Enrichment and chemical forms of arsenic in the sediment cores of the Daliao River System in China

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The Daliao River System (DRS) in Liaoning Province has been subjected to heavy anthropogenic influences as a result of rapid economic development in the past ca. 50 years. The objective of this paper is to report enrichment and chemical forms of As in the core sediments of the DRS to evaluate As contamination, mobility, and bioavailability. Four sediment cores down to ca. 50 cm depth were taken from the DRS. The sediment cores were generally sliced into 2 cm layers between 0-10 cm depth and 3 cm layers below 10 cm depth, leading to 71 sediment samples. The chemical forms of As in the samples were operationally fractionated into non-specifically adsorbed As (NSA), specifically-adsorbed As (SA), amorphous and poorly crystalline Fe and Al hydrous oxides-bound As (AMO), well-formed crystalline Fe and Al hydrous oxides-bound As (CMO), and residual As (RES). Total content of As in the core sediments ranged from 1.2 to 638 mg kg-1, with an median of 10.1 mg kg^{-1}. The enrichment factor of As in the core sediments ranged from 1.3 to 386, with an median of 5.8. The proportions of As in the NSA, SA, AMO, CMO, and RES fractions were, in average, 2.0(0.3-10.3)%, 26.6(2.4-52.3)%, 44.7(21.9-74.4)%, 11.7(2.1-21.2)%, 15.0(0.7-40.6)%, respectively. The sediment core collected in a tributary receiving municipal and industrial effluents from Shenyang city (captial of Liaoning Province) were seriously contaminated, with the highest content of 638 mg kg^{-1} As. The proportion of SA-As was higher in the sediment core near the estuary than in the other sediment cores, probably because the high concentrations of cations such as Na, K, Ca, and Mg in estuarine water increase specific sorption of As. Generally, the rank order of the average As proportion in each fraction was: bound to amorphous Fe and Al oxides, specifically sorbed As > residual As, bound to crystalline Al and Fe oxides > non-specifically sorbed As. Therefore, mobility and bioavailability of As in the core sediments are relatively high. The sediment of the tributary receiving municipal and industrial effluents from Shenyang city was severely contaminated and should be remediated.

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