Comparison of portable X-Ray fluorescence analysis with total digestion of urban soils in Fredericton, New Brunswick, Canada

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Situated on a floodplain between the Saint John River and elevated terrain to the west, the urban centre of Fredericton, New Brunswick, overlies an aquifer that supplies potable water to ~95% of the city. A soil survey completed in 2016 examined 101 sample sites, with a focus on locations overlying the aquifer. Near-surface 'A' samples were collected at a depth of ~10–15 cm and, where possible, underlying 'B' samples were collected at a depth of >30 cm. Subsamples <63 microns were submitted to Activation Laboratories Limited (Actlabs) and analyzed by INAA or TD-ICP to determine elemental concentrations for 50 elements. 'A' group samples collected in the downtown area were found to surpass the Canadian Council of Ministers of the Environment (CCME) soil quality guidelines for As, Ba, Cr, Cu, Ni, Pb, V, and Zn. Anthropological activities, weathering, and elemental mobility were suggested to have contributed to the observed elevated elemental concentrations.

Building on the previous study, 66 urban centre 'A' sample splits were analyzed by portable X-Ray fluorescence (pXRF) to determine the elemental concentrations of 38 elements. For the majority of samples, pXRF analysis demonstrated lower elemental concentrations than samples analyzed by INAA/TD-ICP, with the exception of Ba, Mo, Pb, and V which exhibited higher concentrations. Similar to the INAA/TD-ICP results, As, Ba, Cr, Cu, Pb, V, and Zn were found to surpass CCME soil quality guidelines for the protection of environmental and human health using pXRF analysis, with Mo and Co also surpassing the guidelines.

In comparison to INAA/TD-ICP, pXRF analysis is advantageous as it requires minimal sample preparation and is a non-destructive method of elemental analysis. While other chemical digestion methods are known to provide more accurate concentration results for certain elements, this study indicates that pXRF can be used in environmental applications as a rapid low-cost first method for determination of anomalous concentrations of selected elements.

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