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SHORT COMMUNICATION

Continuity and change in cereal grinding technology at Kültepe, Turkey

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Abstract Change in Mediterranean grinding technology during the Hellenistic/Roman period affected the pattern of dental microwear since external grit particles were finer when flour was prepared using large rotary querns. Therefore, it is possible to detect the technological change through the analysis of human dentition. Here, the sample of teeth from Kültepe (ancient Kanesh), Turkey, is investigated to determine if the grinding technology changed at this site between the Middle Bronze Age ($n = 12$) and Hellenistic/Roman period ($n = 4$). A Hellenistic/Roman sample from Assos ($n = 7$) is also included for comparative purposes. The proportions and size of linear and nonlinear features did not differ significantly between periods or sites, which indicates that in spite of technical advances, old grinding technologies were still used in the Hellenistic/Roman period in Anatolia.

Keywords Dental microwear · Cereal grinding · Querns · Middle Bronze Age · Hellenistic-Roman period · Anatolia

Introduction

When the economic subsistence strategy of human populations inhabiting the Fertile Crescent shifted from gathering wild grass grains to plant cultivation, cereal grinding became a very important household activity. The first tools used to convert grain into flour were mortars and saddle querns (Dubreuil 2004) operated by females who spent a considerable part of their days on food preparation (Molleson 1989). This grinding technology remained relatively unchanged until the first millennium BCE, when rotary querns and so-called Olynthus (lever) mills were introduced in the western and eastern Mediterranean, respectively (Thurmond 2006). However, the most valuable improvements occurred during the Hellenistic and Roman periods when the invention of large rotary querns operated by animals and water mills moved cereal grinding from the household to the community level. The quality of flour also improved through the utilization of finer grinding stones (Peacock 1980; Wikander 1985; Braun 1991).

The history of grinding technologies may be traced using written sources and evidence of grinding stones at archaeological sites (Wikander 1985). However, where these types of evidence are absent or scarce, it is also possible to detect shifts in cereal grinding technology using the analysis of enamel microwear patterns. The introduction of large mills with finer grinding stones changed the size of grit particles included in the flour; grit produced by saddle querns was more variable with relatively large particles (Samuel 2000), while new grinding techniques produced smaller grit particles (Braun 1991). This type of change may be easily detected on the enamel surface of the tooth, as finer flour is expected to produce more linear than nonlinear features and features with smaller widths (Sołtysiak 2011).

Previous research has shown that this assumption is valid for the middle Euphrates valley in Syria, where teeth dated to the Bronze Age exhibited more prominent linear features and more nonlinear features on dental enamel, while the enamel of Late Roman and later teeth was affected chiefly by parallel striations (Sołtysiak 2011). Here, we examine whether similar

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Fig. 1 Map of Anatolia with locations of Kültepe and Assos

patterns may also be observed in Central Anatolia. Unlike the Euphrates valley, in Central Anatolia, it is unclear when and to what extent the new grinding technologies were adopted by the local population, although evidence for water mills has been documented in large cities and coastal areas of Asia Minor in the Late Roman period (Wikander 1985; Wilson 2001, 2002) and some isolated saddle querns from the Late Medieval period have been found in Southeastern Anatolia (Deveci and Ensert 2003).

Material

The sample of human teeth examined for microwear in the current study was gathered from Kültepe, an important archaeological site situated near modern Karahöyük village on the Kayseri Plain of Cappadocia (Özgüç 2003; Atici et al. 2014) (Fig. 1). During the Middle Bronze Age (MBA, c. 2000–1500 BCE), Kültepe was known as the city of Kanesh/Nesha that included an Old Assyrian trade colony. Virtually abandoned after the Iron Age, it was used as a cemetery for the local rural population through the Hellenistic and Roman periods (3rd c. BCE to 5th c. CE) (Özgüç 2003). Excavations at the site involve an international team coordinated by Fikri Kulakoğlu from the University of Ankara. The sample of available human remains includes several dozens of skeletons found in the domestic contexts (lower town) dated to c. 1830–1710 BCE and 176 skeletons from the Hellenistic-Roman cemetery (Üstündağ 2009, 2014). From that sample, we selected 12 MBA and 10 Hellenistic-Roman individuals with dentition suitable for enamel microwear analysis, i.e. without macroscopic evidence of taphonomic alterations.

