Re-Mapping Karanis: Geographic Information Systems (GIS) and Site Analysis

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During the late nineteenth and early twentieth centuries, Egypt disgorged a wealth of papyri that flooded the antiquities market, and subsequently, these documents entered the collections of museums and research institutions around the world. Some of this material came to light through accidental discovery or targeted treasure hunting; other caches of papyri were found during excavations. Early excavations varied widely in terms of their attention to provenance and findspots. The material discovered during these early explorations became the foundation upon which researchers in European and North American institutions built the discipline of papyrology. Although discoveries of papyri during controlled excavations in the contemporary period offer exciting opportunities and supply researchers with new and useful sources of data, many papyrologists continue to publish texts from the collections established more than 100 years ago. This material should, of course, be published, but we are often faced by two discrete kinds of papyri: those irreparably divorced from their ancient environments, and those that can be investigated as part of a larger assemblage of materials, that is, within their geographic and physical context.

Recent work in both papyrology and archaeology has emphasized this idea of context – understanding how objects, texts and architecture interact on the micro and macro levels – that is, in an individual room, insula, site, or region. The value of such an approach is readily apparent, but the absence of sources of contextual data for many of the papyri in collections worldwide presents a similarly conspicuous problem. For some papyri, the problem of contextual study in insoluble – we have no information on findspots or associated artifacts. Other texts – especially those discovered in early excavations – can be linked to contextual data, but the process of doing so is daunting and laden with problems of access: maps and plans must be located and interpreted, dusty excavation records must be unearthed, and artifacts must be identified and perhaps cleaned. Essentially, the problem lies in collecting and accessing disparate sources of data that have sometimes been disassociated because of disciplinary boundaries. At the

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1 This paper would not have been possible without generous funding in 2005 from the Collaborative for Advanced Research and Academic Technologies (CARAT) and the Rackham School of Graduate Studies while I was a graduate student in the Interdepartmental Program in Classical Art and Archaeology (IPCAA) at the University of Michigan. I am especially grateful to Traianos Gagos who served as my mentor while I was a fellow in the CARAT program. I received significant assistance from many members of the staff of the Kelsey Museum, including Sharon Herbert, the director, Terry G. Wilfong, Associate Curator, Robin-Meador Woodruff, former registrar of the Kelsey Museum, and Sebastián Encina, the Coordinator of Museum Collections. Karl Longstreth, the head librarian of the Map Library, was also instrumental in facilitating my work.


3 See, for example, B.P. Grenfell et al., Fayûm Towns and Their Papyri (London 1900), and more recently, D. Montserrat, "'No Papyrus and No Portraits': Hogarth, Grenfell, and the First Season in the Fayum, 1895–1896," BASP 33 (1996) 133–176.

University of Michigan, for example, the papyri from Karanis are stored in the papyrus collection in the Graduate Library, while all of the artifacts, plans and excavation data are located in the Kelsey Museum of Archaeology. The data is even separated virtually: the Kelsey Museum and the papyrus collection each have separate websites that disseminate their material to the rest of the world. In the case of the latter, the papyri are cataloged along with hundreds of thousands of other texts from multiple collections via the APIS (Advanced Papyrological Information System) database. This is certainly not a criticism, because both collections provide phenomenal access to scholars, researchers and the public. But such a disciplinary division of material is common and can be a challenge for scholars wishing to examine different categories of evidence that may derive from the same physical context.

We can approach the issue of re-contextualizing archaeological data from excavations conducted in the late nineteenth or early twentieth century by applying contemporary field techniques. In particular, it is possible to use a Geographic Information System to associate topography, architecture, artifacts and papyri. This paper presents technical information about the methods that I used to create a data storage system for the papyri and artifacts discovered during the University of Michigan excavations at Karanis. This process involved a number of problems and difficulties that needed to be overcome in order to map the site; each of these issues will be discussed in detail.

