Interaction and the end of the Late Bronze Age as displayed through neutron activation analysis of Late Helladic sherds: a case study on Asine in the Argolid, Greece

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Abstract

This article discusses the results of neutron activation analysis made on a limited number of LH IIIB and LH IIIC period sherds from the Argive settlement Asine, Greece. The analysis indicates that the transformation from the palatial to the post-palatial period, on a local level of a village as Asine, was not signified by loss of contacts with the surrounding world. Rather continuity and interaction prevailed, although with other geographical areas as production and use of pottery in the LH IIIB period apparently had a more regional preponderance. The geographical dominance of pottery assigned to producers in north-eastern Peloponnese and distributed over the Mediterranean was terminated, but other operators may have responded to the demand for pottery.

Keywords NAA neutron activation analysis · Asine · Greece · Late Bronze Age · Interaction · Continuity

Introduction

A major puzzle in Mycenaean studies is the causes and implications of the destruction of settlements and in particular the palaces in about 1200 BC. Following a phase of apparent prosperity during Late Helladic IIIB, the complex administrative system visible during this period is no longer to be seen. Linear B tablets, large-scale storage facilities and other expressions of a centralised political power appear not to have survived. Several studies have tried to come to grips with the nature and consequences of the disaster that struck (Drews 1993; Nur and Cline 2000; Maran 2009; Sjöberg in Weiberg et al. 2010; Drake 2012; Middleton 2012; Knapp and Manning 2016; Lantzas 2016; Finné et al. 2017; Whittaker 2017; Driessen 2018; Weiberg and Finné 2018). Scholars who have devoted attention to this event are not necessarily in agreement, yet it is widely held that the highly organised

society visible in the archaeological record during LH IIIB experienced a radical change also in existing socio-economic structures.

Not everything was made subject to such dramatic change, however. An increasingly voluminous literature argues that society beyond the palaces displayed a considerable amount of resilience, opening up for new modes of exchange and less centralised control (Small 1998; Sjöberg 2004; Galaty and Parkinson 2007; Crielaard 2011; Nakassis et al. 2011; Parkinson et al. 2013; Pullen 2013; Shelmerdine 2013). Before long, many settlements were revived or can be seen to have continued to function across this momentous divide. If the polity was heavily centralised, and the economy very dependent on that central power, what were the sources of resilience? Or is it simply an expression of our lack of knowledge about society beyond the palaces? One way of resolving the conflicting information available to us is to think of LH IIIB society and economy as being made up of distinct circles or activities, only some of which were controlled by the palaces (Halstead 1992; Sjöberg 2004). In their shadow, everyday activities continued without much interference from central powers, and, as a result, when the palaces fell on hard times, the rest of society was not as severely affected. Local production and lateral exchange links would then have continued as in the past or were made to fill the gap. As has been shown with respect to pottery production, for instance, there is little

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mention in the Linear B records of the industry or trade in its products (Galaty 1999; Knappett 2001; Whitelaw 2001); hence, as an industry, it can be assumed to have been of a more decentralised character. As such, it may have weathered the crisis better than would otherwise have been the case. Even so, a dominant source of ceramics at least in the Argolid, the one characterised as belonging to the MYBE group, disappears from the archaeological record outside the region as we move from LH IIIB to LH IIIC. Therefore, we need to find a means to assess the changes, if any, that affected production, exchange and use across these two periods also for industries and products that might have operated in a more decentralised mode.

Addressed to the exchange part of the equation, this article aims to analyse the provenance of sherds found in a decentralised context. It does so with a view to investigating continuity or change, approaching the issue of exchange and more indirectly production in a manner partly along the lines suggested by Gilstrap (2014). If it can be shown that intra-regional exchange does not change across the divide, it will provide an additional piece of evidence for the resilience of Argive society also as the palaces collapsed. If, on the other hand, there is no evidence for continued exchange, we will have to assess the situation differently. For while the absence of similar ware in LH IIIC as compared to LH IIIB cannot irrevocably be taken as a sign of disruption, it will force us to allow for that possibility, and we will therefore need to devote more effort to establishing the precise state of affairs. In either case, indications of inter-regional exchange (or its absence) serve to put any evidence of intra-Argive movements of pottery in a wider context.

For the purposes of this assessment of provenance and distribution of ceramics as seen from the vantage point of localities away from the palaces and settlements immediately adjacent to them, the paper will focus on Asine. A small settlement at the margins of the Argive plain, it also had the potential to act as an entrepôt for the region. As a research site, it combines the two useful traits of being peripheral and being a potential gateway with the advantage of having been the object of extensive archaeological investigations for about a century. In order to leverage this to the benefit of our understanding of ceramics provenance and exchange, against the background of the important prior contributions made by pottery experts, we build our contribution on a strategic sample of sherds from Asine on which neutron activation analysis is performed.

