

Long term records of dust transport over the global oceans: Past results and future challenges to understanding the oceanic dust record

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Beginning in the early 1980's and continuing through the late-1990s, a group at the University of Miami established and operated a network of about 25 aerosol sampling stations distributed over the global ocean. This unique data set has been widely used to test chemical transport models and to estimate ocean deposition. Here I review the history of the network and present an integrated overview of the mineral dust results. Using this record as background and recognizing that there is at present no integrated program of global ocean aerosol measurements, I address a number of questions that must be considered in future research. Where should we be measuring dust and other aerosols to most effectively characterize future trends? Given the importance of Fe in ocean biogeochemistry, what aerosol properties should we measure and where should we measure them? What do we know about atmospheric dust deposition processes and how can we improve our knowledge about them? Are there potentially significant high-latitude dust sources that we should investigate? Are there important sources that might impact the Southern Ocean and what do we need to know about them?

I make the case that greater cooperation is needed between the ocean communities and the atmospheric communities if we are to understand the processes that affect ocean deposition and how these might change in the future with changing climate.

Vanadium stable isotopic fractionation in geologic materials measured by MC-ICPMS

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Vanadium (V) exists in multiple valence states (0⁰, 2⁺, 3⁺, 4⁺, 5⁺) and its partitioning is strongly influenced by redox conditions. There are two naturally occurring stable isotopes of vanadium: ⁵⁰V and ⁵¹V. Reconnaissance theoretical calculations suggest isotopic fractionation is also redox controlled and can be large at low temperatures (~4 ‰) and small but significant at magmatic temperatures (0.2 ‰). The potential of this system spans multiple disciplines of the earth sciences, with applications as diverse as investigations of ocean anoxia, mantle metasomatism, and core formation. However, there are significant obstacles to the precise and accurate determination of V isotopic compositions. Foremost, ⁵⁰V has an abundance of only 0.25%. To make matters worse, there are problematic isobaric interferences of ⁵⁰Ti and ⁵⁰Cr on this minor isotope. Here we present a new chemical separation protocol that achieves >90% yields, and is specifically designed to remove Cr and Ti from a range of sample matrices. Isotopic measurements are made with a Nu plasma MC-ICPMS with a standard-sample-standard approach to correct for mass bias. Faraday cups are equipped with 10¹¹ Ω resistors, except the cup collecting ⁵¹V, which uses a 10⁹ Ω resistor to allow measurable intensities of ⁵⁰V without signal overload on ⁵¹V. Machine performance is evaluated by measurement of two V solution standards against one another (from Alfa Aesar and BDH chemicals). The widely available Alfa Aesar V solution standard is assigned a δ⁵¹V value of 0 ‰. The long-term offset of BDH chemicals V solution is δ⁵¹V = -1.21 ± 0.19 ‰ (n=404) over 8 months. We consider this the best precision currently obtainable for 'real' samples. We present standard addition tests on a variety of USGS reference materials using an in-house enriched ⁵⁰V standard with δ⁵¹V = -17.3 ‰ to investigate possible matrix effects. We examine the magnitude of isotopic fractionation in a range of geologic materials and compare this with theoretical estimates.