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Ships, Routes, and Connectivity: Seafaring Technology and the Making of the Early Late Bronze Age Aegean

Salvatore Vitale, Angiolo Querci*

Keywords: Aegean Bronze Age connectivity; Minoanization; Crete and the SASCAR (Southeast Aegean-Southwest Coastal Anatolian Region); Ships and harbors; Ancient seafaring technology

Parole chiave: connettività nell'Egeo nell'Età del Bronzo; minoicizzazione; Creta e la SASCAR (*Southeast Aegean-Southwest Coastal Anatolian Region*); navi e porti; tecnologie della navigazione antica

Abstract

The early Late Bronze Age (LBA) Aegean was a phase of intense interactions, typified by the widespread distribution of Cretan cultural diacritics across the eastern Mediterranean. In the last decades, this Minoanized "New Cultural Environment" was extensively analyzed using the lenses of human mobility and network theory. Taking a different approach, in this contribution we discuss the importance of ships and harbors as decisive factors for the circulation of things, goods, and ideas. To do so, we focus on a case study regarding interregional connections between Crete and the Southeast Aegean-Southwest Coastal Anatolian Region (SASCAR). In the first part of our paper, we briefly review the distribution of Minoan and Minoanizing cultural diacritics in the SASCAR. In the second and the third parts, based on recent research about the so-called "SASCAR String", we discuss early LBA Aegean seafaring technology, considering such factors as the directionality, duration, and seasonality of ancient sailing. In the fourth part, we explain how sea routes connected Crete with major early LBA hubs in the SASCAR, namely Ialysos on Rhodes, the "Serraglio" and Ayios Panteleimon on Kos, and Miletus on the west coast of Anatolia. In the fifth and final part, we provide some concluding remarks about the relevance of ancient seafaring technology for our understanding of connectivity and cultural entanglements in the early LBA Aegean.

Nel Mediterraneo orientale, l'inizio della Tarda Età del Bronzo (TeB) ha rappresentato una fase di intensa connettività, caratterizzata dalla diffusa presenza, in tutto il bacino dell'Egeo, di elementi di origine cretese. Negli ultimi anni, questo "Nuovo Ambiente Culturale" minoicizzato è stato molto studiato attraverso modelli quali mobilità e *network theory*. Per esaminare questa importante fase, il presente contributo utilizza un approccio alternativo, che pone al centro dell'analisi l'importanza di navi e porti, considerandoli come fattori cruciali per la circolazione di oggetti, beni ed idee. In particolare, l'articolo prende in esame uno specifico caso di studio concernente i rapporti culturali e commerciali tra Creta e la cosiddetta SASCAR (*Southeast Aegean-Southwest Coastal Anatolian Region*). Nella prima parte del contributo, si propone un breve riesame della distribuzione dei principali materiali minoici e minoicizzanti all'interno dell'area SASCAR. Nella seconda e nella terza parte, sulla base della recente definizione della cosiddetta "*SASCAR String*", si discutono le tecniche di navigazione in uso nell'Egeo all'inizio della TeB, con particolare attenzione a fattori quali direzionalità, durata e stagionalità dei viaggi. Nella quarta parte, vengono ricostruite le possibili rotte che mettevano in comunicazione Creta con i principali snodi commerciali nella SASCAR, cioè Ialysos a Rodi, il "Serraglio" e Ayios Panteleimon a Kos e Mileto sulla costa occidentale dell'Anatolia. Nella quinta e ultima parte dell'articolo, si propongono alcune osservazioni conclusive sull'importanza dello studio della navigazione antica per la comprensione di connettività e intrecci culturali nella fase iniziale della TeB nell'Egeo.

Introduction

In the Aegean, the early Late Bronze Age (LBA) was a phase of intense cultural interactions, characterized by the wide circulation of Minoan type features (fig. 1)[1]. While connectivity within this "new cultural environment" has been extensively investigated through the lenses of human mobility and network theory[2], this contribution discusses

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[1] Broodbank 2004; Davis, Gorogianni 2008; Gorogianni *et alii* 2016 (all with abundant previous bibliography).

[2] Mokrišová 2016; Knappett 2018 (both with abundant previous bibliography).

