Cd isotope fractionation in some phytoplankton: A novel proxy for Fe limiting status in the oceans

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The concentrations of carbon dioxide and dusts in Antarctica ice cores exhibit close correlation, indicating that Fe input in the oceans may regulate carbon cycling and climate change globally. The information of bioavailable Fe status in the surface waters of the oceans may help us appreciate how carbon dioxide has been cycled on Earth. Because Fe status in seawater influences intracellular Cd composition and transport in phytoplankton, Cd isotopic fractionation in phytoplankton may serve as a useful proxy for Fe availability in oceanic surface waters. Here, we show that marine diatom take up light Cd isotopes under Fe limited condition, attributed to dominant high affinity transporter for Cd under Fe deplete condition and to dominant low affinity non-specific Fe transporter for Cd under Fe deplete condition. Our findings elucidate why Cd isotopic composition are relatively light in seawater and Fe-Mn crusts collected in the Southern Ocean, where the surface water is Fe-limited and diatom is dominant. We anticipate our study provide the basis for applying Cd isotopic composition in environmental recorders (e.g., biogenic hard parts, coral reef, Fe-Mn crusts) to re-establish Fe limiting and non-limiting status in the contemporary and ancient oceans.

Characterization of airborne dust particles in the coal mining area of Cam Pha, northern Viet Nam

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Cam Pha, located in Quang Ninh province, is one of the largest coal mining areas in Viet Nam (reserves ~10 Gt). This study focuses on the mineralogical and chemical characterization of airborne dust. Exposure to dust is a major challenge for the population living near the mines, especially the open-pit mines. Additional major dust sources comprise mine dumps containing the overburden, a coal-processing facility, a coal-shipping harbour, mining traffic, and various industries, including coal-fired power stations.

Coarse particles (d_p >2.5 μm) have been collected with the passive sampler device Sigma-2 on transparent adhesive collection plates for subsequent single-particle analysis by automated optical microscopy according to VDI guideline 2119 [1]. Select specimens, sampled during different meteorological conditions, were investigated further by SEM-EDX single-particle analysis and by determining their bulk chemical and isotopic composition (ICP-MS and MC-ICP-MS, respectively).

Wind directions indicate that the particles are mainly derived from the open-pit mines, consistent with bulk chemical and isotopic data ($^{87}Sr/^{86}Sr$ = 0.7278 – 0.7427; ε_{Nd} = -14.6 – -14.9; $^{206}Pb/^{207}Pb$ = 1.1789 – 1.1884), which suggest that the dust contains mostly natural materials (coal, silicate minerals from sedimentary rocks). Relative to the coal, the bulk airborne dust is enriched in Na, Mg, K, and Ca, but depleted in most other components. Element-ratio plots reveal some systematic differences between the dust samples and specimens of coal and overburden, pointing to an additional, yet unknown particle source. To verify the hypothesis of an additional dust source and to provide quantitative data on the mineralogical composition of the dust samples, we are currently optimizing the automated SEM-EDX single-particle analysis technique.

[1] VDI (1997): *VDI guideline* **2119**, part 4.