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Research Article

Mediterranean Early Iron Age chronology: assessing radiocarbon dates from a stratified Geometric period deposit at Zagora (Andros), Greece

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In this article, the authors present an analysis of radiocarbon dates from a stratified deposit at the Greek Geometric period settlement of Zagora on the island of Andros, which are among the few absolute dates measured from the period in Greece. The dates assigned to Greek Geometric ceramics are based on historical and literary evidence and are found to contradict absolute dates from the central Mediterranean which suggest that the traditional dates are too young. The results indicate the final period at Zagora, the Late Geometric, should be seen as starting at least a century earlier than the traditional date of 760 BC.

Keywords: Mediterranean Europe, Greece, Early Iron Age, Geometric period, radiocarbon, chronology

Introduction

The Greek Geometric period, named after the patterns painted on the ceramics produced at the time, spanned the latter part of the Early Iron Age. One of its sub-phases, the Late Geometric, witnessed the beginnings of Greek colonisation in the central Mediterranean and significant cultural developments, such as the introduction of the Greek alphabet

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Table 1. Geometric period dates based on the traditional chronology.

Ceramic phase		
Attic	Euboean	Date BC
LG II	LG II	735/730–700
LG I	LG I	760/750–735/730
MG II	SPG IIIb	800–760/750
MG I	SPG IIIa	850–800
EG II	SPG II	875–850
EG I	SPG I	900–875

LG: Late Geometric; EG: Early Geometric; MG: Middle Geometric; SPG: Sub-Protogeometric.

(Coldstream 1977; Powell 2002; Hall 2014: 68–94). The traditional dates assigned to the Geometric period are based on finds of Greek ceramics (primarily Euboean, Attic and Corinthian) in Near Eastern strata whose destruction was dated by documented historical events. In southern Italy, finds of these types of ceramics in Greek colonies were correlated with the date that the colonies were established, provided by the Greek historian Thucydides writing three centuries after the foundations supposedly took place (Table 1; Coldstream 1968: 302–31). For example, Thucydides' foundation date for Megara Hyblaea in Sicily is given as 245 years before its residents were driven out by Gelon of Syracuse (*History of the Peloponnesian War* 6.4.2; Smith 1921), an event recorded by Herodotus as being prior to the Persian defeat in 480 BC (*Histories* 7.156; Godley 1922) and estimated by modern scholarship to be *c*. 485–480 BC (Evans 2016: 2). This gives a date of 730–725 BC for the foundation of Megara Hyblaea, where the earliest Corinthian pottery was recognised by Coldstream (1968: 323) as Late Geometric in style. Coldstream (1968: 316) dates the transition between Corinthian Late Geometric and the subsequent Early Proto-Corinthian pottery style using a destruction level at Al Mina in Syria dated to 720 BC and utilises the Thucydidean foundation dates of cities such as Megara Hyblaea to corroborate his dating of this transition.

In the central and western Mediterranean, where sites have been dated using Greek ceramics, the traditional dates have been called into question following radiocarbon analyses suggesting a higher/older chronology than traditionally assigned (Randsborg 1991; Nijboer *et al.* 2000; Nijboer 2005; van der Plicht *et al.* 2009; Guidi 2018). Such observations are supported by older dates obtained from stratified contexts in the Aegean (Wardle *et al.* 2014; Gimatzidis & Weninger 2020). Nevertheless, arguments to maintain the traditional chronology persist and are mainly based on evidence from Levantine settlements (Gilboa & Sharon 2001; Coldstream & Mazar 2003; Finkelstein & Piasetzky 2006; Fantalkin *et al.* 2011, 2020). Gimatzidis and Weninger (2020) recently proposed a revision to the long-standing Geometric period chronology established by Coldstream (1968). Their dates, obtained from the tell settlement of Sindos in the north Aegean, revealed that Geometric period phases were up to 150 years older than in the established system. As Gimatzidis and Weninger (2020: 25) themselves admit, resistance from proponents of the established chronology is to be expected and more dates from short-lived samples in stratified contexts in Greece are needed to support any chronological refinement.

