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Inhalt

Beiträge

Projektberichte

Sammlungen

ArchäoInformatik

CeramEgypt: Towards a broader application of the portable ED-XRF on Egyptian pottery of Greek and Roman times

Lars Heinze – Markus Helfert

2015 wurde das ANR/DFG-geförderte, deutsch-französische Projekt CeramAlex unter dem Namen CeramEgypt in erweiterter Form neu aufgelegt. Einen wichtigen Anteil an diesem Projekt haben naturwissenschaftliche Untersuchungen ptolemäischer und kaiserzeitlicher Keramik aus ägyptischen Ausgrabungskontexten, die mithilfe der portablen energiedispersiven Röntgenfluoreszenz (P-ED-RFA) analysiert werden. In diesem Beitrag wird Einblick in die Möglichkeiten und Grenzen der Methode am Beispiel einer Serie von Messungen im Musée des Beaux-Arts von Lyon gegeben. Das Material stammt aus einem im 19. Jahrhundert ausgegrabenen frühkaiserzeitlichen Kontext des oberägyptischen Koptos. Neben matrizengeformten Lampen und Terrakottafiguren, wurden eine Reihe einfacher scheibengedrehter Gefäßformen sowie Modeln für die Herstellung von Figuren und Reliefplaketten gemessen. Als Ergänzung zu den bestehenden makroskopischen Untersuchungen gelang eine differenziertere Unterscheidung möglicher Produktionen. Bei diesen mag es sich zum einen um lokale und importierte Waren handeln, zum anderen aber auch um verschiedene, möglicherweise lokale Werkstätten.

In 2015, the successful ANR/DFG-funded project CeramAlex was renewed under its new name, CeramEgypt. While its predecessor had been focusing mainly on the study of Greek and Roman pottery from a smaller amount of settlements within the vicinity of Alexandria, the second phase of this project aims to broaden this picture by now studying the whole of Egypt. For this purpose, different tasks within the CeramEgypt project have been apportioned to three research groups: Axis A approaches Egyptian pottery found in Egypt from a material point of view and aims to differentiate possible production centers by using chemical analyses; Axis B is collecting typological data, which archived and organized with the help of the project's own database, shall lead to an atlas of pottery vessels from the post-Dynastic periods; and finally, Axis C attempts to integrate many of the results of the other two groups and will additionally study selected pottery assemblages to trace the underlying aspects of pottery production and trade within the economic history of Egypt. The following report aims to outline the methods and first results of Axis A.

Given the limited amount of time, a successful sampling strategy to gain a first overview of the geochemical traits of the vast amounts of pottery from Greek and Roman Egypt naturally has to be a highly selective process. CeramEgypt conducts its sampling program with two teams: the first is located at the Centre d'Etudes Alexandrines (CEAlex) and the second at the University of Cologne. Both teams work together closely, to cover a maximum of sites and European collections that hold objects of interest: namely ceramic vessels and other implements that are closely linked to kilns or at least can be – from an archaeological point of view – associated with a certain origin of production. To undertake the X-ray fluorescence analysis for the sourcing of the ceramics, each of these teams has a Thermo Scientific Niton XL3t 900 S He GOLDD+ analyser at his disposal. In addition to the calibration provided by the manufacturer, these portable energy dispersive X-ray fluorescence (pXRF) analysers have been further adjusted with an empirical calibration for ceramics to the same standards that are used by the work group at the University of Frankfurt under the direction of Markus Helfert[1]. Through this, the two devices now produce exchangeable sets of data and can be used with a maximum of independence for the sampling process. Additionally, these methods enable us to include data that was taken from other portable XRF devices, such as the one used by the Frankfurt work group, so long as these analysers have been all adjusted to the same standards.

1 For this method, see Helfert 2013.

Further improving the calibration

As an initial venture, a small campaign has been conducted at Lyon from the 15–29 October 2015, bringing together the two authors of this article, Mai Abdelgawad from the CEAlex, and the two portable XRF devices from Alexandria and Frankfurt. Thanks to the hospitality of the laboratory of Archéologies et Archéométrie de la Maison de l'Orient et de la Méditerranée (MOM)[2], we were able to again verify the internal calibration by re-measuring some of the pottery formerly gathered by different researchers (P. Ballet, J.-Y. Empereur, S. Élaigne), and analysed by Maurice Picon with the MOM's stationary WD-XRF. Additionally, we conducted a series of measurements at the MOM to further expand the project's reference material database. Therefore, samples from Chios, Cyprus and Asia Minor, which include mostly amphorae and cooking vessels, were analysed to be used in future for comparisons of imported pottery found in Egypt itself.

