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ARCHAEOMETRY

CHARACTERIZATION OF EASTERN SIGILLATA C (ESC) FROM THE YK SECTOR AT KLAROS: AN ARCHAEOLOGICAL AND ARCHAEOMETRIC APPROACH

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Abstract: The popularity of the sanctuary of Klaros began to rise around the turn of the millennium, reaching its zenith in the 2nd and 3rd centuries AD. Recent excavations in the YK Sector, situated near the propylon of the oracle centre, have yielded significant data regarding this period. The Roman-period fine ware assemblage recovered from the sector includes Italian Sigillata, Eastern Sigillata A, B, and C, Late Roman C (LRC), African Red Slip Ware, and Late Roman Light-Coloured Ware. This study focuses specifically on Eastern Sigillata C (ESC), a group not previously examined as a distinct assemblage at Klaros, providing new evidence for the sanctuary's role as one of the consumption centres in Ionia. Comprising 75 diagnostic fragments, the ESC assemblage contributes significantly to the chronology of the sanctuary. The majority being dated to the 2nd and 3rd centuries AD, these finds correspond to the final major phase of activity before the sanctuary lost its original oracular function. Moreover, parallel to the transformation of the sanctuary, the ESC group represents a transitional stage between terra sigillata and Late Roman Red Slip wares. Archaeometric analyses of the relevant samples from the site proved to be a helpful method in classifying specimens that are typologically and macroscopically indistinguishable from many Eastern Sigillata B and early LRC examples. Compositional analyses also highlighted hints on the predecessor-successor relationship, particularly between ESC and LRC. Furthermore, the chemical analysis results demonstrate that the samples compositionally correlate to those of Çandarlı (Pitane) productions, confirming it as a primary source. The typological and archaeometric examination on ESC wares offers new insights on the history of the sanctuary as well as the shifting ceramic consumption patterns of the region.

Keywords: *Klaros, Ionia, Roman Period, Terra Sigillata, Eastern Sigillata C, Archaeometry.*

INTRODUCTION

Klaros is an ancient oracle centre located in Ionia, with its foundation dating back to the 13th century BC. Today, the sanctuary is located in modern Ahmetbeyli, Menderes in İzmir and is situated between the ancient cities of Kolophon and Notion[1]. One of the main objectives of the recent

[1] ŞAHİN 1998, 18–19.

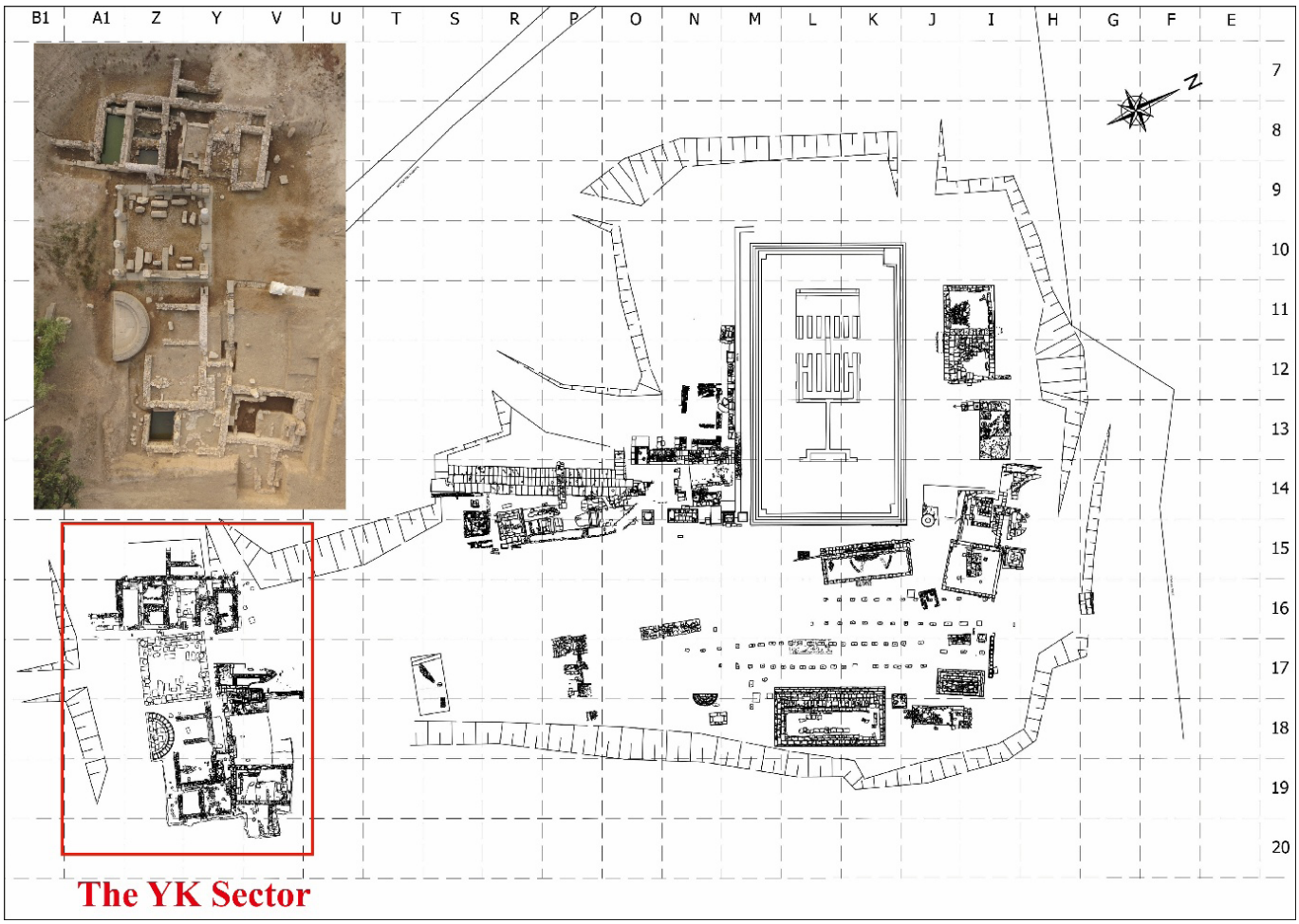

Fig. 1. YK Sector is marked on the site plan of the sanctuary, and an aerial view of the sector (Klaros Excavation Archive).

archaeological excavations is to obtain data regarding the Roman period, particularly focusing on the 1st and 2nd centuries AD and beyond. This is because this period marks the beginning of the sanctuary's peak popularity, followed shortly thereafter by its decline in function. In line with this objective, the excavations carried out in the YK Sector have provided crucial evidence. Archaeological campaigns in this sector were conducted in two main phases: between 2001-2005 and 2018-2021[2]. The Eastern Sigillata C (ESC) tablewares, which are the subject of this paper, were unearthed during the excavations carried out in those years[3]. The structure called the YK Sector, positioned on the east and west sides of the propylon, was initially constructed during the Hellenistic period and remained in use for various purposes until the 7th century AD (Fig. 1). However, archaeological evidence suggests that from the 4th century onwards, the sanctuary lost its original oracular function, and the YK Sector was repurposed, possibly serving as a workshop[4]. Consequently, the ESC assemblage, represented by 75 diagnostic pieces, provides important data regarding the period immediately prior to this functional decline.