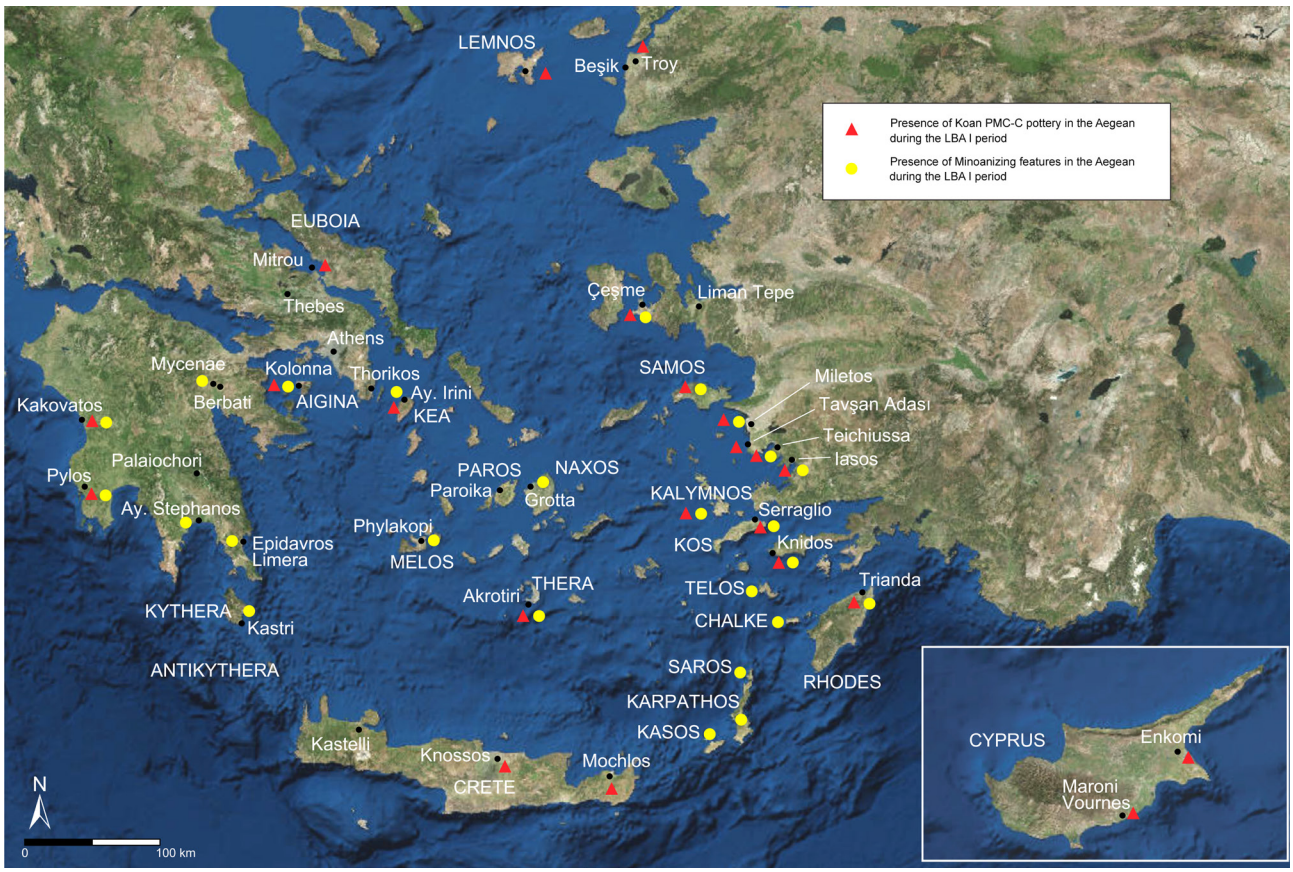

Fig. 1. Distribution of Koan PMC-C pottery and Minoanizing cultural features in the Aegean during LBA I (base map from Google Earth, adapted by C. McNamee, S. Vitale, Tina Ross).

the role of ships, sea routes, and harbors as decisive factors for the circulation of goods and ideas across the Eastern Mediterranean[3].

Specifically, we concentrate on a case study concerning interregional connections between Crete and the Southeast Aegean-Southwest coastal Anatolian region (SASCAR)[4]. To do so, we critically reconsider early LBA sea routes, sailing technology, and weather patterns within their wider cultural context. Our future broader aim is to develop and experimentally test a reliable model for ancient navigation and material exchange in the prehistoric Aegean.

In the first part of our paper, we briefly review the distribution of Minoan and Minoanizing features across the SASCAR, as evidence for interregional contacts between Crete and this area. In the second and the third parts, we discuss early LBA seafaring technology, with details on the directionality, duration, and seasonality of Aegean sailing, based on recent work on the so-called SASCAR String[5]. In the fourth part, we explain how sea routes linked Crete with major early LBA hubs in the SASCAR. In the fifth part, we conclude with some remarks on the importance of ancient seafaring technology to understand cultural interactions and the making of the early LBA Aegean.

This paper stems from the results of the "Serraglio, Eleona, and Langada Archaeological Project" (SELAP). SELAP is an on-going research endeavor directed by S. Vitale and C. McNamee, under the auspices of the Italian Archaeological School at Athens[6].

S.V.

[3] For the importance of wind conditions and ships' seaworthiness for a refined understanding of LBA connectivity, see Safadi, Sturt 2019; Tartaron 2018.

[4] This paper could not have been written without the assistance provided by the author's friends and colleagues currently or formerly employed by the Ephorate of Antiquities of Dodecanese, especially M. Chalkiti, T. Marketou, M. Michailidou, F. Seroglou, and E. Skerlou. Additional thanks are due to Calla McNamee for her useful comments on the subjects examined within this article. Last, but not least, we are also very grateful to the staff of the British School at Athens, especially the Assistant Director Georgios Mouratidis and the Archivist Amalia Kakissis, for granting permission to publish here the MM IIA-MM IIB cup from the "Serraglio" included in the BSA sherd collection (Box, MUS.XV031.01; Fig. 2:a).

[5] Vitale, Querci 2022.

