Areal and temporal variation of rainwater geochemistry at five sites in Japan

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We determined the elemental and Sr isotopic compositions of monthly rainwater and some road dust and plant at five sites in Japan (Sapporo, Toyama, Kumamoto, Kukizaki, and Kiso) during a period from 1998 to 2001, in order to elucidate the areal and temporal variation of provenance for water-soluble materials. The seasalt component (Cl^-, Na^+, and Mg^{2+}) was high at Sapporo, Toyama, and Kumamoto in winter due to picking up seasalt aerosol by cold and dry Siberia airmass passing over the Sea of Japan. The Ca^{2+} content in rainwater tended to become high from March to June, and showed a positive correlation with $nssSO_4^{2-}$, NO_3^-, and Sr^{2+}, indicating a potential use of Sr isotope as a provenance tracer of Ca^{2+} and acidic components. The $^{87}Sr/^{86}Sr$ of rainwater was generally high in spring irrespective of sites and years, and the maximum $^{87}Sr/^{86}Sr$ for each site was around 0.7105, the value being almost identical to the $^{87}Sr/^{86}Sr$ of water and/or weak-acid soluble minerals (calcite and gypsum) in Kosa aerosols derived from arid areas in northern China. The high Ca and $^{87}Sr/^{86}Sr$ in spring rainwater is attributed to the dissolution of these Kosa minerals since the Kosa phenomena are active in spring. The minimum $^{87}Sr/^{86}Sr$ of rainwater (0.7070-0.7085) was variable dependent on sites, although the $^{87}Sr/^{86}Sr$ variations of plant and acid leachate from road dust were large for some sites. The $^{87}Sr/^{86}Sr$ of plant and weak-acid extractable component from road dust varied between sites and even within a single site. The maximum proportion of the three components in the Sapporo rain water was 50-80% seasalt component for winter rain, 60-80% plant and road-dust component for summer rain and 40-50% water-soluble Kosa minerals for spring rain, although further examination is required to make clear the provenance of locally-derived aerosols in rain water.

Anoxic nitrification in marine sediments.

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Nitrogen cycling in anoxic marine sediments is more complex than traditionally thought. Recently-discovered complexities both within the nitrogen cycle itself and involving manganese (and possibly iron) provide potentially important pathways for the oxidation of ammonia-N to nitrate or N_2. Anaerobic ammonium oxidation (Anammox) by *Planctomycetales* type bacteria has been shown to be an important source of dinitrogen in Danish continental shelf sediments, the Black Sea, and Golfo Dulce in Costa Rica. Anoxic nitrification by ammonia oxidising bacteria utilising buried MnO_2 is an important process in Scottish Sea Lochs and Canadian continental margin sediments.

Here we present the latest results from field and laboratory studies into anoxic nitrification by MnO_2. In this study, pore-water nitrate peaks and molecular analysis of DNA and RNA extracted from anoxic sediments of Loch Duich, an organic rich marine fjord, support the hypothesis that nitrification is occurring throughout the anoxic zone. Analysis of ammonia oxidiser 16S rRNA gene fragments amplified from sediment DNA indicated the abundance of autotrophic ammonia oxidising bacteria throughout the sediment depth sampled, while RT-PCR analysis indicated their potential activity throughout this region. A large non-steady state pore-water nitrate peak at ~22 cm correlated with discontinuities in this ammonia oxidiser community. In addition, a subsurface nitrate peak at ~8 cm below the oxygen penetration depth, correlated with the depth of a peak in nitrification rate, assessed by transformation of ^{15}N-labelled ammonia. The source of the oxidant required to support nitrification within the anoxic region is uncertain. It is suggested that rapid recycling of N is occurring based on a coupled reaction involving Mn oxides (or possibly highly labile Fe oxides) buried during small-scale slumping events. Ongoing research is therefore centred on laboratory mesocosm experiments to simulate these events. Results from these experiments and from fieldwork in Loch Fyne, a manganese-rich sea loch, provide additional insight into the complexities of the interactions between N, Mn and Fe.