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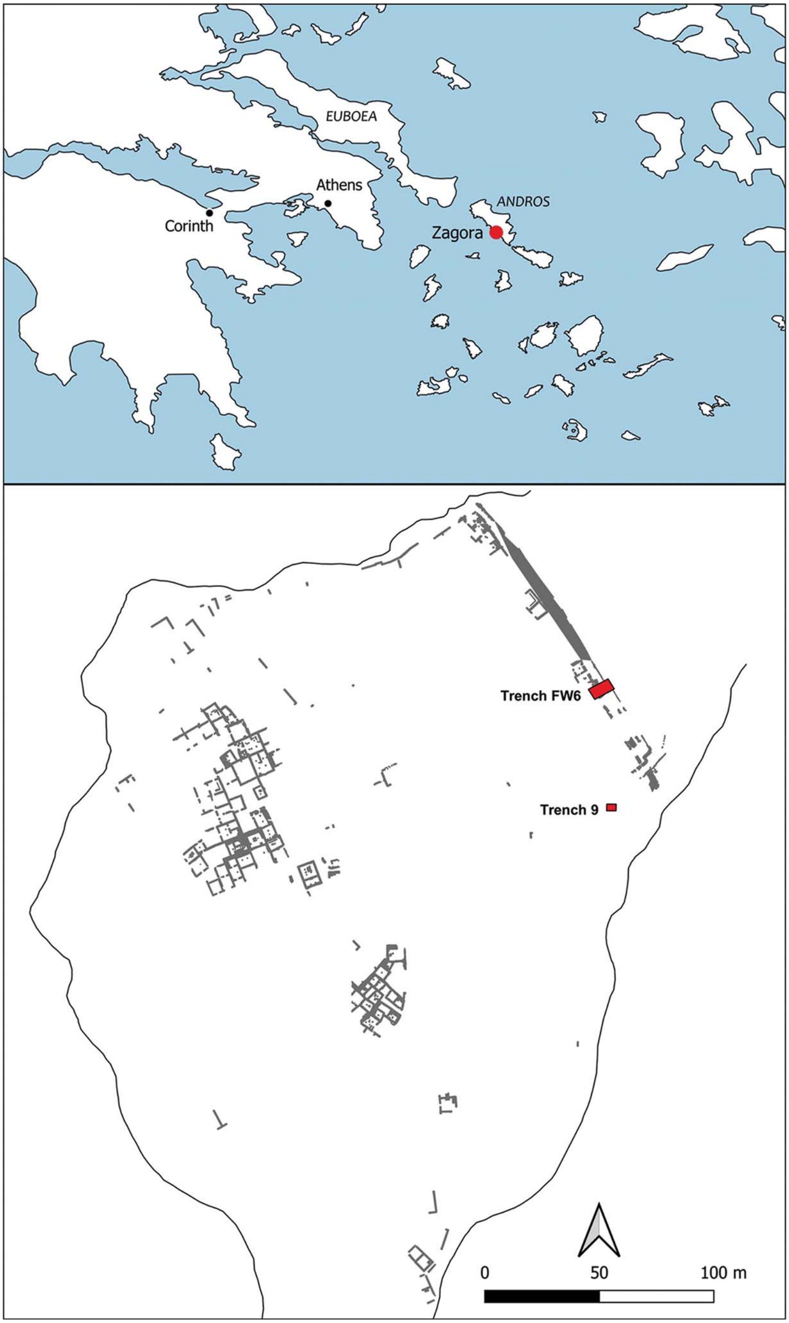

Figure 1. Map showing location of Zagora (upper); and a site plan showing location of trenches 9 and FW6 (lower; site plan after Coulton, McCallum, Anderson and Wilson, figure by authors).

Zagora on the island of Andros (Figure 1) provides evidence to illustrate this discussion, with occupation spanning from the Euboean Sub-Protogeometric III and Attic Middle Geometric, through to Late Geometric II. Andros is 11km south-east of Euboea, one of

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the main ceramic production centres in Greece during the Geometric period and origin of the majority of imported fineware ceramics excavated at Zagora (Cambitoglou 1981).

In this article, we present 10 short-lived radiocarbon dates of cattle and caprine bones recovered from a stratified deposit in trench 9 at Zagora, excavated in 2014, with levels containing material dating from Sub-Protogeometric III/Middle Geometric to Late Geometric I. The objective is to date some of the earliest stratigraphic sequences at Zagora and provide dates for the open-air surfaces in this area, the latest of which was still in use when the settlement was abandoned. One further date is obtained from a hare bone recovered just below the major extension of the fortification wall in trench FW6 excavated in 1969, providing a *terminus post quem* for this work.

The Late Geometric period is usually avoided for ^{14}C analysis because the traditional dates assigned to it (760–700 BC) are on a flat area of the calibration curve, the Hallstatt Plateau, which produces similar radiocarbon ages between *c*. 800 BC and 400 BC. The recent study by Gimatzidis and Weninger (2020), however, included early Late Geometric I samples (Late Geometric Ia) and found that they pre-dated the Hallstatt Plateau and were consistent with the ^{14}C results from the central Mediterranean, which prompted the inclusion of Late Geometric I period samples in this study.

