

Translocation of typical harmful heavy metals in typical paddy and lake ecosystems

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The environmental and biogeochemical behaviors of harmful heavy metals, like cadmium (Cd) and mercury (Hg), in Se-rich environments, are receiving widespread attention, due to their co-migration and potential interactions that may affect the risk assessment. Rice is the staple food for humans, and the bioaccumulation of the heavy metals in grains is harmful to consumers; similarly, as an important source of foods, heavy metals that accumulated in aquatic products also potentially threaten human health. However, the co-translocation of heavy metals in the Se-rich paddy ecosystem and freshwater lake ecosystem is poorly understood. Here, field investigations with respect to the paddy ecosystem of Enshi and the lake ecosystem of Chaohu, in China were conducted. Positive correlations between soil Hg and roots Hg and between soil Hg and leaves Hg were observed, indicating that Hg in roots is majorly from the soil while the Hg in leaves is majorly from the Hg in air, which is released from the soil. The negative correlations of Se in roots and $TF_{(grains/roots)}$ and $TF_{(stems/roots)}$ imply that Hg translocation from the soil to the above-ground parts was inhibited, possibly by the interactions and Hg and Se. In the Chaohu lake ecosystem, the co-enrichment of Cd, Hg, and Se in a 30cm depth of sediment column was found. At the top 1cm layer sediment, the Cd, Hg, and Se concentrations reached 2.06, 0.19, and 0.63 mg/kg respectively, with the corresponding enrichment factors are 30.91, 5.82, and 6.31, showing a strong impact by human activities. After the calculations based on the potential ecological risk index (RI) proposed by Hakanson (1980), it was demonstrated that the risk index caused by heavy metals increased by nearly 10 times compared to 150 years ago, without considering Se. These findings imply that lots of work still need to be done to deal with the challenges posed by heavy metal pollution in typical Se-rich terrestrial ecosystems.