British Geological Survey
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Arsenic speciation of sediments from the Thames estuary, London, UK

Michael J Watts, Tom S Barlow, Helen Taylor, Amanda Gardner and Christopher H Vane

Introduction

Arsenic is generally present in the environment as arsenate (As^{V}) and to a lesser degree as arsenite (As^{III}), or the methylated compounds monomethylarsonate (MA) and dimethylarsinate (DMA)[1,2], whilst Ellwood et al (2003)[3] reported the presence of arsenosugars (As-sugars) in lake sediments. Measurement of individual arsenic (As) species provides valuable information on the varied toxicity of inorganic and organic forms of As. As^{III} is considered the most toxic and mobile of As species in soil and sediment. Information regarding the chemical forms (species) of As is useful to understand possible mobilisation from sediment into aqueous phase, since soil and sediments cannot be isolated from geochemical cycles[4]. The aim of this work was to determine total and measurable arsenic species in the mobilisable fraction of 36 sediment cores from the Thames estuary using a phosphoric/ascorbic acid extraction, followed by HPLC-ICP-MS analysis[5].

Conclusion

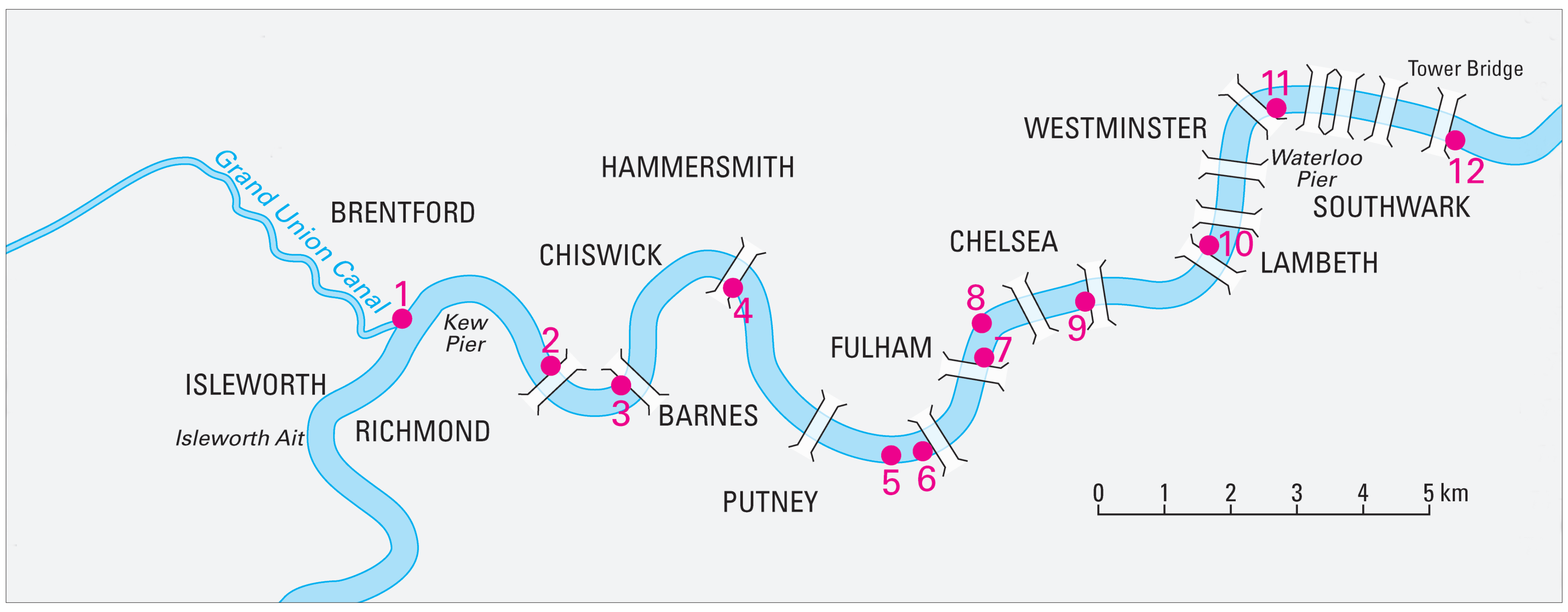
Individual sediments influence Arsenic recovery, because of varying chemical and physical parameters with depth and between cores.

