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Trace elements in country foods, from berries to beavers: a geochemical perspective on micronutrients and non-essential, chalcophile elements

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There is ongoing concern about the significance of contamination of traditional foods ("country foods") from resource extraction in northern Canada: open pit mining of base metals and bitumen; smelting and refining of metallic ores; upgrading and refining of bitumen; conventional oil extraction and refining, as well as logging and road construction. In addition, there are growing perceptions of health risks associated with the consumption of these foods. All trace elements, however, have a natural source, including potential anthropogenic contributions. In many cases, studies have failed to establish background concentrations using appropriate reference samples. We have analyzed a small but diverse collection of plants and animals (native tobacco, fish, berries, moose, beaver, Labrador Tea, wild rice, and Rat Root) which are all important to First Nations peoples of Canada. Here, emphasis is placed on data obtained from samples collected in rural and remote locations far from industrial activities. Using the metal-free, ultraclean procedures and protocols employed at the SWAMP laboratory, we document enrichments of micronutrients essential to plants (e.g. Cu, Fe, Mn, Mo, Ni, Zn) and animals (e.g. these, plus Co, Cr, V), and distinguish these from enrichments of elements that have no biological function (e.g. As, Cd, Pb, Sb, Tl). To date, we have identified the natural enrichment of Cd in leaves and fruits of plants, Tl in fish, and both elements in liver, kidney and muscle of beaver. Using conservative, lithophile elements such as Y, it is possible to distinguish between trace elements supplied to plants predominantly from atmospheric dust deposition (e.g. Al, Pb, V) versus root uptake (Cd, Cu, Fe, Mn, Ni, Zn). It is hoped that the natural enrichments of Cd, Cu, Fe, Mn, Ni, Tl, and Zn presented here, will provide helpful context for interpreting data obtained from plants and animals collected near industrial activities.