Materials and methods

Sampling

Faunal samples were obtained from trench 9 (Figures 2 & 3), which is located in a natural depression in the marble bedrock. It comprises successive fills delimited by three compact surfaces, providing the best recorded and deepest stratigraphy at Zagora. This depression is believed to have been used as a garbage dump prior to the laying of each of the three surfaces (Miller *et al.* 2020). The animal bones within are most likely refuse from human consumption, based on the presence of butchery cut marks on several specimens. An abundance of fineware sherds were recovered from this trench in association with the faunal remains (Miller *et al.* 2020), suggesting the bones in the fill are the remains of cultural episodes such as feasting events. This trench was excavated until bedrock or sterile soil (level 20) was reached. Stratigraphic units 9 and 14 (not illustrated) belong to deposits within surface 2 and level 13, respectively (Figure 2). One further sample was taken from the stratigraphic unit immediately below the fortification wall extension in trench FW6. Only herbivores were sampled to exclude marine reservoir offsets and none of the bones exhibit evidence of being used as tools.

The ceramics in trench 9 testify to the presence of older residual material in the fills, which highlights a potential risk of associating objects found in the same context. Walls at Zagora were constructed exclusively of stone, so there is little chance that residual bones from decayed mudbrick were deposited in trench fills. The earliest ceramic material recovered from Zagora is roughly contemporary with the earliest material in trench 9 (level 19), suggesting that neither the faunal remains nor ceramics in this level are residual material. Due to resource limitations, samples from trench 9 levels 10–13 were not included in the study. These omitted levels are not considered crucial for our objectives and they are relatively dated to

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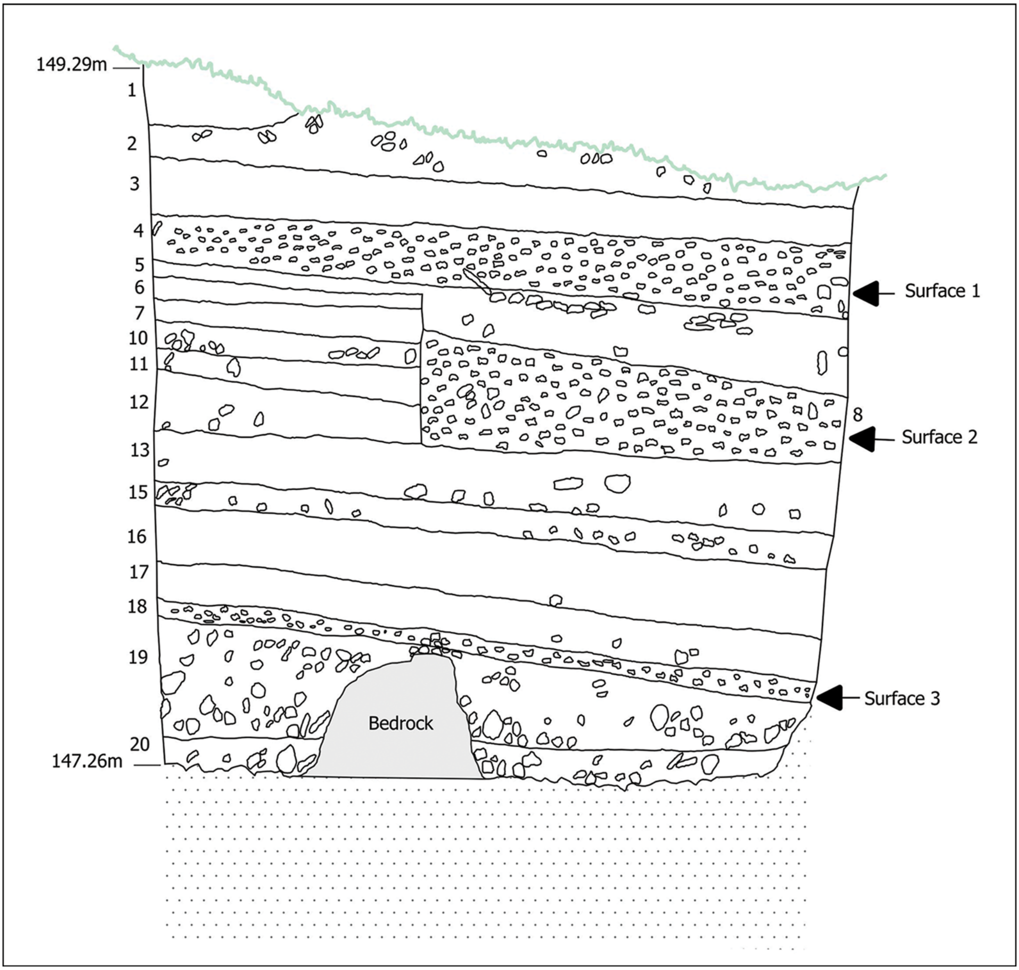

Figure 2. Profile of trench 9 showing stratigraphic levels and location of identified surfaces. Samples studied derive from levels 5–7 and 15–19. Height is in metres above sea level (digitisation by R. Alagich of original trench 9 profile drawing by A. Carr & H. Gwyther).

the Middle Geometric/Sub-Protogeometric III periods, so the earliest Late Geometric level from trench 9 will be dated.

