Family Fortunes: A Quantitative Analysis of the Early Iron Age Cemeteries at Knossos, Crete

Early Iron Age Cemeteries at Knossos

Dominic Pollard, Institute of Archaeology, University College London

[dominic.pollard.16@ucl.ac.uk](mailto:dominic.pollard.16@ucl.ac.uk)

03 June, 2019

The Early Iron Age cemeteries of Knossos, Crete, represent the richest source of archaeological material at the site for the whole period between the end of the Bronze Age and the emergence of the Archaic *polis*. However, despite well-published excavation reports on the two largest burial grounds, the Fortetsa and Knossos North cemeteries, and a number of studies dealing with various artefact classes and individual tombs therein, no substantial comparative, quantitative analysis of these two cemeteries has yet been undertaken. This paper provides such an analysis, examining both the synchronic and diachronic variation among the tombs in these two cemeteries. Through the application of a range of quantitative techniques, this study isolates a pattern of increased rates of burial among a few select tombs, and goes on to consider the broader social contexts within which these tombs were built and used, as well as discussing the possible nature of the burying groups. This paper demonstrates the potential for quantitative analyses to contribute to nuanced, context-specific theories of social practice, and advocates their wider application to the archaeological record of the Cretan Early Iron Age. It also serves as a demonstration of maximal research reproducibility, with the full datasets and code underpinning the analysis made freely available to download and use

# Keywords:

Early Iron Age; Knossos; Burial; Quantitative; Open-Access; Reproducibility

##### pagebreak

# Introduction

Three principal interests converge in this paper: a reorientation of the focus of Early Iron Age Cretan archaeology; the application of computational, and quantitative methods to supplement traditional modes of archaeological inference; and open-access, reproducible research. To begin with the first, it may be felt that, of all ancient sites on Crete, Knossos is the last in need of further archaeological attention. The city and palace of Knossos, first excavated well over a century ago (Evans 1921; 1928; 1930), retain a pre-eminent position in popular and academic accounts the island’s Bronze Age (BA), and few, if any, other Cretan sites have been so thoroughly dug, reconstructed, and contested.

For one, though, this is not the Knossos of that illustrous, palatial period, but rather the town as it persisted and evolved during the subsequent Early Iron Age (EIA). Research into this once maligned period has grown apace in recent decades, beginning with the pioneering works of Coldstream (1977), Desborough (1972), and Snodgrass (1971) and culminating in the rejection by most scholars of the appelation and interpretive bagguage of the so-called ‘Dark Ages’ (see Kotsonas 2016; Morris 1997). Nonetheless, our knowledge of many EIA settlements remains often underdeveloped in comparison with those of the second millennium BC.

Secondly, and welcome though they are, a number of recent publications on the socio-economic (Wallace 2010) and settlement (Nowicki 2000) changes which accompanied the BA-EIA transition have directed scholarly attention toward a pattern of elevated, defensible settlements supposedly founded in response to the dangers of this turbulent period. This is reflected in survey work, which has focussed extensively around the Bay of Mirabello, where such sites are numerous (Haggis et al. 2005; Hayden 2005; Watrous et al. 2012). This has, unfortunately, engendered a certain disregard for settlement characterised by different topographies, especially in the centre of the island. There remains, therefore, a need for studies addressing the social dynamics at such sites (Knossos, Phaistos, Grivila, Eleutherna etc.), with a long-term view to comparative appraisal of the divergent trajectories of communities across Crete in the EIA (Kotsonas 2011a; Whitley 2011:667–8).

As to the second and third of my stated interests, several authors have recently demonstrated the great potential of quantitative, statistical, spatial, and network analyses to elucidate social dynamics, settlement patterning, and systems of inter-regional communication across Crete and the wider Aegean. Such work encourages the use of large (often pre-existing) datasets, and the sharing of both data and methods to facilitate reproducible, collaborative research (Bevan and Wilson 2013; Knappett 2011; Knappett et al. 2011). The cemeteries of Knossos offer an opportunity to introduce such approaches into EIA research on Crete, where they have yet to make much of an impact (see Kotsonas 2011b). The Fortesta and North Cemetery complexes are both well-published (Brock 1957; Coldstream and Catling 1996) and have been studied with regard to their ‘oriental’ imports (Antoniadis 2012), antique artefacts (Crowe 2016), and religious context (J.N. Coldstream 1984a). But a lack of quantitative analyses, or systematic comparisons between the cemeteries, has left us with many intuited trends, some exceptional tombs, but a general impression of un-patterned multiplicity.

With a dataset including information on every find and tomb recorded in the Fortetsa and Knossos North Cemetery publications (Brock 1957; Coldstream and Catling 1996), the following analysis seeks to address this present lack. In doing so, I aim to demonstrate the potential for quantitative methods, firstly, to permit identification, and nuanced characterisation, of significant patterning in the archaeological material; secondly, to facilitate a more systematic appraisal of the cemeteries’ largest tombs and their distinctive histories; and, finally, to offer not just generalities, but tangible and context-specific considerations of the motivations and identities behind the burial groups themselves, with a view to eventually comparing such results with mortuary assemblages across the island.

# Early Iron Age Knossos

## Settlement Evidence: ‘A meagre filling in a very thick sandwich’

Settlement evidence at EIA Knossos is, in a word, insubstantial. Speaking of the town’s stratigraphic sequence, Coldstream lamented that “the remains of [this] period are like a meagre filling in a very thick sandwich” between Bronze Age and later Greek and Roman levels (Coldstream 1991: 287). Most individual finds of Protogeometric (PG) or Geometric (G) date take the form of flimsy foundations, patches of earth floor, wells or pottery scatters, and for a time it was argued that the area in the EIA comprised several dispersed villages, which later coalesced into a single city, as per Aristotle’s model of synoecism (Αίο 1950).

However, a concentration of activity slightly to the west of the old palace presented a good case for continuing, nucleated settlement (Hood and Smyth 1981), something strongly advocated by Coldstream (1984b; 2000), and, more recently, findings of the Knossos Urban Landscape Project suggest a PG settlement of up to 40ha (Kotsonas et al. 2011: 5-8). This estimate remains our best guess in the absence of substantial excavated deposits but, if it is accurate, then EIA Knossos was one of the largest sites of the contemporary Aegean.

## The Early Iron Age Cemeteries

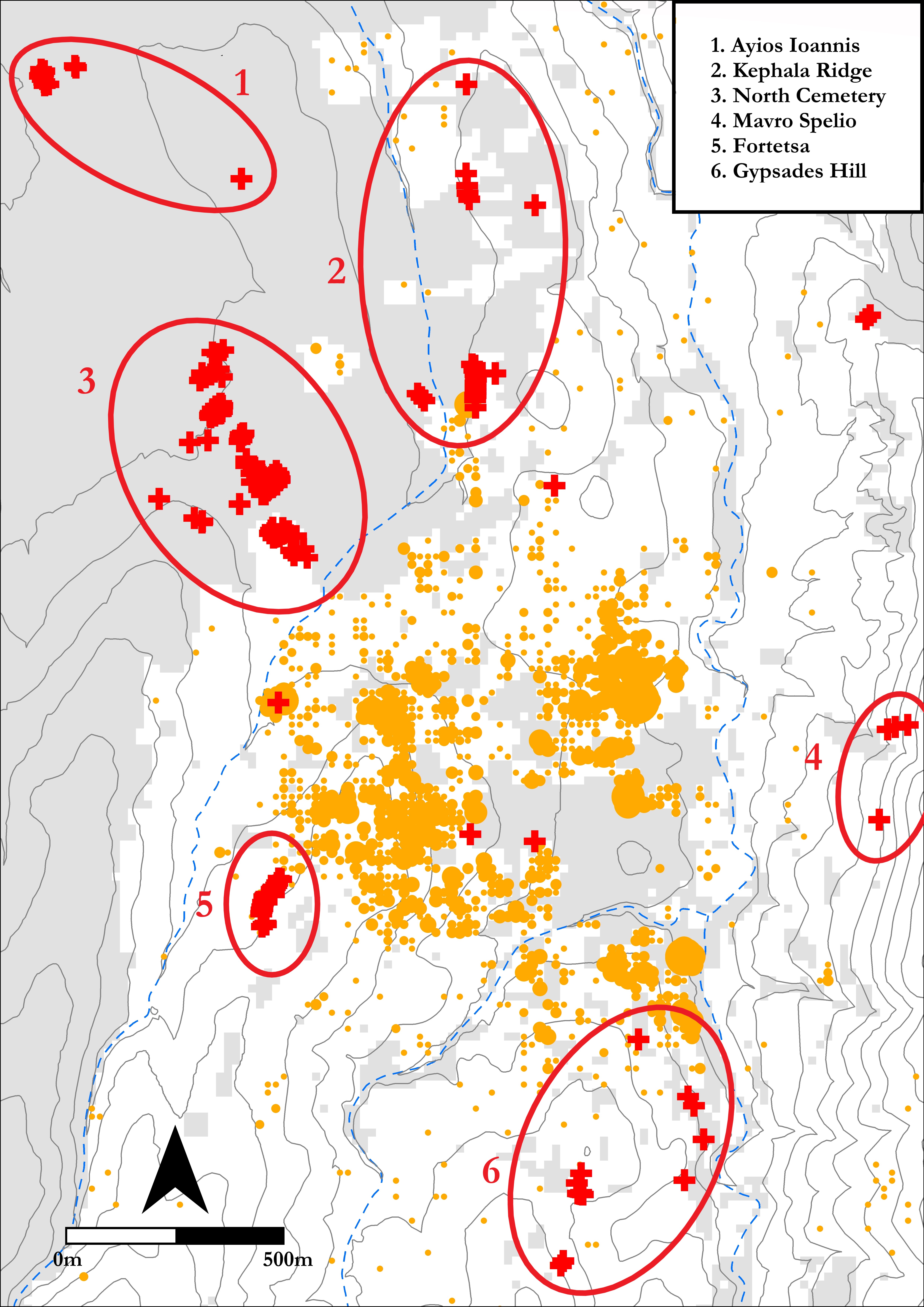


Figure 1 goes around here

Survey aside, our most abundant evidence for EIA Knossos comes from the mortuary record (see Figure 1. The transitional period between the Late Bronze Age (LBA) and EIA yields few if any securely datable interments, but later evidence is more plentiful, with multiple burials known from the Kephala ridge (Coldstream 1963: 38; Hogarth 1899: 82-5), the modern suburbs of Ayios Ioannis and Atsalenio (Boardman 1960; Davaras 1968: 133–46), the cave of Mavro Spelio (Antoniadis 2012: 58-9), and the Khaniale Teke site with its well-known tholos (Boardman 1967; Hutchinson and Boardman 1954; cf. Hoffman 1997 Kotsonas (2006)). Taken together, these scattered tombs point to a richly variegated set of funerary practices but, despite their reasonable number, are so dispersed and often isolated that they provide little scope for systematic quantitative analysis.

Fortunately, far larger burial accumulations are to be found in the Fortetsa and the Knossos North cemeteries, which together comprise some 134 tombs, ranging in date from the Subminoan (SM) to Late Orienatalising (LO) periods. Though many were robbed in antiquity, and others destroyed by the digging of later burials, building work, or just the ravages of time, they still represent the most abundant source of evidence for not just mortuary practices, but for social life of any kind at EIA Knossos.

## The Fortetsa and Knossos North Cemeteries

The cemetery on the slope facing the eponymous village of Fortetsa is composed of twelve tombs excavated in 1933, and another eight uncovered in 1935 (Brock 1957: xi). These cluster in three main groups. The largest of these, comprising nine tombs, is arranged on a north-south axis, with the *dromos* of each tomb extending downslope to the west. To the north lies a cluster of five tombs and, to the south, another of three. Finally, three tombs excavated in 1933 – L, TFT and Π – which lie close to the main road north of the Acropolis hill (Brock 1957: 1-2), are now considered to belong the Knossos North Cemetery (KNC).

To the northeast of the Fortetsa cemetery, a collection of ten badly damaged tombs known as the Fortetsa 1967 tombs were probably the southernmost burials of the KNC. Unfortunately, all had been looted at the time of excavation, and no *in situ* deposits were found. They are thus excluded from present analysis. Northwest of these, and just south of the Teke Tholos, the Teke tombs represent the northern reaches of the KNC. The central section of the KNC comprises the ‘Medical Faculty’ site, named for the extension of the University of Crete that prompted major rescue excavations here in 1978 (Coldstream and Catling 1996: 53-55).

The tombs themselves fall into three main types, the chamber tomb, shaft grave, and pit cave or tomb; the latter two are largely Subminoam phenomena, with the former by far the most abundant. It comprises a descending ramp or passage, the *dromos*, leading to the chamber itself, cut into the *kouskouras* bedrock. The *dromos* and chamber are separated by the *stomion*, an opening often set a step or two lower than the *dromos*, which is covered by a large stone slab, smaller stacked stones, or combination of both (Antoniadis 2012: 47-8). The majority of burials are cremations, a rite that appears at Knossos in the Subminoan period, in the Tomb 200+ complex in the KNC (Coldstream 1994: 109). Inhumation does not completely disappear in the EIA, but by the Orientalising period it appears restricted solely to child burials (Antoniadis 2012: 69).

## Chronological Developments in the Cemeteries

The initial foundation of the cemeteries has received much attention. It has been claimed that no tomb crosses the Late Minoan IIIC-SM divide (Coldstream 1998: 58; Coldstream 2006: 582), though there is a possibility that this is a classificatory artefact (Hallager 2010). Instances of BA tombs reused in the EIA are known (e.g. the Khaniale Teke tholos), and Cavanagh (1996), based on a cluster analysis of tomb dimensions, could not reject the possibility of some KNC tombs being of BA date, though other evidence would suggest this is unlikely (Whitelaw, pers. comm.).

During the use of the cemeteries, correspondences have been highlighted between changing pottery styles and episodes of tomb construction and abandonment. The Protogeometric B (PGB) style, first defined by Brock (1957: 143), who hailed it as “the most remarkable phase in Cretan vase-painting”, is apparently a Cretan anomaly, evincing a melding of Attic geometric motifs, patterns possibly deriving from Near Eastern metalwork, and iconography drawn from the Minoan repertoire (J.N. Coldstream 1984a: 93-94). Coldstream has argued that the concurrence of this style with a rash of newly founded tombs points to a reformulation of elite mortuary display, noting how, in this period also, redeposited Minoan larnakes began appearing in and around some tombs, in one case even inspiring the decoration of a PGB vessel (in T. 107; see J.N. Coldstream 1984a; 1994: 112–13). Whether simply nostalgia (Coldstream 1998: 60), or a more tactical strategy by newly emerging elite groups (Coldstream 1994: 114-15), it seems that the Bronze Age past possessed a significant and enduring cultural cachet.

The final mystery of the chronological sequence at the KNC and Fortetsa is the quite abrupt cessation of burials around 630 BC. There had been changes in tomb use in both cemeteries in the preceding century, with few new tombs built, though interments in old tombs continued (Brock 1957: 4; Cavanagh 1996: 651-3). The ensuing period, accompanied by equally scanty settlement evidence, has become known as the ‘Archaic Gap’. The causes of this lacuna, which persists until the recrudescence of archaeological evidence in the Late Archaic period, remain unknown. Although various explanations have been forwarded, (Coldstream et al. 1999: 301-2; Huxley 1994: 126; Kotsonas 2002: 41-4), there are now strong reasons to doubt the settlement was abandoned (Whitelaw, pers comm.).

