

Origin and fractionation of heavy metals of sediments in the drinking water source of Beijing

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The Miyun Reservoir, the only one surface drinking water source of Beijing, incepted kinds of pollutants from rivers, agricultural production, mining activity, tailing and so on. Four sediment cores (35cm per core) were collected from Miyun Reservoir and cut into slices of 5 cm each core. Samples were subjected to a total digestion technique and analyzed by ICP-OES for Cr, Pb, Cd, Co, Cu, Mn, Ni, Ti, V and Zn, and by AFS for As and Hg. The seven-step sequential extraction technique was determined the distribution of speciation for heavy metals (except As and Hg). The results revealed the contents of heavy metals were not apparent enrichment compared with the shale standard. Most of heavy metals decreased while the depth increased. The results showed that the main fraction for most of heavy metals was residual phase. Additionally, the extractive phase of Cd was higher and reached 60%, the following was Ni, Co, Zn and Pb.

The origin of heavy metals was identified by multivariate analysis with total content. The results of correlation analysis revealed obvious correlation between heavy metals. Cu, Mn and V were highly correlated among them ($r > 0.800$; $p < 0.01$), Cr and Ni were also identified, whereas As and Ti were less correlated with Cu, Mn and V ($r > 0.500$; $p < 0.01$). The correlation coefficients were not as high as among Hg, Co and other heavy metals. PCA showed there were five principal components. PC1 included Ti, Cd, Cu, Mn and V, PC2 were Cr and Ni, PC3 were As and Zn, PC4 was Hg, and PC5 was Co. Therefore, the five principal components represented five primary origins of heavy metals, which were erosion of rocks, industrial and mining, agricultural production and domestic sewage, atmospheric deposition and secondary pollution of water environment, respectively. The results provided scientific basis for protection of drinking water source of Beijing.

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Isotope fractionation of transition metals by higher plants

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Transition metals such as Fe, Cu and Zn are present as trace elements in organisms, but are essential for life. Thus variations in transition metal isotope composition may be important in tracing the interaction between geosphere and biosphere, to trace the pathways of these elements into and within biological system. A prerequisite for these applications is an adequate understanding of the mass fractionation of these isotopes during steps of biological uptake and translocation. Here we report the result of a case study for isotope fractionations of Fe, Cu, Fe and Zn by higher plant using a Cu accumulator *Elsholtzia splendens*.

Elsholtzia splendens growth-experiments were carried out in green house and in soils with different chemical properties, namely: copper contaminated soil collected from natural environment denoted as CK, CK with addition of sulphur powder, CK with addition of EDDS, and CK with addition of both EDDS and sulphur. Soils, roots, stems and leaves were measured for Cu, Fe and Zn isotope ratios using Nu Plasma HR MC-ICPMS after digestion and chemical purification. The results display some prominent features, taking Cu isotopes as an example: 1) relative to soils, the plants show overall lighter isotope enrichment, implying significant isotope fractionation occurred during Cu uptaking of the root from the soil and light Cu isotope were taken preferentially; 2) from soil to root to stem, Cu isotope composition become progressively lighter, indicating stepwise mass fractionation during Cu uptaking and translocating; 3) relative to stems, leaves enrich heavy Cu isotope by ca.0.3%, suggesting a change in Cu transport mechanism from stems to leaves, and showing that heavy Cu isotope can be preferentially taken at some stage during biological processes; 4) the extent of light isotope enrichment of the plant relative to soil varies with the chemical property of the soil, and the light Cu isotope enrichment is enhanced by the addition of EDDS.

The results presented above enhance our knowledge about mass fractionation processes of transition metal isotopes in higher plants significantly.