Data collection, processing and interpretation

Our stay at Lyon was also used to study an assemblage of vessels and terracotta figurines from Koptos (**Fig. 1**), stored at the Musée des Beaux-Arts de Lyon (MBA). Permission to study this material was kindly granted by the curator of antiquities, Geneviève Galliano. Mrs. Galliano has also been highly supportive during the selection of some of the presumably local and imported objects[3]. As this was the first material from a museum's collection measured for CeramEgypt, we would like to expand a bit further on how assemblages like these can be made useful in addition to the study and measurements of ceramic objects on site in Egypt.

The MBA's collection contains most of the material that Adolphe Reinach and Raymond Weill retrieved during their excavation of Koptos in 1910 and 1911. The stored assemblage consists of a large variety of vessels, lamps and terracotta figurines. Some of these were partially broken, others were well preserved. According to Pascale Ballet and Geneviève Galliano, who thoroughly studied the terracotta figurines from this assemblage as well as the excavation's documentation, a large portion of the objects can be traced to one closed deposit dated to the early Imperial period[4]. Therefore, these objects provide us with a small glimpse at this particular chronological horizon of the city. As a sampling strategy, an array of better attested vessel types, lamps and terracotta figurines have been chosen for the pXRF measurements. The studied vessels comprised of each 10 plain ware beakers and bowls (**Fig. 2**), 4 plain ware serving vessels (jugs and amphoriskoi) and 4 miniature vessels. Of the six sampled mold-made lamps, some deriving from identical molds have been chosen, in addition to a small variety produced from varying molds. The much wider range of terracotta figurines was approached in a similar manner. Smaller series originating from the same mold were studied next to single objects that could range from possible local productions to presumably imported figurines. Additionally, eight molds for terracotta figurines have been analysed, although none of these directly matched with any of the preserved figurines. As a test, a small series of thin-walled barbotine decorated sherds from the collection has been analysed as well, although these only comprised of a small number that turned out to not be statistically reliable[5].

Up to three single measurements have been taken at different spots per individual object. For these, already existing and preferably clean fractures were chosen[6]. A brief and preliminary overview of these results is now presented.

2 We are very grateful to Cécile Batigne Vallet, Valérie Merle and Alain Bernet for hosting us at the MOM and for providing us with the sample material.

3 All common pottery wares, most of the terracotta figurines and the lamps have been cautiously classified as local. This was, of course, then supposed to be tested with the results of the pXRF measurements.

4 Ballet 1999; Ballet – Galliano 2010 (for a brief discussion of the context, see pp. 210–211).

5 This was very likely due to the thinness of the objects as well as to a higher degree of surface contaminations.

6 Usually, the protocol within our project requires fresh and preferably flat new fractures for the measurements. This, unfortunately, was not always possible with the objects stored in museums. Tests conducted have, nevertheless, indicated that cleaned older fractures can serve as a sufficient alternative to freshly created ones.