The history of the Karanis excavations directly determined the data sources that were created as part of the investigation of the site. The University of Michigan team began work at Karanis in 1924 and continued on the site for the next 11 years until 1935. A topographic map was initiated during the first year of excavation to supply the Michigan team with a base map of the site. (Fig. 1) As buildings were unearthed, they were mapped and elevations and plans were created to record the architecture. Different periods of occupation on the site were tentatively identified by the Michigan team and designated as separate settlement layers. These settlement layers were each given a letter designation, beginning with the top layer, A, and continuing downwards to the supposed Ptolemaic layer, F. All of the finds were

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6 For this project, I used ArcGIS 9.1, manufactured by Environmental Systems Research Inc. (ESRI), <http://esri.com/>.


documented in the Record of Objects according to a room designation; these large volumes – one for each year of the excavation – acted as the primary record of the field project. The Michigan team also documented their work at the site with thousands of on-site photographs and even a moving picture. In all, more than 100,000 artifacts and papyri were unearthed.

Once the excavation was closed, the finds were distributed between Egypt and the University of Michigan according to a prearranged division; Egypt received most of the material, but many papyri and artifacts were brought to the United States. In the 70 years since the excavations were completed, numerous volumes on the finds and papyri have appeared, and in the past two decades, the Papyrus Collection and the Kelsey Museum have begun to make their respective collections available online. The wealth of material is astounding, but there is little overlap between the two collections and each artifact or text has been published on the web as a discrete record.

In 2004, through a fellowship from the Rackham School of Graduate Studies at the University of Michigan and the Collaboratory for Advanced Research and Academic Technologies, I began the process of linking these separate sources of data within the ArcGIS software suite, a collection of spatial mapping programs that are widely used in both archaeology and the larger professional world. My work was intended to accomplish a number of goals: (1) to replicate the maps and plans of the site in digital form (2) to include all of the layers within a single platform to allow the reconstruction of site stratigraphy and (3) to populate this GIS map with all of the finds, both papyri and artifacts, from the site.

I first created a digital version of the topographic map that had been produced during the course of excavation. (Fig. 3) Using the triangulation points that were established during the first season of excavation, I was able to place the virtual map of Karanis in real space, so that it can be viewed and investigated alongside larger Digital Elevation Models and topographic maps. I then digitized each of the topographic lines and I created an elevation model for the site based on these data.

Next, I used scaled maps that were drawn of each excavation square to digitize buildings and rooms. (Fig. 4) Digitization was undertaken by hand using scanned negatives of building plans that are currently housed in the Kelsey Museum. The scanned negatives were georeferenced to the GIS map by using data points and the ten-meter grid squares originally established by the excavation. (Fig. 5) The ArcGIS program uses layers similar to those found in Adobe Photoshop – these layers each contain spatial data and the layers can be made visible or invisible depending on what features the end user would like to see. (Fig. 6) In accordance with the conventions used by the original excavators, each of the original excavation layers was mapped as a digitized layer, so that structures associated with the top layer of occupation (A) were placed in a different digital file from those associated with the second layer (B) or third layer (C) and

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Gazda and Wilfong, op.cit. (above, n. 7) 14.


Supra, n. 6.

For the purposes of digitization, I used a combination of scanned hard-copy maps held by the Kelsey Museum and various sized negatives of plans from the 1930s that each map a 10 meter grid square.
so on. Structures and features that were reused or continued in use from earlier to later levels were placed in separate layers, so that, for example, second layer walls and structures that continued to be used in top-layer constructions received a distinct digital layer, in this case, "Second Layer in Top Layer." On the other hand, second layer constructions that only appeared in the second layer were grouped as part of the "Second Layer." This formulation mimicked the original maps. I also digitized separate features that represented restored walls and features, such as ovens. The different layers can be made visible or invisible, creating a virtual reconstruction of the excavated site, where permutations of architecture are appropriately aligned and stratified.

This GIS file reproduces the maps and plans of the Karanis houses and temples, but a further step was necessary to link the map with the excavated artifacts and papyri. In order to do this, I digitized a series of polygonal spaces – called shapefiles within the program – that represent the interior spaces in each building or even open areas on the site. These shapefiles represent the soil layer that was excavated as the interior of a room or as an open area on the site. As the excavators did not use recording methods that permit the reconstruction of soil layers, all artifacts are associated with architecture. I assigned each shapefile the number associated with the soil strata in the Record of Objects, so that the soil discovered in room B of house C91 would receive the number C91B. I intended to use this number to query the in-house records of the Kelsey Museum of Archaeology and the Papyrus Collection, both maintaining separate FileMaker Pro databases.

