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Evaluation of Contaminations and Sources of Heavy Metals in Sediments at Samrak Delta of Nakdong River in Busan, Korea Using Geostatistical Methods

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This research used several geostatistical methods to assess heavy metal contaminations and their sources of sediments at Samrak Delta of Nakdong River in Busan, Korea. The mean concentration of heavy metals in sediments were Fe (16.42 %), Al (15.56 %), Mn (0.31 %), Zn, Pb, Cr (0.03 %), Ni (0.02 %) and Cu (0.008 %), which were mainly attributed to the intense industrial and irrigation activities, and also geogenic sources. Groundwater in the sediments also contains the high concentrations of heavy metals such as Fe and Mn. Canonical correlation analysis (CCA) exhibited a significant relationship between physicochemical parameters (sand, silt, clay, TOC, $CaCO_3$) and heavy metals (Fe, Al, Mn, Zn, Pb, Cr, Ni, Cu), and the importance of physicochemical parameters in regulating the amount of heavy metals in sediments. Artificial neural network (ANN) showed a good correlation and model efficiency for simulated outputs except Fe, Pb and Zn. Silt, Clay, TOC and $CaCO_3$ controlled the concentrations of heavy metals in sediments. Principal component analysis (PCA) produced two factor loadings of PCA 1 of Fe, Mn, Pb, TOC, Cr, silt and Al, 75.4 % in variance, and PCA 2 of Cu, Ni, Zn and $CaCO_3$, 24.6 % in variance. It suggested that heavy metals were originated from geogenic sources and effluents from industries. Cluster analysis (CA) was helpful for the classification of contamination sources of heavy metals. This study suggests that geostatistical techniques are essentially necessary for the effective management of heavy metal contaminations and policy decision making processes to reduce the contamination level of heavy metals in deltaic region.