## Heroes and Heirlooms: Object Biographies and Exceptional Burials

A popular approach to the study of Knossos’ EIA tombs has been the investigation of ‘object biography’, a term derived from Appadurai (1986) and Kopytoff (1986). Influenced by Mauss’ (1954) formulation of ‘the gift’, they stressed the mutuable nature of an object’s value, and its capacity for acquiring a ‘biography’ through the transformations of its social existence. These ideas, fertilised by the Homeric motif of gift-giving (Whitley 2002: 220-1), and the remarkable archaeological parallels for such items – such as the boar’s tusk helmet from Tomb 200+ and that given to Odysseus by Meriones (*Iliad* 10.260-271) - have been brought to bear on certain elaborate burials of the EIA.

Catling’s discussion of the Tomb 200+ complex is a notable example. Tomb 201 contained a bronze sword, spearhead, and arrowhead, an iron dirk or knife, fragments of an antique bronze stand, probably of Cypriot origin, and pieces of the aforementioned helmet (Catling 1995: 123). Catling identifies similarities between this tomb and burials at Tiryns, Kaloriziki, and the famous *hērōön* of Lefkandi; all contained imported items, were of ‘warrior grave’ type, and formed loci for later burials. Catling argues that individuals who dared to travel abroad in this time of more limited seafaring, accruing exotica and stories from distant lands, would have been accorded exceptional treatment in death (Catling 1995: 127–8).

Complementing the theme of heroes abroad has been a similar interest in foreigners at home. Two caches of gold jewellery, found in pits flanking the entrance to the Teke Tholos, were argued by Boardman (1967) to be foundation deposits – a Near Eastern custom – for the tomb of an immigrant Phoenician craftsman. Kotsonas has revisited this attribution, deeming the tholos more probably that of an elite individual or family with a monopoly over a metal workshop’s output (2006: 155–9). While certainty in such individual cases may be moot, it seems unlikely that foreign traders or craftsmen never visited or resided at Knossos during the EIA (Hoffman 1997: 176–85; Schreiber 2003: 293-306).

## Number Crunching: Quantitative Analyses of the Cemeteries

Generally speaking, the above analyses have tended to rely more on particular finds, tombs, or observable, but limited, patterns in the data; only a few authors have pursued more quantative approaches. Cluster analyses have been employed by both Cavanagh (1996: 653-7) and Antoniadis (2012: 193-7), the most sophisticated statistical techniques so far applied to the material. Antoniadis (2012: 172-6) also divided the EIA tombs of Knossos into three groups, those with fewer than 10 pots, fewer than 50, and more than 50, and found that, in each successive case, the proportions of tombs containing ‘oriental’ imports and imitations increased, suggesting unequal access to such prestigious goods. Yet even here the available data could be further interrogated (with, for instance, the number of imported items *per burial*). The present paper thus seeks to extend and nuance a number of observations that have been made in previous studies, as well as revealing patterns thus far unacknowledged, through use of a more systematic approach to quantitative analysis.

# Methods

## Databases

The cornerstone of the present study is a database (or, rather, three linked databases) based on the excavation reports for the Fortetsa and Knossos North cemeteries (Brock 1957; Coldstream and Catling 1996). The first includes an entry for each individual ceramic vessel. Variables includes the tomb, the vessel shape, its surviving dimensions, its ceramic period and corresponding absolute dating measures. In addition, all imports, ‘oriental’ imitations, and antique (that is, Bronze Age) artefacts were categorised, using the studies of Antoniadis (2012), Jones (2000), and Crowe (2016). In total, this database comprises just over 4540 individual artefacts.

The second database is similar, but with each entry corresponding to a find other than a ceramic vessel. A ‘material’ variable was added, as of course these finds were not all made of the same substance. This database included some 1620 individual artefacts.

The final database concerns the tombs themselves. Each tomb was accorded its own entry, with variables including dating (both in relative and absolute terms), surviving dimensions, and the known and estimated number of interments, as well as a tally of the objects recorded in the other two databases. Finally, the total number of imports, imitations and antiques in each tomb was calculated.

Taken together, these databases offer the opportunity for carrying out a diverse range of quantitative analyses. It must be conceded that, with many of the tombs evidently looted or damaged over the centuries, this cannot be a complete picture of the tombs’ original contents. If we assume, though, that natural or accidental destruction was relatively indiscriminate, and that, even in cases of looting, certain object classes (particularly cinerary urns) were seldom robbed, then the data are by no means rendered useless. As Snodgrass (1996) notes, the situation means we should be extremely cautious about making negative arguments – that is, conclusions drawn about the lack of features in certain tombs – but may be somewhat more hopeful in the forming of positive ones.

## Reproducibility and Data-sharing

Evermore archaeologists have begun to advocate the utility, indeed the necessity, of making available not just the data, but the full methodologies underpinning our academic output. It is felt that, with the opportunities afforded by current technologies (digital databases, statistical software packages, online repositories etc.), there remain ever fewer obstacles to the full and free sharing of both data and workflows (see Marwick and E. Pilaar Birch 2018). In Marwick’s words (**???** 445), “[t]he technical problems are largely solved; the challenge now is to change the norms of the discipline to make high reproducibility a canonical attribute of high-quality scholarly work”.

This article is, among other things, an attempt to bring these principles of maximal reproducibility to the archaeology of EIA Crete. Within this field, catalogues and excavation reports abound and, though many of these may be forgiven based on their dates of publication, the lack of readily utilisable digital data from a number of recent articles and monographs, indeed, the failure to even present data such that they could be manually digitsed, is less pardonable.

There are, of course, complications to the sharing of data and methods. There are valid reservations around issues of copyright, the protection of sites from looting, the possibility of being scooped with one’s own data, or simply the significant time investment of preparing open-access research. But I would argue that the potential gains outweigh these concerns, and that research on the EIA would benefit greatly from the greater accessability of datasets and workflows.

In this vein, the present article has been composed making use of Ben Marwick’s ‘rrtools’ (see Marwick 2017b; Marwick 2017a), an open-source package for the statistical software R Studio, which provides the author with the tools to create a self-contained ‘compendium’, which can be freely downloaded, and from which anyone can reproduce the entire workflow of the present analysis. Though not visible in the present paper, every chart and table herein was produced directly, through written code, from the raw data using R. This code, as well as the raw and derived datasets, complete bibliography (in BibTex format, for export to any major reference manager), figures, and article as originally written are included in the compendium. It can be downloaded as a repository from GitHub, at the following address: <https://github.com/DCPollard94/knossoscemeteries>, and the raw datasets have been stored with the online repository Figshare, here: (**NB a URL will be included pending acceptance of the article**). The data are made available through an MIT license, which permits unlimited use, ammendation, and dissemination thereof, yet frees the present author from any responsibilty for that use, or perceived errors or inaccuracies in the data. It is sincerely hoped that others may further explore and expand upon the research presented here by downloading this compendium.

## Estimating Interments

A first important step in preparing the data for analysis was the estimation of the number of individuals buried in each tomb. The method chosen broadly follows that of Cavanagh (1996: 659-660), who took the number of pithoi (the most common urn) and the number of pithoi, amphorae and kraters (which were sometimes used as such) as middle and upper estimates of the number of interments, with all securely identified interments being the lower limit (Figure 2). In the present study, the mean of these three estimates was taken, to provide a single aggregate measure for the purposes of analysis.

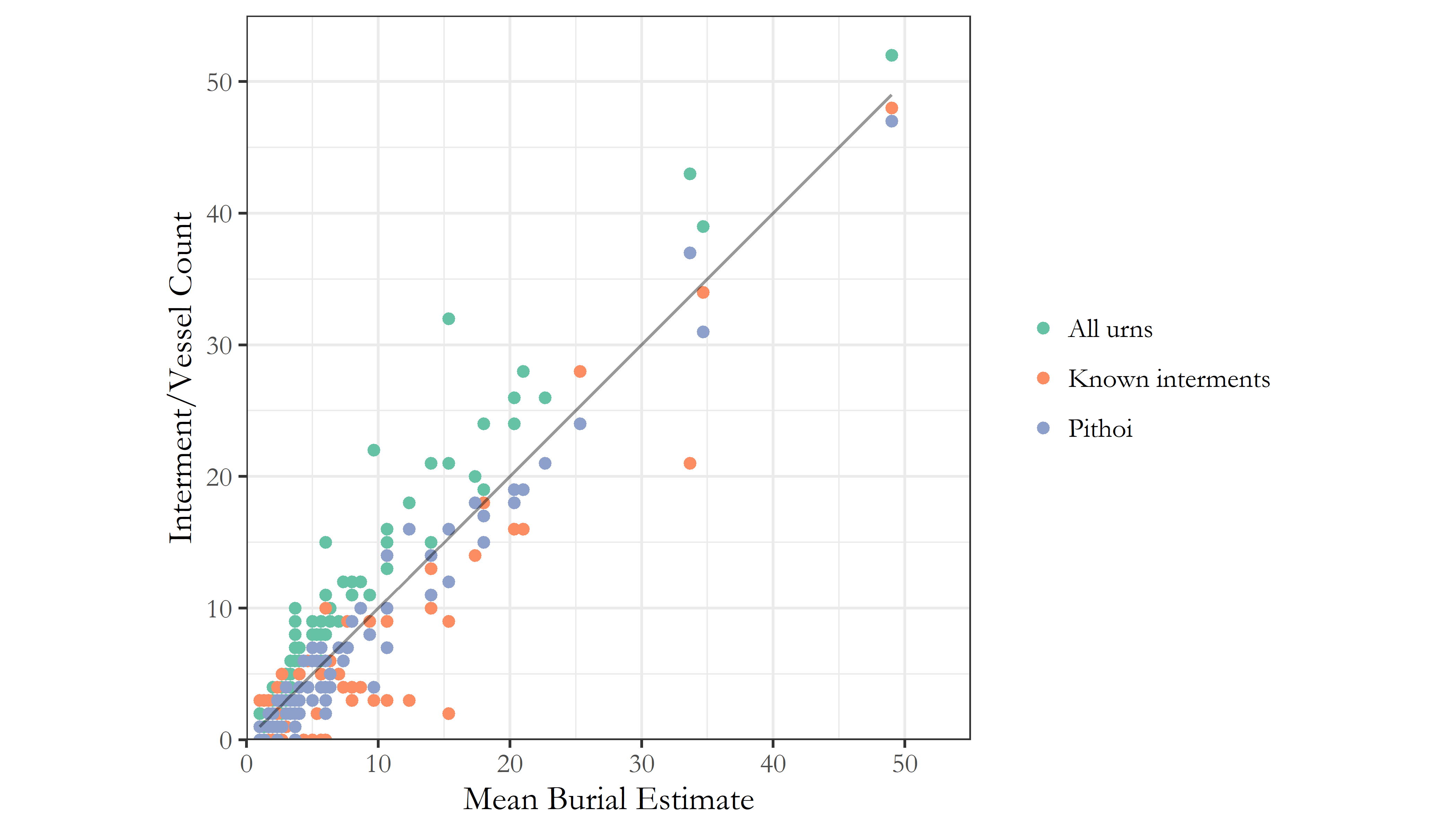


Figure 2 goes around here

For most diachronic analyses, however, pithoi alone were taken as the best proxy for burial numbers. In most cases, any tombs lacking identified remains or a single vessel suitable for use as an urn were not considered, thus excluding what are presumably among the most heavily damaged and looted tombs.

## Aoristic Approaches to Dating

Another major concern was the temporal uncertainty implicit in the assigning of individual vessels to stylistically-defined periods. A vessel attributed to the PGB period could, on our best estimates, date anywhere between 840 and 810 BC. This situation results in major challenges to the visualisation and analysis of such data. A simple, if coarse, solution is to use the midpoint of the range assigned to each vessel (i.e. 825 for our PGB example). This is used in a couple of instances in the present paper when the division of vessels into centuries renders the inaccuracies of such a method less significant.

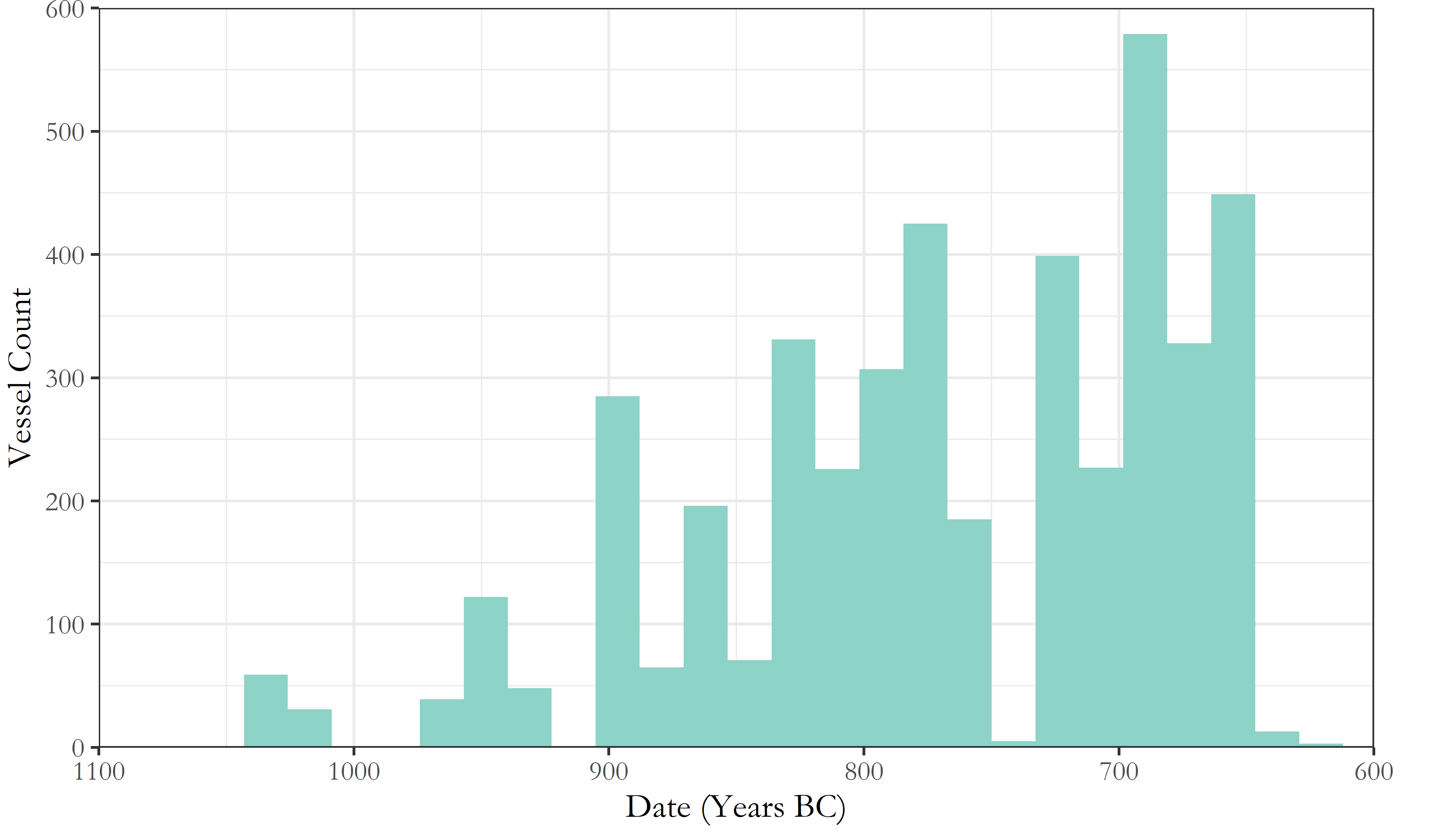


Figure 3 goes around here

But the artificial clustering this technique engenders around select absolute dates can prove misleading, as in Figure 3; the apparent cessation of depositions for 30 years in the 8th century is simply a fiction generated by the processing of the data.

