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SPATIAL DISTRIBUTION AND SOURCE APPORTIONMENT OF POTENTIALLY TOXIC ELEMENTS IN DILUVIAL AND ALLUVIAL TOPSOIL AROUND XIAOLONGTAN LIGNITE DEPOSIT, GEJIU YUNNAN PROVINCE, CHINA

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Abstract

Lignite mining can significantly increase potentially toxic elements (PTEs) in soils through excavation and coal combustion. This study measured the concentrations of As, Hg, Cd, Cu, Pb, and Zn in diluvial and alluvial topsoil, as well as lignite samples, from the Xiaolongtan Lignite Deposit (XLD) in Gejiu, Yunnan Province, China. GIS mapping and absolute principle component scores -multivariate linear regression (APCS-MLR) model were employed to determine the spatial distribution, identify pollution sources, and assess source-specific ecological and health risks. Topsoil PTEs concentrations (mg/kg) ranged from 5.78–117 (As), 0.03–0.30 (Hg), 0.12–2.07 (Cd), 6.10–5221 (Cu), 3.28–978 (Pb), and 15.1–2620 (Zn), exceeding local background levels. Lignite contained (mg/kg) 16.8 (As), 0.07 (Hg), 0.72 (Cd), 44.2 (Cu), 58.2 (Pb), and 134 (Zn), higher than national and global averages. Enrichment factors (EF) followed the order Cu > As > Cd > Zn > Pb, suggesting anthropogenic inputs. Two principal components were identified: PC1 (68.26%) associated with Cu, Pb, Zn, Cd from agriculture and traffic; and PC2 (31.74%) associated with As and Hg from mining, industry, and weathering. The total ecological risk was extremely high (RI = 5817.15), with PC2 contributing more (25.45%) than PC1 (22.74%). Non-carcinogenic risks were significant, with total hazard index (THI) values of 43.8 (children) and 19.6 (adults); carcinogenic risks were also high (TCR = 5.1×10^{-3} for children and 2.2×10^{-3} for adults). Overall, mining and industrial activities were the major sources of ecological and health risks, with As posing the greatest threat, requiring enhanced management and control.

Key words: APCS-MLR model, Potential toxic elements, source apportionment, Source-specific risk assessment, Xiaolongtan Lignite Deposit

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