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# Elemental Identification of Artifacts and Pigments from Ancient Ilion with X-ray Fluorescence

William Aylward – William Marx – Donna Strahan\*

## Abstract

This article presents the results of exploratory research at Troia in 2009, when questions about elemental identification in metalwork, decorated terracotta figurines and plaques, and painted wall and ceiling plaster were addressed with a Bruker Tracer IV portable X-ray fluorescence instrument. Artifacts sampled were found in excavations since 1988 across all parts of Ilion's Greek, Roman and Byzantine phases. Principal research questions involved the value of elemental analysis for exposing details of manufacture and technique, for facilitating the dating of artifacts, and for distinguishing local products from imported ones. The data generated by this study also allows for preliminary comparison of Ilion's corpus of metalwork against trends in the composition of ancient metalwork across the ancient Mediterranean and Near East.

Elemental identification of pigments on painted plaster included both wall and ceiling decoration from Hellenistic and Roman buildings at Ilion. Principal research questions involved the value of elemental analysis for revealing the ingredients in pigments used by the wall- and ceiling-painters, and for identifying variation in pigments across place and time in the topography of Ilion. Overall, results reveal the value of exploratory research for capturing and distilling data for similar classes of artifacts in the life of an ancient city, and for formulating questions for future research.

## Zusammenfassung

Dieser Artikel stellt die Ergebnisse der 2009 in Troia mit Hilfe eines tragbaren Bruker Tracer IV-Röntgenfluoreszenzgerätes durchgeführten Untersuchungen zur Identifizierung der Elemente in Metallartefakten, verzierten figürlichen Terrakotten und Tontäfelchen sowie bemaltem Wand- und Deckenverputz vor. Die dabei untersuchten Gegenstände wurden seit Grabungsbeginn 1988 in allen Bereichen des griechischen, römischen und byzantinischen Ilion gefunden. Das Hauptforschungsfrage richtete sich nach dem Nutzen der chemischen Elementanalyse zur Gewinnung von Informationen über Herstellungsprozess und Techniken, zur möglichen Datierung, zur Unterscheidung lokaler Produkte gegenüber Importen. Die gewonnenen Ergebnisse dieser Studie erlauben einen vorläufigen Vergleich des Bestandes an Metallobjekten in Ilion gegenüber der Zusammensetzung anderer Bestände im Mittelmeerraum und Vorderen Orient.

Die chemische Bestimmung der Farbpigmente auf bemaltem Verputz bezieht sich auf die Wand- und Deckenmalerei hellenistischer und römischer Bauten in Ilion. Die Resultate zeigen den Wert naturwissenschaftlicher Forschung bei der Gewinnung und Aufbereitung von Daten ähnlicher Objektklassen, die im Leben einer antiken Stadt eine Rolle spielten. Sie ermöglichen auch die Formulierung künftiger Forschungsfragen.

## Introduction

This article presents the results of elemental identification of metalwork, decorated terracotta figurines and plaques, and painted wall and ceiling plaster from Ilion with X-ray fluorescence (XRF). A plan of the ancient city showing the findspots of artifacts mentioned in the text appears in Fig. 1. Ancient lit-

erary sources and modern observations attest to the presence in the Troad of many of the elements discussed in this article, but the focus of our research was on the corpus of finds at Ilion, not on potential mineralogical sources, so sourcing the ingredients of the artifacts is not an aim of this article.<sup>1</sup>

It is important to distinguish *quantitative* from *qualitative analysis* of elements. The latter is the

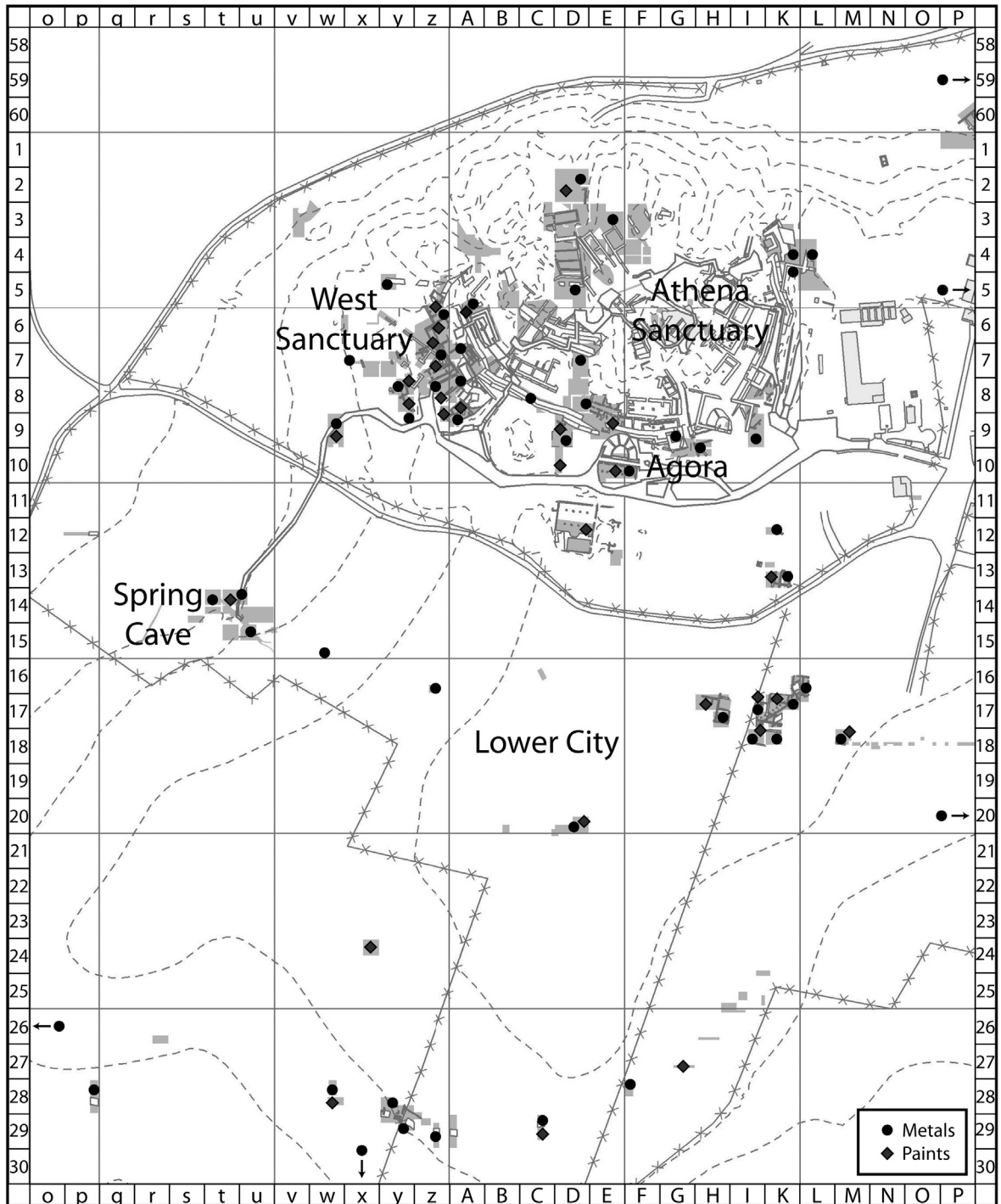


Fig. 1: Plan of Ilios showing areas of excavation mentioned in the text.

focus of our exploratory study. XRF tests like the ones published here provide a reliable test for the presence or absence of elements, but not for absolute

quantities or compounds. Accordingly, our data provides a general list of elemental ingredients and their combinations in the artifacts studied, but not with

the degree of precision required for investigation of their chemical or physical interrelationships.

There are a number of limitations in XRF testing, especially in the field. For example, the XRF unit is unable to detect elements with an atomic number below that of magnesium (Mg), which means that XRF testing provides no positive evidence of organic materials. In addition, for reasons of portability, an optional vacuum pump attachment, which enhances data quality for lighter elements, such as aluminum (Al), was not used for tests of any artifacts in this study. It is also imperative to stress that with XRF technology, the information depth is different for different elements, increasing with atomic number. For painted plaster, this presents a challenge, because the beam may penetrate beneath the painted surface and capture data for base coats of plaster below. Thus the composition of plaster behind a finished painted surface may obscure interpretation of pigment composition.<sup>2</sup> As a control, we also tested unpainted surfaces of plaster from the same rooms. Where necessary, data from these tests can help to clarify the elements present in paints applied to the surface. For metalwork, the challenges to interpretation are similar, but are sometimes compounded by the frequent application of plating or surface enrichment and corrosion on the surfaces of ancient metal artifacts, especially on copper-alloy objects.<sup>3</sup> Where this was obvious, we make note of it, but even trace elements from lost or deteriorated surface treatments can skew a reading aimed at the fundamental composition of the artifact beneath. However, in general terms, the X-ray penetrates to a depth sufficient for collecting reliable subsurface data. In the case of large objects, it is also true that elements may not be evenly distributed. In the case of our study, most objects tested were quite small, and scans of different parts of the same artifacts allowed for scrutiny of outliers. In addition, the »live« functionality of the portable XRF instrument increased degrees of confidence about the elements present in the artifacts by allowing for on-the-spot comparison of multiple readings from different parts of the same artifact, and for the collection of additional readings, or readings of longer duration, as necessary. On the other hand, sometimes peaks of similar energy overlap. For example, the arsenic (As) K-alpha and the lead (Pb) L-alpha lines merge

into one peak on the spectrum display. Therefore, the human eye has difficulty assigning the peak to a specific element. Finally, the X-ray beam of a portable XRF instrument lacks the precision of stationary laboratory instruments in that the beam size of the portable instrument is sometimes wider than an object under testing.<sup>4</sup> Therefore, objects large enough to interact with the entire beam will naturally produce higher elemental readings than objects whose small size permits them to interact with only a fraction of the beam. We acknowledge this equivocation and aim to correct it by stressing qualitative over quantitative results.

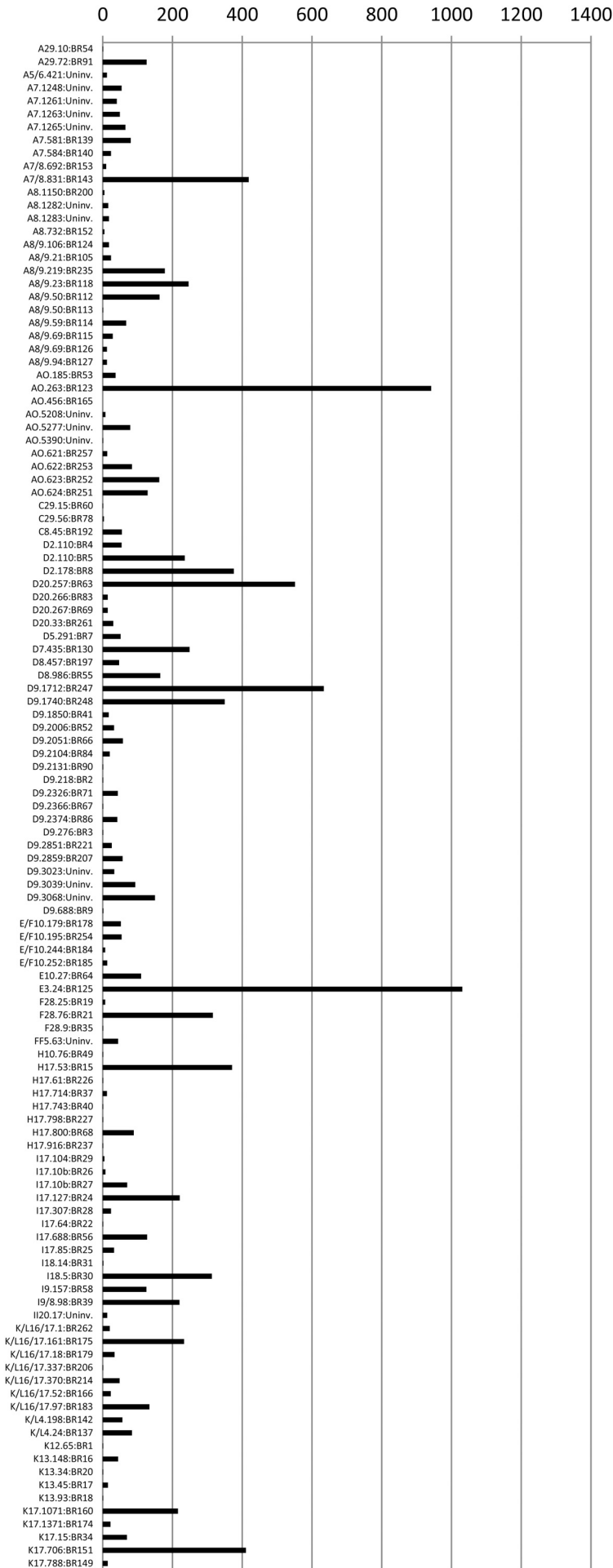
## Methods

All artifacts at Ilion are conserved and, in some cases, consolidated in an on-site conservation laboratory using all organic materials. These materials do not alter the elemental composition of artifacts nor are they detectable by XRF.<sup>5</sup> In any case, most tests avoided modern conservation treatments. Surfaces to be tested were wiped free of dust, but not cleaned.

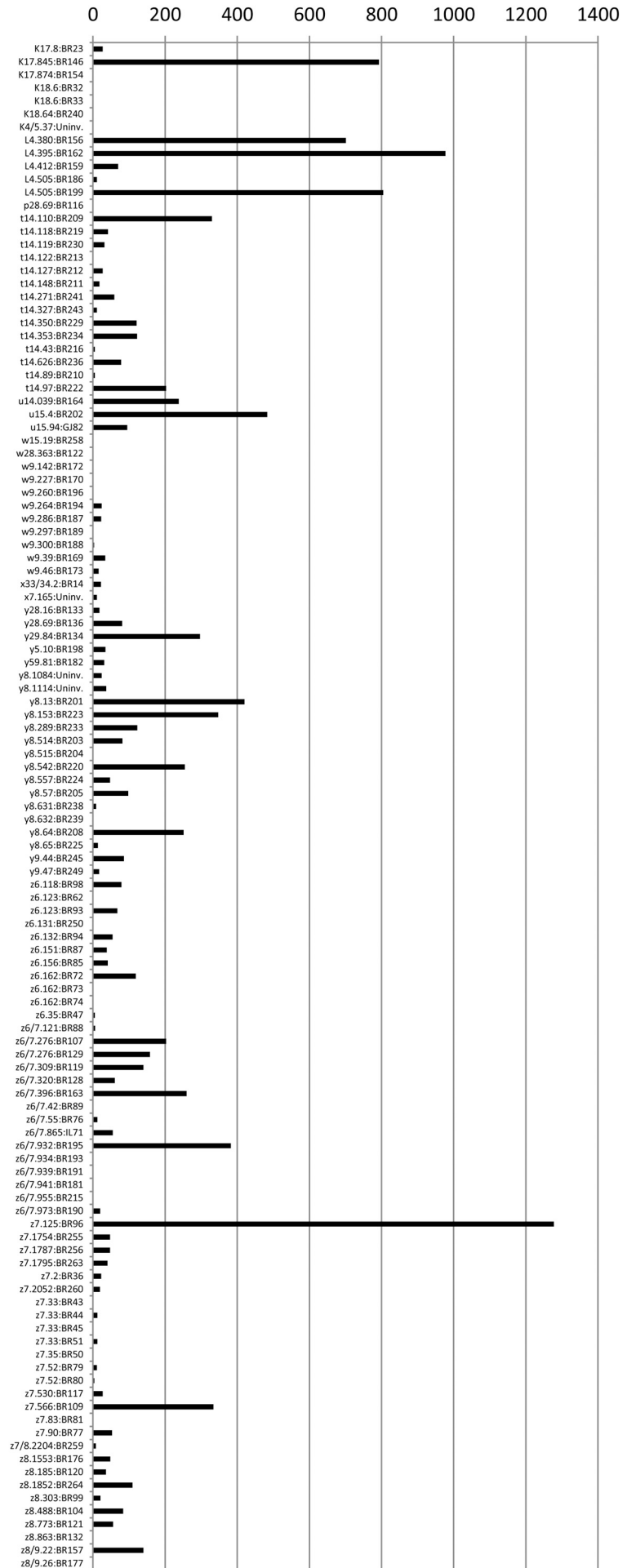
Almost all XRF tests were performed for 30 seconds. A few longer tests are included but they have been normalized to 30-second tests through division by the appropriate factor.<sup>6</sup> For all tests of metal artifacts, the XRF instrument was fitted with a titanium/aluminum filter in accordance with the manufacturer's recommendations for testing elements with higher atomic numbers.<sup>7</sup> For all tests of painted surfaces, in order to perform the most inclusive tests possible, no filter was used.

Bruker's ARTAX software was then used to generate relative numerical values from the spectra for elements of interest. The following steps were followed in the software for each spectrum: first, a manual identification of elements of interest using the periodic table tool; second, an automatic »evaluation,« in which the software performs a curve-fit, integration, and escape-peak and background corrections. This process provides a net value for each element's major XRF line. Essentially a numerical representation of the peak on the spectrum, this value was copied into an excel spreadsheet for relative comparisons among artifacts of a like material. These are the values displayed in all tables and graphs.

# As



# As (cont.)



## Metalwork Quantification

873 tests of 353 total artifacts in the following general groups were conducted: 232 copper-alloy objects (BR), 80 iron and 39 lead objects (IL), and two gold- and silver-alloys.<sup>8</sup> Artifacts were typically tested more than once.

## Elemental Identification

Elements of interest were identified by examining all spectra in general groups and compiling lists of elements which very probably or definitely occur in the corpus. The elements identified in the ARTAX software and present in our tables and graphs are strictly the elements in these lists (Tables 1–3).

For each artifact, one representative spectrum was selected using the following method: after all spectra for a given artifact were processed in the ARTAX software and results were transferred to an excel spreadsheet, the spectrum with the highest net count for the primary element in that artifact (i. e. copper (Cu), iron (Fe), or lead) became the representative sample. Both the actual composition of the artifact and the quality of the reading can bear on one spectrum giving a higher primary element count than others; therefore, the logic behind this method is twofold. First, because this method selects representative samples which demonstrate the high-end of primary element presence in each artifact, our comparisons among artifacts are as standardized as possible. Second, because the primary element in each artifact is always present in large quantities, its net count can serve as an approximate relative measure of a reading's quality. Thus the numbers given for each element in our tables and graphs derive from what is most likely an artifact's best reading.

## Interpretation

### Copper alloys

Results for bronze artifacts from Ilion confirm what is generally assumed for objects made from copper alloy and thus testify to the accuracy of our XRF tests. For example, bronze weights show high lead

content (BR213, BR258) relative to other bronze artifacts.<sup>9</sup> Antimony (Sb) is infrequent in pre-Roman alloys at Ilion, and so its presence at significant levels in two bronze objects without good archaeological contexts provides some clue to their relative date at Ilion (BR30, BR253).<sup>10</sup> In other cases, visual inspection led to speculation about gilding, but the presence of gold was not confirmed by XRF (BR78, BR262). Also worthy of note is that XRF tests of metalwork at Ilion produced no evidence for mercury- (Hg)-amalgam gilding, even though, according to Pliny the Elder 33.20 and Vitruvius 7.8.4, quicksilver (a.k.a. mercury) is required for proper gilding of metals.<sup>11</sup>

For bronze objects from Ilion three elements are worthy of comment: arsenic, lead and tin (Sn). Several artifacts unrelated in function and date have relatively high arsenic contents (BR96, BR123, BR146, BR156, BR162, BR199, BR215) (Figs. 2–3). One artifact in this group was found in the Lower City (BR146 from quadrat K17), but all others belong to contexts on the sloping topography around the immediate periphery of the citadel (quadrats D2, D9, L4, y8, and z6/7). One possible explanation for arsenic-rich copper alloys at Ilion concerns a passage in Strabo 13.1.56, who mentions a local source of *oreichalkos* in the Troad in his description of an alloy of copper and a silver-colored molten metal drawn out by heat from ore found at Andeira, near Cebren.<sup>12</sup> Eaton and McKerrell claim this ore to be rich in arsenic minerals, which also take on a silvery appearance when heated.<sup>13</sup> Arsenical copper alloy at Ilion could be a sign of local manufacture, but it has not been proven that Strabo's *oreichalkos* was not brass, in which case zinc would be the significant element. As problematic as this question is for metals, it is interesting to note that arsenical minerals may have been locally available ingredients based on the presence of arsenic in painted plaster from buildings at Ilion (see below).

Copper alloy wasters (BR181, BR193, BR215), casting debris (BR62), and part of a bronze gate-system for lost-wax casting (BR191) all belong to a deposit in quadrat z6/7 in the West Sanctuary identified with a bronze casting operation dated to ca. 225 BC (Figs. 4–5).<sup>14</sup> All of these artifacts also have relatively high lead content and similar tin content. This provides a clue for the identification of alloys manu-



factured in the West Sanctuary in the late third century BC (Fig. 6).<sup>15</sup> A Hellenistic bronze boss found near the casting pits has a similar elemental profile (BR50). It may be that objects found elsewhere at Ilion with similar elemental profiles are also possible candidates for manufacture in the West Sanctuary. Some of these are dated to the Hellenistic period by their archaeological contexts, such as a fragment of a bronze vessel (BR67), a bronze knife (BR71), and two other bronze bosses: BR58 from quadrat I9 and BR237 from quadrat H17. The dated bosses with this elemental profile provide a potential clue for the date of bosses with a similar elemental profile from undated contexts. The undated bosses come from quadrats D9 and K13 (BR2, BR3, BR20, BR90), and are all close matches for both lead and tin. Another potential boss from quadrat K18 (BR32) registers somewhat lower for lead and tin, but fits the same proportional pattern.<sup>16</sup> Because of these discoveries, it is now possible to formulate the hypothesis that these objects were products of the Hellenistic bronze casting foundry in the West Sanctuary, where bosses seem to have been a focus of production, most likely for the decoration of doors and furniture in the sanctuary. Bronze statuary has not been discovered here, but it is conceivable that cult buildings in the sanctuary were decorated with statues produced on-the-spot.<sup>17</sup> Indeed, the presence of lead in copper alloy objects apparently produced in the West Sanctuary is consistent with what can be expected for statues.<sup>18</sup> Also assignable to this bronze casting operation are a number of bronze objects dated to later phases of occupation at Ilion by their archaeological contexts, but which were conceivably residual artifacts in those deposits or recycled by later generations of Il-

Fig. 3: BR96: Copper-alloy tweezers with relatively high arsenic count from the West Sanctuary.



ians. These include two triangle clasps (BR81, BR189) and two bronze bosses (BR40, BR227) from contexts in quadrat H17 dated to AD 25 and 200, respectively. Good elemental matches are also found in part of a bronze sheet (BR206) from a context in quadrat K/L16/17 dated to AD 375 and in a boss (BR54) found near the surface in quadrat A29. Among these, the bosses are especially good candidates for future research to investigate if they relate to products of the bronze casting operation in the West Sanctuary. Also significant is the apparent clustering of artifacts from this group in Ilion's Lower City: BR40, BR227, and BR237 from quadrat H17, and BR32 and BR33 from quadrat K18 nearby. A pattern of new artifact production for public areas near Ilion's city center and later re-use in the Lower City is consistent with the use and re-use of other classes of artifacts at Ilion, especially terracotta roof tiles.<sup>19</sup>

Several phenomena concerning the use of tin in copper alloys from Ilion are also noteworthy, although not easily explained. Copper alloys in objects of thin, cylindrical shape, such as pins, nails, and wire (e. g., BR91, BR128, BR222) have negligible tin content and higher copper content, probably indicating that these objects are in fact pure copper,

Fig. 4: BR191: Copper-alloy gate-system for lost-wax casting in the West Sanctuary of Ilion ca. 225 BC. TRD32060a.