A alternative way of dealing with temporal uncertainty, and the method employed extensively in this paper, is the use of so-called ‘aoristic analysis’ (for original use in criminology, see Ratcliffe 2000; for archaeological applications, see Crema et al. 2010; Crema 2012; Johnson 2004). Here, rather than give a pot a single date, the entire time span under investigation is divided into equal chunks (in this case, decades), and probability values summing to 1 are then assigned for each vessel, per chunk of time, based on its accordant date range. So, our PGB vessel, datable between 840 and 810 BC, would register a value of 0.33 for each of those three decades. These values for individual vessels can then simply be summed to produce tomb- or cemetery-level signatures. A particular attraction of this method is that it incorporates temporal uncertainty into the size of the resulting values, that is, “events with tight temporal definition contribute more to the total probability over their range than do loosely defined events” (Johnson 2004:450).

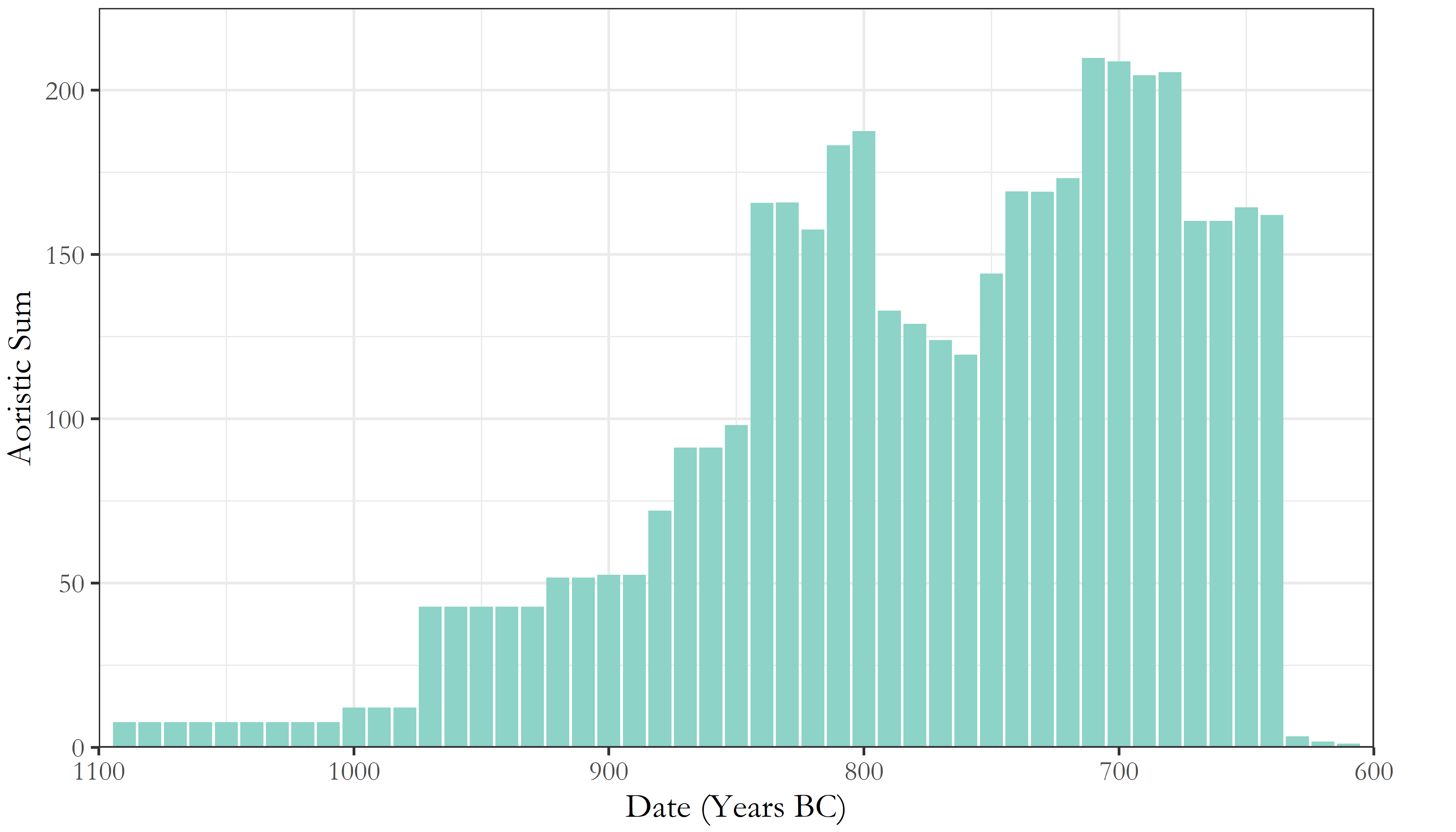


Figure 4 goes around here

As seen in Figure 4, the artificial peaks and troughs of the simple averaging method are avoided, and different patterns become visible. Though these methods present their own limitations (see Crema et al. (2010), 1123-1124), they are considered a more robust and productive approach to the temporal uncertainty of ceramic dating and, as such, are used for much of the present analysis.

# Analysis

## Introduction

The great advantage of the large, quantitative dataset employed here is that it permits investigation of several nested levels of potentially significant patterning. From individual burials, to collective tombs, to whole cemeteries, we have the opportunity to study and compare both the synchronic and diachronic variation across these various levels. In so doing, I first investigate the broad temporal trends in tomb construction, burial, and pottery deposition across both cemeteries, isolating a notable trend among a select group of tombs. I then examine these more closely, in an attempt to understand what sets them apart from the rest. Tomb dimensions, rates of burial, and changes in the composition of assemblages through time are all considered, to produce an account which speaks to the changing social landscape of EIA Knossos, drawing together issues of group identity, external relations, and the communication of wealth and status through funerary practice.

## Temporal Developments in the Knossian Cemeteries

An obvious place to begin is with the chronology of the burials themselves. The rate and number of interments being made through time provides the background against which to consider all other developments.

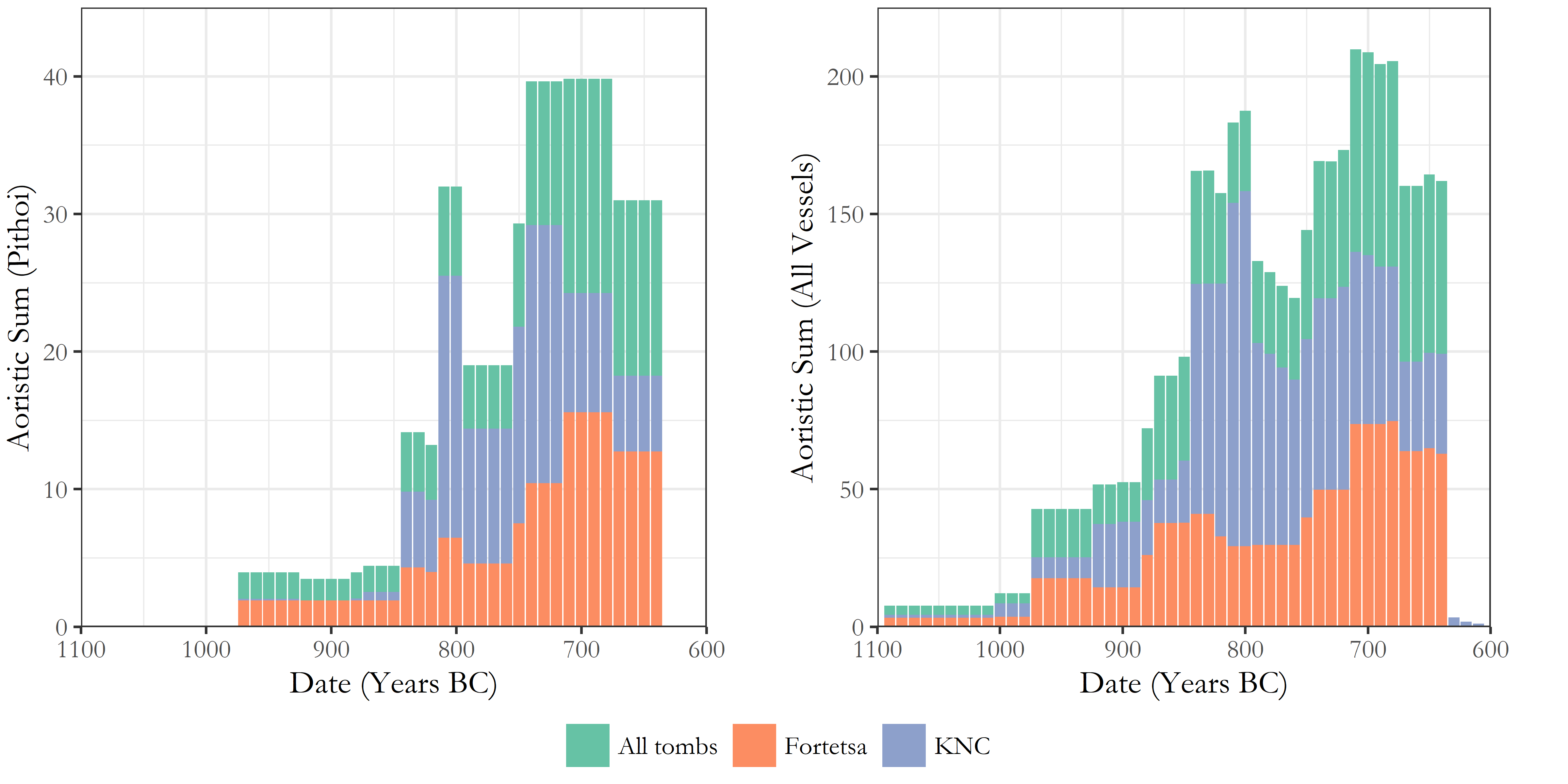


Figure 5 goesaround here.

Figure 5 presents the aoristic sums of pithoi (as a proxy for burials) and of all vessels, respectively. Despite differences in scale and timing, it is immediately apparent that Fortetsa and the KNC experieced similar chronological developments in burials and, to a slightly lesser degree, grave goods. In both cemeteries, the rate of cremation burial began rising around the end of the 9th century, plateaued slightly in the early 8th, and then rose again to a peak in the late 8th and early 7th. Across all vessels, the developments are more volatile, but largely similar, especially regarding the late spike in burial activity. We might assume that these developments would be mirrored in the construction of new tombs, but this proves not to be the case.

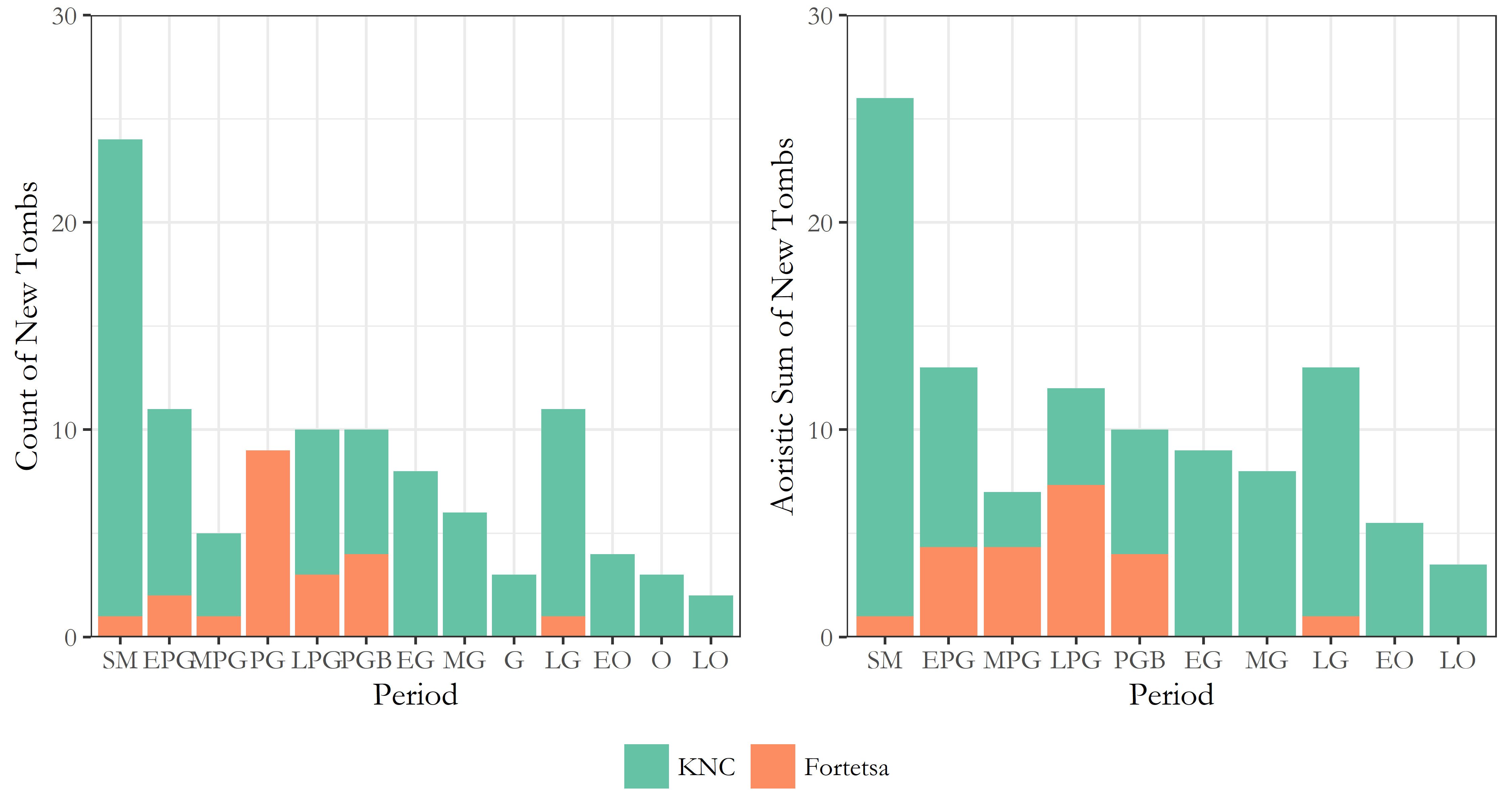


Figure 6 goes around here

Figure 6 presents two ways of dating the construction of the tombs. On the left, counts are based on the ceramic phase considered most likely to correspond to the tomb’s first use, including ‘PG’, ‘G’ and ‘O’ where no greater specificity was possible. On the right, aoristic sums are presented, spreading the uncertainty associated with those general assignations. In both cases, the trend appears clear. The KNC began with a large number of new tombs built during the, admittedly prolongued, SM period, followed by a protracted decline in rates of consruction, offset by small resurgences in the late 9th and 8th centuries. It should be noted, too, that many of the later “tombs” are not chamber tombs, but a mix of pit, larnax, and pithos burials. The Fortetsa, meanwhile, saw next to no new chamber tomb construction from the 8th century onwards. The abatement of chamber tomb construction has been noted before (Brock 1957: 4; Cavanagh 1996: 652–3) and somewhat implicitly read as evidence of restructuring of the funerary rite, if not a decline in the fortunes of the wider community. But this image of a waigning investment in chamber tombs sits uneasily with the observable growth in mortuary activity.