[6] SELAP's 2009 to 2023 seasons were made possible through grants from the Ministry of Education, Lifelong Learning and Religious Affairs of the Hellenic Republic; the Institute for Aegean Prehistory (INSTAP); the Shelby White Leon Levy Program for Archaeological Publications; the University of Calabria; the Mediterranean Archaeological Trust; and the Rust Family Foundation. SELAP is also very grateful to the former and present Directors of the Italian Ar-

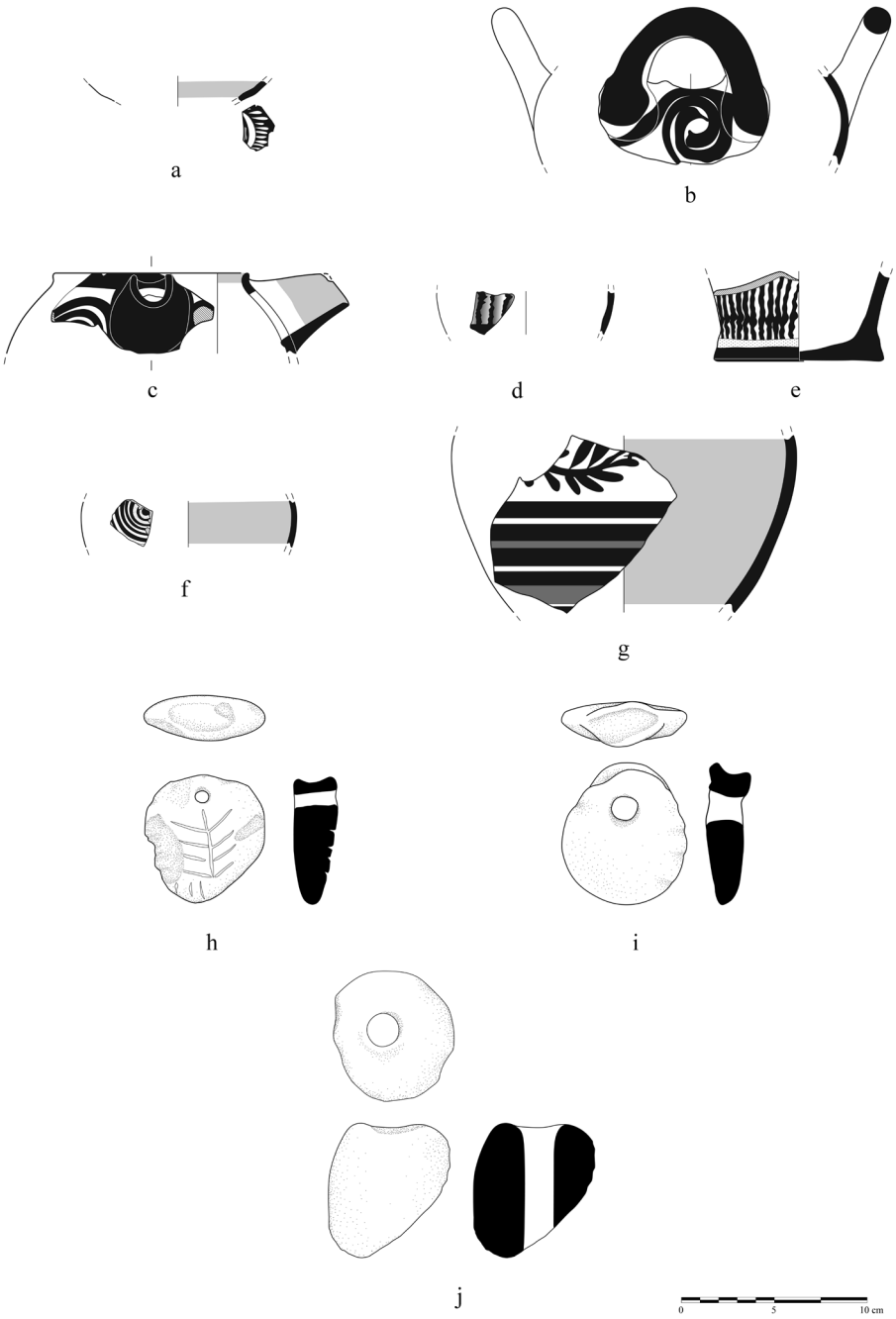

Fig. 2. a-g: Imported Minoan pottery from MBA and LBA IA Mature Kos;
h-j: Imported and locally made Minoan type loomweights from LBA IA Mature to LBA IB Kos.
a: MM IIA-MM IIB, LoD polychrome cup (from the BSA Box, MUS.XV031.01; reproduced with permission of the British School at Athens);
b: LM IA, DoL hole-mouthed/bridge-spouted jar;
c: LM IA, DoL bridge-spouted jar;
d-e: LM IA, DoL polychrome and DoL closed shapes;
f: LM IA, DoL semiglobular cup;
g: LM IA, DoL polychrome bowl; h: LBA IA-LBA IB, imported, Minoan type discoid loomweight with a Linear A mark;
i: LBA IA-LBA IB, locally made, Minoan type discoid loomweight;
j: LBA IA-LBA IB, locally made, Minoan type cylindrical loomweight
(S. Regio, M. Rossin, T. Ross, C. Kolb).

1. Crete and the SASCAR

During the Early Bronze Age (EBA) and at the onset of the Middle Bronze Age (Table 1), the SASCAR was characterized by local cultural developments, with continuous interactions between sites on the southeast Aegean islands and sites on the west coast of Anatolia[7]. The intensity of these contacts was variable, with peaks during the Anatolian Trade Network System, dating to the EBA 2 Late and the EBA 3 Early phases[8]. Links between the SASCAR and western Anatolian cultures occurred, especially in terms of burial and potting practices[9].

Contacts with Crete began during the Minoan Protopalatial phase, dating between Middle Minoan (MM) IB and MM IIB or to the MBA in the SASCAR (Table 1). This is demonstrated by the presence of Cretan pottery

chaeological School at Athens, Emanuele Greco and Emanuele Papi, for logistical and scientific support to the project. For previous summaries of SELAP's research, see Vitale 2012; Vitale *et alii* 2017.