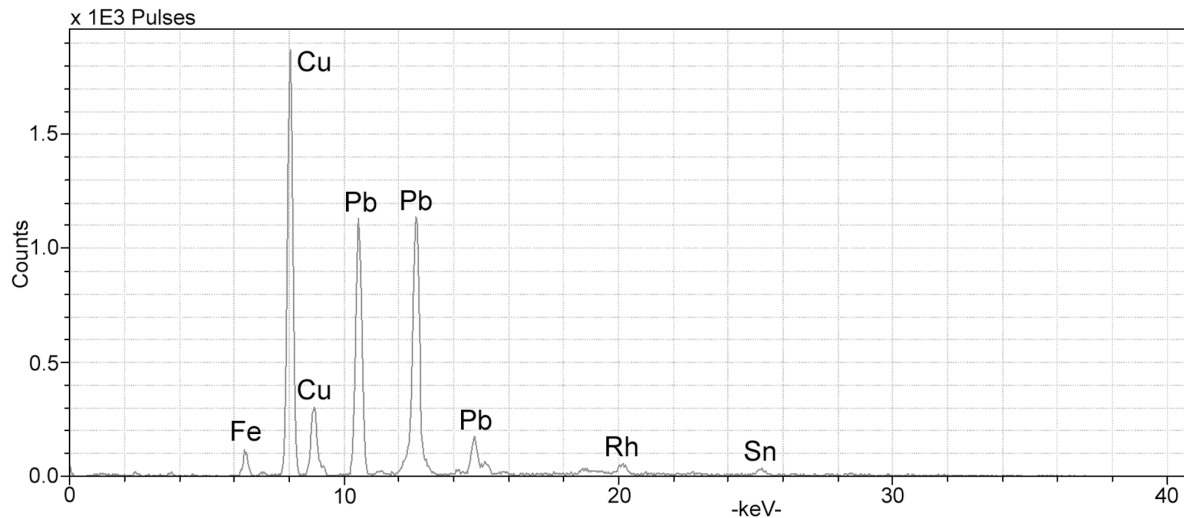


Fig. 5: Spectrum for BR191.

a material easier to work than copper-tin alloys (Fig. 7). Also of interest is the relatively low tin content in objects dated from late Hellenistic times (ca. 100–50 BC) (Fig. 8). This happens to be a period of reduced construction in the city between the revitalization of the acropolis ca. 225–150 BC and the expansion and development of the Lower City in the Julio-Claudian era. The relative absence of tin in metalwork at Ilium is consistent with the downturn in the economy which one would expect during a period of reduced construction. A notable exception concerns several bronze objects found in quadrats t14 and u15 in front of the Spring Cave, an area where debris from an unidentified religious precinct on the west side of the city was dumped in the second half of the second century BC (BR202, BR213, BR229, BR234, BR241, BR243).<sup>20</sup> The presence of tin in objects from this discreet context suggests that the economy of the unidentified religious precinct may have operated at levels different from those of Ilium in Hellenistic times. Several objects from this deposit (BR202, BR212, BR213, BR216, BR230) are also noteworthy for the first apparent presence of zinc (Zn) in bronzes from Ilium (Fig. 9).<sup>21</sup>

#### Iron

Objects of iron manufacture at Ilium were not as revealing in terms of elemental identification, save for

two points of interest. Relatively high lead content detected on large iron Pi-clamps (IL10, IL11, IL13) from the Hellenistic phase of the Bouleuterion (ca. 175 BC) shows that the clamps were leaded into place, a technique confirmed by visual examination of the iron clamps. Thus, the XRF tests corroborate what is known about these objects from independent evidence. Also of interest is a clay crucible (IL3) found in quadrat H17 in the Lower City, from a context dated to late Roman times by African Red Slip ware and a coin of the Roman emperor Aurelian (Fig. 10).<sup>22</sup> Tests of the interior revealed relatively high proportions of silver (Ag), strontium (Sr), and zirconium (Zr). The presence of silver in the crucible is a potential indicator of silver casting in the Lower City of Ilium in the third century AD (Fig. 11).

#### Lead

Study of lead objects at Ilium with the XRF instrument provided a reminder about the limitations of this technique for elemental identification. For example, as mentioned above, the detection of arsenic in objects with high lead counts is challenging because the arsenic K-alpha and lead L-alpha lines overlap on the spectrum display. In other respects, however, elemental identification of lead objects at Ilium returned a number of results consistent with expectations. In general, these objects had extremely

# Pb

# Pb (cont.)

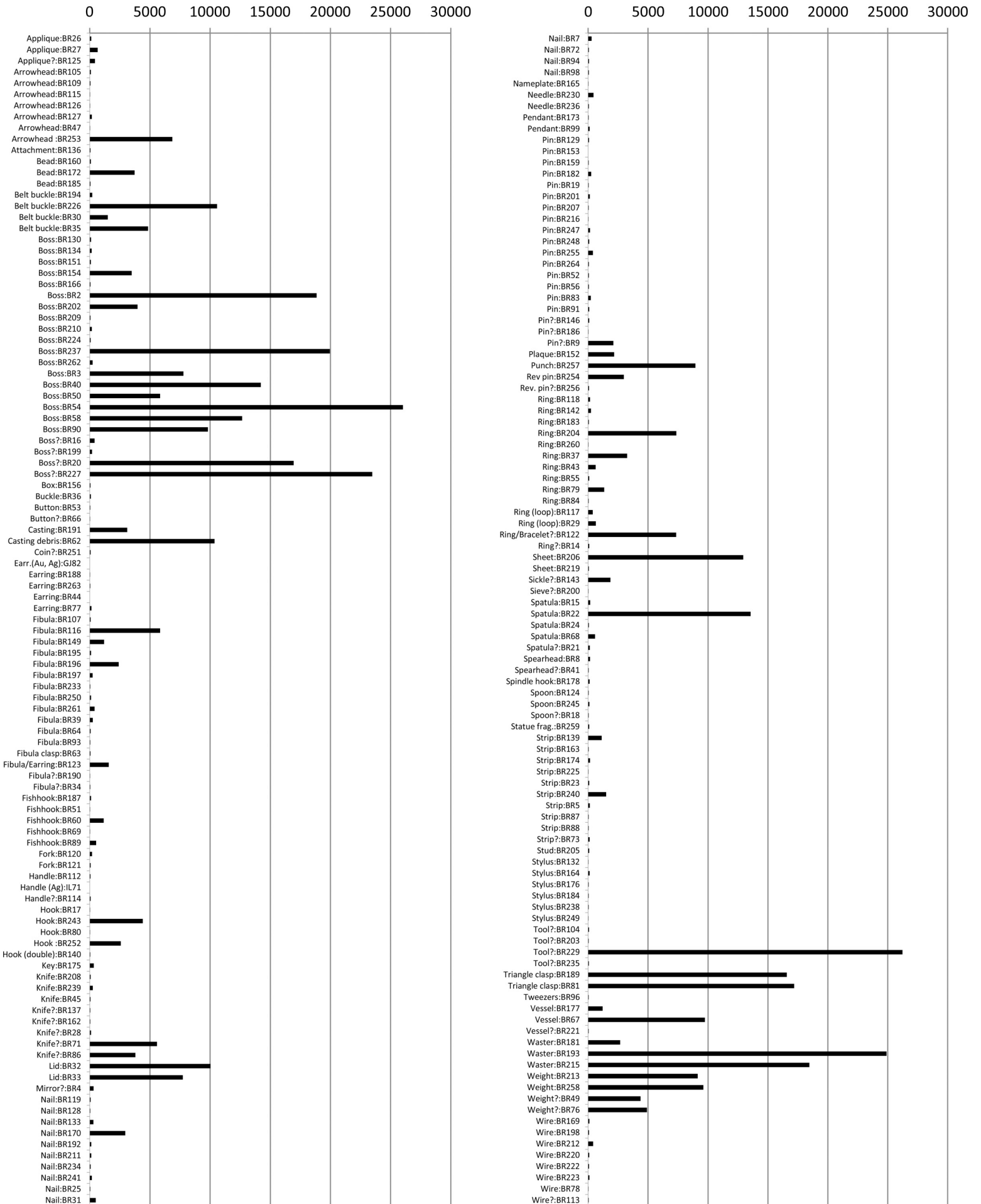


Fig. 6: Lead (Pb) in bronze artifacts from Ilion arranged by function.



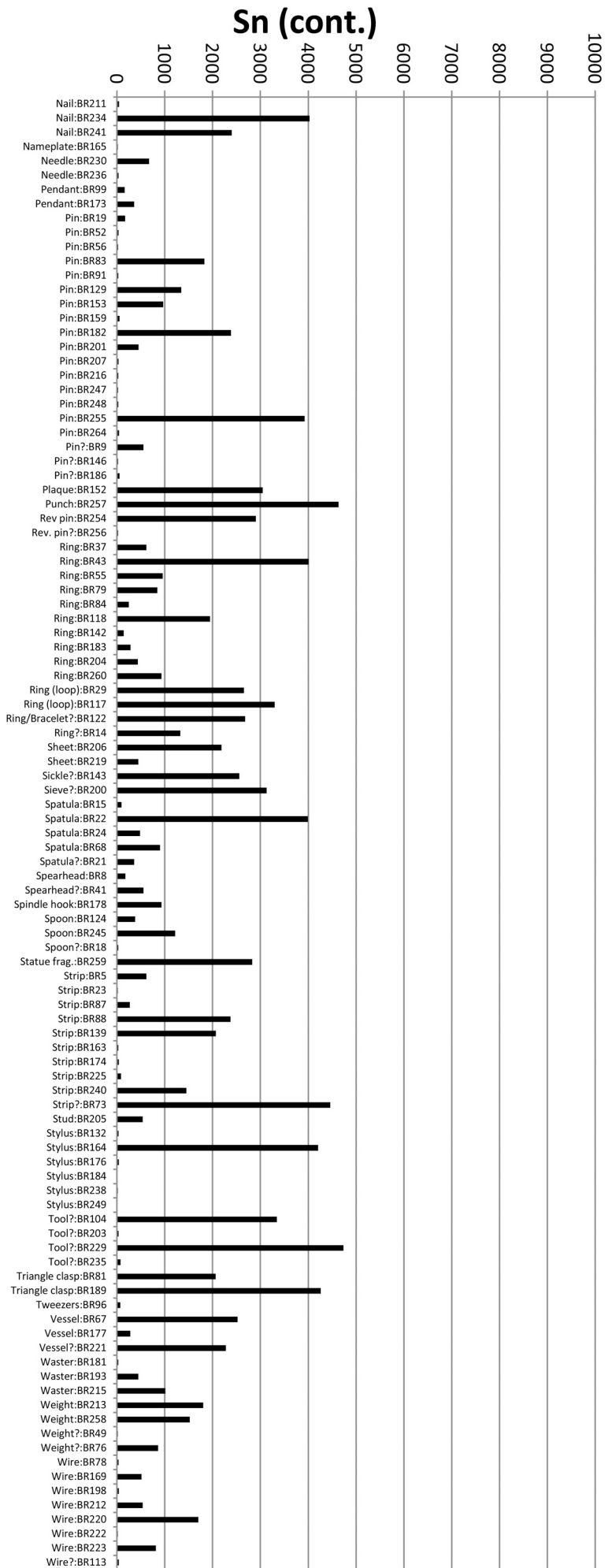
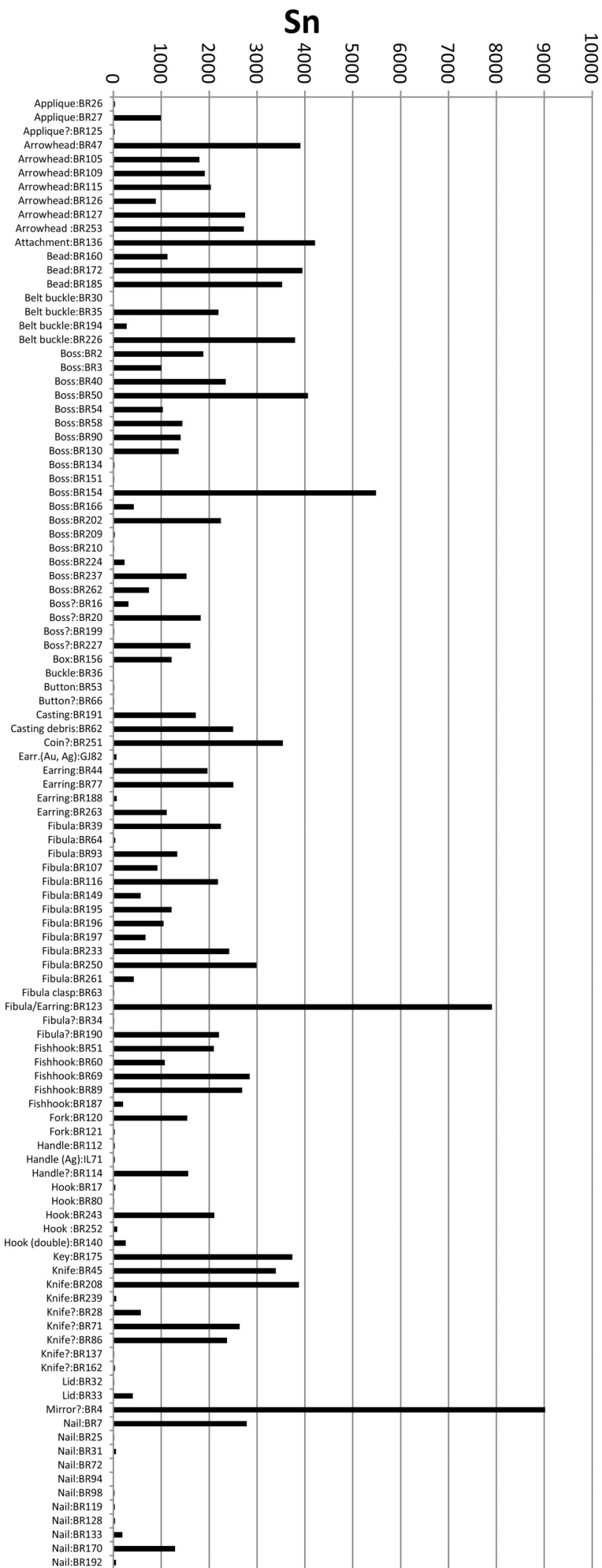
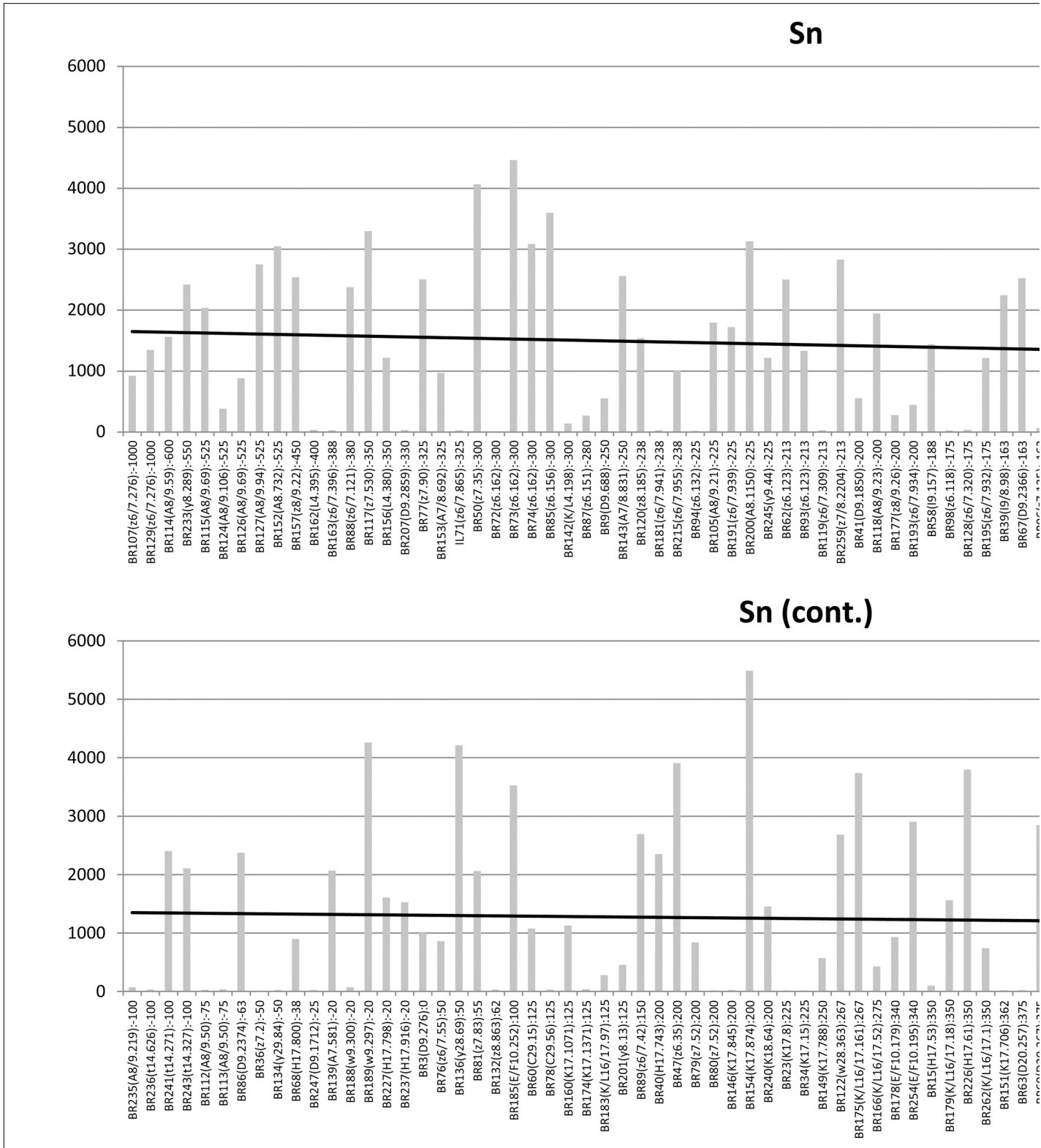


Fig. 7: Tin (Sn) in bronze artifacts from Ilion arranged by function.



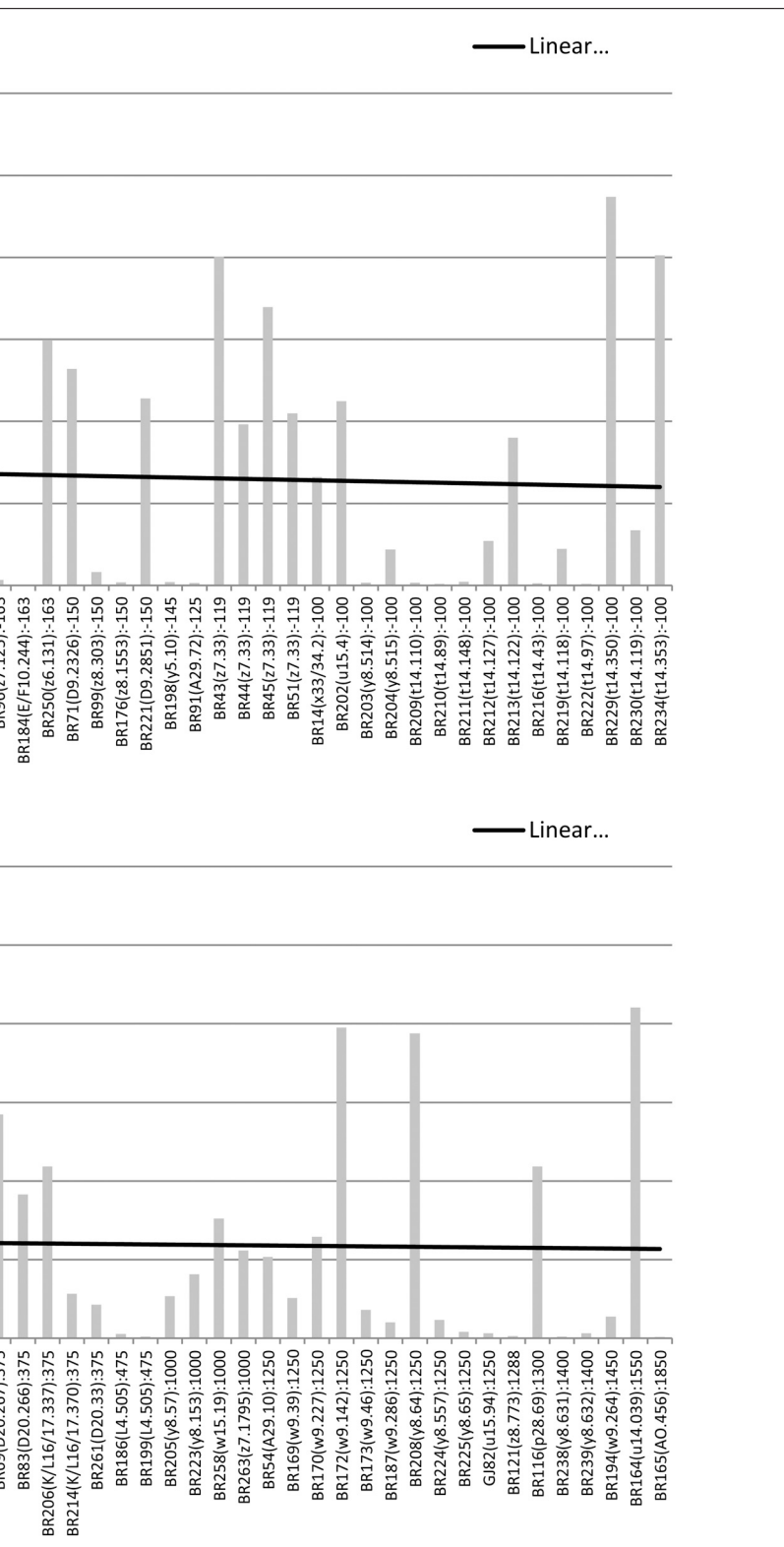


Fig. 8: Tin (Sn) in bronze artifacts from Ilion arranged by date.

low counts for every element except lead itself. In the case of lead objects employed in marble construction, such as revetment clamps (IL73, IL93, IL94), relatively higher counts for calcium (Ca) were to be expected from contact with marble. The most significant discovery concerns relatively higher counts for tin in objects dated to the fourth century AD and later: e. g., IL20, IL86, and IL94 (Fig. 12). This pattern has also been observed by A. Wyttenbach and P. A. Schubiger<sup>23</sup> and may provide some basis for relative dating of lead objects of uncertain date at Ilion with similarly high counts of tin (e. g., IL23).

### Painted Terracotta Figurines and Painted Wall and Ceiling Plaster

#### Quantification

502 tests of 136 total artifacts in the following general groups were conducted: 32 terracotta figurines or plaques (TC), 85 fragments of wall decoration (WD), and 19 uninventoried objects, which are also mostly painted wall and ceiling plaster. Distinct colors on each artifact were tested once. For each artifact, one test of the blank material to which paint had been applied was also performed as a control. Archaeological findspots are illustrated in Fig. 1.

#### Elemental Identification

Elements of interest were identified by examining all paint spectra and compiling a list of elements shown by the spectra's peaks to very probably or definitely occur in the corpus (Table 4). The elements identified in the ARTAX software and present in our tables and graphs are strictly the elements in this list.

#### Interpretation

##### Painted Terracotta Figurines

General observations about elements used to decorate terracotta figurines include the following. Tests of traces of white pigment revealed levels of calcium much lower than detected on white pigments used

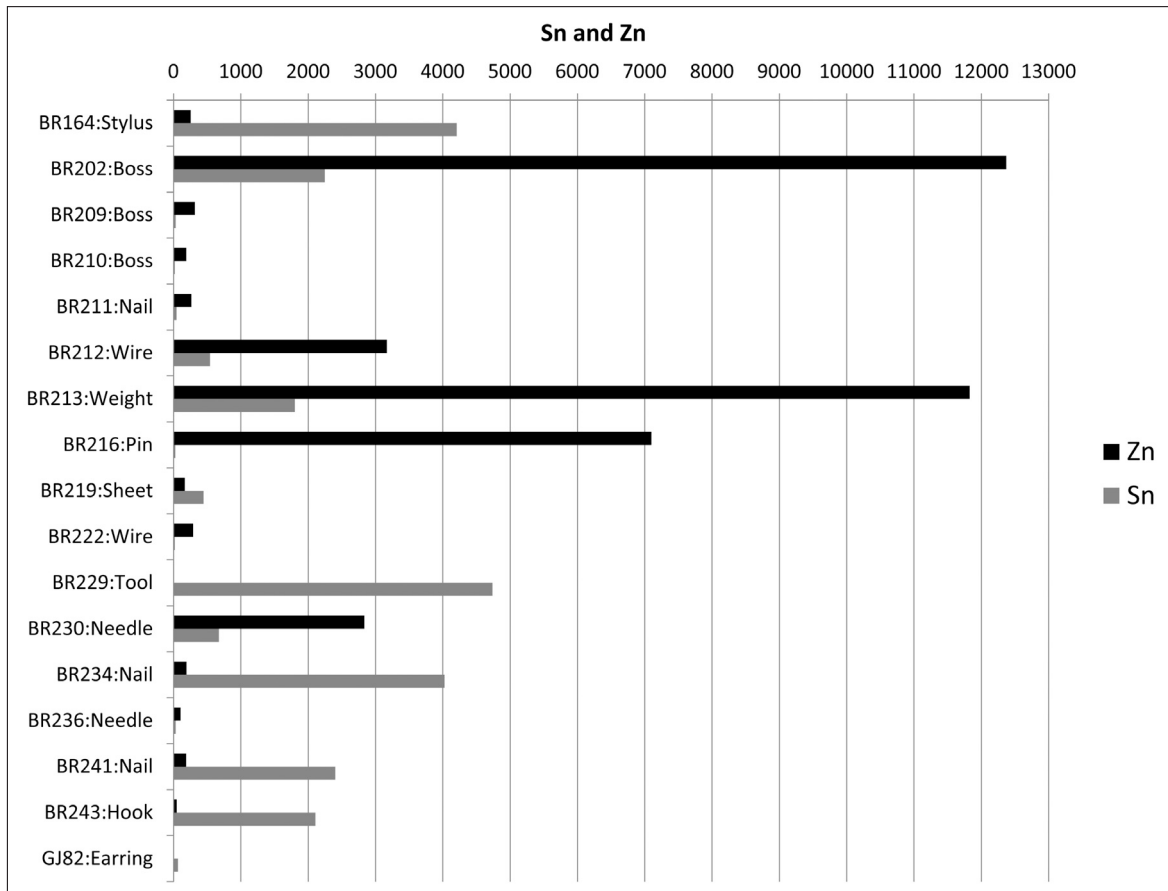


Fig. 9: Tin (Sn) and zinc (Zn) in bronze artifacts from Ilion found in front of the Spring Cave.

for painted wall and ceiling plaster. This may be a consequence of calcium-rich substrate plaster on walls and ceilings, but it may also signal a different elemental composition for whites in these media at Ilion. The presence of titanium (Ti) in the colorants and clay of several terracotta figurines is also noteworthy.<sup>24</sup> Lead is also associated with white pigment in antiquity, but our tests indicate a significant presence of lead in a number of colors in addition to white, including yellow, green, tan, red, blue, and black.<sup>25</sup> Among items with relatively high lead content, terracottas suggest the existence of two distinct groups: one from the West Sanctuary dated to ca. 150 BC (TC1013, TC1073) and another from the Lower City dated to ca. AD 50 (TC177, TC399, TC184). Terracottas with traces of paint in yellow (TC177 and TC399) and white and blue (TC184) are significant for their levels of arsenic and uniform archaeological date of AD 50.

