Atmospheric inputs of iron and nitrogen to the Atlantic Ocean derived from large-scale field sampling

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Atmospheric inputs of nutrients may play a significant role in regulating marine primary productivity, with, for example, the oligotrophic sub-tropical gyres potentially sensitive to nitrogen inputs and the high-nutrient low chlorophyll (HNLC) regions sensitive to iron. Global and basin-scale estimates of atmospheric nutrient inputs require the use of reliable, well-validated model outputs, since field sampling on these scales is generally impractical. While many models of the atmospheric deposition of individual nutrient species exist, there is an extreme lack of field data available with which to calibrate and validate these models.

This presentation will discuss the development of climatological estimates of atmospheric nitrogen and iron deposition to the Atlantic Ocean based on measured concentrations of these elements in aerosol and rainwater samples collected during 12 long transect cruises. These estimates will be compared to model outputs and the biogeochemical implications of the measured nutrient input rates discussed.

Ultra-precise and accurate radiogenic and stable isotope ratio determinations

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Multiple-collector inductively coupled plasma mass spectrometry (MC-ICPMS) and a new generation of thermal ionization mass spectrometers (TIMS) have triggered an avalanche in the quantity of isotopic data being produced by geochemists. In particular, MC-ICPMS has been used to generate improved data for radiogenic systems (Pb), extinct radiogenic systems (^{26}Al-^{26}Mg, ^{60}Fe-^{60}Ni, ^{182}Hf-^{182}W), and develop new “heavy” stable isotope systems (e.g. Mg, Si, Fe).

Debate exists as to the best approach for making these isotopic measurements, and conflicting results for some isotopic systems have been reported by different groups. For example, it has been debated whether the double spike or Tl doping approach yields the most precise and accurate Pb isotope data yet, surprisingly, external normalisation techniques offer the simplest way of producing high quality Pb isotope data. However, the situation for non-traditional stable isotope systems is not so straightforward. For example, external normalisation techniques for Fe isotope determination by HR-MC-ICPMS have been shown to produce data of comparable precision and accuracy ($\leq \pm 0.03‰$; 2 sd) to double spike methods and data produced by both techniques confirm that high temperature fractionation of Fe isotopes is common in igneous systems. However, the situation for Mg-Si isotopes is more perplexing with various groups reporting that Earth and chondrites have the same or different isotopic compositions. In the case of Ni stable isotopes, it appears difficult to obtain accurate stable isotope data without the use of the double spike methodology.

The measurement of small anomalies of the daughter elements of extinct radionuclides allows identification of different stellar fingerprints in meteorites and to develop a higher (sub-Myr) resolution timescale for processes in the early Solar System. While some discrepant results have been reported, it is possible to show that the isotopic abundances of, for example, ^{26}Mg and ^{60}Ni (and perhaps ^{87}Sr) can now be measured with a precision and accuracy $<0.005‰$ permitting dating of meteorites and their constituents with precisions $<\pm 0.1$ to $\pm$ 0.5 Myr. These levels of precision and accuracy require investigation as to whether cosmogenic effects (Ni) and/or nucleosynthetic anomalies (Sr) can compromise the information available from these systems.