A REVIEW OF ESC RESEARCH

The research of ESC started in 1911, when modern Çandarlı (ancient Pitane) was identified as a manufacturing centre for terra sigillata, making it the first production centre of its genre discovered in the Eastern Mediterranean. That same year, S. Loeschcke conducted a test excavation at the site, and his subsequent 1912 publication established a typology of 29 main types, which remains the foundation for ESC research today[5]. In 1972, J. W. Hayes formalised this repertoire under the name "Çandarlı Ware" in his seminal work Late Roman Pottery, providing both a typological and a chronological framework for the ESC[6]. In the 1980s, a French survey project led by J. Y. Empereur and M. Picon established the first chemical fingerprint of ESC produced in Pitane[7]. This was followed by more recent archaeometric analyses by S. Japp, G. Schneider, and H. Mommsen, which successfully distinguished Pitane's production from other centres in the Pergamon micro-region, such as the Ketios

[2] ŞAHİN *et alii* 2007, 595–596; ŞAHİN *et alii* 2008, 434–435; ŞAHİN *et alii* 2009, 120–123; ŞAHİN *et alii* 2010, 253–255; ŞAHİN *et alii* 2020, 507–522; ŞAHİN *et alii* 2022, 469–486; TOPAL *et alii* 2023, 329.

[3] Archaeological excavations in the YK Sector continued in 2022 and 2023, and the evaluation of findings from these seasons is currently underway. See: TOPAL *et alii* 2024, 363–376; TOPAL *et alii* 2025, 79–93.

[4] For the archaeological evidence indicating the repurposing of the YK Sector as a workshop during this period, see: ZUNAL 2023, 91–105.

[5] LOESCHCKE 1912, 344–407.

[6] HAYES 1972, 316–322.

[7] EMPEREUR/PICON 1986, 143–146.

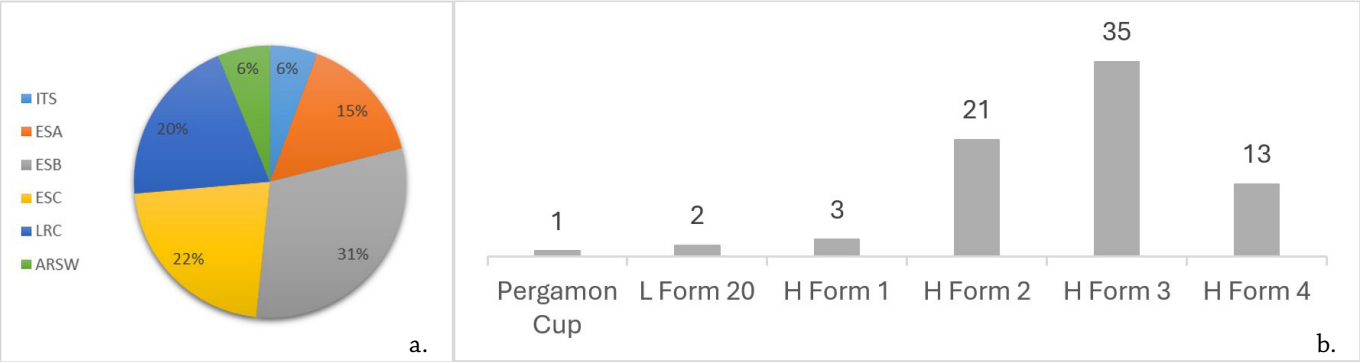

Fig. 2a. The quantitative composition of fine wares (pie chart by the author).
Fig. 2b. The typological distribution of the ESC assemblage (bar chart by the author).

Valley[8]. Most recently, the Pitane Survey (2019-2021), conducted by P. M. Bes and A. Keweloh-Kaletta, has provided a clearer diachronic picture. They offered archaeological evidence that tableware manufacture at Pitane did not cease in the 3rd century but continued into Late Antiquity with the production of LRC[9].

MATERIAL AND METHODS

A total of 75 potsherds, identified by their profile features and slip characteristics, were examined in detail. Following the typological study, fabric analysis was conducted on fresh fractures using a Bresser DST-1028 portable digital microscope (5.1 MP). Macroscopic descriptions based on visual properties (colour, shape, inclusions) were recorded for all samples using a Leica EZ4 W stereomicroscope. For mineralogical and petrographic characterization, thin sections of six representative samples-selected to reflect different macroscopic groups-were prepared at the Department of Geological Engineering, Pamukkale University (PAU), Türkiye. These thin sections were oriented to reveal the full cross-section from the core to the surface and were examined under a Leica DM750P polarizing microscope. Chemical analyses were performed using two complementary methods. First, semi-destructive measurements were taken on fresh breaks of the sherds using a Hitachi X-MET 8000 Expert p-XRF Analyzer (50kV, 6-position filter wheel optimized for elements from Mg to U)[10]. Second, whole-rock major and trace element compositions of selected samples were determined using ED-XRF spectrometry (Spectro Xepos II) at the geochemical laboratory of Kastamonu University, Türkiye. For the latter, samples were ground to a particle size of 200 mesh using a ring grinder.

ARCHAEOLOGICAL EVALUATIONS OF ESC AT KLAROS

Fig. 2a presents the general quantitative distribution of the fine ware assemblage recovered from the YK Sector at Klaros. As illustrated, the largest proportion belongs to the Eastern Sigillata B (ESB), while Italian Sigillata (ITS), Eastern Sigillata A (ESA), and African Red-Slip Ware (ARSW) appear as secondary, minor groups[11]. Notably, while ESC represents the second-largest group within the sigillata category, Late Roman C (LRC) constitutes the primary group among the Late Roman tablewares. The comparable proportions observed between the ESC and LRC groups point to a transitional phase between these two traditions within the tableware repertoire. Furthermore, the overall decline in ceramic quantities during the Late Roman period suggests a decrease in the intensity of activity within the sanctuary (or at least within the YK Sector). Fig. 2b details the internal typological subdivision of the ESC assemblage, identifying Hayes Form 3 as the predominant type within the group, followed by Hayes Forms 2 and 4, respectively.

The ceramic assemblage from the YK Sector, illustrated in Fig. 3a and 3b, comprises 75 diagnostic fragments that correspond closely to the manufacturing repertoire of the Çandarlı (ancient Pitane) workshops, as recently characterized by Bes and Keweloh-Kaletta[12]. Quantitatively, the assemblage is heavily dominated by the standard Middle Roman forms of the 2nd and 3rd centuries AD. Among these, the hemispherical bowl with an incurved rim, classified as Hayes Form 3 (ESC 28-62), constitutes the most frequent type, representing approximately 47% of the total diagnostic assemblage. This is followed by the dish with an out-turned rim, Hayes Form 2 (ESC 7-27), which forms the second largest group. The chronological sequence begins with a minor presence of early forms dating to the 1st and early 2nd centuries AD[13], such as Loeschcke Types 20 and 29. The dominance of Hayes Form 3, particularly the abundance of miniature versions and one example bearing pad-like kiln support's scars[14] (ESC 22), provides direct evidence of production and stacking techniques employed at Pitane. The later horizon of the assemblage is defined by the flanged bowls of Hayes Form 4 (ESC 63–75)[15].

[8] JAPP 2009, 193; SCHNEIDER/JAPP 2009, 287–306; MOMMSEN/JAPP 2009, 269–286.
[9] BES/KEWELOH-KALETTA 2025, 211–294.
[10] For the article discussing the p-XRF analysis method and its results via PCA analysis, see: AYCAN/DASZKIEWICZ/SCHNEIDER forthcoming.
[11] Late Roman Light-Coloured Ware (LRLC) is represented by only a single base fragment within the context; due to its solitary presence, it has been excluded from the quantitative visualization (pie chart).
[12] BES/KEWELOH-KALETTA 2025.
[13] While the main assemblage concentrates in the Roman period, ESC 1 (a Pergamon production) represents an earlier phase, dating to the mid-to-late 2nd century BC. See for similar forms: MEYER-SCHLICHTMANN 1988, Pl. 7, 1.S1.
[14] LOESCHCKE 1912, 353; BES/KEWELOH-KALETTA 2025, 238–239.
[15] HAYES 1972, 316–322.