Among the most important discoveries for terracottas at Ilion is the identification of tin in significant levels across the entire face of small votive plaques (Figs. 13–14).<sup>26</sup> Tin at these levels was not identified on horseman plaques from Ilion (TC588, TC888, TC941, TC1055), or on any terracotta figurines in our sample set (Table 4, Fig. 15). It appears as if tin was used by the makers of these plaques on its own as a surface treatment, perhaps appealing to Ilions who dedicated these votives for their silver appearance or reflective qualities. Unlike silver, costly and quick to tarnish, tin did not corrode black but rather retained its silvery color.<sup>27</sup> All twelve votive plaques with tin were found in the West Sanctuary at Ilion, and eleven of the twelve were found in a range of contexts that need not date later than 300 to 150 BC<sup>28</sup> Tin may have been applied to the terracotta plaques over a primer coat, or bole. On some plaques this appears to be present in an iron-rich yellow-ochre

residue (e. g., Fig. 13, lower right). The votive plaques bear iconography of consequence for Hellenistic religion: a thunderbolt (TC1414), a bow and quiver (TC1030, TC1084, TC1135), a winged caduceus (TC1173, TC1417), the knot of Herakles (TC1106, TC1447, TC1574), and bunches of grapes (TC1100, TC1359, TC1432). Except for the winged caduceus, all of these motifs appear on terracotta plaques discovered at Ilium by Schliemann and Dörpfeld.<sup>29</sup>

A large terracotta figurine of a seated Cybele (TC1143) with traces of surface decoration was discovered in several fragments in the Lower City (quadrat w28) in a deposit dated to the middle of the third century AD (Fig. 16).<sup>30</sup> XRF tests confirmed the presence of gold on the left breast and on the left part of the face and suggest that the entire figure may have been gilded (Fig. 17). Bole is suspected for traces of pink on several parts of this figurine, but XRF tests are inconclusive about elemental composition. Iron is present, but is also no doubt present in large amounts in the fired clay figurine, and therefore cannot be assigned to the trace of pink with great certainty. Most probably, the pink color is a mixture of a calcium carbonate white and a lead- or iron-based red. Lead is indeed present on the figure, especially so in a reading taken on a trace of color at the right eye. This presence seems to indicate that the eyes may have been decorated with added paint (Table 4).

#### Painted Wall and Ceiling Plaster

The interpretation of elements used in pigments for painted wall and ceiling plaster at Ilium is facilitated by archaeological context to a degree beyond that seen in the preceding interpretation of metalwork and painted terracotta figurines. Samples discussed below belong to the decoration of rooms in houses from different parts of the city with good archaeological dates. Moreover, unlike artifacts described above that could have easily moved from place to place at Ilium, most of the wall and ceiling plaster described below was painted on-the-spot for the structure it adorned, and it collapsed and was buried in the very same place.

Most painted plaster discovered at Ilium belonged to Roman houses in the Lower City, a broad



Fig. 10: IL3: Late Roman clay crucible from the Lower City. TRD17951a.

plateau approximately 72 hectares in size to the south, east, and west of the acropolis and protected by a masonry city wall about 3,600 meters long.<sup>31</sup> Painted plaster in the following discussion was found in houses that can be grouped in two general areas: near the center of the Lower City in quadrats D20, H17, I17, I18, K17, and M18; and along the southern edge of the Lower City, about 400 meters to the south of the acropolis in quadrats C29, g27, and x24. Parts of a house on the periphery of the Agora were also found in quadrat K13. The earliest known houses in this region are Hellenistic, but most houses from which painted plaster was recovered belong to Roman Imperial times, mainly from the late first through fifth centuries AD.

Painted wall and ceiling plaster has also been found in public buildings, most notably the so-called Mosaic Building in the West Sanctuary (quadrat z8), dated to 250–225 BC. Excavators discovered evidence for imitation drafted-margin masonry collapsed from the walls. The painted decoration indicates imitation marble revetment rendered in red, yellow, purple, light blue, dark blue, blue with yellow or red veins, and red and dark blue with yellow veins.<sup>32</sup> Painted plaster was also discovered in contexts loosely connected with other buildings in the West Sanctuary in quadrats A8, A8/9, z6, and y9. A dump in front of the Spring Cave in quadrat t14, dated the second half of the second century BC, seems to include detritus from an unknown sacred precinct, perhaps in the nearby West Sanctuary.<sup>33</sup> Other public buildings with fragmentary evidence

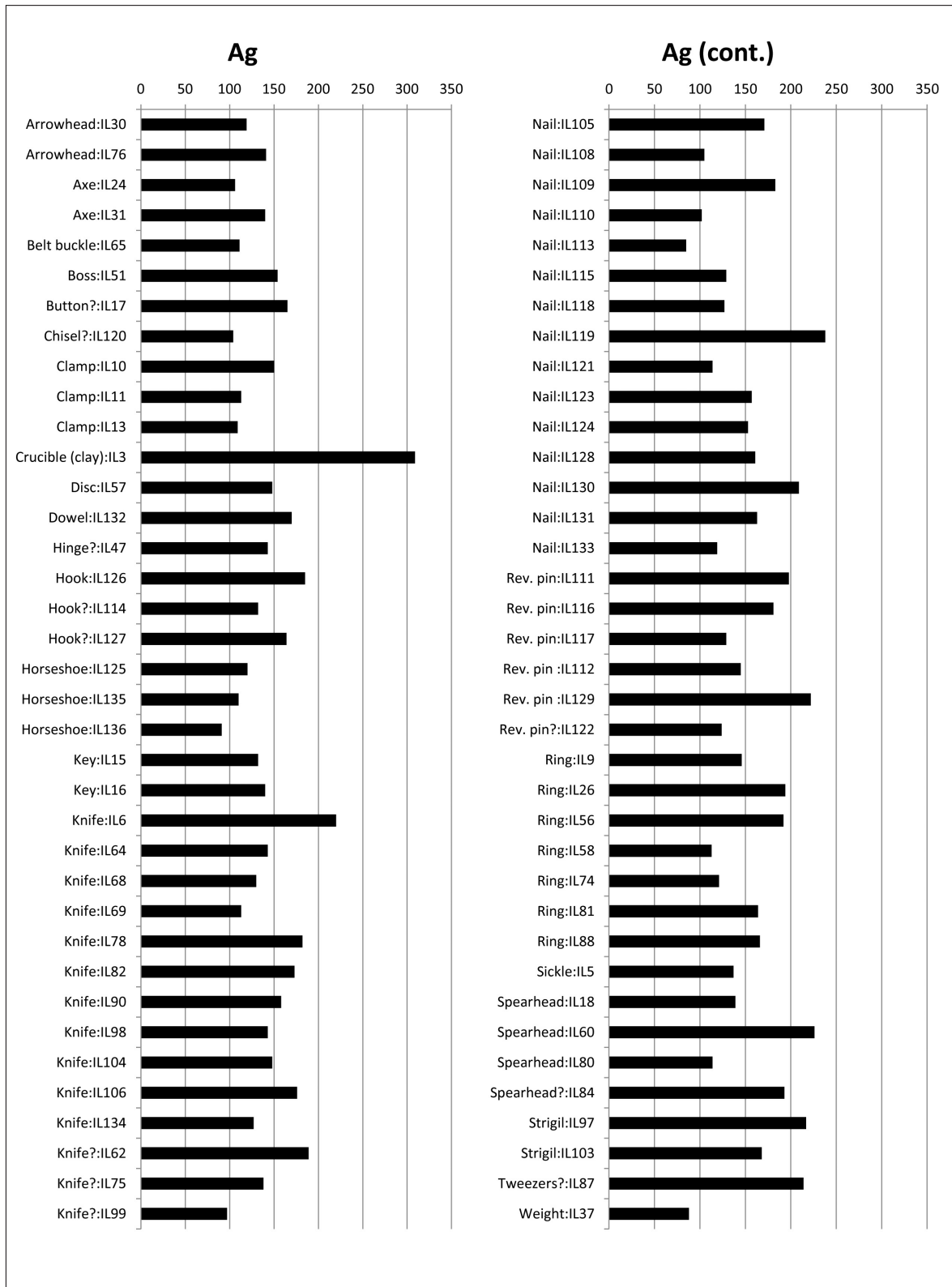


Fig. 11: Silver (Ag) in iron artifacts from Ilion arranged by function.



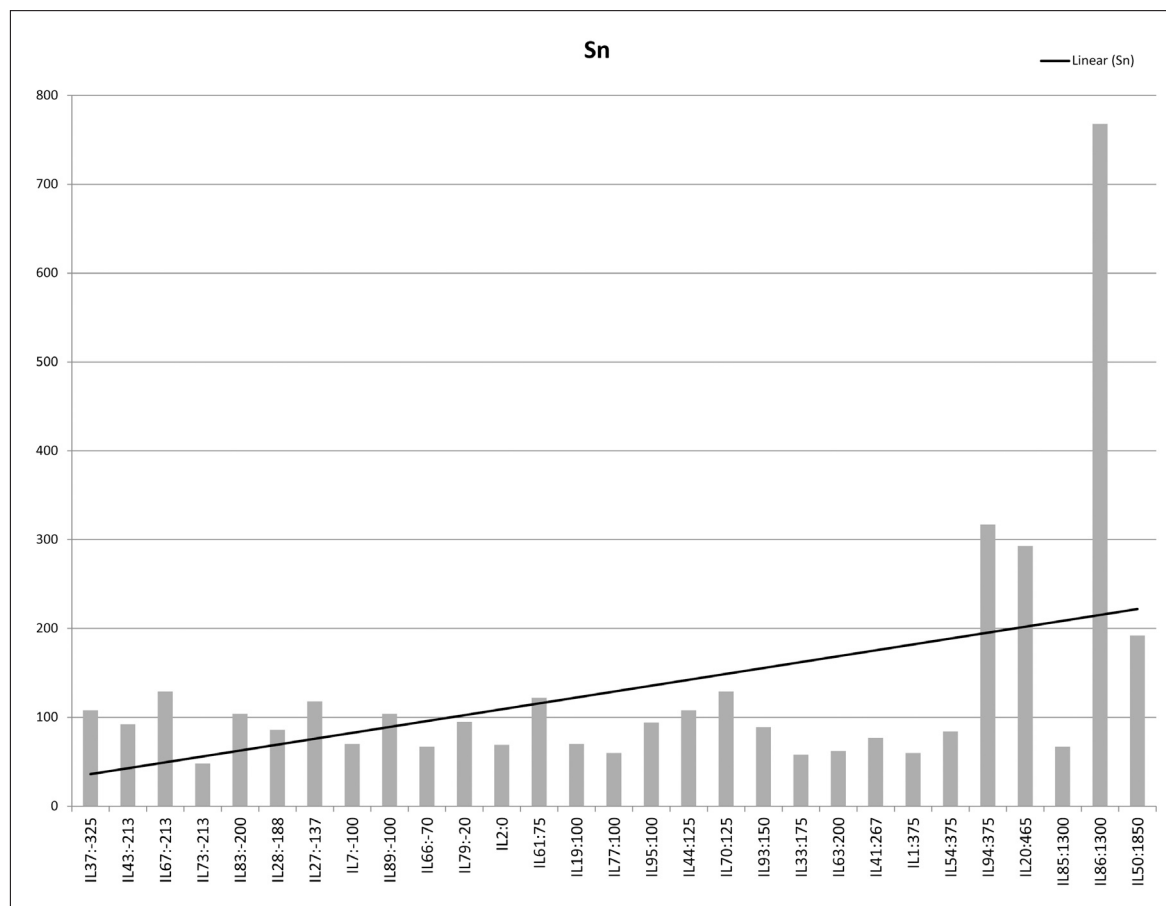


Fig. 12: Tin (Sn) in lead artifacts from Ilion arranged by date.

for painted plaster decoration include the Odeion (quadrats E/F10) and the Bath/Gymnasium (quadrats D/E11/12) in the Agora, both of Roman Imperial date.<sup>34</sup> A few fragments of painted plaster have also been found in contexts associated with the sanctuary of Athena on the acropolis (quadrats A5, D2, D9, D10, E9), but not in direct association with specific buildings.

In general, the principal mineral colorants used for painted wall and ceiling plaster at Ilion are consistent with ingredients known from Pompeii and Rome in the second half of the first century AD.<sup>35</sup> Blues are copper-based, yellows test positive for lead, iron, and sometimes arsenic, calcium is the chief ingredient for whites, and reds were most frequently made with iron.<sup>36</sup> Some green paints show a mixture of elements also found in yellows and blues, including copper and, on two occasions, arsenic (WD34

and WD66). As the following discussion shows, at least in the case of red in public buildings at Ilion, Roman-period colorants did not always follow Hellenistic precedents. Key observations for painted wall and ceiling plaster at Ilion are focused on four elements: arsenic, copper, mercury and iron.<sup>37</sup>

In the preceding section, significant levels of arsenic were noted in traces of paint on terracotta figurines dated to AD 50 (yellow on TC177 and TC399, and blue and white on TC184). Arsenic appears in similar levels on fragments of painted plaster dated between AD 50–150: yellow on WD34, white on WD184, and whitish-green on WD34, all dated to ca. AD 50, as well as red and green on WD66, both dated to ca. AD 150. It appears that arsenic was a common ingredient for pigments at Ilion between AD 50–150, and that it was used across media, for both terracottas and interior decoration (Fig. 18).

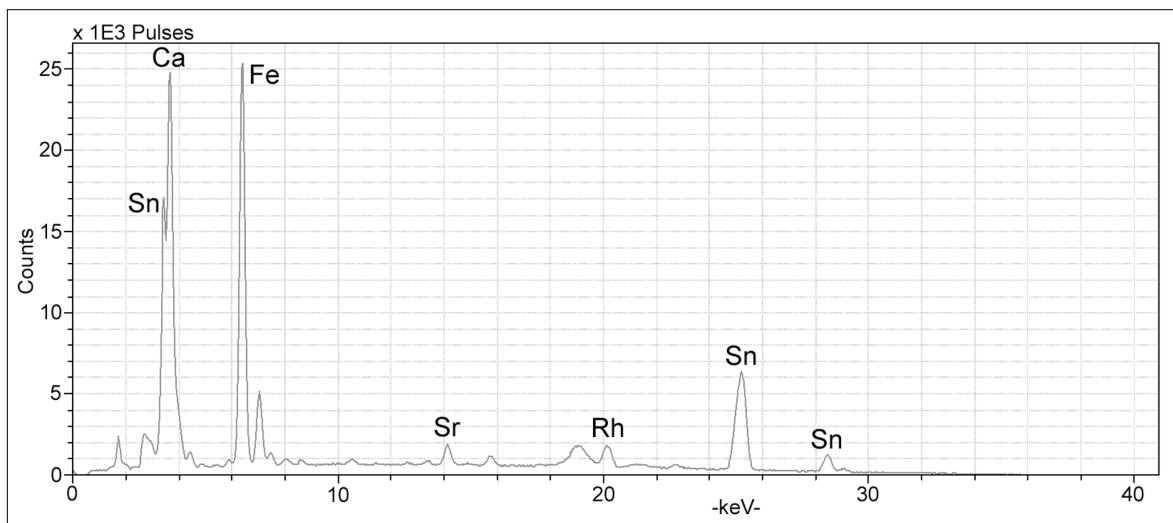


Fig. 13. Votive plaques from Ilion with significant amounts of tin (Sn) identified on vestiges of surface decoration. TRD48705b.

Copper appears in relatively high levels in blue and green paint (Fig. 19). Most artifacts with high copper counts for traces of blue or green paint belong to contexts in the Lower City: D20, M18, I17, K17, and g27.<sup>38</sup> At the very least it seems reasonable to con-

clude that blues and greens mixed with a copper-based pigment are well attested for domestic contexts at Ilion in Roman Imperial times (Fig. 20). According to Vitruvius 7.11.1, blue is a color mixed from copper, sand, and natron flowers. Judging by

Fig. 14: Spectrum for TC1135.





# Elemental Identification of Artifacts and Pigments from Ancient Ilion

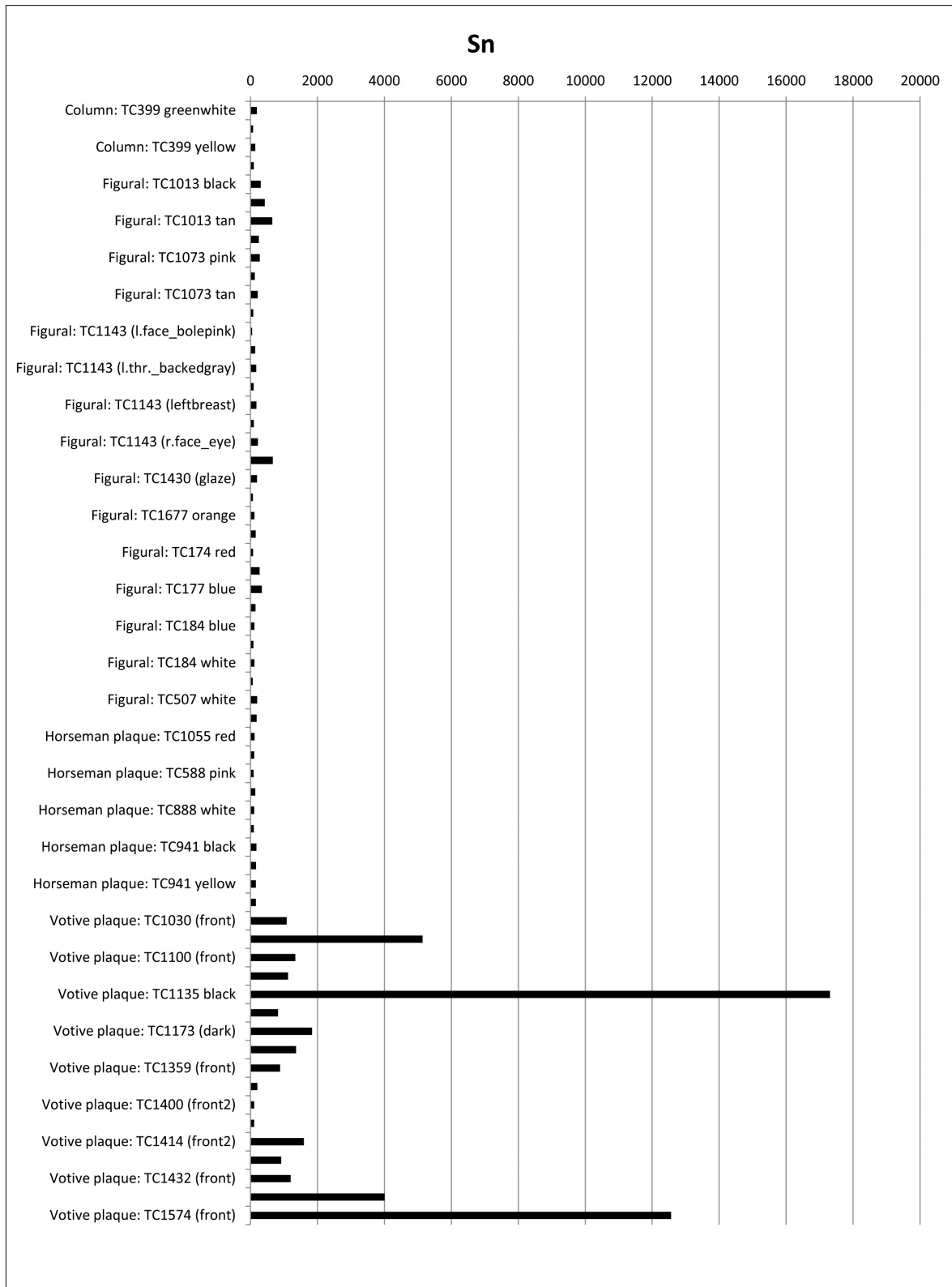


Fig. 15: Tin (Sn) on the surface of terracottas from Ilion arranged by function.

the copper content in blue paint from Ilion, the recipe used there was not inconsistent with Vitruvius, although other recipes certainly were in use in Roman times. It is also important to note that Vitruvius 7.14.2 describes other recipes for blue-like colors, such as indigo and purple, which use only organic ingredients. Needless to say, these mixtures elude the technology of the XRF instrument.

Mercury is present to a marked degree in specimens of red paint found in painted plaster from Hellenistic contexts in the West Sanctuary (ca. 225–133 BC), especially in uninventoried specimens from quadrats A8/9, γ9, and z8/9 (Figs. 21–22).<sup>39</sup> Red painted wall plaster with noteworthy mercury has also been found at the Spring Cave in debris that appears to represent clean-up from an unknown sacred precinct at Ilion (WD102). In other words, mercury-laden red (cinnabar) only appears at Ilion in public buildings near the acropolis. Red painted

plaster from houses in the Lower City reveals a much different signature, with iron apparently providing the red ingredient (Fig. 23).<sup>40</sup> It is probably not a coincidence that the Lower City contexts for red with iron are all Roman, whereas mercury appears in red near the acropolis, especially in the West Sanctuary, in exclusively Hellenistic contexts. Estimates for the cost of red paint made with mercury (*cinnabaris*) at Pompeii in the Roman Imperial period relate that it was nearly three times the cost of other colorants for red.<sup>41</sup> Also worthy of note is the story of the house of Faberius on the Aventine Hill at Rome, where, according to Vitruvius 7.9.2, walls painted in red with a mercury base became mottled after exposure to the sun and required repainting. At Ilion, it seems that iron was the preferred ingredient for red by Roman times.

Special mention is due to a small fragment of painted plaster from a Late Bronze Age context just outside the west wall of the citadel (z/A7.2318). This specimen has a higher copper peak than any other artifact with blue pigment tested from the corpus of Greek and Roman finds from Ilion. Our spectrum for the Late Bronze Age specimen shows a very convincing match for so-called »Egyptian blue« pigment of the very same type recently identified on a wall painting of an archer from the Palace of Nestor at Pylos (Fig. 24).<sup>42</sup> Comparison of the data from Troia and Pylos shows Si, Ca, Fe, Cu, and Sr present in similar relative amounts. Also noteworthy are the similar proportions of Si, Ca, and Cu, all of which are consistent with the chemical formula for Egyptian blue:  $\text{CaCuSi}_4\text{O}_{10}$ , cuprorivaite.<sup>43</sup> Since this very same blue pigment is securely identified for the palette of Mycenaean painters at Pylos, Thera, Thebes, and Crete, the specimen from Troia can be added to the list of artifacts from Troia which demonstrate contact with Mycenaean civilization.<sup>44</sup>

Twenty-two wall plaster samples from Ilion were evaluated using XRF, Fourier transform infrared (FTIR) microspectrometry, and polarizing light microscopy (PLM) in 2002.<sup>45</sup> Twelve of these samples were also tested in our study. In all 12 cases, our results match results of these earlier XRF tests, adding a measure of confidence to both studies. Of special note are two samples of blue wall plaster (WD94 and WD102) with large copper peaks identified as »Egyptian blue« by FTIR microspectrometry. It is

Fig. 16: TC1143: Seated terracotta Cybele from the well in quadrat w28. TRD16677a.



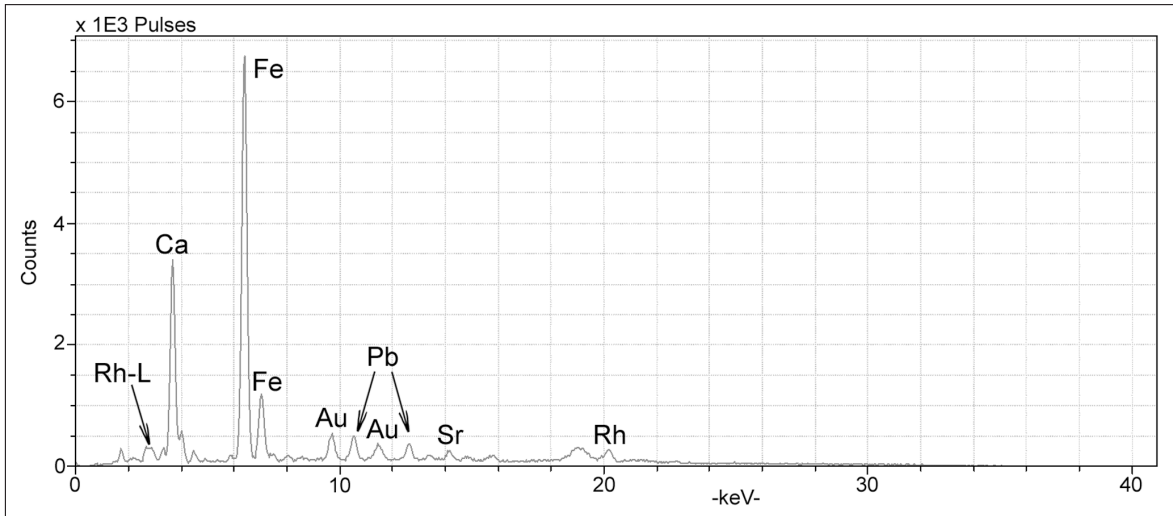


Fig. 17: Spectrum for TC1143.

