

## **Die Türbe im Artemision**

Ein frühosmanischer Grabbau in Ayasuluk/Selçuk und  
sein kulturhistorisches Umfeld



SABINE LADSTÄTTER

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und sein kulturhistorisches Umfeld

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## MEDIEVAL CERAMICS FROM THE TÜRBE: AN ARCHAEO-METRIC VIEWPOINT<sup>1</sup>

### 1. INTRODUCTION

In the past archaeological research in Ephesos has mainly focused on the Greco-Roman remains but information about the later periods is gradually also becoming available<sup>2</sup>. The Türbe excavations, therefore, provided a good opportunity to develop interdisciplinary approaches to the Byzantine and Turkish occupations of the site. Previous archaeological and archaeometric studies of Medieval ceramics from the Artemision<sup>3</sup> made it possible for us to define and characterize parts of the local repertoire, further complemented by studies in Hamam<sup>4</sup>. However, the lack of stratified contexts in the older excavations of the Artemision made it difficult to place this material within the broader framework of pottery production in Ephesos, and more generally in Medieval Western Anatolia.

Furthermore, our knowledge of Byzantine and post-Byzantine ceramics workshops in the region has significantly improved over the last years, thanks to extensive studies<sup>5</sup> and to research focused more specifically on single sites such as Pergamon, Ephesos, Anaia and Miletos<sup>6</sup>. Traces of local production are present at many sites<sup>7</sup> and archaeometric studies have provided tools for a better definition of Western Anatolian Medieval ceramics and more comprehensive approaches to their production and diffusion<sup>8</sup>.

The Türbe excavation has supplied further evidence for pottery manufacture in Ephesos/Ayasuluk, as layers of rubefied soil associated to kiln furniture and wasters were found under the foundations of the Türbe<sup>9</sup>. They also offer the opportunity to study Medieval ceramics in Ephesos in context. In spite of the high degree of fragmentation of the sherds, it was hoped that connections with the Artemision material, better preserved but without contexts, would enable us to complete the picture reached in 2005<sup>10</sup>. These excavations did supply several examples similar to the main ›middle Byzantine production‹ manufactured in Chalkis<sup>11</sup> whose chronology in the 12<sup>th</sup> and 13<sup>th</sup> centuries is well established thanks to research carried out in Corinth<sup>12</sup>. These

<sup>1</sup> Many thanks to J. Vroom and to S. Ladstätter for giving us the opportunity to carry out this study. Part of it was undertaken as an MA subject by M.-M. Carysiotis while an intern in the »Laboratoire de Céramologie« in Lyon. Other parts were completed in the framework of: the POMEDOR project, funded by the French National Research Agency (ANR) and we acknowledge the support of the ANR under reference ANR-12-CULT-0008; the French-Polish PICS program directed by A. Peignard-Giros (University Lumière-Lyon 2, HiSoMA, Lyon) and H. Meyza (Institute of Mediterranean and Oriental Cultures, Polish Academy of Sciences, Warsaw). We are grateful to them as well as to the CNRS (French National Center for Scientific Research). We would like to thank G. Parrer for his help, E. Findik, N. Math and members of the Ephesos team for the drawings, and the staff of the »Laboratoire de Céramologie«.

<sup>2</sup> Krinzinger 2005; Ladstätter 2010; Pfeiffer-Taş 2010a.

<sup>3</sup> Vroom 2005b; Sauer – Waksman 2005.

<sup>4</sup> Pfeiffer-Taş 2011; Okyar et al. 2011.

<sup>5</sup> Böhlendorf-Arslan 2004.

<sup>6</sup> Spieser 1996; Doğer 2004; Vroom 2005b; Mania 2006; Böhlendorf-Arslan 2008; İnanan 2010.

<sup>7</sup> Böhlendorf-Arslan 2004, III, map 6.

<sup>8</sup> E.g. Waksman 1995; Waksman – Spieser 1997; Waksman – François 2004/2005; Sauer – Waksman 2005; Waksman 2013.

<sup>9</sup> G. Parrer, in this volume; J. Vroom – E. Findik, in this volume.

<sup>10</sup> Sauer – Waksman 2005.

<sup>11</sup> Waksman – von Wartburg 2006; Waksman et al. 2014.

<sup>12</sup> Sanders 2000; Sanders 2003b.

periods have been little documented so far in Ephesos/Ayasuluk<sup>13</sup> and represent an earlier phase of occupation when compared to the Artemision material<sup>14</sup>.

The aim of the present investigations is, on the one hand, to gain further knowledge about pottery production in Ephesos during the Medieval period, using chemical analysis and building on the preliminary study of the Artemision material<sup>15</sup>. On the other hand, analyses have made it possible for us to test the hypothesis of the presence of the main ›middle Byzantine production‹ in Ephesos, thanks to comparative data available at the »Laboratoire de Céramologie« in Lyon<sup>16</sup>, whose database was also used to investigate the origin of other imports.

## 2. SAMPLING

The sampling (tab. 1 pls. 1–5) was selected by J. Vroom<sup>17</sup>, with some later additions by the authors. It included the following categories:

- reference and possible reference samples for local production: tripod stilts, used to stack glazed ceramics in the kiln (BZY 332–333: pl. 2), biscuit-fired sherds (BZY 377 [?]. BZY 378: pls. 1. 3), overfired sherds (BZY 284–286: pl. 2), and pieces of clayey (building [?]) material with prints of organic temper (BZY 334–335: pl. 1). The latter may correspond to a different choice in clay resources, as we had previously seen for example in the case of kiln walls<sup>18</sup>. Possible local references coming from the kiln context (So 5.1, SE 071 and SE 078)<sup>19</sup> where considered local reference *stricto sensu*.

- Polychrome Sgraffito Ware with a profile and fabric similar to a biscuit-fired sherd, thus likely to be local as well (BZY 379: pl. 2, similar to BZY 378);

- plain glazed, Monochrome and Polychrome Sgraffito Wares, divided by J. Vroom<sup>20</sup> into two categories according to fabric (pls. 1–3. 5: BZY 287–298. 331. 372 [first category]; BZY 299–304 [second category]). The first category was expected to be local, the second one, mainly represented by sherds covered with a brown glaze, was thought to be imported, possibly from another Western Anatolian site. Samples of more coarsely potted painted or plain glazed wares (BZY 380–383: pls. 1–3) were added to the first category;

- wares dated back to the Beylik period<sup>21</sup>, similar to ceramics from the Artemision previously attributed to a local or regional production<sup>22</sup>. Based on their techniques of decoration they are related to the Islamic world: turquoise glazed (BZY 371) and moulded wares (BZY 373: pls. 1. 3);

- ceramics decorated with various techniques, corresponding to different types previously shown to belong to the same ›Middle Byzantine production‹<sup>23</sup>: ›Fine Sgraffito‹<sup>24</sup> (BZY 311–316: pl. 1), Incised Sgraffito or ›Aegean Ware‹<sup>25</sup> (BZY 324–330: pls. 1. 4), Green and Brown Painted Ware (BZY 317–323. 374–376: pl. 4), Slip-painted Ware (BZY 305–310: pl. 4) and related glazed sherds based on form, fabric and surface treatment. They represent the earlier phase of occupation of the site within our sampling.

<sup>13</sup> Parman 1989.

<sup>14</sup> Vroom 2005b.

<sup>15</sup> Sauer – Waksman 2005.

<sup>16</sup> Waksman – von Wartburg 2006; Waksman et al. 2014.

<sup>17</sup> Cf. J. Vroom – E. Findik, in this volume, for a detailed description and tab. 1 for correspondence with their catalogue numbers.

<sup>18</sup> Waksman – Capelli – Cabella (forthcoming).

<sup>19</sup> G. Parrer, in this volume.

<sup>20</sup> J. Vroom – E. Findik, in this volume.

<sup>21</sup> J. Vroom – E. Findik, in this volume.

<sup>22</sup> Sauer – Waksman 2005.

<sup>23</sup> Waksman – von Wartburg 2006; Waksman et al. 2014.

<sup>24</sup> Morgan 1942.

<sup>25</sup> Megaw 1975.



### 3. CHEMICAL ANALYSIS AND STATISTICAL HANDLING OF DATA

Chemical analysis of the samples was carried out by Wavelength Dispersive – X Ray Fluorescence (WD-XRF) at the »Laboratoire de Céramologie« in Lyon. Twenty-four elements are quantified, seventeen of which are usually taken as active variables in multivariate statistical treatments used to classify ceramics into groups of similar chemical composition. These include eight major and minor elements in ceramics ( $\text{MgO}$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$ ,  $\text{K}_2\text{O}$ ,  $\text{CaO}$ ,  $\text{TiO}_2$ ,  $\text{MnO}$ ,  $\text{Fe}_2\text{O}_3$ ) and nine trace elements (V, Cr, Ni, Zn, Rb, Sr, Zr, Ba, Ce).

Classifications of the samples were obtained by hierarchical clustering analysis applied to standardized data, using euclidian distance and average linkage<sup>26</sup>. The corresponding diagram, called a dendrogram, initially represents each sample as a vertical bar at the bottom of the figure (figs. 1–3). The two samples that are the most alike in elemental composition are connected by a horizontal link which is placed lower the more chemically similar the samples are. The two samples are then fused into a »pseudo sample« of average composition. The same process is repeated, with the linkage being formed at growing heights, until all the samples are connected. The resulting diagram constitutes the dendrogram. It shows clusters of samples of similar composition linked at a lower level, all the clusters being ultimately linked together at the top of the diagram. This representation is however not sufficient in itself to define compositional groups, as it does not take into account the significance of elemental differences between clusters. Further examination of the raw data is still needed in order to be able to interpret classifications in terms of productions and workshops<sup>27</sup>.