Asine by the bay: geographical scope of the study

The Argive Plain, located in the north-eastern part of the Peloponnese, is a coastal plain of about 243 km², surrounded

by hills and low mountains rising to 400–700 m above sea level. After the polar caps started to melt, the coastline shifted position and at the east side of the Argive plain Tiryns came closer to the coast (Zangger 1991). The final deposit affecting the area seems to have taken place in the LH IIIB2 or early LH IIIC period caused by diversion of a stream close to Tiryns (Zangger 1994). The settlement of Asine is located in the south-eastern ‘appendix’ of this geographically well-defined plain. The location of the village on the coast will be of importance in evaluating the status of the site in a regional settlement system as proximity to water, and harbour facilities, give a settlement a natural advantage in extra-regional exchange.

Sample choice

The sherds in the analysis are all from the Lower Town of Asine, excavated by O. Frödin and A.W. Persson in 1926 and published in 1938. The publication is rewarding in many ways, but there are also some problems, notably the stratigraphy, information on which is at times conflicting (e.g. excavated material does not always match excavation records). A later re-examination of the houses located in the Lower Town has established a clear dominance for LH IIIC remains. This is in contrast to evidence from the LH IIIA/B period, which is fragmentary; layers older than LH IIIC were not systematically pursued (Sjöberg 2004). That said, there are other areas attesting to LH IIIA/B habitation in the area of Asine, including the Barbouna Area as well as the nearby village of Zafer Aga (Frizell 1978; Santillo Frizell 1980; Sjöberg 1996). Also the chamber tombs add to our knowledge on the extent to which there is continuous habitation (Mountjoy 1996; Sjöberg 2004). Although no larger and more detailed study on assemblage composition has been made on the material from the Lower Town, we may note that similar to the Barbouna area (Santillo Frizell 1980), Lower Town pottery display a combination of decorated tableware, storage vessels and coarse ware.

The archaeological material from the old excavations, stored in the Historic Collections of Gustavianum, Uppsala University Museum, Sweden, consists mainly of sherds kept in approximately 5000 boxes. The finds and documentation from Asine are now available in the online database PRAGMATA (Nordquist and Lindblom 2020). The pottery excavated in the Lower Town was cleaned and ‘usually washed in nitric acid’ (Nordquist and Hägg 1996, 14). Combined with a lack of whole shapes and even good profiles, this makes identification and dating problematic (Santillo Frizell 1980; Sjöberg 2004). The boxes usually provide information on the excavation date, find context and sometimes depth of the layer. However, since the find context only refers

to rather broad areas, it is not always easy to collate with excavation map and field diaries (Sjöberg 1997, 2004; Lindblom et al. 2018).

A total of ten samples from the excavations in the Lower Town conducted in 1926 are analysed here. Visual inspection assessing decoration and fabric was used to select five sherds from each period, LH IIIB and LH IIIC (Figs. 1 and 2, Table 1). As mentioned, material from LH IIIB is infrequent in the predominantly LH IIIC context of the Lower Town, and material from the earlier period is spread out in boxes dominated by LH IIIC material. As the prime focus was the sherds themselves rather than the detailed specificities of the intra-site find context, this is not a major drawback.

The sherds are described (Table 1), when applicable, by using FM and FS, the classifications assigned to Furumark (1941).

The neutron activation analysis (NAA) procedure and archaeometric results

The samples have been analysed by NAA in the Bonn archaeometry laboratory that uses this method since about 30 years. The resulting weight elemental concentration patterns comprise 30 minor and trace elements, if present above the detection limit, measured often with uncertainties of only a few percent. This pattern or elemental profile characterises the

Fig. 1 LH IIIB sherds Asin 21–25. Photo: B.L. Sjöberg

Fig. 2 LH IIIC sherds Asin 26–30. Photo: B.L. Sjöberg

composition of the clay paste used by the ancient potters to produce their wares. It can be assumed to have a high probability to be different for pottery workshops at different locations or regions, even different for different paste recipes in a single workshop. Pottery vessels or sherds having the same composition inside small uncertainty bars, therefore, can be assumed to have the same origin. This origin and therefore provenance of single vessels is established, if its elemental profile is similar to profiles known from measurements of so-called reference material of this origin. The NAA procedure in Bonn has been described several times (Mommsen et al. 1991; Mommsen 2011; Gilboa et al. 2017 and

references therein). The important parameters are summarised here: pottery sample size 80 mg, irradiations at the Research Reactor Geesthacht, Germany, at a flux of about 5×10^{13} neutrons per cm^2 and s during 3 h; 4 measurements at different time intervals after the irradiation, Bonn NAA pottery standard (composition given in Mommsen and Sjöberg 2007) calibrated with the Berkeley pottery standard (Perlman and Asaro 1969). The comparison of the obtained elemental profiles is done with a statistical filter procedure developed in Bonn (Mommsen et al. 1988a; Beier and Mommsen 1994). Out of a large databank all samples statistically similar to a given elemental composition can be filtered out to form a group of

