British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

London Earth

Examining the soil chemistry of London's parklands

Kate Knights and Cathy Scheib

London Earth

London Earth is a high-resolution, systematic geochemical baseline survey of soil across the Greater London Authority (GLA) area. More than 6000 topsoil samples were recently collected and analysed by XRFS for total concentrations of 53 elements, plus pH and loss-on-ignition. These samples cover a wide range of land uses and soil types. London has a large number of green spaces, including large parks, wetlands, heaths and common-lands, borough parks, country parks and private estates, plus a range of domestic and public gardens. The aim of the *London Earth* survey is to define the baseline geochemistry of topsoils (c.5–20 cm depth) — a snapshot of the chemical make-up of soils. Characteristics of the baseline geochemistry of some of London's parklands are presented here.

Soil geochemistry data for London's parklands reveal new information about the effects of urbanisation on the city's soils. Geological sources of some elements and soil processes are key. The *London Earth* information from the parklands can be used to understand and compare in the soil chemistry with areas around parklands where the geology is similar because the parks have remained free from urban pressures.

London parklands

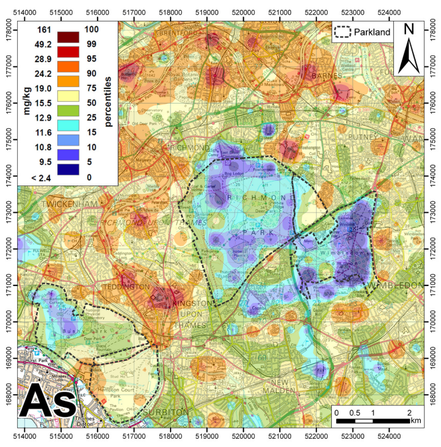
London's parklands are large open spaces (approximately >½ km^2) which are subject to less disturbance than other urban soils. In particular, the Royal Parks have been historically protected and maintained as open spaces. However, even the Royal and other parks have been subjected to a degree of anthropogenic influence. Metal, ceramic or glass fragments were observed in 45% of *London Earth* samples from the main Royal Parks. Man-made materials, such as brick, ash or plastic, were observed at 81% of all sites sampled across the GLA, including parklands.

Some environmentally important elements are characteristically elevated in urban centres due to a range of anthropogenic activity. A summary of the typical concentration values for a selection of elements from the *London Earth* survey are shown in the table below.

Element	As	Ca	Cr	Cu	Fe	Ni	Pb	Zn
Median concentration	15.5 mg/kg	1.33 wt% (CaO eq.)	71.7 mg/kg	46.9 mg/kg	3.82 wt% (Fe_2O_3 eq.)	25.5 mg/kg	185 mg/kg	158 mg/kg

Table 1 Median topsoil concentration values for selected elements from the *London Earth* survey (n=6288).

South-west London: Richmond Park, Bushy Park, Hampton Court Park, Wimbledon Common

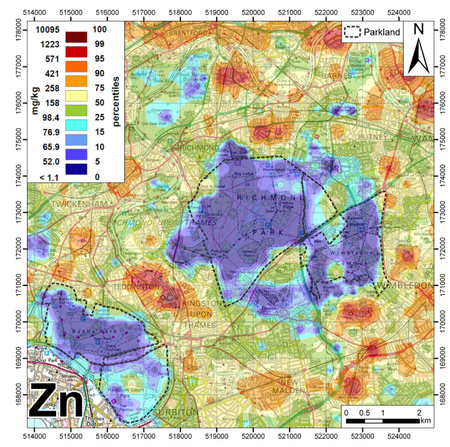


Across Richmond Park, Bushy Park, Hampton Court Park and Wimbledon Common (outlined), concentrations in soil of As (Map 1), Ca, Cr, Cu, Fe, Ni, Pb, and Zn (Map 2) are typically low (<15th percentile of data) compared to the whole GLA dataset.

In these parklands these eight elements, indicative of urbanisation and/or contamination, are substantially less concentrated than in soils from surrounding built-up areas. This is unique considering the geological similarities across the area. They are some of the largest open spaces in London and the maps reveal how relatively undisturbed land has lower concentrations of these elements.

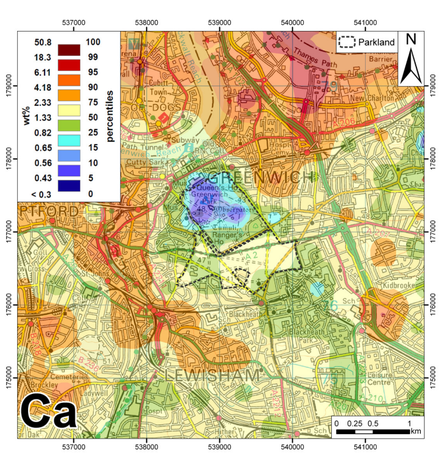
It is concluded that the soils of these large parklands have retained a more natural geochemical signature than the surrounding built-up areas over the same geological parent material. A comparison with other London soils where the geology is similar can help to establish how human activity has changed the urban chemical environment of the GLA.

Map 1 *(left)* Arsenic concentrations in topsoil across south-west London. The parklands mentioned are outlined for reference.



