

## PROGRESS REPORT FOR AINGRA09013

<b>PROJECT TITLE</b>	<b>Late Roman amphorae &amp; cooking wares from Jordan: PIXE/PIGE elemental characterization for provenancing &amp; trade studies</b>	
<b>INVESTIGATOR(S)</b>	<b>Institution and Department</b>	
<b>Chief Investigator</b>	<b>Dr Kate da Costa</b>	Archaeology, The University of Sydney
Other Investigators	none	
Students	none	
ANSTO Investigators	David Cohen; Mihail Ionescu	
Specialist Committee	A	

### SCIENTIFIC OBJECTIVES

Elemental characterization of ancient ceramics is a fundamental tool in studies of past economies. This project will analyse two types of ceramics by PIXE/PIGE, selected as part of an ARC Discovery project in Jordan, with complementary results expected, each illuminating ancient trade patterns. We aim to define the range of fabrics used to manufacture the most common amphora in the Late Roman Levant, LR6, which has never previously been done. We also plan to demonstrate objectively that cooking wares produced in the Galilee are found in far eastern ancient Palaestina, and are a marker fabric for trade within that province.

### PROGRESS REPORT and RESEARCH OUTCOMES

86 + 4 Carbon samples were analyzed by the HVEE 2MV Tandetron (PIXE/PIGE) in early October 2009. One of the carbon samples was poorly placed on the holder and the results were left out. One of the ceramic samples returned abnormal results and was reanalyzed in early December. The reanalysis replicated the original readings. A duplicate of this sample was analyzed by XRF in January 2010 with results more in line with expectations, suggesting the pellet analyzed by PIXE was contaminated during preparation.

Of the remaining 85 samples, 8 had been analyzed on the now-obsolete accelerator at ANSTO Lucas Heights in the late 1990s, and were included to allow comparison between the new set of results and the older data held by many University of Sydney researchers.

77 samples represented 6 groups of ceramics; 33 LR6 amphorae sherds, representing a variety of visually distinct fabrics; 9 certain Galilean cooking pot sherds and 15 possible Galilean for identification; 4 alternative cooking pot fabrics; 3 Gaza amphorae; 5 alternative amphorae fabrics; and 7 glazed Islamic sherds. The latter 4 groups were included to provide contrast for the potential LR6 amphorae sherds, as the aim of the project was to determine if they formed a single chemical group.

Results are still being processed, but initial interpretation shows that the LR6 amphorae sherds made of BSWP fabric form a coherent, chemically defined group – although 5 samples may require re-identification. Galilean cooking pots also form a cohesive group, and the definition by this technique will supplement the Israeli INAA characterization of the fabric.

Sample preparation was paid for by funds raised through fees from a paying volunteer scheme associated with the ARC part-funded Borders of Arabia and Palaestina project at the University of Sydney. Many of the sherds included in the project were collected as part of the BAP project.

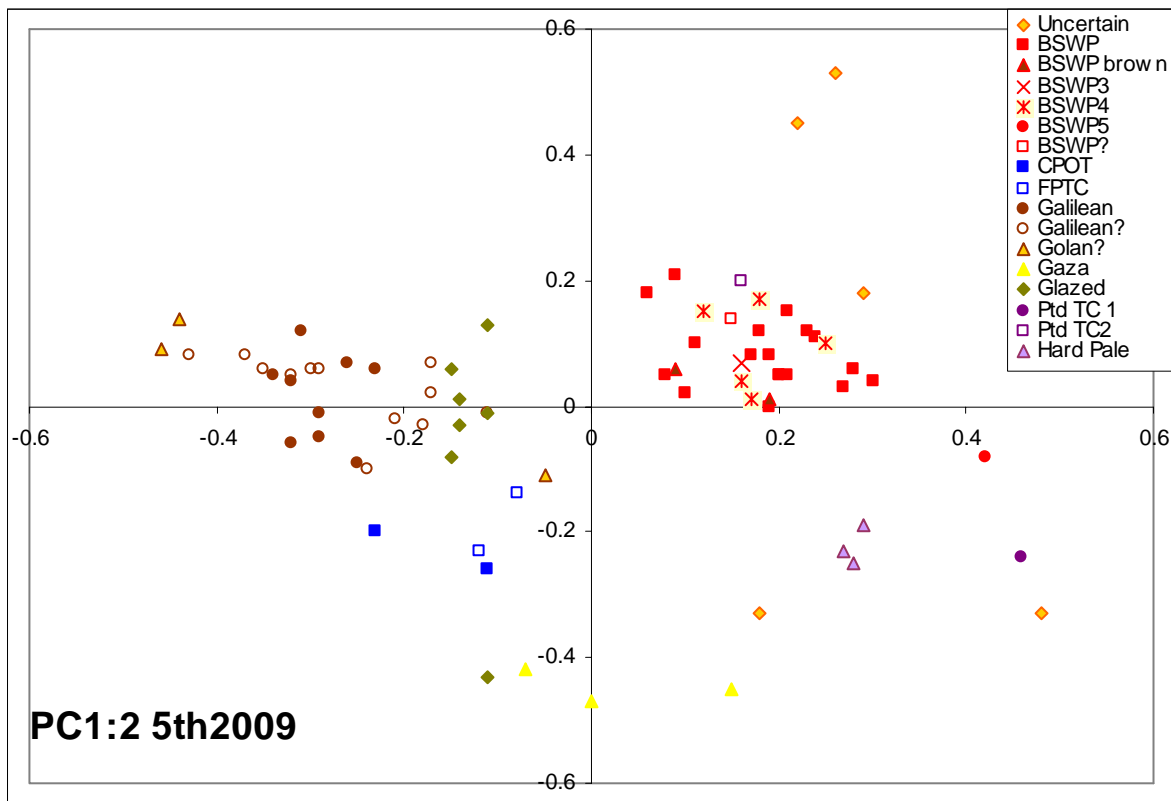
An article, jointly authored with ANSTO, to be submitted to NIMB is under preparation.

