

**NON-DESTRUCTIVE PXRF
FOR ARCHAEOLOGICAL PROVENANCING:**

OBSIDIAN AND CERAMICS FROM THE NEAR EAST

By

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ABSTRACT

The study of exchange networks in the Near East elucidates aspects of economic, social and political relations between past societies. For this region, obsidian and ceramics have been the key indicators for exchange. Non-destructive pXRF offers unique advantages for archaeological provenancing including non-destructive, *in situ* analysis. However, this technique presents significant methodological challenges for accurate and precise analysis, and provenance determination in the absence of geological reference materials.

This thesis critically evaluates the application of non-destructive portable x-ray fluorescence (pXRF) analysis of obsidian and ceramic artefacts to archaeological provenancing. Experimental matrices are utilised for determining the parameters for accurate and precise analysis of archaeological materials. The archaeological utility of the developed methodology is then assessed in case studies of Chalcolithic earthenware ceramics, Chalcolithic obsidian and Byzantine lead glazed ceramics. In these case studies, the potential of legacy datasets and archaeological artefacts of known provenance to provide useful comparative geochemical data for provenancing artefacts is evaluated.

The results indicate that non-destructive pXRF has the potential to discriminate between compositional groups with high sensitivity when artefacts unamenable to analysis are omitted and appropriate methodology is applied during analyses. Although accurate and precise analyses can be achieved for both obsidian and ceramics, the relatively low number of diagnostic elements reported has greater implications for sourcing ceramics. Legacy datasets have the potential to accurately identify the provenance of obsidian artefacts whereas for ceramics, reference material that reflects contemporary manufacturing practices is required for accurate comparative analysis. Museum collections of artefacts have the potential to make significant contributions to reconstructing aspects of trade and exchange by expanding the scope of provenancing studies.

These case studies into discrete aspects of trade and exchange networks in the Near East attest to the value of non-destructive pXRF in generating accurate and appropriate data to address archaeological questions. In this region, exchange networks linked to different

artefact classes were largely disparate, and over time evolved in complexity and scale to encompass the entire Mediterranean.

CANDIDATE'S CERTIFICATION

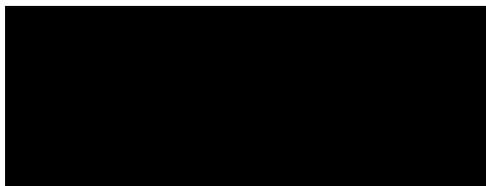
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I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis and all sources used have been acknowledged in this thesis.



PUBLICATIONS

The following publications are reproduced in this thesis in full;

- Forster, N., P. Grave, et al. (2011). "Non-destructive analysis using PXRF: methodology and application to archaeological ceramics." X-Ray Spectrometry **40**(5): 389-398.
- Forster, N., P. Grave. (2012) "Non-destructive pXRF analysis of museum-curated obsidian from the Near East." Journal of Archaeological Science **39**: 728-736.
- Forster, N., P. Grave. "Lead leaching effects on non-destructive pXRF analysis of Byzantine Cypriot lead glazed ceramics." Submitted to Archaeometry 2 April 2012.

The following publications were also completed as outputs from this research;

- Grave, P., V. Attenbrow, et al. (2012). "Non-destructive pXRF of Mafic Stone Tools." Journal of Archaeological Science. In press.
- McLaren, T., C. Guppy, et al. (2012). "Rapid, non-destructive total elemental analysis of Vertisol soils using portable x-ray fluorescence (PXRF)." Soil Science Society of America Journal. In press.
- Tighe, M., N. Forster. "Rapid, non-destructive elemental analysis of tree and shrub litter." Submitted to Ecological Indicators 4 April 2012.

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- Forster, N. and P. Grave (2011). Non-destructive PXRF of archaeological ceramics. AXAA 2011 Schools, Advanced Workshops, Conference and Exhibition. Sydney, NSW.
- Forster, N., J.J. Huntley, et al. (2011). Moving Beyond "Does it Work or Now": Fundamental Non-destructive PXRF and applications. 2011 Lapita Pacific Archaeology Conference: "Pacific Archaeology: documenting the past 50,000 years to the present". Samoa.

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