Heavy metal contamination in the semi-urbanised Laurel Creek Watershed, Waterloo (Ontario), Canada

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Metal pollution in our watersheds can have numerous and sometimes severe impacts on the health of organisms which interact with the affected water sources. Some metals are required for cellular growth and maintenance as micronutrients, but are toxic at larger doses, while others are not required and are toxic at even low concentrations. Anthropogenic activities provide pathways for these metals to enter waterways, including industrial activities, mining, and transportation. There is currently a limited amount of literature addressing metal budgets and pathways within individual drainage basins, leading to some limitations of the understanding of heavy metal sources and interactions within these basins. Here, we study Waterloo region, and specifically the Laurel Creek drainage basin (80 km2 basin area, population 123,500, precipitation 907 mm/year). The Laurel creek watershed has a myriad of land uses that makes it a perfect local setting for our metal budget approach. This tributary to the Grand River is divided in agricultural land (37% basin area), and a mosaic of residential (32% of basin), commercial (4.5% of basin), and industrial land (7% of basin), with some brownfields constituted of previously active tanneries. Extensive datasets, mostly at very high resolution, are available, both historical and current, including climate, GIS data on land use, drinking water, storm water management and sewage system, particulate levels, and measurements of various other factors influencing contaminant pathways, with ongoing sampling for many of these. Using the data available, along with an available water model and GIS processing, the aim is to create a water and metal budget, following the methodology first presented by [1]. The budget will focus on specific target heavy metals, such as copper, nickel, and cadmium. We anticipate that this work will introduce a more detailed conceptual model for heavy metals in urban settings, with a better description of some overlooked sources. This study will serve as a stepping stone for larger watershed studies.

[1] Meybeck *et al*.. (2007). Science of the Total Environment, 375, 204-231.

Evaporation as the transport mechanism of metals in arid regions

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Arid regions are wide and vast areas of the globe with a relatively low population density. Arid regions are known for the deserts, the scarcity of fresh water and long periods of draught. The main climatic process that dictates water flow in soils in such areas is evaporation rather than precipitation e.g. [1]. While groundwater protection is a main issue in temperate regions, arid regions do not have such concerns when dealing with soil contamination. Contaminated sites are often not a priority, as its remediation, since there is no real scarcity of land for certain economic activities and overlooking how contamination of desert areas could ever affect human health.

This study tests the hypothesis of heavy metals coupled flow with the evaporating soil water in arid climates. Laboratory tests were performed to study the migration of heavy metals in an artificially spiked soil, using compressed air as evaporation driving force. A loamy and a sandy soil, collected near Al-Hasa, Saudi Arabia, are spiked with a heavy metal solution that is representative of a landfill leachate in developing country [1], and then used in this study. Main results show that while evaporation does transport heavy metals to the surface of a sandy soil, the loamy soil does not show the same trend. Therefore, contaminant accumulation predominates at the surface of sand soils in arid and semi-arid regions. Given that 90% of the land in Saudi Arabia, and for the most of arid regions, is sand, contaminated sand sites can pose a considerable hazard to the environment, especially biota, humans included. Ingestion or inhalation of sand particles from contaminated sites is a public health issue that should be assessed in arid regions. Sand and silt size particles from arid regions do travel long distances and may present an aerosol problem elsewhere. This is a source of atmospheric pollution that has been overlooked.

[1] Elrick & Mermout (1994) J. Hydrology **155**, 27-38. [2] Rawat *et al*.. (2009) *J. Hazard. Materials* **172**, 1145-1149.

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