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Natural enrichments of Cd and Tl in bark of trees consumed by beaver (*Castor canadensis*) in a rural watershed devoid of point sources of metal contamination

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In a previous study of beaver (*Castor canadensis*) from a small stream in a rural region of southern Ontario, organ tissue, especially kidney, had remarkable enrichments of Cd and Tl (13.3 ± 4.8 mg/kg and 68 ± 61 µg/kg respectively, n=5). However, the concentration of both elements in the dissolved fraction (<0.45 µm) of the river is very low: 1.2 ± 0.3 and 1.6 ± 0.1 ng/l of Cd and Tl respectively (Shotyk et al., 2019: https://doi.org/10.1016/j.scitotenv.2019.03.303).

To help explain this phenomenon and determine whether the accumulation of Cd and Tl in beaver tissue can be attributed to the diet of the animal, bark was collected from 40 species of trees and shrubs from the same location as well as soil and sediments. All the samples were analyzed in the metal-free, ultraclean SWAMP lab (www.swamp.ualberta.ca) following an acid digestion procedure and ICP-MS analysis.

Willow and poplar, two favourite foods of the beaver, are very rich in Cd (up to 8.5 mg/kg) whereas soils and underlying lacustrine sediments from which the soils were derived show Cd concentrations ranging from 77 to 394 µg/kg.

The values recorded for the transfer factor (TF), using the 1.5 m depth soil layer to calculate the enrichment of Cd in bark, in willow and poplar vary between 5 and 21. Even though Cd is potentially toxic, these plants preferentially accumulate this metal over essential micronutrients such as Cu, Mn, Ni and Zn. At the same time normalizing the Cd/metal ratios in bark to the corresponding ratios in the dissolved fraction of the river yields the Stream Enrichment Factor: this shows that all plant species accumulate Tl preferentially over Rb; in this case, neither is essential, but the former is more toxic than the latter.

Our results suggest that the abundance of Cd versus Tl in plant and beaver tissue is not a reflection of differences in bioavailability, but rather on the preferential uptake of Cd by plants. Apparently, the biogeochemical cycle of Cd in the riparian zone is dominated by active plant uptake, and this has ramifications for biomonitoring of environmental contamination.