Ancient and Traditional Technologies: Analysis and Reconstruction
An Evaluation of Decorative Techniques on a Red-Figure Attic Vase from the Worcester Art Museum using Reflectance Transformation Imaging (RTI) and Confocal Microscopy with a Special Focus on the “Relief Line”

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ABSTRACT

Decorative features on a Greek red-figure stamnos in the collection of the Worcester Art Museum were examined using Reflectance Transformation Imaging (RTI) and scanning laser confocal microscopy. These two surface examination tools helped to answer questions relating to the decorative process, particularly the tools and techniques that Attic painters used to create the so-called glossy black “relief lines” and “relief dots.” This research also incorporated fabricated mock-ups to help understand the ancient technology. It was determined that the relief line was not produced by an extruded method, but with a brush made of one or very few hairs, an idea first proposed by Gérard Seiterle in 1976 and termed Linierhaar. It was observed that not one but two distinct types of relief lines exist: the “laid” line (proposed by Seiterle) characterized by a ridge running through the middle of the line and the “pulled” line (proposed in this paper) which has a furrowed profile. Both line types were reproduced with a Linierhaar. Additionally, relief dots were replicated using a conventional brush. Surface examinations of other red-figure vessels using RTI and the confocal microscope suggest these conclusions apply to vessels of this genre as a whole.

INTRODUCTION

Greek black- and red-figure pottery production started around the first half of the 6th-century BCE and lasted a little over three centuries through the first third of the 4th-century BCE [1]. Black-figure technique characterizes the first part of this period, which later gives way to the red-figure technique around 520 BCE with an overlap of both for about 30 years [2].

The method used to produce the distinctive red and black color of Greek Attic vases is one of the milestones in the history of ceramic technology. According to this ceramic tradition, the black portions on the vessels are the painted sections. The paint is technically a glaze, referred to as “glossy black glaze” or “black gloss,” consisting of dilute clay rich in iron, oxygen, silicon and potassium [3]. The unpainted parts of the vessel reveal the natural red color of the fired clay body. After decorating the vessel with the glaze, it was fired in three stages—first under oxidizing, then under reducing and finally under re-oxidizing conditions to achieve the red and black colors of these ceramics. This ingenious process was only rediscovered 70 years ago by the German chemist Theodor Schumann [4].

Today there is consensus regarding the materials and the three-stage firing technique used to make these vessels, but an ongoing debate remains over the sequence of the decoration process and especially over the tools and methods used to create certain decorative features such as the so-called glossy black “relief lines” and “relief dots.”
EXPERIMENT

The Worcester Art Museum has in its collection a fragmentary red-figure *stamnos* attributed to the Tyszkiewicz Painter and dated to c. 480 BCE (Figure 1).

![Figure 1. Stamnos attributed to the Tyszkiewicz Painter, c. 480 BCE (Worcester Art Museum, 1953.92). In the forefront is Peleus with Thetis behind him, and on either side are two of Thetis’ companions.](image)

Depicting the sea goddess Thetis and her female companions struggling against the advances of Peleus as she transforms herself into numerous wild animals, the stamnos displays an unusually wide repertoire of decorative surface features used by red-figure painters. The goal of this project was to answer some of the questions regarding the decorative process used by Attic painters using two complimentary surface examination methods now available to art conservators: Reflectance Transformation Imaging (RTI) and scanning laser confocal microscopy. The research focuses especially on the relief line and incorporates fabricated mock-ups to provide comparative material to the ancient vessel.
The RTI instrument used for this project consists of a fixed light array, also referred to as the “dome,” and high-resolution digital camera (Figure 2). To generate an RTI file, forty individual digital images are taken of the same surface detail on an art object as it appears under various angles of illumination. Fitting software is used to combine the forty images into one interactive file, resulting in a high-resolution, 2-dimensional representation of an object’s intricate 3-dimensional surface. Upon opening the file on the computer, the viewer can manipulate the angle of illumination using the mouse and apply various transformation algorithms to optimize the conditions for viewing surface topography and discern features not otherwise visible. One such function is the “specular enhancement” feature, which is particularly useful to characterize topography. For the purpose of this publication, relevant still-captures from these interactive files were selected.

Use of the Olympus LEXT-4000 scanning laser confocal microscope was generously provided by the Surface Metrology Department at Worcester Polytechnic Institute (WPI) (Figure 3). This instrument produces images and surface measurements for a range of metrology functions in a number of formats including topography and 3D elevation maps.

DISCUSSION

Decorative Features on the Worcester Stamnos and the Sequence of Application

The decorative features on the Worcester stamnos will be discussed in the sequence that they were likely applied by the vase painter in Antiquity. Figure 4 shows recessed lines produced with a hard tool on the unfired surface to serve as a preliminary sketch for a figure’s leg.
Figure 4. RTI still-capture with specular enhancement showing a detail of the stamnos in Fig. 1 with preliminary sketch lines defining Peleus’ right leg.

These lines were probably made with a stick of charcoal [5], a slate pencil [6] or a small, blunt tool made of wood or metal [7].

Following a possible pre-firing [8], the glazing process on the vessel started with defining the figures by outlining them with either a dilute glaze or directly with the relief line (some figures are only partially defined with relief lines). The relief line was then used for painting the details within the figures such as faces, hair, body parts and folds in garments; curly hair or fancy trim on garments were depicted with raised dots, also referred to as relief dots (Figure 5).
Figure 5. RTI still-capture showing a detail of Theit’s face in Fig. 1 with relief lines used to outline the face and to depict facial features, and with relief dots for curly hair.

Both the relief line and relief dots will be discussed in depth later in this paper. Other details in the figures as well as the decorative border below the figural composition were then painted more broadly, likely with a brush using a glaze more dilute than the glaze used for the relief lines (Figure 6).
Figure 6. Detail of the border in Fig. 1 painted with dilute glaze.

Unlike the relief lines, these lines are flush with the surface, and depending on the degree of dilution their color ranges from black where thick, to brown to a faint golden honey color where thin.

The next step in the decorative process was to paint the background with glaze in two stages. First the broad contour line was applied with the purpose of creating a safe margin around the delicate and complex edges of the figures to protect them from being disrupted by the thicker brush used for painting in the background, an action probably executed at a relatively fast pace compared to the other techniques (Figure 7).
Figure 7. RTI still-capture with specular enhancement showing the head in upper left of Fig. 1 and the corresponding contour line in the black background.

Figure 8 is a detail of the head in Figure 7 showing how the black contour line covers the relief lines outlining this head and how some relief lines extend into the background— their appearance is more rounded and less crisp then the relief lines within the red figure, indicating that the contour line was applied after the relief lines.
Figure 8. Detail of Figure 7 at a different angle of illumination showing how the relief lines that outline the figure are painted over with background glaze. The white arrow points at the edge of the contour line glaze on top of a relief line.

The next stage was to paint in the remaining large area of background with glaze. This glaze covered part of the contour line resulting in an overlap area, which is clearly visible in Figure 9.