Radiocarbon dating and stable isotope analyses

Radiocarbon dating and stable isotope analyses were carried out at the Chronos ^{14}C Facility, University of New South Wales (UNSW), following their protocols (Turney *et al.* 2021). Bone samples were chemically pre-treated following 'code SFC', which involved decalcification, acid-base-acid rinses, gelatinisation and syringe filtering (45µm pore size). Stable carbon and nitrogen isotopic compositions were determined using an Elementar precisION® isotope ratio mass spectrometer coupled to an Elementar vario ISOTOPE cube elemental analyser. Isotopic compositions were calibrated relative to the Vienna PeeDee Belemnite

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Figure 3. Trench 9 final photograph 2014 (photograph courtesy of the Australian Archaeological Institute at Athens and the Zagora Archaeological Project).

(VPDB) and atmospheric N_2 (AIR) scales using USGS40 and USGS41. Measurement uncertainty was monitored using one internal standard (L-Alanine, Sigma-Aldrich) with well-characterised isotopic compositions (n=43, δ^{13}C= −19.08±0.13‰, δ^{15}N = −1.64 ±0.26‰). Precision of replicate standard and sample measurements was ±0.13‰ for δ^{13}C and ±0.19‰ for δ^{15}N. Accuracy, determined from observed and known δ values of standards, was ±0.13 for δ^{13}C and ±0.49 for δ^{15}N. Total analytical uncertainty was estimated to be ±0.18‰ for δ^{13}C and ±0.52‰ for δ^{15}N.

Radiocarbon calibration and Bayesian age modelling

Radiocarbon calibration was undertaken using IntCal20 (Reimer *et al.* 2020) in OxCal 4.4 (Bronk Ramsey 2009a). Bayesian age modelling was performed through the same platform, using chronometric data and known stratigraphic information (Bronk Ramsey 2009a). The 'General' outlier model was applied to all dates, with each given a 5% prior probability of being an outlier (Bronk Ramsey 2009b). This statistical analysis identifies and downweighs outlying age measurements according to their degree of offset—for example, a date identified as an outlier at 95% posterior probability will be largely discounted from the model. Given the lack of chronometric data for levels 8–14, a double boundary was included. This denotes a sequential rather than a contiguous relationship between levels 7 and 15. Stratigraphically, however, only levels 10 to 13 are missing from the right side of trench 9 (see Figure 2). Calibrated dates have been rounded to five years and all modelled/calibrated estimates are noted at 95.4% credible/confidence intervals.

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Figure 4. Euboean Late Geometric krater rim fragment recovered from trench 9, level 5 (Inv. 14–499) (photograph courtesy of the Australian Archaeological Institute at Athens and the Zagora Archaeological Project).

Ceramic chronology of ^{14}C-dated levels in trenches 9 and FW6

Fineware ceramics recovered from the two studied contexts were highly fragmentary in nature. Therefore, a further refinement of their dates into relative chronology sub-divisions was not always possible (McLoughlin & Paspalas in press). In trench 9 (Figure 2, Table 1), immediately below surface 1 (level 5), Sub-Protogeometric/ Middle Geometric ceramic fragments as well as some early Late Geometric pieces were recovered, dating this level to Late Geometric I (McLoughlin & Paspalas in press). Among these Late Geometric sherds is a rim fragment from a Euboean krater (Inv. 14–499; Figure 4). Below this level and later than surface 2, in levels 6–7, an absence of Late Geometric sherds precludes a Late Geometric date. The recovery of an Attic Middle Geometric skyphos body fragment (Inv. 14–049) and various Sub-Protogeometric III fragments dates these levels to Middle Geometric/Sub-Protogeometric III. However, level 12 contains a Middle Geometric II fragment (Inv. 14–631; Figure 5), possibly from an Attic amphora. This means that levels 6–7 can be dated to Middle Geometric II/Sub-Protogeometric IIIb.

