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Anthropogenic emissions as a persistent source of soluble Fe to the subtropical North Atlantic Ocean

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Iron (Fe) is an important micronutrient for marine biota, and Fe addition to the surface open ocean is dominated by atmospheric sources. Historically, studies have focused largely on the importance of Fe supplied by the deposition of atmospheric mineral dust, but work in the past decade has shown the dramatic importance of terrestrial anthropogenic combustion and wildfires. These pyrogenic Fe sources have a highly soluble atmospheric Fe aerosol composition, which when deposited to the surface ocean can be readily utilized by phytoplankton (Sedwick *et al.*, 2007; Luo *et al.*, 2008; Tang *et al.*, 2021). More recently, stable Fe isotopes (δ^{56}Fe) have been applied as a useful tracer to discern and quantify the presence of non-dust Fe in aerosols collected from different ocean basins (Kurisu *et al.*, 2016; Conway *et al.*, 2019). Here, we present bulk and soluble aerosol δ^{56}Fe in samples collected from a year-long time series at Bermuda as part of GEOTRACES Process Study GApr13. We use these data to disentangle the sources supplying aerosol Fe to the subtropical North Atlantic Ocean; using a two-component mixing model, we show bulk δ^{56}Fe is dominated by natural desert dust in the high dust season, but that anthropogenic Fe influences bulk aerosol composition in the low dust season. Importantly, soluble aerosol measurements show that anthropogenic combustion is a pervasive source of soluble Fe throughout the time-series. To further identify various sources (i.e., wildfires and ship emissions) supplying aerosol bulk and soluble Fe to the North Atlantic, we compared output from the CAM6-MIMI aerosol-Fe deposition model with observations and find corroborating evidence for previous a finding that wildfire aerosol δ^{56}Fe is determined by the provenance of soils supplying Fe aerosols (Bunnell *et al.*, 2025).

References

Sedwick, P. *et al.* (2007). Geochemistry, Geophysics, Geosystems, 8(10).

Luo, C *et al.* (2008), Global Biogeochemical Cycles, 22(1).

Tang, W. *et al.* (2021). Nature, 597, 370-375.

Kurisu, M, *et al.* (2016). Chemistry Letters, 45(8), 970-972.

Conway, T. M. *et al.* (2019). Nature Communications, 10(1), 2628.

Bunnell, Z. B. *et al.* (2025). Global Biogeochemical Cycles, 37(2), e2022GB007441.