Exploring the effect of chloride from de-icing salts on heavy metal concentrations in urban soils: a case study in Halifax, Nova Scotia, Canada

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Established in 1749, Halifax has long been home to various factories and extensive military installations, and experienced the largest ever non-nuclear explosion. Still an active port city, Halifax soils variably reflect aspects of this and its geological past. A pilot study by the 2013/2014 Environmental Geoscience class at Dalhousie University determined heavy metal concentrations in residential soils of the Halifax Peninsula. At each of over 30 residences, three samples were obtained: house dripline, roadside, and an ambient sample from an open location on the property. The samples were dried, sieved to <1 mm and analyzed using X-Ray Fluorescence (XRF) for Pb, As, Cr, Cu, Zn, Ba, V, Cd, Co, Se, Mo, and Sn. In many cases, dripline values of some metals were greater than ambient values, which in turn were higher than roadside values.

One possible explanation for the lower roadside metal values is mobilization of metals by chloride from de-icing salts. Sodium chloride (NaCl) is particularly effective for anti-icing and de-icing in Halifax due to the moderate climate. The objective of this study is to explore the process of chloride leaching and its impact on metal mobility using soils from the Halifax Peninsula. Soil samples were collected to a depth of 10 cm and sieved to <2 mm. For each sample, leaching experiments were done with controls of 0%, 3.5%, and 23% NaCl solutions to represent pure water, saline water, and brine, respectively. For each experiment, an 85 g (approximately 1 cm thickness) soil subsample was placed in a Buchner funnel with filter paper, and compacted slightly. Subsequently, 565 mL of solution was poured through, to represent the annual average precipitation in Halifax scaled down by a factor of 10. For the 3.5% and 23% controls, 200 mL of the saline solutions were added, followed by 465 mL of distilled water. This is to account for the fact that salt loading occurs mostly from December to March, with approximately 36% of the total annual precipitation occurring in the winter months. Pre- and post-leaching heavy metal concentrations will be analyzed using XRF to determine if metal concentrations have decreased as a function of salinity. Metals of focus will be those with existing guidelines set by the Canadian Council of Ministers of the Environment. No results have been obtained to date; however, gradual darkening of the leachate from the 0% to 23% controls may suggest greater leaching with higher salinity.

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