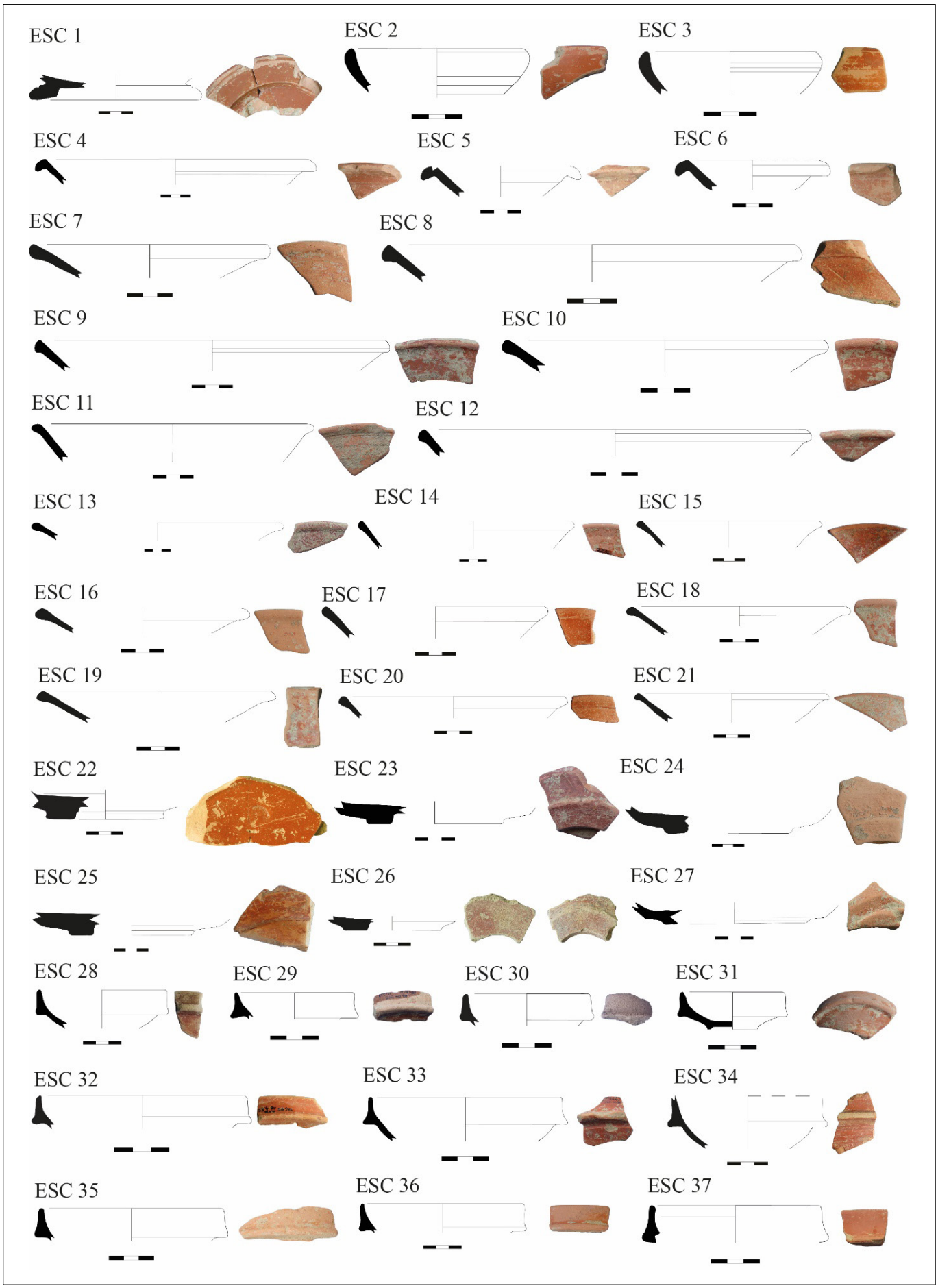

Fig. 3a. The ESC assemblage from the YK Sector (photographs and drawings by the author).

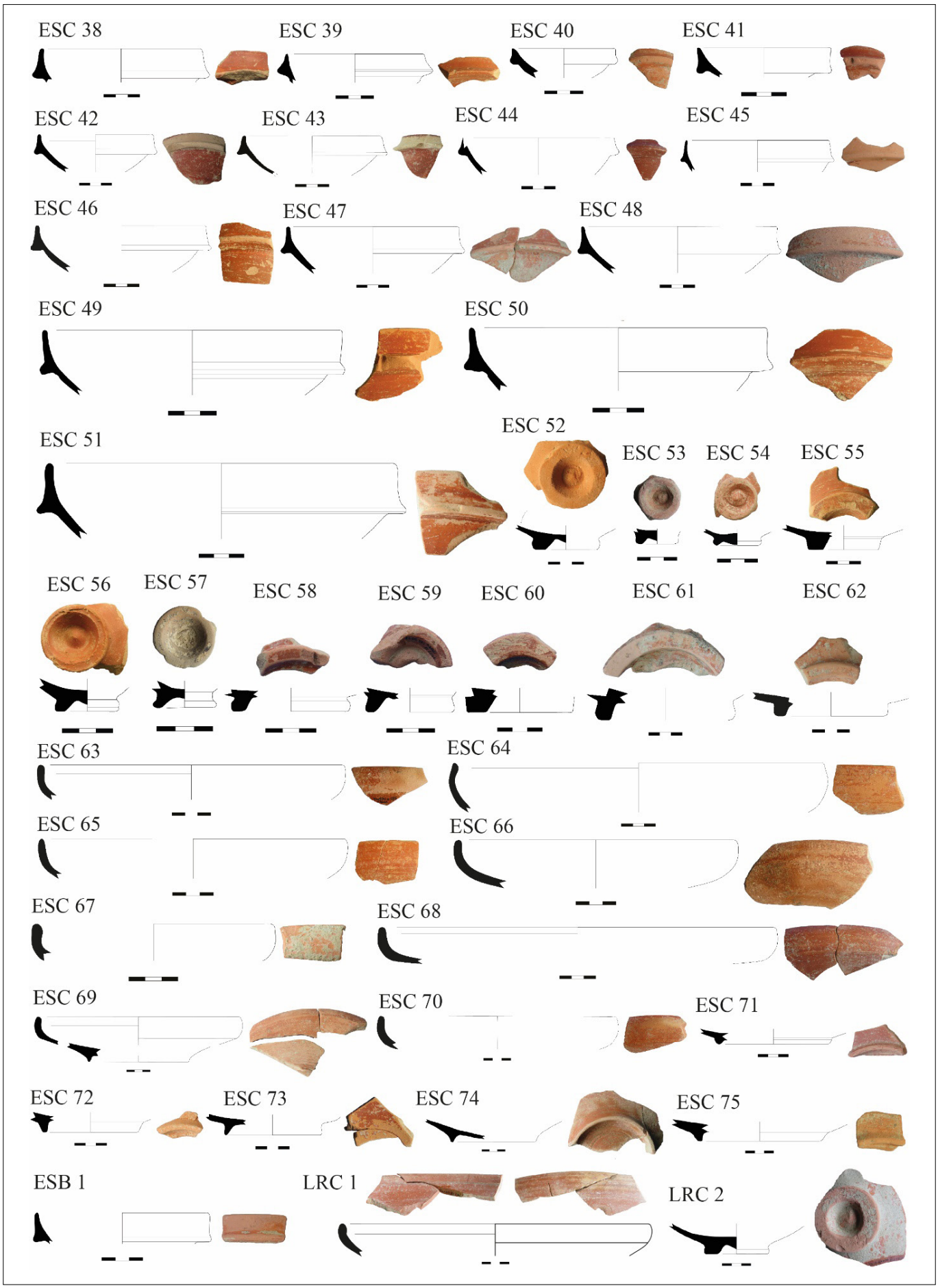

Fig. 3b. The ESC assemblage and other comparative tablewares from the YK Sector (photographs and drawings by the author).

