London Earth: anthropogenic and geological controls on the soil chemistry of the UK's largest city

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The soil geochemical survey of the Greater London (UK) area, comprising over 6400 sample sites, is the most detailed and comprehensive urban mapping project carried out to date. In order to give insight into the environmental impacts of urbanisation and industrialisation, as well as to characterise the geochemical baseline of the UK's most populous city, samples were collected at a density of 4 sites per km^2. The <2 mm fraction from the topsoil samples (5 – 20 cm) was analysed by X-ray fluorescence spectrometry (XRFS). Resulting data for over 50 elements were subject to rigorous quality control procedures to ensure accurate and inter-comparable data.

Anthropogenic modification to soil baseline concentrations is evident across the urban area. A notable feature is the 'central zone' of higher concentrations of, for example, Pb, Sb, Ca, Zn, Cu, Sn and As in the oldest, most intensely urbanised parts of the city. In the cases of Pb and Sb in particular, high-density traffic is a likely source. Local 'hotspots' of elevated concentrations, related to particular anthropogenic activities, can also be identified. For example Se, Cd, Ni, Cu and Zn show particularly elevated concentrations in the vicinity of an industrial area on the banks of the river Lee in north London, whilst Cr and Cd also display high concentrations around Heathrow airport in the west.

Despite these anthropogenic controls, a strong geological control on soil chemistry is observed for many elements. This is particularly evident in south London where high baseline concentrations of, for example, Ca, Ce, I, La, Mn, Nd, P, Sr, Y and Zr, relate to the influence of the Cretaceous chalk bedrock. In the north-western quadrant of London and along the northern boundary of the project area, high baseline concentrations for a number of elements (Al, Fe, Mg, K, Cr, La, Ti, Ga, Rb and Ni) are associated with the outcrop of Palaeogene clays. Elevated levels of Hf and Zr correspond to areas of Eocene marine and Quaternary wind-blown deposits.

One of the most interesting features of the mapped data is the consistently low concentrations of metals associated with the Royal Parks (Bushy and Richmond), Hampton Court and nearby Wimbledon Common in southwest London, which contrast with surrounding areas. Throughout the urban evolution of London these parks have avoided significant residential or industrial activity and remain free of imported soil, wastes or 'made ground'. Consequently, comparison of geochemical baselines within and outside the parks, where underlying geology is consistent, can help to provide an indication of ambient anthropogenic geochemical modification of London's soils.