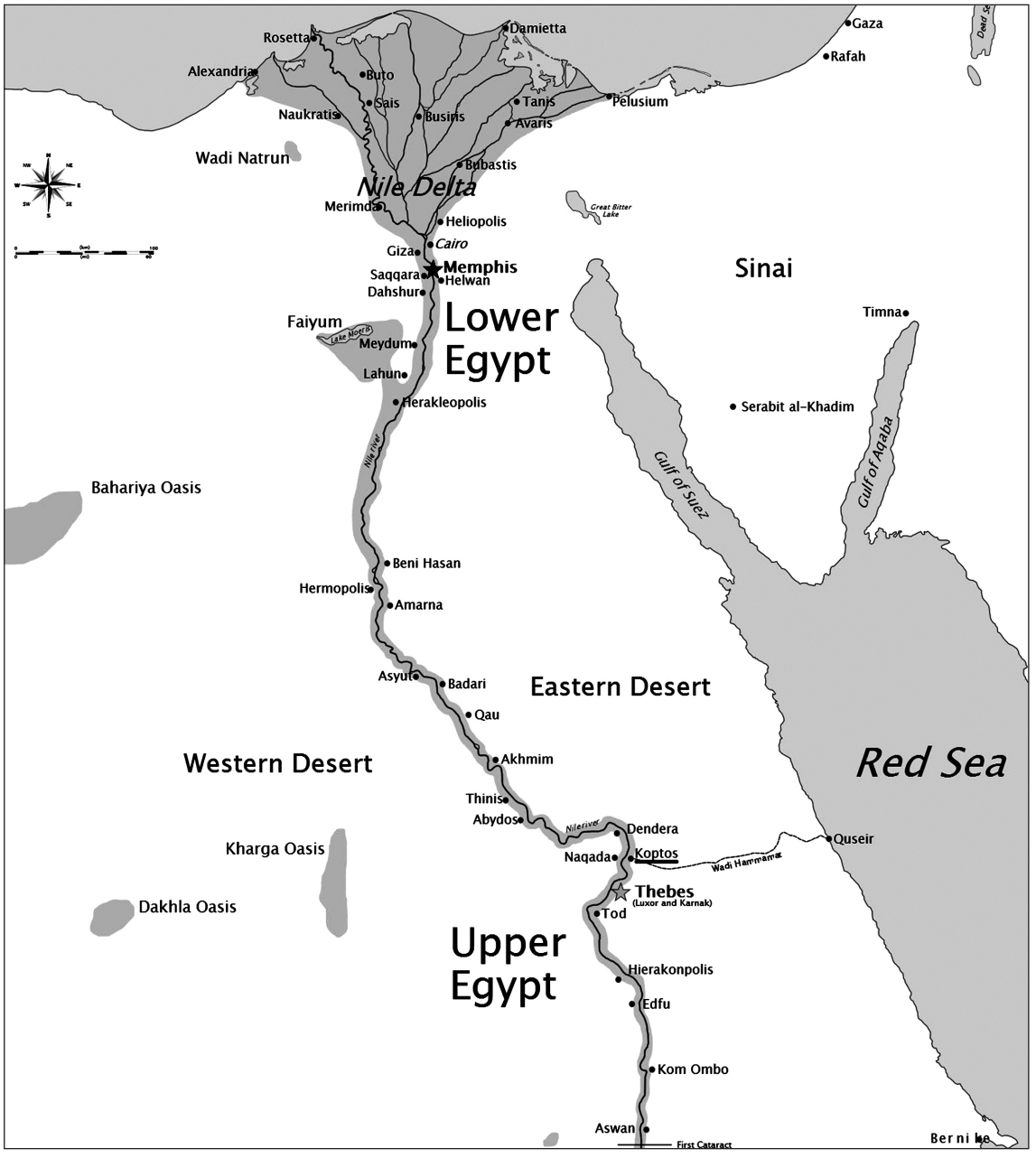

Fig. 1: Map of ancient Egypt. The site of Koptos is underlined red.

The processed chemical data, as shown in the principal component analysis (PCA) plot on **Fig. 3**, showed an interesting distribution[7]. A central group of measurements is formed by the plain ware serving vessels, the lamps, and the miniature vessels. This field also contains a large portion of the figurines and molds, with only four outliers spread over the right part of the plot. It documents that these outliers are not part of the Koptos core group and thus should be seen as possible imports. Since this has already been suggested for at least three of these objects based on their fabric and/or iconography, this is a welcome confirmation for the archaeological argumentation.

7 For the PCA the following well detectable chemical elements have been used: Si, Ti, Al, Fe, Mn, Ca, K, V, Cr, Ni, Cu, Zn, Rb, Sr, Y, Zr, Nb, Ba and Pb.

Fig. 2: Overview of two boxes holding some of the plain ware beakers and bowl from early imperial Koptos stored at the Musée des Beaux-Arts de Lyon.

The better part of the plain ware bowls and beakers found at Koptos are largely separated from this core group, although the bowls seem to somehow form an intermediate position with recurring overlaps between the main group and the much wider scattered beakers. This is of special importance, since both groups of vessels also show a different production technique in contrast to the wheel thrown or mold made vessels and figurines mentioned above. The main body seems to be built from coils while spirals on their flat bottoms indicate, that they were at least partially worked on a slow turning wheel. Thus, it can be assumed that they were produced by different workshops as the rest of the vessels. These could potentially be allocated in Koptos or its vicinity as well, but might have used either slightly different clay sources or were processing the local clay in a different manner, thereby changing its chemical composition. Since aspects like these will be faced frequently during the chemical analysis conducted for the CeramEgypt project, it is promising to know that the measurements could be sensible for such aspects of production.

The small test series on some of the barbotine decorated vessels from Koptos at least indicated that these can mostly be separated from the main Koptos group comprised of miniature and serving vessels, the lamps, and the terracotta figurines. However, a differentiation between the presumably Aswan imports and some of the unknown fabrics has not been very successful. Most of the Aswan candidates, however, do form a rather consistent group that needs to be tested against other possible Aswan productions in the future.

Preliminary results

The results are promising as they suggest that material stored in European collections does hold the potential to create, on an interim basis, preliminary chemical reference groups for certain Egyptian sites and chronological periods. This, of course, should only be seen as a last resort, and should only be reserved for scenarios where Egyptian sites and their ceramic material are currently not accessible.

