Development of Methodologies for Health Risk Evaluation Tools using Geochemical Data from Urban Soils
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Introduction:
In urban environments the natural background geochemical signature of the soil is modified and augmented by anthropogenic inputs (gaseous and particulate matter emitted into the air with subsequent deposition and waste material from industrial processes). Geochemical surveys of soils in urban areas capture a summation of these inputs. When considering the effect of soil on human health, ingestion is considered to be an important exposure pathway for potentially harmful elements (PHE) to enter the human body. The amount of PHE, which enters the systemic circulation is governed by the amount of PHE released in the gastrointestinal tract, this is the bioaccessibility fraction.

This study illustrates the use of a validated in vitro bioaccessibility test (Figure 1) to measure the bioaccessibility of PHE in urban soils from Northampton (Figure 2) and produce bioaccessibility hazard maps. A combination of 3 approaches, detailed below were used to examine the processes that control PHE bioaccessibility:

1: Sequential extraction of soils to measure the solid phase distribution of the PHE’s
   • to determine the physico-chemical hosts of the bioaccessible fraction

2: Self-modelling mixture resolution (SMMR) of soil geochemical survey data
   • to distinguish between the natural and anthropogenic intrinsic soil constituents

3: The physical properties of the soil as measured by the near infrared spectroscopy

Conclusions:
1: Bioaccessible arsenic appears to be associated with the carbonate (Ca), Al oxide (Ca-Al), amorphous Fe oxide (Fe-Al-P) and dissolution of the more crystalline Fe oxide phase (Fe-Al-P), Figure 5
2: Both total and bioaccessible arsenic are mostly geogenically controlled (Figures 7 and 8), with some point source inputs from anthropogenic contamination e.g. sewage works
3: Decomposition of the NIR spectra into spectral components using MLR analysis has shown that spectral soil properties can be used to predict arsenic bioaccessibility given the total arsenic content of the soils

References:
Cave, M. R., et al., 2004. Evaluation of a method for identification of host physico-chemical phases for trace metals and measurement of their solid phase partitioning in soil samples by nitric acid extraction and chemometric mixture resolution, Geochimica Exploration Environment Analysis, 47.