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Chasing spider webs to track sources of metal air contamination in Colombian megacities

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While urban populations are continuously exposed to airborne heavy metals, their source attribution remains challenging. Here, we evaluated the use of spider webs as source bioindicators by coupling trace metal concentrations (26 elements) and Pb isotope ratios in 88 urban samples collected in Bogotá and Medellin (Colombia). Aluminium-normalized enrichment factors (EF) were calculated and ranged from 1 up to 492, revealing highly variable contamination levels.

Metals with no enrichment (2-10), indicating a predominantly geogenic origin, showed similar assemblages for both Medellin (V, Fe, Co, Ba, Ca, Ti, K, As) and Bogotá (Sr, V, Th, U, Ni, Co, Ba, Ca, Ti, K, As, Cr). More metals showed severe to very severe EF (5-10) in Medellin (Cr, Mo, Pb, Cu, Cd, Zn, Mo) than in Bogotá (Mo, Cu, Pb) whereas extremely severe enrichment (>50) was limited to Ab, Se, Sb in Medellin and to Zn, Cd, Ag, Se, Sb in Bogotá. These highlight strong anthropogenic contributions, particularly in Bogotá.

While EF alone indicate anthropogenic contributions, Pb isotope ratios proved their added value as a complementary robust tool for precise source discrimination. Pb isotope analysis showed deviation from pre-industrial soil signatures, highlighting the predominance of Pb in the urban air with greater isotope heterogeneity observed in Bogotá. Overall, this study demonstrate that spider webs are a cheap and reliable proxy for tracking sources of metal air pollution.