Lower crustal material in the source of the Ontong Java Plateau?

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Was an oceanic plateau as large as Ontong Java Plateau (OJP) a product of voluminous melting by a mantle plume or just a consequence of unusual plate tectonic processes during the Aptian time (120 My ago)? Our Os-Hf results on the plateau lavas put further constraints on the origin of the OJP, suggesting that the plateau is a product of a two-component mantle source possessing distinct Os isotope signatures that are both suprachondritic (0.12-0.17 for Kwaimbaita-type lavas and 0.24-0.60 for Singgalo-type lavas) and different from MORB (with an average composition of 0.125, [1]). In contrast, Hf isotope results for the same Central Malaitan and ODP Sites 807, 1185, and 1187 samples show a slight difference between the Singgalo- and Kwaimbaita-type lavas in ^{176}Hf/^{177}Hf, consistent with previous results for the ODP Leg 192 lavas [2]. Both isotopic groups of lavas have Hf isotope compositions that lie on the terrestrial array defined by MORB and OIB data in Hf-Nd diagram but have a gentler slope, reminiscent of the Hawaiian data trend. Both the involvement of pelagic sediments and altered, recycled normal MORB oceanic crust do not have the required Pb and Hf isotopic compositions that can explain the Os-Pb and Os-Hf trends of the OJP data. Instead, the Os and Hf isotopic compositions of the OJP lavas both indicate an origin distinct from the shallow mantle tapped by MORB lavas. Our modeling results indicate that the Os isotopic composition of the Singgalo-type lavas may be explained by incorporation of up to 40% lower continental crust material into the Kwaimbaita-type source of the OJP lavas. This is broadly consistent with suggestions by [3] and [4] but differs from previous interpretation in inferring that the entrained recycled crust is lower continental crust. The present interpretation allows for widespread contamination of the OJP mantle source with delaminated lower crust, possibly during continental break-up, that paved the way for the birth of the Pacific ocean in the past.

References

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Impact of organic ligands on antimony behavior in aquatic systems

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Although a huge number of studies have been devoted to metal-organic ligand interactions in natural aquatic systems, the effect of dissolved organic matter on the behavior of toxic metalloids like Sb, Se or As is still very poorly known. This is because metalloids are subjected to strong hydrolysis in aqueous solution, by forming neutral and negatively charged hydroxide species. This strong affinity to hydroxide ligands was believed to limit their complexing with organic ligands in comparison to most metals which exist as simple cations in solution. In this study, we combined systematic solubility and potentiometry measurements with in situ XAFS spectroscopy and dialysis experiments to assess structures and stabilities of antimony aqueous complexes formed with organic ligands having functional groups typical of natural organic matter.

Results show that both trivalent (Sb^{III}) and pentavalent (Sb^{V}) antimony form surprisingly stable complexes with hydroxy-carboxylic and hydroxy-phenolic functional groups of organic ligands (lactic, oxalic and citric acids, and catechol), with Sb/ligand stoichiometries from 1:1 to 1:3, over a wide pH range ($2<pH<9$). The key condition for the formation of such complexes is the establishment of a five-membered chelate cycle via Sb-O-C bonds with two adjacent functional groups of the organic ligand. In these species, Sb^{III} and Sb^{V} are respectively four- and six-coordinated, as demonstrated by XAFS spectroscopy.

The stability constants determined for Sb^{III} organic-complexes have been used to approximate Sb complexing with natural humic acids which possess the same functional groups as those investigated in this study. Results show in unpolluted organic-rich natural waters up to 60% of total Sb may be complexed with humic and fulvic acids via carbolylic and hydroxy-carboxylic groups, which is also in agreement with dialysis experiments on a commercial humic acid. Thus, organic matter plays an important role in Sb transfer in natural waters than believed. Our findings indicate that because of the high selectivity of Sb to bidendate linkages with two adjacent functional groups of organic ligands, antimony may serve as a proxy for such moieties in aqueous humic and fulvic acids.

Our results imply that natural organic matter may also exert an important effect, largely neglected before, on the transport of analogous metalloids like As and Se in aquatic systems.