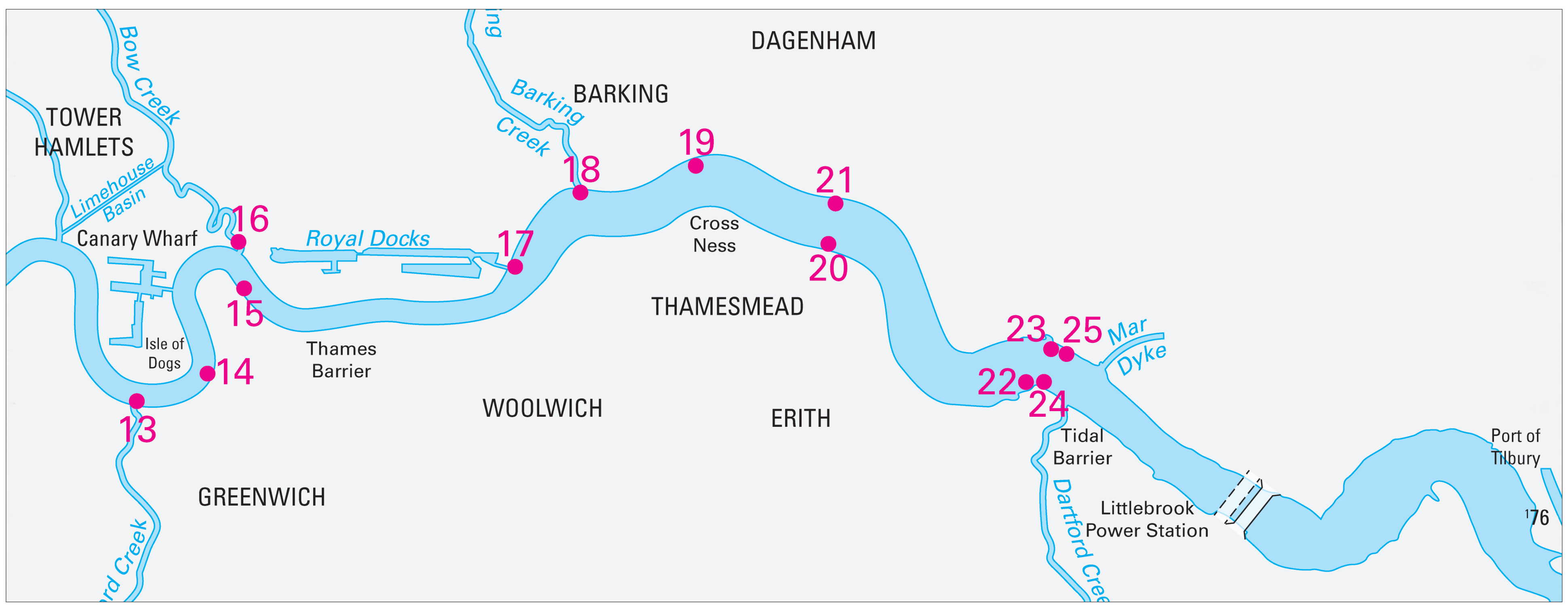
Overall, an indication of As species present is given for a comprehensive study of River Thames sediments.