The levels in between surfaces 2 and 3 (levels 15–17) are primarily dated to Sub-Protogeometric. From level 15, fragments of a skyphos, possibly Euboean (Inv. 14–424 and 14–436; Figure 6), date to Sub-Protogeometric III. A pedestal foot from level 16 (Inv. 14–581) is from the Sub-Protogeometric II–IIIa transition. Level 17 produced a Euboean closed vessel (Inv. 14–320), possibly a small amphora, and a pendant semi-circle skyphos rim and upper-body fragment (Inv. 14–501), both dating to Sub-Protogeometric III.

Pottery associated with surface 3 includes small, closed vessels with concentric semi-circles (Inv. 14–307) and monochrome cups (Inv. 14–314) dating broadly to Sub-Protogeometric. Recovered from the same surface in the adjoining trench 3 were Middle Geometric cup fragments (Inv. 13–052 and 13–122) and a Euboean cup (Inv. 13–102) dated to Sub-Protogeometric III, assigning this surface a Middle Geometric/Sub-Protogeometric III date.

The fill below surface 3 (level 19) includes monochrome cups, amphora fragments and a closed vessel fragment with opposed diagonals, all possibly dating as early as the Late Protogeometric or as late as Sub-Protogeometric III (McLoughlin & Paspalas in press). However, this level can be securely dated to Sub-Protogeometric III by the presence of pendant semi-circle skyphoi fragments (Inv. 14–750, 14–450, 14–454, 14–271, 14–273, 14–274, 14–238, 14–255), a small amphora or lekythos (Inv. 14–437), sherds from closed Euboean vessels (Inv. 14–420 and 14–266) and an amphora rim fragment (Inv. 14–259).

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Figure 5. Attic or Atticising Middle Geometric II fragment recovered from trench 9, level 12 (Inv. 14–631) (after McLoughlin & Paspalas in press: fig. 3B).

Figure 6. Sub-Protogeometric III skyphos fragment recovered from trench 9, level 15 (Inv. 14–424) (after McLoughlin & Paspalas in press: fig. 5E).

Trench FW6, level 5, directly below the fortification wall extension, produced a number of residual Sub-Protogeometric and Middle Geometric sherds. This level is dated by a krater fragment (Inv. 2592; Figure 7) and a skyphos rim fragment (Inv. 2594), which can both only be identified more broadly as originating from Late Geometric period vessels.

Radiocarbon dates from Zagora

Radiocarbon dating and stable isotope results are shown in Table 2. Bayesian age modelling results show agreement between the chronometric and archaeological data, with no outlying dates (Figure 8). Overall, the dated sequence does not span more than a couple of centuries. The double boundary placed between levels 7 and 15 denotes no temporal gap, as these include zero at the 95.4% confidence interval (see online supplementary material Figure S1). This suggests that the occupation at this point in the sequence was continuous and short. From the bottom of the cultural sequence in trench 9, the model estimates the start of levels 19 (Middle Geometric/Sub-Protogeometric III) to 1015–925 BC, 7 (Middle Geometric II/Sub-Protogeometric IIIb) to 950–890 BC, and 5 (Late Geometric I) to 935–850 BC. With the exception of levels 7 and 5, the distributions do not overlap at the 68.3% confidence interval (see Figure S2), denoting cultural events that were generally temporally distinct, yet in close sequential order. The age of surface 3 is represented by level 18, dated to 1000–925 BC, while surface 2 is represented by level 8, which falls within the range of 955–900 BC. Surface 1 postdates all radiocarbon dated levels, with a *terminus post quem* of 930–840 BC (estimated end of level 5). UNSW-223 (2762±20 BP or 980–830 BC), extracted from trench FW6 under the fortification wall extension, is relatively dated to Late Geometric I. Given that this date is comparable with UNSW-220 (2764±20 BP or 980–830 BC), evidence suggests that the construction of this extension took place

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Figure 7. Late Geometric krater fragment recovered from trench FW6, level 5 (Inv. 2592) (photograph courtesy of the Australian Archaeological Institute at Athens).

at the same time. At the end of the sequence (levels 7–5), where the calibration curve is non-monotonic, the use of prior information provides more accurate, unimodal ages for the cultural events.

Discussion

The radiocarbon dates from Zagora have provided absolute dates for some of the earliest material recovered from the settlement. Dates from the bottom of the fill in trench 9 change the commencement of occupation at Zagora from *c*. 900 BC (Miller *et al*. 2020; McLoughlin & Paspalas in press) to sometime between the last quarter of the eleventh and the third quarter of the tenth century BC. The first of the surfaces in trench 9 was laid sometime between the first and third quarters of the tenth century, suggesting the bottom of the trench was filled to this point soon after refuse began to accumulate here. Surface 2 was laid between 955 and 900 BC and the final surface after 930–840 BC. This final surface is similar in composition and height to the road surfaces uncovered just inside the fortification wall gateway and appears to have been in use until the settlement's abandonment *c*. 700 BC (Miller *et al*. 2020). The radiocarbon dates suggest that the fortification wall expansion and the laying of the upper surface in trench 9 may have been part of a single episode of rebuilding at the settlement. The width of the fortification wall was more than doubled to approximately 7m at this time (Cambitoglou 1981: 23), suggesting the possibility that a significant threat prompted the residents of Zagora to instigate such major construction.

