

SOLID PHASE DISTRIBUTION OF CHROMIUM IN INDUSTRIALLY CONTAMINATED URBAN SOIL, GLASGOW

A. Broadway^{1*}, J.G. Farmer¹, B.T. Ngwenya¹, M.R. Cave², F.M. Fordyce³,
R.J.F. Bewley⁴.

1. School of GeoSciences, University of Edinburgh, Edinburgh, Scotland, UK.
2. British Geological Survey, Keyworth, England, UK.
3. British Geological Survey, Edinburgh, Scotland, UK.
4. URS Corporation Ltd, Manchester, England, UK.

Like many cities throughout the UK, Glasgow has a long history of both urbanisation and industrialisation, resulting in elevated concentrations of potentially harmful elements. Between 1830 and 1968 Glasgow was home to one of the world's largest producers of chromium-based chemicals. Chromite ore processing residue (COPR) arising from the factory was used as infill material across large areas of SE Glasgow, resulting in widespread land contamination with Cr(VI), a known carcinogen of significant mobility^{1,2}. A recent survey by the British Geological Survey (BGS) of the Glasgow urban environment has highlighted numerous sites with chromium concentrations exceeding guideline values generated by the Contaminated Land Exposure Assessment (CLEA) model. Whether or not these sites pose a hazard to human health depends on a number of factors, including the bioaccessibility of the chromium present. Bioaccessibility will be dependent on the nature of the association between chromium and soil itself. For example, since one of the major pathways for exposure to contaminated soil is through oral ingestion, then chromium associated with a mineral phase that is not stable under acidic conditions might be mobilised in the stomach and become available for absorption.

As part of a current research project into bioaccessibility and the human health risks posed by contaminated land, the solid phase distribution of chromium in 27 selected Glasgow soils has been investigated. This was achieved using a fast, nonspecific extraction method combined with chemometric data processing, known as the Chemometric Identification of Substrates and Element Distributions (CISED) method³. Extracts were analysed for 26 elements by ICP-AES.

Chromium was found to be associated with a range of different soil physicochemical phases, including carbonates, iron oxides and aluminosilicates. The data collected have been compared to total chromium and Cr(VI) concentrations for the same samples. Samples with a low Cr(VI) concentration tended to have a low extractable chromium, which was strongly associated with iron oxides. Samples with elevated Cr(VI) concentrations (up to 1485 ± 24 mg/kg) had much higher extractable chromium, mainly associated with aluminosilicate and iron oxide phases. It is believed that this variation in solid phase distribution, and the degree of extractability may relate to the original source of chromium in the different soils, i.e. those with naturally occurring chromium (low Cr(VI)) and those with chromium contamination (elevated Cr(VI)). It is hoped to relate information on the solid phase distribution of chromium to its bioaccessibility.

1. Bewley, R. J. F., Jeffries, R., Watson, S., Granger, D.: 2001. *Environmental Geochemistry and Health*, **23**: 267

2. Farmer, J.G., Thomas, R.P., Graham, M.C., Geelhoed, J.S., Lumsdon, D.G., Paterson, E.: 2002. *Journal of Environmental Monitoring*, **4**: 235
3. Cave, M.R., Milodowski, A. E., Friel, E. N.: 2004. *Geochemistry: Exploration, Environment, Analysis*, **4**: 71