### 4. RESULTS AND DISCUSSION

The first dendrogram (fig. 1) shows the classification of samples from the Türbe together with those previously analyzed from the Artemision<sup>28</sup>, with reference to chemical groups defined in 2005<sup>29</sup>. The identification of groups corresponding to local production (pls. 2–3) relies on both 2005 groups and on new reference samples. The new data strengthens previous local groups b and c (groups 2 and 4 in fig. 2) and do not constitute additional separate entities, some samples remaining unclassified or marginal to one of the groups. The new reference samples, including the two pieces of clayey material (BZY 334–335: pl. 1, top left), belong to one of the groups 2/b and 4/c. The local status of the latter, which was not supported in 2005 by local references *stricto sensu*, is now better attested; its possible subdivision – as it may appear in figure 1 – is not considered significant at the present state of research (tab. 2). On the other hand, the ongoing reconsideration of moulded wares<sup>30</sup> and the uncertain status as local reference of sample BZY 377 re-qualifies group 2/b as »local *lato sensu*«. Both groups 2 and 4 correspond to non- or low-calcareous pastes and share a number of common features (e.g. fairly high to high concentrations of iron, potassium and aluminium), group 4/b being further characterized by its noticeably high iron contents (more than 10 %  $\text{Fe}_2\text{O}_3$ ) (tab. 2). The chemical features of these groups, together with their possible relationships with the local geology, are discussed in Sauer and Waksman (2005).

Groups 2/b and 4/c include Plain Glazed and Polychrome Sgraffito Wares but samples decorated in the Islamic tradition (turquoise glazed and moulded wares) belong within our sampling to group 2/b only (pl. 1, bottom right; 3). They are manufactured with clayey material possibly exploited at a later period and correspond to the introduction in the regional repertoire of a new stylistic and technological tradition. The manufacture of moulded wares using a matrix – exam-

<sup>26</sup> E.g. Picon 1984.

<sup>27</sup> Picon 1993.

<sup>28</sup> With the exception of ceramics with synthetic paste, whose bodies were manufactured with a completely different technique; these were not considered here.

<sup>29</sup> Sauer – Waksman 2005.

<sup>30</sup> Waksman et al. (forthcoming).

ples of which were found in Ephesos in the Artemision<sup>31</sup> as well as in Miletos<sup>32</sup> – is not attested in the Byzantine pottery production. Similarly, the turquoise-glazed pottery corresponds to a glaze recipe where the fluxing agents include alkali<sup>33</sup>, and not only lead as in the case of Byzantine ceramics<sup>34</sup>. Turquoise-glazed and moulded wares are both very common in the Islamic world, where they are usually associated either with synthetic pastes, or with calcareous to highly calcareous ones<sup>35</sup>. In Ephesos, the association of a low-calcareous paste with turquoise glaze or moulded decoration suggests a deviation from the typical ›Islamic‹ features, a hypothesis which would require further research on these little-studied categories of wares.

Two new groups (fig. 1, groups 1 and 3) which were not represented in the 2005 sampling are now identified and characterized. They contain no local reference and both correspond to imports that we were able to attribute to productions previously defined in Lyon's laboratory. Group 1 gathers all the samples related to the main ›Middle Byzantine group‹ (pl. 1, bottom left; 4), with few exceptions such as an atypical sherd (BZY 316). Through its association of samples bearing different techniques of decoration (Sgraffito, Painted, Slip-painted Wares, etc.), group 1 shows the same trends as the main ›middle Byzantine production‹. The latter was previously defined chemically using samples coming from various sites in Cyprus, Greece, Turkey, the Ukraine, Lebanon, etc. which reflect its large diffusion<sup>36</sup>. This production was recently shown to originate from Chalkis (Greece)<sup>37</sup>. The chemical match of the two groups (fig. 2; tab. 2) confirms the presence of the main ›Middle Byzantine production‹ in Ephesos and shows that the site was included in Chalkis' trade network in the 12<sup>th</sup>–13<sup>th</sup> centuries.

Comparative material matching the other imported group (fig. 1: group 3; pl. 5) was found thanks to preliminary laboratory investigations of pottery production in the nearby site of Anaia/Kadikalesi<sup>38</sup> (tab. 2). The classification (fig. 3) illustrates how group 3 is integrated into Anaia's reference group. Although the close vicinity of the two sites, separated by a few tens of kilometres, makes it little surprising, Anaia seems to have been an important trading post in the Middle/Late Byzantine period<sup>39</sup>, as revealed by the large quantities of its pottery products found in Crusader Acre<sup>40</sup>.

One may note that examples of both groups 1 and 3 were found throughout the stratigraphy of the Türbe excavations. This fact may be explained by fluvial disturbances<sup>41</sup> and most of the Byzantine material may be in secondary position and have been brought to the Türbe site from other parts of the Ayasuluk area.

<sup>31</sup> Vroom 2005b, 49 pl. 11 nos. 31–32.

<sup>32</sup> Böhlendorf-Arslan 2008, 389–390.

<sup>33</sup> E.g. Picon – Thiriot – Vallauri 1995.

<sup>34</sup> Armstrong – Hatcher – Tite 1997; Waksman 2005. With the noticeable exception of ›Polychrome White Wares‹ (Vogt et al. 1997).

<sup>35</sup> E.g. Blackman – Redford 1994; Pérez-Arantegui et al. 1995; Waksman 2011; Waksman (forthcoming).

<sup>36</sup> Waksman – von Wartburg 2006.

<sup>37</sup> Waksman et al. 2014.

<sup>38</sup> Waksman 2013.

<sup>39</sup> Mercangöz 2010.

<sup>40</sup> Stern – Waksman 2003; Waksman 2013.

<sup>41</sup> F. Stock – H. Brückner, in this volume; G. Parrer, in this volume; J. Vroom – E. Fındık, in this volume.

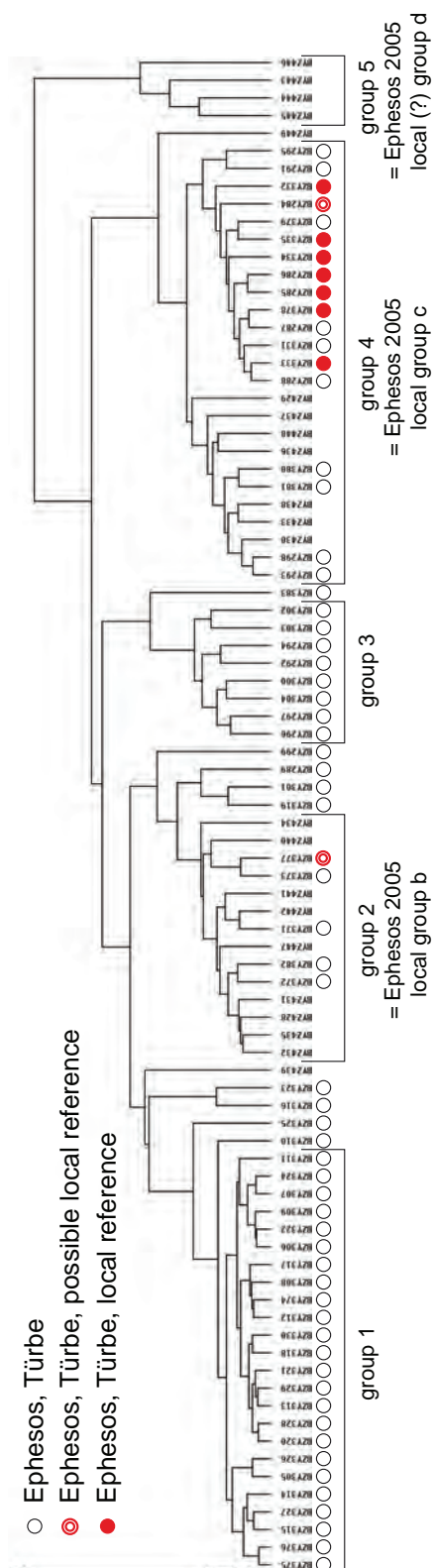


Fig. 1 Classification according to chemical compositions of ceramics from the Türbe excavations, together with samples previously analyzed from the Artemision (Sauer – Waksman 2005). Samples are identified by their laboratory number, and by symbols in the case of the Türbe, local references being specified. The main compositional groups are underlined, correspondence with groups defined in 2005 is indicated (S. Y. Waksman)

