ARCGIS AS A NEW TOOL FOR ASSESSING CONSERVATION CONDITION

By Siska Genbrugge

As a student in the Conservation Program, I am working on an MA thesis project focused on a specific problem that occurred on a single object: a Ptolemaic mummy cartonnage mask owned by the Robert V. Fullerton Art Museum at CSU San Bernardino. The object had been displayed conforming to the highest museum conservation standards: it had been placed on a stable mount made of inert materials and enclosed in an airtight display case with controlled temperature, humidity, and light levels. And yet some painted areas were actively flaking.

In October 2008, the mask arrived at the UCLA/ Getty Villa conservation laboratory, and a preliminary inspection of the mask confirmed that only a dull yellow-brown paint was flaking. These flaking areas of paint were visually difficult to distinguish from other painted areas with the same yellow-brown appearance. A majority of the research was aimed at determining why these select areas were preferentially flaking. To answer this research question, a variety of analytical techniques commonly employed by conservators were used. These included X-ray fluorescence (XRF), polarized light microscopy (PLM), and gas chromatography-mass spectroscopy (GCMS) performed by Michael Schilling and Joy Mazurek at the Getty Conservation Institute, combined with the use of a nontraditional tool, but one that is commonly employed by archaeologists, a geographic information system (GIS).
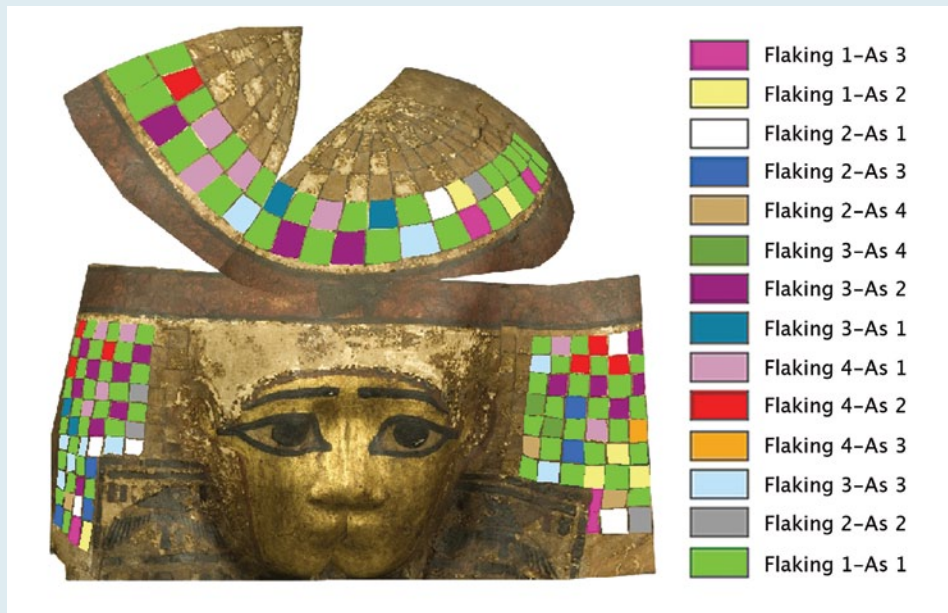
Elemental analysis of sample areas with a portable XRF revealed that the flaking yellow-brown paint contained a high amount of arsenic, while the non-flaking areas contained a lower amount or even no arsenic. There are two main pigment groups that contain arsenic: yellow orpiment (As_2S_3) and orange-red colored realgar (As_4S_4). None of the literature I consulted mentioned flaking as a common type of deterioration of paint layers containing those pigments. The dispersion samples were made from areas of flaking paint that XRF revealed as being arsenic-containing, and were analyzed with PLM. The high power magnification afforded by PLM revealed a brown amorphous mass with sparsely dispersed pigment particles which could be identified as orpiment and deterioration products of orpiment. The brown mass was identified with GCMS as degraded gum arabic, but the gum could be ruled out as the cause of flaking because the same degraded gum arabic was found in the other painted areas that were not flaking.

With the famous quote of Marcel Proust in mind—"The only real voyage of discovery consists not in seeking new landscapes, but in having new eyes, in seeing the universe through the eyes of another" (*The Captive*, 1923)—I started a search for new ways to look at the cartonnage. A course on GIS in archaeology given by Michael Harrower was the perfect opportunity to explore a new way of looking at objects. GIS can provide a condition assessment that cannot be created by regular visual condition reports made using Photoshop. The main advantage of ArcGIS software for condition-assessment purposes is the program's

Resulting 3D image made with PhotoModeler. This image could not be imported into ArcGIS without the loss of the surface texture; unfortunately, a condition assessment requires that the surface texture be visible.

Flaking Degree vs Arsenic Count

■ (magenta)	Flaking 1–As 3
■ (yellow)	Flaking 1–As 2
□ (white)	Flaking 2–As 1
■ (blue)	Flaking 2–As 3
■ (tan)	Flaking 2–As 4
■ (green)	Flaking 3–As 4
■ (purple)	Flaking 3–As 2
■ (teal)	Flaking 3–As 1
■ (pink)	Flaking 4–As 1
■ (red)	Flaking 4–As 2
■ (orange)	Flaking 4–As 3
■ (light blue)	Flaking 3–As 3
■ (gray)	Flaking 2–As 2
■ (bright green)	Flaking 1–As 1

A combination layer of flaking degree and arsenic amount. Flaking 1 indicates no flaking, and flaking 4 means severe flaking. As 1 means no arsenic detected, while As 4 means there is a high amount of arsenic detected with XRF.

most basic function: the mapping and layering of information on a picture of the object. For example, using the software, one layer can be created with information about flaking degree, a second layer with information about surface coatings, and so forth. For each layer, a color code can be applied to categorize information. For example, four categories of paint condition were created whereby bright blue represents areas with non-flaking paint, and dark blue is the complete loss of the paint. The advantage of ArcGIS software is that nonvisual information can be attached to a layer, such as the exact amount of arsenic obtained with XRF analysis from the different areas and the degree of flaking observed. One can quickly create a new layer that combines the information of two layers, thereby connecting analytical results to visual observations, which allows for a powerful visual interface that has the potential to confirm or deny relations between sets of data.

The main drawback of ArcGIS is that the program is designed for mapping sites in 2D or 2.5D and not for small-scale 3D objects like the mummy mask. As a consequence, most of the problems were encountered when attempting to import an image of the object into the program. A 3D image made of the object with PhotoModeler 6 software could not be imported; instead, a "flattened" image had to be used. For this project, only a part of the object, the checkerboard patterned headdress, was analyzed. XRF measurements were taken from every square of the checkerboard pattern and although portable XRF data are not precisely quantitative, they allowed to compare relative concentrations of elements. The data were imported onto the ArcGIS file and the results confirmed that where the XRF measured a higher peak of arsenic, the flaking was heavier.

Even though the cause(s) of the paint flaking couldn't be retrieved, the object was stabilized successfully. The treatment performed consisted of reducing the glossy appearance of a previously used consolidant, Paraloid B-72. This same consolidant was used in a lower concentration to stabilize flaking paint.

The innovative aspect of this project was the way in which existing techniques were applied and combined to assess the condition of a unique object of cultural heritage. XRF was applied as a semi-quantitative technique, and GIS, a tool not used by object conservators, was used to aid in the assessment of the condition of an object.

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