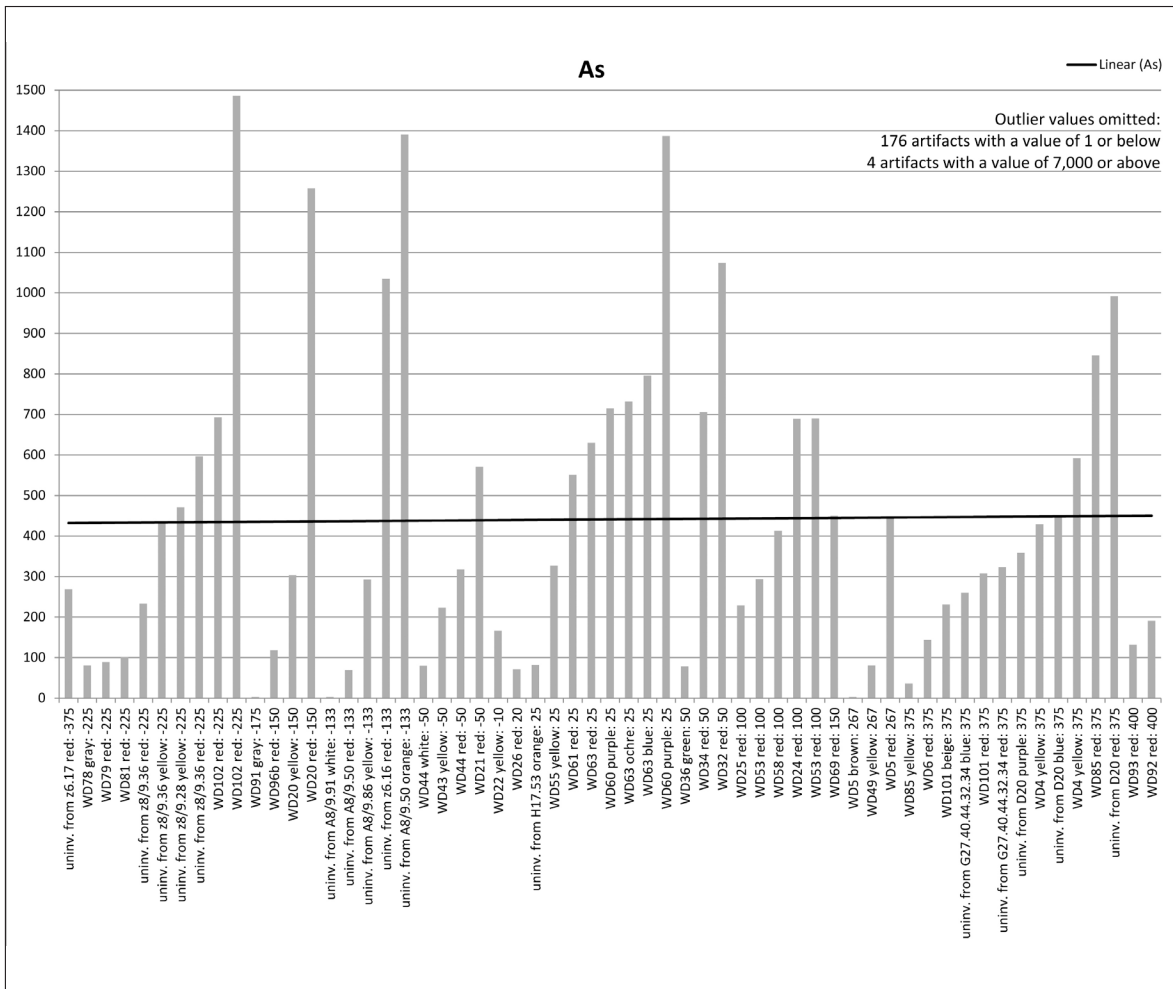


Fig. 18: Arsenic (As) in painted plaster from Ilion arranged by date.

# Cu

Outlier values omitted:  
20 artifacts with a value of 1,000 or above

# Cu (cont.)

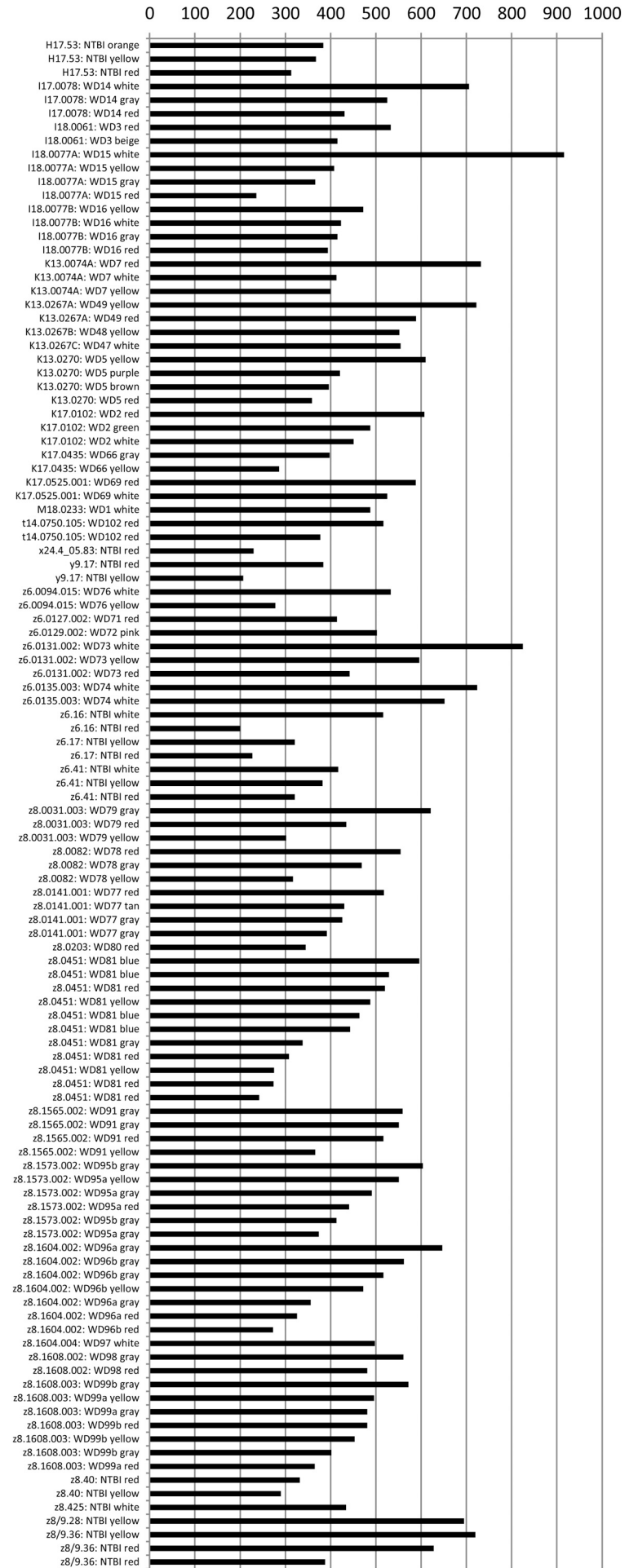
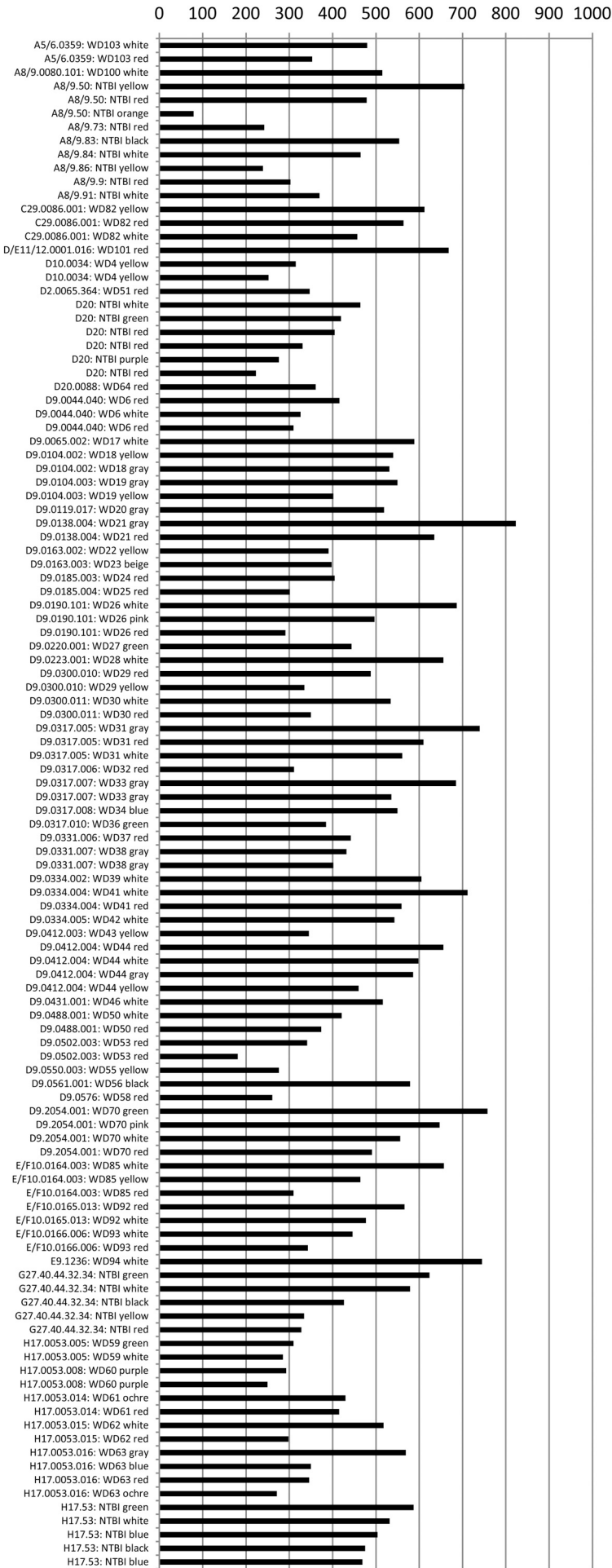




Fig. 20: Painted ceiling plaster from the Lower City house in quadrat D20, fourth century AD, with copper present in blue and green.

now possible to suggest that other blues with a strong copper peak, such as those found on TC177 or on ceiling painting from quadrat D20, are also »Egyptian blue« (Table 4). Blue on a painted sarcophagus from Çan, dated to the fourth century BC and now in the Çanakkale Archaeological Museum, tested positive for »Egyptian blue« in a separate study.<sup>46</sup> Also worthy of mention is a mercury-rich red pigment (WD102) identified as »vermilion« by PLM, thereby confirming our assumption that the presence of mercury indicates cinnabar pigment. Finally, as anticipated by frequent iron peaks in our data, iron-based pigments are commonly identified by FTIR microspectrometry and PLM: several reds are hematite, and a green is celadonite (the pigment »green earth«). We may now associate the majority of reds in our study with hematite, since iron is consistently present in readings but mercury and lead are relatively rare. Likewise, it is possible that many greens from Ilion included celadonite, since only two out of ten green samples (WD34 and WD66) show elemental evidence of production from the mixing of blue and yellow.<sup>47</sup> However, combining an iron-based yellow with an organic blue is another possible recipe for making green. This combination would generate a spectrum much like that of celadonite, and, accordingly, it is not possible to associate celadonite with all iron-rich greens.

Fig. 19: Copper (Cu) in painted plaster from Ilion arranged by quadrat.

### Artifacts from the Çanakkale Archaeological Museum

In August 2009, the Çanakkale Archaeological Museum kindly permitted XRF testing of several artifacts from the Troad in their collection. Some key results follow (Tables 5–6).

Several marble artifacts were tested for traces of paint, but all results were negative.<sup>48</sup> Iron was identified in varying relative amounts in the spectra for all marble objects tested, but, since iron is expected in marble, it was impossible to confirm the presence of iron-based paint. More important is the absence of detection by XRF of any other elements which might constitute pigments. Of special interest is the slightly over-life size statue of Hadrian from Ilion (Fig. 25). The statue adorned the stage building of the Odeion between the time of its dedication ca. AD 124, probably in conjunction with the emperor's visit to Ilion, and the collapse of the stage building in the second half of the fifth century AD.<sup>49</sup> Most of the statue was recovered from the original architectural collapse, found mostly undisturbed, in 1993. In three tests of different surfaces of the statue, no traces of paint were detected. It is possible that the statue was in fact unpainted, especially since the archaeological evidence for the Odeion reveals a history of refurbishment and repair in the third and fourth centuries, which suggests that the building and its decoration may have never been complete. Nonetheless, there are several other possible explanations for the absence of paint. First, the statue adorned the stage building for over three hundred years and may have simply lost its paint over such a long period of exposure. Second, cleaning of the statue after discovery may have inadvertently removed traces of paint.<sup>50</sup> Finally, we were unable to examine the Hadrian statue under a microscope before selecting points for testing, and thus may not have tested areas most likely to preserve traces of paint.

Other artifacts tested with XRF were discovered at other sites in the Troad. From Gümüşçay, about 100 km northeast of Ilion in the Granicus River Valley, several parts of a two-wheeled funeral cart were found within the Kizöldün tumulus next to the Polyxena sarcophagus, which is also in the Çanakkale Archaeology Museum.<sup>51</sup> The cart belongs to the same late sixth-century BC context as the marble

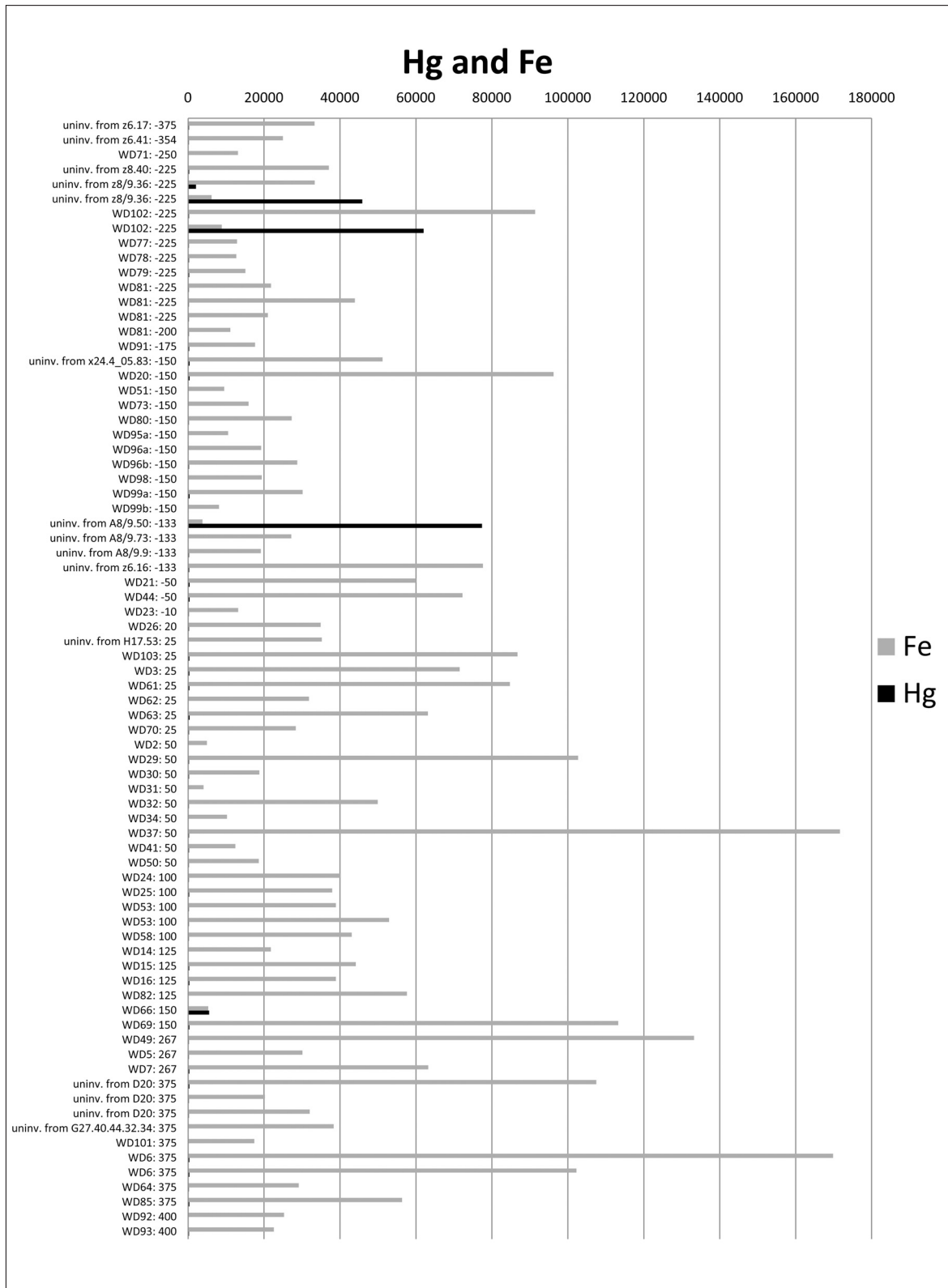


Fig. 21: Mercury (Hg) and iron (Fe) in red painted plaster from Ilion arranged by date.



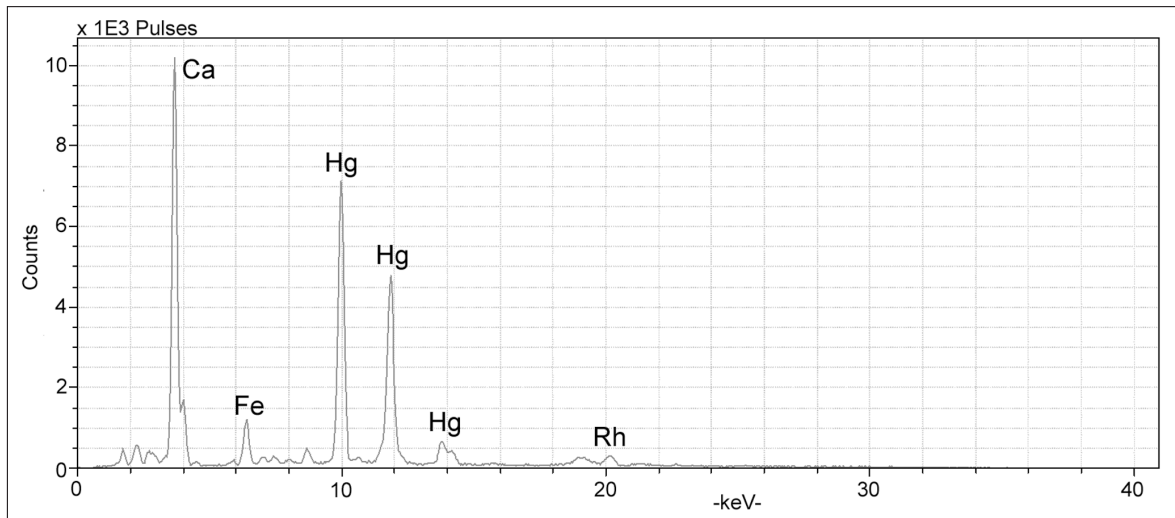


Fig. 22: Spectrum for z8/9.36.



Fig. 23: Mercury-based red painted wall plaster from quadrat A8/9 in the West Sanctuary (*left*) and iron-based red painted wall plaster from quadrat g27 in the Lower City (*right*).

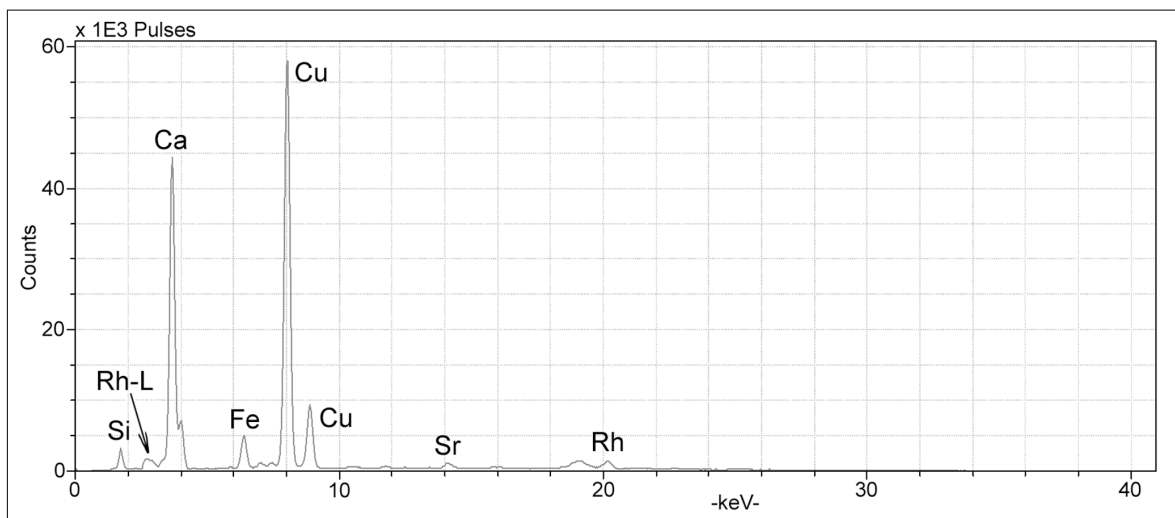


Fig. 24: Spectrum for z/A7.2318.



Fig. 25: Statue of Hadrian in the Çanakkale Archaeological Museum, showing William Marx and Donna Strahan conducting the XRF tests.

sarcophagus, which depicts on its principal face the sacrifice of the Trojan princess Polyxena, and was probably used as a hearse to convey the body to the tomb. Most of the wooden cart did not survive, but the excavators recovered several of its metal decorative attachments.<sup>52</sup> XRF shows that the metal attachments are copper-alloy. Finials, cleats, two rings with nails, and caps all contain relatively high levels of lead. Three small rings without nails and one ring with a nail were of tin-bronze without lead. Tests suggested that the cart's decorative finials had been tinned, probably for decorative effect. However, examination of the finials under a microscope revealed that the high tin readings are a product of a dense tin oxide corrosion layer which formed preferen-

tially over the original alloy. As this case makes clear, XRF results must be evaluated with respect to observable object properties before any conclusions are possible.

From an early Roman cemetery discovered about 100 km northeast of Iliion at Parion in 2004, excavators from the Çanakkale Archaeological Museum recovered a number of artifacts from undisturbed graves, mostly constructed from terracotta tiles.<sup>53</sup> Among the finds was a medicine box with medical instruments and pills still inside. The box and the tools inside were made from copper alloy. A spoon and a scoop contain significant levels of zinc. A hook shows three distinct elemental profiles: highly pure copper on the lower part of the shaft, tinning on the upper part of the shaft, and silver inlay in the bezel. The latter two elements were visually identified by Strahan and subsequently confirmed by XRF.<sup>54</sup> Four types of pills survived in the box. Elements with a strong presence in all of them include iron, copper, zinc, and lead. Lead is the dominant element in at least two of the pills, and one, light-brown in color, tested positive for arsenic.

## Summary

The research described above contributes a new layer of data to the study of artifacts from Iliion. Most objects subjected to XRF testing have good archaeological contexts. Thus the identification of elements in recipes for metalwork, and in pigments used for painted wall and ceiling plaster and for the decoration of terracotta figurines and votive plaques can now be tied to a corpus of artifacts with good archaeological contexts. Questions about the local production of metalwork are brought into sharper focus by the connection of specific artifacts to places of production, and by the grouping of artifacts in time or space on the basis of elemental composition. XRF testing has also confirmed for the first time the use of tin for the decoration of terracotta votive plaques at Iliion.