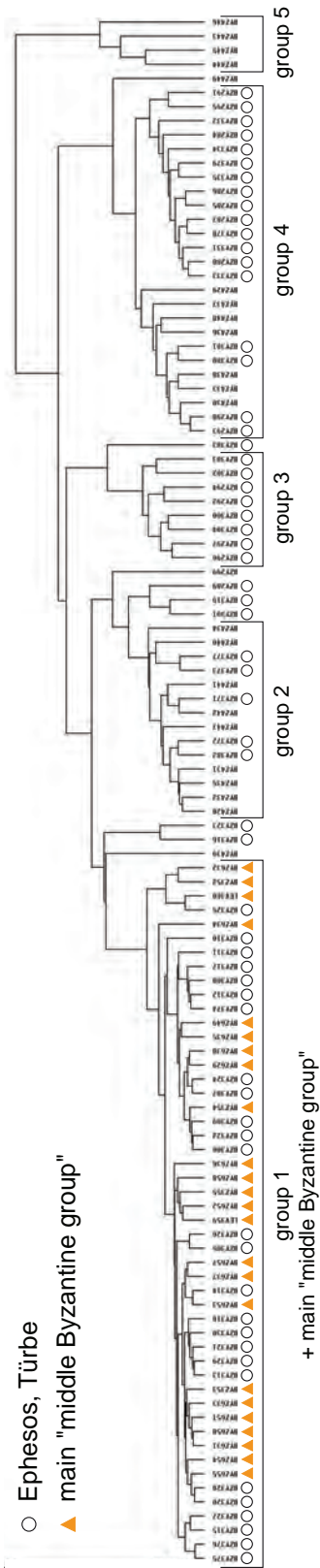


Fig. 2 Classification according to chemical compositions of ceramics from the Türbe and the Artemision excavations, together with comparative material corresponding to the main middle Byzantine production (Waksman – von Wartburg 2006) (S. Y. Waksman)

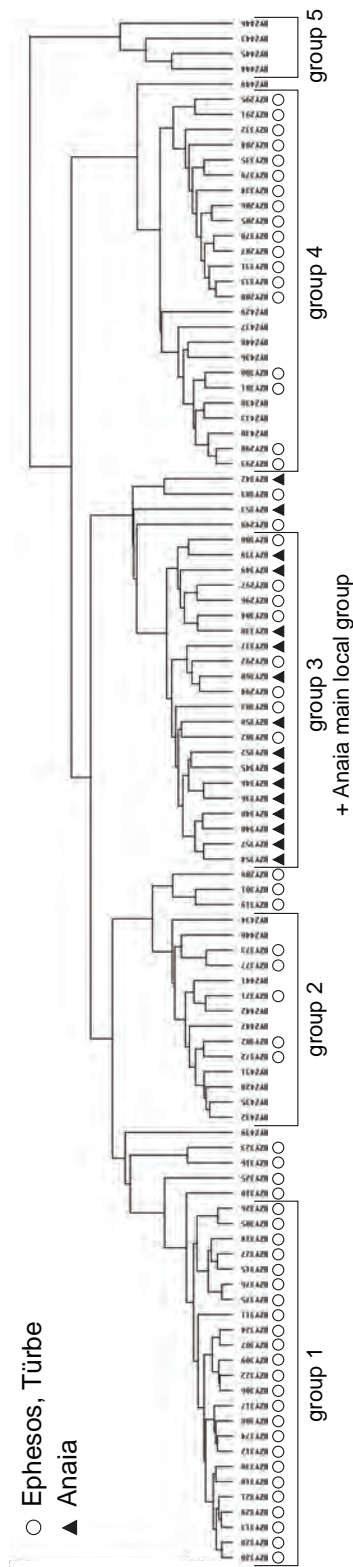


Fig. 3 Classification according to chemical compositions of ceramics from the Türbe and the Artemision excavations, together with comparative material from Anaia (Waksman 2013) (S. Y. Waksman)

Tab. 1 List of samples analyzed from the Türbe excavations, with indication of the excavations context, of the correspondence with the catalogue entries (J. Vroom – E. Findik this volume) and of the chemical group (S. Y. Waksman)

Lyon lab. no.	Ephesos inventory number [J. Vroom's number and code]	Short description after Vroom – Findik this volume	Catalogue entry	Chemical group
BZY284	Tur2010 S06 77 406, n.1, G9	overfired waster	219	4
BZY285	Tur2010 S05.1 78 306, n.2, G9	overfired waster	217	4
BZY286	Tur2010 S05.1 78 306, n.3, G9	overfired waster	218	4
BZY287	Tur2010 S05.1 78 306, n.4, PSg10	polychrome sgraffito	82	4
BZY288	Tur2010 S05.1 78 306, n.5, PSg5	polychrome sgraffito		4
BZY289	Tur2010 S06 77 406, n.6, PSg10	polychrome sgraffito		
BZY291	Tur2010 S07 103 468, n.8, MSg5a	monochrome sgraffito, yellow glaze		4
BZY292	Tur2010 S06 77 406, n.9, PSg3	polychrome sgraffito		3
BZY293	Tur2010 S04 37 155, n.10, PSg3	polychrome sgraffito		4
BZY294	Tur2010 S010 160 601, n.11, MSg10	monochrome sgraffito, green glaze	60	3
BZY295	Tur2010 S01 134 532, n.12, MSg8	monochrome sgraffito, yellow glaze	68	4
BZY296	Tur2010 S07 42 204, n.13, MSg12	monochrome sgraffito, green glaze	67	3
BZY297	Tur2010 S09 150 372, n.14, MSg13	monochrome sgraffito, yellow glaze		3
BZY298	Tur2010 S09 150 372, n.15, MSg13	monochrome sgraffito, yellow glaze, external green glaze		4
BZY299	Tur2010 S06 77 379, n.16, MSg9	monochrome sgraffito, brown glaze		
BZY300	Tur2010 S011 164 638, n.17, MSg9	monochrome sgraffito, brown glaze		3
BZY301	Tur2010 S07 85 340, n.18, MSg9	monochrome sgraffito, brown glaze		
BZY302	Tur2010 S08 161 608, n.19, MSg9	monochrome sgraffito, brown glaze	64	3
BZY303	Tur2010 S07 103 468, n.20, MSg9	monochrome sgraffito, brown glaze	65	3
BZY304	Tur2010 S08 161 608, n.21, MSg9	monochrome sgraffito, brown glaze	63	3
BZY305	Tur2010 S02.1 141 541, n.22, MPI	slip-painted ware		1
BZY306	Tur2010 S04.1 90 344, n.23, MPI	slip-painted ware		1
BZY307	Tur2010 S04.1 83 323, n.24, MPI	slip-painted ware		1
BZY308	Tur2010 S09 138 610, n.25, MPI	slip-painted ware		1
BZY309	Tur2010 S02.1 138 519, n.26, MPI	slip-painted ware		1
BZY310	Tur2010 S05.1 72 286, n.27, MPI	slip-painted ware	9	1
BZY311	Tur2010 S09 165 632, n.28, MSg1	monochrome sgraffito, "Fine sgraffito" type		1
BZY312	Tur2010 S06 77 379, n.29, MSg1	monochrome sgraffito, "Fine sgraffito" type		1
BZY313	Tur2009 S01 5 20, n.30, MSg1	monochrome sgraffito, "Fine sgraffito" type		1
BZY314	Tur2010 S06 77 379, n.31, MSg1	monochrome sgraffito, "Fine sgraffito" type		1
BZY315	Tur2010 S08 163 615, n.32, MSg1	monochrome sgraffito, "Fine sgraffito" type		1

Tab. 1 (cont.) List of samples analyzed from the Turbe excavations, with indication of the excavations context, of the correspondence with the catalogue entries (J. Vroom – E. Findik this volume) and of the chemical group (S. Y. Waksman)

Lyon lab. no.	Ephesos inventory number [J. Vroom's number and code]	Short description after Vroom – Findik this volume	Catalogue entry	Chemical group
BZY316	Tur2010 S07 85 340, n.33, MSg1	monochrome fine sgraffito, green glaze		
BZY317	Tur2009 S06 77 379, n.34, PP1	painted ware, "Green and Brown painted" type		1
BZY318	Tur2010 S02.1 138 519, n.35, PP1	painted ware, "Green and Brown painted" type		1
BZY319	Tur2010 S09 166 644, n.36, PP1	painted ware, "Green and Brown painted" type		
BZY320	Tur2010 S04.1 96 383, n.37, PP1	painted ware, "Green and Brown painted" type		1
BZY321	Tur2010 S04.1 94 365, n.38, PP1	painted ware, "Green and Brown painted" type	21	1
BZY322	Tur2010 S04.1 83 323, n.39, PP1	painted ware, "Green and Brown painted" type		1
BZY323	Tur2010 S04 37 155, n.40, PSg3	polychrome sgraffito	76	
BZY324	Tur2010 S09 166 644, n.41, MSg3	incised sgraffito, "Aegean Ware" type		1
BZY325	Tur2010 S09 166 644, n.42, MSg3	incised sgraffito, "Aegean Ware" type	54	1
BZY326	Tur2010 S05.1 70 279, n.43, MSg3	incised sgraffito, "Aegean Ware" type	56	1
BZY327	Tur2010 S02.1 140 534, n.44, MSg3	incised sgraffito, "Aegean Ware" type, green glaze		1
BZY328	Tur2010 S01 134 532, n.45, MSg3	incised sgraffito, "Aegean Ware" type	53	1
BZY329	Tur2010 S05.1 70 279, n.46, MSg3	incised sgraffito, "Aegean Ware" type		1
BZY330	Tur2010 S05.1 72 286, n.47, MSg3	incised sgraffito, "Aegean Ware" type, green glaze	55	1
BZY331	Tur2010 S06 77/114 460, n.48, MSg3	monochrome sgraffito, yellow glaze	66	4
BZY332	Tur2010 S05.1 71 301, n.49, V1	tripod stilt	212	4
BZY333	Tur2010 S05.1 78 306, n.50, V1	tripod stilt		4
BZY334	Tur2010 S05.1 71 301, n.51, V4	clayey material		4
BZY335	Tur2010 S05.1 78 306, n.52, V4	clayey material		4
BZY371	EAT 2010, S06 77/114 443	turquoise glazed ware		2
BZY372	EAT 2010, S07 49/229	polychrome sgraffito	93	2
BZY373	Turbe/Artemision, SE 22/98-17, sondage 1	moulded green-turquoise glazed ware	144	2
BZY374	Tur2009 S01 22/100, 40.34	painted ware, "Green and Brown painted" type	29	1
BZY375	EAT 2010, S04-1 84/332, 32	painted ware, "Green and Brown painted" type		1
BZY376	EAT 2010, S04-1 104/388	painted ware, "Green and Brown painted" type		1
BZY377	Turbe/Artemision, SE 20/95-1, 1	biscuit-fired ware	108	2
BZY378	Tur2010 S05.1 71 301	biscuit-fired ware		4
BZY379	EAT 2010, S02.1 139/529	polychrome sgraffito	81	4
BZY380	EAT 2010, S09 157 394, 426	plain glazed ware, brown glaze	113	4
BZY381	EAT 2010, S06 77/406, 376	painted ware		4
BZY382	EAT 2010, S01-114, 366	painted ware		2
BZY383	EAT 2010, S02 19/206, 18	plain glazed ware, yellow glaze		

