Application of isotope ratio tracing to source residentiallead exposure in children in St. John's, Newfoundland, Canada

[a]Foley R, [b]Bell T, [c]Sylvester P J, [d]Manton W I

Lead isotopes were used to determine the sources and pathways for residential lead exposure in children living in St. John's, Newfoundland, Canada. The study utilized blood and environmental samples collected as part of a larger biomonitoring project (leadnl.com) that investigated children's exposure to lead in soil, tap water and house dust in a range of housing age stock. Of the 55 soil, 247 dust, 30 water and 35 paint samples analyzed for lead isotopes, water had a higher percentage (40.5%) of isotope ratios $^{206}Pb/^{207}Pb/^{208}Pb/^{207}Pb$ nearest in Euclidean distance to children's blood, compared to soil (29.7%), dust (27%) and paint (8.1%). Pearson r correlation coefficients showed that the lead isotope ratios ($^{206}Pb/^{207}Pb$) for water were significantly correlated (r=0.573, p=0.001) with children's blood. The large range ($^{206}Pb/^{207}Pb$=1.097-1.948) in the lead isotope ratios for blood suggests that lead exposure for children living in St. John's is highly variable; however, case studies are presented that show how the ratio tracing approach was able to identify a likely exposure source for each child. The similarities in lead isotope ratios ($^{206}Pb/^{207}Pb$) for front-entrance floor dust and interior floor dust (r = 0.786, p = 0.001) and drip-line soil (i.e., along the perimeter of a house) and front-entrance floor dust (r=0.617, p=0.025) suggest that soil is contributing to lead inside the home. The drip-line soils of the oldest homes in St. John's (i.e., pre-1946-1960) have been contaminated by less radiogenic lead than play areas in the yard. The lead in dip-line soil likely originated from old weathered paint ($^{206}Pb/^{207}Pb$ <1.14) flaking and falling into the soil; on the other hand, the dumping of coal ash possibly contributed to the less radiogenic lead in the soil of children's play areas ($^{206}Pb/^{207}Pb$ <1.16). Due to the successful application of the lead isotope technique in St. John's, it is recommended for use in cities with a similar lead pollution history.

a Memorial University (rfoley@mun.ca)
b Memorial University
c Memorial University
d University of Texas at Dallas