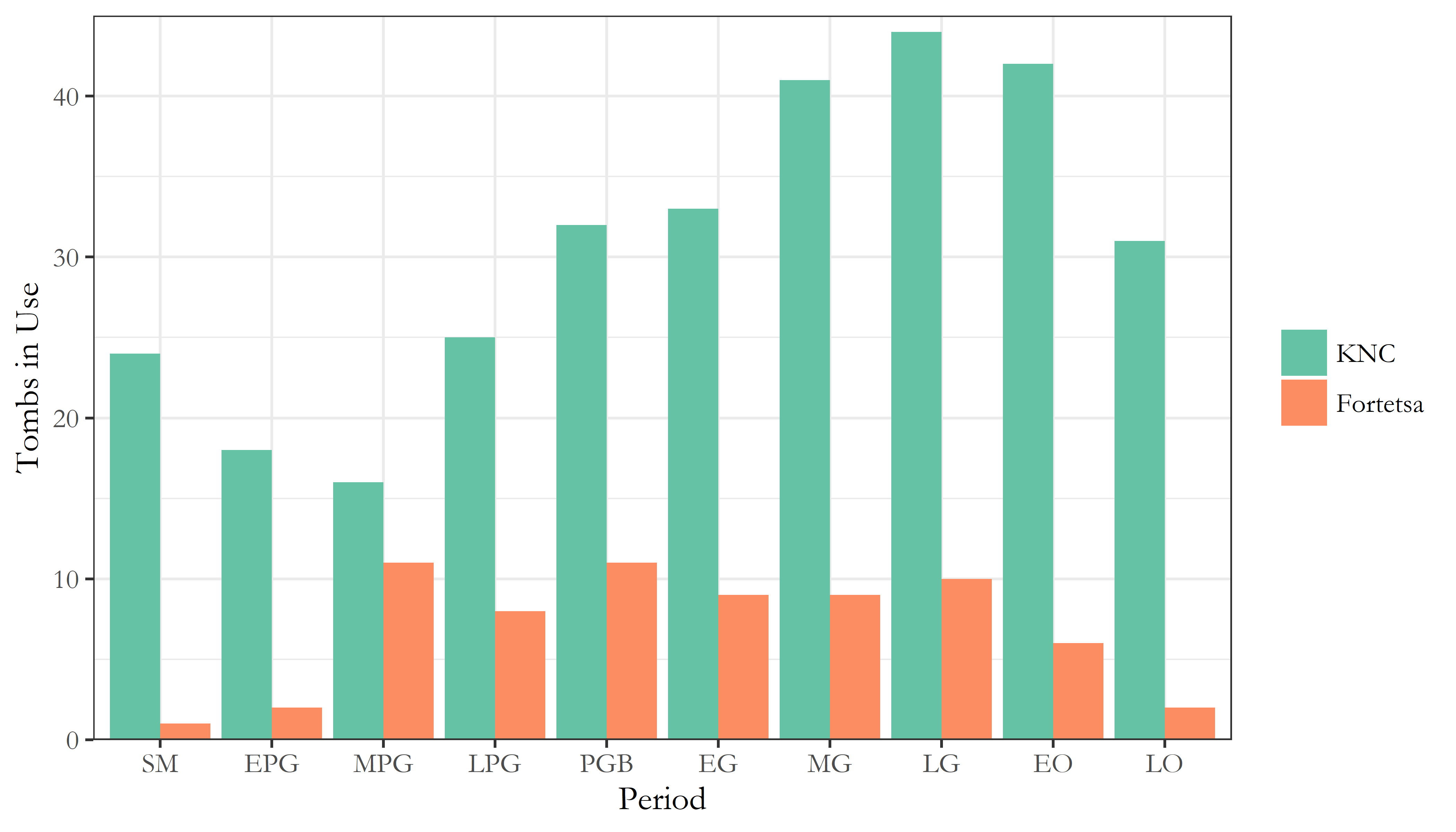


Figure 7 goes around here

These countervalent trends are observable too in the number of tombs receiving depositions in each period (Figure 7). At Forteta, this number remained relatively stable from the MPG to LG periods before declining (and bear in mind, there were only around 20 tombs belonging to this cemetery throughout the period), while at the KNC, the number of tombs in use rose to a preak in the late 8th century before declining. But this is not the whole story.

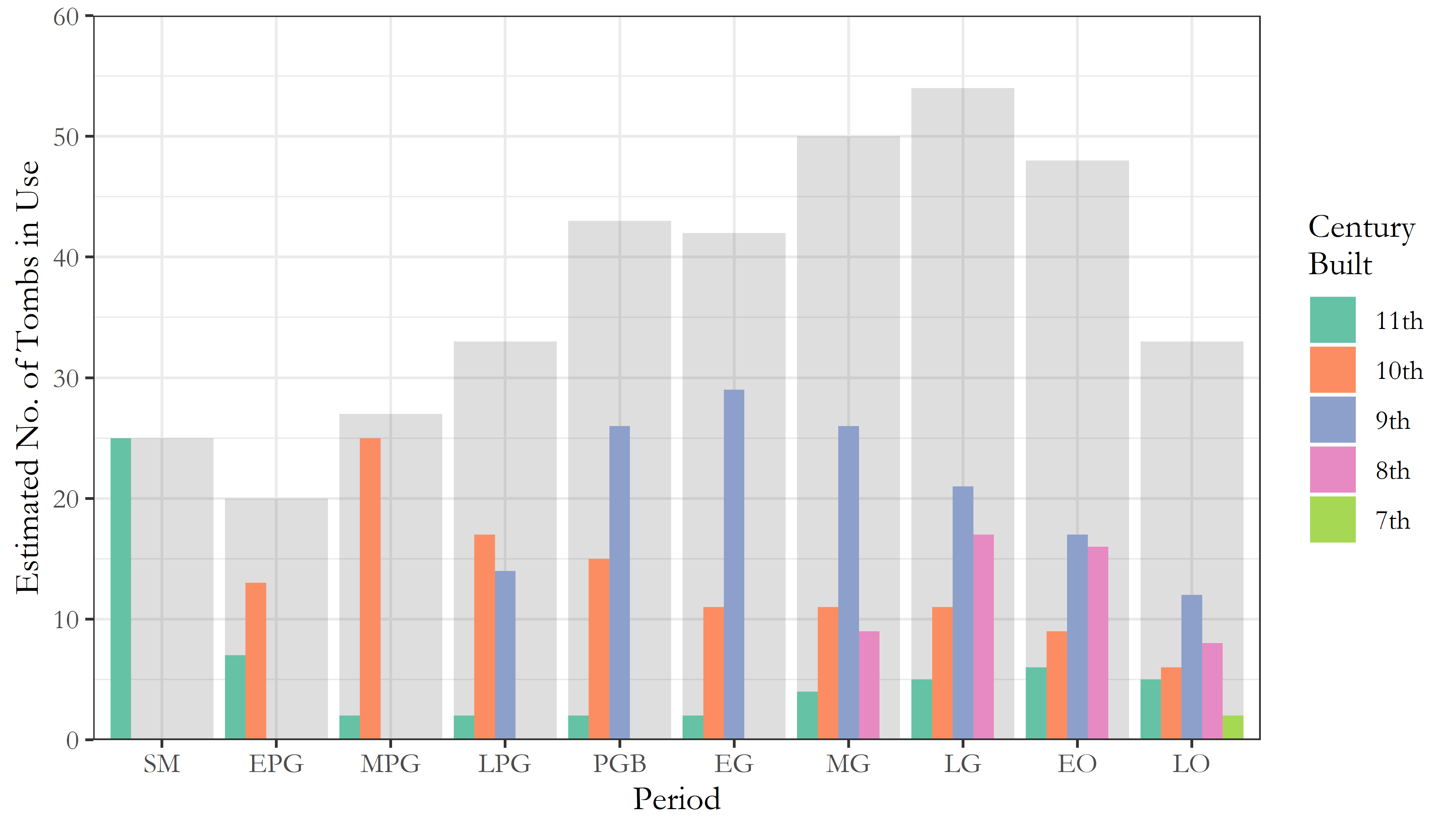


Figure 8 goes around here

By dividing the tombs in use into the centuries during which they were built (Figure 8), we see a wave-like pattern with each cohort steadily going out of use as new ones were constructed. This would seem to accord with Cavanagh’s (1996) suggestion that “[t]he length of time the tombs last seems […] to reflect the duration of the social group which had access to the sepulchre”, and that, if such access was lineally inehrited, frequent fission would result in limited trans-generational use. We might expect, then, that it was the 8th century tombs coming into use that spurred the dramatic rise in burial rates previoulsy noted. But this is not the case.

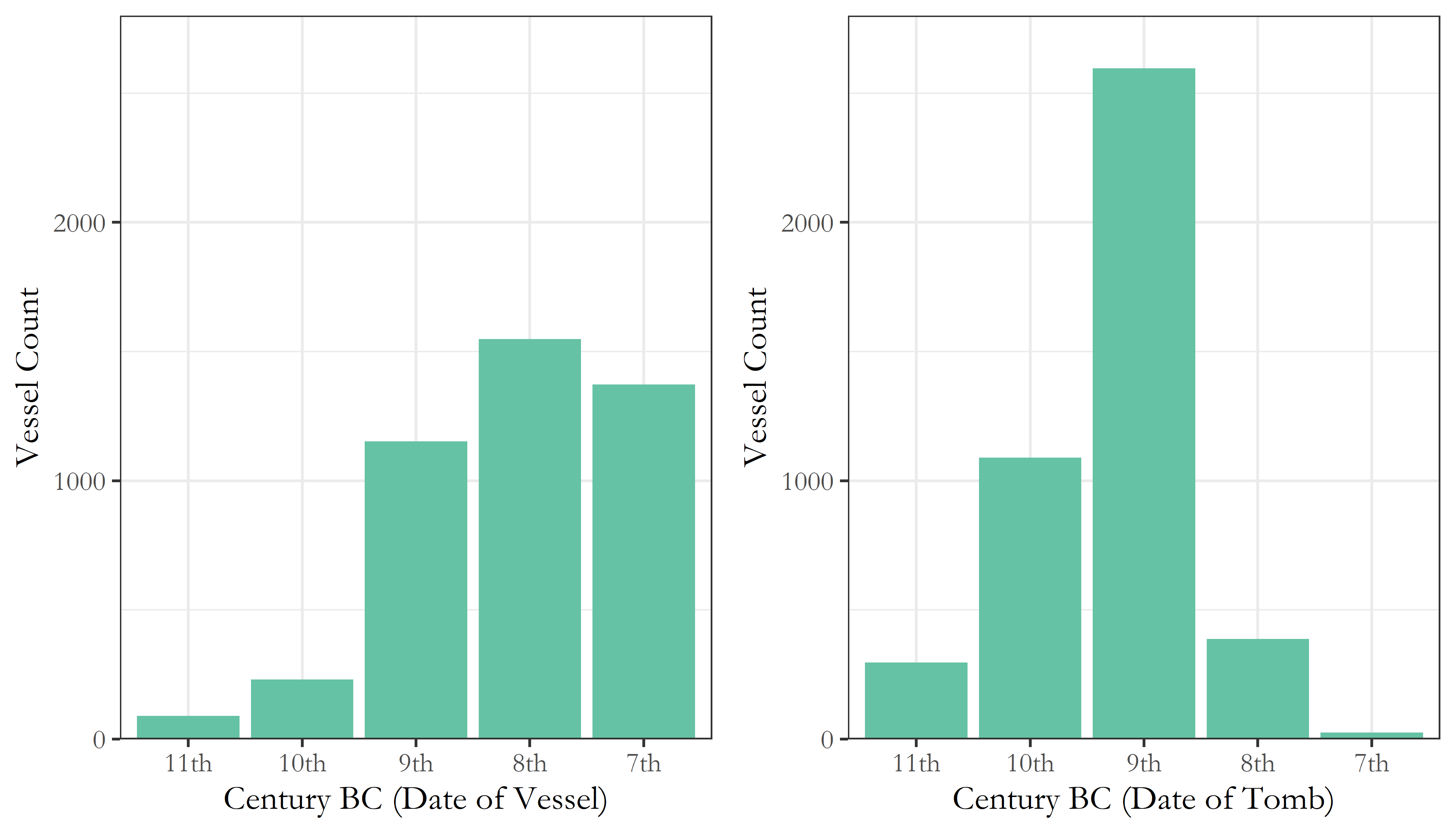


Figure 9 goes around here

In Figure 9, all vessels are assigned, firstly, to the century in which they were produced and, secondly, to the century in which the tomb they were found in was built. So, though the late 8th and early 7th centuries represented the apex of burial activity across both cemeteries, it was not the tombs built in those centuries which received the lion’s share of the burials and associated ceramics. This is all the more notable when, returning to Figure 8, we see that the number of 9th and 10th century tombs in use by this time was declining.

*Table 1 goes around here*

The significance of these findings can be seen in Table 1. Using pithoi as a proxy for burials, we can estimate the changing rates of burial through time. And while for the most these remained around three per tomb per century, in the 8th and 7th centuries, tombs founded in the 9th century saw a rapid rise in the rate of burial, peaking at over 11 per tomb per century. Though these estimates are no doubt very rough, the marked nature of this divergence suggests it is not simply an artefact of imperfect data.

But Table 1 also demonstrates the markedly low rates of burial which predominated at both cemeteries; two to four burials per tomb per century amounts to a very selective burial rite. It seems unlikely, then, that the rising rates of burial noted above are, for instance, the direct result of population growth; the increase is too rapid, and appears concentrated only in certain (older) tombs, not to mention that, based on KULP’s survey data, the major population increase at EIA Knossos probably occurred back in the Protogeometric period (Whitelaw, per comm.).

## Isolating the Phenomenon

We are yet to draw out which older tombs precisely are responsible for the observible patterning so far discussed. We might assume the tombs which became the focus of intense later burial activity would be those which yielded the most burials and grave goods when excavated and, happily, this supposition proves true.

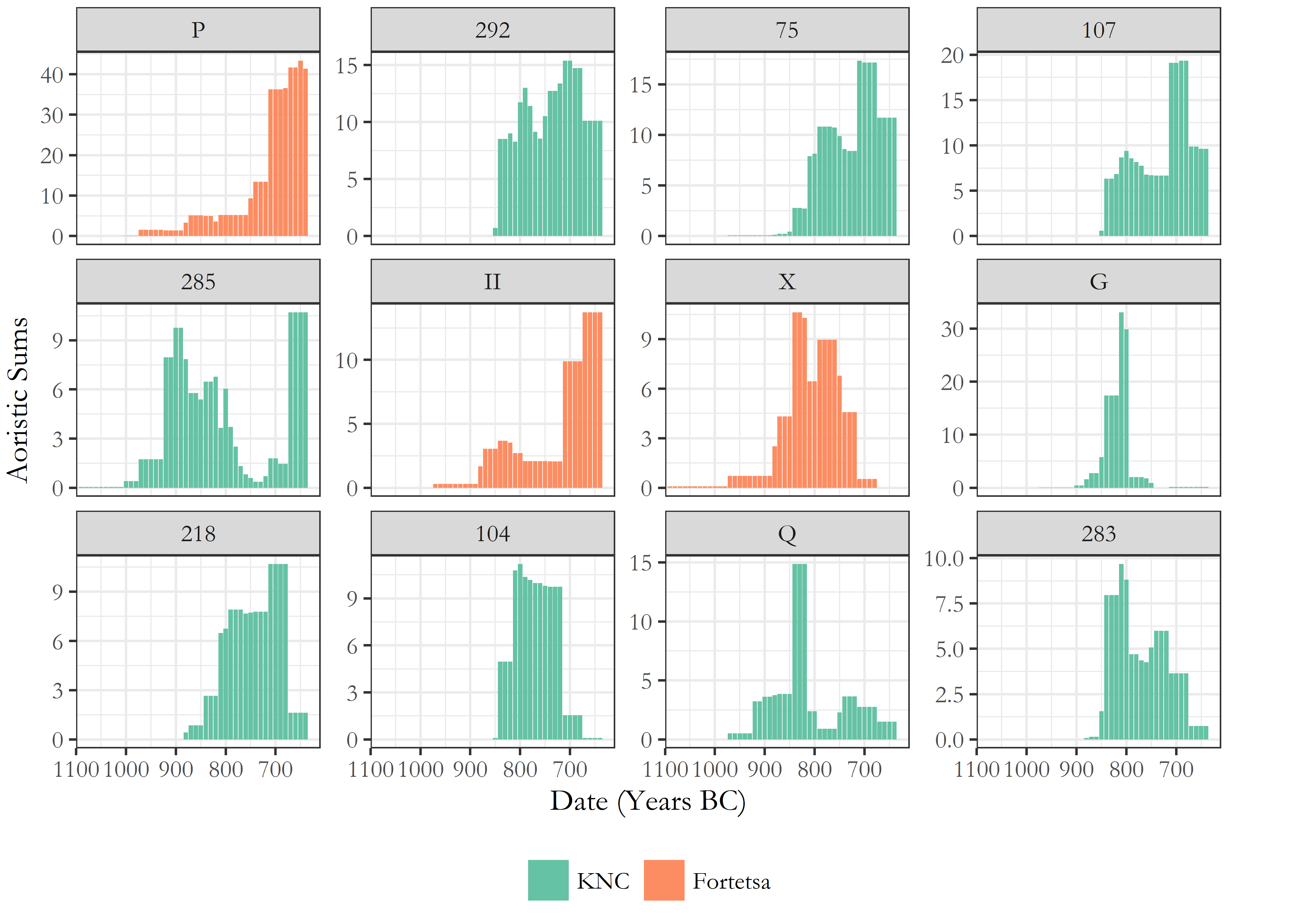


Figure 10 goes around here

The 12 tombs with the most associated vessels are all chamber tombs, 10 dating to the 9th century and two to the 10th, and seven of which did exhibit late, intense episodes of deposition (Figure 10). In fact, Tombs P, 292, 75, 107, 285, II and 218 (henceforth ‘Group A’) between them account for 35.11% of the entire ceramic assemblage from both cemeteries. All but Tomb 285 date to the 9th century, and together they underpinned the discussed late spate of burials. Interestingly, Tombs X, G, Q, 104 and 283 (‘Group B’), however, evince a different pattern, with their respective peaks coming around a century earlier, which, as seen in Figure 5 was another period of increased burial activity. So despite receiving the greatest quantities of burials and grave goods, these tombs nonetheless seem to have achieved that distinction via different routes. And, indeed, the differences between them may shed much light on the late surge in burial activity here discussed.