Tab. 2 Chemical compositions of samples from the Türbe excavations and from the Artemision (Sauer – Waksman 2005), ranked as in the dendrogram shown in fig. 7. Comparative data are indicated for the main Middle Byzantine production (Waksman – von Wartburg 2006) and for Anaia's local production (Waksman 2013). – Major and minor elements are given in oxides weight %, trace elements in parts per million (ppm); m: mean,  $\sigma$ : standard deviation, n: number of samples. Elements between brackets are indicative; data with an asterisk were not used in the calculation of m and  $\sigma$ . (S. Y. Waksman)

Lab no.	CaO	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	K <sub>2</sub> O	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	MgO	MnO	(Na <sub>2</sub> O)	(P <sub>2</sub> O <sub>5</sub> )	Zr	Sr	Rb	Zn	Cr	Ni	(La)	Ba	V	(Ce)
group 1																				
BZY375	4,98	7,23	0,866	3,64	59,54	19,53	2,36	0,1165	1,32	0,17	186	107	151	99	149	101	40	617	134	110
BZY376	5,05	7,31	0,862	3,59	59,44	19,51	2,37	0,1175	1,30	0,16	180	107	149	102	144	96	24	631	129	104
BZY315	4,40	7,25	0,868	3,62	59,97	19,44	2,36	0,1224	1,56	0,19	189	107	145	100	145	89	36	615	134	92
BZY327	4,91	7,01	0,853	3,60	60,30	19,04	2,34	0,1158	1,43	0,19	190	105	144	99	141	101	35	603	124	91
BZY314	4,49	7,25	0,872	3,70	59,77	19,63	2,30	0,1177	1,45	0,21	180	111	146	94	139	94	24	650	142	84
BZY305	3,89	7,31	0,847	3,62	60,98	19,35	2,26	0,1170	1,26	0,16	176	95	150	100	148	105	37	584	137	67
BZY326	4,44	7,32	0,856	3,65	59,97	19,56	2,36	0,1151	1,34	0,17	175	103	149	100	145	94	24	640	131	69
BZY320	4,58	7,34	0,856	3,71	59,65	19,76	2,35	0,1157	1,20	0,18	180	103	150	105	153	113	47	623	132	89
BZY328	4,93	7,40	0,852	3,70	58,94	19,71	2,45	0,1203	1,38	0,19	174	107	148	101	146	106	24	625	133	89
BZY313	5,19	7,51	0,863	3,73	58,17	20,15	2,41	0,1198	1,39	0,22	175	107	155	102	148	109	24	644	143	88
BZY329	4,72	7,49	0,868	3,77	58,99	19,99	2,39	0,1177	1,28	0,17	175	109	154	102	149	97	24	652	134	88
BZY321	5,00	7,72	0,866	3,79	58,23	20,32	2,40	0,1197	1,19	0,16	177	102	155	110	146	95	32	641	135	85
BZY318	4,95	7,60	0,862	3,82	58,39	20,09	2,44	0,1245	1,30	0,18	173	107	151	99	145	109	40	620	150	83
BZY330	4,67	7,65	0,859	3,89	58,66	20,29	2,35	0,1200	1,14	0,15	170	109	156	102	153	100	46	648	140	76
BZY312	4,79	7,76	0,877	3,91	57,91	20,63	2,40	0,1216	1,21	0,18	168	107	162	103	154	111	57	663	144	105
BZY374	5,06	7,72	0,875	3,76	57,84	20,41	2,53	0,1247	1,26	0,20	169	106	160	106	155	112	24	686	148	95
BZY308	5,48	7,77	0,857	3,87	57,42	20,43	2,40	0,1249	1,18	0,22	162	101	158	106	156	109	48	668	133	98
BZY317	4,80	7,58	0,884	3,84	58,28	20,34	2,36	0,1227	1,33	0,25	177	106	156	107	155	93	40	674	134	104
BZY306	5,00	7,79	0,877	3,91	57,55	20,73	2,43	0,1239	1,16	0,18	162	101	155	111	150	108	33	690	126	86
BZY322	5,09	7,71	0,864	3,84	57,76	20,47	2,53	0,1215	1,26	0,15	165	105	157	109	156	114	35	656	130	80
BZY309	5,60	7,68	0,865	3,87	57,09	20,59	2,42	0,1240	1,17	0,20	161	108	156	113	152	101	45	682	138	80
BZY307	4,82	8,00	0,861	3,95	57,25	20,96	2,56	0,1257	1,07	0,19	154	99	162	107	158	118	24	672	141	81
BZY324	5,03	7,95	0,872	4,01	56,93	21,11	2,47	0,1218	1,07	0,21	160	108	164	106	155	103	38	693	146	76
BZY311	4,98	8,13	0,875	4,06	56,39	21,29	2,46	0,1263	1,28	0,19	154	103	163	106	149	112	50	682	153	96
m	4,87	7,56	0,865	3,79	58,56	20,14	2,40	0,1207	1,27	0,19	172	105	154	104	150	104	35	648	137	88
$\sigma$	0,35	0,28	0,009	0,13	1,20	0,59	0,07	0,0035	0,12	0,02	10	4	6	5	5	8	10	30	8	11

Tab. 2 (cont.) Chemical compositions of samples from the Türbe excavations and from the Artemision (Sauer – Waksman 2005), ranked as in the dendrogram shown in fig. 7. Comparative data are indicated for the main Middle Byzantine production (Waksman – von Wartburg 2006) and for Anania's local production (Waksman 2013). – Major and minor elements are given in oxides weight %, trace elements in parts per million (ppm); m: mean,  $\sigma$ : standard deviation, n: number of samples. Elements between brackets are indicative; data with an asterisk were not used in the calculation of m and  $\sigma$ . (S. Y. Waksman)

Lab no.	CaO	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	K <sub>2</sub> O	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	MgO	MnO	(Na <sub>2</sub> O)	(P <sub>2</sub> O <sub>5</sub> )	Zr	Sr	Rb	Zn	Cr	Ni	(La)	Ba	V	(Ce)
marginal to group 1																				
BZY310	5,23	7,78	0,869	3,83	57,39	20,65	2,43	0,1287	1,21	0,19	164	101	159	111	223	168	39	688	127	87
BZY325	5,86	6,65	0,842	3,37	60,82	18,16	2,32	0,1117	1,41	0,19	218	117	135	94	149	93	57	596	113	92
unclassified																				
BZY316	10,51	8,36	0,957	3,03	56,13	17,83	1,84	0,1496	0,64	0,33	182	159	132	112	263	224	24	602	135	78
BZY323	9,19	7,99	0,935	3,13	56,87	18,08	2,57	0,1319	0,61	0,26	184	179	140	105	295	244	24	469	150	79
BZY439	4,70	7,47	0,980	3,23	61,19	17,56	2,89	0,0894	1,40	0,27	248	226	137	111	155	192	55	661	131	108
group 2 = group b 2005																				
BYZ432	3,78	8,39	0,961	3,90	56,27	20,68	4,03	0,0986	1,35	0,24	180	261	183	124	209	291	62	738	142	122
BYZ435	4,72	8,37	0,934	4,25	54,97	20,74	3,99	0,1015	1,29	0,29	169	275	183	125	218	294	59	724	136	119
BYZ428	4,24	8,58	0,977	3,90	54,81	21,35	4,22	0,0967	1,35	0,21	169	275	195	124	208	280	61	723	140	125
BYZ431	4,22	8,59	0,973	4,00	54,98	21,03	4,19	0,1001	1,34	0,27	175	262	188	140	220	301	54	795	138	124
BZY372	3,17	8,46	0,974	4,04	56,39	21,33	3,77	0,0963	1,24	0,26	171	254	184	114	201	234	54	712	138	125
BZY382	3,46	8,67	1,010	4,10	55,10	21,79	3,90	0,1043	1,19	0,22	178	280	186	126	191	205	63	724	149	123
BYZ447	6,14	8,15	0,960	3,93	54,36	20,74	3,53	0,0926	1,31	0,24	180	279	171	121	196	208	63	764	134	116
BZY371	4,41	8,36	0,927	3,79	56,44	20,12	4,21	0,1006	1,07	0,19	173	251	170	115	225	280	55	654	143	108
BYZ442	4,01	8,33	0,968	3,59	57,70	19,69	3,93	0,0928	1,22	0,23	177	252	171	119	214	319	55	677	135	115
BYZ441	4,95	8,33	0,915	3,88	55,57	20,25	3,84	0,1043	1,45	0,47	162	228	162	129	199	277	53	756	142	121
BZY373	3,14	8,16	0,981	3,86	57,81	20,57	3,52	0,0911	1,35	0,22	188	251	175	115	172	198	51	710	149	128
BZY377	2,49	8,20	0,999	4,04	57,22	21,57	3,40	0,0956	1,46	0,22	193	268	183	118	158	156	88	708	148	129
BYZ440	3,32	8,29	1,024	4,21	55,53	21,98	3,58	0,0929	1,49	0,23	195	340	196	125	159	182	62	835	137	127
BYZ434	3,42	9,01	1,013	4,40	54,29	22,38	3,35	0,1113	1,46	0,28	170	248	199	138	204	229	52	778	138	119
m	3,96	8,42	0,973	3,99	55,82	21,02	3,82	0,0985	1,33	0,26	177	266	182	124	198	247	59	736	141	122
$\sigma$	0,89	0,22	0,031	0,20	1,13	0,73	0,29	0,0055	0,11	0,07	9	25	11	8	21	49	9	45	5	6



