Metal-rich anthropogenic glass particles within sediments in an urbanised river basin: novel observations on contaminated sediments.

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Introduction:
Sediments in urban systems are commonly highly contaminated [1]. Routine assessment has tended to be undertaken on bulk sediment samples using bulk chemical techniques. However, recent analyses [2] has indicated the presence of anthropogenic grains in some contaminated sediment, highlighting the need for more robust mineralogical analysis for risk assessment. The aim of this study was to assess the nature of metal-containing glass grains in urban sediment using grain-specific chemical and mineralogical analysis techniques. The overall aim of this research was to understand the implications of this novel research to contaminated urban sediment assessment.

Methods
The study area was the urbanised connurbation of Manchester, NW England. Sediments were sampled from road surfaces (road-deposited sediment - RDS), channel-bed sediments from a major river in the conurbation (the River Irwell) and a major man-made water body (the Salford Quays of the Manchester Ship Canal). All sediment samples were analysed for pseudo-total metal contents using micrwave-assisted acid digestion. The minerlaogy and chemistry of the grains within the samples were studied on polsihed resin-impregnated blocks using scanning electron microscopy, EDX chemical analysis, elctron micrprobe analysis and Raman spectroscopy.

Results
Three major types of slag material have been identified in the urban sediments of Manchester: Fe-poor glass (observed in RDS and river sediments), Fe-rich glass (observed in RDS and river sediments) and Fe- and metal-rich (Salford Quays sediments). These grains are derived from anthropogenic processes and act as significant hosts for contaminant metals in these sediments. We interpret these glass grains to be slag material derived from industrial iron ore and metal smelting processes, or the vitrification of municipal solid waste incineration ashes. The resulting slag is input into urban sediment either through erosion of historical wastes or through the use of slags in road material and cement.

Discussion and Conclusions
We have documented that glass grains containing significant metal concentrations are widespread throughout the urban sediment system in Manchester. Therefore, these grain types should be considered in sediment assessment on a wider scale. We recommend that experimental leaching tests should be undertaken upon these glass grain types to reflect the conditions experienced by sediments on street surfaces, in gully pots and in sewers, in rivers and during early diagenesis in aquatic water bodies. In addition, sequential extraction schemes should be modified to take account of alumino-silicate and high-temperature glass materials.

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References: [1] Taylor, K.G. and Owens, P.N. (2009) *J Soils Sediments* **9**:111-122 ; [2] Taylor, K.G. and Robertson, D.J. (2009) Applied Geochemistry,