

Sr-Nd-Pb-Os isotopes of CAMP tholeiites from northeast America

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The Central Atlantic Magmatic Province (CAMP) is one of the largest CFB provinces on Earth, extending over a surface in excess of 10^7 km² in circum-Atlantic regions. Here we document the geochemical characteristics of CAMP lavas flows, sills and dikes from NE U.S.A. and Nova Scotia (Canada).

All the samples are low-Ti basalts and compared to N-MORBs they display LILE and LREE enriched patterns with negative Nb anomalies. Based on major and trace element characteristics (REE patterns, TiO₂ vs La/Yb diagrams), three groups can be defined: (1) the Talcott-Orange-Mt Zion Church flow units, all the Nova Scotia samples (North Mountain basalts and Shelbourne dike) and the lower part of the Palisades sill (TiO₂ ≈ 0.5-1.3 wt%, La/Yb ≈ 4-6), (2) the Holyoke-Preakness-Sander-Hickory flow units (TiO₂ ≈ 0.7-1.1 wt%, La/Yb ≈ 2.5-3.5) and (3) the Hampden-Hook flow units (TiO₂ ≈ 1.3-1.5 wt%, La/Yb ≈ 2).

All the samples plot in the field of CAMP low-Ti basalts in Pb-Pb and Sr-Nd isotope plots (²⁰⁶Pb/²⁰⁴Pb = 18.16-18.69, ²⁰⁷Pb/²⁰⁴Pb = 15.57-15.67, εNd from -4.1 to 2.3). Most of the samples display initial ¹⁸⁷Os/¹⁸⁸Os ratios in the range of typical upper mantle magmas. Nevertheless, some samples have quite radiogenic initial ratios (up to 0.479) suggestive of crustal contamination.

The Talcott-Mt Zion Church-Orange-North Mountain-Shelbourne group shows continental-like Sr-Nd-Pb isotopic ratios, which coupled with their mostly non-radiogenic Os compositions, may argue for a dominant source contribution from subduction-metasomatised sub-continental lithospheric mantle (SCLM). The Hook-Hampden and the Holyoke-Sander-Preakness-Hickory units as well as the Rapidan sill are slightly distinct from the other samples since they yield ²⁰⁶Pb/²⁰⁴Pb >18.5 and are closer to the NHRL. These characteristics may suggest a contribution from an asthenospheric component.

Evaluating the impact of marine organic aerosols on climate

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A large fraction of the uncertainty in predicting future climate may be related to the number concentration of marine aerosol that are prescribed or diagnosed in global climate models. Therefore, correct assessments of aerosol number concentration, size distribution and chemical composition over pristine marine regions may have profound effect on model predicted extent of human-induced climate change.

The effects of marine organic aerosols on microphysical properties of shallow clouds and the Earth's radiative budget are explored by the NCAR Community Atmosphere Model (CAM5.0), coupled with the PNNL Modal Aerosol Model. Sea spray enrichment by organics is estimated using wind speed dependent size-resolved parameterization, while marine-source secondary organic aerosol is inferred from the ocean emissions of biogenic trace gases. The ability of sea spray to act as cloud condensation nuclei (CCN) are not fully understood; therefore CAM5 simulations cover the range of possible scenarios in aerosol mixing state and hygroscopicity parameter based on our recent lab experiments. The size, number, and CCN distributions of aerosols generated by a bubble-bursting process were determined using a differential mobility analyzer (DMA)-condensation particle counter (CPC)-CCN counter (CCNc) system. Predicted concentration of organic aerosol and CCN in remote marine atmosphere was compared to *in situ* data. Simulations show that over the oceans marine organics can yield up to 10% increase in surface CCN (0.2%) (see Fig. 1). Changes associated with liquid water path and droplet number can increase short-wave forcing by -0.2Wm^{-2} . The disproportional effects of marine aerosols between pre-industrial and current climate and land vs. ocean have also been observed.

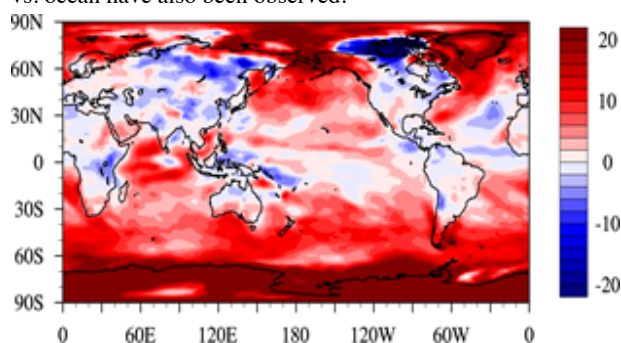


Figure 1: Annual average percentage change in surface CCN (0.2%) concentration due to marine emissions.