Tab. 2 (cont.) Chemical compositions of samples from the Türbe excavations and from the Artemision (Sauer – Waksman 2005), ranked as in the dendrogram shown in fig. 7. Comparative data are indicated for the main Middle Byzantine production (Waksman – von Wartburg 2006) and for Anania's local production (Waksman 2013). – Major and minor elements are given in oxides weight %, trace elements in parts per million (ppm); m: mean,  $\sigma$ : standard deviation, n: number of samples. Elements between brackets are indicative; data with an asterisk were not used in the calculation of m and  $\sigma$ . (S. Y. Waksman)

Lab no.	CaO	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	K <sub>2</sub> O	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	MgO	MnO	(Na <sub>2</sub> O)	(P <sub>2</sub> O <sub>5</sub> )	Zr	Sr	Rb	Zn	Cr	Ni	(La)	Ba	V	(Ce)
marginal to group 2																				
BZY319	4,27	8,37	0,918	4,46	54,42	21,18	4,87	0,0981	0,91	0,24	174	315	182	131	148	95	66	857	145	110
BZY301	5,53	8,37	0,891	4,22	54,36	20,63	4,62	0,0946	0,80	0,25	175	263	171	132	145	104	53	835	128	126
BZY289	6,36	7,89	0,876	4,21	55,60	19,89	3,49	0,1055	1,02	0,27	187	287	163	119	129	87	51	857	141	91
BZY299	5,58	9,83	0,891	3,73	52,23	21,44	4,57	0,1348	0,88	0,30	198	191	160	137	264	212	62	639	177	109
group 3																				
BZY296	11,28	8,50	0,737	3,27	51,89	18,85	3,93	0,1507	0,33	0,81	158	277	143	137	288	315	36	549	133	81
BZY297	12,18	8,68	0,745	3,15	50,54	19,74	3,89	0,1379	0,18	0,53	155	286	148	128	274	265	24	538	137	97
BZY304	12,75	8,39	0,741	3,09	50,23	19,01	4,60	0,1639	0,31	0,45	167	264	148	123	277	274	37	565	137	95
BZY300	14,08	8,20	0,711	2,81	50,59	18,25	4,24	0,1660	0,25	0,49	148	251	135	118	289	286	24	487	126	85
BZY292	9,22	8,70	0,795	3,19	52,58	20,17	3,75	0,1470	0,32	0,57	165	234	152	120	310	257	43	446	157	93
BZY294	10,07	9,23	0,787	2,96	51,60	19,90	4,45	0,1449	0,21	0,41	157	223	150	138	329	340	40	476	167	93
BZY303	10,90	8,22	0,758	3,49	51,46	19,86	3,89	0,1419	0,53	0,37	169	264	170	112	241	210	35	533	126	86
BZY302	9,24	9,34	0,803	3,40	50,30	21,70	4,24	0,1521	0,20	0,36	165	271	172	130	271	245	46	451	140	68
m	11,22	8,66	0,760	3,17	51,15	19,69	4,12	0,1506	0,29	0,50	161	259	152	126	285	274	36	506	140	87
$\sigma$	1,72	0,43	0,032	0,22	0,86	1,04	0,30	0,0100	0,11	0,15	7	21	13	9	26	41	8	46	15	10
BZY383	13,40	6,36	0,719	3,26	53,59	16,44	4,63	0,1167	0,95	0,31	170	240	151	93	200	166	36	579	108	85

Tab. 2 (cont.) Chemical compositions of samples from the Türbe excavations and from the Artemision (Sauer – Waksman 2005), ranked as in the dendrogram shown in fig. 7. Comparative data are indicated for the main Middle Byzantine production (Waksman – von Wartburg 2006) and for Anaia's local production (Waksman 2013). – Major and minor elements are given in oxides weight %, trace elements in parts per million (ppm); m: mean,  $\sigma$ : standard deviation, n: number of samples. Elements between brackets are indicative; data with an asterisk were not used in the calculation of m and  $\sigma$ . (S. Y. Waksman)

Lab no.	CaO	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	K <sub>2</sub> O	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	MgO	MnO	(Na <sub>2</sub> O)	(P <sub>2</sub> O <sub>5</sub> )	Zr	Sr	Rb	Zn	Cr	Ni	(La)	Ba	V	(Ce)
group 4 = group c 2005																				
BZY293	1,46	11,45	1,024	4,28	52,24	24,04	3,39	0,1386	1,27	0,29	237	162	174	158	169	97	54	830	200	149
BZY298	1,63	11,60	1,018	4,39	52,07	24,08	3,54	0,1377	0,95	0,32	235	169	172	155	167	94	58	816	200	138
BZY430	1,45	11,05	1,036	4,19	52,55	24,07	3,36	0,1312	1,43	0,26	235	168	178	154	164	108	72	916	203	143
BZY433	2,39	10,64	1,031	4,30	52,65	23,48	3,30	0,1299	1,51	0,30	258	168	182	144	167	106	77	932	194	139
BZY438	1,44	11,05	1,049	4,33	52,60	24,20	3,25	0,1142	1,42	0,27	257	169	185	158	159	98	71	929	194	142
BZY381	1,19	10,62	1,029	4,37	53,63	23,24	3,52	0,1261	1,72	0,24	244	163	173	147	169	91	77	796	197	141
BZY380	1,15	10,54	1,027	4,19	54,26	23,05	3,70	0,1082	1,38	0,24	248	162	172	146	188	112	73	798	211	139
BZY436	1,48	10,96	1,039	4,39	52,58	23,83	3,52	0,0902	1,46	0,30	252	168	176	154	179	126	80	922	203	141
BZY448	2,03	11,15	1,013	4,14	52,01	23,62	3,77	0,1159	1,36	0,47	239	208	180	156	222	144	76	998	215	134
BZY437	1,46	11,56	1,032	4,40	51,25	24,04	4,08	0,1457	1,46	0,29	236	157	181	161	218	156	76	875	218	153
BZY429	1,35	11,07	1,019	4,14	51,25	24,48	3,29	0,1297	1,33	0,27	212	149	*134	149	161	88	70	898	201	154
BZY288	1,46	11,28	1,012	4,00	53,24	23,22	4,08	0,1647	1,01	0,28	210	157	161	145	220	144	63	760	195	116
BZY333	1,54	11,17	1,007	4,00	53,30	23,11	4,08	0,1517	1,06	0,29	214	155	162	150	215	150	72	746	200	116
BZY331	1,40	11,11	1,016	4,19	53,40	23,11	3,87	0,1613	1,17	0,31	217	162	163	143	196	121	52	777	188	125
BZY287	1,59	11,16	1,005	4,01	53,11	23,12	4,15	0,1456	1,08	0,28	204	154	160	146	226	167	71	723	204	129
BZY378	1,25	11,16	1,032	3,98	53,28	23,42	4,06	0,1510	1,14	0,29	207	152	168	150	207	148	70	746	207	134
BZY285	1,55	10,77	0,996	4,09	53,65	22,55	4,44	0,1561	1,09	0,27	220	153	159	152	246	152	64	729	197	121
BZY286	1,60	10,68	0,990	4,34	53,28	22,46	4,44	0,1589	1,41	0,26	224	151	159	145	242	160	66	717	209	129
BZY334	1,66	10,81	0,980	4,13	53,19	23,00	3,98	0,1306	1,52	0,29	203	161	160	153	201	136	63	731	197	127
BZY335	2,80	11,03	0,988	4,04	52,50	22,77	4,21	0,1567	0,99	0,27	207	163	158	150	224	153	55	742	189	145
BZY379	1,45	11,07	1,019	3,94	53,37	23,14	4,13	0,1562	1,16	0,26	206	155	162	145	216	149	55	756	203	162
BZY284	1,46	10,84	1,000	4,59	53,14	23,03	3,76	0,1683	1,37	0,27	225	162	159	145	198	115	57	784	195	139
BZY332	1,75	10,88	0,969	4,86	53,36	22,31	4,02	0,1426	1,21	0,26	200	164	164	139	212	148	72	754	203	126
BZY291	1,65	12,71	1,045	4,09	51,09	23,91	3,68	0,1578	1,10	0,30	183	157	176	156	164	105	62	828	202	130
BZY295	1,14	12,22	1,002	3,99	52,88	23,33	3,55	0,1350	1,20	0,31	182	152	169	159	166	103	76	757	187	129
m	1,57	11,14	1,015	4,21	52,80	23,38	3,81	0,1402	1,27	0,29	222	162	169	150	196	127	67	810	200	136
$\sigma$	0,42	2,13	0,194	0,82	10,02	4,46	0,77	0,0304	0,28	0,06	45	30	33	28	43	32	14	164	38	27

