Geochemical characteristics of urban centres within the UK

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Abstract

The British Geological Survey's Geochemical Baseline Survey of the Environment project (G-BASE) is responsible for the systematic geochemical mapping of the land surface of Great Britain. Samples of soils, stream sediments and stream waters collected at an average density of 1 sample per 1.5 km^2 are determined for up to 46 elements/parameters. The project has covered over three-quarters of the U.K providing a comprehensive overview of the baseline geochemistry of Great Britain.

Concerns over land quality in population centres have raised interest in the concentrations and behaviour of chemical substances within the urban environment. This prompted the G-BASE project to expand the geochemical survey into urban areas. The sampling strategy of urban areas differs to that of the regional survey as only soil samples are collected, but at a much higher density of 4 samples per km^2. Top (5 - 20 cm) and deeper (35 – 50 cm) samples are collected at each site. 22 urban centres from different parts of the UK have been surveyed so far, including Swansea, Glasgow, Nottingham and East London, representing diverse geological environments and varied land-use histories. The extensive dataset of over 16000 samples gives a unique picture of the status of UK urban soil chemistry.

In this study, various data analysis techniques have been utilised to identify the main features and characteristics of the urban soil chemical data. The urban data are placed in context with respect to the typical background concentrations in G-BASE rural soils. The distribution of the elements is considered in terms of underlying parent material and past and present land-use. Case studies will be presented.

Of the urban areas surveyed, many have a significant industrial past and the data indicate a legacy of soil contamination. For example, Swansea has a history of metal smelting, coal mining and steel production which has apparently left large parts of the city with extremely elevated concentrations of many metals. Of all the urban centres sampled, Swansea has the highest background levels of As, Cu, Pb, Sn and Zn in surface soils, with median values of As (53 mg kg^{-1}), Cu (114 mg kg $^{-1}$) and Pb (224 mg kg $^{-1}$). All 22 urban centres have median topsoil values of Pb and Sn that exceed the overall rural medians, demonstrating that these elements are consistently enriched within the urban soil environment.

However, the data also show that the distributions of environmentally sensitive elements within several urban areas are strongly influenced by the underlying parent material. For example, Northampton, in the East Midlands, has high levels of As, Co, Cr, Ni and V, in both surface and deeper soils, that are controlled by the presence of underlying Jurassic ironstone formations.

The G-BASE urban geochemical mapping project has generated data on the status of soil chemistry in many UK towns and cities. The comprehensive nature of the G-BASE regional geochemical dataset allows a unique opportunity for the characteristics of urban geochemical data to be compared with those for rural environments and we are thus able to provide a valuable insight into the impacts of urbanisation on some soil chemistry.