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Insights into Fe sources and cycling in Southcentral Alaska from Fe isotopes

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Iron (Fe) is a recognized micronutrient capable of limiting marine production [1], and Fe derived from fluvial and aeolian sources plays an important role in supporting Fe-limited ocean ecosystems such as the NE subarctic Pacific. Therefore, the rate of CO_2 exchange into surface ocean, and its total flux of burial into oceanic sediments may be potentially impacted by changes in Earth surface conditions affected by climate change [2-5]. More recently, pyrogenic aerosols derived from forest fires have been found to enhance primary production by supplying a high amount of soluble Fe [6, 7]. Stable Fe isotopes vary in continental weathering products, volcanic ashes, and pyrogenic aerosols, and may provide constraints on Fe sources and fluxes to the ocean [6, 8]. Here we investigate the Fe isotope composition of various potential sources of Fe to the surface ocean including Alaska glaciofluvial silt, loess, volcanic ash, and combustion products from forest fires to establish isotopic signatures of Fe to the Gulf of Alaska and probe the formation mechanism and transport processes.

Fe isotopic composition of glaciofluvial silt and volcanic ash have a restricted range of δ^{56}Fe values (from -0.02‰ to +0.074‰, n=19), in contrast to loess which spans a larger Fe isotopic range (from -0.322‰ to +0.046‰, n=9). δ^{56}Fe values of loess are correlated to organic content and total Fe content, and these samples have the highest proportion of easily reducible Fe, determined through sequential Fe extractions. On the other hand, pyrogenic aerosols sourced Fe is supposed to have much lower δ^{56}Fe values and higher solubilities than those of natural Fe. The results from this study may provide insight into source apportionment to marine surface environments, and reveal the source variability of Fe and nutrient bioavailability.

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