The dates presented here generally support the chronology revision proposed by Gimatzidis and Weninger (2020) at Sindos (Table 3). This includes their proposed beginning of Late Geometric I which, at 870 BC, fits with our estimate of 935–850 BC. The possibility of an even earlier commencement at Zagora requires further testing because the timing of Late Geometric I is based on one measurement. Future efforts will be affected by the calibration curve shape at this period, however. Our findings also support a substantially longer Greek Late Geometric period than assumed under the traditional chronology—assuming the Late Geometric II period does indeed end *c*. 700 BC—although this is yet to be tested with absolute dating of well-stratified deposits containing Greek Late Geometric II material.

Prior to the Late Geometric, much of Zagora was probably open space while during the final Late Geometric phase the settlement was densely occupied (Cambitoglou *et al*. 1988;

Table 2. Radiocarbon dates from Zagora, including dates calibrated against IntCal20 (Reimer *et al.* 2020).

Lab code	Species	Trench	Level	Relative chronology	Level description	Collagen yield (% wt)	%C	% N	C: N	$\delta^{13}C$ (VPDB)	$\delta^{15}N$ (Air)	Date (BP)	Date (BC at 68.3%)	Date (BC at 95.4%)
UNSW-219	*Bos taurus*	9	19	MG/SPG III	Fill under surface 3	10.9	42.0	15.5	3.2	−19.9	5.5	2826 ± 20	1010–930	1050–915
UNSW-221	*Bos taurus*	9	19	MG/SPG III	Fill under surface 3	10.5	42.3	15.6	3.2	−19.7	6.1	2814 ± 20	1000–930	1015–905
UNSW-214	*Bos taurus*	9	18	MG/SPG III	Surface 3	4.3	42.5	15.6	3.2	−20.3	6.3	2815 ± 20	1000–930	1045–905
UNSW-215	*Caprinae*	9	17	MG/SPG III	Fill under surface 2	12.6	41.6	15.3	3.2	−20.2	4.9	2818 ± 20	1005–930	1045–905
UNSW-217	*Caprinae*	9	16	MG/SPG III	Fill under surface 2	6.7	39.9	14.7	3.2	−21.3	4.6	2810 ± 20	1000–925	1015–905
UNSW-213	*Caprinae*	9	15	MG/SPG III	Fill under surface 2	4.8	39.8	14.6	3.2	−18.8	5.0	2809 ± 20	990–925	1015–905
UNSW-216	*Caprinae*	9	15	MG/SPG III	Fill under surface 2	7.2	41.0	15.0	3.2	−20.4	6.3	2807 ± 20	990–920	1015–905
UNSW-222	*Capra hircus*	9	7	MG II/SPG IIIb	Fill under surface 1	5.2	40.6	14.8	3.2	−20.8	5.8	2753 ± 20	920–835	970–825
UNSW-218	*Caprinae*	9	6	MG II/SPG IIIb	Fill under surface 1	3.9	41.2	14.9	3.2	−21.2	5.2	2759 ± 20	925–840	980–830
UNSW-220	*Caprinae*	9	5	LG I	Fill under surface 1	1.8	37.2	13.6	3.2	−20.5	3.7	2764 ± 20	930–840	980–830
UNSW-223	*Lepus europaeus*	FW6	5	LG I	Immediately under wall	6.7	36.4	13.5	3.2	−21.2	3.5	2762 ± 20	930–840	980–830

LG: Late Geometric; MG: Middle Geometric; SPG: Sub-Protogeometric.

