

Assessment of heavy metal pollution in marine sediments along the southeastern coast of South Korea

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In the marine environment, heavy metals released from industrial complexes exist in the solid phase, where they can be adsorbed onto marine sediment particles and precipitate. Moreover, these metals have the potential to bioaccumulate, ultimately posing health threats to humans through the food chain. This study assessed heavy metal pollution and environmental risk by analyzing the heavy metal content in marine sediments along the southeastern coast of South Korea, the location of one of the major steel industrial complexes. Sampling was carried out at 22 sites and concentrations of As, Cd, Cr, Cu, Ni, Pb, and Zn were determined in samples pretreated with a mixed acid solution (HF:HNO₃:HClO₄ in a 4:4:1 ratio) using an Inductively Coupled Plasma Mass Spectrometer (iCAP ProX, Thermo Fisher Scientific) at the Integrated Analytical Center for Earth and Environmental Sciences. Heavy metal pollution and environmental risk assessment were conducted using the Threshold Effect Level (TEL, As: 14.5; Cd: 0.75; Cr: 116; Cu: 20.6; Ni: 47.2; Pb: 44.0; Zn: 68.4 mg/kg) and the Probable Effect Level (PEL, As: 75.5; Cd: 2.72; Cr: 181; Cu: 64.4; Ni: 80.5; Pb: 119; Zn: 157 mg/kg) in the Korean Sediment Quality Guideline (SQG), the Geo-accumulation Index (I_{geo}), the Pollution Load Index (PLI), and the Ecological Risk Index (ERI). The results of heavy metal pollution assessment indicated that the concentrations of As, Cr, Cu, and Zn slightly exceeded the TEL at several sites (As at 2 sites; Cr at 2 sites; Cu at 3 sites; Zn at 11 sites). Concentrations of Cd in sediment samples exceeded the PEL at 10 of the 22 sites, with a maximum of 32.52 mg/kg, approximately 12 times higher than the PEL. The I_{geo} indicated that the Cd levels were classified as “Strongly polluted” or higher at 17 sites. The PLI revealed “Pollution exists” at all sites. According to the ERI, 15 sites were classified as having an impact rating of “high” or above on the benthic ecosystem. These results suggest that the current levels of heavy metal contamination in the study area are severe, with cadmium, in particular, posing a potentially serious risk to the ecosystem.