[7] Marketou 1990a, pp. 101-102; Marketou 1990b; Marketou 2004; Marketou 2010a, pp. 762-763; Marketou 2010b, pp. 775-777; Vitale 2013, pp. 47-63; Vitale, Morrison 2018 p. 49; Vitale *et alii* 2017, pp. 236-238, 241-243; Vitale *et alii* 2022, pp. 154-155.

[8] Marketou 1990a, pp. 101-102; Marketou 1990b; Sahoglu 2005, pp. 339-361; Vitale *et alii* 2022, p. 155.

[9] Marketou 2004; Vitale 2013; Vitale *et alii* 2017, pp. 236-238, 241-243.

Morricone 1975; 1982		Marketou 1990a; 2010a	Vitale 2006; 2012	Vitale 2023		Approximate Synchronisms	
Building Phases	Suggested Chronology	Suggested Chronology		Building Phases	Suggested Chronology	Crete	Greek Mainland
-	-	EBA 3 Early	-	I:1	EBA 3 Early	EM IIB-EM III	EH III
-	-	EBA 3 Late	-	1:2	EBA 3 Late		
-	-	MBA	-	II	MBA	MM IA-IIIA	MH I-III Early
Settlement Preceding City I, First Sub-Phase	MM III	LBA IA Early	LBA IA Early	III:1.a	LBA IA Early	MM IIIB or LM IA Early-Advanced	MH III Late
Settlement Preceding City I, Second Sub-phase		LBA IA Mature	LBA IA Mature	III:1.b	LBA IA Mature	LM IA or LM IA Final	LH I
City I	MBA III-LBA I or LBA I	LBA IB	LBA IB	III:2	LBA IB	LM IB	LH IIA
City II, First Sub-phase	LBA IIIA (= end of the period)	Disturbed LM II/LH IIB to LM/LH IIIC Late Sequence	LBA II-LBA IIIA1	III:3.a	LBA II-LBA IIIA1	LM II-LM IIIA1	LH IIB-LH IIIA1
City II, Second Sub-phase			LBA IIIA1	III:3.b	LBA IIIA1	LM IIIA1	LH IIIA1
City III, First Sub-phase	LBA IIIA-LBA IIIB		LH IIIA2-LH IIIB1	III:4.a	LH IIIA2-LH IIIB1	LM IIIA2-LM IIIB1	LH IIIA2-LH IIIB1
City III, Second Sub-phase	LBA IIIB Final (= end of the period)		LH IIIB1-LH IIIB2 Late	III:4.b	LH IIIB1-LH IIIB2 Late	LM IIIB1-LM IIIB2	LH IIIB1-LH IIB2 Late
City IV	LBA IIIC		LH IIIC Early-Late	III:5	LH IIIC Early-Middle/Late	LM IIIC Early-Subminoan	LH IIIC Early-Late
Continued Occupation		-	-	IV:1	EPG-MPG	Subminoan-EPG	EPG-MPG
EIA Cemetery	PG		-	IV:2	MPG-LPG	EPG	MPG-LPG
Abbreviations: EM (Early Minoan); EH (Early Helladic); MM (Middle Minoan); MH (Middle Helladic); LM (Late Minoan); PG (Protogeometric).							

Table 1. Chronological Sequence at the "Serraglio" on Kos during the Bronze Age and the PG Period, with Aegean Approximate Synchronisms.

imports at Miletus, the "Serraglio" on Kos (fig. 2:a), and Trianda on Rhodes[10]. Besides pottery, during this period, Minoan type seals were recovered at Miletus, alongside ceramic vessels with Linear A signs[11]. Some of these inscribed vessels are considered local, while others are said to have been imported from sites located on Crete, in the Cyclades and in the SASCAR[12]. Particularly impressive is also a building with painted walls and an early *polythyron* from Trianda[13]. This context dates from MM IIA to MM IIB in Cretan terms, based on some imported Kamares sherds[14].

The peak of contacts between Crete and the SASCAR occurred in the mature phase of the Minoan Neopalatial period, dating between MM IIIB and Late Minoan (LM) IB or LBA IA Early to LBA IB in the SASCAR (Table 1). Indeed, during LBA IA Mature, imported and locally made Cretan type features, including pottery (fig. 2:b-g), frescoes, loomweights (fig. 2:h-j), cultic items, and evidence for Linear A writing, were present at various locations across the SASCAR[15]. The quantity and quality of the finds, as well as the estimated size of the settlements, indicate the existence of three main hubs, corresponding to harbor towns at or around Miletus on the west coast of Anatolia, the "Serraglio" and Ayios Panteleimon on northeast Kos, and Trianda on Rhodes[16].

The SASCAR was an ideal basis for trade operations, such as the acquisition of raw materials from Anatolia and the Near East, which were of prominent economic interest for the Cretan palaces. On the other hand, contacts with Minoan polities offered the communities in the SASCAR an opportunity to participate in and take advantage of the economic and political networks of the "new cultural environment" that typified the LBA IA Aegean[17]. This is demonstrated by the wide dissemination of Koan Painted Medium-Coarse to Coarse (PMC-C) pottery, a class mixing Local and Minoan cultural features[18]. Through this class, Koan products were exported to every corner of the Aegean along the same trade routes followed by other Minoan and Minoanizing objects (fig. 1).

S.V.

[10] The earliest pottery imports date to MM IB and come from Miletus. MM IIA-MM IIB ceramic imports are known from Miletus, the "Serraglio", and Ialysos. Marketou 1998, p. 43; Marketou 2009, p. 82, fig. 14:b; Marketou 2010b, pp. 777-779; Marketou 2018, pp. 264-265; Raymond 2005; Raymond 2009; Raymond *et alii* 2016, pp. 63-67; Vitale *et alii* 2022, p. 155.