For broader comparison, the teeth of nine individuals from Assos have also been studied. This city was located on the southern side of the Biga Peninsula in NW Turkey, along the coast near Çanakkale. Continuous archaeological research has been conducted at Assos since 1981, and since 2005, work has continued under the directorship of Nurettin Arslan from Çanakkale Onsekiz Mart University. Human remains were found in sarcophagi that contained mixed bones of many individuals. It is difficult to date such contexts with great confidence, but sarcophagus type and associated grave goods broadly date to a period of use from the 3rd c. BCE to the 4th c. CE (Arslan 2008), making this sample roughly contemporary to the second sample from Kültepe. Skeletons from both Kültepe and Assos are stored at the Anadolu Üniversitesi in Eskişehir.

It is difficult to deduce the social position of all these individuals, but it is not likely that any of them belonged to higher social strata in their respective populations. Although the size and the importance of Kültepe in the network of exchange differed between the MBA and the Hellenistic-Roman period, it may be deduced that the diet of all investigated individuals was based on local agricultural resources, as the enamel microwear patterns change very quickly during the lifetime.

During the MBA, the most important plants used in city of Kanesh were wheat and barley, as elsewhere in the Near East (Fairbairn 2014), and the cereals were processed using saddle querns. The evidence of plant use in the Hellenistic-Roman period at Kültepe and Assos is much more limited, but available data from other contemporary Anatolian sites (e.g. Sagalassos: Fuller et al. 2012) suggests that wheat and barley were still primary crops. The most important difference between the sites is the distance from the sea: Assos is located on the shore of the Aegean Sea while the shortest distance from Kültepe to the Mediterranean Sea is c. 200 km.

Methods

Some taphonomic factors can affect the enamel surfaces (Teaford 1988; King et al. 1999; Pérez-Pérez et al. 2003, Romero and De Juan 2013), and the experimental study has shown that original microwear features may be obliterated by acids, but mechanical modification by soil mineral particles is unlikely (King et al. 1999). Moreover, postmortem damage (e.g. during transportation and storage) may be relatively easily