MACROSCOPIC AND MICROSCOPIC COMPARATIVE CHARACTERIZATION OF ESC

Macroscopic examination of the ESC assemblage revealed a consistent fabric with two different colour variations[16]: a dominant reddish-orange hue (2.5 YR 6/6, light red) and a secondary yellowish shade (5 YR 8/2, pink)[17]. The fabric is very hard with a slightly rough surface texture, characterized by abundant flat, circular voids and a well-sorted matrix (Fig. 4: ESC 22a, ESC 42). Thin section analysis of the ESC samples confirmed these observations, revealing a moderately to well-sorted distribution of inclusions, primarily quartz with a minor presence of muscovite. The quartz grains range in size from 0.02 to 0.25 mm, while the muscovite laths measure approximately 0.03 mm. The porosity consists of a single group of generally irregular voids (Fig. 4: ESC 22b, cross polarized; 22c, plane polarized light).

Macroscopic fabric analysis proved essential for the correct classification of specimens where typological identification was ambiguous due to morphological similarities. For instance, sample ESB 1 (Fig. 3b-4) exhibits a profile parallel to ESB forms (e.g., Hayes Form 60[18]), yet simultaneously resembling variation of Hayes Form 3 like ESC 32 (Fig. 3a), which is classified as Hayes Çandarlı Form 3. Similarly, LRC 1 (Fig. 3b-4) is morphologically comparable to LRC Hayes Form 1; it also resembles Hayes Çandarlı Form 4. Also, LRC 2 (Fig. 3b-4) was classified as Hayes Çandarlı Form 3. However, a detailed macroscopic examination of the fabrics (Fig. 4: ESB 1, LRC 1-2) clearly distinguishes these wares from the ESC. The ESB 1 sample is characterized by a pink fabric (5 YR 8/3) containing dense mica inclusions with no other visible tempering agents and a nearly void-free structure. The LRC 1-2 sample exhibits a light red clay (10R 5/6, LRC 2 is slightly more orangish) distinguished by lime (calcite) particles of varying sizes and characteristic channel type voids-features rare in the ESC matrix. Finally, ESC 45 (Hayes Çandarlı Form 3; Fig. 3b-4) generally differs from other ESC in terms of tone and composition. Although it is similar to ESB 1 in tone, it lacks mica, confirming its classification as ESC.

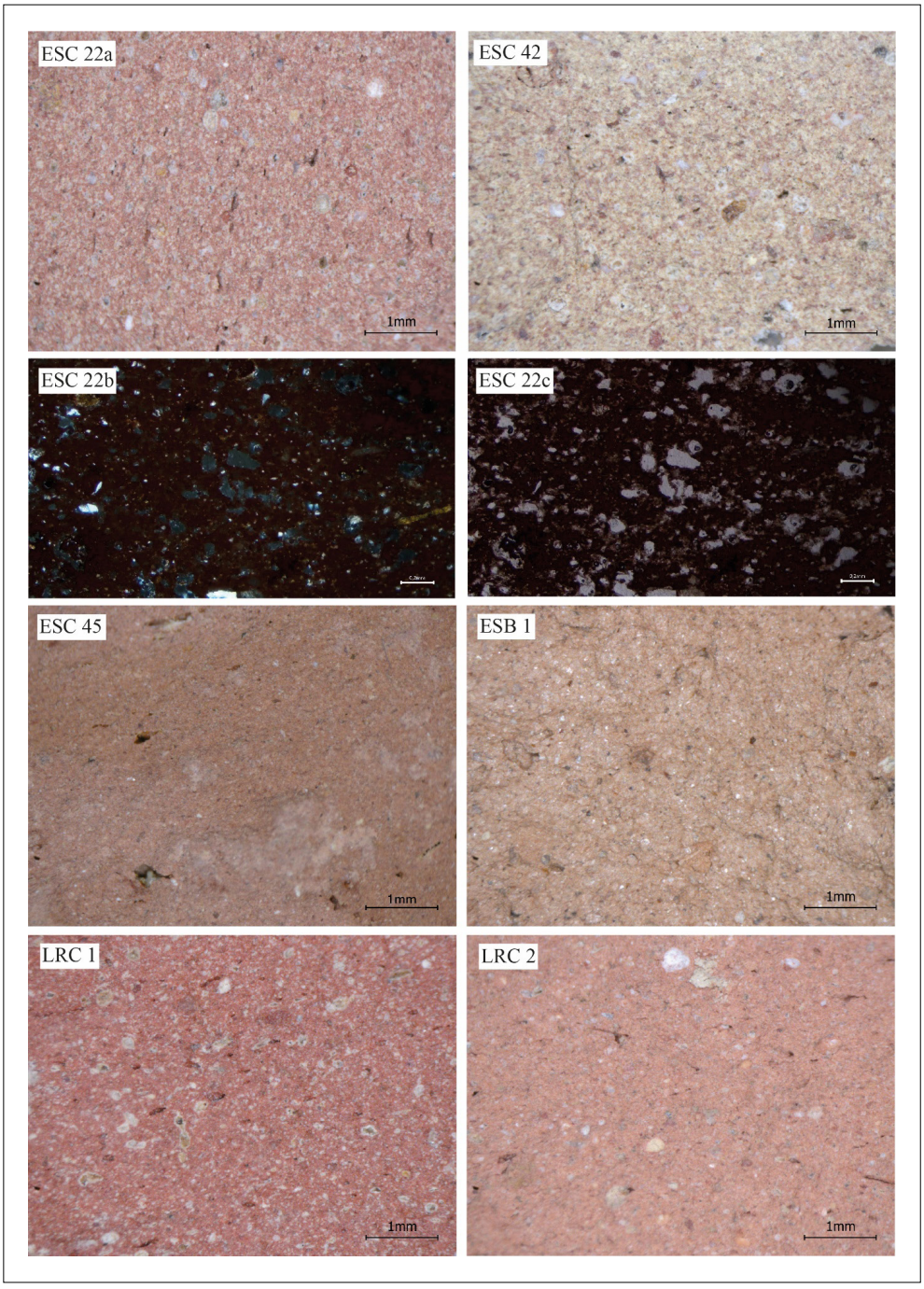

Fig. 4. Selected macrophotographs and micrographs of ESC and comparative samples of ESB and LRC from the YK Sector (macrophotographs and micrographs by the author).

[16] Although chemically identified as a Pergamon production, ESC 1 is macroscopically indistinguishable from the Çandarlı wares. This observation parallels Japp's findings, which notes that despite distinct chemical compositions, the fabrics from these two centres can be visually deceptively similar. See: JAPP 2014, 19.

[17] These two fabric types correspond to the reference groups defined for Çandarlı. See: BES/KEWELOH-KALETTA 2025, 252, Fig. 28.

[18] HAYES 1985, 64, Pl. 14, 3.