[11] Niemeier 2005, pp. 3-4, col. pls. 7-9; Del Freo *et alii* 2015.

[12] Del Freo *et alii* 2015, p.16. Some of the inscribed fragments are considered possible Koan imports. Given the current lack of inscribed vessels recovered on Kos, this attribution cannot be verified and thus must not be accepted until proven through comparative petrographic and chemical analyses.

[13] Marketou 2014.

[14] Marketou 2018, pp. 264-265.

[15] See Vitale 2016, p. 87, table 5:4.

[16] Marketou 1990a; Marketou 1998; Marketou 2010a, pp. 777-779, 762-763; Marketou 2010b, pp. 779-785; Niemeier 1998, pp. 29-47; Kaiser 2009; Vitale, Hancock Vitale 2013; Raymond *et alii* 2016; Vitale 2016, pp. 278-279; Vitale 2018; Vitale *et alii* 2021; Vitale *et alii* 2022.

[17] Davis, Gorogianni 2008.

[18] Morricone 1975, pp. 296-326, figs. 265-313; Marthari *et alii* 1990; Vitale 2018 (all with abundant previous bibliography).

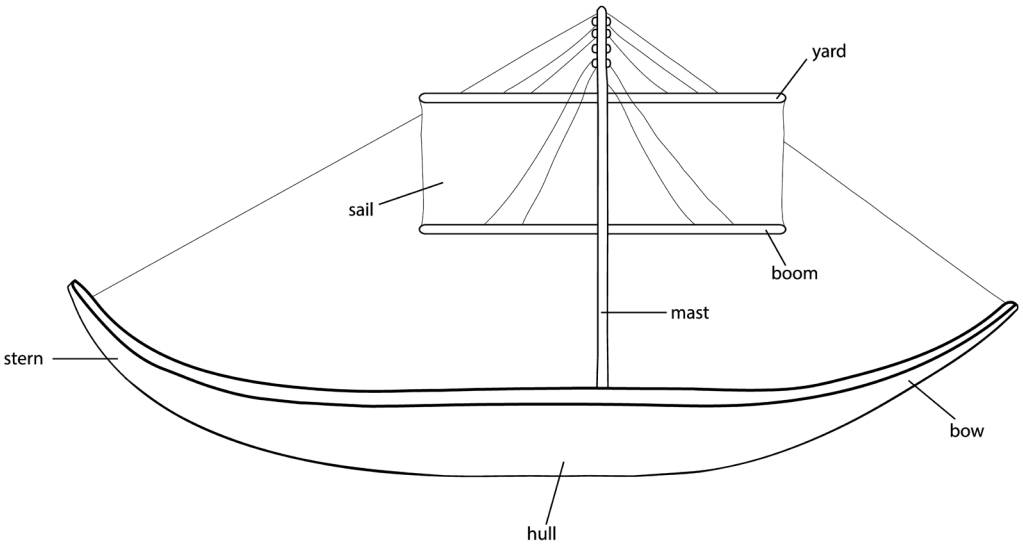

Fig. 3. Sketch drawing of a LBA Aegean light displacement boat (A. Querci, C.. McNamee, S. Vitale).

2. LBA Ships: Typology, Seaworthiness, Weather, and Sailing Season

Besides the scanty material remains from a few shipwrecks, most notably that from Uluburun[19], Aegean ships are known from, often schematic, iconographic imagery[20]. Based on these limited data set, early LBA ships likely consisted of light displacement boats with a crescent and slightly asymmetric hull and a boom-footed, square sail armed on a mast, which was approximately placed in the middle of the boat (fig. 3)[21].

While these ships were suitable for downwind and, in light wind conditions, beam reach sailing, windward sailing was not an option. Rowing against the winds could have been possible only in mild weather conditions and for limited amounts of time[22].

To define the range of the Aegean LBA sailing season, in addition to boats' seaworthiness, one must also consider the impact of ancient climate conditions over meteorological patterns. Although the debate on this subject is ongoing, we follow the majority of scholars in believing that Aegean LBA climate and weather conditions were similar to those experienced today[23].

If so, the Aegean must have been characterized by two main meteorological seasons: winter and summer[24]. The latter, extending approximately from the mid of May to early October, was more suitable for sailing, because of the more stable weather conditions. Aegean LBA summers must have been typified by prevalently northerly winds and sea breezes. The time span from the mid of June to the mid of September must have had particularly strong northerly winds that ancient sources called Etesians and are currently known as Meltemi[25].

A sailing season ranging from the mid of May to early October seems reasonable for the Aegean LBA and agrees with a critical reconsideration of ancient literary sources (Table 2)[26]. Downwind southward sailing was possible during this entire period. The time frame from the mid of May to the mid of June, with days being longer than 12 hours and no Etesian winds, was the best time for northward navigation through a beam reach sailing. This is especially true in the SASCAR where ancient sailors could take advantage of sea breezes blowing at a right angle to the Anatolian coastline. Because of the absence of Etesian winds, the period from the mid of September to early October was also suitable for northward sailing. The smaller amount of daylight, however, makes this time frame less ideal to cover long distances.

A.Q.