### DATA

Elemental concentrations of elements in ancient ceramics were collected, and reported as ppm. Due to high errors or low concentrations, only the following elements will be useful for the project: F(AREA), Na(440), Al(1014), Si, K, Ca, Ti, Mn, Fe, Ni and Zn. 85 samples (and 4 pellets of C for calibration) were analysed. One pellet's results were abnormal, and the sample was rerun, with nearly identical results. Subsequent testing by another result (off-site)

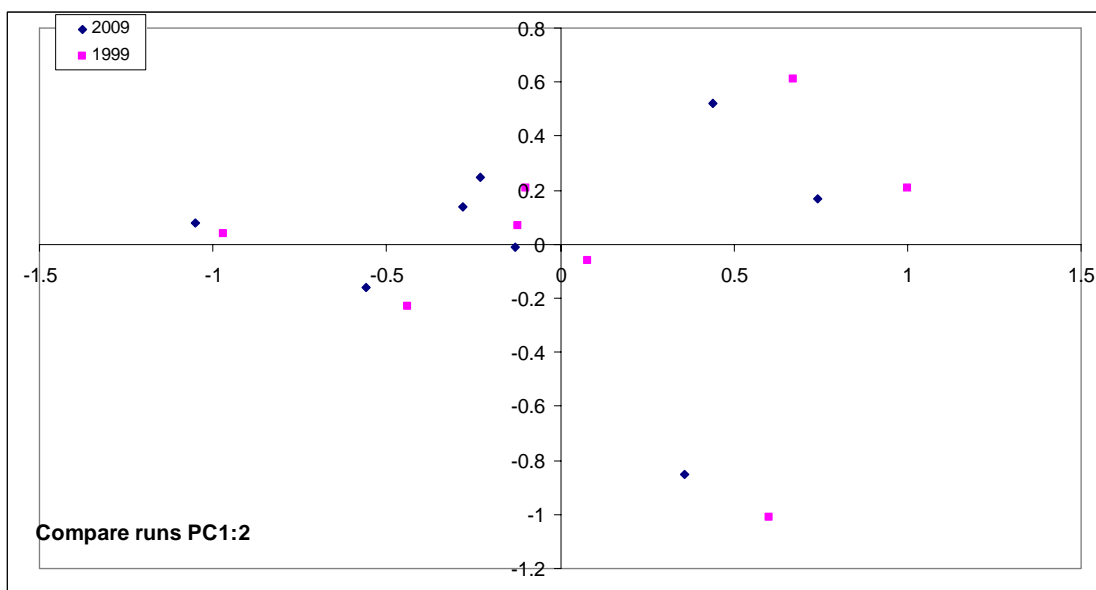
showed that the pellet was contaminated. 8 samples had been previously analysed by ANSTO on the old accelerator and were included to allow calibration for older results, held by many University of Sydney archaeology researchers.


Results for the new samples, in the graph of PCA shown below, clearly demonstrates the effectiveness of the technique, with samples, apart from some outliers which need to be examined more closely, conforming to ware assignments.



Further comparison within each group needs to be made, and each group further investigated. BSWP/LR6 amphora are subject to a petrographic analysis programme. The Galilean cooking pots have been characterized by INAA in Israel, and comparison needs to be made with those results, although there is little overlap between the elements reported by both techniques.

The graph below shows the results of the reanalyzed lamp fragments. Clearly the results are similar, but the systemic shift suggests a single factor influencing the more recent results. Investigations into the cause of this are still underway.



<b>Signature of Investigator preparing the report for</b> <b>After signing this report please fax this page with your signature for our files</b>	<b>Proj: AINGRA09013</b> <b>Date:</b>
	31/1/2010

**PUBLICATIONS / REPORTS arising as a result of your work.**

No publications yet submitted. One article planned for NIMB, another for a peer-reviewed archaeological journal

**PhD STUDENTS**

Sarah Kelloway, 1<sup>st</sup> year PhD student, Archaeology, University of Sydney. Her thesis is not directly related to this project, but this project provided an opportunity for her to develop technical sample preparation skills, and become familiar with the technique and its uses.