Tab. 2 (cont.) Chemical compositions of samples from the Türbe excavations and from the Artemision (Sauer – Waksman 2005), ranked as in the dendrogram shown in fig. 7. Comparative data are indicated for the main Middle Byzantine production (Waksman – von Wartburg 2006) and for Anaia's local production (Waksman 2013). – Major and minor elements are given in oxides weight %, trace elements in parts per million (ppm); m: mean,  $\sigma$ : standard deviation, n: number of samples. Elements between brackets are indicative; data with an asterisk were not used in the calculation of m and  $\sigma$ . (S. Y. Waksman)

Lab no.	CaO	Fe <sub>2</sub> O <sub>3</sub>	TiO <sub>2</sub>	K <sub>2</sub> O	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	MgO	MnO	(Na <sub>2</sub> O)	(P <sub>2</sub> O <sub>5</sub> )	Zr	Sr	Rb	Zn	Cr	Ni	(La)	Ba	V	(Ce)
BYZ449	1,64	9,85	1,101	3,63	56,28	22,19	2,96	0,1000	1,44	0,28	255	149	148	132	169	118	67	670	196	124
group 5 = group d 2005																				
BYZ445	1,98	8,74	1,050	2,27	61,23	18,37	3,59	0,1192	1,69	0,74	222	115	103	104	446	332	37	426	169	76
BYZ444	1,75	9,17	0,999	2,27	60,58	18,44	4,29	0,1590	1,54	0,56	204	81	98	97	429	409	42	463	162	83
BYZ443	2,15	9,43	1,082	1,62	61,42	18,81	3,22	0,0878	1,85	0,13	214	119	85	79	387	331	39	344	181	79
BYZ446	0,89	8,75	1,057	2,43	63,14	20,15	2,17	0,1126	0,91	0,19	271	70	125	105	290	272	50	401	153	105
comparative data: main "Middle Byzantine production" (n = 24, Waksman – von Wartburg 2006)																				
m	5,16	7,19	0,850	3,81	58,78	19,65	2,46	0,1148	1,49	0,17	182	121	146	103	143	108	41	661	138	82
$\sigma$	0,57	0,37	0,013	0,17	1,33	0,78	0,12	0,0039	0,15	0,02	16	18	9	6	7	6	3	39	8	4
comparative data: Anaia, local production, main group (n = 16, Waksman 2013)																				
m	11,64	8,56	0,758	3,12	50,34	19,85	4,57	0,1486	0,37	0,36	155	263	162	122	275	244	47	490	151	103
$\sigma$	1,76	0,53	0,032	0,25	0,91	1,16	0,59	0,0172	0,09	0,16	5	36	13	11	28	27	10	45	12	11

## 5. CONCLUDING REMARKS

The Türbe excavations provided information about the Byzantine and Turkish periods of Ephesos/Ayasuluk. Chemical analyses confirm the presence of several categories of ceramic imports belonging to the main ›Middle Byzantine production‹ from Chalkis that were widespread in the Mediterranean and date back to the 12<sup>th</sup> and 13<sup>th</sup> centuries<sup>42</sup>. Ephesos is part of the distribution area of this production, together with several other Western Anatolian sites such as Pergamon<sup>43</sup> and the nearby castle of Anaia/Kadikalesi, where it is present in significant quantities. Pottery was also manufactured in Anaia. Anaia's products were diffused not only at a regional level, as shown here through examples found in Ephesos, but also reached the Crusader states as seen by its noticeable presence in Saint-Jean-d'Acre<sup>44</sup>.

Ceramic production in Ephesos is documented in the Türbe excavations through the discovery of rubefied layers, kiln furniture and wasters<sup>45</sup>. Several local groups, *stricto* or *lato sensu*, showing different chemical features, may be identified. These groups do not differ from those previously defined in a preliminary study of the Artemision material<sup>46</sup>. The present study complements the previous chemical characterization and further illustrates the local/regional manufacture of various types of table wares, from coarsely potted plain glazed to more ›sophisticated‹ ceramics of ›Islamic‹ types (turquoise glazed and moulded wares). The latter would correspond to the introduction in the repertoire of new stylistic and technological traditions, a phenomenon which would have occurred at the Beylik period in other Western Anatolian sites as well, such as Miletos<sup>47</sup> and, possibly, Sardis<sup>48</sup>. In Ephesos, the association of turquoise glaze or moulded decoration with low-calcareous pastes, instead of calcareous ones, suggests an adaptation of the initial pottery traditions, as may be observed for example in Syria.

The high degree of fragmentation of the sherds in the Türbe excavations on the one hand, and the fluvial disturbances of the stratigraphy on the other hand, made it difficult to reconstruct the typo-chronological features of the local repertoire. Some connections could be made with the better preserved material from the Artemision, but were limited within our sampling. It is hoped that further sampling and analyses of ceramics coming from other excavations in Ephesos/Ayasuluk (›Tribüne‹ [= Odeion in the Artemision], İsa Bey Hamam, etc.) will make it possible for us to give further insight into these questions.

Sylvie Yona Waksman, in collaboration with Marie-Myriam Carytsiotis

<sup>42</sup> Sanders 2003b; Waksman et al. 2014.

<sup>43</sup> Waksman – Spieser 1997: ›Fine sgraffito group‹.

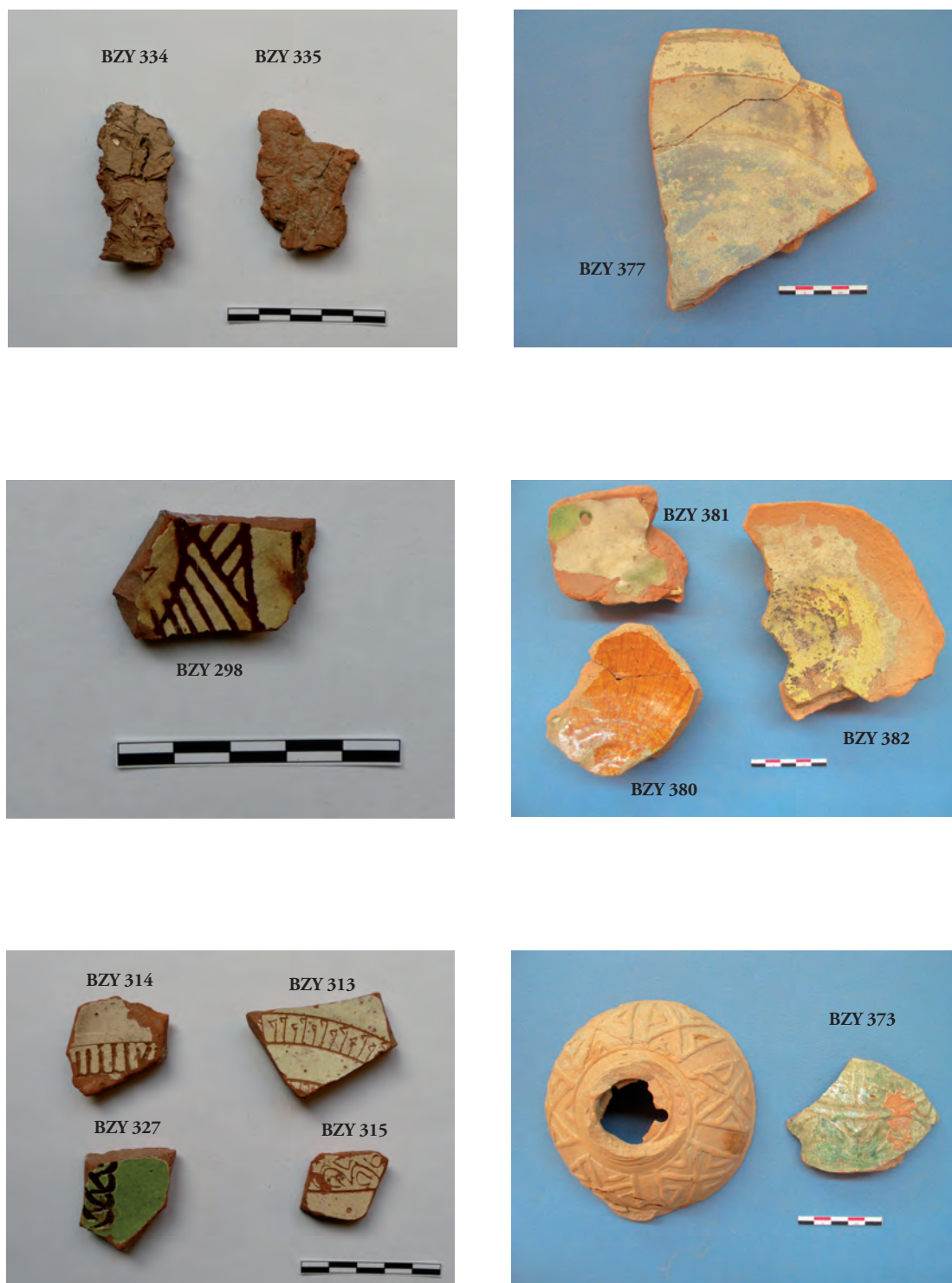
<sup>44</sup> Waksman 2013.