OUTCOMES OF CHEMICAL ANALYSES

Portable X-Ray Fluorescence (p-XRF) analysis was conducted on the majority of the tableware assemblage recovered from the YK Sector, apart from a limited number of specimens added to the study at a later stage. The Principal Component Analysis (PCA) plot, generated from the p-XRF data, revealed a chemical distribution that closely aligns with the archaeological classifications. Although the ESC group exhibits minor compositional overlaps with the ESB, LRC-Gryneion, and ITS groups in peripheral zones, the majority of the samples are concentrated in a distinct, separate cluster. Consequently, based on the p-XRF results, the provenance of the ESC assemblage was determined to be Çandarlı, with the exception of ESC 1, which originates from Pergamon. The PCA results, in accordance with macroscopic examinations, further confirm that samples ESC 45 and ESC 69 cluster within the ESC group, while LRC 1 and 2 fall within the LRC (Phokaia) group (Fig. 5). To check the p-XRF data, Energy Dispersive X-ray Fluorescence (ED-XRF) analysis was also performed on selected samples, and the results were cross-referenced with WD-XRF-based reference groups. Fig. 6 presents the average

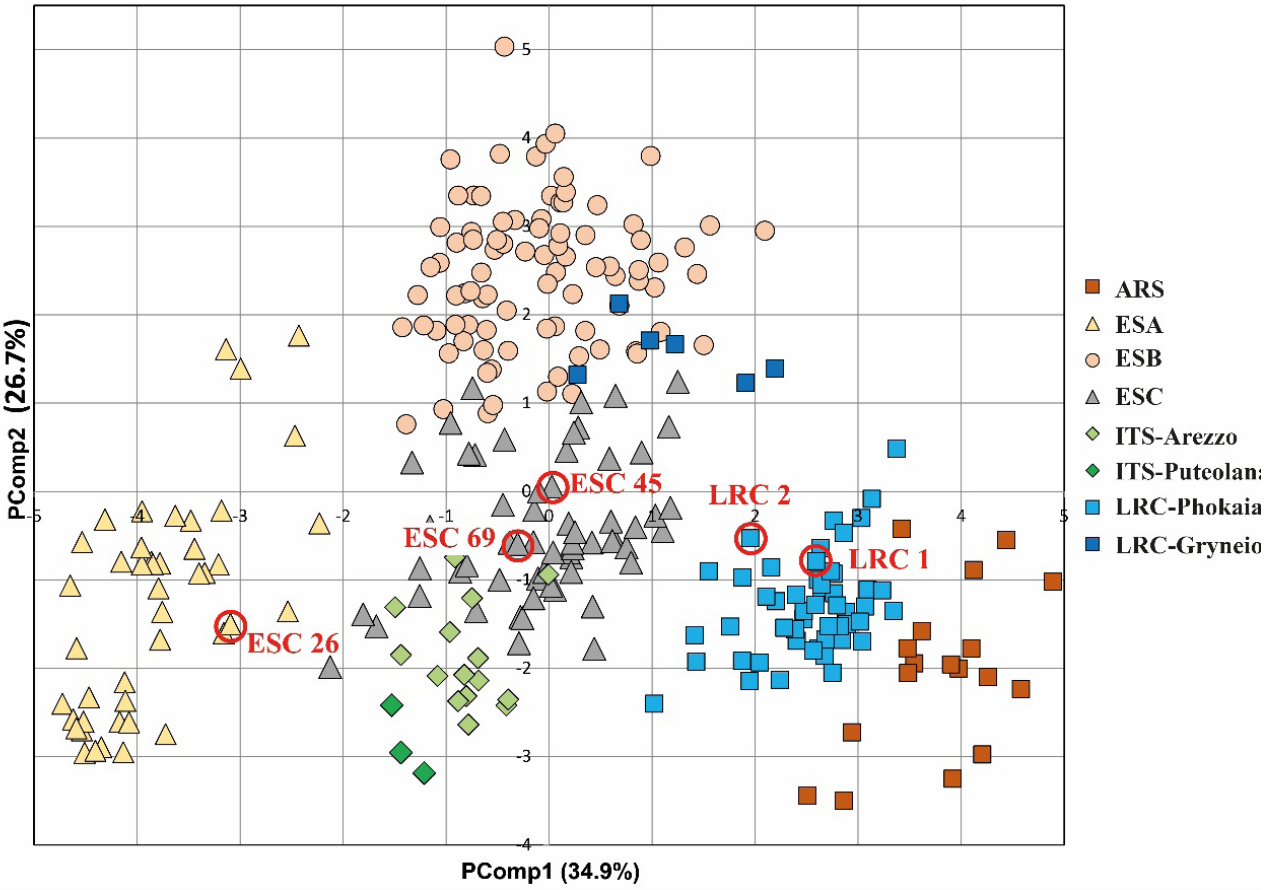

Fig. 5. PCA of tablewares from the YK Sector (AYCAN/DASZKIEWICZ/SCHNEIDER forthcoming).

Site of production	Type of analysis	References and Samples	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	V	Cr	Ni	Zn	Rb	Sr	Y	Zr	Nb	Ba	Ce
ESA	WD-XRF	mean (n=144)	49,1	0,750	14,5	8,35	0,110	7,70	**15,7**	1,16	2,41	0,28	129	**354**	**334**	97	71	408	21	113	7	255	39
ESC Pergamon	WD-XRF	mean (n=24)	60,6	1,030	18,6	7,40	0,110	3,03	**5,0**	0,64	3,25	0,29	116	**253**	**154**	88	144	308	28	182	17	733	74
LRC Phokaia	WD-XRF	mean	64,3	0,903	18,2	6,02	0,047	1,94	**5,1**		2,96	0,13	130	**122**	**54**	81	158	205	28	243	13	341	
ESC Çandarli	WD-XRF	mean	56,0	0,901	17,2	7,18	0,115	3,44	**11,0**		3,02	0,21	130	**225**	**151**	95	141	276	25	166	16	672	
ESC Çandarli	p-XRF	mean (n=60)	53,9	1,041	18,1	7,87	0,093	4,42	**9,7**		3,51	0,29	108	**261**	**176**	72	216	262	22	155	8	353	
ESC Pergamon	p-XRF	ESC 1	54,8	1,265	16,2	9,29	0,111	4,68	**5,9**		2,4	0,34	76	**317**	**212**	85	107	212	22	147	17	296	136
ESC Pergamon	ED-XRF	ESC 1	47,7	0,933	17,5	6,13	0,089	4,67	**8,6**	0,88	2,2	0,44	124	**293**	**213**	90	107	254	23	153	11	284	< 2,0
ESC Çandarli	p-XRF	ESC 69	52,8	1,128	15,9	9,48	0,106	5,29	**7,7**		2,5	0,2	121	**297**	**223**	110	95	213	24	166	19	355	123
ESC Çandarli	ED-XRF	ESC 69	45,5	0,496	15,3	5,07	0,066	12,9	**14,6**	2,25	0,9	0,26	57	**194**	**184**	60	19	218	12	59	3	107	14
LRC Phokaia	p-XRF	LRC 1	50,0	1,152	23,5	8,02	0,052	3,05	**5,7**		2,8	0,43	99	**139**	**80**	220	172	231	32	246	25	281	117
LRC Phokaia	ED-XRF	LRC 1	57,8	0,721	20,8	4,59	0,037	2,91	**4,5**	1,30	2,2	0,14	112	**99**	**83**	73	114	162	20	173	10	172	38,7
LRC Phokaia	p-XRF	LRC 2	59,0	1,65	16,0	7,89	0,13	3,87	**3,9**		2,36	0,18	115	**313**	**118**	62	135	157	23	193	24	326	169
LRC Phokaia	ED-XRF	LRC 2	55,6	0,858	20,8	3,76	0,053	4,13	**3,8**	2,53	1,9	0,15	96	**185**	**76**	37	77	96	13	101	6,8	161	34,4
ESC Çandarli	p-XRF	ESC 26	47,7	0,888	14,4	9,27	0,165	7,27	**13,3**		1,6	0,28	91	**328**	**246**	87	59	324	18	154	17	336	167
ESC Çandarli	ED-XRF	ESC 26	46,6	0,704	15,3	5,58	0,112	7,24	**14,0**	2,37	1,6	0,3	105	**221**	**174**	67	55	262	19	130	6,8	258	< 2,0

Fig. 6. Results of P-XRF and ED-XRF analyses on selected samples from the YK Sector (by the author).

p-XRF values for the ESC group alongside the individual p-XRF and ED-XRF values for the selected samples, as well as the WD-XRF-based reference groups for Çandarlı, Pergamon, Eastern Sigillata A (ESA) and Phokaia[19]. Notably, for ESC 1, the CaO concentration, a key discriminator between Çandarlı and Pergamon productions, is consistent with the Pergamon reference group in both the p-XRF and ED-XRF results. When examining ESC 69, LRC 1, and LRC 2, the chemical differentiation is distinct. The values for CaO, Cr, and Ni, which serve as markers distinguishing Çandarlı from Phokaia, confirm the attribution of ESC 69 to Çandarlı and LRC 1 and 2 to Phokaia. Lastly, sample ESC 26 was initially tentatively assigned to the ESA group due to its intermediate position in the PCA plot, despite its morphological resemblance to Hayes Çandarlı Form 2. However, based on the ED-XRF results, it has been reclassified as ESC. While CaO concentrations are high in both reference groups and thus non-discriminant, Cr and Ni values are characteristically lower in ESC than in ESA. Then, the ED-XRF data for ESC 26 align with these lower values, confirming its attribution to the ESC group.