[19] The Uluburun ship was probably of Cypriot or Levantine origin and its cargo, dating to the final phase of Late Helladic (LH) IIIA2, was at least 200 years later than LBA IA Mature, which represents the main focus of this contribution. Nevertheless, it is likely that Cypriot and Levantine boats were similar to Aegean vessels, and it is unlikely that advances in shipbuilding from LBA IA to LH IIIA2 Late were so radical to make comparisons between these time periods misleading. For the Uluburun wreck, see Pulak 1999.

[20] Van de Moortel 2017; Wedde 2000.

[21] Querci 2023, pp. 56-93 (with abundant previous bibliography).

[22] Querci 2023, pp. 93-120 (with abundant previous bibliography).

[23] Vitale, Querci 2022, pp. 135-136; Querci 2023, pp. 133-136 (both with abundant previous bibliography).

[24] Morton 2001, p. 47; Ritossa 2011, p. 71.

[25] Heikell, Heikell 2018, p. 29; Ritossa 2011, pp. 71-73; Soukissian *et alii* 2007, pp. B-9-B-14.

[26] Beresford 2013, pp. 10-12; Janni 1996, p. 111; Medas 2004, pp. 34-42; Querci 2023, pp. 136-141.

Weather Patterns			Seafaring Patterns			
Meteorological Summer	Meteorological Sub-Phases (Based on Wind Patterns)	Prevailing Winds	North-South Direction	Prevailing North-South Navigation Types	South-North Direction	Prevailing South-North Navigation Types
Mid-May to Early October	Mid-May to Mid-June	Prevailing north winds, sea breezes, and occasional south winds	Yes	Downwind Sailing + Rowing	Yes	Beam Reach Sailing + Rowing
	Mid-June to Mid-September	Etesian Winds	Yes (best time span for this direction)		No	-
	Mid-September to Early October	Prevailing north winds, sea breezes, and occasional south winds	Yes		Yes	Beam Reach Sailing + Rowing

Table 2. Proposed Weather and Seafaring Patterns in the LBA Aegean (after Vitale, Querci 2022, with revisions).

3. The SASCAR String

In a recent contribution, we used the information about LBA ships provided above for a pilot study on sailing patterns in the SASCAR[27]. In this article, we used the distribution of Koan PMC-C Light on-Dark (LoD) and Dark-on-Light (DoL) pottery to identify all possible stations in a regional trade network, which arbitrarily set Kos at the center of the system and had Rhodes and Samos as its south and north terminals. We called this network the "SASCAR String".

Through this methodology, at least ten locations were identified along a coastal sailing route, which included Trianda, Knidos, the "Serraglio", Vathy's Cave, Iasos, Teichiussa, Tavşan Adası, Miletus, Tigani, and the Heraion. These stations were situated circa 20 nautical Miles (nM) from one other (fig. 4:a).

Hypothesizing a mean speed of 5 knots, a reasonable value for conditions of downwind sailing during the season of the Etesian winds, it would have been possible to cover 20 nM in only 4 hours[28]. However, in case of northward sailing, necessary to account for the distribution of PMC-C pottery from Kos to Samos, 20 nM could only have been covered in about 10 to 15 hours. This time span allowed ancient sailors to safely reach a shelter, after a full day of navigation from one location to the other, provided that this part of the trip was undertaken between the mid of May and the mid of June[29].

Our previous research also indicated that the SASCAR String must have been a viable route for regional connectivity in the area long before the beginning of the LBA, reaching back as early as the EBA[30].

S.V., A.Q.

4. Crete and the SASCAR String

At the peak of the Minoan Neoplatial period, the SASCAR String was incorporated in the wider interregional networks connecting Crete, the Dodecanese, and the Cyclades. From Crete, the entrance gate to the SASCAR was likely Trianda on Rhodes (fig. 4:b). Thanks to prevailing northwest winds, a ship could have sailed the 60 nM between Knossos and Cape Sideros, the easternmost limit of Crete, in 12 to 15 hours at any time during the sailing season. After that, no less than four stops were necessary to cover the difficult 140 nM from Cape Sideros to Trianda, where the sea can be very rough[31]. Chelatros on Kasos, Pighadia on Karpathos, Prassonisi on southern Rhodes, and the islands of Alimia or Chalke along the west coast of Rhodes were potentially good shelters to spend a night along such a cruise. Cultural contacts between Crete, Kasos, and Karpathos are well documented in the LBA, confirming the feasibility

[27] Vitale, Querci 2022.
[28] Casson 1971, pp. 282-288; Querci 2023, pp. 104-106.
[29] Burke 2011, p. 66; Casson 1971, pp. 281-296.
[30] Vitale, Querci 2022.
[31] Heikell, Heikell 2018, p. 524.

