Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.22018

Monitoring Air Contamination in Bogotá: An Innovative Approach Using Spider Web Heavy Metals and Lead Isotope Analysis.

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Bogotá is one of Latin America's most polluted megacities posing a significant thread for its over 10 million residents. Due to its altitude (2600m) and surrounding mountains, air pollutant dispersion is rather limited. Moreover, most of the city vehicles are old and their emissions not regulated exacerbating the problem. Combined with the reduced efficiency of combustion processes in this oxygen-low atmosphere, its inhabitants are exposed to high levels of aerosols. The annual average for $PM_{2.5}$ in the city was 18.2 μg/m^3 in 2018, far exceeding World Health Organization recommendations of 5 μg/m^3. Seasonal variations show higher daily $PM_{2.5}$ values from January to March, often triggering pollution episodes during this period. Despite the severity of the issue, the sources of these aerosols and their spatial impact within the city remain unresolved. Traditional studies have relied on active aerosol collection, but recent advances have highlighted the potential of bioindicators, such as mosses, plant leaves, needles, lichens, and notably, spider webs. Spider webs, being inexpensive, easy to collect, and widespread, offer a cost-effective means for high-resolution environmental pollutant monitoring. In the present study we collected 45 spider webs thought the city that were then analysed for 32 heavy metals and their lead (Pb) isotope ratios. Our findings reveal the highest metal enrichment factors in the southwestern part of the city, a region with significant industrial activity and road traffic. Pb isotope ratios further indicate that the atmospheric metal budget in the city is not only influenced by road traffic and coal combustion but also by terrigenous sources, such as resuspended soil particles. This study underscores the utility of spider webs as bioindicators and provides crucial insights into the multifaceted sources contributing to Bogotá's air pollution problem.