Geophysical Research Abstracts
Vol. 18, EGU2016-15439, 2016
EGU General Assembly 2016

Development of integrated protocols to track the deposition and impacts of metal contaminants in tidal riverine environments

Helen M. Roe (1), R. Timothy Patterson (2), Nawaf Nasser (2), Robin J. Edwards (3), and Conor Graham (1)

(1) School of Geography, Archaeology and Palaeoecology, Queen's University Belfast, Belfast, UK, (2) Department of Earth Sciences, Carleton University, Ottawa, Canada, (3) Department of Geography, Trinity College, Dublin, Ireland

Tidally-influenced rivers are particularly vulnerable to the effects of metal contamination, yet are amongst the most complex fluvial environments in terms of their sediment deposition and transport patterns. We present the results of an interdisciplinary study that aims to elucidate the fluxes and deposition of metal contaminants in a tidally-influenced river system in Northern Ireland, with a view to developing protocols that will have wide applicability for the monitoring and assessment of metal contaminants in similar environments in other regions. We employ a novel methodology that combines ICPMS analysis of sediments, ITRAX-based core analysis and the examination a important group of shelled protozoans (foraminifera), which occur widely in tidal riverine environments, and which are highly sensitive to metal contamination. The responses shown by the group vary between species and with different levels of contaminant exposure. Some species, for example, show increased relative abundances in proximity to discharge sources, whilst others develop chamber deformities. Application of our integrated multi-proxy approach to the analysis of surface sediment samples and cores provides a framework for assessing both the spatial and temporal patterns of metal deposition and the impact of contaminants on the biota.

Modern sediment samples (n=90) were collected at varying distances from a point contamination source (a former industrial site) in different morpho-sedimentary settings. The impact of 25 measured variables on the modern foraminiferal faunas was considered, including 20 metals, pH, conductivity, elevation and particle size. Channel sediments in close proximity to the contamination source and with the highest levels of Fe, Cu, Zn, Mg and As, yielded the sparsest foraminiferal faunas (Shannon Diversity Index values 0-1.5), whilst the highest prevalence of foraminiferids showing chamber deformities were observed in channel edge and levée bank sites. Kernal density plots showing metal loading and foraminiferal concentrations across the site aided in determining spatial trends. The sediment core data revealed that deformed foraminiferal specimens can extend >15 cm below the contemporary floodplain surface to horizons that pre-date the historical onset of the contamination, suggesting vertical mobilisation of sediment and/or infaunal migration. Etching of the foraminiferal tests in association with reduced pH conditions was also observed for some species. Biometric analysis of tests using SEM imagery further aided in the identification of deformities and the delimitation of graded responses to contaminants.

The results of this study of core and surficial samples indicate that the adoption of integrated methodologies that combine established geochemical analysis techniques (e.g. ICPMS analysis) with the observed ecophenotypic response of key indicator microfossil groups (e.g. foraminifera) can provide invaluable data on habitat responses to environmental contamination. Such long-term habitat evaluation data is invaluable to policy makers and planners when prioritising management and remediation efforts.