Table 1 List of samples analysed and discussed in the paper

Asine inventory number	NAA sample number	Type	Context	Remark	NAA
LH IIIB					
AS1712	Asin21	FS 284 deep bowl FM 46 running spiral	Area: Lower Town, Mycenaean Palace- Upper Mycenaean house, antae	Frizell 1978, figs. 47, 48. 32. LH IIIB Santillo Frizell 1986, fig. 26. 235a French and Stockhammer 2009, fig.14.1. LH IIIB2	TheB
AS1712	Asin22	FS 284 deep bowl FM 58 chevron	Area: Lower Town, Mycenaean Palace- Upper Mycenaean house, antae	Frizell 1978, figs. 65b; 66. 107, LH IIIB. French and Stockhammer 2009, figs. 4.1; 13.8. LH IIIB2	MYBE
AS2478	Asin23	FS 284 deep bowl FM 75 panel with arrow fringe	Area: Lower Town. Trench: House N	Mountjoy 1986, fig. 143.10. LH IIIB1	MYBE
AS 1362	Asin24	FS 9 krater? FM 23 whoorl-shell	Area: Lower Town, Mycenaean Palace-West of the palace. South room	Frizell 1978, figs. 57. 64; 59 Mountjoy 1986, figs. 135; 156	Single
AS1362	Asin25	FS 284 deep bowl, FS 305 stemmed bowl? FM 75 panel with joining semi-circle fringe	Area: Lower Town, Mycenaean Palace-West of the palace. South room	Santillo Frizell 1986, fig. 26. 234. LH IIIB (krater or big deep bowl) Mountjoy 1986, figs. 161.9; 165. LH IIIB2. French and Stockhammer 2009, figs. 6. 3; 12. 1; 19. 3. LH IIIB2	MYBE
LH IIIC					
AS3664	Asin26	FS? FM 46 appears in LH IIIC on FS 284 deep bowl, kraters, FS 63 collar-necked jar	Area: Lower Town, Lower Section, Myc. Palace, immediately above palace floor	Mountjoy 1986 LH IIIC	TanA
AS5338A	Asin27	Handle-body with splash round stub. FS63 collar-necked jar, FS69 amphora or FS128 hydria?	Area: Lower Town, Mixed-Two contexts: 1. Upper Mycenaean house, 240-260, 26/6-26; 2. North-west of upper Mycenaean house, 220-240, 23/6-26	Santillo Frizell 1986, no. 410 Mountjoy 1986 Figs. 171; 178 LH IIIC or Transitional?	AEGE
AS2945	Asin28	FS 282 krater? FM53, a broad wavy line? Body banded	Area: Lower Town, Lower Section, Mycenaean palace, above the floor	Mountjoy 1986. LH IIIC: M/L?	KnoL/TheB
AS2945	Asin29	FS 284 deep bowl? FM50 antithetical spirals, panel framed by zigzag	Area: Lower Town, Lower Section, Mycenaean palace, above the floor	Santillo Frizell 1986, fig. 16. 119 panel zigzag, p. 76, LH IIIC Mountjoy 1986, fig. 189. 2. LH IIIC:E	ChiA
AS5545	Asin30	FS? FM? Body banded	Area: Lower Town, East-Lower part	LH IIIC	UI26

samples of the same origin. During the filter process the experimental uncertainties of single samples or the standard deviations of already existing groups are considered and also possible dilutions or elutriations of the clay paste are corrected by a best relative fit factor. These features cannot be included in the often used principal component analysis or the different cluster analyses producing dendrograms (Baxter 2003).

Comparing the Bonn databank of known pottery profiles, several of the 10 samples could statistically be matched to already formed groups as indicated in Tables 2 and 3. Three of the five samples from the LH IIIB period (Asin 22, 23, 25) have the composition MYBE that is very common in all sample sets from sites in the Argolid. It was seen already during the first measurements of the laboratory in Bonn in samples from Mycenae and Tiryns (Mommsen et al. 1988b, called there MB) and ascertained by already existing NAA measurements of the Lawrence Berkeley National Laboratory (LBNL) (Karageorghis et al. 1972). Wasters from the Berbati

workshop(s) with this same profile assigned all members of the group MYBE to an origin of this site. But the Berbati pottery workshop itself is known to have been probably not in use after LH IIIA1, however although no additional kiln is found wasters from LH IIIA2/LH IIIB periods suggest that production continued (Åkerström 1987; Schallin 1997, 2015; Klintberg 2011). In addition, more recent NAA studies have demonstrated that this pattern must represent a general profile both geographically and chronologically assigned to also other regions and production centres than Berbati (Zuckerman et al. 2010; Mommsen 2012). For example, pieces with the MYBE profile are found in a set of samples from Corinth of the classical period (Mommsen et al. 2016). As long as no other reference material with this profile at a given site is analysed, we prefer to indicate the entire north-eastern Peloponnese as origin for the profile MYBE.