<sup>45</sup> G. Parrer, in this volume.

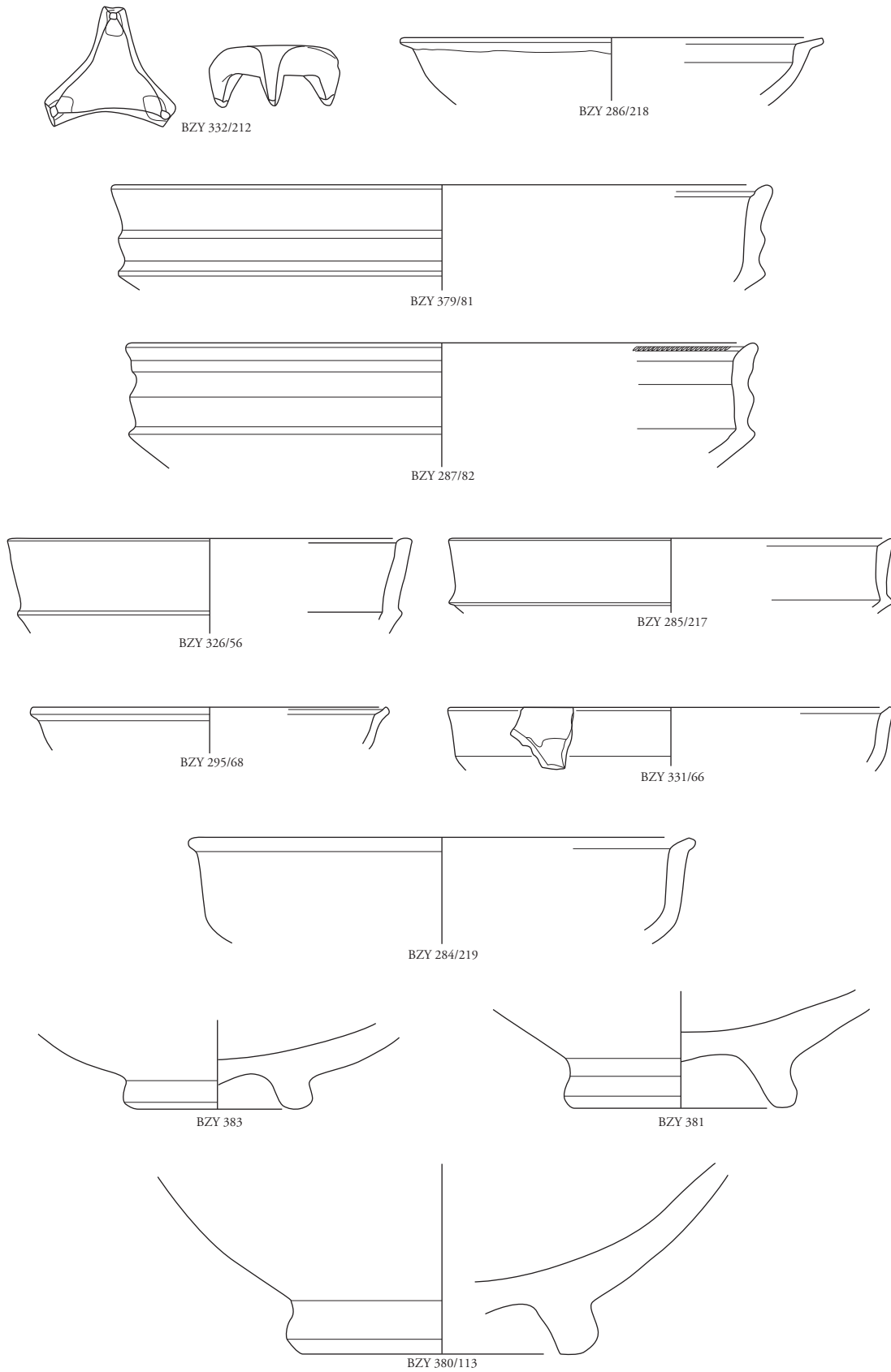
<sup>46</sup> Sauer – Waksman 2005.

<sup>47</sup> Böhlendorf-Arslan 2008.

<sup>48</sup> Scott – Kamilli 1981.

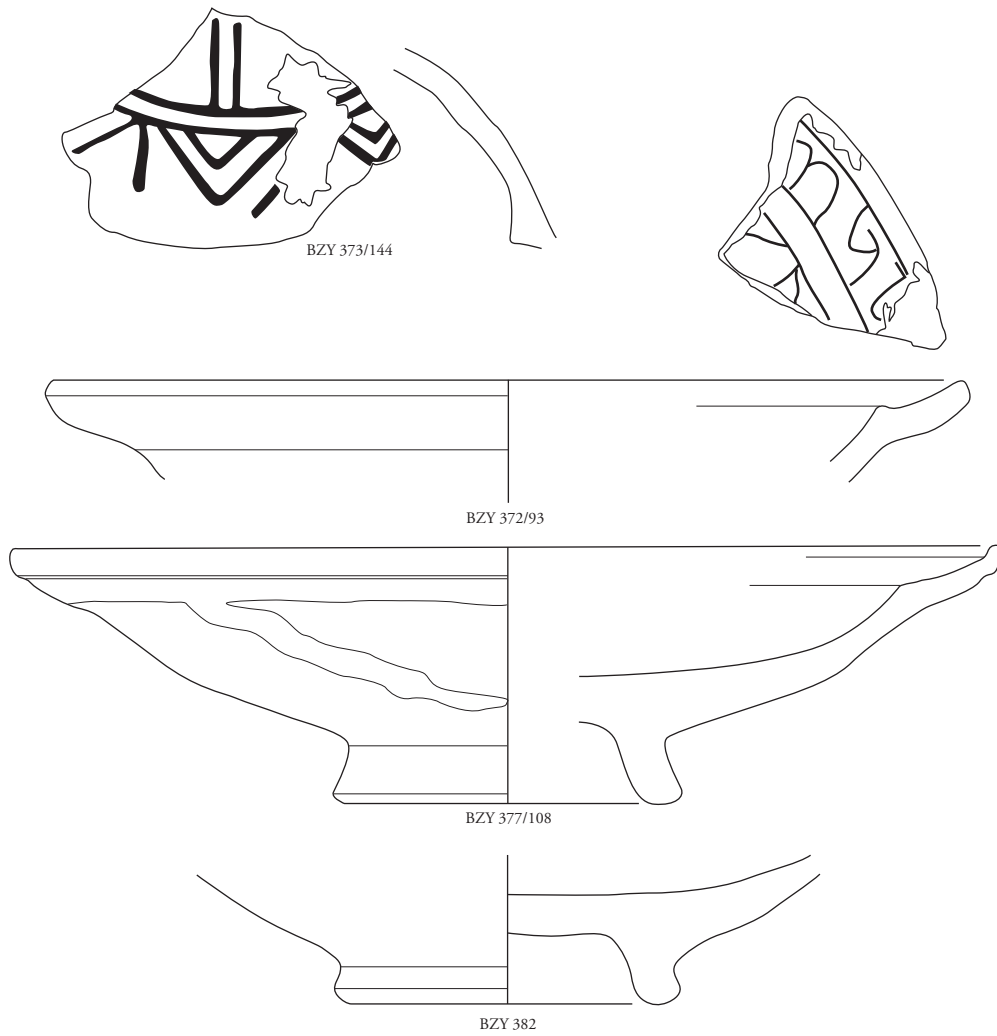


Pl. 1 Examples of samples analyzed: possible local references: clayey material (BZY 334–335) and biscuit fired waster (?) (BZY 377); samples shown to be local *stricto sensu*: Sgraffito Ware (BZY 298), coarsely pot-  
 ted Plain Glazed Ware (BZY 380–382), or *lato sensu*: moulded wares in the Islamic tradition (BZY 373);  
 imported wares of ›Fine Sgraffito‹ and ›Aegean Ware‹ types (BZY 313–315, BZY 327), shown to belong  
 to the main ›Middle Byzantine production‹ (Waksman – von Wartburg 2006; Waksman et al. 2014) (Photos  
 © S. Y. Waksman – M.-M. Carytsiotis)