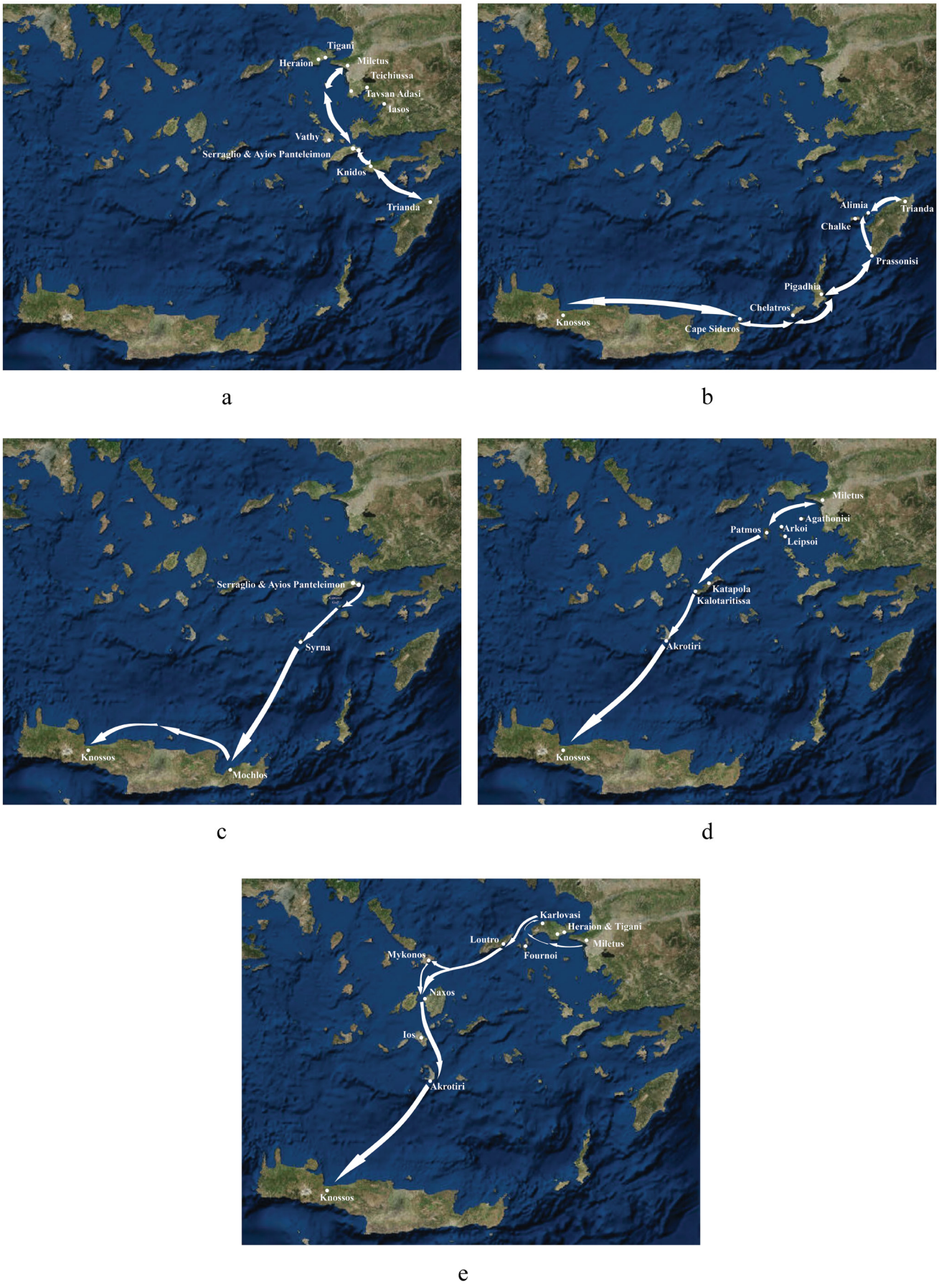

Fig. 4. Aegean MBA and LBA IA to LBA IB regional and interregional sea routes. a: The SASCAR String; b: Connections between Crete and Trianda on Rhodes; c: Connections between Crete and northeast Kos (the "Serraglio" and Ayios Panteleimon); d-e: Connections between Crete and Miletus on the southwest Anatolian coast (base map from Google Earth, adapted by A. Querci).

of this route[32]. In ideal weather conditions, the prevalently northeastern winds active in this area would allow to reach Trianda through a beam reach sailing in about five to six days. The opposite route would have been a feasible homecoming trip.

If the journey was meant to continue towards one of the other two main hubs in the southeast Aegean, the SASCAR String would have provided a consolidated route to reach Kos and Miletus (fig. 4:a), as well as a convenient journey back to Rhodes and from there to Crete, via Karpathos and Kasos[33].

There were, however, also more direct ways back to Crete from both Kos and Miletus. One of these comeback options connected northeast Kos with Knossos via northeast Crete, for example the area of Mochlos, where imported Koan PMC-C pottery is well attested (fig. 4:c)[34]. The waters around the northern coast of Kos are often angry, making navigation potentially unsafe. For this reason, ancient mariners would have preferably sailed along the southern coast of Kos. The overall trip would have been circa 130 to 140 nM long. The only feasible intermediate stations were the Kamares Gulf in southwest Kos and the islet of Syrna, circa 30 nM southwest of the Kamares Gulf. R. Heikell and L. Heikell remind us that in the south side of this islet "there is a large bay which local fishermen use"[35]. In ideal weather conditions, along this route, ancient ships would have reached Mochlos in about three days. From Mochlos, an additional day of travel was needed to reach Knossos.

As far as direct returns from Miletus are concerned, there were two main possibilities via Thera and the Cyclades (fig. 4:d-e). The first did not include a stop in Naxos, while the second did. The site of Akrotiri on Thera has abundant traces of contacts with Crete, as well as with Kos and the SASCAR, as shown by several imported PMC-C vessels[36]. The incidence of Minoan objects on Naxos is less impressive compared to Akrotiri and the presence of Koan imports on this island is not verified (fig. 1). Nevertheless, recent fieldwork on Naxos has revealed the existence of a possible Minoan type of peak sanctuary, located at the site of Stelida[37].