Map 2 *(right)* Zinc concentrations in topsoil across south-west London. The parklands mentioned are outlined for reference.

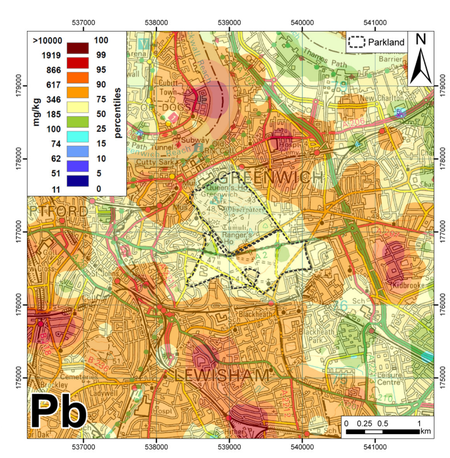
South-east London: Greenwich Park and Blackheath



Greenwich Park and Blackheath soils have low to intermediate concentrations (<50th percentile class) of Ca (Map 3), Cr, Fe, Ni, and Zn. Unlike the results for south-west London parklands, concentrations of As, Cu, and Pb (Map 4) lie in the range of >50th percentile compared to the GLA-wide data. Notably the major A2 road passes through the area.

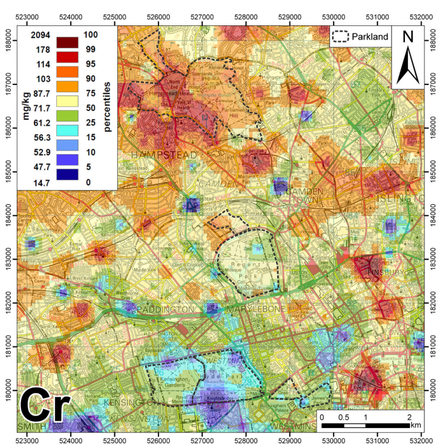
These parklands are underlain by the Harwich Formation of sand and flints, in contrast to surrounding lower land underlain by river deposits (dominantly alluvium and gravel deposits). The mapped distribution of higher Ca relates closely to river deposits, likely due to higher organic matter content in soil over alluvium. Map 3 also highlights the Greenwich Park boundary by notably low Ca. Concentrations of Pb (Map 4) are distinctly less elevated in the two parklands. This results from the combined effects of the geology and land use. Despite these parklands being small by comparison to those in south-west London, the contrast between built-up and undisturbed open space is still evident.

Map 3 *(left)* Calcium concentrations in topsoil across part of south-east London including Greenwich Park and Blackheath (outlined).



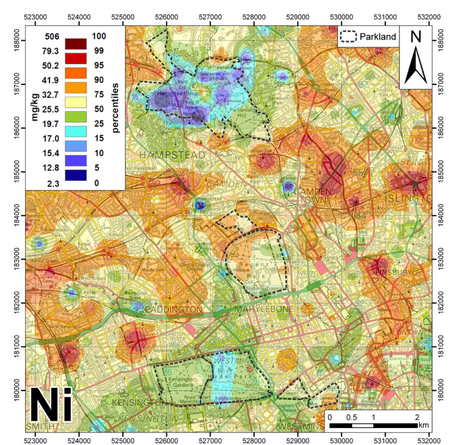
Map 4 *(right)* Lead concentrations in topsoil across part of south-east London including Greenwich Park and Blackheath (outlined).

North-central London: Hyde Park, The Regent's Park, Primrose Hill, Hampstead Heath and Parliament Hill



Concentrations of Cr (Map 5) around Hampstead are above the 75th percentile (87.7 mg/kg) in soils over sandstone (Bagshot Formation), distinct from observed low to intermediate concentrations across other parklands over clay bedrock and river deposits. Ca, Cu, Fe, Ni (Map 6), and Zn, have low to intermediate concentrations across all the parklands in this area. As and Pb are generally elevated in Primrose Hill and The Regent's Park, but not in Kensington Gardens, Hyde Park and Green Park. The city-wide distribution of As and Pb shows a cluster of the highest concentrations in the centre of the GLA, and the oldest parts of London are likely to have the most modified soils in the city for these elements. Lower As and Pb values over Hampstead Heath and Parliament Hill are perhaps partially attributable to the distinct geology, and being on high ground, less influenced by diffuse pollution from anthropogenic activities concentrated in the city-centre. This example shows that, alongside man-made influences, geological sources of some elements are important.

Map 5 *(left)* Chromium concentrations in topsoil across part of north-central London including the main Royal Parks, Hampstead Heath and Parliament Hill (outlined).



Map 6 *(right)* Nickel concentrations in topsoil across part of north-central London including the main Royal Parks, Hampstead Heath and Parliament Hill (outlined).

Contact information

Kate Knights www.bgs.ac.uk email: londonearth@bgs.ac.uk

Map images after British Geological Survey (2011). Interpolated colour maps created using an Inverse Distance Weighting algorithm in ArcGIS to estimate soil element concentrations between the known sample points.

British Geological Survey, 2011. London Earth: As; Ca; Cr; Cu; Fe; Ni; Pb; Zn (respectively) in topsoils. G-BASE Geochemical Map. Keyworth, Nottingham, UK.