At this juncture, I encountered two problems. Primarily, the Kelsey Museum and the Papyrus Collection use different fields to indicate the original findspot. While the Papyrus Collection lists rooms without placeholders (i.e. 0) and includes both building and room number in the same field, the Kelsey Museum uses placeholders and has separate fields for buildings and rooms. So, in the example listed above, room C91B would be listed as C91B (one field) in the Papyrology database but as building C0091 and room 00B (two fields) in the Kelsey database. I circumvented this problem by listing three separate fields within the GIS tables, but this workaround may cause unforeseen problems when the database is actively used.

The second problem was more complicated, and involved linking the rooms to the two different data sources. The ArcGIS software has the capability to link the spatial data – the rooms and architecture – with databases while inside the GIS platform, but this would require a static copy of the database or access to the two encrypted databases. As both the Kelsey Museum and the Papyrus Collection constantly update their data and add new records, using a static copy of the database would have been shortsighted. Furthermore, the ArcGIS software has known issues with querying FileMaker Pro databases rather than the more Microsoft Windows-compatible Access databases, problems that would have significantly complicated the process of data retrieval. Luckily, a third option presented itself in the form of the online databases implemented by both the Kelsey Museum and the Papyrus Collection.

The University of Michigan Digital Library (UMDL) project provides access to both online databases. I worked with UM library staff to establish a web-based query that would collate data from both collections according to the field code for room or building and room. I built an expression into a new data field that would create an "http" address using both the Papyrology Building-Room field and the two Kelsey Museum fields. It is currently possible to open the GIS map of Karanis and, using the identify
feature, to access the contents of the room by selecting this "http" field. A web browser window then displays the combined results of the two searches, one in the Kelsey database and the other in the Papyrology database.

The use of the web-based query does have limits. Ideally, the program should allow one to study distribution patterns over the entirety of the site. For example, one should be able to search for "ostracon" or "Homer" and produce a map of the houses and rooms where the relevant texts or artifacts appear. This sort of query, however, relies on building more complicated searches and directly querying the data in the FileMaker Pro databases. The above-mentioned problems associated with communication between ArcGIS and Filemaker as well as issues of access to the encrypted files currently prevent queries to move from object to map, rather than vice-versa. In time, this problem will be solved.

The full digitization of the site is not yet complete, but it is still possible to use the GIS software to achieve a more robust, virtual picture of the site, its architecture and material culture. In part, this is achieved through visual means, as the topographic data can be used to create a three dimensional reconstruction of the Karanis mound (Fig. 7). The layers can then be overlaid on top of this reconstruction and staggered to provide a sense of the different occupation phases of the site. It is also possible to use the GIS based map to visually orient oneself on the site in a particular house or building, and to effectively "see" which structures lie nearby. Using the links to the databases, one can even look into the neighboring properties and investigate what lies inside. Basic satellite imagery from Google Earth can be draped over the site to give a better idea of site topography and the visible remains, further increasing the user’s ability to envision the site as an occupied landscape.

The GIS platform offers a wide range of uses for the storage and study of archaeological and papyrological data. This data source allows us to reconstruct – as closely as possible – the excavated strata and to study the texts and artifacts with reference to their findspots. As a tool, the GIS structure can contribute to reunifying texts and artifacts, bringing us one step closer to bridging the disciplinary divide between archaeology and papyrology.
Fig. 1: Detail of Topographic Map of Karanis. The sunken area in the center of the map is the result of the work of sebbakhin who pillaged the site for organic material to use as fertilizer.
Fig. 2:
Plan of Excavation Square G11, Top Layer
Fig. 3:
Topographic map created in ArcGIS
Fig. 4:
Map of Grid Square within GIS software
Fig. 5:
Digitized grid square in ArcGIS
Fig. 6:
List of Layers in ArcGIS
Fig. 7:
Layers displayed in ArcScene