Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37421

High Time Resolution Monitoring of Trace Element-Bearing Particulate Matter Around a Copper Smelter Using ICP-MS and spICP-ToF-MS: A Spatial and Indoor/Outdoor Study

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Airborne particulate matter (PM) emitted from non-ferrous smelters has been a continuous concern over the years. The release of these PMs, which contain potentially toxic elements like Pb, Cu, As and Cd, can be problematic for the health of the population living around these types of smelters. The copper smelter present in Rouyn-Noranda, Quebec, is the only one of its type in Canada. It is also the largest electronics recycler in North America. Nonetheless, the smelter is facing challenges with respect to its PM emissions. Samples were collected at short time intervals (~8 min.) using a μ-Coriolis around the copper smelter and in different buildings in the city of Rouyn-Noranda, Québec. The samples collected were analyzed using inductively coupled plasma-mass spectrometry (ICP-MS) for total metal quantification and by single particle ICP-Time-of-Flight-MS (spICP-ToF-MS) to determine PM composition and concentration. The objective of this study was to monitor, at high time resolution, the composition and the concentrations of these trace elements containing PMs. A distance-based analysis allowed us to assess the concentration of the different trace elements as a function proximity from the smelter, while considering wind direction. Simultaneously, particle compositions were determined by spICP-ToF-MS. Secondly, an analysis of PMs compositions and concentrations was performed in which the inside and outside of different buildings were compared under different conditions (i.e. windows closed or opened, dust resuspension, etc.). Metal concentrations were both lower further away from the smelter, and inside buildings compared to outside. The spICP-ToF-MS analysis provided valuable insights into the multi element chemistry of the particles. Understanding the composition and concentration of these airborne particles, on a single particle level can better inform us on their toxicity.