## Not All Tombs are Created Equal

The indices employed so far – the distribution of artefacts between tombs, and the construction and use of the tombs through time – inform us of the temporal or aggregate features of the cemeteries, but they tell us little of the tombs as they were built or first used. In attempting more synchronic comparisons, we shall first consider the physical dimensions of the tombs as built - a potentially rich context for the negotiation of social power, status and group membership.

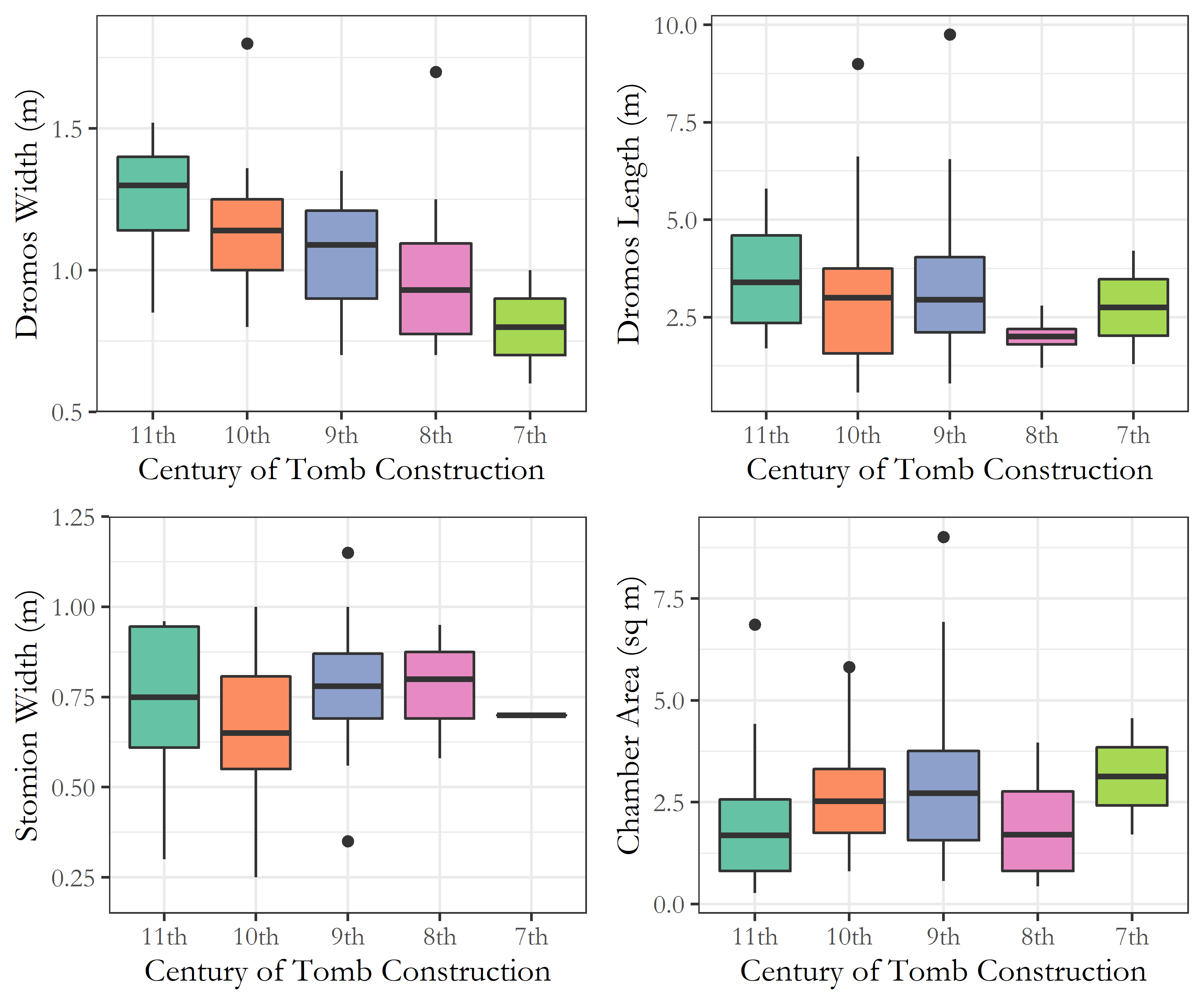


Figure 11 goes around here

In Figure 11, we see that, through the centuries, tomb dimensions did vary, and sometimes consistently, as with the trend toward narrower *dromoi*. The 9th-century tombs, though, which include all but two of the 12 discussed above, do not particularly stand out. It does seem that chambers were, on average, larger in this period as well as exhibiting greater variety than at any other time. Then again, even the largest chambers are not exactly cavernous, and the extra labour expended on construction would have been limited. The *dromos* is a plausible area for conspicuous demonstrations of scale but, with their frequently poor preservation, we cannot be confident in assessing this. It appears at any rate that they were gradually declining in size, albeit with some notable outliers.

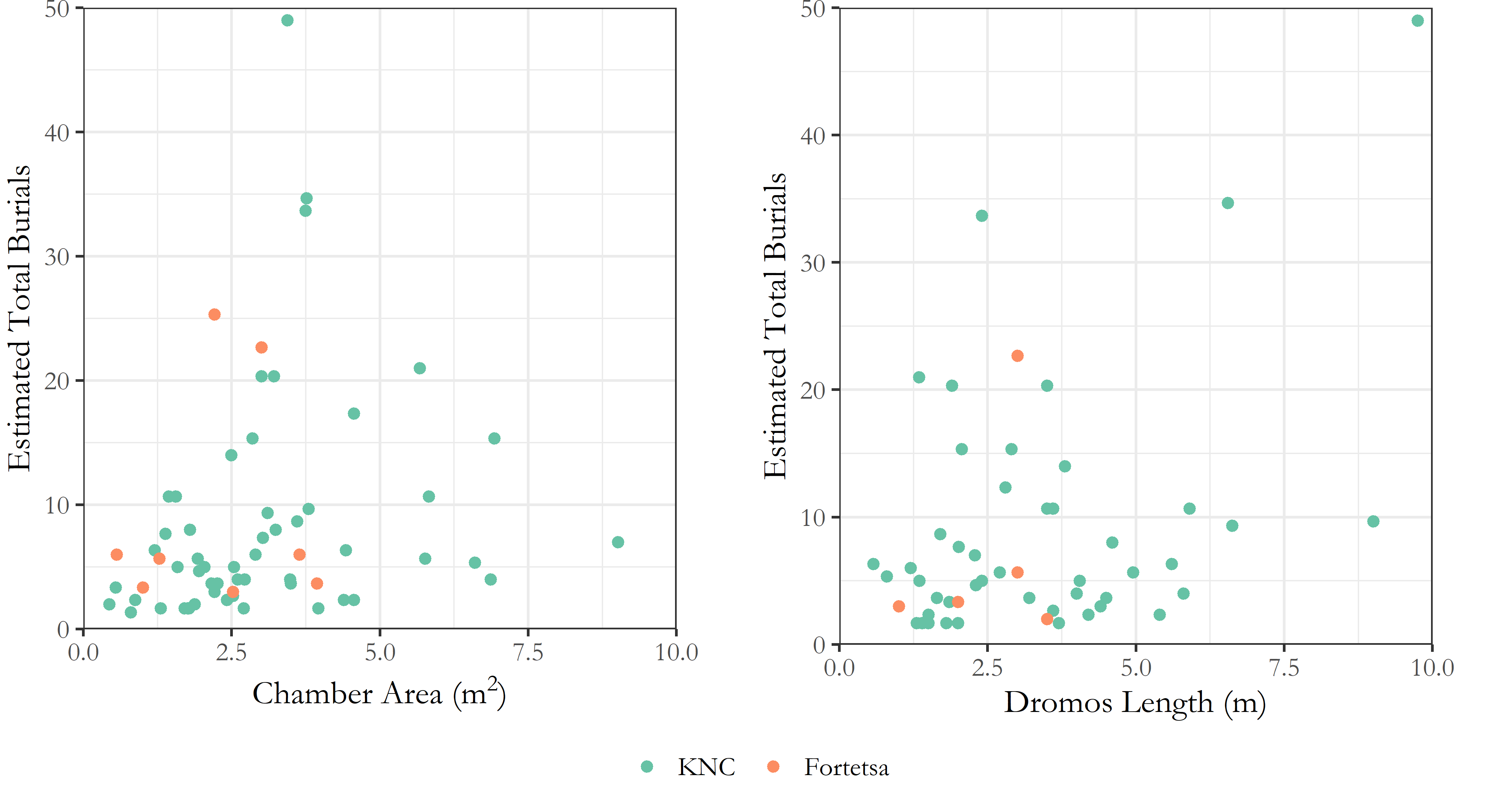


Figure 12 goes around here

Furthermore, it seems that no clear relationship existed between the physical size of a tomb and its eventual buried population (see Figure 12). True, over half of all tombs do not exceed 2.6 sq m in area, while nine of the ten tombs with the most burials do. But many of the very largest tombs are decidedly middling when it comes to burial numbers. Things are even less clear for the *dromos*; the largest two tombs by burial numbers also had exceptionally long *dromoi*, but the next eight tombs with the longest *dromoi* do not rank highly on interments.

It seems dubious, then, whether the scale of the tombs when built carried overt social meanings but, even if it did, this didn’t proved irrelevant to their later reuse. Several tombs had niches cut into their *dromoi*, or the *stomion* extended, to fit in later burial urns. Sometimes, urns from within the chamber were relocated to such niches to make space for new interments (e.g. T. TFT; Brock 1957: 3–4). The impression is of competition for inclusion into the sepulchral group, further implying the tombs’ original builders little anticipated their eventual popularity.

## Imports, Interments, and Indices of Wealth

Dimensions aside, we can still consider the early use of these tombs through comparisons between the scale and composition of their respective assemblages through time.

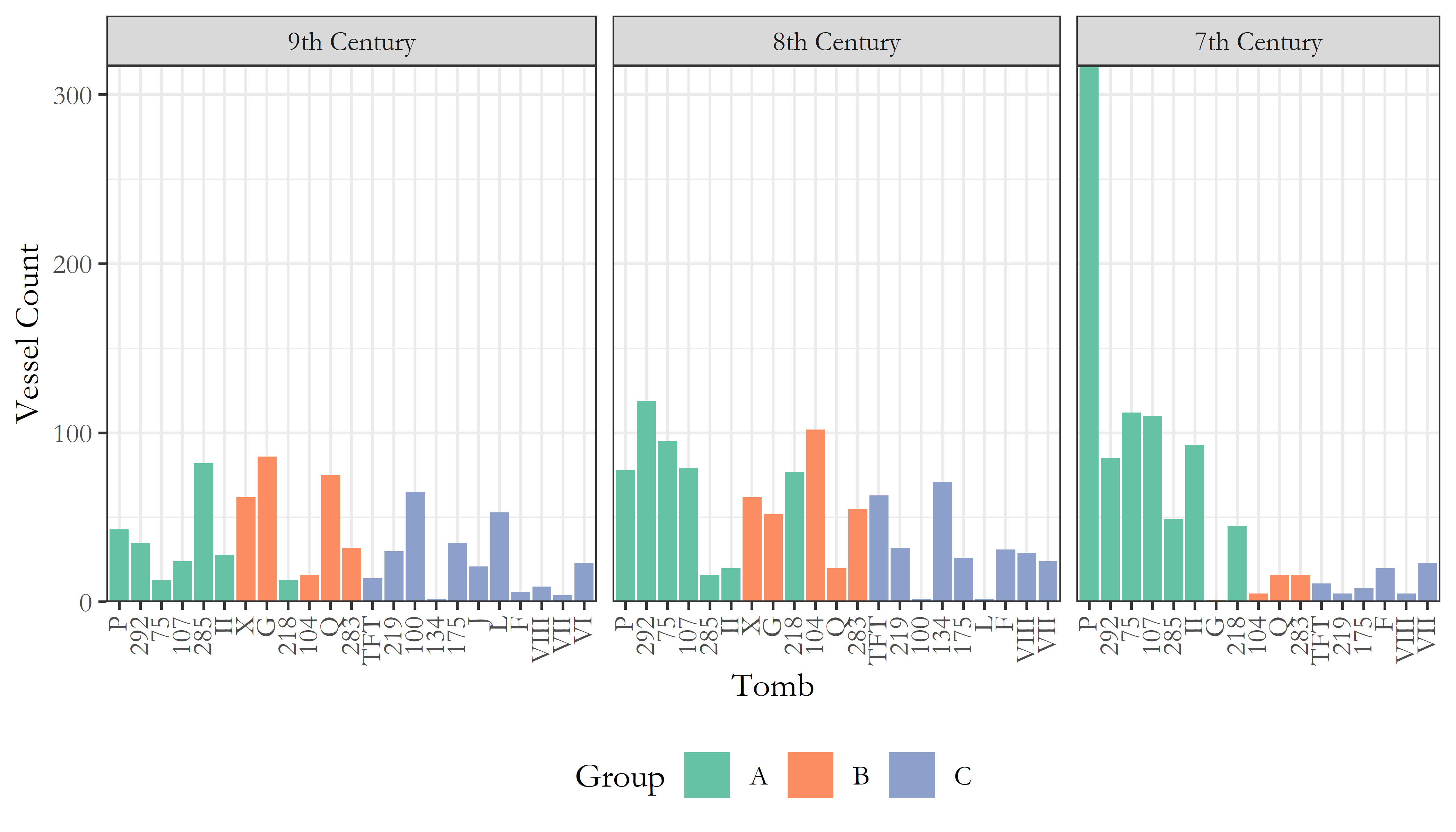


Figure 13 goes around here

And in Figure 13 we see that the tombs of Group A were relatively unremarkable in the scale of their depositions during the 9th century, only diverging significantly from the rest in the subsequent two hundred years. Group B, meanwhile, had their respective peaks in the 9th or 8th centuries, with a near total decline afterwards. In short, they seem to have followed a more conventional trajectory, going out of use as new tombs were built. As a working hypothesis, let us suppose that these two distinct patterns of use correspond to behaviours born of differing socio-politcal and economic contexts. How far might this hypothesis take us in explicating these patterns, and how visible might it be?