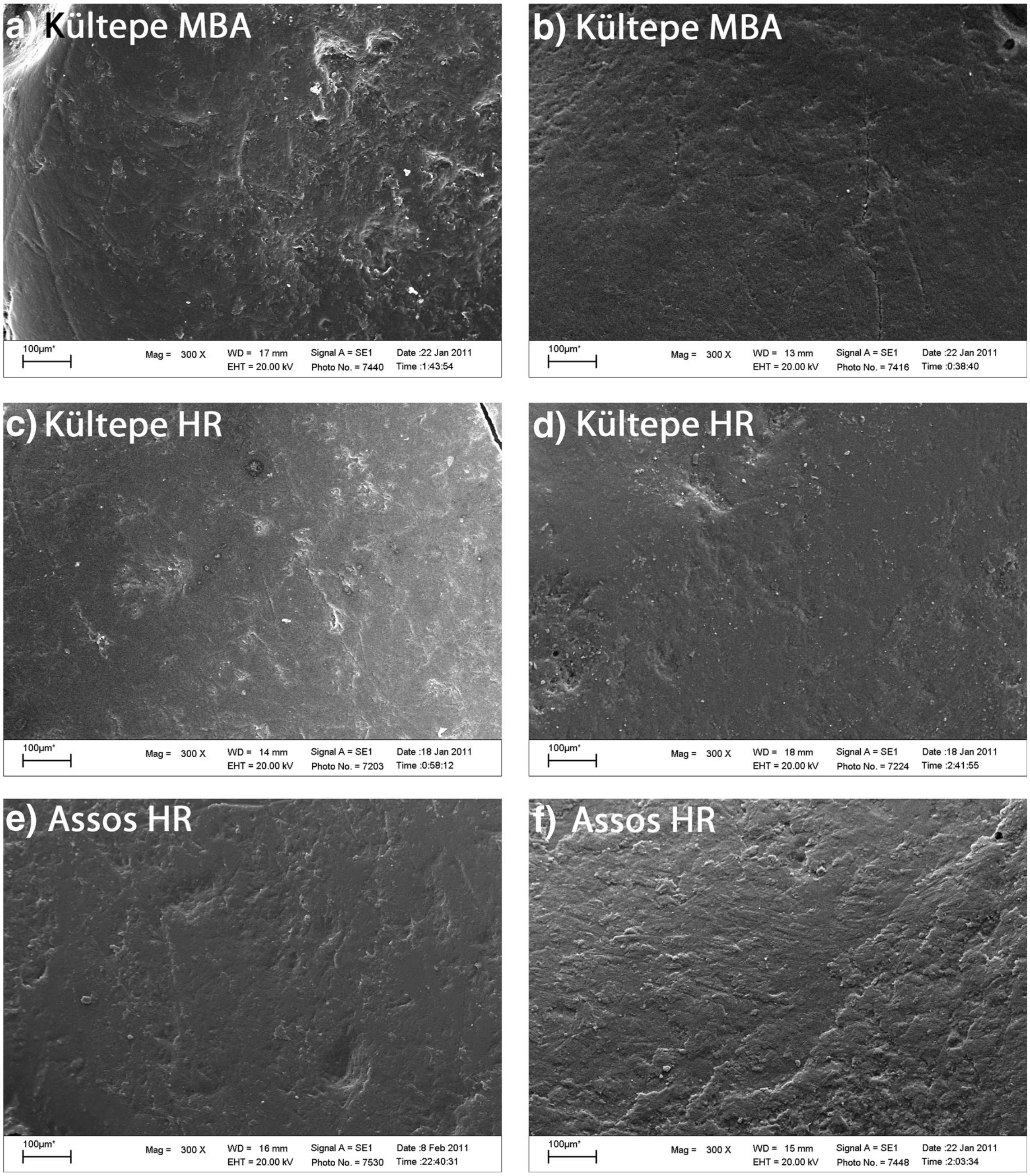

Fig. 2 Enamel surface with evident postmortem erosion (*from top to bottom*: MBA Kültepe (**a**, **b**), HR Kültepe (**c**, **d**), Assos (**e**, **f**))

distinguished using its shape, size, and pattern (Estebaranz et al. 2007; Romero and De Juan 2013).

Since the average wear of first molars is usually higher than the wear of second molars, lower second molars with a degree of wear on the protoconid cusp scored between 2 and 5 in Scott's (1979) scale were selected for analysis to maximize the sample size. If both mandibular second molars were preserved for one individual and did not differ significantly in degree of dental wear, the right one was selected for analysis. Each tooth was cleaned with water and soft brushes and dried to produce a polyurethane resin (RenCast FC52) cast using silicone negatives (Gumosil B poli-condensing rubber).

SEM pictures were taken with a LEO 1430VP microscope at the Faculty of Biology, University of Warsaw. The chosen surface was the protoconid facet x, a phase II facet which should show microwear pattern differentiated by diet (cf. Krueger et al. 2008). This facet was also selected for the relatively low morphological variation of the protoconid as compared to hypoconid and hypoconulid. Depending on the observed size of the facet x, between one and four micrographs were taken under a magnification of ×300.

All micrographs were reviewed to select those suitable for use in the microwear pattern analysis. If three or four pictures were available, we selected the two with the lowest evidence of external dirt present. The second picture was used to gauge feature consistency in the facet area. In many cases, postmortem erosion was evident on the micrographs and these were not used.

The features were counted and measured using Microwear 4.02 software (Ungar 2002) and then classified manually into four groups depending on their shape and size: small linear features (LS, up to 5 μm in breadth), large linear features (LL, more than 5 μm in breadth), small nonlinear features (NS, up to 20 μm in diameter) and large nonlinear features (NL, more than 20 μm in diameter). Moreover, the standard deviation for average relative orientation and average length of all linear features were calculated. Finer flour with lower average grit particle size is expected to produce more small linear features with less variable orientation (cf. Sołtysiak 2011).

Pictures were processed in a random order, without prior reference to their origin and tags to avoid systematic error. Differences in frequencies between two micrographs of the same facet have been tested using the χ^2 test to assess consistency. For testing differences in distribution of specified variables between three subsets, we used Kruskal-Wallis ANOVA. Correpondence analysis (CA) was chosen to assess the overall pattern of feature frequencies. All statistics were calculated using Statistica 10 software.

Results

From the original set of 31 individuals from the two sites, eight cases were rejected due to taphonomic modification in all micrographs (see Fig. 2). Specifically, the rejection was based on the following criteria: (1) presence of large irregular nonlinear features with sharp margins (e.g. Fig. 2a, d, e), (2) presence of dirt adhering to the tooth surface in large quantity (e.g. Fig. 2b, e, f), and (3) overall obliteration of the microwear features, likely due to acids and/or weathering of tooth surface (e.g. Fig. 2c, d).