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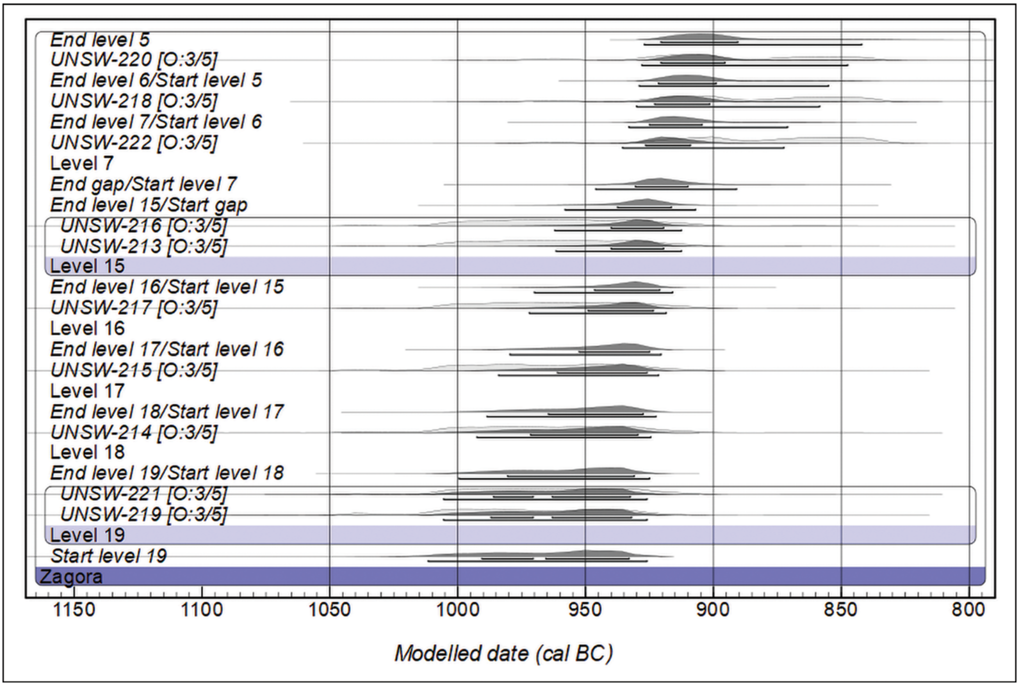

Figure 8. Bayesian age model for Zagora (figure by authors).

Beaumont *et al.* 2012). The population at Zagora is believed to have doubled each generation during the Late Geometric period (Green 1990), which under the traditional chronology spans around 60 years. Increasing the duration of the Late Geometric period to over 150 years would make these changes more gradual and less dramatic than previously thought. In Greece more widely, the population is also believed to have increased rapidly during the Late Geometric period, highlighted by Snodgrass' (1977) calculation of a sevenfold increase in graves per generation in Attica. A longer Late Geometric period allows for a more modest rate of population growth in Greece during this time. The increase in population at Zagora is also reflected in the landscape surrounding the site, where a reduction in available land during the Late Geometric period may have caused farmers to adopt more intensive agricultural practices (Alagich *et al.* 2021).

Changing the start date of the Late Geometric period to over a century earlier also backdates significant cultural episodes in Greek history, such as the introduction of the Greek alphabet. The earliest definitive evidence for the use of the Greek alphabetic script appears during Late Geometric I and examples of inscriptions on ceramic vessels become numerous throughout Greece and the Mediterranean towards the end of the Late Geometric period (Bartoněk & Buchner 1995; Kenzelmann Pfyffer *et al.* 2005; Tzifopoulos 2012). There are rare examples of words incised after firing on Middle Geometric period potsherds, but they generally originate from contexts that cannot be securely dated (Kourou 2017). If the traditional chronology is used, it is intriguing that after several centuries of supposed illiteracy the use of writing for trivial purposes (such as jokes) became widespread within a single

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Table 3. Traditional Aegean chronology for the Sub-Protogeometric III/Middle Geometric and Late Geometric I periods, along with proposed modifications to the chronology by Gimatzidis and Weninger (2020) and modelled dates from Zagora; *earliest date for Sub-Protogeometric III/ Middle Geometric at Zagora is a *terminus ante quem* date for this period.

Period	Date BC (Traditional)	Date BC (Sindos)	Date BC (95.4%) (Zagora)
SPG III/MG	850 to 750	990 to 870	1015–925* to 930–855
LG I	760/750 to 735/730	870 to 730	935–850 to (to be determined)

LG: Late Geometric; MG: Middle Geometric; SPG: Sub-Protogeometric.

generation (Papadopoulos 2016). Revising the beginning of the Late Geometric I period to more than a century earlier would allow a longer timespan for the diffusion of writing and support suggestions by Semitic scholars for a transmission of the alphabet during the ninth century BC or even earlier (Sass 2005: 133–46). Janko (2015) has argued this point based on the traditional chronology being inconsistent with Greek philological evidence, which better supports the older radiocarbon dates from the central Mediterranean.

