

# Heavy Metal Contamination and Metal Isotope Analysis of River Sediments around Ulsan Port, Korea

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Ulsan, located in the southeastern part of the Korean Peninsula, is a major port city with extensive industrial infrastructure, including petrochemical complexes, the Hyundai Motor plant, and multiple industrial complexes. These industries contribute to environmental pollution, particularly heavy metal contamination in nearby river sediments. This study investigates heavy metal contamination in river sediments around Ulsan Port through elemental composition and metal isotope analyses.

To achieve this, elemental quantification was conducted using ICP-MS (Agilent 7900), while metal isotope ratios were analyzed using MC-ICP-MS (Nu Plasma II) at the Division of Earth and Environmental Sciences, Korea Basic Science Institute (KBSI). These high-precision techniques enable accurate differentiation between natural and anthropogenic pollution sources, providing more precise contamination source identification than conventional concentration-based methods. The combination of elemental and isotopic analyses enhances the ability to trace industrial pollution and to identify sources of contamination in sediments will be improved.

The analysis results indicate that sediments from the Onsan National Industrial Complex, located south of Ulsan Port, exhibited the highest concentrations of Zn(> 1.9 wt%), Pb(> 3500 ug/g), and Cd(> 700 ug/g). Additionally, Zn isotope values in this area were significantly elevated compared to other locations, suggesting a distinct pollution source. A large-scale zinc smelter located in this area may be a major factor in the pollution, as the surrounding river sediments show high concentrations of heavy metals and different Zn isotope values from other regions due to the discharge from the industrial process. Analysis of these components and isotopes can be used to infer that this is the source of heavy metal contamination of the river sediments.

This study highlights the importance of continued monitoring and further research on the application of metal isotope in pollution assessment. By integrating elemental and isotopic analyses, future studies can improve the tracking of pollution source and support contaminated sediment cleanup projects. This study provides a scientific basis for improving environmental policies, strengthening pollution control measures, effective cleanup projects, and enforcing legal regulations to manage heavy metal pollution in the Ulsan Port area.