## Notes

- \* For permission to conduct research at Troia, the authors thank Prof. Dr. Ernst Pernicka, Prof. Dr. Ch. Brian Rose, and the General Directorate of Museums and Monuments in Ankara, Turkey. For permission to test artifacts in the Çanakkale Archaeological Museum the authors thank Nurten Sevinç, Director of the Museum. For technical support and advice with the Bruker Tracer IV X-ray fluorescence instrument, we thank Dr. Bruce Kaiser. For assistance at Troia, the authors thank Sarah Rous, Daniel Albright, Diane Thumm-Doğrayan, and Dr. Gebhard Bieg. All photographs are by G. Bieg, except for Figs. 20, 23 by William Aylward, Fig. 16 by Rick Bullard, and Fig. 25 by Ch. B. Rose. William Marx prepared the data tables and graphs.
- 1 Modern observers recognize iron, magnetite, silver-lead, lead-zinc-silver, and a galena-sphalerite ore rich in silver and gold: Ryan 1960, 2–6, 29, 81. For minerals in the Troad, see Pernicka et al. 1984; Pernicka et al. 2003. For the absence of local tin, see Muhly 1993, 251.
  - 2 See discussion in Sciuti et al. 2001, 135–136.
  - 3 See discussion in Ferretti et al. 1997, 241.
  - 4 Maximum kV: 40.
  - 5 In many cases, the laboratory record book maintained by conservators was useful for distinguishing treated from untreated surfaces.
  - 6 The authors were trained on the Bruker Tracer IV XRF instrument by Dr. Bruce Kaiser, who kindly visited the University of Wisconsin-Madison on June 30, 2009, and who generously responded to follow-up questions from the field. William Marx performed all tests at the archaeological site and produced the tables and graphs that appear in this article.
  - 7 For metals, the X-ray beam was generated with tube settings at 40kV and 1.60µA. For painted surfaces, the X-ray beam was generated with tube settings at 40kV and 4.00µA.
  - 8 The gold- and silver-alloys were inventoried as GJ82 (earring) and IL71 (small handle). IL71 is mostly silver, with traces of gold. GJ82 is mostly gold, with a fairly high amount of silver. Both are very low in copper, tin, and lead.
  - 9 Corrosion products do not accurately represent the alloy composition of a metal. Depending on the burial environment, different elements will corrode at different rates. Therefore, XRF readings can only be taken as a general indication of the composition of the alloy. Of all the elements in a copper-alloy, lead is particularly inaccurate.
  - 10 For antimony in late repairs to the Capitoline Horse at Rome, perhaps originally fifth century BC, see Ferretti et al. 1997, 243. Cf. Craddock 1976, 104–105.
  - 11 Cf. Vittori 1979, 35–39. Oddy 1991, 31 suggests that mercury for gilding belongs to the third century AD and later. Cf. Kakoulli 2009, 60.
  - 12 Leaf 1914–16, 19–28. Strabo's reference to *oreichalkos* derives from Theopompos, the fourth-century BC historian: see discussion in Eaton – McKerrrell 1976, 187–188. For arsenic in deposits of arsenopyrite in the Troad, see Ryan 1960, 66. For high arsenic concentrations in ground water at Troy, see Wolkersdorfer – Göbel 2004, 161.
  - 13 Eaton – McKerrrell 1976, 184–188, and 169–175 for the relative absence of arsenical copper in the Troad in the Early and Middle Bronze Age, when tin bronze was the norm. For a different interpretation of *oreichalkos*, see Craddock 1978, 6–8.
  - 14 The bronze-casting pits are described by Rose 1998, 79–85. For contemporary casting pits in Athens, see Craddock 1977, 112–113. For analysis of casting debris from the production of leaded tin bronze between the seventh to fifth centuries BC at Khirbet edh-Dharih in Jordan, see Klein – Hauptmann 1999, 1075–1082.
  - 15 Among these, BR181 and BR191 have the lowest counts for lead, but they also have relatively low copper counts as a consequence of corrosion or clay accretion, which is visually confirmed for both artifacts. Manual comparisons of the spectra for BR181 and BR191 with the spectra of the wasters and debris discovered at the foundry site in quadrat z6/7 confirm that these two objects fit the elemental profile of the foundry group.
  - 16 Function uncertain; object could also be a lid or stopper.
  - 17 Rose 1998, 82.
  - 18 Dungworth 1997, 902; Craddock 1977, 104–107. Pliny the Elder 34.20 discusses lead in the production of copper alloys suited for vessels and utensils.
  - 19 Aylward 2005, 171 note 142.
  - 20 This deposit is discussed in a forthcoming volume on the Lower City of Ilion by Rose et al., *forthcoming*.

- <sup>21</sup> For zinc and the definition of Roman brass, see Dungworth 1997, 902–907; Craddock 1978, 9–14.
- <sup>22</sup> ARS: P31. Coin of Aurelian: C83. For clay crucibles from an early-Imperial Roman brass-working operation at Xanten, see Rehren 1999, 1083–1087. For ancient crucibles in general, see Bayley – Rehren 2007, 46–55.
- <sup>23</sup> Wyttenbach – Schubiger 1973, 199–207..
- <sup>24</sup> For terracotta figurines and painted plaster, titanium was identified in tests of the following colors and/or base material: white (TC184 and WD73), red (TC399, WD53, WD69, and uninventoried wall plaster from z6.16), black (TC941), and throughout a large terracotta figurine of Cybele (TC1143).
- <sup>25</sup> For lead white, see Kakoulli 2009, 44.
- <sup>26</sup> The authors are grateful to Sarah Rous for recommending these plaques for testing.
- <sup>27</sup> Cf. Gillis et al. 1995, 251–260.
- <sup>28</sup> The exception is TC1447, from a context dated ca. AD 125, but it could very well be residual. TC1577 in the Çanakkale Archaeological Museum (Inv. No. 9215) belongs to this group, but, like TC1447, its context (y8.519) is later in date, ca. AD 50–150. Judging by its coloration, TC1577 was apparently also decorated with tin, although it was unavailable for XRF testing.
- <sup>29</sup> Schliemann 1880, 618 nos. 1459–1464 suggests that they were used to decorate boxes or furniture. Winnefeld 1902, 444 and Beilage 58.3.
- <sup>30</sup> Tekkök et al. 2001, pl. 29; Rose 1995, 99–100. Original height ca. 41 cm.
- <sup>31</sup> For the Hellenistic and Roman city wall, see Aylward – Wallrodt 2003. Less than 2 % of the Lower City has been investigated by excavation, but remote sensing has revealed a Hellenistic and Roman city plan.
- <sup>32</sup> The Mosaic Building is described in Rose 1998, 85–86.
- <sup>33</sup> Spring Cave: Rose et al., *forthcoming*; Rose 2000, 61–65; Rose 1999, 55–61.
- <sup>34</sup> Odeion: Rose 1999, 46–49; Rose 1998, 92–96; Rose 1997, 101–102; Rose 1994, 88–93. Bath/Gymnasium: Rose 2000, 58–59.
- <sup>35</sup> See Sciuti et al. 2001, 135–137.
- <sup>36</sup> For calcium-carbonate white, see Kakoulli 2009, 54–55.
- <sup>37</sup> A few fragments of yellow had relatively high readings for potassium, all dated to ca. AD 125–267 (WD82, WD5, WD48).
- <sup>38</sup> Other quadrats with artifacts with noteworthy copper in blue and green paint are D9, E9 and t14.
- <sup>39</sup> For cinnabar as a pigment for red, see Kakoulli 2009, 49–51.
- <sup>40</sup> The single exception to this pattern is a fragment of red with somewhat elevated mercury (WD66) from a Lower City context dated to AD 150.
- <sup>41</sup> Sciuti et al. 2001, 137 Table 3. Vitruvius 7.8.1 mentions Ephesos as an early supplier of mercury. Mercury smelting has been identified at Roman-period sites in Turkey and Bulgaria: see sources in Craddock 1977, 109; cf. Ryan 1960, 69–72.
- <sup>42</sup> Brecoulaki et al. 2008, 378–383 (nearly identical in color to fig. 15, position 229); Kakoulli 2009, 38–44, 61–66; Uda 2005, 19–21. The Troia spectrum was produced with the X-ray tube set to 40kV. The authors are grateful to E. Pernicka for recommending the blue pigment from Troia for testing.
- <sup>43</sup> Variation in Fe and Sr are perhaps due to differences in the composition of the substrate plaster or instrument settings.
- <sup>44</sup> Brecoulaki et al. 2008, 380 note 52. Thebes: Brysbaert 2008, 2761–2769. For cuprorivaite in Egypt and Mesopotamia, see Hatton et al. 2008, 1591–1604; Jaksch et al. 1983, 525–535. Troia: Jablonka – Rose 2004, 617, 619, 624–625.
- <sup>45</sup> Rose et al., *forthcoming*.
- <sup>46</sup> Sevinç et al., 2001, 404–405.
- <sup>47</sup> In both samples, copper from blue and arsenic from yellow is present.
- <sup>48</sup> Statue of Hadrian from the Odeion (SS39); statue of draped male from quadrat L5 (Jablonka 2006, 14–15 fig. 16); Hellenistic gravestone (Inv. 235); small marble torso (Inv. 10219).
- <sup>49</sup> Rose 1994, 88–93.
- <sup>50</sup> Discovery and conservation predate D. Strahan's participation at Troia and notes on the treatment of the Hadrian statue were unavailable to the authors.
- <sup>51</sup> Sevinç 1996, 251–264.
- <sup>52</sup> Sevinç 1996, 252, 254 fig. 5.
- <sup>53</sup> The finds are in preparation for publication by the Çanakkale Archaeological Museum.
- <sup>54</sup> For other Roman medical kits, see Jackson 1997, 1471–1473; Jackson – La Niece 1986, 119–167. High levels of zinc were also found in a medical scoop from Roman Britain: Jakielski – Notis 2000, 379–389.

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Inventory	Behalter	Function	Date	Number	Al	Fe	Co
of Samples							
BR1	K12.0065	Uncertain	?	4	5	125	30
BR2	D09.0218	Boss	?	4	25	55	1
BR3	D09.0276	Boss	0	2	0	323	4
BR4	D02.0110	Mirror?	?	2	27	242	13
BR5	D02.0110	Strip	?	3	7	731	41
BR7	D05.0291	Nail	?	1	2	331	9
BR8	D02.0178	Spearhead	?	4	24	871	69
BR9	D09.0688	Pin?	-250	1	25	244	18
BR14	x33/34.0002	Ring?	-100	5	30	379	17
BR15	H17.0053	Spatula	350	4	16	476	12
BR16	K13.0148	Boss?	?	4	24	210	-3
BR17	K13.0045	Hook	?	3	5	847	11
BR18	K13.0093	Spoon?	?	3	27	327	0
BR19	F28.0025	Pin	?	2	16	694	0
BR20	K13.0034	Boss?	?	3	2	5135	48
BR21	F28.0076	Spatula?	?	2	14	623	34
BR22	I17.0064	Spatula	?	4	8	200	3
BR23	K17.0008	Strip	225	3	31	353	11
BR24	I17.0127	Spatula	?	3	24	885	30
BR25	I17.0085	Nail	?	3	19	1404	20
BR26	I17.010b	Applique	?	3	17	215	9
BR27	I17.010b	Applique	?	3	13	274	0
BR28	I17.0307	Knife?	?	3	5	959	32
BR29	I17.0104	Ring (loop)	?	3	20	558	35
BR30	I18.0005	Belt buckle	?	3	24	313	1
BR31	I18.0014	Nail	?	2	4	1065	1
BR32	K18.0006	Lid	?	3	16	8147	105
BR33	K18.0006	Lid	?	3	2	797	19
BR34	K17.0015	Fibula?	225	3	6	113	7
BR35	F28.0009	Belt buckle	?	3	8	1634	32
BR36	z07.0002	Buckle	-50	3	13	509	2
BR37	H17.0714	Ring	?	3	2	73	3
BR39	I09/08.0098	Fibula	-163	3	17	241	19
BR40	H17.0743	Boss	200	1	16	65	2
BR41	D09.1850	Spearhead?	-200	3	3	326	14
BR43	z07.0033	Ring	-119	4	17	491	3
		(with incised decoration)					
BR44	z07.0033	Earring	-119	3	18	375	21
BR45	z07.0033	Knife	-119	2	6	179	10
BR47	z06.0035	Arrowhead	200	3	31	63	23
BR49	H10.0076	Weight?	?	3	32	1178	26
BR50	z07.0035	Boss	-300	2	14	1014	78
BR51	z07.0033	Fishhook	-119	3	18	112	17
BR52	D09.2006	Pin	?	2	17	764	60
BR53	AO.0185	Button	?	2	6	128	13
BR54	A29.0010	Boss	1250	2	12	291	19
BR55	D08.0986	Ring	?	3	11	119	8

Table 1: Quantification of major elements identified for bronze artifacts from Ilion.



Elemental Identification of Artifacts and Pigments from Ancient Ilion

Ni	Cu	Zn	As	Ag	Sn	Sb	Au	Pb	Bi
1	100639	410	1	312	558	25	2	2587	81
25	41183	1	1	126	1878	12	2	18848	153
29	32977	44	1	97	1005	25	9	7790	77
165	71894	128	54	129	9018	33	20	318	25
30	80300	280	235	81	615	44	16	149	32
134	76216	189	51	103	2785	32	2	289	34
122	94703	333	376	148	179	41	5	165	42
7	74963	153	2	88	554	40	4	2107	61
25	64063	252	22	120	1323	42	4	94	11
48	93227	6078	371	149	97	23	10	169	27
1	93411	2267	44	170	317	36	12	400	32
20	82109	228	15	119	38	46	16	37	17
1	55612	7758	1	97	31	47	9	39	4
39	57600	9063	7	196	173	34	11	37	46
6	30888	46	1	120	1823	26	20	16940	138
25	71912	10328	316	119	361	63	4	146	43
16	38706	371	1	141	3993	60	8	13561	124
1	92397	25409	27	99	17	68	7	95	9
1	76912	281	221	117	484	38	11	61	33
1	91807	280	32	143	21	69	21	46	8
36	111185	426	8	120	34	48	5	120	23
29	84557	1134	70	130	995	24	13	665	61
1	73491	12931	24	120	577	44	11	106	27
0	59788	153	5	144	2655	38	11	648	20
220	88040	273	313	576	9	1834	11	1494	53
36	66977	277	2	362	53	152	8	505	31
12	22288	27	1	102	18	5	-4	10030	85
7	32096	64	1	111	406	39	2	7731	69
15	78363	4034	69	75	19	55	20	44	11
4	29333	2713	1	180	2194	48	10	4845	40
26	63293	180	23	85	11	48	5	98	10
37	21548	342	12	86	616	35	9	3262	32
1	97767	356	220	98	2247	33	3	250	38
29	50924	102	1	135	2351	98	4	14209	115
16	84270	243	17	76	555	72	4	48	11
1	74679	147	1	106	4009	5	9	632	34
128	55844	123	12	125	1964	58	19	18	12
62	96704	271	1	132	3394	46	4	55	16
9	80255	239	5	117	3907	26	6	31	20
14	62132	179	1	140	20	24	5	4374	60
5	37762	123	1	222	4066	-7	9	5851	82
22	53503	104	12	56	2097	43	5	36	6
23	87104	256	32	118	32	51	14	55	14
16	98345	21470	37	127	20	42	7	48	22
34	24825	11	1	72	1034	45	16	26031	180
9	51238	130	165	78	958	27	16	99	21

## William Aylward – William Marx – Donna Strahan

BR56	I17.0688	Pin	?	3	13	883	51
BR58	I09.0157	Boss	-188	2	4	192	8
BR60	C29.0015	Fishhook	125	3	18	397	3
BR62	z06.0123	Casting debris	-213	2	4	461	133
BR63	D20.0257	Fibula clasp	375	3	33	1170	50
BR64	E10.0027	Fibula	?	3	40	307	45
BR66	D09.2051	Button?	?	2	36	374	29
BR67	D09.2366	Vessel	-163	2	2	52	4
BR68	H17.0800	Spatula	-38	3	22	493	17
BR69	D20.0267	Fishhook	375	2	21	164	9
BR71	D09.2326	Knife?	-150	3	2	515	46
BR72	z06.0162	Nail	-300	3	4	979	37
BR73	z06.0162	Strip?	-300	2	3	220	14
BR74	z06.0162	Uncertain (decorative)	-300	2	18	499	0
BR76	z06/07.0055	Weight?	50	3	10	990	88
BR77	z07.0090	Earring	-325	3	14	216	21
BR78	C29.0056	Wire	125	2	23	58	28
BR79	z07.0052	Ring	200	1	18	50	1
BR80	z07.0052	Hook	200	3	5	616	1
BR81	z07.0083	Triangle clasp	55	2	1	353	1
BR83	D20.0266	Pin	375	5	7	515	20
BR84	D09.2104	Ring	?	3	38	147	1
BR85	z06.0156	Uncertain (decorative)	-300	3	23	490	25
BR86	D09.2374	Knife?	-63	3	9	427	14
BR87	z06.0151	Strip	-280	3	19	1799	44
BR88	z06/07.0121	Strip	-380	3	12	805	24
BR89	z06/07.0042	Fishhook	150	3	15	451	24
BR90	D09.2131	Boss	?	5	8	236	1
BR91	A29.0072	Pin	-125	3	9	645	20
BR93	z06.0123	Fibula	-213	3	13	566	11
BR94	z06.0132	Nail	-225	3	1	1300	63
BR96	z07.0125	Tweezers	-163	3	15	1864	54
BR98	z06.0118	Nail	-175	3	8	161	95
BR99	z08.0303	Pendant	-150	3	8	292	28
BR104	z08.0488	Tool?	?	5	3	214	45
BR105	A08/09.0021	Arrowhead	-225	3	11	365	15
BR107	z06/07.0276	Fibula	-1000	4	20	219	26
BR109	z07.0566	Arrowhead	?	3	18	217	1
BR112	A08/09.0050	Handle	-75	3	12	339	15
BR113	A08/09.0050	Wire?	-75	4	26	445	40
BR114	A08/09.0059	Handle?	-600	4	12	261	31
BR115	A08/09.0069	Arrowhead	-525	3	7	165	14
BR116	p28.0069	Fibula	1300	2	7	173	20
BR117	z07.0530	Ring (loop)	-350	4	10	355	0
BR118	A08/09.0023	Ring (unjoined)	-200	3	21	141	24
BR119	z06/07.0309	Nail	-213	3	16	543	93
BR120	z08.0185	Fork	-238	2	10	287	12
BR121	z08.0773	Fork	1288	3	12	383	0
BR122	w28.0363	Ring/Bracelet?	267	3	3	485	25

Continuation of table 1



Elemental Identification of Artifacts and Pigments from Ancient Ilion

48	91266	303	127	179	25	33	10	640	20
12	45017	34	125	163	1439	118	-6	12667	157
33	36600	120	1	77	1077	61	0	1162	18
40	34829	32	1	121	2503	39	6	10370	88
1	85004	300	551	98	22	25	13	70	33
51	95110	20052	110	118	38	65	8	75	22
33	100187	238	58	74	22	44	9	35	28
7	48005	90	1	141	2524	45	11	9746	88
51	79928	259	89	172	900	80	12	582	36
15	39386	120	14	91	2848	19	9	25	10
57	62700	75	43	145	2641	20	0	5591	70
14	53992	179	119	78	11	19	6	68	19
24	68710	237	2	126	4462	27	9	127	16
1	75907	216	1	88	3084	10	5	86	19
1	54546	119	12	110	863	60	9	4909	71
40	50751	170	53	107	2507	23	13	139	14
60	64545	15997	3	71	32	68	20	21	5
27	6689	25	11	107	843	28	2	1348	16
79	56088	152	4	86	19	33	15	33	12
49	18298	83	1	143	2063	42	7	17195	102
16	85151	236	14	80	1830	11	7	228	26
23	29132	59	20	11711	249	31	31	41	16
25	72436	227	41	123	3600	32	12	40	19
21	64454	182	42	104	2375	130	7	3789	42
1	81153	225	38	101	269	26	12	40	8
12	60711	174	6	175	2376	42	11	42	11
31	48018	131	1	68	2692	7	8	534	17
37	60087	110	1	153	1408	201	12	9821	97
21	100655	351	126	74	31	40	16	98	34
1	70062	207	68	121	1333	16	13	54	19
9	49295	175	54	105	17	103	11	79	19
114	70202	209	1278	128	68	40	31	52	20
34	89029	218	79	108	25	36	12	62	24
11	96632	307	21	94	162	47	6	133	20
4	86431	192	84	114	3346	45	6	78	11
1	81286	201	24	118	1798	33	11	102	20
54	89760	267	203	123	923	20	10	84	22
11	63695	198	334	51	1912	29	12	62	20
15	69782	169	163	118	30	95	21	63	23
19	49060	158	1	86	38	55	12	43	5
1	74006	217	67	104	1564	15	9	85	26
17	90236	195	29	123	2040	21	5	28	13
1	35262	208	1	107	2186	7	7	5849	64
30	82479	389	27	168	3299	44	12	386	28
35	46453	103	246	107	1945	64	10	152	21
1	89926	241	140	94	28	28	13	75	16
52	79069	190	36	74	1542	35	12	188	24
23	56188	168	56	70	29	24	9	72	13
1	51875	142	1	129	2683	38	8	7341	88

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BR123	AO.0263	Fibula/Earring	?	3	7	79	11
BR124	A08/09.0106	Spoon	-525	4	6	964	40
BR125	E03.0024	Applique?	?	3	15	1184	30
BR126	A08/09.0069	Arrowhead	-525	3	23	183	1
BR127	A08/09.0094	Arrowhead	-525	3	6	116	1
BR128	z06/07.0320	Nail	-175	3	20	122	49
BR129	z06/07.0276	Pin?	-1000	2	10	303	6
BR130	D07.0435	Boss	?	2	15	357	38
BR132	z08.0863	Stylus	62	3	1	463	6
BR133	y28.0016	Nail	?	3	31	1050	0
BR134	y29.0084	Boss	-50	3	6	381	7
BR136	y28.0069	Attachment (decorative)	50	3	1	351	25
BR137	K/L04.0024	Knife?	?	3	4	716	-2
BR139	A07.0581	Strip	-20	2	12	1097	11
BR140	A07.0584	Hook (double)	?	2	14	1302	61
BR142	K/L04.0198	Ring	-300	3	28	380	11
BR143	A07/08.0831	Sickle? (heavy strip)	-250	3	0	1822	37
BR146	K17.0845	Pin?	200	3	13	306	8
BR149	K17.0788	Fibula	250	2	7	1712	20
BR151	K17.0706	Boss	362	2	6	620	14
BR152	A08.0732	Plaque (decorated)	-525	2	2	291	24
BR153	A07/08.0692	Pin	-325	4	29	121	0
BR154	K17.0874	Boss	200	3	10	362	37
BR156	L04.0380	Box	-350	3	9	527	0
BR157	z08/09.0022	Uncertain (jewelry)	-450	3	15	646	17
BR159	L04.0412	Pin	?	3	11	726	469
BR160	K17.1071	Bead	125	2	8	213	15
BR162	L04.0395	Knife?	-400	2	11	314	59
BR163	z06/07.0396	Strip	-388	5	23	733	31
BR164	u14.0039	Stylus	1550	3	15	1066	41
BR165	AO.0456	Nameplate	1850	2	15	98	1
BR166	K/L16/17.0052	Boss	275	3	28	283	3
BR169	w09.0039	Wire	1250	3	24	1892	23
BR170	w09.0227	Nail	1250	2	7	374	11
BR172	w09.0142	Bead	1250	2	8	876	2
BR173	w09.0046	Pendant	1250	3	29	961	35
BR174	K17.1371	Strip (decorated)	125	2	21	740	0
BR175	K/L16/17.0161	Key	267	2	22	105	8
BR176	z08.1553	Stylus	-150	3	22	1132	1
BR177	z08/09.0026	Vessel	-200	3	11	271	10
BR178	E/F10.0179	Spindle hook	340	2	24	664	22
BR179	K/L16/17.0018	Uncertain	350	3	22	584	13
BR181	z06/07.0941	Waster (imbedded in mortar)	-238	2	9	268	21
BR182	y59.0081	Pin	?	3	11	605	18
BR183	K/L16/17.0097	Ring	125	2	19	1220	91
BR184	E/F10.0244	Stylus	-163	3	28	319	14
BR185	E/F10.0252	Bead	100	2	19	208	23

Continuation of table 1

Elemental Identification of Artifacts and Pigments from Ancient Ilion

18	36336	56	942	191	7906	89	15	1575	30
13	73331	222	18	83	382	5	10	46	9
2	84549	219	1031	87	28	56	15	432	51
37	91094	254	12	56	885	40	1	26	5
11	83531	206	12	95	2751	24	7	179	78
1	113107	310	61	115	36	19	13	40	23
36	73910	230	158	86	1346	34	6	77	19
1	99916	349	249	104	1364	65	11	106	43
6	54248	137	1	78	32	43	9	21	3
48	86394	253	18	99	187	38	2	305	51
12	86485	269	297	178	25	179	5	158	41
64	71463	209	81	116	4213	8	9	68	13
43	93845	281	84	91	19	15	8	53	18
22	74647	142	80	125	2070	12	18	1133	31
1	65911	262	24	97	260	56	17	54	13
45	63024	205	56	112	142	35	8	243	28
16	78372	187	419	84	2559	12	9	1860	57
58	64623	176	793	103	25	31	6	93	30
43	72518	9502	14	159	572	79	2	1197	33
108	84525	18733	411	120	21	83	15	89	31
51	77749	192	5	104	3049	34	-2	2174	41
21	59418	200	10	104	968	25	11	12	9
23	56841	118	1	119	5488	71	18	3492	51
1	79518	268	701	71	1218	51	9	60	29
38	79421	212	140	150	2541	32	13	51	14
1941	60235	1	70	116	57	30	8	39	15
36	57680	165	216	110	1130	31	6	90	16
58	107666	272	977	119	34	53	4	46	116
30	107617	273	260	69	29	40	6	36	36
35	87005	254	238	70	4206	37	12	127	23
1	79997	43632	0	59	19	36	37	21	42
1	96302	16741	23	142	429	51	8	67	13
1	100773	323	34	124	514	28	6	105	24
23	69128	191	1	106	1290	76	5	2949	50
28	53620	169	1	159	3951	60	-1	3733	47
5	64626	246	16	153	360	59	13	45	17
1	78266	307	22	124	39	45	13	157	23
16	88666	240	233	99	3738	58	7	331	39
49	69165	293	48	121	38	52	12	47	17
27	33488	68	1	68	280	57	13	1205	16
1	80988	178	52	166	930	47	6	126	26
17	74735	345	34	105	1563	44	8	340	34
14	11339	7	1	62	31	42	5	2678	25
40	84754	203	31	114	2386	26	0	255	23
1	67630	213	134	122	282	38	24	54	22
25	97674	280	7	123	6	34	4	50	24
22	57842	162	13	111	3525	18	9	60	11

