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# Iron in the Arctic Ocean: Across the size continuum characterization to assess the influence of iron colloidal fraction

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Although marine iron has been extensively studied since the formulation of the Iron Hypothesis [1], significant uncertainties remain regarding its oceanic biogeochemical cycle, particularly in mass balance estimates. Marine iron cycle depends on a complex speciation among various physicochemical forms that controls its behavior and bioavailability. However, the specific dynamics of these forms are poorly understood. This is particularly the case of the colloidal fraction which, despite its reactivity and likely importance in transformation and transport processes of marine iron, remains poorly studied, defined, and characterized. Especially in the Arctic, the cryosphere is a major source of iron in colloidal form, and changes caused by climate change, such as accelerated ice melt and increased river inputs, tend to affect particle fluxes, the distribution of iron forms, and thus the iron and carbon cycles.

This study investigates iron in the Arctic Ocean, focusing on the size continuum and the colloidal fraction. Seawater samples from open ocean and Baffin Bay were collected. The particulate, colloidal, and truly dissolved fractions were separated based on intrinsic material properties rather than conventional operational size cut-offs, which are known to introduce significant measurement biases in terms of size distribution and concentration estimates. In this study, we developed and implemented an integrated suite of analytical approaches designed to capture the full size continuum of marine matter. Our analyses revealed site-specific colloidal populations, reflecting spatial variability likely linked to local sources. The concentrations found along the size continuum highlight the importance of linking physical and chemical data on marine matter in order to gain a more specific understanding of the dynamics of the different forms of iron in its ocean cycle, particularly in a rapidly changing Arctic Ocean.

[1] Martin, J.H (1990), *Paleoceanography*, *5* (1), 1–13.