ASSESSMENT AND DISCUSSION

The composition and chronology of the ESC assemblage recovered from the YK Sector offer broader implications for understanding the socio-economic dynamics of the Klaros sanctuary. The chronological distribution of the finds mirrors the historical trajectory of the site; the proliferation of Hayes Çandarlı Forms 2 and 3 corresponds precisely with the Antonine and Severan periods, an era documented as the sanctuary's zenith in terms of visitor traffic and oracular consultation[20]. The subsequent decline of Klaros in the mid-3rd century AD parallels the sharp decrease in the quantity of fine ware groups (Fig. 2a). Therefore, the ESC group, alongside the earlier ESB assemblage, represents the final intensive phase of the sanctuary's activity, after which only sporadic LRC finds are recorded. The presence of these standard tablewares in the YK Sector, situated near the propylon, suggests that this area facilitated communal activities, likely related to the reception or dining of officials, visitors, and pilgrims, before the site's function transformed in Late Antiquity. The provenance data highlights the sanctuary's integration into specific regional supply networks. While the presence of ESB indicates earlier commercial ties to the Meander Valley, the overwhelming dominance of Çandarlı (Pitane) products in the subsequent phase indicates that during the 2nd and 3rd centuries AD, Klaros relied heavily on regional North Ionian and Aeolian workshops rather than long-distance imports from Italy or North Africa. This establishes Klaros as a "consumption centre" closely tied to the economic sphere of the Western Asia Minor region during its peak.

The methodological challenges addressed in this study emphasize the complexity of the transition from Middle to Late Roman pottery traditions. The morphological ambiguity between certain ESC types and the successor LRC wares has historically complicated the dating of archaeological contexts. The data from Klaros demonstrate that visual classification alone is often insufficient for transitional pieces. The chemical distinction established here between the "look-alike" ESC and LRC fabrics confirms that while manufacturing technology and aesthetic preferences (forms and slips) evolved continuously, the raw material sources remained distinct. This continuity in form but divergence in fabric marks the tangible shift from the terra sigillata tradition to the red slip ware tradition. Specific examples from this study illustrate this complexity: while LRC 1 reflects the typological and slip transition between ESC and LRC, the case of LRC 2, which is morphologically a Çandarlı Hayes Form 3 but chemically proven to be Phokaian, demonstrates active typological interaction and imitation between workshops. Consequently, it is concluded that distinguishing between these two production groups is impossible without the aid of chemical analysis. Methodologically, the reclassification of sample ESC 26 following the comparative analysis of p-XRF and ED-XRF results serves as a critical caveat. This instance indicates that p-XRF data must be interpreted with care and that outlier pieces necessitate re-analysis with higher-precision instruments to ensure accuracy. Moreover, it highlights that archaeometric results cannot be isolated from typological and macroscopic evaluations, as ESC 26 is morphologically indistinguishable from the standard ESC assemblage despite the initial chemical deviation.

CONCLUSION

The examination of the ESC assemblage from the YK Sector constitutes a vital historical benchmark for the sanctuary of Klaros. The chronological concentration of the finds mirrors the sanctuary's zenith during the Antonine and Severan periods, an era marked by intense spiritual consultation during crises such as the Antonine plague, thereby reinforcing the identification of the YK Sector as a hub for visitor-related consumption prior to its functional decline. Beyond its historical implications, this study underscores the necessity of archaeometric characterization in refining the classification of fine wares with visually deceptive fabrics and similar forms. The detection of a Pergamon-produced specimen (ESC 1) that is macroscopically indistinguishable from the dominant Çandarlı group and alongside the identification of Phokaian wares (LRC 1 and 2) that share morphologically identical forms with the ESC samples, empirically confirms that chemical analysis is indispensable for accurate attribution during this transition period. Additionally, even though it involves only a single sample incompatible with the p-XRF results, the reclassification of ESC 26 demonstrates that such data should not be interpreted in isolation from typological and macroscopic evaluations. This indicates the need for careful interpretation and necessitates the re-analysis of suspicious fragments via higher-precision instruments to ensure accuracy. Ultimately, by defining the chemical and typological boundaries between ESC and the successor LRC wares, this research establishes the YK Sector assemblage

[19] For the Pergamon and ESA WD-XRF references, see: SCHNEIDER 2000, 58, Table 3; for the Çandarlı and Phokaia, up-to-date WD-XRF data were utilized, see: AYCAN/DASZKIEWICZ/SCHNEIDER forthcoming.

[20] The sanctuary reached its peak in the 2nd-3rd centuries AD, producing "theological oracles" and advising on crises such as the Antonine plague. See: FOWDEN 2008, 547–548.

as a critical reference point for the transitional ceramic horizons of the region.

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CATALOGUE

Cat. No. 1 (ESC1). Pergamon Applique Ware Base. H. 2.3; D. 15.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 2 (ESC2). Loeschcke Form 20. Rim fragment. H. 2.0; D. 11.2. **Clay:** 7.5YR 7/4 (pink). **Slip:** 2.5YR 5/6 (red).

Cat. No. 3 (ESC3). Loeschcke Form 20. Rim fragment. H. 2.2; D. 10.4. **Clay:** 7.5YR 7/4 (pink). **Slip:** 2.5YR 5/6 (red).

Cat. No. 4 (ESC4). Hayes Form 1 / Loeschcke Form 29. Rim fragment. H. 2.6; D. 26.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 5 (ESC5). Hayes Form 1 / Loeschcke Form 29. Rim fragment. H. 2.3; D. -. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 6 (ESC6). Hayes Form 1 / Loeschcke Form 29. Rim fragment. H. 2.2; D. -. **Clay:** 2.5YR 6/6 (light red). **Slip:** 10R 5/6 (red).

Cat. No. 7 (ESC7). Hayes Form 2. Rim fragment. H. 2.3; D. 15.6. **Clay:** 5YR 6/8 (reddish yellow). **Slip:** 10R 5/8 (red).

Cat. No. 8 (ESC8). Hayes Form 2. Rim fragment. H. 2.2; D. 24.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 9 (ESC9). Hayes Form 2. Rim fragment. H. 2.2; D. 26.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 10 (ESC10). Hayes Form 2. Rim fragment. H. 1.9; D. 19.8. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 11 (ESC11). Hayes Form 2. Rim fragment. H. 2.8; D. 21.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 12 (ESC12). Hayes Form 2. Rim fragment. H. 1.7; D. 24.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 13 (ESC13). Hayes Form 2. Rim fragment. H. 2.0; D. 29.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 14 (ESC14). Hayes Form 2. Rim fragment. H. 3.0; D. 23.0. **Clay:** 5YR 6/8 (reddish yellow). **Slip:** 10R 5/8 (red).

Cat. No. 15 (ESC15). Hayes Form 2. Rim fragment. H. 2.5; D. 16.0. **Clay:** 2.5YR 6/8 (light red). **Slip:** 2.5YR 4/6 (red).