Finally, the 23 cases were used for the microwear analysis, including 12 teeth from the MBA strata at Kültepe, four teeth from the Hellenistic/Roman strata at Kültepe and seven teeth from Assos (see Table 1 for details). Two micrographs were available for 13 individuals. Of these, only one case differed significantly ($p < 0.05$) in the frequencies of observed features and in three further cases the difference was close to the conventional significance level ($0.05 < p < 0.1$) (Table 2).

The three subsets did not differ significantly in the calculated frequencies of the four feature categories or other characteristics, although the sample from Assos did demonstrate a lower number of total features and the MBA Kültepe average length of linear features was higher than in both HR samples. Also, the frequency of small linear features seems to be higher

Table 1 General description of the analysed sample

ID	Site	Chronology	Tag	Sex	Age at death
A1	Kültepe	MBA	2008 M35	F	20–25
A2	Kültepe	MBA	2006 2Ac.K. MkI LI-II2	M	20–25
A3	Kültepe	MBA	2006 No nr Ind1	M	40–45
A4	Kültepe	MBA	2006 No nr. Ind2	F	20–25
A5	Kültepe	MBA	2007 M84 Ind 2	F	20–25
A6	Kültepe	MBA	2008 M5	M	25–30
A7	Kültepe	MBA	2006 M4 Ind 2	F	20–25
A8	Kültepe	MBA	2008 M1	F	20
A9	Kültepe	MBA	2006 6A. Room 6 M3 Ind 2	F	30–35
A10	Kültepe	MBA	2008 M14 Ind1	F	20–25
A11	Kültepe	MBA	2006 M6 Ind 2	F	−50–60
A12	Kültepe	MBA	2007 M86	?	15–16
B1	Kültepe	HR	2008 M30 Ind1	F	20
B2	Kültepe	HR	2008 M12	F	16–17
B3	Kültepe	HR	2008 M37 Ind 1	F	25–30
B4	Kültepe	HR	2007 M31 Ind 1	M	20–25
C1	Assos	HR	2006 WN Sarc 22 Ind2	M	20–25
C2	Assos	HR	2006 WN Sarc22 Ind1	F	20
C3	Assos	HR	2006 WN Sarc25 Ind1	M	40–50
C4	Assos	HR	2006 WN A4 Sarc25 Ind2	F	20–25
C5	Assos	HR	2004 WN Sarc 25 Ind3	F	20
C6	Assos	HR	2006 WN Sarc23 Ind 2	M	30
C7	Assos	HR	2006 WN A4 Sarc23 Ind1	F	20–25

in the later than in the earlier period. However, distributions of all variables overlap significantly for the three subsets (Table 3).

On the other hand, the CA allows observation of some interesting patterns. The frequencies of the four feature categories are quite variable (χ^2 = 748.79 for 4 categories and 36 micrographs) and the first two dimensions explain more than 90 % of inertia. The first dimension (68 % of inertia) discriminates primarily between linear and nonlinear features, and the second dimension (23 % of inertia) discriminates chiefly between large linear and all other features (Fig. 3).

Teeth from MBA Kültepe show the highest overall variability and are dispersed widely on the diagram, although two vague clusters may be observed, one small cluster indicating numerous linear features (specimens A2, 3, 4 and 11) and a larger cluster with more nonlinear features (specimens A1, 5, 6, 7, 8, 9 and 10). On the other hand, nonlinear features are least common in a subset of four late specimens from Kültepe. The pattern of the Assos subset is less clear, but it seems to follow the early subset from Kültepe with two similar clusters and a lower abundance of large linear features than in Kültepe (see Fig. 4 for typical examples of enamel microwear in Kültepe and Assos).