The late 9th and early 8th centuries are consistently interpreted as periods of artistic development, increased overseas trade, and renewed vigour in the construction of tombs and the visibility of the burial rite. The PGB style reflects a uniquely Cretan blend of Attic and Near Eastern forms, while the appearance of BA ‘antiques’ in the tombs from this period onwards is felt to reflect rejuvinated, even competitive interest in the Minoan past.

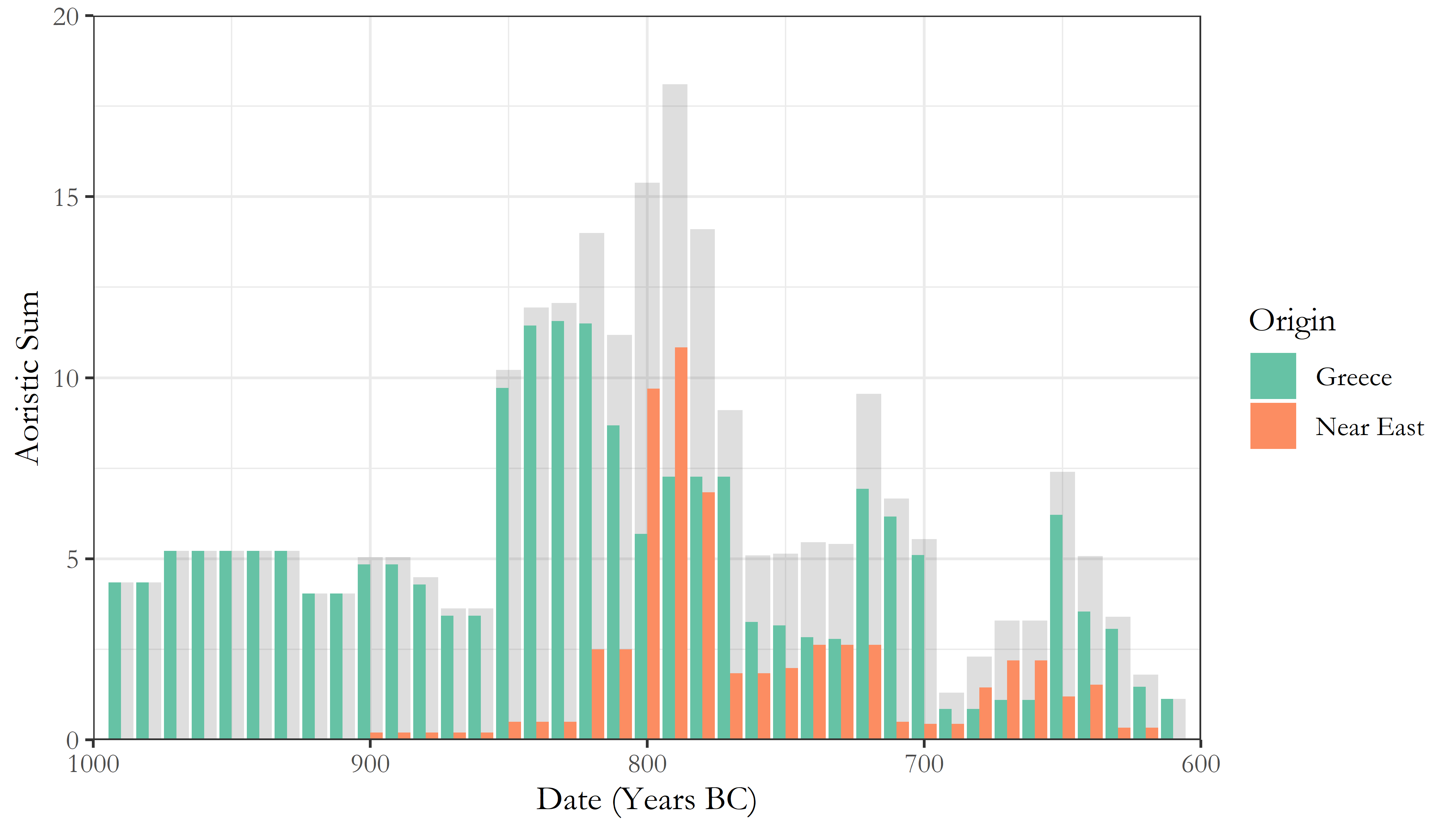


Figure 14 goes around here

The rise in imported items is clearly seen in the tomb assemblages, with a succession of increased Greek and Near Eastern imports respectively in the late 9th and early 8th centuries (Figure 14). Taken as a very coarse proxy for its engagement with the wider Mediterranean, the late 9th and early 8th centuries would seem to encompass the most outward-looking phase of the EIA Knossian community. This much has been relatively well understood for some time, at least at the KNC, but we can further examine how these imports were distributed among the various groups of tombs.

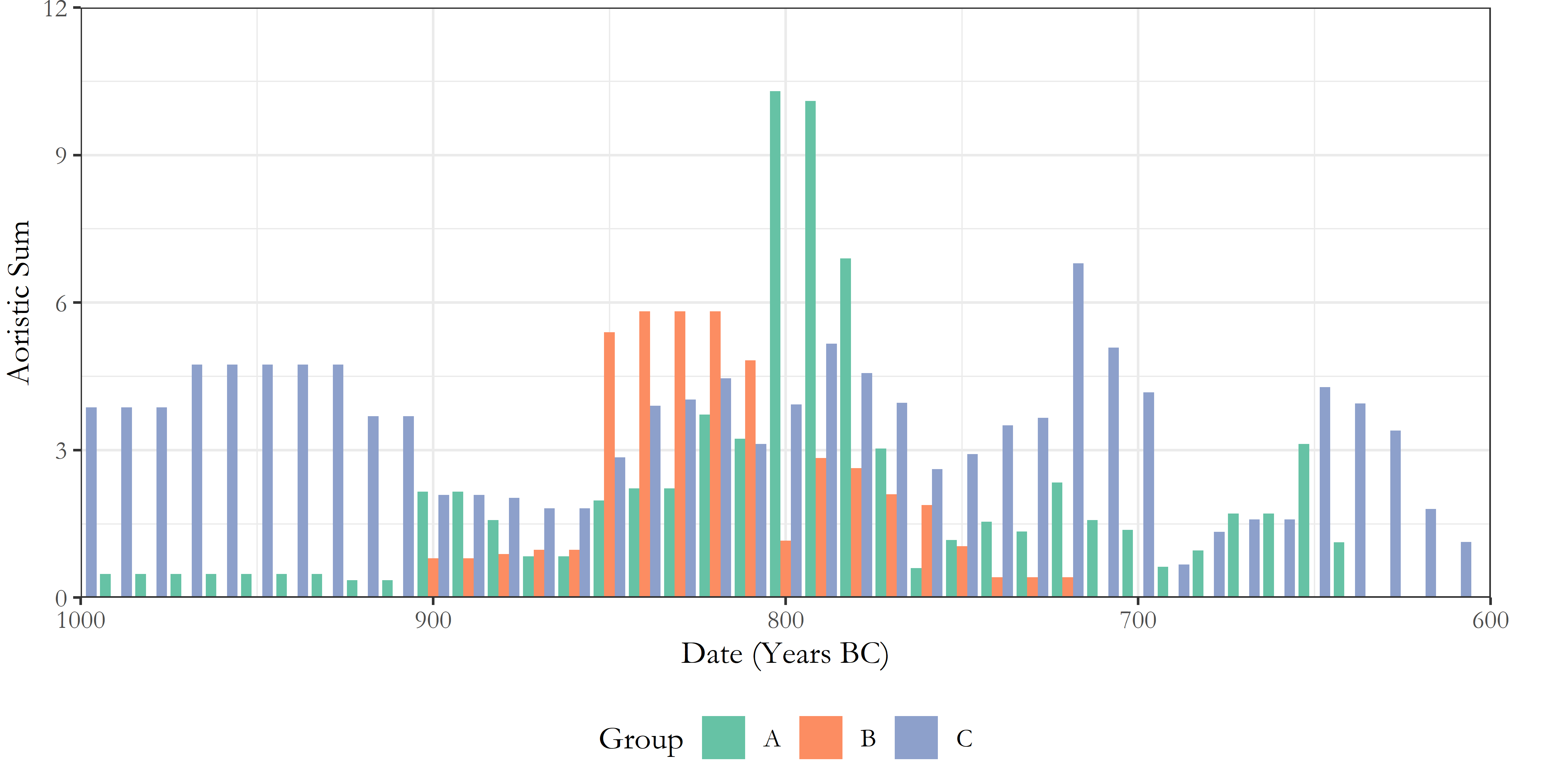


Figure 15 Insert Figure 15 here

In Figure 15, it is apparent not only that a range of tombs benefitted from the increase in imports in the LPG-EG periods, but that there was also potentially significant patterning in where those artefacts ended up. The Group A and B tombs trace quite different paths, even echoing those of Greek and Near Eastern imports more generally - indeed, tombs Q and G contained only Greek imports - while across all other tombs (‘Group C’), there was no doubt variegation not observable here. This period is often charactersied as one of ‘strategies’ of mortuary display employed by a variety of elite groups, and this certainly accords with these observed trends; certain artefact types cluster in particular tombs, but with many engaging in some form with the deposition of, presumably valuable, from overseas.

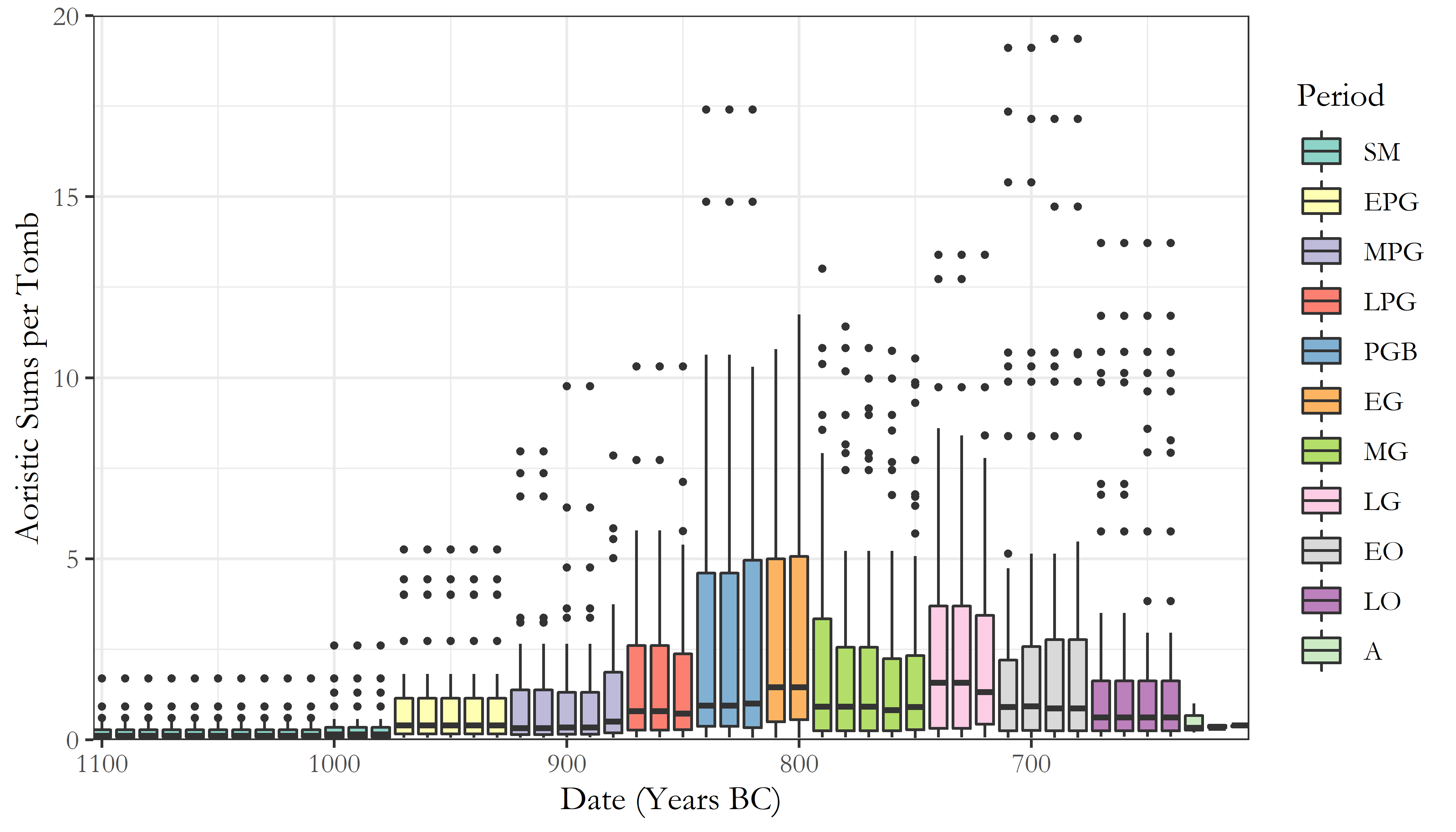


Figure 16 goes around here

Does something of the sort apply more even generally at this time? Figure 16 presents a boxplot of the total aoristic sums across both cemeteries, colour-coded by ceramic phase. The important observation is that the PGB and EG exhibit the largest interquartile ranges (IQRs) of any period, and each possess only a single outlier (beyond 1.5 times the IQR). The Orientalising period, on the other hand, exhibits much reduced IQRs, and a proliferation of outliers far and above the range of the other tombs. In other words, whilst both the PGB-EG and EO-LO periods witnessed an expanding volume and range of burial activity, in the earlier period this was distributed more evenly across the total burying population. One speaks of increasing plurality, the other of divergence.