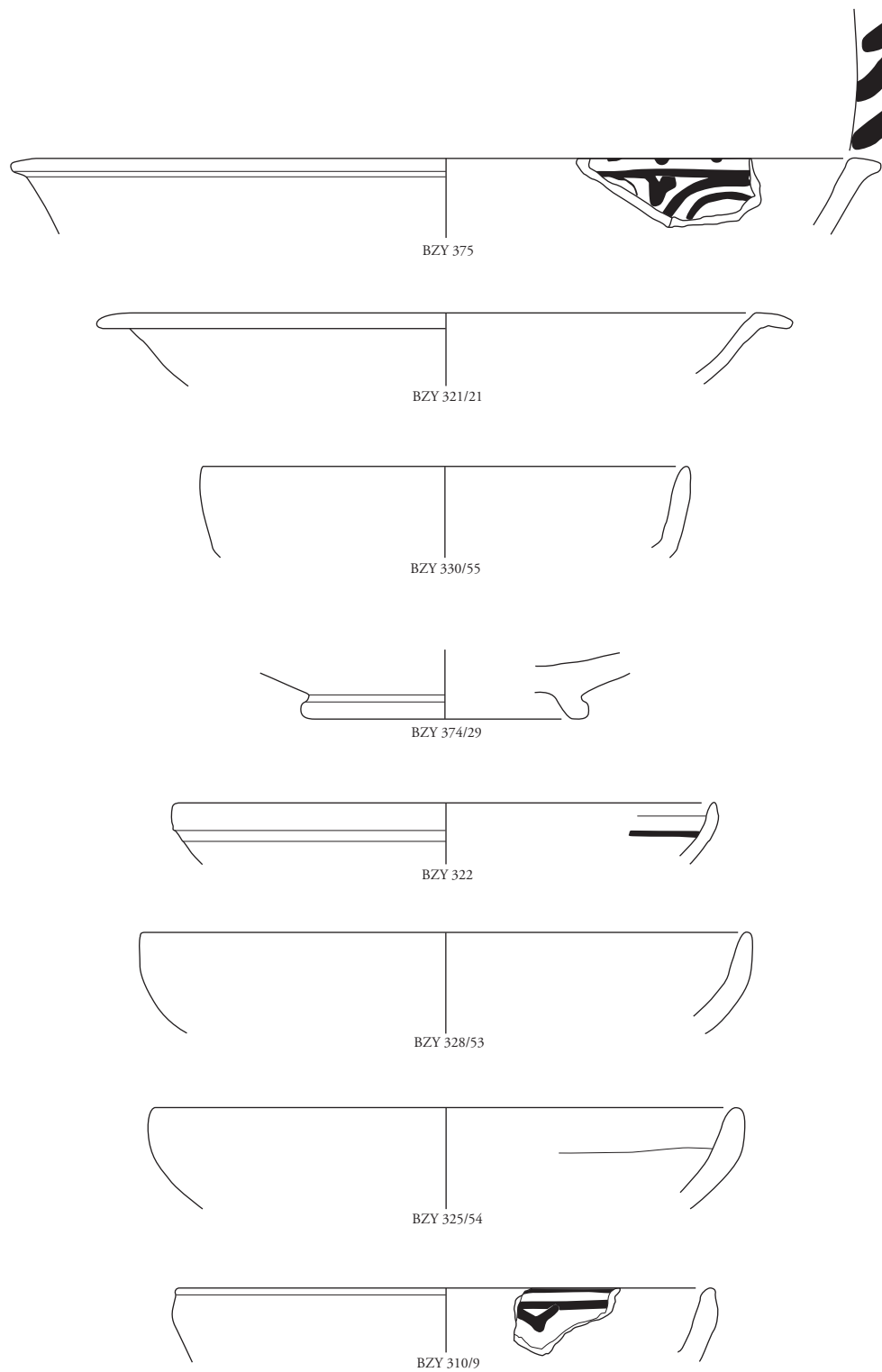


Pl. 2 Ceramics analyzed, classified by chemical groups

Chemical group 4: local production *stricto sensu* (Sauer – Waksman 2005: local group c); Lyon laboratory no./cat. no. (J. Vroom – E. Findik this volume) are indicated (Drawings OeAI Archive Vienna, layout S. Y. Waksman, © OeAI)

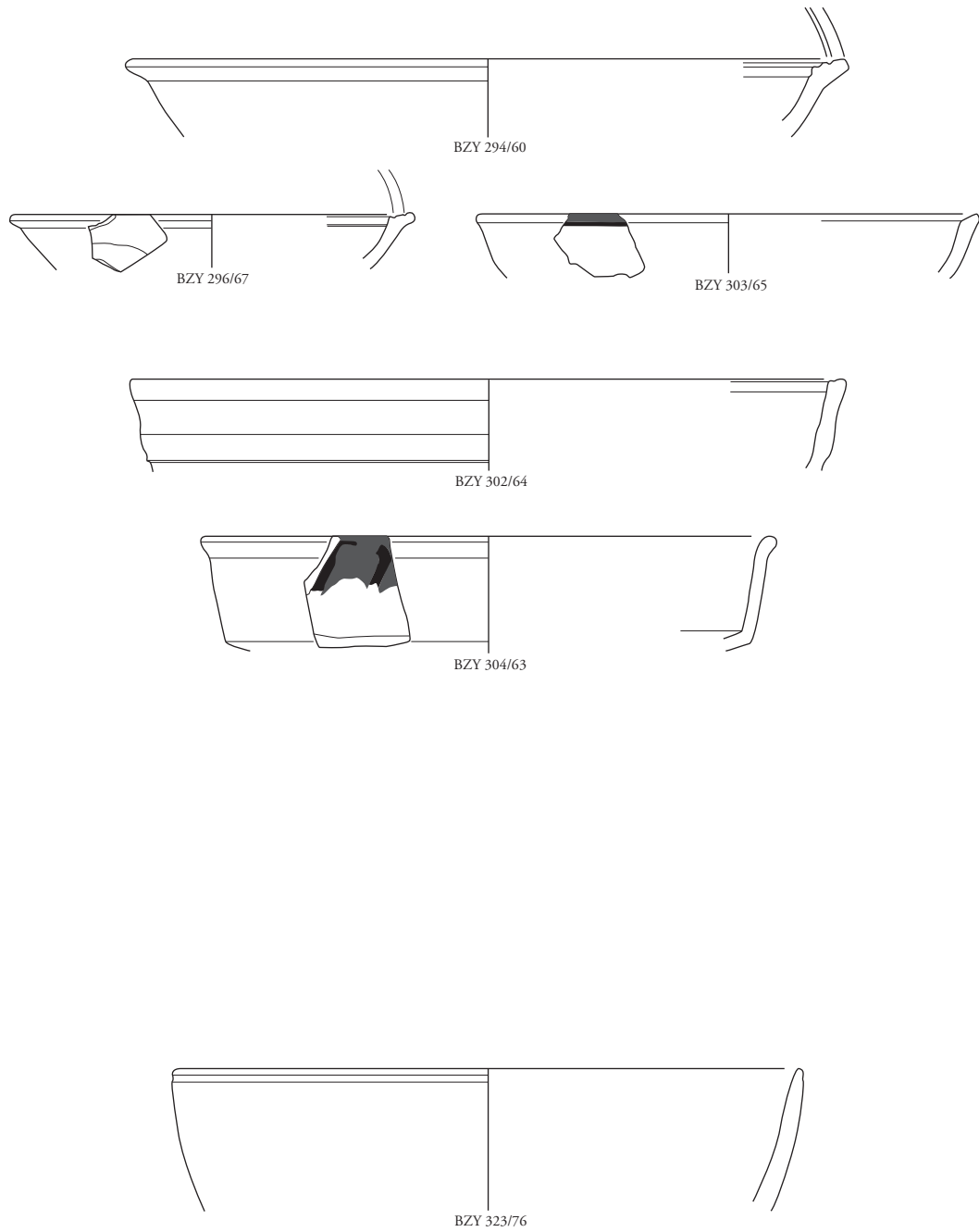


Pl. 3 Ceramics analyzed, classified by chemical groups  
 Chemical group 2: local production *lato sensu* (Sauer – Waksman 2005: local group b); Lyon  
 laboratory no./cat. no. (J. Vroom – E. Findik this volume) are indicated (Drawings OeAI Archive  
 Vienna, layout S. Y. Waksman, © OeAI)



Pl. 4 Ceramics analyzed, classified by chemical groups  
 Chemical group 1: main ›Middle Byzantine production‹; Lyon laboratory no./cat. no. (J. Vroom – E. Findik this volume) are indicated (Drawings OeAI Archive Vienna, layout S. Y. Waksman, © OeAI)





Pl. 5 Ceramics analyzed, classified by chemical groups.  
 Top, chemical group 3: Anaia Wares; bottom, unclassified sample BZY 323; Lyon laboratory no./cat. no. (J. Vroom – E. Findik this volume) are indicated (Drawings OeAI Archive Vienna, layout S. Y. Waksman, © OeAI)



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Zitierweise und Abkürzungen folgen den Richtlinien des Österreichischen Archäologischen Instituts <<http://www.oelai.at>>, zusätzlich werden folgende Abkürzungen verwendet:

Diam.	diameter
EAT	Ephesos-Artemision-Türbe
est.	estimated
FNr.	Fundnummer
H.	height
H <sub>abs.</sub>	absolute Höhe
IF	Interface
Ind.	Individuum
L.	length
NO	Nordosten
NW	Nordwesten
OK	Oberkante
pres.	preserved
Th.	thickness
SE	Stratigrafische Einheit
So	Sondage
SO	Südosten
SW	Südwesten
u. GOF	unter Geländeoberfläche
UK	Unterkante
W.	width



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