Table 2 Frequency of enamel microwear features in Kültepe and Assos

ID	LS	LS%	LL	LL%	NS	NS%	NL	NL%	All	Orient.	Length	χ^2	*p*
A1a	41	39	22	21	34	33	8	8	105	31.49	132.01	3.765	0.288
A1b	53	30	35	20	77	43	13	7	178	32.34	106.44		
A2a	77	56	49	36	10	7	1	1	137	25.03	147.24	4.791	0.188
A2b	64	45	59	41	19	13	1	1	143	24.23	147.1		
A3a	59	46	55	43	9	7	5	4	128	26.69	120.88	7.639	0.054
A3b	44	45	32	33	18	19	3	3	97	34.02	167.04		
A4a	52	63	19	23	8	10	3	4	82	32.87	106.9	3.276	0.351
A4b	42	51	24	29	14	17	3	4	83	33.97	161.14		
A5a	31	28	25	23	38	35	16	15	110	27.67	114.98	8.209	0.042
A5b	21	15	38	28	64	46	15	11	138	27.21	131.13		
A6	40	47	15	18	20	24	10	12	85	21.9	110.83		
A7	10	11	30	34	42	47	7	8	89	19.58	185.92		
A8	22	16	49	35	65	46	5	4	141	15.32	127.36		
A9	35	39	18	20	28	31	9	10	90	50.07	130.47		
A10	48	36	23	17	50	37	14	11	135	28.51	119.86		
A11	42	68	8	13	12	19	0	0	62	77.14	139.68		
A12	20	17	54	46	39	33	4	3	117	34.32	118.08		
B1a	76	55	42	31	13	9	6	4	137	31.55	138.82	2.637	0.451
B1b	70	52	47	35	15	11	2	1	134	33.45	120.77		
B2a	44	42	34	32	23	22	4	4	105	28.39	117.93	3.640	0.303
B2b	25	30	36	43	20	24	2	2	83	32.15	118.19		
B3a	53	54	21	21	22	22	3	3	99	29.36	96.61	4.405	0.221
B3b	45	44	35	34	20	20	2	2	102	35.68	124.61		
B4	48	66	10	14	15	21	0	0	73	30.49	113.54		
C1a	24	47	8	16	13	25	6	12	51	34.02	75.69	4.722	0.193
C1b	19	29	12	18	27	41	8	12	66	55.51	84.2		
C2a	78	68	17	15	16	14	3	3	114	28.62	113.74	7.419	0.060
C2b	72	62	31	26	14	12	0	0	117	19.5	136.31		
C3a	74	64	27	23	4	3	10	9	115	31.05	94.29	6.189	0.103
C3b	59	58	31	31	8	8	3	3	101	31.01	108.86		
C4a	41	53	21	27	13	17	3	4	78	34.06	113.47	6.472	0.091
C4b	59	61	13	14	15	16	9	9	96	33.11	112.04		
C5a	11	23	11	23	23	49	2	4	47	36.28	143.76	4.957	0.176
C5b	21	45	7	15	18	38	1	2	47	35.34	102.89		
C6	53	77	13	19	3	4	0	0	69	42.78	114.33		
C7	32	52	4	6	24	39	2	3	62	41.89	111.3		

LS small linear features, *LL* large linear features (>5 μm in breadth), *NS* small nonlinear features, *NL* large nonlinear features (>20 μm in diameter), *Orient.* standard deviation of linear feature orientation, *Length* average length of linear features

Table 3 Kruskal-Wallis test results for observed microwear features

Feature	Kültepe MBA (*n* = 12)		Kültepe HR (*n* = 4)		Assos HR (*n* = 7)		*H*	*p*
	Mean	SD	Mean	SD	Mean	SD		
Subset A								
LS%	38.88	0.18	54.25	0.10	54.86	0.17	4.39	0.112
LL%	27.42	0.11	24.50	0.09	18.43	0.07	2.58	0.276
NS%	27.42	0.14	18.50	0.06	21.57	0.17	1.45	0.484
NL%	6.67	0.05	2.75	0.02	5.00	0.04	2.28	0.312
All	106.75	25.48	103.50	27.00	76.57	27.92	4.79	0.091
Orientation (SD)	32.55	16.54	29.95	1.37	35.53	5.26	4.03	0.133
Length	129.52	21.28	116.73	17.36	109.51	20.85	4.72	0.094
Subset B								
LS%	35.00	0.18	48.00	0.15	54.9	0.15	5.20	0.075
LL%	27.83	0.10	31.50	0.12	18.43	0.08	4.63	0.099
NS%	31.25	0.13	19.00	0.06	22.57	0.16	3.09	0.213
NL%	6.17	0.04	1.25	0.01	4.14	0.05	5.17	0.075
All	113.17	33.95	98.00	26.84	79.71	25.15	4.32	0.116
Orientation (SD)	33.22	16.49	32.94	2.19	37.02	11.25	1.49	0.475
Length	137.09	24.17	119.28	4.64	109.99	15.46	7.03	0.030

Discussion and conclusion

In comparison with the previous study on the enamel microwear pattern in the middle Euphrates valley (Sołtysiak 2011), the present results are much less clear in spite of higher number of specimens. In the Euphrates valley, the discrimination between the Bronze Age and Roman/Islamic subsets was very clear and most differences in specific variables were significant, showing a meaningfully higher frequency of small linear features and their more uniform orientation in the later subset. It perfectly fit the expected pattern for finer flour and smaller grit particles after the introduction of large mills in the Roman period. Here, there is no clear evidence of change in grinding technology in Kültepe nor do the specimens from Assos follow the expected pattern.