Cat. No. 16 (ESC16). Hayes Form 2. Rim fragment. H. 1.7; D. 15.7. **Clay:** 2.5YR 6/8 (light red). **Slip:** 2.5YR 4/6 (red).

Cat. No. 17 (ESC17). Hayes Form 2. Rim fragment. H. 2.1; D. 16.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 18 (ESC18). Hayes Form 2. Rim fragment. H. 1.5; D. 17.2. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 19 (ESC19). Hayes Form 2. Rim fragment. H. 2.2; D. 16.8. **Clay:** 2.5YR 6/6 (light red). **Slip:** 10R 5/6 (red).

Cat. No. 20 (ESC20). Hayes Form 2. Rim fragment. H. 1.7; D. 17.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 21 (ESC21). Hayes Form 2. Rim fragment. H. 2.4; D. 15.6. **Clay:** 2.5YR 6/8 (light red). **Slip:** 10R 4/8 (red).

Cat. No. 22 (ESC22). Hayes Form 2. Base fragment. H. 2.4; D. 9.8. **Clay:** 2.5YR 7/4 (light reddish brown). **Slip:** 2.5YR 5/6 (red).

Cat. No. 23 (ESC23). Hayes Form 2. Base fragment. H. 1.7; D. 10.2. **Clay:** 2.5YR 6/8 (light red). **Slip:** 2.5YR 4/6 (red).

Cat. No. 24 (ESC24). Hayes Form 2. Base fragment. H. 2.0; D. 11.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 10R 5/6 (red).

Cat. No. 25 (ESC25). Hayes Form 2. Base fragment. H. 2.6; D. 12.2. **Clay:** 5YR 7/6 (reddish yellow). **Slip:** 2.5YR 4/8 (red).

Cat. No. 26 (ESC26). Hayes Form 2. Base fragment. H. 1.9; D. 8.0. **Clay:** 2.5Y 8/4 (yellow). **Slip:** 2.5YR 5/6 (red).

Cat. No. 27 (ESC27). Hayes Form 2. Base fragment. H. 1.7; D. 11.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 28 (ESC28). Hayes Form 3 (Miniature). Rim fragment. H. 3.0; D. 10.4. **Clay:** 5YR 8/3 (pink). **Slip:** 10R 4/6 (red).

Cat. No. 29 (ESC29). Hayes Form 3 (Miniature). Rim fragment. H. 1.6; D. 7.4. **Clay:** 2.5YR 6/8 (light red). **Slip:** 2.5YR 4/6 (red).

Cat. No. 30 (ESC30). Hayes Form 3 (Miniature). Rim fragment. H. 2.0; D. 8.2. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 31 (ESC31). Hayes Form 3 (Miniature). Complete profile. H. 2.3; D. 6.4; D. (Base) 3.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 32 (ESC32). Hayes Form 3 (Miniature). Rim fragment. H. 1.8; D. 11.0. **Clay:** 2.5YR 7/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 33 (ESC33). Hayes Form 3 (Miniature). Rim fragment. H. 2.8; D. 12.4. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 34 (ESC34). Hayes Form 3 (Miniature). Rim fragment. H. 3.8; D. 11.4. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 35 (ESC35). Hayes Form 3 (Miniature). Rim fragment. H. 2.2; D. 12.4. **Clay:** 5YR 7/4 (pink). **Slip:** 2.5YR 5/8 (red).

Cat. No. 36 (ESC36). Hayes Form 3 (Miniature). Rim fragment. H. 2.2; D. 12.8. **Clay:** 5YR 7/4 (pink). **Slip:** 2.5YR 5/8 (red).

Cat. No. 37 (ESC37). Hayes Form 3 (Miniature). Rim fragment. H. 2.4; D. 10.4. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 38 (ESC38). Hayes Form 3 (Miniature). Rim fragment. H. 2.8; D. 13.2. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 39 (ESC39). Hayes Form 3 (Miniature). Rim fragment. H. 2.2; D. 11.2. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 40 (ESC40). Hayes Form 3 (Miniature). Rim fragment. H. 2.3; D. 8.0. **Clay:** 5YR 6/6 (reddish yellow). **Slip:** 2.5YR 6/8 (light red).

Cat. No. 41 (ESC41). Hayes Form 3 (Miniature). Rim fragment. H. 2.9; D. 8.8. **Clay:** 2.5YR 6/6 (light red). **Slip:** 10R 5/8 (red).

Cat. No. 42 (ESC42). Hayes Form 3 (Miniature). Rim fragment. H. 3.4; D. 10.4. **Clay:** 5YR 8/2 (pink). **Slip:** 2.5YR 5/6 (red).

Cat. No. 43 (ESC43). Hayes Form 3 (Miniature). Rim fragment. H. 3.2; D. 12.0. **Clay:** 5YR 8/3 (pink). **Slip:** 10R 4/6 (red).

Cat. No. 44 (ESC44). Hayes Form 3 (Miniature). Rim fragment. H. 3.0; D. 13.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 45 (ESC45). Hayes Form 3 (Miniature). Rim fragment. H. 2.8; D. 12.8. **Clay:** 5YR 7/6 (reddish yellow). **Slip:** 10R 4/4 (red).

Cat. No. 46 (ESC46). Hayes Form 3. Rim fragment. H. 4.0; D. 14.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 47 (ESC47). Hayes Form 3. Rim fragment. H. 4.3; D. 15.8. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 48 (ESC48). Hayes Form 3. Rim fragment. H. 4.0; D. 16.8. **Clay:** 5YR 6/6 (reddish yellow). **Slip:** 10R 4/8 (red).

Cat. No. 49 (ESC49). Hayes Form 3. Rim fragment. H. 4.0; D. 18.6. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 50 (ESC50). Hayes Form 3. Rim fragment. H. 3.7; D. 17.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 51 (ESC51). Hayes Form 3. Rim fragment. H. 5.0; D. 22.5. **Clay:** 5YR 7/4 (pink). **Slip:** 10R 4/8 (red).

Cat. No. 52 (ESC52). Hayes Form 3. Base fragment. H. 2.0; D. 5.5. **Clay:** 5YR 7/6 (reddish yellow). **Slip:** 2.5YR 5/8 (red).

Cat. No. 53 (ESC53). Hayes Form 3. Base fragment. H. 1.1; D. 3.1. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 54 (ESC54). Hayes Form 3. Base fragment. H. 1.2; D. 3.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 55 (ESC55). Hayes Form 3. Base fragment. H. 2.2; D. 6.0. **Clay:** 2.5YR 7/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 56 (ESC56). Hayes Form 3. Base fragment. H. 2.0; D. 3.8. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/6 (red).

Cat. No. 57 (ESC57). Hayes Form 3. Base fragment. H. 1.4; D. 3.2. **Clay:** 2.5YR N6/ (reddish gray). **Slip:** N 2.5/ (black).

Cat. No. 58 (ESC58). Hayes Form 3. Base fragment. H. 1.3; D. 7.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 10R 5/8 (red).

Cat. No. 59 (ESC59). Hayes Form 3. Base fragment. H. 1.5; D. 5.6. **Clay:** 2.5YR 6/6 (light red). **Slip:** 10R 5/8 (red).

Cat. No. 60 (ESC60). Hayes Form 3. Base fragment. H. 1.6; D. 7.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 10R 5/8 (red).

Cat. No. 61 (ESC61). Hayes Form 3. Base fragment. H. 2.7; D. 12.0. **Clay:** 5YR 7/4 (pink). **Slip:** 10R 4/8 (red).

Cat. No. 62 (ESC62). Hayes Form 3. Base fragment. H. 1.8; D. 9.0. **Clay:** 5YR 7/4 (pink). **Slip:** 10R 4/8 (red).

Cat. No. 63 (ESC63). Hayes Form 4. Rim fragment. H. 2.7; D. 23.2. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 64 (ESC64). Hayes Form 4. Rim fragment. H. 4.3; D. 32.4. **Clay:** 5YR 6/8 (reddish yellow). **Slip:** 2.5YR 4/8 (red).

