Distribution of bioavailable iron in the Pacific Ocean and relationships to dust delivery and potential continental sources

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Iron (Fe) is essential for the growth of marine phytoplankton and plays an important enzymatic role in many biochemical reactions such as photosynthesis and nitrogen fixation. Eolian dust (loess) is the major source of Fe to the surface waters of the open ocean, and its transport from the continents to the oceans is a fundamental component of the Earth system and its geochemical cycles. In this study, we explore the links between highly reactive atmospheric Fe dust inputs and marine biogeochemical responses by analyzing loess outcrops in China (the source) and several deep-sea sediment records from the Pacific Ocean (sink) across glacial-interglacial intervals.

In an oxic ocean it is likely that Fe is available only in trace amounts due to its low solubility and high biological and particle reactivity and therefore is often the limiting micronutrient. The Fe in wind-blown dust deposited in the ocean may be present in a wide range of minerals that reflect the geology of the source area, weathering processes, and alteration during transport (e.g., atmospheric processing). The relationship between possible changes in dust deposition and corresponding changes in bioavailable iron in the ocean are the main question examined in this study.

Since Fe bioavailability cannot be measured directly, we used a state-of-the-art Fe speciation technique and total acid dissolution to characterize Fe inputs. To date we have found higher concentrations of highly reactive (dominantly oxide) Fe and total Fe in the ocean sediments (Fe_{HR} 1.5 wt.%, Fe_{T} 7.8 wt.%) in comparison to the continental loess (Fe_{HR} 0.7 wt.%, Fe_{T} 2.9 wt.%). This difference could have major implications for the fluxes of reactive Fe to the ocean. However, when we analyze the reactive iron enrichment factor we see both sites falling in the range of typical continental margin sediments (oceans Fe_{HR}/Fe_{T}: 0.3; continent Fe_{HR}/Fe_{T}: 0.2). *No* significant differences are seen in terms of mineralogy, grain size, and glacial versus interglacial deposition and the distribution of bioavailable iron. We will further explore Fe record in the ocean through isotope approaches that should illuminate the source relationships and pathways of Fe cycling.