Isotope Studies for the Sources of Urban Pb in the Soil of Maricopa County

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Abstract: Soil is one of the largest recipients of urban pollutants in the environment. Our preliminary study of Pb distribution in the soil of Maricopa County has exhibited strong urban influences on the hot spots of high Pb concentration. Eighty soil samples randomly selected from the 200-point survey were analyzed for Pb isotopic compositions with Inductively Coupled Plasma Mass Spectrometry. The result shows that desert samples have large variations in isotope ratios (0.70 to 0.90 for 207Pb/206Pb, and 1.80 to 2.15 for 208Pb/206Pb) with a small concentration range (10 to 30 ppm), while urban samples have small variations in isotope ratios (0.80 to 0.85 for 207Pb/206Pb, and 2.00 to 2.10 for 208Pb/206Pb) but a big concentration range (10 to 200 ppm). The isotopic pattern for desert samples is similar to published bedrock minerals in Arizona. Our hypothesis is that urban Pb is from a single unknown source, because the isotopic composition is so tightly constrained. We are analyzing samples of roadside and railroad soil profiles to test if this urban input is from historical leaded gasoline, burning of coal, or other sources.

Sample Analysis:
- Surface (10 cm) and lower (10 to 30 cm) soil, dried, sieved, and ground
- Digested with mixture of concentrated HCl, HNO₃, and HF in microwave
- Analyzed with ICP-MS
- Plotted with GIS and R package

Comparison of Pb Isotope Ratios between Urban and Desert Samples

Pb Concentrations (μg/kg) in 200 Point Sample

Comparison of Surface and Lower Soil Kriging Contours

Example of fitting Pb surface 10 cm soil data with variogram

Different bedrock samples from Papago Park and one paint sample from my apartment show similar isotope patterns: they have small isotopic and concentration ranges. Thus urban Pb input might be from one source that has similar isotopic ratios as the desert background.