Atmospheric iron from crustal sources: prognostic aerosol composition in GISS/ModelE

JAN P. PERLWITZ[1], CARLOS PÉREZ[1*], RON L. MILLER[1]
AND SERGIO RODRIGUEZ[2]

[1]NASA Goddard Institute For Space Studies and Dept of Applied Physics and Applied Math, Columbia University, New York, USA, jan.p.perlwitz@nasa.gov, carlos.perezga@nasa.gov, ronald.l.miller-1@nasa.gov (* presenting author)
[2]Izaña Atmospheric Research Centre, Agencia Estatal de Meteorología, Tenerife, Spain, srodriguezg@aemet.es

Introduction

The emission of aerosol iron from crustal sources is subject to significant uncertainty. Many atmospheric model studies assume spatially homogeneous total iron content at dust sources, typically 3.5% by mass. Moreover, as iron oxides and hydroxides are comprised of more than 50% iron by mass, models usually consider them as the main suppliers of dissolved iron resulting from dust deposition. A recent experiment [1] has shown a large contribution by clays - their low iron content offset by their large solubility - to the total dissolved iron from dust samples. This and other studies suggest the need for explicit representation of individual minerals in dust-climate models in order to improve our understanding of the atmospheric iron cycle and iron deposition as an input to ocean biological productivity.

Methodology

We have implemented prognostic budgets of separate mineral types into an Earth System Model: GISS/ModelE. Each mineral type (composed of iron and/or other elements) is separately transported and modified within the atmosphere. Spatially-dependent concentrations of illite, kaolinite, smectite, calcite, quartz, feldspar, iron (hydr)oxide, and gypsum are predicted by the model based on an updating of the source mineralogy proposed in the seminal work of [2]. We use downwind observations to constrain the mineral content of aerosols leaving the source.

Discussion

We evaluate model results against global observations of mineral aerosols with emphasis on multiyear measurements of size-segregated dust elemental composition at the Izaña Observatory (Tenerife, Canary Islands), situated downwind of important North African dust sources. We highlight the strengths and limitations of the source prescription of [2] and propose new strategies to represent mineral tracers in dust models.

[1] Journet *at al.* (2008) *Geophys. Res. Let* **35,** L07805. [2] Claquin et al. (1999) *J. Geophys. Res* **104, D18,** 22,243-22,256.

Hg stables isotopes assessing methylmercury bioaccumulation, sources, and metabolization in the pelagic food web of Lake Baikal (Russia)

VINCENT PERROT[1]*, MIKHAIL PASTUKHOV[2], VLADIMIR N. EPOV[1], DAVID AMOUROUX[1] AND OLIVIER F.X. DONARD[1]

[1] Laboratoire de Chimie Analytique Bio-Inorganique et Environnement, IPREM, CNRS-UPPA-UMR-5254, Pau, France (*v.perrrot@etud.univ-pau.fr)
[2] Laboratory of geochemical mapping and monitoring, Institute of Geochemistry SB RAS, 1A Favorskogo Street, PB-304, Irkutsk, 664033, Russia

Monomethylmercury (MMHg) is the main chemical form of mercury that threatens human populations via food consumption after its bioaccumulation and biomagnification in food webs [1]. Nowadays, Hg stable isotopes mass dependent and mass independent fractionation (MDF and MIF) is a powerful tool to identify Hg sources and transformations within the environment [2]. In aquatic ecosystems, several Hg transformations may affect Hg molecular speciation and thus Hg isotopes fractionation, inferring toughness to unravel accurately Hg isotopic signature observed in samples. The aim of this study was to investigate Hg bioaccumulation, trophic transfer and its metabolization in top predator organs, through the measurement of total Hg isotopic composition and Hg compounds (i.e. MMHg and inorganic Hg(II)) specific isotopic composition (CSIC) in the pelagic food web of the oligotrophic and remote freshwater Lake Baikal (Russia).

Carnivorous pelagic sculpins fish (Comephoridae and Cottocomephoridae families) and their predator seals (*Phoca sibirica*) were especially investigated. Significant MIF was observed in both samples with no significant differences (Δ^{199}Hg of 4.59±0.55‰ (n=27) and 4.62±0.60‰ (n=7), respectively. This high MIF was related to efficient MMHg demethylation before bioaccumulation in organism's muscles. On the other hand, Hg trophic transfer (from sculpins to seals) does not produce Hg MIF whereas MDF is likely during this process since seals muscles have δ^{202}Hg about 1‰ higher than sculpins muscles. Seals organs (liver, kidney, muscle, hair, intestine …) displayed significantly different Hg speciation, with liver and kidney mostly composed of Hg(II) whereas hair and muscle have more than 80% MMHg (figure 1).

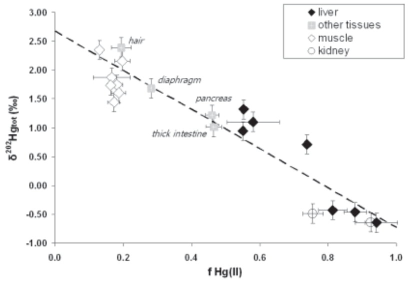

Figure 1. $\delta^{202}Hg_{tot}$ as a function of the fraction of inorganic Hg in seals tissues

Hg CSIC in seals tissues showed MMHg and Hg(II) enriched in heavier and lighter isotopes, respectively, with a δ^{202}Hg difference of about 3.2‰. MMHg demethylation in these top predator mammals was thus identified as a major process leading to MDF, but no MIF, of Hg isotopes before storage and/or elimination within the different organs, such as residual MMHg in muscle and Hg(II) in liver.

[1] Morel et al. (1998). *Annual Review of Ecology and Systematics*, **Volume 29**, pp543-566
[2] Bergquist and Blum (2009). *Elements*, **Volume 5**, pp353-357