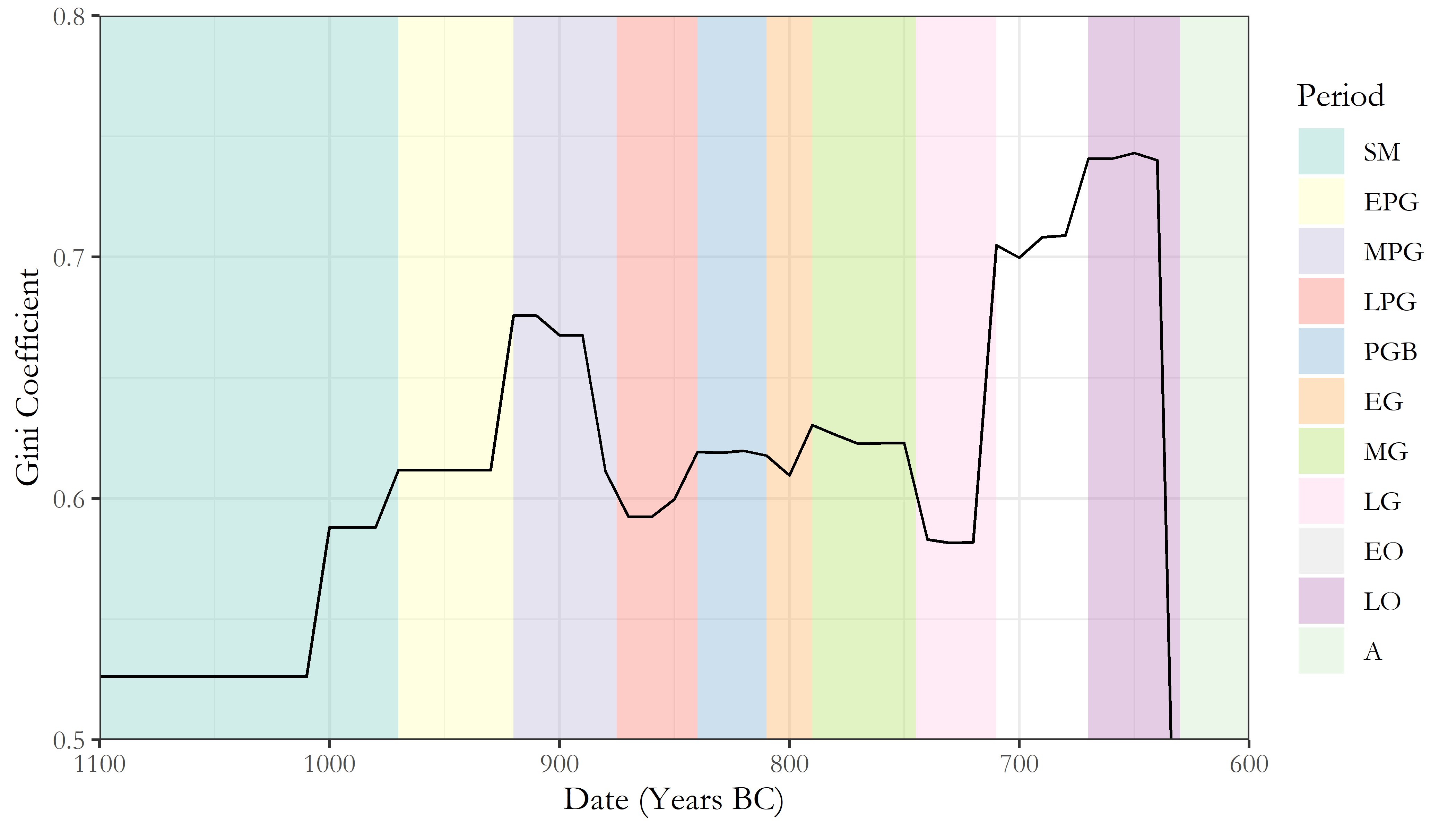


Figure 17 goes around here

This characterisation is supported further by considering the Gini coefficient of the distribution of pottery between the tombs (see Figure 17. Using the aoristic sums as a probablistically-weighted estimate of the volume of material deposited in each tomb in each decade, use of the Gini coefficient can give an (albeit rough) estimate of how unequally distributed that material was. And, though values were always relatively high (i.e. unequal) within the cemeteries, the major spike in the Gini coefficient seen in the Orientalising period does contrast markedly with the modest rise and plateau of the PGB-EG. The Gini coefficient is most commonly used in the assessment of income inequality, but I want to stress here that it is not “wealth” in any meaningful sense that we are talking about here. Indeed, if anything, the late flourit of burial activity here discussed may be a case of quantity, and not quality.

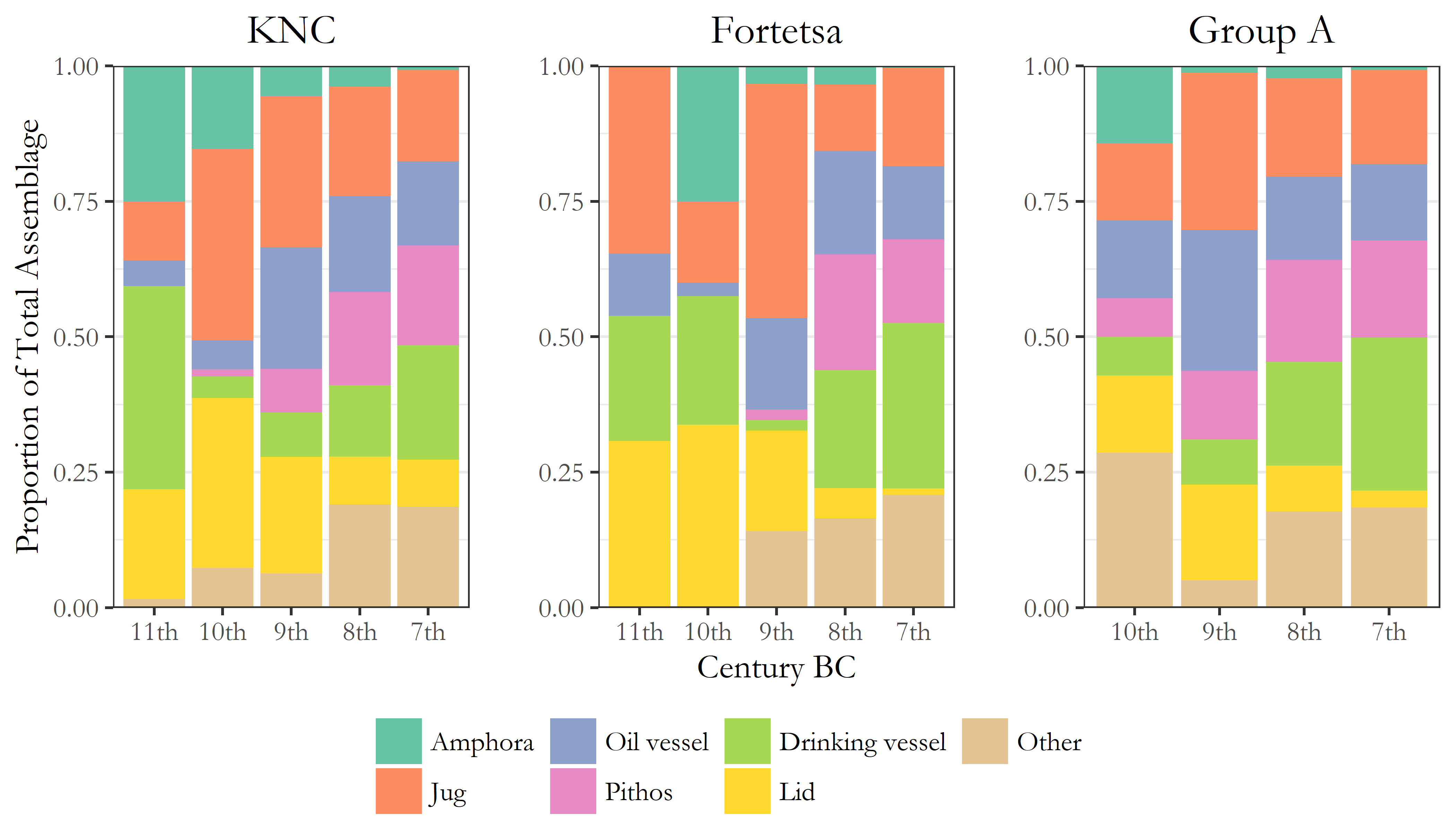


Figure 18 goes around here

Figure 18 shows the composition of the total pottery assemblage from each cemetery, and of the Group A tombs, through the centuries. In all cases, there appears to be the steady crystallisation of a basic ‘burial kit’, comprising a pithos and lid, an oil vessel, a jug, and a drinking vessel. The proportion of grave goods comprising ‘other’ vessels - pyxides, askoi, trays, stands, dinoi, kernoi, kraters, lekanai and more - declines to become only a minor part of the standardised repertoire of the 7th century. The tombs of Group A did not break with this mould, and their assemblages seem as conventional as any other during the last century of use in the cemeteries.

Plainly, the main focus of this article has been on ceramics and not other artefacts of metal, stone, glass, and organic materials, due to their less well-developed chronologies, but even the raw distribution of such artefacts may make more sense in the light of the foregoing discussion. There is, perhaps unsurprisingly, a relatively strong (Spearman’s ρ=0.7152995) correlation between the number of ceramic and non-ceramic finds across the tombs, and, certainly, many of the most seemingly precious objects were recovered from among the larger tombs. But the monopoly those tombs would appear to have over such objects, perhaps tempting one initially to speak of ‘elite’ or ‘high-status’ tombs, evaporates when the number of those objects is divided by the number of burials represented. This fact has seldom, if ever, been appreciated in prior discussions of the cemeteries.

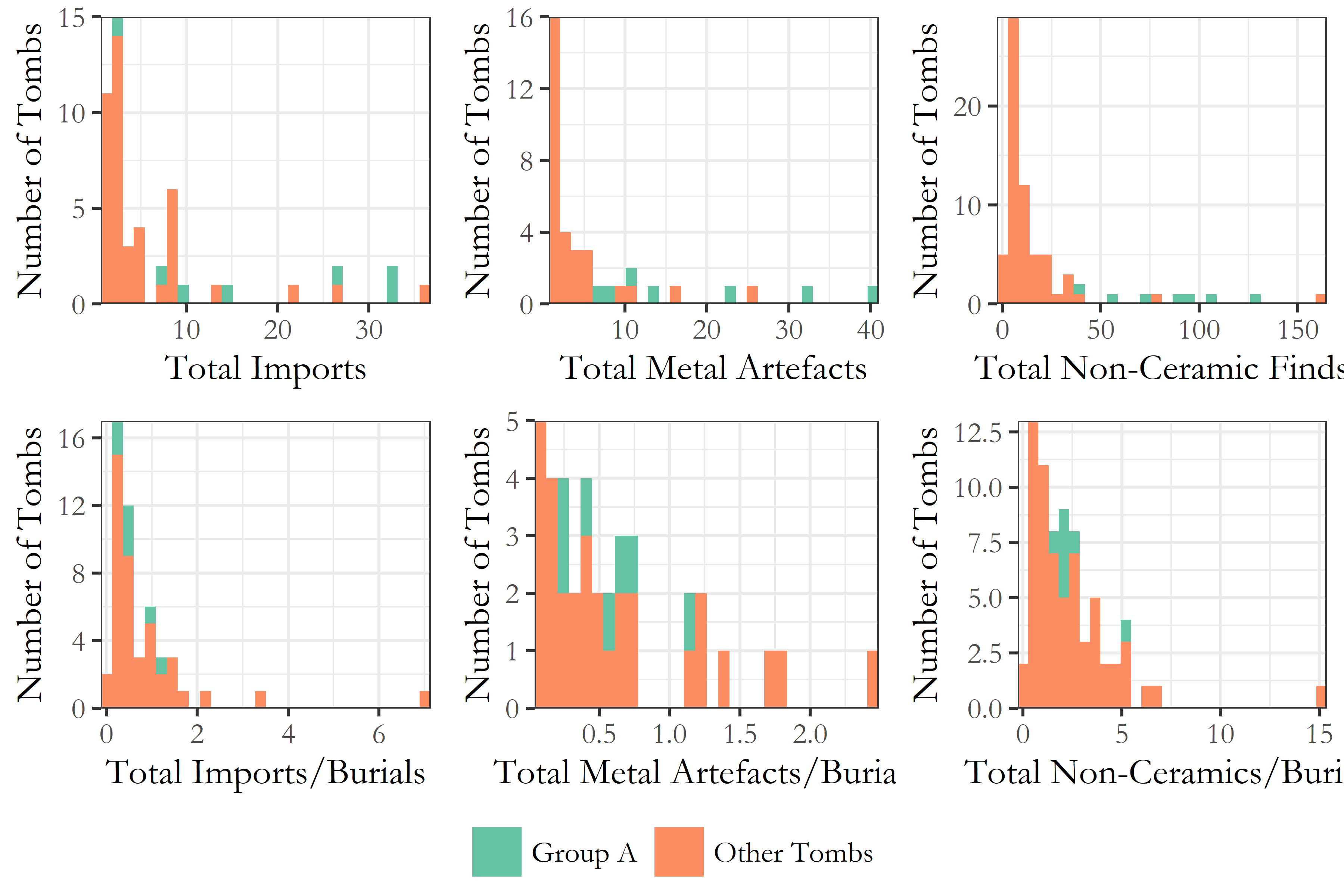


Figure 19 goes around here

Figure 19 thus supports the view which has emerged from the foregoing analysis, that the major increase in burial activity at both Fortetsa and the KNC was not a phenomenon linked in any straightforward way to simple principles of ‘elite’ or ‘wealthy’ burial. To summarise, towards the end of 8th century BC, a select group of tombs, all of which had been constructed back in the 9th or 10th, became the foci of a major increase in burials, something which did not occur among the tombs built around that time. We have seen how little about the physical dimensions or early use of these tombs presaged their later popularity, and that, while a similar, if smaller, increase in burial activity occurred around a century earlier, in the PGB-EG periods, this contrasted in the comparative diversity of its associated assemblages, and their distribution across the tombs. The later burials were marked by great uniformity in the associated grave goods - set against a backdrop of waining tomb construction and declining imports - and this apparently limited and consistent repertoire may explain why many of the most-used tombs prove exceptional only in their absolute quantities of artefacts, and not the accoutrements of each individual burial.

# Discussion

It remains to consider how we might characterise the burying groups responsible behind these various, intriguing trends. The traditional view is that such groups were immediate families (Brock 1957, 41; Boardman (1967): 63; Coldstream and Huxley (1996): 291). The relatively short lifespan of many tombs (often only two or three generations) has been taken as evidence for direct, lineal inheritance, with the tomb going out of use as families moved, individuals founded new tombs, or the line came to an end. The idea of lineal groups is supported by the, admittedly circumstantial, evidence of men, women and children being found within single tombs, and one (contentious) instance of an apparently hereditary mandibular deformity in three non-contemporary skulls in the same tomb (Musgrave 1996).

The model of lineal inheritance has been recently challenged by Kotsonas (2011b: 131), however, who considers it ‘probably the greatest factoid in the archaeology of Crete of the given period’. He argues that the rise in interments during the 8th century is too great to be explained by population growth, as would be necessary for the possibility of direct lineal inheritance to be preserved. Certainly, it seems illogical that population increases would lead to the consolidation of burials within only extant tombs. The trend instead must reflect reconfigurations of the burying groups themselves, which Kotsonas feels may have, also or instead, comprised age- and sex-grades.

Yet it is hard to be conclusive, as our current understanding of the social organisation of the early Cretan *poleis* remains patchy. Perlman and Gagarin’s (2016) recent study of the Cretan law codes reminds us, importantly, if lamentably, that there is an often underappreciated degree of diversity apparent from the Archaic inscriptions in the offices, institutions, and social groups of the early city-states. In the traditional view, political authority was concentrated in the hands of the *kosmoi*, aristocratic magistrates selected from the leading, hereditary *startoi*, or ‘clans’, networks of extended lineages controlling the ancestral estates on which worked attendent serfs and/or slaves (Willetts 1982, 240). But despite elements of this account probably being accurate, others remain equivocal, such as the nature of the *pyla*, or ‘tribe’, and its relation to the *startos* (which may itself be a military grouping), the distinction between an *astos* and a *poliatas*, both clearly formulations of the rights-bearing civic actor, and the ancestry and spread of the *agelai*, seemingly an adolescent age-grade so far only attested at Eltynia [Gagarin and Perlman (2016): 36; 78-80]. Indeed, many terms which might illuminate social divisions and groupings within the Archaic Cretan populace are only attested at one or two sites, and even then sometimes appear to differ in their form or function.

It wouldn’t be helpful at present, then, to draw any simple parallel between the Knossian burial groups and, say, powerful *startoi*, a term which is not even attested outside of Gortyn in this period (ibid:, 1-2). But archaeological and textual evidence suggests that, in general terms, such supra-familial kinship groups were undergoing a transition during this period, suggesting some such attribution for the burying groups at Knossos is not unreasonable, given the noted changes there also. Elsewhere on Crete, we see a shift to unmarked, individual burials, and more austere grave goods, as well as an apparent reorientation of sanctuary deposits away from extra-mural to suburban spaces, and a rise in utilitarian, mass-produced votives (ibid.: 34-6). At Knossos, a small number of pithos burials in pits do appear in the KNC and Fortetsa volumes (Brock 1957: 98; Coldstream and Catling 1996: 162), and recent re-excavation of the Teke plot identified numerous small pit burials around three chamber tombs (Evely 2012), raising the possibility that others exist, but have gone unrecognised in prior excavations. At Azoria, major urban remodelling in the 7th century saw the earlier, agglutinative house forms of neighbouring Kavousi Vronda and Kastro give way to larger, more formally planned dwellings with little evidence of renovation or remodelling, while larger, apprently civic, buildings were constructed to accommodate major public gatherings (Haggis, Mook, Fitzsimons, C Margaret Scarry, et al. 2011; Haggis, Mook, Fitzsimons, Margaret C Scarry, et al. 2011; Haggis 2014).