However, this negative evidence is no less interesting, as it shows that the transition from simple to more sophisticated tools in cereal grinding was perhaps a more complicated process than suggested by previous research. Although the distribution of teeth from all three chronological subsets in the CA

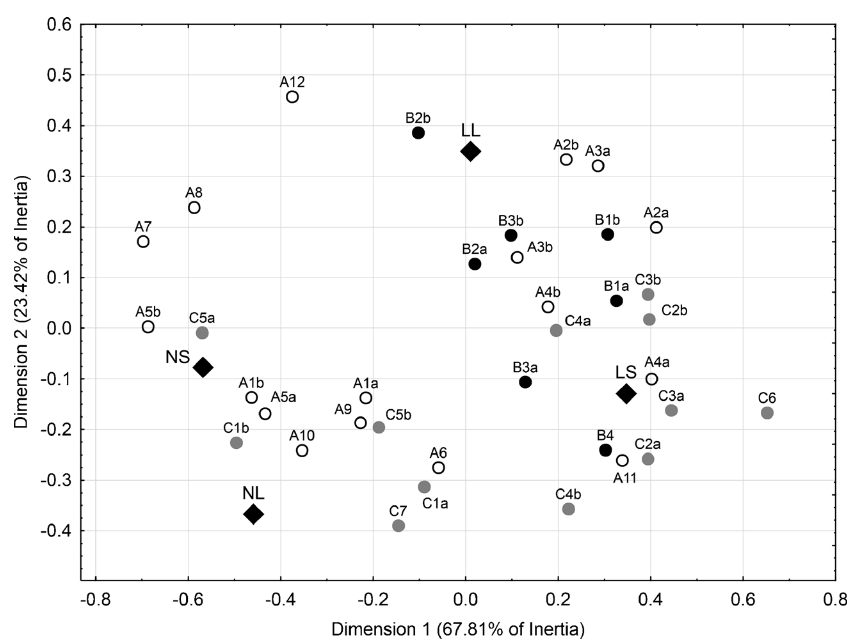

Fig. 3 Correspondence analysis biplot for the data from Table 2. *Empty black circles*: Kültepe, MBA; *filled black circles*: Kültepe, HR; *gray circles*: Assos, HR

biplot overlap to a large degree, there is a clear tendency towards more linear features in the Hellenistic/Roman sample from Kültepe, although the proportion of small and large linear features is similar to the MBA sample from this site. The distribution of the Hellenistic/Roman subset from Assos is even more unexpected, as it is similar to the distribution of the MBA subset from Kültepe and only the proportion of large linear features is a bit lower in the former.

The observed outcome may be explained by the degradation of Kültepe from an important urban trade centre in the first half of the second millennium BCE to a marginal rural community. During the Hellenistic period, regional trade routes shifted to Caesarea and also bioarchaeological studies reveal a clear decline of health and living conditions that seem to reflect the inferior role of the site (Üstündağ 2009). Although water mills and "industrial" production of wheat is attested in archaeological finds in Asia Minor at that time, there is no archaeological evidence from Kültepe which would indicate that these new technologies found their way into marginal rural areas of central Anatolia.

Taking the overall picture into account, it may be concluded that the transition from primitive to more advanced