Absolute dates from Late Geometric contexts throughout the Mediterranean are rare due to the coincidence of this period with the Hallstatt Plateau under the traditional chronology. Nevertheless, several ^{14}C dates were obtained from animal bones found in association with Late Geometric ceramics at the Phoenician colony of Carthage in Tunisia, which all dated from around the end of the ninth to the beginning of the eighth century BC. This date agrees with classical literature for a late-ninth-century foundation for this city, which is significantly older than the mid-eighth-century foundation previously accepted under the traditional Greek ceramic chronology (Doctor *et al.* 2005, 2008; Maraoui Telmini & Schön 2020). In addition, three dates were obtained from animal bones associated with Late Geometric ceramics at Francavilla Maritima in southern Italy to date early Euboean presence here. The samples produced dates on the Hallstatt Plateau but were narrowed to the first half of the eighth century BC on archaeological grounds (Nijboer 2016: 40). The precise subdivision of the Late Geometric was not provided for these sherds, but our results and those of Gimatzidis and Weninger (2020) imply they were probably either late Late Geometric I or Late Geometric II.

The earliest Phoenician colonial foundations in the western Mediterranean, such as Carthage, are traditionally dated by the presence of Phoenician ceramics associated with Greek Late Geometric vessels, which date these colonies to the middle of the eighth century BC at the earliest (Aubet 2008). During this century, the Levant witnessed significant pressure from Assyrian military activity. Under the traditional chronology it was thought that the Phoenician colonial expeditions to the west may have been precipitated by displaced peoples or by the Phoenician need to obtain silver for Assyrian tribute payments (Aubet 1993). This view is now challenged (Aubet 2008) based on new radiocarbon dates, particularly from Huelva in Spain where material from contexts containing the earliest Phoenician ceramics produced dates in the early ninth century BC (Nijboer & van der Plicht 2006). These revised dates suggest that the migrations to the west were not accelerated by Assyrian aggression but were rather an organic growth of the long-distance trading expeditions instigated during the reign of King Hiram I, a century earlier (Aubet 2008). This pre-colonial trading phase and a

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late-ninth-century foundation of Carthage are in concordance with the proposed earlier commencement of the Greek Late Geometric period.

In northern Italy and central Europe, radiocarbon and dendrochronological data supportive of older Iron Age dates have conflicted with the established chronology from southern Italy, where dates are traditionally assigned using correlations with Greek ceramics (Coldstream 1968; Morris 1996). As discussed by Nijboer (2005), the narrow range of dates assigned to Greek Late Geometric ceramics has artificially imposed a similarly narrow range of dates on indigenous ceramics found in the same context without considering that the local vessels may have been part of a much longer tradition. Use of the established chronology therefore results in a "cluttering" of events towards the middle of the eighth century BC (Nijboer 2016: 36), during the Middle Geometric II–Late Geometric I transition, when significant Greek activity in Italy began in earnest (d'Agostino 2006). An earlier start to the Late Geometric period would allow for a longer phase of pre-colonial trade before the Greeks established their colonies and a better fit with absolute dates from further north in Italy and central Europe (van der Plicht *et al.* 2009; Nijboer 2016). This would not only 'de-clutter' the middle of the eighth century in Italy, but also provides a better explanation for the population increases observed in Greece in the period and the diffusion of the Greek alphabet.

Conclusions

The radiocarbon dates reported here are the first from Zagora and among very few obtained from the Geometric period in Greece. Our results date the commencement of the earliest occupation at Zagora to between 1015 and 925 BC. Laying of the final surface in trench 9, an open public space a short distance from the fortification wall gateway, took place sometime after 930–840 BC, at about the same time as the significant expansion of the fortification wall itself. The results from Zagora broadly support the revision of the Greek Geometric period chronology advanced by Gimatzidis and Weninger (2020), who propose that the onset of the Sub-Protogeometric III/Middle Geometric and Late Geometric periods need to be raised by at least a century.

Bayesian modelling suggests that the Late Geometric I period at Zagora started no later than 935–850 BC. Even if the Bayesian modelling were discounted, Late Geometric I ceramics from two secure deposits at Zagora were found in context with animal bones whose non-modelled dates at 95.4% confidence date no later than the third quarter of the ninth century BC. This explains the previously assumed rapid population growth at Zagora and in Greece more widely during the Late Geometric period as instead being one of a more gradual increase. Given Zagora's proximity to the Greek ceramic production centres, this evidence should considerably promote the argument for adopting a higher chronology for the Late Geometric period. This supports the absolute dates from Carthage, Italy and central Europe and better explains some of the historical events and cultural developments, such as the adoption of the Greek alphabet, that took place during the Middle Geometric and Late Geometric periods throughout the Mediterranean. Our results should further encourage researchers to obtain radiocarbon dates from Late Geometric I contexts in Greece and beyond to help refine the boundaries of this important phase of Mediterranean history.

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Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.15184/aqy.2024.16.

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