Cat. No. 65 (ESC65). Hayes Form 4. Rim fragment. H. 2.8; D. 22.0. **Clay:** 2.5YR 7/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 66 (ESC66). Hayes Form 4. Rim fragment. H. 3.6; D. 20.8. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 67 (ESC67). Hayes Form 4. Rim fragment. H. 2.3; D. 14.0. **Clay:** 5YR 6/8 (reddish yellow). **Slip:** 2.5YR 4/8 (red).

Cat. No. 68 (ESC68). Hayes Form 4. Rim fragment. H. 3.0; D. 32.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 69 (ESC69). Hayes Form 4. Complete profile. H. 5.7; D. (Rim) 25.6; D. (Base) 12.6. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 70 (ESC70). Hayes Form 4. Rim fragment. H. 3.6; D. 25.0. **Clay:** 5YR 7/4 (pink). **Slip:** 2.5YR 5/8 (red).

Cat. No. 71 (ESC71). Hayes Form 4. Base fragment. H. 2.5; D. 11.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 72 (ESC72). Hayes Form 4. Base fragment. H. 1.8; D. 8.8. **Clay:** 2.5YR 7/6 (light red). **Slip:** 2.5YR 4/8 (red).

Cat. No. 73 (ESC73). Hayes Form 4. Base fragment. H. 1.8; D. 8.4. **Clay:** 5YR 6/6 (reddish yellow). **Slip:** 2.5YR 4/8 (red).

Cat. No. 74 (ESC74). Hayes Form 4. Base fragment. H. 2.8; D. 11.0. **Clay:** 2.5YR 6/6 (light red). **Slip:** 2.5YR 5/8 (red).

Cat. No. 75 (ESC75). Hayes Form 4. Base fragment. H. 3.3; D. 13.0. **Clay:** 2.5YR 6/8 (light red). **Slip:** 10R 4/6 (red).

REFERENCES

AYCAN/DASZKIEWICZ/SCHNEIDER forthcoming
Aycan, H./Daszkiewicz, M./Schneider, G., Roman tablewares from Klaros: Possibilities and limitations of p-XRF measurements for chemical classification, *Prähistorische Zeitschrift*.

BES/KEWELOH-KALETTA 2025
Bes, P. M./Keweloh-Kaletta, A., The Manufacture of Eastern Sigillata C and Late Roman C at Çandarlı, Ancient Pitane, Results of the Intensive Survey (2019-2021), *Istanbuler Mitteilungen 74*, 211–294.

EMPEREUR/PICON 1986
Empereur, J. Y./Picon, M., A propos d'un nouvel atelier de 'Late Roman C', *Figlina: Documents du Laboratoire de céramologie de Lyon* 7, 143–146.

FOWDEN 2008
Fowden, G., The individual and the gods. In: Bowman, A. K./Garnsey P./Cameron A. (eds.), *The Cambridge Ancient History, Volume XII: The Crisis of Empire, A.D. 193-337,* Cambridge, 538-551.

HAYES 1972
Hayes, J. W., *Late Roman Pottery* (London).

HAYES 1985
Hayes, J. W., Sigillata Orientali, In: Cattatelli G. P. (Ed.), *Atlante delle forme ceramiche II, Ceramica Fine Romana nel Bacino Mediterraneo, Enciclopedia Dell' Arte Antica (Tardo Ellenismo Impero)*, Roma, 1-96, Pl. 1-24.

JAPP 2009
Japp, S. Archäometrisch-archäologische Untersuchungen an Keramik aus Pergamon und Umgebung, *Istanbuler Mitteilungen 59*, 193–268.

JAPP 2014
Japp, S., Sigillata of Pergamon-Eastern Sigillata C Problems of Classification and Chronology. In: Meyza H./Domżalski K. (eds.), *Late Hellenistic to Mediaeval Fine Wares of The Aegean Coast of Anatolia, Their Production, Imitation and Use*, 11–21.

LOESCHCKE 1912
Loeschcke, S., V. Sigillata-Töpfereien in Tschandarlı, *Athenische Mitteilungen* 37, 344–407.

MEYER-SCHLICHTMANN 1988
Meyer-Schlichtmann C., *Die pergamenische Sigillata aus der Stadtgrabung von Pergamon. Mitte 2. Jh. v. Chr.-Mitte 2. Jh. n. Chr.* (Berlin).

MOMMSEN/JAPP 2009
Mommsen, H./Japp, S., Neutronenaktivierungsanalysen von 161 Keramikproben aus Pergamon und Fundorten der Region, *Istanbuler Mitteilungen 59*, 269–286.

SCHNEIDER 2000
Schneider, G., Chemical and Mineralogical Studies of Late Hellenistic to Byzantine Pottery Production in The Eastern Mediterranean, *Rei Cretariae Romanae Fautores Acta* 36, 525–536.

SCHNEIDER/JAPP 2009
Schneider, G./Japp, S., Röntgenfluoreszenzanalysen von 115 Keramikproben aus Pergamon, Çandarlı, Elaia und Atarneus (Türkei), *Istanbuler Mitteilungen 59*, 287–306.

ŞAHİN 1998
Şahin, N., *Klaros Apollon Klarios Bilicilik Merkezi* (İstanbul).

ŞAHİN *et alii* 2007
Şahin, N./Tanrıver, C./ Akar, D. S./Taştemur, E./Ürkmez, Ö./Önol, İ., Klaros 2005 (5. Yıl), *28. Kazı Sonuçları Toplantısı, Cilt 1,* 589–608.

ŞAHİN *et alii* 2008
Şahin, N./Tanrıver, C./Akar-Tanrıver D. S./Taştemur, E./Önol, İ./Doğan, E./Ürkmez, Ö., Klaros, 2006, *29. Kazı Sonuçları Toplantısı, Cilt 3*, 427–448.

ŞAHİN *et alii* 2009
Şahin, N./Taştemur, E./Dallık, G./Önol, İ., Klaros 2007, *32. Kazı Sonuçları Toplantısı, Cilt 2,* 113–128.

ŞAHİN *et alii* 2010
Şahin, N./Taştemur, E./Karaman, D./Dallık, G./Doğan, E./Tari, D., Klaros 2008, *31. Kazı Sonuçları Toplantısı, Cilt 3*, 247–260.

ŞAHİN *et alii* 2020
Şahin, N./Zunal, O./Günata, G./Aycan, H., Klaros 2018, *41. Kazı Sonuçları Toplantısı, Cilt 3*, 507–522.

ŞAHİN *et alii* 2022
Şahin, N./Topal, C./Zunal, O./Aycan, H./Tatlı, M./Babacan, B./Erdinç, Ü., Klaros 2019-2020, *2019-2020 Yılı Kazı Çalışmaları, Cilt 3,* 469–486.

TOPAL *et alii* 2023
Topal, C./Zunal, O./Aycan, H./Tatlı, M./Babacan, B., Klaros 2021, *42. Kazı Sonuçları Toplantısı, Cilt 4*, Ankara, 329–340.

TOPAL *et alii* 2024
Topal, C./Zunal, O./Tatlı, M./Babacan, B./Altıparmak, Ş. E./Aycan, H., Klaros 2022, *43. Kazı Sonuçları Toplantısı, Cilt 2*, 363–376.

TOPAL *et alii* 2025
Topal, C./Zunal, O./Aycan, H./Babacan, B./Altıparmak, Ş. E., Klaros 2023, *44. Kazı Sonuçları Toplantısı, Cilt 3*, 79–93.

ZUNAL 2023
Zunal, O., Klaros Kutsal Alanı'nda Geç Antik Dönem Dönüşümü: Neden ve Nasıl? *Arkeoloji ve Sanat 172*, 91–108.