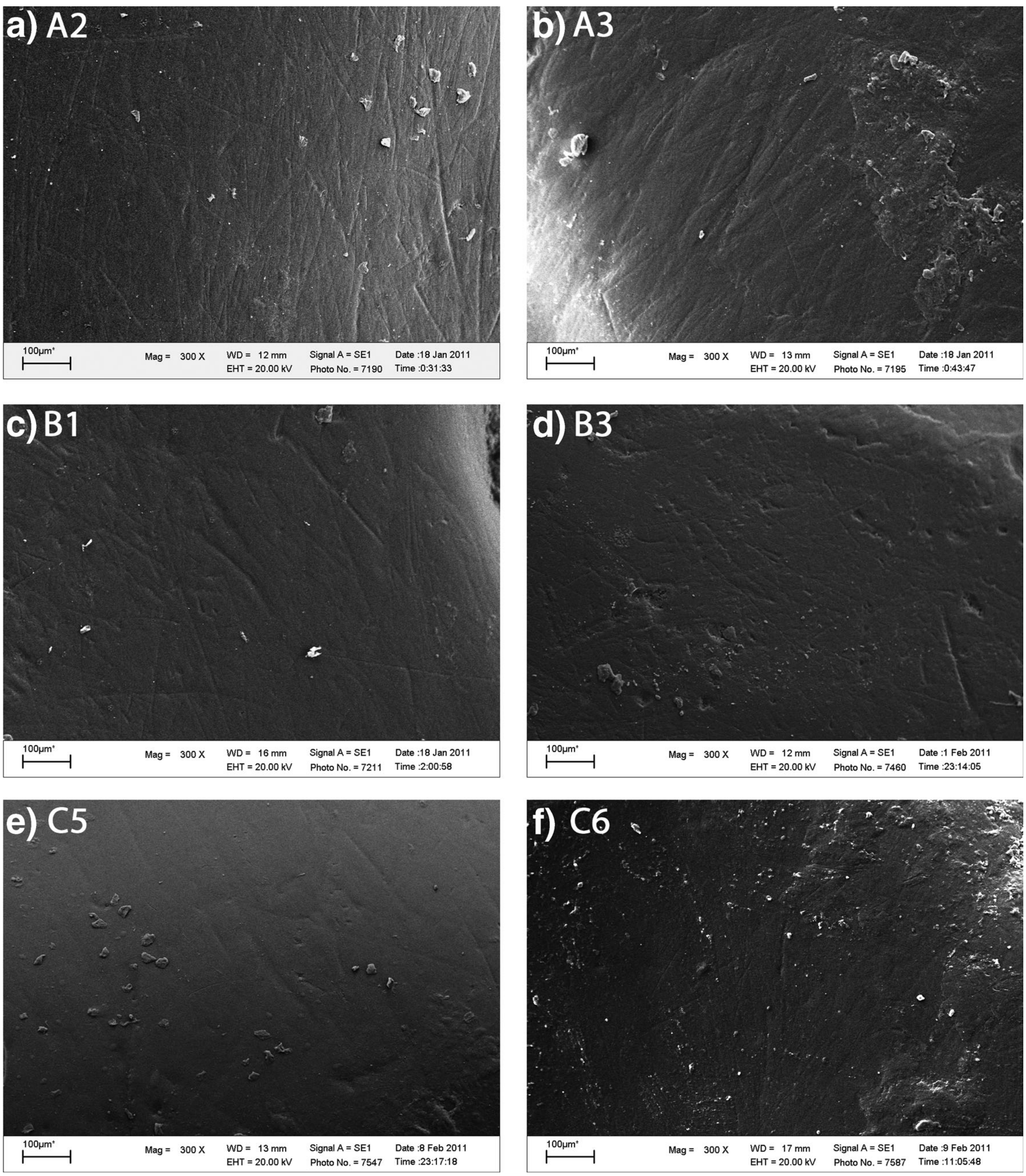

Fig. 4 Examples of enamel microwear in MBA Kültepe (**a**, **b**), HR Kültepe (**c**, **d**), HR Assos (**e**, **f**). See Table 1 for more details about these individuals

grinding tools is not clear at Kültepe and the comparative sample from Assos suggests that flour quality was still variable in the Hellenistic/Roman period in Anatolia. It is then possible that technical improvements were not as universal as suggested by previous research. This conclusion is supported by the occasional finding of saddle querns at medieval sites in Anatolia (Deveci and Ensert 2003). On the other hand, the proportion of nonlinear features decreased from the MBA to the Hellenistic/Roman period, and this may be associated with the impact of new grinding technologies both at the more provincial site of Kültepe and at Assos where the enamel microwear pattern may also have been influenced by a wider use of marine resources.