One vessel Asin 21 from the period LH IIIB has the pattern TheB assigned to workshops at Thebes in Boeotia (Mommsen

Table 2 Asine, 5 vessels of the time period LH IIIB

	Asin21 AS1712 inside p.		Asin22 AS1712 inside unp.		Asin23 AS2478 red p.		Asin24 AS1362 red p.		Asin25 AS1362 Inside unp.	
	C	±δ(%)	C	±δ(%)	C	±δ(%)	C	±δ(%)	C	±δ(%)
As	8.55	1.1	6.32	1.3	21.9	0.5	6.26	1.4	3.33	2.5
Ba	474.	9.1	482.	8.6	388.	11.	415.	9.7	414.	10.
Ca\%	8.27	2.4	10.5	1.7	9.72	1.8	7.30	2.4	7.84	2.2
Ce	63.5	0.8	56.9	0.9	63.8	0.9	57.5	0.9	63.0	0.9
Co	31.0	0.5	28.6	0.5	29.6	0.5	27.7	0.5	28.1	0.5
Cr	317.	0.4	223.	0.5	242.	0.5	265.	0.4	220.	0.5
Cs	5.97	1.5	9.28	1.1	9.90	1.1	7.82	1.2	9.19	1.1
Eu	1.11	2.0	1.03	2.1	1.11	2.0	0.93	2.2	1.09	2.1
Fe\%	5.17	0.4	5.07	0.4	5.62	0.3	5.09	0.4	5.36	0.3
Ga	21.3	7.9	21.4	7.0	23.6	6.4	19.4	8.6	25.1	6.8
Hf	4.11	1.5	3.65	1.6	3.25	1.8	4.41	1.4	4.10	1.5
K\%	2.80	0.8	2.44	0.8	2.87	0.8	2.48	0.9	2.76	0.9
La	29.9	0.3	27.5	0.3	31.6	0.3	26.6	0.3	30.5	0.3
Lu	0.45	3.2	0.41	3.4	0.44	3.3	0.42	3.2	0.44	3.3
Na\%	1.01	0.4	0.53	0.5	0.49	0.6	0.79	0.5	0.65	0.5
Nd	27.3	7.7	20.2	9.6	22.4	8.7	20.2	9.3	25.7	7.7
Ni	326.	12.	300.	13.	269.	14.	228.	16.	245.	15.
Rb	129.	1.9	139.	1.9	156.	1.8	136.	1.9	161.	1.7
Sb	0.56	3.4	0.51	3.3	0.69	2.4	0.53	3.3	0.49	3.5
Sc	20.7	0.1	20.6	0.1	23.5	0.1	20.0	0.1	21.3	0.1
Sm	5.02	0.3	3.97	0.4	4.47	0.4	3.97	0.4	4.50	0.4
Ta	0.89	3.4	0.79	3.7	0.83	3.6	0.88	3.3	0.88	3.5
Tb	0.74	6.6	0.49	9.5	0.60	8.1	0.61	7.5	0.70	7.0
Th	10.7	0.6	10.1	0.6	11.1	0.6	10.4	0.6	11.0	0.6
Ti\%	0.58	9.9	0.58	9.9	0.64	9.1	0.54	10.	0.61	9.6
U	1.55	6.2	2.08	4.1	2.16	4.0	2.27	3.9	2.16	4.1
W	2.10	6.7	2.37	5.4	2.24	5.7	2.31	6.1	2.28	6.0
Yb	2.68	2.0	2.54	1.9	2.66	1.8	2.45	2.0	2.72	1.8
Zn	92.8	2.4	98.9	2.3	103.	2.2	95.8	2.3	110.	2.2
Zr	162.	16.	128.	20.	86.0	31.	128.	20.	121.	22.
Group	TheB		MYBE		MYBE		single		MYBE	
Factor	0.97		1.07		0.98		1.00		0.99	

Concentrations C of elements in µg/g (ppm), if not indicated otherwise, and experimental uncertainties (error) δ in % of C. The sample is member of the group given below the elemental values together with its individual best relative fit factor with respect to this group. Single means chemical loner

and Maran 2000–2001; Schwedt et al. 2006 [group B = TheB]). The match to a very similar pattern KnoL assigned to Central Crete can be excluded here because of amongst others mainly the Rb value of (129 ± 1.9) ppm that is higher for Boeotia than for Central Crete Rb: (106 ± 7.1) ppm (Gilboa et al. 2017). The sample Asin 24 has a chemical composition that is new to us and a single in our databank of now more than 12600 samples from the Central and Eastern Mediterranean. It might represent the first sample of a still unknown pottery workshop or been contaminated in antiquity or in our times.