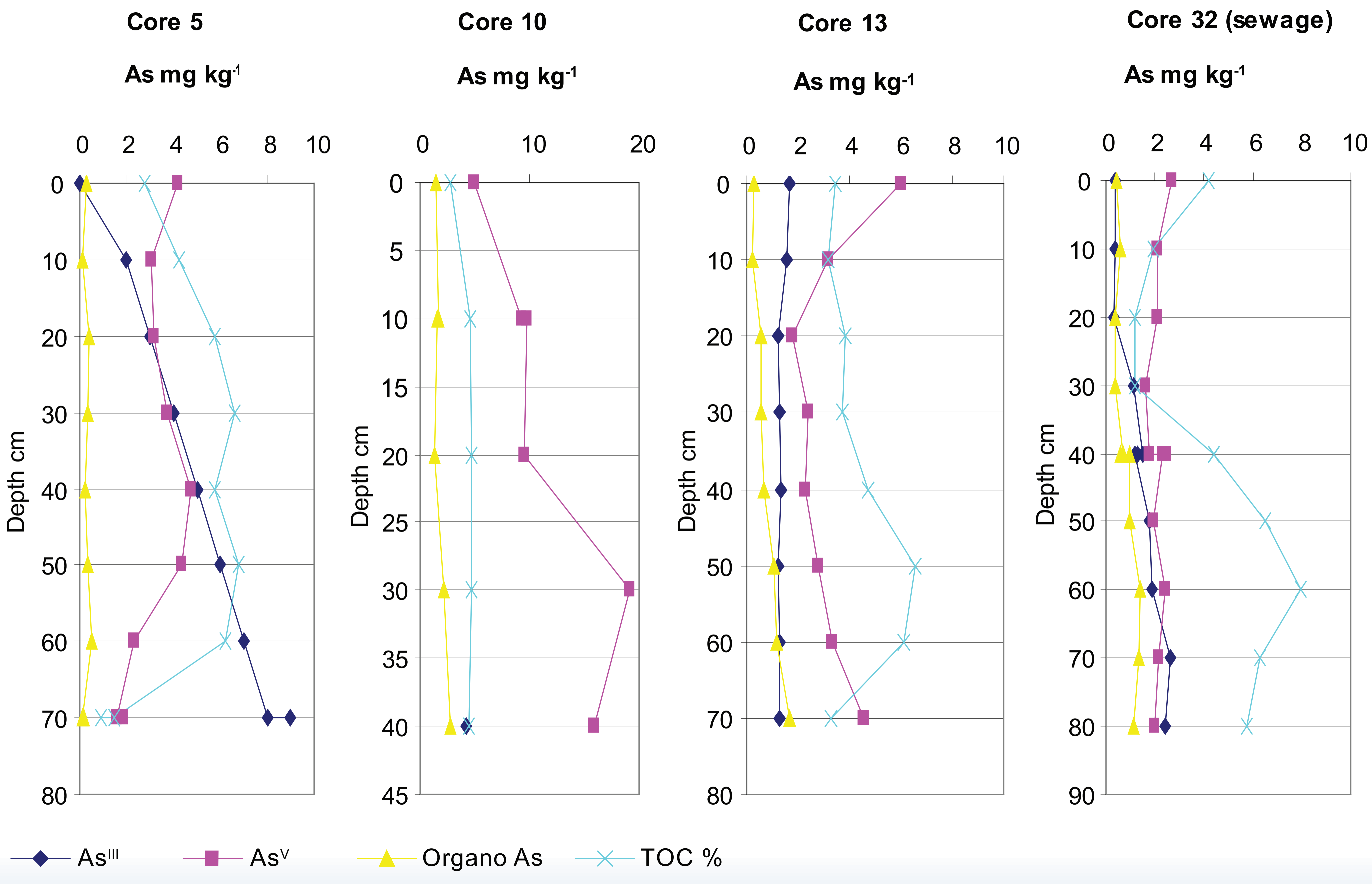
The full dataset will be reported in a peer reviewed publication, with interpretation of depth profiles/sediment chemistry and implications for As mobility/toxicity.

Site description and methods

Core sediments ranging from 0 to 110 cm in depth were collected from 36 sites (only 24 are shown in Figure) between the Upper Thames at Brentford and the Lower Thames at Allhallows. Cores were frozen within 12 hrs of collection and freeze dried prior to sample preparation (<0.45 µm) and digestion or extraction for total and arsenic speciation analyses.







Results and discussion

Total As concentrations in sediments ranged from 4 to 115 mg kg^{-1} for 130 samples taken from 36 cores. These data were generally higher than a worldwide mean[6] of 5 to 40 mg kg^{-1}, but comparable to the scientific literature for reportedly 'above normal' As-sediment concentrations.

Overall extraction recoveries were 42 ± 20 % for As species. The extraction process required a fine balance between gaining high recoveries and avoiding induced redox changes in As^{III} to As^{V} i.e. *recovery vs stability of* As^{III}.

Extraction recoveries of As species were comparable to the scientific literature. Some recovery was sacrificed to reduce redox conditions for As^{III} to As^{V} conversion.

As^{V} was the predominant As species present, with traces of up to ~4 mg kg^{-1} As-sugars (-SO_4), <1 mg kg^{-1} DMA, depending on the location and generally <14 mg kg^{-1} As^{III}.

Overall a mean of 10% As present as organo-As in Thames sediments, but near to sewage outflows, there was a mean of 17%.

As concentrations showed no pattern with depth (see charts). There was no correlation of organo-As with TOC content.

Reference

1. Bednar et al. 2002a, J.Agric. Chem., 50, 7340. 2. Watts et al. 2010, Environ. Geochem. Health, 32,479. 3. Ellwood et al. 2003, Anal. Chim. Acta, 477, 279. 4. Cullen 1989, Chem. Rev., 89, 713. 5. Watts et al. 2008, J.Environ. Monitor., 10, 753. 6. Neff 1997, Environ. Toxicol. Chem., 16, 917.

Contact information

Michael Watts www.bgs.ac.uk email: mwatts@bgs.ac.uk