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Bioavailable Fe Distribution in the Southern Atlantic Ocean on Glacial-Interglacial Timescales

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The relationship between atmospheric and oceanic processes is essential in studies of global climate and its feedbacks. Aeolian dust is a major driver in this climate system through its influence on the oceanic biogeochemical cycles of carbon and nutrients via the coupled delivery of micronutrients like iron. Iron is essential for ocean biota, and its absence has been linked to changes in the concentration of atmospheric carbon dioxide on glacial-interglacial timescales.

The main input of dust to the South Atlantic Ocean originates from the Patagonian desert region. In this study, I have adopted a wet chemical extraction of iron phases in sediments not pre-treated chemically, thus preserving the most reactive forms and their diagenetic products to explore the links between highly reactive atmospheric Fe inputs and marine biogeochemical responses during glacial-interglacial cycles. With this framework, we analyzed three IODP (International Ocean Discovery Program) cores from the South Atlantic Ocean. Our data show that glacial-interglacial differences in bioavailable iron distribution are best ascribed to temporal variance in rates of total dust delivery rather than differences in the reactive of the aeolian Fe pool over the same time scales. Fe_{HR}/Fe_T trends imply that iron solubility is affected by atmospheric processing in ways that increase the solubility of Fe. But analogy to our results in the North Atlantic, we suggest that Fe solubility/bioavailability increases with transport distance and inferred extents of atmospheric processes, which are likely more important the differences in the source region. Atmospheric processing that scales with the transport distance manifests in a loss of that soluble iron during dust deposition in the ocean. Overall, distal regions are likely characterized by relatively lower total dust fluxes but with higher Fe bioavailability compared to sites close to the source region. Further studies involve quantifying the global role of dust and atmospheric processing and related iron solubility as linked to water column and sediment biogeochemistry, including possible related signatures captured in spatial and temporal trends in Fe isotopes.

References:

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