The first direct return route from Miletus to Crete (fig. 4:d) included three stops, based on geographic and meteorological data: Patmos, Amorgos, and Thera. The initial leg from Miletus to Patmos is circa 35 nM long and must be completed through a beam reach sailing. If necessary, it is possible to take advantage of the islands of Agathonisi, Arkoi, and Leipsoi, as intermediate stations. From Patmos, it was necessary to reach Amorgos through a beam reach sailing, docking either at Katapola or Kalotaritissa. This implied, however, the potential risk of facing strong Etesian winds, based on recent work by Heikell and Heikell[38]. The circa 55 nM involved could be covered in 11 hours, at a mean speed of 5 knots. The next station at Akrotiri was less then 45 nM southwest of Amorgos, a distance that could be covered in 9 hours. Akrotiri is circa 60 nM north from Knossos, a distance still compatible with a single daylight sailing. Hence, in ideal conditions, the whole voyage would last at least four days.

The second direct comeback option from Miletus through Naxos and Akrotiri (fig. 4:e) implied several problematic aspects. Sailing straight to Naxos is not compatible with the seaworthiness of the Aegean ships. To prevent the leeway, ancient mariners were first forced to go northward to Samos and Ikaria. The sites of Tigani and the Heraion on southern Samos were well integrated in the SASCAR String[39]. To reach Ikaria from Tigani or the Heraion involved an intermediate stop at Chrisomilia on Phournoi, which is circa 35 nM far from Miletus. As pointed out by Heikell and Heikell, however, anchorage is difficult at Chrisomilia, because of deep waters[40]. Thus, a cabotage route along the north coast of Samos to reach Karlovasi was probably a better option. The river mouth at the eastern edge of this town could have worked as a possible anchorage during the LBA[41]. From Karlovasi, direct sailing to Ikaria was simpler. This island does not have many good anchorages. The water pilot today suggests Loutro, but this location is now equipped with a breakwater. At any rate, to take advantage of more variable wind conditions, the route to Ikaria was more easily accomplished outside of the season of the Etesian winds.

From Ikaria, in following winds, it was possible to cover the 70 nM dividing Loutro from the area of the modern harbor of Naxos, at any time within the sailing season. The same applies to the circa 50 nM long distance from Naxos to Akrotiri. These legs, however, are not easily covered, because during the summer the Aegean can be extremely rough in the Cyclades. The best way to complete the 70 nM between Ikaria and Naxos was probably through a direct single

[32] Marketou 2010a, p. 770. According to Marketou, Ormos Chelatros on Kasos was characterized by a "dense MM/LM IA settlement pattern" and Ormos Pighadia was the seat of a settlement during LBA I. Both were safe bays offering a good shelter from the Etesian winds, see Heikell, Heikell 2018, pp. 524-529.

[33] Vitale, Querci 2022.

[34] Vitale 2018, p. 154, col. pl. 1; Morrison *et alii* 2022.

[35] Heikell, Heikell 2018, p. 510.

[36] Marthari 1990; Marthari *et alii* 1990.

[37] Carter, Athanasoulis 2024.

[38] Heikell, Heikell 2018, p. 311. Specifically, Heikell and Heikell state that "when the *Meltemi* is blowing there are severe gusts off the S side of Amorgós and big seas on both the NW and SE sides".

[39] Vitale, Querci 2022, pp. 137-138.

[40] Heikell, Heikell 2018, p. 470.

[41] For the definition of what can be identified as a good LBA harbor, see Blue 1997.

trip. The only possible station between these islands was Mykonos, but this option was also not ideal. In fact, the voyage from Loutro to Mykonos should have been covered through a beam reach sailing, facing potentially strong Etesian winds. On the other hand, the trip between Naxos and Akrotiri was simpler and, if necessary, could be split in two legs by stopping at Ios.

A.Q.

5. Concluding Remarks

This paper provided new data on sea routes between Crete and the SASCAR during the early LBA, when the process of Minoanization reached its peak in the Aegean. Combined with the distribution of Minoan and Minoanizing features, the analysis of sailing technology shed new light on ancient navigation practices, especially the directionality, seasonality, and duration of travels during the Cretan Neopalatial phase.

Our work identified regional and interregional sailing patterns, which incorporated open and coastal sea routes. These travels joined multiple discrete locations situated on Crete, the SASCAR, and the Cyclades, at different distances from one other. The journeys could be covered in a north to south, as well as in a south to north fashion. The direction of the movements was affected by weather conditions that would vary according to different periods within the navigation season and would impact the duration of the voyages. Likely, when possible, departure and return dates would have been scheduled to combine trade needs with the most favorable weather conditions.

Early LBA navigation would have been risky outside of the window between the mid of May and early October. Sailing from northeast Crete to Rhodes would have been easier before the beginning or after the end of the season of the Etesian winds, *i.e.* before the mid of June or after the mid of September. The same would have been true for journeys moving from south to north across the SASCAR. It should also be noted that, although possible, including Naxos in a direct return route from Miletus to Crete would have been problematic.

Our research also showed that the interregional sea routes through which Minoan and Minoanizing objects travelled reflect the incorporation of regional circulation patterns that predate the earliest known contacts with Crete. The SASCAR String, for instance, was a flourishing trade route at least from the EBA, both before and during the Anatolian Trade Network System[42]. Minoanization benefited from previously established networks and possibly revived and increased inner connectivity within the SASCAR, along these traditional sea routes.

Our research thus suggests that more attention should be placed on the local regional and sub-regional branches of broader Aegean networks. Such an approach would contribute to a more refined understanding of the interaction patterns that oriented the directionality of travel and exchange in the early LBA Minoanized Aegean.

S.V.

[42] Vitale, Querci 2022, pp. 138-139.

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