The picture is different for the time period LH IIIC. None of the 5 samples has the concentration pattern MYBE. Sample Asin 26 has the Boeotian pattern TanA assigned by a clay sample to a workshop(s) at or near Tanagra (Mühlenbruch and Mommsen 2011). A second sample Asin 28 has a composition that archaeometrically has to be assigned with nearly similar probabilities to Boeotia (group TheB despite the low Rb value) and Central Crete (group KnoL, Gilboa et al. 2017). Sample Asin 27 has also a pattern AEGE already known and indicating with high probability an origin from Aegina

(Mommsen et al. 2001). Asin 29 is according to its concentration pattern an import from Chios (Demakopoulou et al. 2017; Lis et al. 2020; Huy et al. 2020). With lower probability, an origin in Attica is possible, nevertheless with deviating lower Rb and K. The last sample Asin 30 has a profile UI26, with 15 members in the Bonn databank that is still not located with certainty (Forsén et al. 2017).

Discussion

The LH IIIB period

As has been noted above, the MYBE concentration profile was not delimited to the workshop(s) of Berbati only but points very probably to a number of different workshops in the region of the north-eastern Peloponnese so far not identified. A larger number of Late Helladic sherds from Midea have this profile; according to Demakopoulou et al. (2017), the pottery was produced in specialised workshops intended for the great Argive centres but also for export. Although set in another regional context, the kingdom of Pylos, in an early study, Whitelaw (2001) demonstrated the decentralisation of pottery production with limited palatial involvement. As was pointed out by Whitelaw, in any attempt to extrapolate the Pylos model to other regions, caution should be exercised, but the results of the investigation are of interest for how we might understand the construction of regional economies in the wider Late Helladic society. With an improved knowledge concerning production and distribution of Argive pottery, the importance of adopting a regional lens for assessing the nature of the economy should not be neglected.

As concerns Asine specifically (see Maps 1 and 2), the samples do not contradict observations to the effect that regionalism in production and exchange may be at hand. This is so as three samples in this case study (Asin 22, 23, 25) show the well-known pattern MYBE, as expected in a LH IIIB Argive context. These samples and the sample Asin 21, originating in the Boeotian source TheB, point to Asine either taking part in an inter-regional exchange system based on demand at the regional/local level or possibly, thanks to the favourable location on the coast, operating as a gateway for pottery distributed to and from the Argive region or both. While we are in no position to discriminate between these potential explanations, it shows that Asine took part in a wider system of exchange.

That the system did at times extend beyond the shores of the Argolid is not in doubt. The issue here is rather when, in what period or periods. As recently pointed out by Jung et al. (2015), the mass export of fine Mycenaean pottery has long been observed in the material from eastern part of the Mediterranean. There typological features have demonstrated a production directed towards local consumers across the sea. At Tell Kazel, for example, a broad spectrum of types showed

to be Mycenaean imports. As demonstrated by macroscopic examination and later confirmed by NAA analysis, the majority had an Argive origin (Jung 2018). The corpus of pottery material on export from the Greek mainland and specifically the Argolid has indeed expanded with the NAA method. Thus, pottery found in some tombs at Laish/Dan was imported from the Argolid (Gunneweg and Michel 1999). This study has since been followed by several others, including analyses of material from Tell el-Safi/Gath Israel (Mountjoy and Mommsen 2001; Ben-Shlomo et al. 2008). Results from an analysis of pottery from Northern Israel, based on NAA, list 138 samples out of 183 vessels as sharing the MYBE profile. That study also identifies the complexity in trade patterns with intra-regional distribution of imported pottery of the clay profile MYBE with Tell Abu Hawam acting as the main gateway for the region (Zuckerman et al. 2010). The geographical extent of trade and the complexity of the operations are also demonstrated in a sample from Tarsus-Gözlükule, Turkey, as NAA assigns it to the north-east Peloponnesian group, MYBE (Mommsen et al. 2011). Similarly, in a recent study by Spataro et al. (2019), Mycenaean pottery found at Amara West (Nubia, Sudan) is attributed to the MYBE group.

Combined, these recent studies give a hint of the magnitude of trade contacts during the Late Bronze Age IIIB, and, critically, they help position the Argive economy as a partner in long-distance trade with external markets. It also suggests that the palatial period in the Argolid may not have been dependent on one major palatial site (i.e. Mycenae), for the distribution of goods. Instead, thanks to geographical location or infrastructure, several sites may have functioned as nodes for commercial activity. Due to its position as a centre but also with a port as favourable located close to the coast, Tiryns is likely to have been an important node for maritime contacts (Maran 2009; Stockhammer 2011; Kardamaki et al. 2016). Yet there is nothing to suggest that Tiryns, to the extent it served as the transshipment point at all, was alone and Asine could be one of the alternatives available. It is simply not possible to tell. What the samples analysed do demonstrate is that Asine participated in an intra-Argive exchange, possibly both as a local consumer of the regionally produced high-quality pottery and conceivably also as a node for extra-regional distribution of regional and non-regional products.