## William Aylward – William Marx – Donna Strahan

BR186	L04.0505	Pin?	475	3	20	677	33
BR187	w09.0286	Fishhook	1250	2	6	844	20
BR188	w09.0300	Earring	-20	3	20	131	1
BR189	w09.0297	Triangle clasp	-20	3	11	426	33
BR190	z06/07.0973	Fibula?	?	2	16	226	46
BR191	z06/07.0939	Gate system	-225	5	11	349	42
component for casting							
BR192	C08.0045	Nail	?	2	31	1526	42
BR193	z06/07.0934	Waster	-200	2	8	121	13
BR194	w09.0264	Belt buckle	1450	4	24	693	0
BR195	z06/07.0932	Fibula	-175	3	8	269	29
BR196	w09.0260	Fibula	?	3	8	176	13
BR197	D08.0457	Fibula	?	3	10	1271	17
BR198	y05.0010	Wire	-145	3	16	509	43
BR199	L04.0505	Boss?	475	2	3	513	0
BR200	A08.1150	Sieve?	-225	2	18	569	1
BR201	y08.0013	Pin	125	3	3	603	35
BR202	u15.0004	Boss	-100	3	18	367	9
BR203	y08.0514	Tool?	-100	2	24	131	46
BR204	y08.0515	Ring (loop)	-100	2	7	110	5
BR205	y08.0057	Stud	1000	3	9	844	24
BR206	K/L16/17.0337	Sheet	375	2	5	239	11
BR207	D09.2859	Pin	-330	3	5	345	48
BR208	y08.0064	Knife	1250	2	27	323	44
BR209	t14.0110	Boss	-100	2	12	1616	35
BR210	t14.0089	Boss	-100	2	16	929	43
BR211	t14.0148	Nail	-100	3	20	280	53
BR212	t14.0127	Wire	-100	3	11	262	2
BR213	t14.0122	Weight	-100	3	16	317	1
BR214	K/L16/17.0370	Uncertain	375	4	13	3362	50
BR215	z06/07.0955	Waster	-238	4	1	725	36
BR216	t14.0043	Pin	-100	3	12	1194	1
BR219	t14.0118	Sheet	-100	2	6	601	1
BR220	y08.0542	Wire (decorated)	?	3	15	418	1
BR221	D09.2851	Vessel?	-150	4	3	888	61
BR222	t14.0097	Wire	-100	3	24	988	20
BR223	y08.0153	Wire	1000	2	11	173	5
BR224	y08.0557	Boss	1250	3	22	796	21
BR225	y08.0065	Strip (patina)	1250	2	16	258	1
BR226	H17.0061	Belt buckle	350	3	12	698	18
BR227	H17.0798	Boss?	-20	3	11	350	8
BR229	t14.0350	Tool?	-100	2	36	52	25
BR230	t14.0119	Needle	-100	3	14	277	3
BR233	y08.0289	Fibula	-550	3	8	108	25
BR234	t14.0353	Nail	-100	2	20	158	32
BR235	A08/09.0219	Tool?	-100	2	18	208	34
BR236	t14.0626	Needle	-100	3	26	132	2
BR237	H17.0916	Boss	-20	3	0	255	0
BR238	y08.0631	Stylus	1400	3	9	855	27

Continuation of table 1

Elemental Identification of Artifacts and Pigments from Ancient Ilion

1	75978	98	11	133	56	28	5	34	8
51	28137	4897	23	66	202	46	19	104	8
34	33709	56	3	4247	72	28	14	33	6
50	30089	1	1	127	4261	41	11	16584	109
1	89548	296	20	137	2205	21	14	26	8
18	22993	67	2	305	1722	43	2	3116	14
1	76306	297	55	134	56	37	15	128	24
15	19090	5	1	114	447	30	-1	24912	164
4	63186	5848	24	88	278	41	12	209	20
50	71017	230	382	152	1215	271	11	115	19
11	63251	1011	1	101	1048	57	7	2412	47
1	74283	215	47	180	673	18	10	234	9
37	53546	137	35	75	39	16	13	72	9
16	102062	304	805	138	21	59	9	185	41
314	53343	171	5	117	3132	9	12	21	22
263	48378	168	420	129	453	35	12	147	33
85	65773	12371	483	106	2248	53	13	3973	87
1	84357	192	82	97	32	45	11	37	19
13	51083	43	2	73	438	34	5	7367	85
1	69596	183	98	84	537	71	11	95	21
17	38367	74	1	84	2187	9	-5	12951	110
20	66350	207	57	51	32	35	5	43	21
13	81197	237	251	77	3879	39	7	77	21
20	90159	317	330	166	32	56	8	64	31
11	56823	189	5	86	19	35	12	182	13
82	92668	265	18	117	44	48	10	122	10
8	27747	3168	27	76	541	55	10	416	22
62	51021	11828	1	134	1802	56	5	9146	93
36	69672	6386	48	158	567	25	11	244	26
12	22742	30	1	77	1015	12	6	18465	152
1	69647	7098	5	101	27	34	15	27	18
37	63297	165	42	95	446	35	13	53	12
36	55495	122	255	73	1700	23	11	100	16
27	69686	195	26	109	2279	28	21	46	16
1	95618	290	203	118	17	67	9	74	26
16	30786	59	347	71	815	45	17	104	14
19	80173	266	47	104	233	67	12	84	20
21	94046	28288	14	147	83	22	8	35	15
35	50014	2322	1	121	3797	95	7	10581	86
29	27582	33	1	97	1609	45	-3	23470	168
21	6494	1	121	119	4738	42	27	26243	185
1	29057	2835	32	130	672	44	11	456	21
143	73504	213	123	122	2422	45	7	48	18
1	76193	192	122	97	4026	20	9	82	12
70	98619	326	178	126	73	34	9	61	28
16	39234	104	78	77	32	50	13	57	12
34	32835	19	1	166	1527	120	0	19954	149
1	78131	251	9	131	20	25	6	36	16

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BR239	y08.0632	Knife	1400	2	5	602	0
BR240	K18.0064	Strip	200	2	1	380	25
BR241	t14.0271	Nail	-100	2	0	528	18
BR243	t14.0327	Hook	-100	2	34	12287	215
BR245	y09.0044	Spoon	-225	2	11	805	23
BR247	D09.1712	Pin	-25	2	20	379	16
BR248	D09.1740	Pin	?	3	1	1247	32
BR249	y09.0047	Stylus	?	2	19	1644	18
BR250	z06.0131	Fibula	-163	5	13	614	33
BR251	AO.0624	Coin?	?	2	21	555	77
BR252	AO.0623	Hook	?	3	33	1122	14
BR253	AO.0622	Arrowhead	?	3	11	697	19
BR254	E/F10.0195	Revetment pin	340	3	4	743	0
BR255	z07.1754	Pin	?	2	10	638	16
BR256	z07.1787	Revetment pin?	?	2	5	1682	68
BR257	AO.0621	Punch	?	3	8	164	3
BR258	w15.0019	Weight	1000	2	22	562	3
BR259	z07/08.2204	Statue fragment (drapery?)	-213	1	9	494	28
BR260	z07.2052	Ring	?	2	25	503	55
BR261	D20.0033	Fibula	375	2	21	1582	1
BR262	K/L16/17.0001	Boss	350	2	12	229	1
BR263	z07.1795	Earring	1000	4	15	635	2
BR264	z08.1852	Pin	?	2	15	429	24
uninventoried	FF5.63	?	?	2	14	1052	57
uninventoried	AO.5390	?	?	5	9	352	27
uninventoried	AO.5208	?	?	2	13	478	0
uninventoried	AO.5277	?	?	3	8	864	43
uninventoried	II20.17	?	?	2	5	1374	57
uninventoried	K4/5.37	?	?	1	13	4723	112
uninventoried	A5/6.421	?	?	2	20	388	12
uninventoried	A7.1248	?	?	2	18	964	16
uninventoried	A7.1261	?	?	2	26	726	30
uninventoried	A7.1263	?	?	1	17	536	11
uninventoried	A7.1265	?	?	1	21	682	38
uninventoried	A8.1282	?	?	1	19	534	17
uninventoried	A8.1283	?	?	1	14	988	45
uninventoried	D9.3023	?	?	1	22	74	6
uninventoried	D9.3039	?	?	1	21	625	61
uninventoried	D9.3068	?	?	2	17	77	44
uninventoried	X7.165	?	?	2	15	320	2
uninventoried	Y8.1084	?	?	1	16	1031	39
uninventoried	Y8.1114	?	?	1	13	661	30
GJ82	u15.0094	Earring (Au and Ag)	1250	2	1	40	2
IL71	z06/07.0865	Handle (Ag)	-325	3	76	316	2

Continuation of table 1

Elemental Identification of Artifacts and Pigments from Ancient Ilion

23	81651	270	1	144	63	52	-1	261	22
25	87180	335	1	123	1454	23	8	1511	61
13	61354	185	59	147	2402	84	16	177	16
2	15035	46	11	56	2108	38	9	4413	68
20	74436	182	86	109	1218	26	13	114	11
7	78139	336	634	100	24	39	6	156	32
1	83657	228	350	138	28	53	11	92	36
1	59828	167	17	77	10	24	6	34	10
24	54694	258	1	60	2992	41	15	104	20
1	79991	294	129	69	3540	30	-1	72	29
1	58451	184	162	150	83	60	21	2588	54
11	36434	80	84	105	2725	3236	12	6872	72
34	77966	149	54	141	2906	58	4	2987	52
7	53390	197	47	136	3927	1	6	401	26
1	73259	224	47	169	26	15	19	83	28
46	45169	48	13	147	4637	84	0	8949	78
2	30123	46	1	107	1525	41	11	9622	77
1	33057	76	8	81	2829	39	19	90	13
21	43016	127	19	111	932	22	12	35	12
0	69239	12858	30	182	428	43	10	408	29
12	90855	7236	20	131	742	31	7	242	29
1	53516	906	40	115	1115	18	9	44	13
1	45622	147	110	106	42	39	20	67	7
1	84676	296	44	153	7	15	3	54	7
14	53988	74	1	104	2687	56	4	12232	118
25	24900	68	8	120	2268	36	11	8413	82
9	96132	264	79	130	71	37	15	75	26
1	56716	7630	13	96	135	22	7	1229	36
25	60327	206	1	131	1766	29	3	1281	38
1	60914	175	12	101	1317	34	13	35	18
1	72499	204	54	183	1968	33	9	20	29
1	38076	434	40	96	550	29	22	28	14
2	56165	220	49	120	688	16	16	63	12
60	66248	449	65	142	2885	31	33	112	17
1	42430	145	16	96	168	28	5	55	12
36	71305	301	18	117	1341	30	10	26	20
9	28119	100	33	112	735	38	14	117	13
25	58001	244	93	133	2498	-4	23	151	20
102	28874	94	150	160	1298	113	24	176	34
20	32176	5981	11	153	19	22	8	126	25
16	30582	102	24	137	389	20	10	261	12
87	45909	199	37	155	196	42	13	54	11
26	240	5	95	3890	64	8	7571	2	-3
61	236	0	55	39811	30	12	117	3	4

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Inventory	Behalter	Function	Date	Number	Ca	Fe	Ni
of Samples							
IL3	H17.0028	Crucible (clay)	275	3	708	5059	101
IL5	D09.0640	Sickle	0	3	54	64256	4
IL6	D09.0730	Knife	0	2	1	65655	27
IL9	I17.0043	Ring	?	2	393	39826	11
IL10	I09.0005	Clamp	-175	2	1657	32779	11
IL11	I09.0005	Clamp	-175	2	43	59676	10
IL13	I09.0002	Clamp	-175	3	0	66160	22
IL15	F28.0068	Key	?	3	1	60231	14
IL16	K13.0166	Key	-150	3	0	56323	23
IL17	z06.0027	Button?	-119	2	1	57159	27
IL18	z07.0098	Spearhead	-163	2	150	49907	8
IL24	z07.0054	Axe	350	2	0	23904	1
IL26	z06/07.0051	Ring	50	2	133	43563	1
IL30	z07.0060	Arrowhead	90	2	19	44338	17
IL31	z06.0140	Axe	-163	3	36	70944	7
IL37	A07.0044	Weight	-325	2	196	44878	19
IL47	y29.0093	Hinge?	-325	3	214	25934	24
IL51	z06.0032	Boss	-100	3	1	54204	1
IL56	y05/06.0358	Ring	?	2	20	52730	15
IL57	K17.0839	Disc	200	1	376	44421	20
IL58	AO.0402	Ring	?	2	1	44928	7
IL60	y05/06.0352	Spearhead	1000	3	263	59823	16
IL62	z06/07.0354	Knife?	-261	1	183	32032	1
IL64	K/L16/17.0017	Knife	375	3	58	34116	13
IL65	K/L16/17.0016	Belt buckle	375	2	97	57702	17
IL68	w09.0016	Knife	1375	3	208	56811	15
IL69	w09.0028	Knife	1250	2	5	58947	7
IL74	x33/34.0042	Ring	-100	2	34	28861	3
IL75	y/z07/08.1522	Knife?	1275	1	401	40296	15
IL76	u14.0097	Arrowhead	1375	3	1	51198	20
IL78	w09.0123	Knife	1250	2	576	45097	23
IL80	E/F10.0170	Spearhead	437	3	696	44235	5
IL81	K/L16/17.0338	Ring	375	3	1	36659	14
IL82	K/L16/17.0345	Knife	375	2	8	64981	26
IL84	D09.2915	Spearhead?	-575	1	1	41483	13
IL87	y07.0607	Tweezers?	?	1	77	47583	26
IL88	D09.2912	Ring	-575	2	1	47039	22
IL90	y08.0201	Knife	?	1	1	61700	14
IL97	f26.0024	Strigil	160	3	1	18452	2
IL98	x07.0207	Knife	1000	1	988	45323	17
IL99	x07.0208	Knife?	1000	1	0	18529	7
IL103	f26.0115	Strigil	160	4	95	38049	-1
IL104	f26.0004	Knife	?	2	1270	40777	2
IL105	x07.0204	Nail	1000	1	1	73308	2
IL106	u15.0196	Knife	1870	3	421	26181	16
(with silver blade attachment)							

Table 2: Quantification of major elements identified for iron artifacts from Ilion.



Elemental Identification of Artifacts and Pigments from Ancient Ilion

Cu	Zn	As	Sr	Zr	Ag	Sn	Sb	Au	Pb
51	53	9	518	278	309	64	82	29	38
21	6	0	15	14	137	12	17	13	19
43	1	25	86	46	220	27	42	23	104
149	7	2	55	27	146	47	71	29	56
39	13	10	474	41	150	17	17	5	448
11	3	0	30	6	113	22	27	6	677
15	5	1	8	10	109	15	17	7	160
23	16	1	26	36	132	16	37	16	80
47	12	9	54	39	140	37	72	14	49
26	9	4	112	55	165	28	62	21	54
49	10	106	127	36	139	15	40	7	91
20	6	5	17	38	106	40	57	15	42
18	12	7	148	24	194	38	93	13	49
221	4	11	65	41	119	43	70	22	75
72	5	0	47	14	140	18	31	16	62
31	17	0	46	48	88	46	63	22	32
25	5	66	224	42	143	30	88	19	92
173	90	1	94	65	154	61	47	19	37
31	6	1	51	35	192	12	63	11	43
31	16	52	72	48	148	51	65	32	64
35	15	1	59	82	113	35	82	14	28
47	20	0	44	52	226	42	59	28	13
20	10	6	273	99	189	45	60	23	47
17	18	5	83	89	143	52	94	27	53
68	13	28	89	59	111	45	80	8	121
37	5	6	51	37	130	28	95	28	50
19	10	0	23	33	113	4	14	5	17
14	16	14	134	59	121	32	86	25	120
23	27	16	116	48	138	46	58	21	63
9	13	0	39	99	141	42	57	12	38
17	9	2	68	42	182	44	75	26	37
26	15	4	36	18	114	23	14	6	78
32	11	4	47	25	164	37	93	14	25
143	6	0	43	23	173	55	63	22	30
31	20	62	174	43	193	55	76	8	98
61	26	1	94	59	214	23	87	31	64
89	31	20	88	99	166	24	88	32	76
24	12	0	68	62	158	35	72	31	28
24	20	54	269	172	217	59	88	26	239
20	2	2	62	71	143	51	58	14	32
26	12	1	33	21	97	25	58	14	35
31	17	5	129	71	168	11	60	28	112
41	22	1	87	49	148	52	60	34	40
26	7	0	38	50	171	27	47	17	16
27	32	221	136	111	176	42	27	13	80

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IL108	E/F10.0167	Nail	128	2	32	31130	2
IL109	E/F10.0167	Nail	128	2	564	45087	8
IL110	E10.0039	Nail	253	1	97	18601	9
IL111	E/F10.0161	Revetment pin	128	2	622	52023	7
IL112	E/F10.0162	Revetment pin	128	1	44	64055	70
IL113	F10.0049	Nail	128	2	0	62916	9
IL114	E10.0081	Hook?	250	1	218	28932	14
IL115	E/F10.0165	Nail	375	2	227	19309	8
IL116	E10.0120	Revetment pin	437	1	2217	29125	8
IL117	E10.0120	Revetment pin	437	1	394	65856	14
IL118	E10.0120	Nail	437	3	55	45879	9
IL119	E10.0120	Nail	437	2	60	39180	5
IL120	E/F10.0163	Chisel?	?	2	1	52047	3
IL121	E/F10.0163	Nail	128	2	111	52700	6
IL122	E/F10.0163	Revetment pin	?	2	1	56517	11
IL123	E/F10.0163	Nail	128	2	1	64341	22
IL124	E/F10.0168	Nail	128	2	455	48427	10
IL125	E/F10.0158	Horseshoe	350	2	601	34736	6
IL126	E/F10.0158	Hook	350	3	1	47863	21
IL127	E/F10.0158	Hook?	350	2	564	28542	29
IL128	E/F10.0164	Nail	350	1	386	54321	3
IL129	E/F10.0203	Revetment pin	200	1	1004	29518	11
IL130	F10.0124	Nail	128	2	190	59811	3
IL131	E10.0133	Nail	128	1	426	51524	12
IL132	E/F10.0157	Dowel	271	1	1	74475	32
IL133	E10.0099	Nail	128	2	62	46767	18
IL134	z07.1764	Knife	?	1	179	50713	10
IL135	y07.0828	Horseshoe	?	2	1	67953	2
IL136	M18.0122	Horseshoe	1300	3	0	22769	15
uninventoried	K4/5.16	?	?	1	764	8401	14
uninventoried	K4/5.35	?	?	2	366	31897	8
uninventoried	K4/5.36	?	?	1	100	44445	2
uninventoried	K4/5.41	?	?	2	247	37769	18
uninventoried	K4/5.69	?	?	1	1071	21799	8

Continuation of table 2

Elemental Identification of Artifacts and Pigments from Ancient Ilion

52	12	0	41	19	105	19	41	15	44
27	9	0	57	48	183	23	52	22	28
28	17	10	58	31	102	40	44	24	46
19	17	1	22	48	198	18	65	25	47
26	10	7	47	25	145	27	59	18	103
17	2	0	20	16	85	8	27	10	9
28	6	1	78	42	132	50	48	16	41
28	18	4	78	54	129	16	44	12	26
8	18	5	70	73	181	34	55	16	17
33	7	1	31	47	129	41	65	16	34
24	12	1	47	43	127	11	90	15	59
26	16	9	116	112	238	25	75	25	58
35	8	1	32	28	104	49	57	25	34
15	10	0	33	37	114	20	29	5	15
18	9	0	41	40	124	15	59	15	29
21	10	1	36	43	157	41	57	25	48
27	7	2	54	24	153	35	34	15	34
18	14	1	81	35	120	12	14	14	36
32	10	2	47	62	185	20	97	13	21
19	35	17	183	52	164	39	103	20	52
13	14	5	26	38	161	29	43	18	92
23	23	19	157	61	222	29	68	11	55
44	19	2	56	61	209	21	36	14	67
21	2	8	71	44	163	44	81	9	45
19	15	3	21	24	170	41	40	13	43
24	16	7	86	74	119	53	95	28	78
35	26	9	72	55	127	29	84	17	61
26	9	1	8	70	110	18	24	26	19
24	9	1	39	39	91	34	27	25	36
28	33	22	415	137	220	40	46	13	49
35	7	14	140	42	96	24	35	13	64
54	3	6	77	39	154	74	69	9	52
22	26	2	150	66	164	19	61	7	9
123	16	17	148	41	151	25	26	24	35

Inventory	Behalter	Function	Date	Number	Ca	Fe	Ni
				of Samples			
IL1	M18.0142	Cylinder	375	2	137	587	50
IL2	D09.0569	Strip	0	1	1	103	39
IL4	AO.0016	Sling bullet (inscribed) ?		4	1	229	54
IL7	D09.0714	Strip (rolled)	-100	2	130	363	49
IL14	K13.0009	Medallion/Weight (inscribed)	?	3	1	116	51
IL19	A29.0107	Vessel lid	100	2	152	548	47
IL20	H17.1170	Weight	465	1	109	145	39
IL21	I09.0222	Vessel lid	?	2	1	138	47
IL23	H17.1034	Strip (rolled)	?	1	50	279	31
IL27	A29.0042	Vessel lid	-137	2	70	351	53
IL28	z29.0014	Vessel handle	-188	2	108	273	42
IL32	I09.0178	Ingot?	?	2	1	159	73
IL33	I17.0814	Weight	175	2	190	256	60
IL37	A07.0044	Weight	-325	2	27	272	51
IL38	E09.0173	Weight?	?	1	35	177	15
IL41	w28.0043	Roundel	267	2	18	226	32
IL43	w28.0356	Vessel	-213	2	73	250	43
IL44	C29.0445	Vessel	125	4	53	187	38
IL50	y28.0029	Handle	1850	3	236	890	28
IL54	D20.0135	Spatula	375	3	60	160	19
IL59	y29.0269	Vessel handle?	?	2	119	496	23
IL61	E09.0500	Bead	75	2	28	381	26
IL63	L04.0455	Tweezers?	200	2	71	371	53
IL66	z06/07.0873	Tweezers	-70	2	51	263	101
IL67	K17.1351	Clamp	-213	2	66	284	43
IL70	K17.1357	Handle	125	2	27	321	57
IL73	K17.1351	Clamp	-213	2	270	833	37
IL77	K/L16/17.0166	Weight	100	2	385	415	44
IL79	w09.0297	Weight	-20	3	103	357	29
IL83	E/F10.0439	Vessel lid	-200	3	225	282	32
IL85	u15.0170	Hook	1300	2	98	609	14
IL86	t14.0121	Strip (thick, folded)	1300	2	24	247	28
IL89	t14.0087	Vessel	-100	3	211	487	26
IL93	E12/13.0040	Clamp	150	3	345	803	46
IL94	E12/13.0025	Clamp	375	3	289	125	33
IL95	t14.0295	Vessel	100	3	79	248	49
IL107	AO.0625	Clamp	?	2	1	221	47
IL138	z16.0125	Vessel	?	3	98	903	56
uninventoried	G9/10.138	?	?	2	10	275	19
uninventoried	K4/5.34	?	?	2	25	325	38
uninventoried	A7.1260	?	?	1	82	201	30

Table 3: Quantification of major elements identified for lead artifacts from Ilion.

Elemental Identification of Artifacts and Pigments from Ancient Ilion

Cu	Zn	As	Sr	Zr	Ag	Sn	Sb	Au	Pb
106	0	1	94	92	128	60	17	10	48283
164	1	1	93	127	165	69	30	30	51128
142	5	1	185	111	152	88	97	51	55133
122	33	1	198	123	105	70	30	20	48746
128	1	1	144	95	147	139	53	11	52526
125	27	1	299	102	149	70	10	10	51344
75	1	1	103	75	108	293	88	21	33872
104	1	1	126	141	130	106	36	33	54089
116	21	1	89	127	123	702	76	57	53350
141	1	1	168	118	135	118	32	75	50019
96	4	1	143	185	150	86	14	25	49692
87	2	1	98	88	95	117	45	40	56048
112	1	1	161	120	139	58	63	42	47572
145	1	1	124	112	172	108	35	43	51809
86	1	1	105	52	118	20	27	12	16834
164	1	1	127	105	108	77	39	24	54086
192	3	1	169	129	163	92	50	80	51514
68	8	1	157	106	119	108	21	25	41354
84	27	1	103	114	143	192	43	12	44723
201	1	1	129	59	128	84	47	14	47406
153	20	1	129	108	110	84	64	16	52073
171	5	1	122	109	116	122	25	27	54152
109	8	1	139	55	82	62	32	28	46570
94	1	1	113	106	111	67	58	60	47600
72	7	1	167	93	110	129	25	62	53539
75	1	1	136	124	89	129	38	42	51766
51	17	1	225	85	75	48	28	29	44061
126	17	1	199	91	133	60	42	36	40628
154	1	1	171	107	93	95	31	40	50107
61	1	1	135	97	112	104	108	62	47050
101	1	1	153	93	162	67	49	5	29547
130	9	1	66	129	130	768	22	39	52790
100	19	1	177	156	107	104	40	11	47997
141	1	1	48	61	92	89	52	25	43372
131	1	1	75	117	113	317	89	33	43673
118	1	1	125	108	164	94	24	17	52580
83	3	1	82	57	123	64	31	47	38999
88	9	1	226	136	177	118	48	22	31265
102	1	1	84	76	106	84	57	25	41455
92	1	1	154	102	145	69	47	6	36250
98	2	1	192	101	108	99	96	31	46297

Inventory	Behalter	Material Painted	Date	Notes	K	Ca
TC174 black	I17.0084B	Terracotta	50		1524	7010
TC174 red	I17.0084B	Terracotta	50		514	38817
TC174 yellow	I17.0084B	Terracotta	50		1193	28151
TC177 blue	I17.0084E	Terracotta	50		1	11265
TC177 yellow	I17.0084E	Terracotta	50		1	17240
TC184 blue	I17.0084L	Terracotta	50		72	17315
TC184 red	I17.0084L	Terracotta	50		2116	10558
TC184 white	I17.0084L	Terracotta	50		202	5094
TC399 greenwhite	I17.0084	Terracotta	50		67	5338
TC399 red	I17.0084	Terracotta	50		1178	8155
TC399 yellow	I17.0084	Terracotta	50		130	5395
TC507 red	z6.0017	Terracotta	-375		418	15169
TC507 white	z6.0017	Terracotta	-375		7	10298
TC588 pink	z7.0035	Terracotta	-150		603	38175
TC588 white	z7.0035	Terracotta	-150		514	33632
TC880 greenwhite	z6.0116	Terracotta	-225		1489	15521
TC888 white	z7.068	Terracotta	175		110	34322
TC888 yellow	z7.0068	Terracotta	175		829	14190
TC941 black	z8.0122	Terracotta	-150		1225	5452
TC941 red	z8.0122	Terracotta	-150		621	21593
TC941 yellow	z8.0122	Terracotta	-150		446	15554
TC1012 ? (front)	z8.0447	Terracotta	-150		1156	4933
TC1013 black	A8/9.0019	Terracotta	-150		1	6315
TC1013 red	A8/9.0019	Terracotta	-150		1	4650
TC1013 tan	A8/9.0019	Terracotta	-150		1	4676
TC1030 ? (front)	A8/9.0050	Terracotta	-150		256	10014
TC1055 red	z8.0319	Terracotta	-150		412	34830
TC1055 white	z8.0319	Terracotta	-150		489	33031
TC1073 black	A8/9.0079	Terracotta	-150		1	10421
TC1073 pink	A8/9.0079	Terracotta	-150		1	7074
TC1073 red	A8/9.0079	Terracotta	-150		198	12106
TC1073 tan	A8/9.0079	Terracotta	-150		68	8362
TC1073 white	A8/9.0079	Terracotta	-150		557	9107
TC1084 ? (front)	z6/7.0282	Terracotta	-300		1335	4267
TC1100 ? (front)	z6/7.0290	Terracotta	-300		1678	2329
TC1106 ? (front)	A8/9.0081	Terracotta	-100		2281	17912
TC1135 black	A8/9.0108	Terracotta	-200		1100	9920
TC1135 yellow	A8/9.0108	Terracotta	-200		487	14108
TC1143 ? (leftbreast)	w28.0302	Terracotta	267		614	16853
TC1143 ? (leftface_olepink)	w28.0302	Terracotta	267		490	22560
TC1143 ? (leftface_gildtrace)	w28.0302	Terracotta	267		693	20168
TC1143 ? (leftthrone_backedgegray)	w28.0302	Terracotta	267		431	45908
TC1143 ? (leftthrone_redstreak)	w28.0302	Terracotta	267		1526	6159
TC1143 ? (rightface_blackenededge)	w28.0302	Terracotta	267		1035	23335
TC1143 ? (rightface_eye)	w28.0302	Terracotta	267		1	9449
TC1173 ? (dark)	A8/9.0081	Terracotta	-100		1893	5382

Table 4:Quantification of major elements identified for pigments on terracotta figurines and painted wall and ceiling plaster from Ilion.

