Reconstructing historical lead levels using urban dendrochemistry in St. John's, Newfoundland, Canada: species selection, sampling and comparison

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St. John's is a small, light-industrial, port city with a legacy of elevated residential lead (Pb) from the use of paint, gasoline and coal. Soil and indoor dust Pb levels associated with older housing stock represent a potential exposure risk for young children living in these houses. Geochemical analysis of soils from across city neighbourhoods provides a spatial context for understanding environmental Pb burden as the city grew and expanded outwards away from the harbour. For example, there is a significant difference in mean Pb concentration in soils from across housing age cohorts. Urban lake geochemical data document dramatic increases in Pb (6x) in the upper sediments, related to coal burning and leaded gasoline use; the highest inputs and concentrations of Pb occurred about 1970. Tree rings have the potential to record and preserve annually resolved metal concentrations from atmospheric and soil sources (dendrochemistry). The Pb levels in annual growth rings from trees located in the older downtown and former rural areas are potentially useful in understanding the geochemical landscape of St. John's because they would identify the spatio-temporal patterns of soil Pb accumulation and atmospheric Pb concentration in the city during its major development and growth (post 1900s). The most abundant old trees in St. John's are maples (*Acer sp.*), elms (*Ulmus sp.*), beech (*Fagus sylvatica L.,*), horse chestnut (*Aesculus hippocastanum L.*) and pines (*Pinus sp.*) and range between 100 and 165 years old. The oldest trees are mostly located in public parks, cemeteries and government properties near the old downtown. Old spruce and fir trees (>100 years) are preserved in suburban forest parks but were located in rural settings for much of their life.

The initial part of the study involved selection of suitable species and appropriate sampling protocols to limit potential contamination, and assessing the appropriateness of laser ablation analysis for available species. Generally it is considered that coniferous trees are more appropriate for metal pollution studies, but the choice of a particular species can depend on the particular situation, elements of interest and the study aims. Deciduous trees are more common in downtown St. John's. Some of them, however, are

not commonly used in dendrochemistry and require testing to demonstrate reproducible and representative results. Wood preparation procedures can lead to contamination or cross-contamination of metals across rings. We tested different procedures, such as sanding, cutting with blades or using unprocessed cores, to compare contamination effects. An additional challenge is comparing the reaction of different wood samples to laser ablation. This is caused by differences in anatomical structure. Maple, for example, appears to ablate better than spruce or beech. Finally, some species may exhibit high intra-ring variation in element concentration. Documenting this variability in advance of tree-ring measurement is critical for the accuracy of the laser ablation approach; for example, initial results suggest that spruce exhibits reasonable homogeneity within a single ring.

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