Hypothesising for the region of Argolid such a decentralised pattern of pottery production and exchange, as demonstrated by finds of sherds of the MYBE provenance, is consonant with research that suggests that the view of the Late Helladic society as being under total palatial control needs to be revised (Small 1998; Sjöberg 2004; Galaty and Parkinson 2007; Crielaard 2011; Nakassis et al. 2011; Parkinson et al. 2013; Pullen 2013; Shelmerdine 2013). Yet it does not in itself tell us if this state of affairs also pertained to the period following the collapse of the palaces.

Table 3 Asine, 5 vessels of the time period LH IIIC

	Asin26 AS3664 thick		Asin27 AS5338A with handle		Asin28 AS2945 reddish		Asin29 AS2945 beige		Asin30 AS5545	
	C	±δ(%)	C	±δ(%)	C	±δ(%)	C	±δ(%)	C	±δ(%)
As	9.86	1.1	9.69	1.0	11.7	1.0	32.3	0.4	9.37	1.2
Ba	418.	11.	521.	8.1	484.	9.0	381.	11.	413.	10.
Ca\%	8.22	2.7	9.79	2.0	7.91	2.6	8.65	2.2	5.76	3.2
Ce	59.4	0.9	55.1	0.9	59.9	0.9	63.5	0.9	64.3	0.8
Co	36.7	0.5	18.6	0.6	34.5	0.5	36.1	0.5	29.9	0.5
Cr	596.	0.4	386.	0.4	522.	0.4	478.	0.4	390.	0.4
Cs	4.84	1.8	7.01	1.3	5.46	1.6	11.3	1.0	5.40	1.6
Eu	1.10	2.0	1.03	2.1	1.03	2.1	1.17	2.0	1.13	2.0
Fe\%	5.00	0.4	4.46	0.4	5.28	0.3	5.24	0.4	4.90	0.4
Ga	17.9	13.	20.0	10.	25.1	9.2	20.6	11.	18.0	13.
Hf	4.03	1.5	4.98	1.2	3.83	1.6	4.54	1.4	4.62	1.4
K\%	1.76	1.6	1.88	1.3	1.44	1.8	1.76	1.5	2.66	1.1
La	27.7	0.3	26.0	0.3	27.8	0.3	28.1	0.3	29.8	0.3
Lu	0.40	3.5	0.36	3.7	0.40	3.6	0.47	3.2	0.41	3.6
Na\%	1.77	0.4	1.11	0.4	1.44	0.4	1.04	0.5	1.17	0.5
Nd	24.2	8.7	19.1	10.	24.5	8.4	27.1	7.7	24.8	8.2
Ni	460.	8.6	280.	13.	391.	10.	413.	9.8	364.	10.
Rb	86.3	2.5	93.2	2.3	103.	2.3	89.8	2.5	115.	2.1
Sb	0.63	3.3	0.67	2.7	0.57	3.5	1.32	1.6	0.56	3.4
Sc	19.1	0.1	17.4	0.1	20.7	0.1	22.4	0.1	19.5	0.1
Sm	4.72	0.4	4.36	0.4	4.68	0.4	5.13	0.4	4.76	0.4
Ta	0.82	3.6	0.82	3.5	0.89	3.5	0.89	3.5	0.91	3.3
Tb	0.62	7.4	0.61	7.2	0.62	7.7	0.64	7.7	0.67	7.2
Th	9.75	0.6	9.28	0.6	10.4	0.6	10.1	0.6	10.4	0.6
Ti\%	0.69	9.0	0.46	13.	0.48	13.	0.62	10.	0.40	15.
U	1.64	6.5	1.85	5.0	1.72	6.0	2.18	4.4	1.74	5.6
W	1.90	9.0	1.57	9.5	2.13	8.0	2.01	8.0	2.49	6.8
Yb	2.60	2.3	2.35	2.1	2.43	2.3	2.94	1.8	2.69	1.9
Zn	99.3	2.3	89.7	2.3	95.4	2.4	125.	2.0	176.	1.6
Zr	120.	21.	148.	16.	111.	23.	159.	17.	139.	18.
Group	TanA		AEGE		KnoL/TheB		ChiA		UI26	
Factor	0.86		0.91		0.97/1.02		0.80		0.90	

Concentrations C of elements in µg/g (ppm), if not indicated otherwise, and experimental uncertainties (error) δ in % of C. The sample is member of the group given below the elemental values together with its individual best relative fit factor with respect to this group. A membership of the 2nd group shown is statistically possible but with lower probability

The LH IIIC period

One of the samples conforms to a pattern named UI26 (Unlocated group no. 26). The pattern has 15 members in the Bonn databank, mostly unpublished, found in diverse chronological and geographical settings; besides the sample here (Asin 30), it is found, for instance, in 6 other pieces of Aeginetan Ware from Asine dated to the periods EH III to LH IA, in 2 pieces from Tiryns, 2 from Katsingri

(Profitis Ilias), 1 from Lerna and also 1 from Aegina itself. The only published sample is from an Early Helladic sherd collection from Asea, Arcadia. On typological grounds, it is assigned to the so-called Talioti phase, named after the valley Talioti located between Asine and Nauplion (Forsén et al. 2017).

