Methodology to Estimate the Amount and Particle Size of Soil Ingested by Children: Implications for Exposure Assessment at Waste Sites

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Despite considerable efforts to improve the design of soil ingestion studies, substantial variability in daily soil ingestion rates based on different tracer estimates exists in the same subjects. The present study assessed the hypothesis that one of the unexplored causes of this intertracer variation in soil ingestion estimation was related to differences in soil tracer concentration by particle size. The study analyzed the tracer concentration in soil for children in the Anaconda, Montana soil ingestion study for the particle size fraction less than 250 pm in diameter. Soil ingestion estimates for these children were recalculated based on the new soil concentration values and compared to previous findings (E. J. Calabrese, E. J. Stanek, P. Pekow, and R.M. Barnes, submitted, 1996) when the soil concentrations were determined for soil particle size diameter of <2 mm. The results indicated that five tracers (Al, Si, Ti, Y, and Zr) did not have their soil concentrations changed by particle size. However, for three tracers (La, Ce, and Nd) the concentration increased by two- to fourfold with the smaller particle size. Recalculation of soil ingestion estimates indicates that the soil ingestion estimates of the five tracers not varying by particle size did not change while those of the remaining three tracers were decreased by approximately 60%. The revised calculations provide a substantial improvement in intertracer estimates of soil ingestion and suggest that the children ingested soil of small particle size. These findings are of significance since they (1) identify an important potential cause of intertracer variability in soil ingestion estimates, (2) establish a new criterion for soil tracer selection, and (3) develop a method for not only providing improved soil ingestion estimates but also determining the particle size of the ingested soil. These findings offer important potential applications for risk assessment practices at contaminated sites since soil ingestion is frequently the dominant route of estimated contaminant exposure in children.