

## Geochemical Insights into Heavy Metal Exposure in the Colombian Amazon.

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Gold mining in the Guainía region of the Colombian Amazon has led to severe environmental and public health concerns, primarily due to mercury contamination. Mercury, used in artisanal and small-scale gold mining, enters aquatic and terrestrial ecosystems, posing risks to both biodiversity and human populations. To establish baseline contamination levels, we collected 32 soil and sediment samples for multi-element analysis. Our results indicate that while most samples exhibited mercury concentrations below the U.S. Environmental Protection Agency (EPA) threshold of 0.150 mg/kg, several exceeded this limit, corroborating previous reports of contamination in the region (Cáceres Cháves et al., 2022). While our findings contrast with earlier studies that documented alarmingly high mercury levels in the Guainía and Atabapo rivers, other studies reported significantly lower levels, placing our results in between these two extremes (Olivero Verbel et al., 2016; Mendoza et al., 2020). These discrepancies may be due to variations in sampling locations and sampling technique, mercury's rapid transformation into methylmercury, and subsequent bioaccumulation in aquatic food webs. Additionally, enrichment factor (EF) calculations revealed moderate to severe enrichment for elements such as Cd, Zn, S, Cu, Ag, Pb, Mo, Sb, and Se—trace metals likely linked to gold extraction processes. These metals pose long-term risks to ecosystems and human health, particularly through exposure pathways such as direct ingestion of contaminated water, dermal contact with sediments, and bioaccumulation in fish—a dietary staple for indigenous communities. Chronic exposure to these toxic elements has been associated with neurological, renal, and developmental disorders (World Health Organization, 2022), highlighting the urgent need for intervention.

### References

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