The remaining LH IIIC samples diverge as well from the LH IIIB examples as there is no secured regional ware characterised by the MYBE pattern during this period at

Map 1 The Aegean region. Base map: d-maps, URL https://d-maps.com/carte.php?num_car=3170&lang=en

Asine. This is in contrast to sherds of the regional pattern MYBE validated in LH IIIC samples from Midea and Tiryns (Mommsen et al. 1988b; Mommsen and Maran 2000–2001; Demakopoulou et al. 2017). As mentioned earlier, it has until rather recently been assumed that there was one single source for the MYBE production, one probably not in use after LH IIIA/B. However, recent NAA studies have demonstrated that the pattern may represent a general profile both geographically and chronologically assigned to more regions and production centres (Zuckerman et al. 2010). Given the small sample examined the lack of an Argive regional pattern may of course be pure coincidence in the Asine case.

The samples include TanA (Tanagra, Boeotia) a pattern demonstrated in a LH IIIC sample, a skyphos, from Sirkeli, Turkey (Mühlenbruch and Mommsen 2011). Another sample KnoL/TheB (Thebes) is also a clay paste used in Boeotia. Interestingly, the pattern TheB/KnoL is identified in two LH IIIC samples from Punta di Zambrone in Calabria, Italy (Jung et al. 2015). Asin 27, with the composition AEGE, is most probably from Aegina. As concerns the production of the well-known cooking pottery, this continued for long, and

these vessels were traded as late as the LH IIIC early period (Gauss et al. 2017; Lis et al. 2020). Although we still have limited knowledge about production centres, it is worthy of note that the examination of pottery has indirectly demonstrated contrasting practises of manufacturing with also table ware exchanged in the transitional LH IIIB–LH IIIC early period (Gilstrap 2014, 2016). The sample from Asine is perhaps one of those vessels distributed outside Aegina in this transitional period; also the mixed Mycenaean context could be of relevance for dating. The vessel, a jug or hydria, may have been produced in the earlier part of the transitional period and still used in the LH IIIC context of the Lower Town. Stockhammer (2009) has explained reintegration of earlier pottery material in the settlement context of LH IIIC in the Lower Town at Tiryns, as connected to the social positioning of an elite family. Also Maran (2015) has recently adopted this model of palatial relicts in the LH IIIC context operating as former symbols of power directly linking the past with the LH IIIC society. Similarly, Jung et al. (2015) has observed the phenomenon at many Levantine settlements, and not only in religious contexts, with Mycenaean vessels treated with care and

Map 2 The Argolid. Base map: d-maps, URL https://d-maps.com/carte.php?num_car=3170&lang=en

in use for long. The sample Asin 29 with pattern ChiA is assigned to the island of Chios (Lis et al. 2020; Huy et al. 2020). This particular pattern has also been found elsewhere in the Argolid, namely, in a LH IIIB2 floor deposit at Midea in the form of a transport stirrup jar (Demakopoulou et al. 2017). As a parallel to MYBE and AEGE, in both LH IIIB and LH IIIC periods, ChiA may possibly be understood as an instance where the island of Chios for a long period supplied a wider geographical area with pottery. The pattern ChiA has also been identified in two samples of LH IIIC material from the chamber tombs at Perati (Lis et al. 2020).

In sum, the Asine samples illustrate the existence of extensive geographical networks also in the LH IIIC period. This is in line with existing research. It has been suggested for Achaia (Arena 2015) that due to the presence of imported goods in the LH IIIC period, the region probably benefited from the collapse in the end of LH IIIB. As argued by Demakopoulou (2007a, b), the period LH IIIC Middle saw a flourishing in most regions of the Aegean. An interesting settlement is Elateia-Alanoki in Central Greece as according to S. Deger-Jalkotzy (2007) imported vases indicate the geographical range of the external contacts during LH IIIC Middle and Late periods. Against this background, it is worthy of note that the reported abandonment of the cemetery at Elateia-Alanoki in the LH IIIC Early was followed by an increase in use in the subsequent phases. The same pattern of reuse of tombs and dominance of LH IIIC Middle and Late vases has also been found at Asine (Mountjoy 1996; Sjöberg 2004).

A survey of the settlement has demonstrated that the time of expansion of Asine covers the middle and late phases of the LH IIIC period; this can be seen in Houses G, H, I and K located in the Lower Town (Sjöberg 2004). As described by the excavators (Frödin and Persson 1938) and reported in field diaries, Houses H and I both had kilns; there are also some photos of the collapsed constructions. The kiln in House H is described as a potter's kiln of ordinary type, and burnt clay pieces and sherds exposed to high temperature were found in the corresponding boxes. However, analyses have not been made of the material, so firing temperatures are not confirmed. House I is reported to have a more complex construction, but unfortunately no related finds have been found. The extent to which the two possible kilns may have had importance for the household as a supplement to other sources of subsistence can therefore not be established (Sjöberg 1997). Indeed, the LH IIIC kilns set in a house context should not be compared with the earlier larger units in use, such as that at Kolonna, Aegina, that probably was intended for production of greater quantities of pottery (Karkanas 2019). Further, as concern Asine, the accumulation of LH IIIC material in the Acropolis area demonstrates the extension of the settlement (Santillo Frizell 1986; Penttinen 1996).

