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## VARIATION AND ACCUMULATION OF SEDIMENTS AND ASSOCIATED HEAVY METALS ALONG CASCADE DAMS IN THE MEKONG RIVER, CHINA

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### Abstract

Cascade dams alter the movement and accumulation of heavy metals in sediments along the river continuum. 27 sample cross-sections were taken in July 2011 from the Xiaowan, Manwan, and Dachaoshan dams in the middle reach of the Mekong River in southern China and analyzed for content of heavy metal (Zn, Cr, Pb, As, Cu, Ni, and Cd) concentrations in the dammed river reach. There were evident spatial variations of the heavy metal concentrations downstream and upstream of the three cascade dams; the heavy metal pollutions were higher downstream of the Xiaowan Dam and upstream of the Manwan Dam. The mean concentrations of As, Cd, Pb, and Zn were higher than the background values in soil in Yunnan Province in China, and the maximum coefficient of variation of Cd reached 81%. Comparison results of two toxicity guidelines showed that the adverse effects in three cascade dams were not very high; there exists some relatively high pollution level sample sites, which were sufficiently high to cause adverse effects. The calculated geo-accumulation index ( $I_{geo}$ ) results indicate that the investigated sediments can be classified as “unpolluted” with Cr, Cu, Zn, Ni, and Pb, “moderately polluted” with Cd, and “unpolluted to moderately polluted” with As. Except for Cd (moderately pollution indices), all other six heavy metals varied more or less in the range of the local natural background concentrations. This pollution condition can be seen as a good sign for the dam environment. 44%, 26%, 30% of sample sites, which were located in the river center downstream of the Manwan Dam, exhibited low, moderate, and high ecological risks of heavy metal pollution and a decreasing trend of potential ecological risk  $Z_1$  (downstream of Xiaowan and upstream of the Manwan Reservoir) were higher than those in  $Z_2$  (downstream of Manwan and upstream of the Dachaoshan Reservoir). The calculated  $E_i^r$  mean values of the potential ecological risk for individual heavy metals is ordered as  $Cd > As > Pb > Cu > Ni > Zn > Cr$ . The principal component analysis result showed two primary components explaining 92.83% of the total variance. Zn, Cu, Cd, As, and Pb were considered to be “anthropogenic heavy metal loads,” while Cr and Ni were related to represent “natural heavy metal loads.”

**Keywords:** cascade dams, geo-accumulation index, ecological risk, heavy metals, sediment, spatial variation

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