Geophysical Research Abstracts
Vol. 16, EGU2014-15584, 2014
EGU General Assembly 2014

Quantitative assessment of historical coastal landfill contamination using in-situ field portable XRF (FPXRF)

Francis O'Shea, Kate Spencer, and James Brasington
Queen Mary, University of London, School of Geography, London, United Kingdom (f.t.oshea@qmul.ac.uk)

Historically, waste was deposited on low value, easily accessible coastal land (e.g. marsh land). Within England and Wales alone, there are over 5000 historical landfills situated within coastal areas at risk of flooding at a 1 in 100 year return period (Environment Agency, 2012). Historical sites were constructed prior to relevant legislation, and have no basal or side wall engineering, and the waste constituents are mostly unknown. In theory, contaminant concentrations should be reduced through natural attenuation as the leachate plume migrates through surrounding fine-grained inter-tidal sediments before reaching receptor waters. However, erosion resulting from rising sea level and increased storm intensity may re-distribute these sediments and release associated contaminants into the estuarine and coastal environment. The diffuse discharge from these sites has not been quantified and this presents a problem for those landfill managers who are required to complete EIAs.

An earlier detailed field campaign at Newlands landfill site, on the Thames Estuary, UK identified a sub-surface (∼2m depth) contaminant plume extending c. 20 m from the landfill boundary into surrounding fine-grained saltmarsh sediments. These saltmarsh sediments are now at risk of being eroded releasing their contaminant load to the Thames Estuary. The aims of this work were to; 1) assess whether this plume is representative of other historical landfills with similar characteristics and 2) to develop a rapid screening methodology using field portable XRF that could be used to identify potential risk of other coastal landfill sites.

GIS was used to select landfill sites of similar age, hydrological regime and sedimentary setting in the UK, for comparison. Collection of sediment samples and analysis by ICP OES is expensive and time-consuming, therefore cores were extracted and analysed with a Niton Goldd XRF in-situ. Contaminant data were available immediately and the sampling strategy could be adapted in the field to determine the presence, location and extent of the sub-surface contaminant plume. Although XRF analysis has gained acceptance in the study of in-situ metal contamination (Kalnicky and Singhvi 2001; Martin Peinado et al. 2010) field moisture content and sample heterogeneity can suppress X-ray signals. Therefore, sediment samples were also collected and returned to the laboratory and analysed by ICP OES for comparison. Both wet and dry certified reference materials were also analysed in the laboratory using XRF and ICP OES to observe the impact of moisture content and to produce a correction factor allowing quantitative data to be collected in the field.

In-situ raw XRF data identified the location of contamination plumes in the field in agreement with ICP data, although the data were systematically suppressed compared to ICP data, under-estimating the levels of contamination. Applying a correction factor for moisture content provided accurate measurements of concentration.

The use of field portable XRF with the application of a moisture content correction factor enables the rapid screening of sediment fronting coastal landfill sites, goes some way towards providing a national baseline dataset and can contribute to the development of risk assessments.