Another case relatively close by is that of Tiryns, where the palatial architecture was replaced by a village-like occupation with houses arranged around courtyards and with an extensive settled area and a post-palatial culture (Maran 2002–2003, 2006, 2009; Maran and Papadimitriou 2006, 2016; Mühlenbruch 2007; Stockhammer 2011). According to Stockhammer (2011, 209), Tiryns ‘became the new paramount representative center’, this later flourishing of the settlement being ‘the result of the earthquake of 1250 BCE’. Also here a probable LH IIIC kiln has been reported (Kilian 1981, 1982; Rahmtorf 2015). Maran (2005, 2009) observed the presence of foreign objects found at Tiryns, indicating that long-distance trade relations resembling trade structures in the palatial period were resumed after the destruction at the end of LH IIIB. Also at Midea, another major Argive LH IIIB settlement, the LH IIIC period sees continuity, for instance, as demonstrated in building activity and finds of pottery (Walberg 1999; Demakopoulou 2007b, 2015; Demakopoulou et al. 2017).

What all of this demonstrates is that activity continues across the divide LH IIIB to LH IIIC. In some important respects, though, it is different. This goes both for Asine and for the Argive region, including the role of Asine in it. The most important indication is the few reported finds of ware of MYBE provenance in the region as a whole; in that sense, the absence in our sample from LH IIIC is true to form. Yet the small size of the sample does not allow for any clear conclusion on this score: the fact that it is not represented in a sample of five sherds does of course not preclude presence as such. Combining this inconclusive observation with the parallel observations that the MYBE pattern seems to disappear from locations further east and that other extra-Argive links can

be traced in the material at Asine, however, suggests a continuity in the sense that extra-site exchange did not grind to a halt. Rather, exchange networks were either maintained, established anew or developed to fill the gap where others ceased to operate. This happened despite the fate of the palaces, to an extent perhaps also as a result of the collapse. After all, beyond maintaining or re-establishing pre-existing patterns of exchange, it could also include realignment as part of the need or possibilities for filling voids that materialised.

Concluding remarks

This case study based on a limited number of Late Bronze Age sherds from the settlement of Asine demonstrates the need to include local settlement material in analyses of interaction on regional and inter-regional level. It also shows that Gilstrap's (2014) 'indirect' method could prove fruitful. In addition, such a research strategy will provide us with possibilities of discussing the socio-economic structure in a non-palatial context. As concern the presence of mostly regional pottery from the LH IIIB period, this can be interpreted as for local use (on use, consumption, Jung 2012). This must not be construed as Asine having served as an entrepôt. The type of evidence mustered here does not allow for that. Despite a favourable location that could have implied it serving as a gateway for distribution of high-quality pottery from the Argive region, the demand in Cyprus and the Eastern Mediterranean area falls away as LH IIIB turns LH IIIC (Badre et al. 2005; Jung 2006, 2015, 2018; Mommsen 2011). For now, although evidence of MYBE is locally present in LH IIIC (e.g. at Midea; Demakopoulou et al. 2017), we are compelled to note that extensive export of MYBE seems to have ceased after LH IIIB.

With this in mind, the natural or other calamities that appear to have occurred at the end of LH IIIB was not of such a nature so as to having prevented exchange of widely used products such as ceramic ware of different kinds. Hence, our original question can be answered in the affirmative: albeit of perhaps a slightly different profile, exchange as such does not disappear as Asine moves into LH IIIC. As recent literature suggests for the Argive region as a whole, the recovery was faster and stronger than previously believed, and also the inhabitants of Asine succeeded in maintaining exchange networks either as established earlier or to be replaced by new contacts and sites of production. Thus, while for LH IIIC no ware of the MYBE pattern was represented in our small sample, it appears that Asine was involved in exchange networks of some geographical reach, albeit focused on neighbouring parts of Aegean Greece. This attests to a measure of resilience of the settlement and its place in Argive society. Indeed, combined with the results of excavation at the Lower Town and the reuse of the chamber tombs, we may submit that a measure of affluence was enjoyed also at Asine. All in all, although a small quantity of

material only was marshalled for the purposes of this study, we submit that Asine and its hinterland was part of exchange networks in the LH IIIC period, potentially also complex ones that included extra-Argive contact. As such it answers our original question on the resilience of Argive communities beyond the palaces and their continued participation in regional and extra-regional exchange.

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Declarations

Conflict of interest The authors declare no competing interests.

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