Sampling of geochemical heterogeneities within the Hawaiian Plume: A case study of $^{143}Nd/^{144}Nd$

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The observed large isotopic variations in Oceanic Island Basalts (OIB) provide important informations and constraints on the origin, size and sampling of mantle heterogenities. As one of the best defined and studied examples of hotspot volcanism, Hawaiian volcanism plays an important role in our understanding of mantle plumes. There are large isotopic variations in the Hawaiian shield stage tholeiitic lavas. For example, the ε_{Nd} variation in Hawaiian shield lavas covers over 70% of the global OIB ε_{Nd} variation, e.g., Fig. 15 of [1]. In detail, each Hawaiian shield is characterized by a different distribution of ε_{Nd}. The volume-weighted ε_{Nd} distrubution of modern Hawaiian shield lavas is a near-Gaussian distribution, with a peak at 7.0 and an elongated tail towards low ε_{Nd} (-1.5). Except for some details, this observed ε_{Nd} distribution of Hawaiian shield lavas can be reproduced using the simple three-box model discussed in [2]. This model involves a continuously created and recycled crust reservoir, a depleted mantle reservoir and a primitive mantle reservoir, and sub-reservoirs are generated by returning melting residues, and recycling crusts into the depleted mantle. In this model, the mantle geochemical heterogeneities are randomly sampled. Further, we note that the average isotopic compositions of Hawaiian shield lavas are similar to the “matrix” composition in the model of [3], which is an enhanced version of the model of [2]. The matrix in the model of [3] is made up of subreservoirs with sizes less than 15 km. Consequently, we conclude that the isotopic variations in Hawaiian shield lavas may be the result of random sampling of a geochemically heterogeneous mantle at a smaller scale than it is sampled by the MORB volcanism.

Table. Compositions of FOZO, C, Matrix and Average Hawaii

	e_{Nd}	e_{Sr}	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
FOZO	9	-28	19.5	15.6	39
C	5	-14	19.5	15.6	39
Matrix	7	-21	18.7	15.55	38.5
Average Hawaii	6	-10~-14	18.2~18.6	15.43~15.50	37.9~38.2

[1] Hofmann (2003) In The Mantle and Core (ed. R.W. Carlson) Vol. 2, *Treatise on Geochemistry*, pp. 61-101. [2] Kellogg, Jacobsen & O'Connell (2002) *EPSL* **204**, 183-202. [3] Kellogg, Jacobsen & O'Connell. (2007) *EPSL* **262**, 328-342.

Secondary organic aerosol formation from ethylene in the urban atmosphere of Hong Kong: A multi-phase chemical modeling study

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Ethylene is one of the most abundant anthropogenic volatile organic compounds (VOCs) in urban atmospheres. The potential of forming secondary organic aerosol (SOA) by this smallest alkene was not previously considered due to the overlook of SOA formation through in-cloud processing of soluble oxidation products. Ethylene reacts with OH radicals to form glycolaldehyde as one of its major products. Glycolaldehyde can partition into cloud water where it is oxidized to glyoxylic acid and oxalic acid and thereby contributing to SOA formation. A chemistry box model incorporating explicit multiphase reactions of relevant C2 oxygenated species is used to evaluate the SOA mass that can be formed from ethylene under the typical conditions of Hong Kong ambient atmosphere. In an idealized scenario involving five cloud cycles, SOA products in the range of 65-290 ng m^{-3} are predicted when assuming a cloud water content of 0.17-0.50 g m^{-3}, corresponding to an SOA yield of 0.4-1.8%. The major SOA species derived from in-cloud processing of the ethylene oxidation products are oxalic acid (28 ~ 180 ng m^{-3}) and glyoxylic acid (10 ~ 58 ng m^{-3}). Sensitivity tests show that the SOA mass formed in the model depends strongly on the cloud liquid water content; it increases with increasing cloud period length and is less affected by the pH value of cloud droplet. The modeling results indicate that in-cloud processing is a viable pathway for SOA formation from ethylene. A more general implication is that in-cloud processing is a potentially important pathway to generate SOA, especially for places such as Hong Kong, where the annual cloud coverage is over 50%.