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References

Arslan N (2008) 2006 yılı Assos kazı çalışmaları. Türk Arkeoloji ve Etnoğrafya Dergisi 8:49–58

Atici L, Kulakoğlu F, Barjamovic G, Fairbairn AS (eds) (2014) Current research at Kültepe-Kanesh an interdisciplinary and integrative approach to trade networks, internationalism, and identity. Lockwood Press, Atlanta

Braun T (1991) Ancient Mediterranean food. In: Spiller GA (ed) The Mediterranean diets in health and disease. Springer, Berlin, pp. 10–55

Deveci A, Ensert K (2003) Akraçay Höyük kazı çalışmaları. Kazi Sonuçlari Toplantisi 25:381–390

Dubreuil L (2004) Long-term trends in Natufian subsistence: a use-wear analysis of ground stone tools. J Archaeol Sci 31:1613–1629

Estebaranz F, Galbany J, Martínez LM, Pérez-Pérez A (2007) 3-D interferometric microscopy applied to the study of buccal enamel microwear. In: Bailey SE, Hublin J-J (eds) Dental perspectives on human evolution: state of the art research in dental paleoanthropology. Springer Netherlands, Dordrecht, pp. 391–403

Fairbairn AS (2014) Preliminary archaeobotanical investigations of plant production, consumption, and trade at Middle Bronze Age Kultepe-Kanesh. In: Atici L, Kulakoğlu F, Barjamovic G, Fairbairn AS (eds) Current research at Kültepe-Kanesh. An interdisciplinary and integrative approach to trade networks, internationalism, and identity. Lockwood, Atlanta, pp 177–193

Fuller BT, De Cupere B, Marinova E, et al (2012) Isotopic reconstruction of human diet and animal husbandry practices during the Classical-Hellenistic, Imperial, and Byzantine periods at Sagalassos, Turkey. Am J Phys Anthropol 149:157–171

King T, Andrews P, Boz B (1999) Effect of taphonomic processes on dental microwear. Am J Phys Anthropol 108:359–373

Krueger KL, Scott JR, Kay RF, Ungar PS (2008) Dental microwear textures of "phase I" and "phase II" facets. Am J Phys Anthropol 137:485–490

Molleson T (1989) Seed preparation in the Mesolithic: the osteological evidence. Antiquity 63:356–362

Özgüç T (2003) Kültepe. Kaniš/Neša. The earliest international trade center and the oldest capital city of the Hittites, Yapı Kredi Yayınları, Istanbul

Peacock DPS (1980) The Roman millstone trade: a petrological sketch. World Archaeology 12:43–53

Pérez-Pérez A, Espurz V, Bermúdez de Castro JM, et al (2003) Non-occlusal dental microwear variability in a sample of Middle and Late Pleistocene human populations from Europe and the Near East. J Hum Evol 44:497–513

Romero A, De Juan J (2013) SEM, teeth, and palaeoanthropology: the secret of ancient human diets. In: Schatten H (ed) Scanning electron microscopy for the life sciences. Cambridge University Press, Cambridge; New York, pp 236–256

Samuel D (2000) Brewing and baking. In: Nicholson PT, Shaw I (eds) Ancient Egyptian materials and technology. Cambridge University Press, Cambridge, pp. 537–576

Scott EC (1979) Dental wear scoring technique. Am J Phys Anthropol 51: 213–218

Sołtysiak A (2011) Cereal grinding technology in ancient Mesopotamia: evidence from dental microwear. J Archaeol Sci 38:2805–2810

Teaford MF (1988) Scanning electron microscope diagnosis of wear patterns versus artifacts on fossil teeth. Scanning Microsc 2:1167–1175

Thurmond D (2006) A handbook of food processing in classical Rome. Brill, Leiden & Boston

Ungar PS (2002) Microware software, version 4.02. A semi-automated image analysis system for the quantification of dental microwear. Fayetteville, AR USA

Üstündağ H (2009) Kültepe/Kanesh (Turkey), season 2007. Bioarchaeology of the Near East 3:31–35

Üstündağ H (2014) Human remains from Kültepe-Kanesh: preliminary results of the old Assyrian burials from the 2005–2008 excavations. In: Atici L, Kulakoğlu F, Barjamovic G, Fairbairn AS (eds) Current research at Kültepe-Kanesh. An interdisciplinary and integrative approach to trade networks, internationalism, and identity. Lockwood, Atlanta, pp 157–176

Wikander Ö (1985) Archaeological evidence for early water-mills: an interim report. History of Technology 10:151–179

Wilson A (2001) Water-mills at Amida: Ammianus Marcellinus 18.8.11. Class Q 51:231–236

Wilson A (2002) Machines, power and the ancient economy. Journal of Roman Studies 92:1–32