Environmental applications of urban soil quality data in Glasgow, Scotland, UK

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Glasgow is Scotland's largest city and was a major centre of heavy engineering and industrialisation until the mid 20th century. Much of this industry has now declined leaving tracts of derelict/brownfield land, which are gradually being regenerated. As an aid to sustainable planning and development the British Geological Survey has carried out a soil geochemical survey of the Glasgow urban and surrounding rural areas as part of its Geochemical Baseline Survey of the Environment (G-BASE) and geoenvironmental Clyde and Glasgow Urban Super Project (CUSP).

The survey contributes to an overview of land quality in Glasgow and is based upon the collection of <2 mm top (5 – 20 cm) and deeper (35 – 50 cm) soils on a systematic grid at a sample density of 1 per 2 km^2 and 4 per km^2 in rural and urban areas respectively. The samples are analysed for total concentrations of approximately 50 chemical elements by x-ray fluorescence spectrometry.

Results for 1381 urban and 241 rural soils reveal that concentrations of many metals are elevated in urban soils relative to the rural background regardless of the geological parent material. Elements that are commonly associated with anthropogenic contamination such as Pb, Sb and Sn show greatest enrichment in urban versus rural soils (2.6 – 3.3 times, based on median values). Median top-soil Cr (108 mg kg^{-1}) and Ni (47 mg kg^{-1}) concentrations in Glasgow are higher than in many other UK cities as until 1968, Glasgow was home to the world's largest chromite ore processing plant and Cr-processing waste has been dispersed across the city. In contrast, median top-soil Pb (127 mg kg^{-1}) concentrations are similar to those in other UK cities.

The Glasgow soil data have a variety of environmental applications. In terms of ecosystem health, the GRoundwater And Soil Pollutants (GRASP) tool is being developed. It combines soil metal concentration, soil metal leaching potential and depth to groundwater to predict threats to shallow groundwater quality from soil metal pollution.

In terms of human health, the data have been utilised in soil metal bioaccessibility studies to provide better

estimates of As, Cr and Pb exposure risk. However, with the exception of Cr, only a small proportion of soils exceed the current UK residential soil guideline values despite the city's industrial heritage – Se (0%), As, Cd, Ni (2%), Pb (5%), Cr (22%). Of these, only c.10 are garden soils.

Recently, the data have been used to explore spatial relationships between land quality and deprivation across Glasgow. Results reveal a significant correlation (-0.213; p-value<0.05) between soil metal concentration (in an aggregated metal-score) and deprivation. Whilst spatial associations do not imply causal links, the results suggest that poor land quality warrants greater attention in environmental inequality indices in the future.

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