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Reactive iron delivery to Baffin Bay during long-term Greenland Ice Sheet evolution

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Changes to major continental ice sheets have the potential to perturb marine biogeochemical cycles by altering inputs of bio-limiting nutrients, including iron (Fe). To assess how the long-term evolution of the Greenland Ice Sheet may have affected Fe delivery to the ocean, we analyzed sediments collected from IODP Site U1607 in Baffin Bay for Fe speciation. This core, taken from the continental shelf, tentatively dates to the Oligocene and records the expansion of the Greenland Ice Sheet over the past 30 million years. We used sequential chemical extractions to assess changes in the amounts of sedimentary iron that would have likely been biogeochemically available at the time of or soon after deposition. Sequential chemical extractions were used to determine reactive Fe contents in four pools: iron in poorly crystalline oxides, carbonates, crystalline oxides, and magnetite. Analysis by scanning XRF and ICP-OES showed these cores contain intervals of anomalously high Fe deposition, with reactive Fe contents of up to 25 weight percent, representing a substantial enrichment in both total and reactive Fe. Reactive Fe is generally dominated (up to 18 weight percent) by iron in carbonates in these anomalous layers, determined to be mainly siderite ($FeCO_3$) by XRD analysis. Samples high in reactive iron occur sporadically throughout the core, with the highest siderite contents below 700 m depth. Preliminary stable isotope analyses show positive $\delta^{13}C$ values (7-12‰) associated with high iron carbonate intervals, suggesting that the siderite layers may have formed during episodes of methanogenesis, while outside of these intervals $\delta^{13}C$ values are lower (-3‰). These results highlight that long-term changes in glacial and climate conditions may have contributed to significant changes in iron availability in the oceans.