
**Urban geochemical hazard mapping of
St. John's, Newfoundland, Canada**

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The surface soil concentrations ($n = 997$) of ten metals with Canadian Council of Ministers of the Environment soil quality guidelines were mapped on residential properties across the city of St. John's, Newfoundland and Labrador, Canada. Concentrations of all metals were elevated above background levels, five of the ten metals, As, Ba, Cu, Pb, and Zn, had concentrations above environmental health guidelines in more than 20% of samples, and three metals, As, Pb, and V, exceeded human health guidelines in 34 to 47% of samples. Using a contamination index, surface soil was shown to be highly contaminated in the downtown area, primarily on residential properties predating the 1950s. In order of influence, the four metals with the highest contamination factor were Pb, As, Cu and Zn. Compared to background levels, surface soils were significantly enriched in Pb and Cd and moderately enriched in Cr, Cu and Zn. A hierarchical clustering procedure indicated strong statistical relationships between the occurrences of two metal groups across all soil samples. One group, Pb-Zn-Cd, has consistently elevated concentrations in soil sampled adjacent to the exterior walls of buildings, though high values were also recorded in roadside samples and from open spaces on properties. The second group, Cr-Ni-Cu, has moderately elevated concentrations in all sample locations, though slightly higher concentrations along roadsides. The clusters of metals and their spatial concentration patterns suggest that weathered paint, vehicular emissions, and coal burning were important sources for the main contaminants in sampled soils. Of the three metals with significant human health guideline exceedences, Pb and As pose the greatest potential health risk and require further assessment. It is likely that other cities in the Atlantic region that share similar urban history and characteristics have a potentially hazardous geochemical landscape.