More Clear than Mud: Using Os to Unravel Sources of Fe to Seawater through the Cenozoic

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Primary Productivity and Fe Limitation

- Phytoplankton draws down a considerable amount of atmospheric CO₂ and plays a role in modulating climate
- However, primary productivity is limited by Fe bioavailability in high-nutrient low-chlorophyll (HPLC) regions

(Li et al. 2015; J. Plankton Research)
Fe: A Complex System

(Tagliabue et al. 2017; Nature)
Isotopic Fingerprinting

Enriched with $^{54}$Fe

$$
\delta^{56}Fe = \left[ \frac{^{56}Fe}{^{54}Fe_{sample}} \right] \frac{^{56}Fe}{^{54}Fe_{IRMM-014}} - 1 \right] \times 1000
$$
Pelagic Clays as a Potential Archive

(Modified from Dutkiewicz et al. 2015; Geology)
Pelagic Clays as a Potential Archive

- Pelagic clays cover ~50% of the seafloor
- Some clays are heavily enriched with Fe (up to 80 wt.%)
- Pelagic clays are made up of six components
- Here, we focus on Site U1366, with plans to expand the study to Sites U1369 and U1370

(Dunlea et al. 2015; Paleoceanogr.)
Fe Isotope Results

Hydrothermal Component Mixing

Miocene  Oligocene  Eocene  Paleocene  Late Cretaceous

U1366 Fe-Mn nodule (Marcus et al., 2015)

U1366 clays (This study)

Dust

Component Mixing

Reducing Sediment

Cobalt model age (Ma)
Conclusions and Outlook

• Opening of the Drake Passage
  • The opening of the Drake passage (~41 Myr) may have changed ocean circulation and introduced more hydrothermal input

• Diatoms
  – Diatoms became abundant ~34 Myr ago—how did this affect Fe?

• Large Igneous Provinces (LIPS) and volcanic ash inputs
  • LIPS and/or volcanic ash may have increased dust input from 65-75 Myr