## Elemental Identification of Artifacts and Pigments from Ancient Ilion

Ti	Cr	Mn	Fe	Cu	As	Sr	Mo	Sn	Hg	Pb
1244	207	713	46675	658	1	639	142	157	62	3237
684	66	522	34058	444	1	871	61	81	82	789
1120	295	514	52133	412	1	1178	308	275	754	872
485	102	315	18982	33983	93	750	98	341	100	20232
364	171	394	20901	774	2285	807	167	153	175	36198
1076	157	319	29155	1181	8784	965	326	118	295	40280
1351	163	602	61042	564	67	669	160	88	97	996
1990	235	160	18141	342	10995	1105	61	119	40	20459
688	122	818	24553	446	2999	419	112	188	195	49993
1534	207	1621	53492	522	1	763	65	80	56	1482
683	149	767	24508	578	14525	318	147	144	171	42398
855	138	545	50036	528	1	1054	271	69	93	10848
473	71	299	21705	416	8226	750	194	200	116	31231
695	194	587	26279	328	408	2157	126	94	124	643
931	235	899	42286	562	1	1558	90	143	126	466
1120	128	493	42121	312	1	2284	160	186	88	280
664	46	922	35940	438	1	3726	172	111	100	455
1256	180	1016	50972	352	1	1349	156	101	63	314
1694	311	1085	57751	456	502	957	201	181	21	1019
814	90	813	45147	455	1200	1775	163	168	126	651
728	76	766	63372	436	1	1424	152	164	74	916
1440	292	941	50395	383	1	611	169	103	62	338
207	2	56	9609	549	915	711	45	308	825	81684
127	46	72	5705	249	1	630	77	426	1153	89891
73	49	44	2060	309	1	623	67	653	2568	99991
944	199	464	29268	201	157	766	106	1083	88	753
658	128	714	45726	387	1	3541	230	121	155	373
594	106	768	37738	516	1	2265	51	111	111	288
335	36	342	9940	331	1	996	27	251	519	65527
299	30	107	5007	359	1	772	52	280	598	75905
571	25	409	23141	256	1	1144	128	128	150	40369
450	14	264	12206	393	1	916	202	218	225	57890
637	16	497	16035	379	1	1066	169	83	131	31675
460	166	512	22909	505	1	784	37	5142	149	408
1325	321	906	48523	463	1	810	168	1339	53	550
965	161	878	45910	365	1	1247	247	1124	172	538
111	80	115	8794	502	36	1149	212	17312	68	402
651	27	544	49148	244	1	1092	105	822	101	416
903	86	408	37262	457	1	818	107	181	2558	2488
1005	75	337	34131	446	1	1090	304	51	94	9885
1066	102	391	35256	336	1	854	120	138	66	8176
1877	43	235	25788	390	1	1130	85	174	208	394
1715	121	584	63971	401	1	834	283	97	77	1192
1385	99	538	42315	446	1	1283	144	99	107	523
375	38	142	16826	394	1	693	100	224	424	65680
1695	237	1308	65146	747	1	1198	77	1842	48	389



William Aylward – William Marx – Donna Strahan

TC1173 yellow	A8/9.0081	Terracotta	-100		1193	4488
TC1319 red	z5/6.0489	Terracotta	-300		1314	16822
TC1359 ? (front)	z6/7.0827	Terracotta	-100		1979	4216
TC1400 ? (front)	w9.0229	Terracotta	-200		917	23855
TC1400 ? (front2)	w9.0229	Terracotta	-200		826	20185
TC1414 ? (front)	z8.1576	Terracotta	-150		1646	19220
TC1414 ? (front2)	z8.1576	Terracotta	-150		1745	10335
TC1417 ? (front)	z8.1598	Terracotta	-150		2286	24369
TC1427 ? (glassy glaze)	w9.0242	Terracotta	500		1	3244
TC1430 ? (glaze)	z8.1601	Terracotta	-150		2178	10952
TC1432 ? (front)	z8.1608	Terracotta	-125		1416	14758
TC1447 ? (front)	y8.0011	Terracotta	125		270	19253
TC1454 ? (facelight)	y8.0007	Terracotta	125		1351	23076
TC1574 ? (front)	y8.0543	Terracotta	-200		1213	22983
TC1677 orange	z8.1819	Terracotta	-200		1	38025
(uninventoried) red	A8/9.86	Terracotta	-150		924	21350
(uninventoried) white	A8/9.86	Terracotta	-150		1639	13399
(uninventoried) red	z8.465	Terracotta	-150		166	29917
(uninventoried) white	z8.465	Terracotta	-150		856	27771
WD1 blue	M18.0233	Wall/Ceiling plaster	375		122	79000
WD1 white	M18.0233	Wall/Ceiling plaster	375		1	137333
WD2 green	K17.0102	Wall/Ceiling plaster	50	green_mostly	1027	81998
WD2 red	K17.0102	Wall/Ceiling plaster	50	red_mostly	1	131704
WD2 white	K17.0102	Wall/Ceiling plaster	50	white_mostly	1	134851
WD3 beige	I18.0061	Wall/Ceiling plaster	25		1	110713
WD3 red	I18.0061	Wall/Ceiling plaster	25		536	71972
WD4 yellow	D10.0034	Wall/Ceiling plaster	375		1	70044
WD4 yellow	D10.0034	Wall/Ceiling plaster	375		1	86908
WD5 brown	K13.0270	Wall/Ceiling plaster	375		764	107216
WD5 purple	K13.0270	Wall/Ceiling plaster	375	purple_mostly	1252	92358
WD5 red	K13.0270	Wall/Ceiling plaster	375		1131	87241
WD5 yellow	K13.0270	Wall/Ceiling plaster	375		5965	35684
WD6 red	D9.0044	Wall/Ceiling plaster	375	red_dark	1	32535
WD6 red	D9.0044	Wall/Ceiling plaster	375	red_light	1	55204
WD6 white	D9.0044	Wall/Ceiling plaster	375	white_mostly	770	46973
WD7 red	K13.0074A	Wall/Ceiling plaster	375		1	79619
WD7 white	K13.0074A	Wall/Ceiling plaster	375		1	121999
WD7 yellow	K13.0074A	Wall/Ceiling plaster	375		1	105929
WD14 gray	I17.0078	Wall/Ceiling plaster	125		1	108862
WD14 red	I17.0078	Wall/Ceiling plaster	125		1	106917
WD14 white	I17.0078	Wall/Ceiling plaster	125		1	125798
WD15 gray	I18.0077A	Wall/Ceiling plaster	125		201	79346
WD15 red	I18.0077A	Wall/Ceiling plaster	125		1	102707
WD15 white	I18.0077A	Wall/Ceiling plaster	125		1	118368
WD15 yellow	I18.0077A	Wall/Ceiling plaster	125		331	61242
WD16 gray	I18.0077B	Wall/Ceiling plaster	125		1	91034
WD16 red	I18.0077B	Wall/Ceiling plaster	125		1	87499

Continuation of table 4

Elemental Identification of Artifacts and Pigments from Ancient Iliion

1163	187	936	48468	653	1	845	154	1364	74	275
1272	118	1413	47751	608	1	1040	200	163	121	278
1301	216	945	47545	357	3	735	9	886	73	628
1229	153	1578	46411	491	1	2075	117	205	85	1737
628	97	606	28740	346	1	1405	115	111	78	549
1123	224	1025	40773	479	1	780	129	113	190	326
784	659	954	37124	460	1	954	181	1596	119	310
905	154	695	49920	432	1	1725	169	915	95	631
159	6	223	3084	8533	1	315	74	666	2610	93570
1725	281	978	61371	498	1	804	237	194	32	1359
1383	279	1315	56314	542	140	825	182	1199	60	1788
130	214	383	15395	827	1	2702	77	4009	102	828
998	216	288	49969	627	1110	996	94	73	178	689
419	74	825	18773	462	967	1163	219	12562	36	1641
725	29	1083	38631	628	1	6208	171	117	100	652
851	61	527	31191	408	1	1297	168	57	51	7934
1245	143	309	28441	456	1	1217	92	130	64	5061
494	70	1036	87060	378	1	2173	99	157	195	774
1090	198	1337	56199	474	1	1403	124	178	145	229
277	61	209	14447	24399	1	1693	72	348	287	908
69	34	112	2830	488	1	1006	156	205	71	194
488	56	325	18321	488	1	1395	225	189	257	396
77	71	140	4981	607	1	1276	134	247	48	458
85	78	155	2643	451	1	1372	274	65	115	486
99	85	146	16927	415	1	2669	135	112	171	439
783	155	313	71523	533	1	2311	161	54	351	579
62	44	250	146961	315	429	618	212	268	747	1596
50	56	178	113138	252	592	851	104	151	700	1328
206	65	262	15076	396	3	848	310	127	128	437
353	32	207	23147	421	1	935	154	152	267	586
508	13	462	30120	359	449	900	-38	180	193	418
906	39	769	66416	610	1	783	203	38	178	680
219	95	485	169832	416	1	715	235	86	376	2488
873	181	215	102262	310	144	1326	235	242	349	2465
499	56	108	55277	326	1	1934	38	110	200	2507
806	112	255	63227	732	1	1095	142	148	350	334
188	132	151	5605	413	1	1437	178	178	177	374
114	16	236	39507	400	1	1163	72	256	303	428
286	19	688	13725	525	1	2312	132	192	263	366
93	38	982	21790	431	1	2479	230	228	136	4019
91	87	770	4441	706	1	1672	76	12	185	385
555	71	100	63242	366	1	1533	212	102	318	512
243	70	209	44142	236	1	1073	91	212	289	626
115	40	209	5051	916	1	1070	195	210	133	491
463	170	285	86707	408	1	1674	54	332	365	510
301	115	226	27519	415	1	1186	98	130	271	361
140	79	191	38939	394	1	1101	118	132	368	620

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WD16 white	I18.0077B	Wall/Ceiling plaster	125		1	108312
WD16 yellow	I18.0077B	Wall/Ceiling plaster	125		144	66138
WD17 white	D9.0065	Wall/Ceiling plaster	100		1	142555
WD18 gray	D9.0104	Wall/Ceiling plaster	25	gray_mostly	1	127834
WD18 yellow	D9.0104	Wall/Ceiling plaster	25		1	132036
WD19 gray	D9.0104	Wall/Ceiling plaster	25		1	138551
WD19 yellow	D9.0104	Wall/Ceiling plaster	25	yellow_mostly	1	132353
WD20 gray	D9.0119	Wall/Ceiling plaster	-150		1	136211
WD20 red	D9.0119	Wall/Ceiling plaster	-150		952	50312
WD20 yellow	D9.0119	Wall/Ceiling plaster	-150		520	67194
WD21 gray	D9.0138	Wall/Ceiling plaster	-50		1	127592
WD21 red	D9.0138	Wall/Ceiling plaster	-50		1	105489
WD22 yellow	D9.0163	Wall/Ceiling plaster	-10		1	105930
WD23 beige	D9.0163	Wall/Ceiling plaster	-10		1	127217
WD23 red	D9.0163	Wall/Ceiling plaster	-10	red_mostly	133	100061
WD24 red	D9.0185	Wall/Ceiling plaster	100		1	83303
WD25 red	D9.0185	Wall/Ceiling plaster	100		1	83761
WD26 pink	D9.0190	Wall/Ceiling plaster	20	pink_mostly	1	114234
WD26 red	D9.0190	Wall/Ceiling plaster	20	red_mostly	1	114221
WD26 white	D9.0190	Wall/Ceiling plaster	20		1	135208
WD27 green	D9.0220	Wall/Ceiling plaster	-200		2842	91671
WD28 white	D9.0223	Wall/Ceiling plaster	-200		1	141707
WD29 red	D9.0300	Wall/Ceiling plaster	50	red_mostly	1	52380
WD29 yellow	D9.0300	Wall/Ceiling plaster	50	yellow_mostly	1	99905
WD30 red	D9.0300	Wall/Ceiling plaster	50		1	108192
WD30 white	D9.0300	Wall/Ceiling plaster	50	white_mostly	1	126852
WD31 blue	D9.0317	Wall/Ceiling plaster	50	blue_trace	79	66468
WD31 gray	D9.0317	Wall/Ceiling plaster	50		1	123904
WD31 red	D9.0317	Wall/Ceiling plaster	50	red_trace	1	129380
WD31 white	D9.0317	Wall/Ceiling plaster	50	white_mostly	1	137042
WD32 red	D9.0317	Wall/Ceiling plaster	50		45	71564
WD33 gray	D9.0317	Wall/Ceiling plaster	50	gray_dark	1	121810
WD33 gray	D9.0317	Wall/Ceiling plaster	50	gray_light	1	125368
WD34 blue	D9.0317	Wall/Ceiling plaster	50	blue_mostly	1	130687
WD34 green	D9.0317	Wall/Ceiling plaster	50	green_trace	1	94871
WD34 red	D9.0317	Wall/Ceiling plaster	50	red_mostly	1	120259
WD34 yellow	D9.0317	Wall/Ceiling plaster	50	yellow_mostly	1	104668
WD36 green	D9.0317	Wall/Ceiling plaster	50		1021	103058
WD37 red	D9.0331	Wall/Ceiling plaster	50		150	26286
WD38 gray	D9.0331	Wall/Ceiling plaster	50	gray_dark	1	121509
WD38 gray	D9.0331	Wall/Ceiling plaster	50	gray_light	40	114266
WD39 white	D9.0334	Wall/Ceiling plaster	50		1	139983
WD40 ? (primed)	D9.0334	Wall/Ceiling plaster	50		485	82709
WD41 red	D9.0334	Wall/Ceiling plaster	50	red_mostly	1	130924
WD41 white	D9.0334	Wall/Ceiling plaster	50		1	128409
WD42 white	D9.0334	Wall/Ceiling plaster	50		1	138695
WD43 yellow	D9.0412	Wall/Ceiling plaster	-50		1	121183

Continuation of table 4

Elemental Identification of Artifacts and Pigments from Ancient Ilion

80	70	232	3357	423	1	1044	233	266	122	555
586	121	301	65014	472	1	1804	104	131	266	398
42	71	123	1510	589	1	1056	219	183	226	296
32	112	249	5858	531	1	1368	79	219	181	140
33	118	240	6228	540	1	1094	234	245	149	359
4	22	76	4211	550	1	1166	205	159	109	361
50	43	94	14599	402	1	1200	194	227	264	529
76	7	186	3545	519	1	1451	126	182	156	118
210	102	679	96250	1885	1258	1748	141	285	396	931
212	160	210	44703	13734	304	1628	91	83	146	301
87	19	134	4326	823	1	1231	222	170	143	481
4	188	184	60031	635	571	773	253	149	423	619
160	109	85	58741	391	166	1158	150	163	257	591
103	100	217	9825	398	1	1460	167	239	122	371
120	122	298	13158	3385	1	1618	170	242	217	463
901	214	124	40208	405	689	1339	123	189	213	227
938	97	180	37956	301	229	1375	107	99	324	699
146	103	102	8384	497	1	1965	179	97	176	1653
71	39	63	34922	291	71	1425	7	143	271	1772
58	53	181	2849	687	1	1237	115	79	149	361
299	35	289	19255	444	1	1561	90	169	228	292
16	38	164	2046	656	1	1558	242	106	92	111
824	165	127	102717	488	1	1549	193	166	240	2227
313	67	55	39559	335	1	1248	234	169	274	742
271	63	99	18742	350	1	1278	174	157	250	322
93	56	38	4543	534	1	989	283	132	136	238
299	93	212	12016	29495	1	1962	92	151	122	2032
173	90	234	5023	740	1	2174	150	231	109	184
103	60	189	4055	610	1	2106	215	127	119	368
16	68	135	2485	561	1	1222	350	126	124	178
841	78	172	49961	311	1074	1591	216	239	193	649
253	59	207	5171	536	1	1121	145	152	148	198
234	12	214	4263	685	1	1356	150	187	90	240
45	73	180	3784	550	1	1133	183	357	150	552
200	35	267	7239	10729	10806	1120	218	337	143	5554
151	20	140	10232	1184	706	972	128	159	172	673
133	79	67	12517	7347	7162	959	112	217	82	3628
178	62	264	24187	385	78	1281	128	164	169	552
989	154	535	171638	442	1	1167	34	128	267	2837
125	64	47	3103	432	1	1029	133	122	137	198
228	55	212	7087	402	1	1207	188	118	164	311
31	46	102	2040	605	1	1136	191	118	176	254
396	148	581	25534	498	1	1639	271	272	243	307
80	30	205	12447	559	1	1591	182	156	281	367
124	54	248	2822	712	1	1813	119	197	110	314
67	46	123	1525	543	1	831	138	193	181	191
15	98	58	42758	345	223	776	72	176	324	651

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WD44 gray	D9.0412	Wall/Ceiling plaster	-50		1	129688
WD44 red	D9.0412	Wall/Ceiling plaster	-50	red_mostly	1	101235
WD44 white	D9.0412	Wall/Ceiling plaster	-50		1	138666
WD44 yellow	D9.0412	Wall/Ceiling plaster	-50		1	36953
WD46 white	D9.0431	Wall/Ceiling plaster	-50		1	125534
WD47 white	K13.0267C	Wall/Ceiling plaster	375		1	126536
WD48 yellow	K13.0267B	Wall/Ceiling plaster	375		4661	56809
WD49 red	K13.0267A	Wall/Ceiling plaster	375		128	35874
WD49 yellow	K13.0267A	Wall/Ceiling plaster	375	yellow_mostly	1197	81359
WD50 red	D9.0488	Wall/Ceiling plaster	50	red_mostly	1	101867
WD50 white	D9.0488	Wall/Ceiling plaster	50		1	120977
WD51 red	D2.0065	Wall/Ceiling plaster	-150		1	125347
WD53 red	D9.0502	Wall/Ceiling plaster	100	red_lowerlayer	1	82433
WD53 red	D9.0502	Wall/Ceiling plaster	100	red_upperlayer	1	64924
WD55 yellow	D9.0550	Wall/Ceiling plaster	25		1	120126
WD56 black	D9.0561	Wall/Ceiling plaster	100		1	124035
WD58 red	D9.0576	Wall/Ceiling plaster	100		98	72301
WD59 green	H17.0053	Wall/Ceiling plaster	25		2845	85016
WD59 white	H17.0053	Wall/Ceiling plaster	25	white_mostly	1009	95941
WD60 purple	H17.0053	Wall/Ceiling plaster	25	purple_dark	1	67457
WD60 purple	H17.0053	Wall/Ceiling plaster	25	purple_light	273	85370
WD61 ochre	H17.0053	Wall/Ceiling plaster	25		375	88226
WD61 red	H17.0053	Wall/Ceiling plaster	25		369	66263
WD62 red	H17.0053	Wall/Ceiling plaster	25		1	83194
WD62 white	H17.0053	Wall/Ceiling plaster	25		1	114920
WD63 blue	H17.0053	Wall/Ceiling plaster	25		2828	73139
WD63 gray	H17.0053	Wall/Ceiling plaster	25		1	125448
WD63 ochre	H17.0053	Wall/Ceiling plaster	25		344	83227
WD63 red	H17.0053	Wall/Ceiling plaster	25		194	83998
WD64 red	D20.0088	Wall/Ceiling plaster	375		1	111613
WD66 gray	K17.0435	Wall/Ceiling plaster	150		1	116050
WD66 green	K17.0435	Wall/Ceiling plaster	150	green_mostly	1	74920
WD66 red	K17.0435	Wall/Ceiling plaster	150	red_mostly	1	58183
WD66 yellow	K17.0435	Wall/Ceiling plaster	150		1	95499
WD69 red	K17.0525	Wall/Ceiling plaster	150		379	52742
WD69 white	K17.0525	Wall/Ceiling plaster	150		1	130729
WD70 green	D9.2054	Wall/Ceiling plaster	25		3017	35049
WD70 pink	D9.2054	Wall/Ceiling plaster	25		1503	38013
WD70 red	D9.2054	Wall/Ceiling plaster	25		1282	48903
WD70 white	D9.2054	Wall/Ceiling plaster	25		1	100988
WD71 red	z6.0127	Wall/Ceiling plaster	-250		1	105089
WD72 pink	z6.0129	Wall/Ceiling plaster	-225		1	109676
WD72 white	z6.0129	Wall/Ceiling plaster	-225		1	131801
WD73 red	z6.0131	Wall/Ceiling plaster	-150		1	108465
WD73 white	z6.0131	Wall/Ceiling plaster	-150		1	64713
WD73 yellow	z6.0131	Wall/Ceiling plaster	-150	yellow_trace	1	43548
WD74 white	z6.0135	Wall/Ceiling plaster	-150		1	90001

Continuation of table 4

Elemental Identification of Artifacts and Pigments from Ancient Ilion

93	73	191	4473	586	1	971	275	164	139	338
68	109	236	72239	656	318	842	63	137	430	911
46	72	113	2086	598	80	1080	68	141	70	420
96	149	1183	205529	460	1	511	132	169	596	1900
93	155	344	3788	516	1	1090	77	171	137	336
130	80	233	4679	555	1	1256	20	229	77	260
924	46	387	27714	552	1	904	142	230	129	510
1015	140	420	133232	589	1	689	127	326	191	1410
366	67	341	19168	722	81	968	45	187	137	523
397	76	212	18629	374	1	1254	172	252	222	370
127	104	163	4245	421	1	1063	127	183	68	252
120	142	130	9507	347	1	1160	142	126	145	396
834	122	164	38907	181	294	1499	330	205	204	624
1462	174	90	52936	341	690	1438	93	141	229	464
14	70	65	42555	276	327	847	252	167	450	662
135	103	127	3736	579	1	1087	265	118	33	349
284	147	179	43104	261	413	1349	99	179	203	643
242	158	148	39021	310	1	1243	138	179	403	266
157	104	192	28098	285	1	3459	166	231	264	259
231	31	244	99015	250	1387	727	134	250	410	1496
169	119	317	38685	293	715	917	132	158	218	1068
582	79	105	48418	430	1	1177	243	118	298	496
627	156	179	84739	415	551	1353	172	163	371	1025
291	76	193	31851	298	1	1264	173	182	154	500
133	55	243	6180	518	1	1503	133	206	186	307
554	219	293	49545	350	796	1316	154	172	264	813
68	83	271	5113	569	1	900	217	290	140	197
435	208	198	57345	271	732	1408	213	128	246	539
503	105	152	63130	346	630	1340	114	198	386	765
191	46	227	29140	361	1	1104	66	250	222	407
90	142	178	28118	398	1	1164	165	263	530	352
75	67	153	5019	44664	62399	1066	218	254	753	16114
105	73	62	5280	51455	64176	963	117	101	5571	13930
128	173	192	43591	286	1	1204	110	238	356	337
1363	144	152	113288	588	450	658	74	111	350	695
127	79	265	5750	525	1	788	184	122	189	382
677	77	314	32029	758	1	1331	196	343	128	693
426	139	373	17688	647	1	1646	144	134	130	530
724	115	340	28360	491	1	1355	318	192	254	309
94	154	304	5020	556	1	1224	108	193	111	272
380	84	134	13115	414	1	1664	194	88	152	437
528	139	58	6655	502	1	942	91	219	121	316
101	115	320	3066	1051	1	934	142	136	116	647
183	162	259	15938	442	1	939	22	210	72	1588
2553	194	74	5614	825	1	1294	40	186	288	1950
873	113	132	8980	596	1	1385	143	210	316	39756
1403	91	143	4892	652	1	1316	117	76	81	740



