Geochemical behavior of As originated from acidic thermal water during river transport and sedimentation mechanism

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We investigated change in the physico-chemical and redox status of As originated from the acidic Tamagawa thermal waters during transport in Shibukuro and Tama Rivers and sedimentation mechanism in the watershed.

The predominant dissolved As species in the thermal water was arsenite. However, this specie was rapidly oxidized. Thus, the geochemical mobility of arsenate was mainly controlled by the sorption onto hydrous ferric oxides (HFO). Most HFO sorbing As was transported and effectively settled onto the downstream man-made lake.

Most of As in riverbed and shallow part of lake sediments were extracted as reducible phase, indicating that they are originated from the Tamagawa hot spring area transported as HFO sorbates. Furthermore, XANES spectra reveal that As existed as As (V). On the other hand, As in deep part of lake sediments could not be extracted by reducing agent and XANES spectra reveal the conversion to As (III). The arsenite and ferrous ion was also detected in the interstitial water. These results indicate that HFO sorbing As was reduced during the sedimentation process.

The iron-oxidizing bacteria inhabited in acidic river water. The inhabitations of several microorganism including sulfatereducing bacteria in deep part of lake sediment were also confirmed. Taking these facts into consideration, the As mobility in this river system would be possibly controlled by the bacterial activities.

Development of the modern-style geochemical cycle of uranium by 3.5 Ga: A solution to the 'lead paradox'

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From analyses of redox-sensitive elements in many paleosol-, shale-, and submarine basalt- sections 3.5-2.5 Ga in age, we have recognized: (1) depletions of S and C, and depletions/enrichments of U, Mo, Fe, Mn, Cr and Cu in the paleosols; (2) enrichments of U and Mo in many of the black shales; (3) enrichments of U, Fe^{III} and Mo in the basalts that were affected by submarine alteration; and (4) Ce anomalies in many of the paleosols and submarine basalts. Therefore, the behaviours of redox-sensitive elements in these Archean rocks are essentially the same as those in Phanerozoic rocks. This suggests that the Archean oceans were poor in Fe, but rich in U and Mo, and that the modern-style geochemical cycles of redox-sensitive elements through the continental crust, oceans, oceanic crust, and mantle reservoirs have operated since at least ~3.5 Ga. The presence of highly radiogenic Pb in many Archean-age submarine basalts also supports this suggestion. The atmospheric $pO_2 > 0.5$ PAL is necessary to operate the modern-style geochemical cycle of U. Subduction of Fe^{III}- and U-enriched oceanic crust may have created a large-scale heterogeneity of the mantle since ~ 3.5 Ga, including: (a) the Fe^{III}/Fe^{II} ratio, and (b) the 'lead paradox' where the Pb in the mantle, especially in the source regions of OIBs and MORBs, is more radiogenic than in the chondrite-modeled bulk Earth. Therefore, through the creation of the oxygenated oceans and atmosphere, microbes have influenced the geochemistry of the deep Earth and the nature of volcanism since ~3.5 Ga.

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