

Abstract

**IDENTIFICATION OF HEAVY METAL SOURCES IN RIVER SEDIMENT IN THE
KRUPANJ AREA**

DOI: 10.5937/EcoTER26640V

Student: Marija Vesković¹

Mentor: Antonije Onjia^{1*,a}

¹ University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11120 Belgrade,
SERBIA

^a <https://orcid.org/0000-0002-5694-7960>

Abstract

Environmental pollution represents one of the major global challenges of the modern era. Rapid urbanization, industrialization, improper disposal of various types of waste, and increasing agricultural activities contribute significantly to environmental degradation and contamination. Heavy metal (HM) contamination in river systems is closely associated with anthropogenic activities and represents a significant environmental concern. Once introduced into aquatic ecosystems, heavy metals are deposited, adsorbed, and accumulated in the surface layers of sediments. These metals pose a serious environmental threat due to their toxicity to both aquatic and terrestrial organisms. In addition, they are highly persistent in the environment, difficult to eliminate and, their tendency to accumulate in water, sediments, plants, and living organisms may result in adverse effects on ecosystems and human health.

This study investigated sources of HMs in sediment samples along Jadar River in the vicinity of the city of Krupanj, Serbia. A total of twenty-five river sediment samples were collected and analyzed for ten HMs including: antimony (Sb), arsenic (As), cadmium (Cd), chromium (Cr), iron (Fe), manganese (Mn), nickel (Ni), lead (Pb), zinc (Zn), and mercury (Hg).

Principal component analysis (PCA) of metals in the sediment indicated that PC1 (57.0 %) and PC2 (26.3 %) collectively accounted for 83.3% of the total variance. On the first principal component As, Sb, Cd, Pb, Zn, and Hg exhibited strong positive loadings, all exceeding 0.75, indicating a common origin for these elements. Therefore, the first principal component may represent an anthropogenic influence, indicating intensive mining and agricultural activities. Previous studies have shown that the extraction of Sb is commonly associated with accompanying metals such as Pb, As, Zn, Cd, and Hg, while many of these metals may also originate from intensive agricultural practices. The Stolice Mine, located within the investigated area, is an antimony mine, which explains the elevated concentrations of this metal. Within the second principal component Cr, Fe, Mn, and Ni also showed positive loadings. A possible source of these metals in the investigated area may be related to geological processes. Rocks that have undergone sedimentation or metamorphic processes

*onjia@tmf.bg.ac.rs

can be enriched with metals such as Ni, Mn, Cr, and Fe which explains their presence in the investigated sediment. In addition, similar conclusions can also be drawn from the analysis of the dendrogram and the Pearson correlation matrix.

In this study, multivariate statistical analysis revealed the presence of two main factors influencing the distribution of heavy metals in the investigated area, with anthropogenic influence being the dominant one.

Keywords: pollution, anthropogenic influence, geological processes, multivariate statistics

ACKNOWLEDGEMENT

This work was financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (No. 451-03-34/2026-03/ 200135).

REFERENCES

1. Abdelaal, A., Ahmed, M., El-Alfy, M., *et al.* Mar. Pollut. Bull. 2024, 198, 115930.
2. Chen, Z., Zhao, Y., Liang, N., *et al.* Mar. Pollut. Bull. 2024, 205, 116621.
3. Jakovljević, K., Kostić, O., Nikolić, N., *et al.* Environ. Sci. Pollut. Res. 2020, 27(4), 4089–4103.
4. Levresse, G., Lopez, T., Tritlla, J., *et al.* Sci. Total Environ. 2012, 427–428, 115–125.
5. Magesh, N.S. Mar. Pollut. Bull. 2026, 229, 119722.
6. Vesković, J., Onjia, A. J. Hazard. Mater. 2025, 488, 137309.
7. Vesković, J., Stanković, S., Onjia, A., *et al.* Stoch. Environ. Res. Risk. Assess. 2024, 38 (4), 1597–1612.
8. Wang, L., Li, Y., Chen, P., *et al.* Environ. Monit. Assess. 2020, 192(12), 772.
9. Zou, H., Ren, B. Ecol Indic. 2023, 154, 110761.