The measurements also indicate that the analyses could be sensitive enough to suggest considerable differences in chemical compositions, when looking at different groups of productions such as figurines, lamps or different groups of vessel types. We intend to cross-reference these first results for early imperial Koptos with measurements taken on site during the course of our project. During this, we also hope to cover other periods at this site as well, to see if these vary significantly from the results for the ceramic production during early imperial times.

The authors would like to express their gratitude towards Mai Abdelgawad and Valérie Pichot (both CEAlex) for advice and corrections during the preparation of this report.

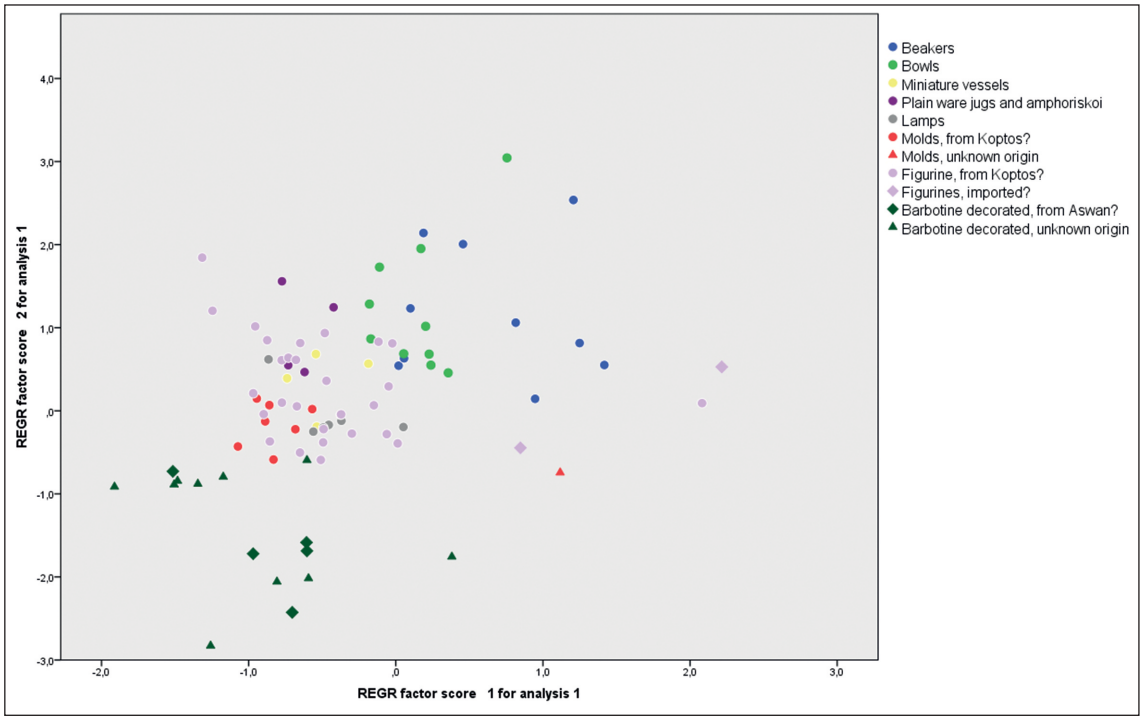

Fig. 3: Principal component analysis (PCA) showing the distribution of the different ceramic groups measured at the Musée des Beaux-Arts de Lyon via p-ED-XRF. Based on their macroscopic differences, these have beforehand been classified as possible local productions (circles), imports (diamonds), and unknown origin (triangle).

Abbreviations

Ballet 1999

P. Ballet, Les terres cuites romaines de Coptos. Du musée à l'atelier, BMLyon 4, 1999, 2–17.

Ballet – Galliano 2010

P. Ballet – G. Galliano, Les isiaques et la petite plastique dans l'Égypte hellénistique et romaine, in: L. Bricault – M. J. Versluys (eds.), Isis on the Nile. Egyptian gods in Hellenistic and Roman Egypt. Proceedings of the IVth International Conference of Isis Studies, Liège, November 27–29 2008 (Liège 2010) 197–220.

Helfert 2013

M. Helfert, Die portable energiedispersive Röntgenfluoreszenzanalyse (P-ED-RFA) – Studie zu methodischen und analytischen Grundlagen ihrer Anwendung in der archäologischen Keramikforschung, in: B. Ramminger – O. Stilborg – M. Helfert (eds.), Naturwissenschaftliche Analysen vor- und frühgeschichtlicher Keramik III. Methoden, Anwendungsbereiche, Auswertungsmöglichkeiten, UPA 238 (Bonn 2013).

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