatures (up to +3.9 ‰) corresponding to lower [DSi]. Subsurface signatures are overall lighter (up to +1.5 ‰), which we attribute to the advection of Atlantic- and Arctic-derived water masses with overall lighter δ^{30}Si and local additions through remineralization from shelf sediments. The signatures of these water masses and of individual Greenlandic Si sources differ markedly, leading to a Si isotope range of as much as 1 ‰ (e.g. from +1.5 to +2.5 ‰) for any given [DSi] in the mid concentration range (~2-8 µM). This Si isotope variability will be compared to macronutrient and trace element levels and other isotope data (e.g. ε_{Nd}, δ^{18}O, δ^{138}Ba) to help constrain the influence of the East Greenland Shelf on the North Atlantic's Si cycle.