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Pb Isotopic Tracing Shows Urban Trees Quench Their Thirst with Tap Water

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Urban trees provide several services to cities, including improving air quality and cooling urban environments during heat waves. Additionally, they can serve as historical records of urban pollution by storing contaminants in their growth rings. However, the varied environmental conditions in cities can affect trees' ability to capture pollutants, which may impact the interpretation of temporal pollution signals in tree rings.

In this study, we analyze lead (Pb) pollution history using tree rings from street and park trees in different neighborhoods of Montreal. Our findings reveal that Pb concentrations and isotopic compositions in tree rings are significantly more variable for street trees than for park trees. The Pb isotopic signatures indicate different contamination sources: park trees display a signature typical of atmospheric deposition, while street trees show a Pb signal characteristic of municipal water system components, such as welds or piping.

This result aligns with the fact that Montreal's aging water infrastructure loses approximately 500 million liters per day to surrounding soils—equivalent to 200 Olympic-sized swimming pools. This lost water is available for uptake by plants, and Pb-isotope analysis of tree wood mini-cores confirms that trees closest to the city's pipe system—such as those on densely built streets with limited soil patches—exhibit Pb signatures linked to geologically old mining districts. In contrast, trees in urban parks show isotopic signatures more typical of aerosol-related contamination in soils.

These findings highlight that street certain trees take up little water from direct rainfall and are instead influenced by leakage from the municipal water system, making them inadequate for tracing the history of atmospheric Pb pollution. Understanding these dynamics can improve urban water management and tree planting strategies in cities.