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WD74 white	z6.0135	Wall/Ceiling plaster	-150		1	121795
WD76 white	z6.0094	Wall/Ceiling plaster	-85		1	126073
WD76 yellow	z6.0094	Wall/Ceiling plaster	-85		1	99124
WD77 gray	z8.0141	Wall/Ceiling plaster	-225	gray_dark	1	113327
WD77 gray	z8.0141	Wall/Ceiling plaster	-225	gray_light	1	115934
WD77 red	z8.0141	Wall/Ceiling plaster	-225	red_mostly	1	108848
WD77 tan	z8.0141	Wall/Ceiling plaster	-225		1	109147
WD78 gray	z8.0082	Wall/Ceiling plaster	-225		1	115482
WD78 red	z8.0082	Wall/Ceiling plaster	-225		1	111816
WD78 yellow	z8.0082	Wall/Ceiling plaster	-225		37	101087
WD79 gray	z8.0031	Wall/Ceiling plaster	-225		1	113723
WD79 red	z8.0031	Wall/Ceiling plaster	-225		1	107574
WD79 yellow	z8.0031	Wall/Ceiling plaster	-225		362	90468
WD80 red	z8.0203	Wall/Ceiling plaster	-150		1	110495
WD81 blue	z8.0451	Wall/Ceiling plaster	-225	blue_dark	1	118519
WD81 blue	z8.0451	Wall/Ceiling plaster	-225	blue_light	1	128250
WD81 blue	z8.0451	Wall/Ceiling plaster	-225	blue_dark	1	129031
WD81 blue	z8.0451	Wall/Ceiling plaster	-225	blue_light	1	129708
WD81 gray	z8.0451	Wall/Ceiling plaster	-200		1	103950
WD81 red	z8.0451	Wall/Ceiling plaster	-225		1	123506
WD81 red	z8.0451	Wall/Ceiling plaster	-225	red_mottled	1	102423
WD81 red	z8.0451	Wall/Ceiling plaster	-225		1	118214
WD81 red	z8.0451	Wall/Ceiling plaster	-200		1	106852
WD81 yellow	z8.0451	Wall/Ceiling plaster	-200		612	76655
WD81 yellow	z8.0451	Wall/Ceiling plaster	-225		1	83283
WD82 red	C29.0086	Wall/Ceiling plaster	125	red_mostly	894	50450
WD82 white	C29.0086	Wall/Ceiling plaster	125		893	70951
WD82 yellow	C29.0086	Wall/Ceiling plaster	125		3770	71905
WD85 red	E/F10.0164	Wall/Ceiling plaster	375		1	89108
WD85 white	E/F10.0164	Wall/Ceiling plaster	375		1	119903
WD85 yellow	E/F10.0164	Wall/Ceiling plaster	375		1	110572
WD91 gray	z8.1565	Wall/Ceiling plaster	-175	gray_dark	1	120117
WD91 gray	z8.1565	Wall/Ceiling plaster	-175	gray_light	1	104669
WD91 red	z8.1565	Wall/Ceiling plaster	-175	red_mostly	1	111671
WD91 yellow	z8.1565	Wall/Ceiling plaster	-175	yellow_mostly	1	101046
WD92 red	E/F10.0165	Wall/Ceiling plaster	400		1	112108
WD92 white	E/F10.0165	Wall/Ceiling plaster	400		1	123761
WD93 red	E/F10.0166	Wall/Ceiling plaster	400		1	108466
WD93 white	E/F10.0166	Wall/Ceiling plaster	400		1	118824
WD94 black	E9.1236	Wall/Ceiling plaster	?	black_mostly	1	119005
WD94 blue	E9.1236	Wall/Ceiling plaster	?		1	71977
WD94 white	E9.1236	Wall/Ceiling plaster	?		1	135542
WD95a gray	z8.1573	Wall/Ceiling plaster	-150	gray_dark	1	108563
WD95a gray	z8.1573	Wall/Ceiling plaster	-150	gray_light	1	114363
WD95a red	z8.1573	Wall/Ceiling plaster	-150		1	117021
WD95a yellow	z8.1573	Wall/Ceiling plaster	-150		1	101492
WD95b gray	z8.1573	Wall/Ceiling plaster	-150	gray_dark	1	95440

Continuation of table 4

Elemental Identification of Artifacts and Pigments from Ancient Iliion

368	159	105	3768	724	1	885	95	166	117	1410
96	92	106	3781	533	1	1094	87	269	226	240
84	64	121	63612	278	1	955	119	75	307	965
178	216	313	12305	426	1	1579	126	185	143	403
143	122	296	9229	392	1	1784	167	196	233	374
182	71	194	12898	518	1	1745	136	196	214	497
176	87	254	18030	430	1	1862	259	182	336	350
98	32	272	6427	469	81	1391	122	207	106	1124
104	99	302	12698	555	1	1462	27	164	250	600
108	112	230	20575	317	1	1535	107	217	212	400
124	128	373	6595	621	1	1469	229	108	132	298
86	22	165	15098	435	89	1923	217	260	286	531
97	53	277	34238	302	1	1944	110	218	229	590
106	129	253	27264	345	1	1527	63	253	230	755
207	64	279	8473	529	1	1476	97	139	130	367
142	159	189	6203	596	1	1468	111	193	130	265
122	80	180	4746	443	1	1539	181	100	184	342
211	1	356	4652	464	1	1925	285	220	154	424
198	103	559	9793	338	1	1714	180	234	176	435
137	144	356	21831	308	101	1269	257	290	209	538
251	33	267	43913	274	1	1282	151	286	226	916
178	69	368	21029	242	1	1674	220	83	228	544
205	32	262	11112	520	1	1757	199	265	208	490
192	103	439	44035	488	1	1794	155	153	243	297
308	10	913	84064	275	1	1430	58	204	411	753
991	115	418	57618	564	1	1424	141	112	184	1400
717	47	271	19188	457	1	1265	173	251	181	1000
489	87	471	32506	612	1	1275	225	157	163	711
265	117	440	56365	310	846	730	215	242	379	604
135	62	316	4211	657	1	912	271	230	65	194
243	112	117	11821	464	36	960	78	148	134	594
152	83	468	7596	551	1	1750	206	158	247	372
337	12	783	10697	559	3	1933	147	232	248	534
116	79	386	17629	517	1	1431	170	160	308	484
162	82	590	40722	366	1	1503	-6	160	350	490
119	47	133	25286	566	191	887	239	178	142	420
153	75	148	5255	477	1	892	332	202	93	264
183	70	319	22559	343	132	896	133	170	244	420
160	93	164	6135	446	1	1003	239	182	109	680
96	110	158	4818	2239	460	1014	145	68	95	399
228	132	133	6311	42988	449	971	222	379	30	333
108	170	55	2343	745	1	843	64	173	241	399
152	103	305	12409	491	1	1729	193	183	176	256
180	93	250	6399	374	1	1470	34	378	113	428
162	68	374	10525	441	1	1779	146	218	149	575
187	130	515	19331	551	1	1688	91	161	156	448
247	119	380	10103	604	1	1555	181	142	177	413

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WD95b gray	z8.1573	Wall/Ceiling plaster	-150	gray_light	1	111991
WD96a gray	z8.1604	Wall/Ceiling plaster	-150	gray_dark	1	99980
WD96a gray	z8.1604	Wall/Ceiling plaster	-150	gray_light	1	107799
WD96a red	z8.1604	Wall/Ceiling plaster	-150		1	99150
WD96b gray	z8.1604	Wall/Ceiling plaster	-150	gray_dark	1	113610
WD96b gray	z8.1604	Wall/Ceiling plaster	-150	gray_light	1	111794
WD96b red	z8.1604	Wall/Ceiling plaster	-150		1	106893
WD96b yellow	z8.1604	Wall/Ceiling plaster	-150	yellow_mostly	27	97076
WD97 white	z8.1604	Wall/Ceiling plaster	-150		1	128060
WD98 gray	z8.1608	Wall/Ceiling plaster	-150		1	119641
WD98 red	z8.1608	Wall/Ceiling plaster	-150		1	106762
WD99a gray	z8.1608	Wall/Ceiling plaster	-150		1	111385
WD99a red	z8.1608	Wall/Ceiling plaster	-150		1	101838
WD99a yellow	z8.1608	Wall/Ceiling plaster	-150		266	66711
WD99b gray	z8.1608	Wall/Ceiling plaster	-150	gray_dark	1	116022
WD99b gray	z8.1608	Wall/Ceiling plaster	-150	gray_light	1	104522
WD99b red	z8.1608	Wall/Ceiling plaster	-150		1	99902
WD99b yellow	z8.1608	Wall/Ceiling plaster	-150		118	91928
WD100 white	A8/9.0080	Wall/Ceiling plaster	-133		1	121761
WD101 beige	D/E11/12.0001	Wall/Ceiling plaster	375		1	101201
WD101 red	D/E11/12.0001	Wall/Ceiling plaster	375		1	98651
WD102 blue	t14.0750	Wall/Ceiling plaster	-225		1	65996
WD102 red	t14.0750	Wall/Ceiling plaster	-225	red_mostly	462	55842
WD102 red	t14.0750	Wall/Ceiling plaster	-225		526	44603
WD103 red	A5/6.0359	Wall/Ceiling plaster	25		826	58721
WD103 white	A5/6.0359	Wall/Ceiling plaster	25		1	132051
(uninventoried) black	G27.40.44.32.34	Wall/Ceiling plaster	375		1	110575
(uninventoried) blue	G27.40.44.32.34	Wall/Ceiling plaster	375		476	44262
(uninventoried) green	G27.40.44.32.34	Wall/Ceiling plaster	375		870	91423
(uninventoried) red	G27.40.44.32.34	Wall/Ceiling plaster	375		1	91168
(uninventoried) white	G27.40.44.32.34	Wall/Ceiling plaster	375		1	113881
(uninventoried) yellow	G27.40.44.32.34	Wall/Ceiling plaster	375		246	52672
(uninventoried) black	H17.53	Wall/Ceiling plaster	25		1	117926
(uninventoried) blue	H17.53	Wall/Ceiling plaster	25	blue_dark	1	110836
(uninventoried) blue	H17.53	Wall/Ceiling plaster	25	blue_light	1	106289
(uninventoried) green	H17.53	Wall/Ceiling plaster	25		3244	68485
(uninventoried) orange	H17.53	Wall/Ceiling plaster	25		118	64815
(uninventoried) red	H17.53	Wall/Ceiling plaster	25		1	83028
(uninventoried) white	H17.53	Wall/Ceiling plaster	25		1	125137
(uninventoried) yellow	H17.53	Wall/Ceiling plaster	25		532	59803
(uninventoried) blue	A8/9.9	Wall/Ceiling plaster	-133		1	109911
(uninventoried) red	A8/9.9	Wall/Ceiling plaster	-133		1	122211
(uninventoried) bluegray	A8/9.50	Wall/Ceiling plaster	-133		1	119840
(uninventoried) bluegray	A8/9.50	Wall/Ceiling plaster	-133	bluegray_dark	1	128378
(uninventoried) orange	A8/9.50	Wall/Ceiling plaster	-133		1	105616
(uninventoried) red	A8/9.50	Wall/Ceiling plaster	-133		0	26061
(uninventoried) yellow	A8/9.50	Wall/Ceiling plaster	-133		1	95479

Continuation of table 4

Elemental Identification of Artifacts and Pigments from Ancient Iliion

134	101	207	9044	413	1	1681	47	178	294	447
269	51	254	9613	356	1	1729	155	112	-1	345
172	162	262	8722	647	1	1880	114	203	66	257
214	29	371	19269	326	1	1596	129	225	111	463
112	80	318	6582	517	1	1848	179	144	101	316
191	65	284	7826	562	1	1886	149	196	86	489
164	56	185	28725	273	118	1766	30	287	274	685
155	65	193	27578	472	1	2024	200	165	182	319
71	28	252	4937	498	1	1387	253	269	143	418
67	51	316	5706	561	1	1610	171	187	109	316
106	219	436	19401	481	1	1694	110	84	164	664
97	34	407	6806	481	1	1544	117	204	353	331
174	138	355	30147	365	1	1634	96	208	391	820
219	95	532	55123	496	1	1738	55	153	241	416
54	86	747	6961	572	1	1675	243	87	81	322
364	82	186	8381	402	1	1425	171	261	69	321
216	115	174	8122	481	1	1261	149	160	144	275
142	92	282	29063	453	1	1686	266	167	237	337
63	56	127	2566	515	1	1730	238	254	210	274
243	112	150	12674	1017	231	2477	148	186	148	1173
195	85	106	17453	668	308	2013	123	99	137	924
261	80	152	6976	63240	1	1264	182	236	170	190
668	76	671	91377	517	1486	1073	161	142	244	1176
244	54	251	8862	377	693	1594	172	176	62037	627
1090	154	251	86755	353	1	1300	169	168	339	288
86	32	235	3089	480	1	1212	74	234	205	333
106	87	99	3100	426	1	1295	216	192	145	338
360	1	367	27288	52862	260	2204	204	104	135	1449
101	113	560	22019	624	1	804	92	124	230	347
126	59	138	38323	328	323	996	117	127	143	683
208	71	344	3470	579	1	893	148	162	144	240
686	1	733	56289	334	1	1480	196	97	304	377
66	4	524	3267	475	1	2409	69	89	183	310
105	106	194	4466	504	1	1133	129	148	97	253
207	81	220	5997	469	1	988	161	257	100	181
145	41	106	44491	587	1	1408	107	138	279	234
424	207	272	53003	384	82	2005	227	171	216	418
206	25	352	35205	313	1	1346	41	192	162	5516
76	33	174	1917	532	1	1144	157	172	168	264
727	147	260	57358	368	1	2677	51	164	245	346
178	73	120	14216	4914	1	2808	315	248	150	562
97	182	42	19155	303	1	1031	108	172	269	737
88	108	317	2631	7880	1	1780	158	140	77	234
30	67	337	2750	2237	1	1416	99	100	206	263
100	56	463	55389	79	1391	821	136	173	422	478
90	77	192	3794	479	69	1532	105	101	77396	913
60	20	407	79649	704	1	1326	118	217	689	467

William Aylward – William Marx – Donna Strahan

(uninventoried) red	A8/9.73	Wall/Ceiling plaster	-133		1	103258
(uninventoried) black	A8/9.83	Wall/Ceiling plaster	-133		1	125915
(uninventoried) white	A8/9.84	Wall/Ceiling plaster	-133		1	137077
(uninventoried) yellow	A8/9.86	Wall/Ceiling plaster	-133		1	95639
(uninventoried) white	A8/9.91	Wall/Ceiling plaster	-133		1	132541
(uninventoried) blue	D20	Wall/Ceiling plaster	375		143	63513
(uninventoried) green	D20	Wall/Ceiling plaster	375		2858	60707
(uninventoried) purple	D20	Wall/Ceiling plaster	375		1	85559
(uninventoried) red	D20	Wall/Ceiling plaster	375	red_dark	79	47437
(uninventoried) red	D20	Wall/Ceiling plaster	375	red_light	1	92522
(uninventoried) red	D20	Wall/Ceiling plaster	375	red_white	223	80762
				background		
(uninventoried) white	D20	Wall/Ceiling plaster	375		1	115537
(uninventoried) red	x24.4_05.83	Wall/Ceiling plaster	-150		1	90525
(uninventoried) red	y9.17	Wall/Ceiling plaster	-133		1	38256
(uninventoried) yellow	y9.17	Wall/Ceiling plaster	-133		1	75275
(uninventoried) red	z6.16	Wall/Ceiling plaster	-133		1	42798
(uninventoried) white	z6.16	Wall/Ceiling plaster	-133		1	134816
(uninventoried) red	z6.17	Wall/Ceiling plaster	-375		1	99848
(uninventoried) yellow	z6.17	Wall/Ceiling plaster	-375		268	75404
(uninventoried) red	z6.41	Wall/Ceiling plaster	-354		241	85174
(uninventoried) white	z6.41	Wall/Ceiling plaster	-354		1	115306
(uninventoried) yellow	z6.41	Wall/Ceiling plaster	-354		126	106414
(uninventoried) yellow	z8/9.28	Wall/Ceiling plaster	-225		1	91084
(uninventoried) red	z8/9.36	Wall/Ceiling plaster	-225	red_dark	1	72886
(uninventoried) red	z8/9.36	Wall/Ceiling plaster	-225	red_light	1	51989
(uninventoried) yellow	z8/9.36	Wall/Ceiling plaster	-225		125	86749
(uninventoried) red	z8.40	Wall/Ceiling plaster	-225		300	71778
(uninventoried) yellow	z8.40	Wall/Ceiling plaster	-225		320	76952
(uninventoried) white	z8.425	Wall/Ceiling plaster	-225		1	117350
(uninventoried) blue	z/A7.2318	Wall/Ceiling plaster	-1200	"Egyptian blue"	138	37347

Elemental Identification of Artifacts and Pigments from Ancient Ilion

329	148	336	27163	242	1	1004	178	137	186	323
78	67	589	2787	554	1	1573	249	247	180	265
38	2	117	1227	465	1	1225	281	240	162	252
46	88	274	57714	239	293	1299	192	124	324	1111
16	110	168	3492	370	3	958	211	132	112	297
319	94	140	10841	36862	446	582	107	192	78	3337
419	160	452	50748	419	1	647	170	126	156	256
208	30	210	44041	276	359	623	138	171	279	857
760	412	222	107472	405	992	1106	277	180	365	1569
222	63	564	20228	331	1	1086	103	203	203	758
330	124	269	32040	223	1	876	97	227	202	394
132	82	159	5599	464	1	587	165	114	176	279
202	83	262	51227	230	1	1020	205	187	388	2175
487	34	250	22621	384	885	1258	218	142	47276	532
636	12	175	57882	207	1	958	106	136	359	696
1853	110	112	77651	200	1035	953	121	187	329	677
50	58	152	1701	516	1	992	125	93	184	222
216	92	72	33315	227	269	1530	156	194	260	457
356	108	159	62090	321	1	2797	198	100	327	711
382	21	102	24988	321	1	1429	121	152	207	563
285	70	211	7570	417	1	1285	166	170	231	363
214	174	108	11401	382	1	1236	-21	204	133	188
139	51	122	46941	695	471	1485	106	104	316	3067
214	92	276	33333	388	597	1316	126	225	2051	295
410	45	573	6187	628	233	1683	144	248	45873	427
232	47	469	40360	720	431	1736	180	203	207	601
430	99	251	37066	332	1	1693	66	207	295	5065
607	157	139	36752	290	1	1550	174	147	291	3110
174	103	368	6273	434	1	1293	245	72	209	347
125	29	137	4286	58512	134	848	35	274	99	108



Inventory	Behalter	Function	Date	Number of Samples	Al	Fe	Co
10536 (Parion medicine box)	?	Lid	early Roman	1	10	359	-17
10536 (Parion medicine box)	?	Box (rim)	early Roman	2	24	340	4
10536 (Parion medicine box)	?	Instrument container	early Roman	1	7	66	2
10536 (Parion medicine box)	?	Hook (shaft)	early Roman	2	13	44	8
10536 (Parion medicine box)	?	Hook (grip)	early Roman	1	33	57	4
10536 (Parion medicine box)	?	Spoon	early Roman	1	7	275	0
10536 (Parion medicine box)	?	Pill (large, dark brown)	early Roman	1	5	85761	3457
10536 (Parion medicine box)	?	Pill (large, white, tan coating)	early Roman	1	1	4499	60
10536 (Parion medicine box)	?	Pill (light brown)	early Roman	1	1	9616	327
10536 (Parion medicine box)	?	Pill (small, dark brown)	early Roman	1	1	5117	155
? (Gümüşçay cart)	?	Band (1)	late 6th c. B.C.	1	6	84	4
? (Gümüşçay cart)	?	Band (2)	late 6th c. B.C.	1	6	361	9
? (Gümüşçay cart)	?	Curve (flat)	late 6th c. B.C.	1	15	53	10
? (Gümüşçay cart)	?	Ring	late 6th c. B.C.	3	10	458	53
? (Gümüşçay cart)	?	Rivet	late 6th c. B.C.	1	6	326	6
? (Gümüşçay cart)	?	White deposit	late 6th c. B.C.	1	1	8002	131
? (Gümüşçay cart)	?	Hub projection (1) tip	late 6th c. B.C.	1	7	6064	37
? (Gümüşçay cart)	?	Hub projection (1) midpoint	late 6th c. B.C.	2	16	301	28
? (Gümüşçay cart)	?	Hub projection (1) curved end	late 6th c. B.C.	1	1	104	1
? (Gümüşçay cart)	?	Hub projection (2)	late 6th c. B.C.	1	3	550	22
? (Gümüşçay cart)	?	Hub projection (3) midpoint	late 6th c. B.C.	1	5	3409	68
? (Gümüşçay cart)	?	Hub projection (3) pin interface	late 6th c. B.C.	1	14	17005	183
? (Gümüşçay cart)	?	Hub projection (4)	late 6th c. B.C.	2	12	814	30
? (Gümüşçay cart)	?	Ring without pin (1)	late 6th c. B.C.	1	18	151	5
? (Gümüşçay cart)	?	Ring without pin (2) cleaned	late 6th c. B.C.	1	18	395	22
? (Gümüşçay cart)	?	Ring without pin (2) corroded	late 6th c. B.C.	1	9	1264	1
? (Gümüşçay cart)	?	Ring with pin (1)	late 6th c. B.C.	1	10	1090	52
? (Gümüşçay cart)	?	Ring with pin (2)	late 6th c. B.C.	1	16	127	6
? (Gümüşçay cart)	?	Ring with pin (2) pin interface	late 6th c. B.C.	1	26	18864	206
? (Gümüşçay cart)	?	Ring with pin (3)	late 6th c. B.C.	1	18	390	1

Table 5: Quantification of major elements identified for artifacts tested in the Çanakkale Archaeological Museum from Parion and Gümüşçay.

Inventory	Behalter	Material Painted	Date	Number	Notes	K	Ca
of Samples							
SS39	E10.0120	Marble (Hadrian)	124	1	tunic at left arm	1	61992
SS39	E10.0120	Marble (Hadrian)	124	1	tunic at left flank	1	48113
SS39	E10.0120	Marble (Hadrian)	124	1	tunic at Medusa head	1	48873
235	?	Gravestone	Hellenistic	3		1	55099
?	L4	Marble (female figure)	?	1		1	36193
?	L4	Marble (female figure)	?	1	border	1	86156
?	L4	Marble (female figure)	?	1	knee	1	89611
10219	?	Torso	?	2		50	71890

Table 6: Quantification of major elements identified for marble artifacts tested in the Çanakkale Archaeological Museum.

Elemental Identification of Artifacts and Pigments from Ancient Ilion

Ni	Cu	Zn	As	Ag	Sn	Sb	Au	Pb	Bi
1744	185410	3152	197	103	1567	20	14	66	117
963	163044	3390	346	98	1955	28	9	789	129
2	26821	101	20	62	918	7	9	66	9
6	31102	67	1	82	1836	19	6	361	14
24	30091	117	1	14631	1521	20	68	518	8
1	83168	13141	8	103	403	16	5	56	15
0	81899	11061	154	91	532	41	34	3507	95
11	21952	65968	1	139	206	-3	208	44565	221
49	19551	24312	418	193	284	13	328	67622	251
49	33254	10628	1	134	326	59	193	64051	411
4	1734	1	1	43	24	20	7	5682	42
12	29020	55	1	49	32	12	3	1476	20
3	13540	20	1	62	181	29	5	2546	21
73	72404	167	32	51	271	4	6	76	11
25	31177	33	1	47	18	20	5	13447	103
416	207	69	51	457	28	42	77	119	69
4	1355	1	1	64	35	26	18	19400	104
30	58240	123	24	46	1802	66	-1	7031	67
42	16386	5	1	52	487	19	-4	24289	126
32	53696	154	1	52	726	15	3	2473	36
21	29049	24	1	35	50	12	-1	8680	63
1	587	6	1	43	25	16	6	1214	14
22	45450	110	1	91	1004	27	8	2181	37
86	69829	137	1	48	1080	15	4	86	13
150	67105	176	1	57	487	35	6	47	8
28	63493	196	10	82	96	20	8	16	10
1	33263	51	1	54	71	13	1	4619	36
31	37751	73	1	64	1229	6	-3	6469	55
1	7759	5	1	67	14	25	4	779	16
30	72289	239	2	85	660	24	4	267	21

Ti	Cr	Mn	Fe	Cu	As	Sr	Mo	Sn	Hg	Pb
23	26	224	944	712	1	259	39	128	190	103
123	27	328	3916	321	1	220	72	160	63	133
66	62	114	1143	268	1	176	-19	92	65	241
28	327	61	675	295	1	177	22	79	281	116
169	38	190	4567	253	1	314	14	73	57	109
41	31	38	1739	344	1	505	94	48	77	116
96	40	54	1950	311	1	561	-22	106	88	177
448	27	705	18354	188	1	434	30	100	87	127