In the Knossian cemeteries, we have seen a somewhat diverse set of burial practices give way to a more prolific, yet more restricted, enumeration of such rites, focussed on a small number of long-established tombs, in the context of diminishing collective tomb construction, and shortly before a complete cessation of such depositions. Together, these varied threads suggest that with the emergence of the archaic *poleis* on Crete, there was a concomitant restructuring of wider social groups, institutions, and behaviours. It seems not unreasonable to infer an emergent emphasis on the citizen, the state, and ideologies of relative egality, within which communal gatherings, intra-mural ritual, and individual graves replaced ostentatious, kin-centred acts of gathering, dedication, and burial.

These issues, naturally, recall the conclusions of Morris (1987: 171-211), who argued 30 years ago that the emergence of the *polis* across the Aegean led to a tension between elite preferences for conspicuous display, and a downplaying of social difference in death, as promoted by the ‘middling’ ideology that the *polis* engendered and promulgated. In his well-known model of the *agathoi* and *kakoi*, Morris argued that, at various times, the relevant spheres of kinship demonstrated in burial could widen and constrict, with more and less distantly related lineages drawn into association through changing social strategies, until the pre-eminence of kinship relations in the structuring of political power declined, along with its manifestiations in mortuary practice.

At Knossos, while some aspects of the noted expansion in the burying population seem explicable within a model like Morris’, others sit more uneasily. Firstly, the burials at issue here are in many ways *not* ostentatious in comparison to the norm. We have seen that the ‘richest’ tombs in terms of finds are far less so when one accounts for the number of burials represented. Likewise, Morris claims that periods of expansion in the rite of burial correspond to greater variety in the associated assemblages, yet, at Knossos, we have seen that the range of grave goods in fact diminished and crystallised during the late 8th and early 7th centuries. But whether this reflected some standard set of accoutrements intentionally shared by the hypothetical *agathoi* of Knossos, or else nascent, egalitarian strictures over elaborate burial is hard to judge. The PGB period seems a far better candidate for such an expansion, with its greater variety in chamber dimensions, relatively broad distribution of (local and imported) grave goods, not to mention the innovative ceramic decoration and reuse of BA artefacts noted elsewhere. One thing is clear; the social context which produced these signatures contrasted markedly with that of a century later, with its ever greater volume of interments in an ever-smaller cohort of tombs, its more uniform assemblages, and its decline of imported items.

It is tempting, though potentially perilous, to link the diminishing range of burial goods to Archaic Crete’s purported austerity, its (quite literally) spartan lifestyles. But, as a more nuanced picture emerges of the island’s relationship with the wider Mediterranean, subtler characterisations are possible. It is telling that the peak for imported items in the tombs came in the 9th century; the Orientalising as a time period feels increasingly misapplied to Crete, when, at Knossos at least, it witnessed far lower rates of ‘oriental’ imports, and only limited adoption of the figural motifs which characterise its appearance elsewhere. This decline in imports was, however, counterpointed by a rise in imitations of Near Eastern vessels (Antoniadis 2012: 170), something which further accords with our growing awareness of the selective nature of Archaic and Classical Crete’s external relations. Erickson (Erickson 2010) has, likewise, argued that *symposia* were practised on Crete, something often disputed, but that their practitioners merely favoured simpler vessel forms than the figurally-decorated wares popular on the mainland. Local, selective adoption of, and responses to, wider social and material trends across the contemporary Aegean is perhaps becoming the hallmark of Archaic Crete, and finds further endorsement in the trends identified in the EIA cemeteries at Knossos. What seems certain is that this was a period of transition wherein, whatever their exact identity, certain actors invested heavily in a final flurry of burials in chamber tombs, with an emphasis on tradition, an established repertoire of items, rites, and venues for one’s passage to the afterlife, before changing social forces effected their abandonment.

# Conclusion

It is important that the present study was a comparative investigation of both the Fortetsa and Knossos North cemeteries. It is notable how similar the observed trends are at both locations. That both underwent similar developments during the EIA suggests, not only that they catered to similar sub-sections of the Knossian population, but that some of the socio-economic and political changes inferred and discussed were real, and community-wide. Further work should seek to extend these comparisons, both into trends unexplored in the present study, and out to the wider funerary landscape of Knossos. I hope to produced such a study but, for the time being, the datasets I am making available alongside this article include the other published EIA tombs in the area, so that others may also explore their possible significance.

There were undeniable limitations to the present work. For one, non-ceramic artefacts were underrepresented due to difficulties with dating, and future work could seek to address this. Issues of gender were sadly little considered, though this was largely due to limitations in the data themselves. There have also been a number of tombs discovered in the last 20 years that fill in the spaces between the Teke plot and the Medical Faculty Site, and ideally these unpublished tombs should be included in further analyses as they, along with the unconsidered Teke tholos and associated tombs, are almost surely part of a single contiguous cemetery (Blackman 1999: 113; Catling 1983: 51; French 1991: 68-69). Finally, a preliminary study was recently taken by the author of select boxes marked as ‘unpublished’ from the KNC deposits kept at the British School at Athens at Knossos. Despite going unmentioned in the publication, this material was not inconsiderable and so, regretably, future study will be necessary to determine whether it threatens the integrity of quantitative analyses such as this. Suffice to say that, at present, it is another pinch of salt with which to take the present findings.

These limitations notwithstanding, the foregoing analysis demonstrates the value of quantitative approaches to the archaeological record of the period. With large datasets, we are able to locate and visualise covariance and significant correlations between different variables, plot changes in the data through time and, ultimately, draw on our findings to inform discussions of social processes. Though the construction of databases can be time consuming, once made they offer the opportunity to subdivide, compare, and plot the data in numerous ways quickly and easily, facilitating investigation of the material from multiple angles. By making datasets available for use by others, as with the data and code for the present study, one’s conclusions can also be independently tested, and alternative interpretations can be voiced. The databases produced for the above analysis contain a large of amount of unutilised data that could facilitate a range of future investigations, and all are welcome to it. With more such analyses, we could begin to a construct a fuller account of the regional diversity in mortuary, and wider social, practices that characterised the communities of EIA and archaic Crete.

##### pagebreak

# Acknowledgements

I would like to thank Borja Legarra Herrero and Corinna Riva for their help and advice from the earliest stages of the present research, as well as the BSA at Knossos for permitting me to examine some of the material from the Medical Faculty excavations. I am indebted most of all to Professor Todd Whitelaw, for his unstinting guidance, feedback and facilitation of my ongoing research.

# About the Author

Dominic Pollard is a PhD candidate at University College London. His research focusses on the Early Iron Age of Crete, with particular interest in the use of computational methods to supplement traditional modes of archaeological inference.

##### pagebreak

# References

Antoniadis, Vyron  
2012 Early Iron Age Cementeries at Knossos: The Appreciation of Oriental Imports and their Imitations by Knossian Society. PhD thesis, Universitat Pompeu Fabra. <http://www.tdx.cat/handle/10803/85060>.

Appadurai, Arjun  
1986 *The Social Life of Things : commodities in cultural perspective*. Cambridge University Press, Cambridge.

Bevan, Andrew, and Alan Wilson  
2013 Models of settlement hierarchy based on partial evidence. *Journal of Archaeological Science* 40(5). May:2415–2427.

Blackman, David  
1999 Archaeology in Greece, 1998-99. *Archaeological Reports* 45:1–124.

Boardman, John  
1960 Protogeometric graves at Agios Ioannis near Knossos. *The Annual of the British School at Athens* 55:128–148.

Boardman, John  
1967 The Khaniale Tekke Tombs, II. *The Annual of the British School at Athens* 62:57–75.

Brock, J.K.  
1957 *Fortetsa: Early Greek Tombs Near Knossos*. Cambridge University Press, Cambridge.

Catling, H W  
1983 Archaeology in Greece, 1982–83. *Archaeological Reports* 29:3–62.

Catling, H W  
1995 Heroes Returned? Subminoan Burials from Crete. In *The Ages of Homer: A Tribute to Emily Townsend Vermeule*, Jane B Carter and Sarah P Morris, editors, pp. 123–136. University of Texas Press, Austin.

Cavanagh, W.G.  
1996 The Burial Customs. In *Knossos North Cemetery: Early Greek Tombs*, J.N. Coldstream and H W Catling, editors, pp. 651–675. The British School at Athens Supplement 28. Vol.II, London.

Coldstream, J N  
1977 *Geometric Greece*. 1st edition. Ernest Benn, London.

Coldstream, J N  
1994 Urns with Lids: The Visible Face of the Knossian ’Dark Age’. In *Knossos: A Labyrinth of History. Papers Presented in Honour of Sinclair Hood*, Don Evely, Helen Hughes-Brock, and Nicoletta Momigliano, editors, pp. 105–122. The British School at Athens, Oxford.

Coldstream, J N  
1998 Minos Redivivus: some nostalgic Knossians of the ninth century BC (a summary). *Brtish School at Athens Studies* 2(POST-MINOAN CRETE: Proceedings of the First Colloquium on Post-Minoan Crete held by the British School at Athens and the Institute of Archaeology, University College London, 10-11 November 1995):58–61.

Coldstream, J N, and H W Catling  
1996 *Knossos North Cemetery: Early Greek Tombs*., editorsJ N Coldstream and H W Catling. The British School at Athens Supplement 28. Vol.I-IV, London.

Coldstream, J. N.  
1963 Five Tombs at Knossos. *The Annual of the British School at Athens* 58:30–43.

Coldstream, J. N., G. L. Huxley, and V. E. S. Webb  
1999 Knossos: The Archaic Gap. *The Annual of the British School at Athens* 94:289–307.

Coldstream, J.N.  
1984a A Protogeometric Nature Goddess from Knossos. *Bulletin of the Institute of Classical Studies* 31:93–104.

Coldstream, J.N.  
1984b Dorian Knossos and Aristotle’s Villages. In *Aux Origines de L’Hellénisme: La Crète et La Grèce. Hommage à Henri van Effenterre.*, Centre Gustave Glotz, editor, pp. 311–322. Université de Paris-I, Paris.

Coldstream, J.N.  
1991 Knossos: An Urban Nucleus in the Dark Age. In *La Transizione Dal Miceneo All’Alto Arcaismo: Dal Palazzo Alla Città. Atti Del Convegno Internazionale, Roma, 14–19 Marzo 1988.*, Domenico Musti, editor, pp. 287–299. Consiglio nazionale delle ricerche, Roma.

Coldstream, J.N.  
2000 Evans’ Greek Finds: The Early Greek Town of Knossos, and its Encroachment on the Borders of the Minoan Palace. *BSA* 95:260–299.

Coldstream, J.N.  
2006 Knossos in Early Greek Times. In *Ancient Greece: From the Mycenaean Palaces to the Age of Homer*, Sigrid Deger-Jalkotzy and Irene S Lemos, editors, pp. 581–596. Edinburgh University Press, Edinburgh.

Coldstream, J.N., and G Huxley  
1996 Fortetsa 1967 Tombs. In *Knossos North Cemetery: Early Greek Tombs*, J.N. Coldstream and H W Catling, editors, p. 284. The British School at Athens Supplement 28. Vol.I, London.

Crema, Enrico R  
2012 Modelling Temporal Uncertainty in Archaeological Analysis. *Journal of Archaeological Method Theory* 19(3):440–461.

Crema, Enrico R., Andrew Bevan, and Mark W. Lake  
2010 A probabilistic framework for assessing spatio-temporal point patterns in the archaeological record. *Journal of Archaeological Science* 37(5). May:1118–1130.

Crowe, Alice  
2016 The Minoan Past in the Past: Bronze Age Objects in Early Iron Age Burials at Knossos, Crete. *Unpublished Master’s Dissertation.*

Davaras, C  
1968 Two Geometric Tombs at Atsalenio near Knossos. *BSA* 63:133–146.

Desborough, Vincent Robin d’Arba  
1972 *The Greek Dark Ages*. Benn, London.

Erickson, Brice L  
2010 *Crete in transition: pottery styles and island history in the archaic and classical periods / Brice L. Erickson.* Hesperia (princeton, n.J.). supplement ; 45. American School of Classical Studies at Athens, Princeton, NJ.

Evans, Arthur  
1921 *The palace of Minos: a comparative account of the successive stages of the early Cretan civilization as illustrated by the discoveries at Knossos I*. Macmillan, London.

Evans, Arthur  
1928 *The palace of Minos: a comparative account of the successive stages of the early Cretan civilization as illustrated by the discoveries at Knossos II*. Macmillan, London.

Evans, Arthur  
1930 *The palace of Minos: a comparative account of the successive stages of the early Cretan civilization as illustrated by the discoveries at Knossos III*. Macmillan, London.

Evely, D  
2012 Knossos Teke (property of G. and N. Frangiadakis). <http://www.chronique.efa.gr/index.php/fiches/voir/2804/>.

French, E.B.  
1991 Archaeology in Greece, 1990-91. *Archaeological Reports* 37:3–78.

Gagarin, Michael, and Paula Jean Perlman  
2016 *The laws of Ancient Crete: c.650-400 BCE*. Oxford University Press, Oxford.

Haggis, Donald C  
2014 Azoria and Archaic Urbanization. In *Cretan Cities: Formation and Transformation*, Florence Gaignerot-Driessen and Jan Driessen, editors, pp. 119–140. UCL, Presses Universitaires de Louvain, Louvain-La-Neuve, Belgium.

Haggis, Donald C, Geraldine Cornelia Gesell, and Leslie Preston Day  
2005 *Kavousi I: the archaeological survey of the Kavousi Region*. INSTAP Academic Press, Philadelphia, Pennsylvania.

Haggis, Donald C, Margaret S Mook, Rodney D Fitzsimons, C Margaret Scarry, Lynn M Snyder, and William C West  
2011 Excavations in the Archaic Civic Buildings at Azoria in 2005-2006. *The Journal of the American School of Classical Studies at Athens* 80(1):1–70.

Haggis, Donald C, Margaret S Mook, Rodney D Fitzsimons, Margaret C Scarry, and Lynn M Snyder  
2011 THE EXCAVATION OF ARCHAIC HOUSES AT AZORIA IN 2005-2006. *Hesperia: The Journal of the American School of Classical Studies at Athens* 80(3):431–489.

Hallager, Birgitta P  
2010 The elusive Late IIIC and the ill-named Subminoan. *British School at Athens Studies* 18(CRETAN OFFERINGS: Studies in honour of Peter Warren):141–155.

Hayden, Barbara J  
2005 *Reports on the Vrokastro area, eastern Crete. Vol. 3, The Vrokastro regional survey project: sites and pottery*. University museum monograph ; 123. University of Pennsylvania Museum of Archaeology; Anthropology, Philadelphia.

Hoffman, Gail L  
1997 *Imports and Immigrants: Near Eastern Contacts with Iron Age Crete*. University of Michigan Press, Ann Arbor.

Hogarth, D.G.  
1899 Knossos: Early Town and Cemeteries. *BSA* 6:70–85.

Hood, Sinclair, and David Smyth  
1981 *Archaeological Survey of the Knossos Area. The British School at Athens Supplementary Volumes, No. 14.* 2nd edition. Thames; Hudson, London.

Hutchinson, R.W., and John Boardman  
1954 The Khaniale Tekke Tombs. *The Annual of the British School at Athens* 49:215–230.

Huxley, G  
1994 On Knossos and her Neighbours (7th Century to Mid-4th Century B.C.). In *Knossos: A Labyrinth of History. Papers Presented in Honour of Sinclair Hood*, Don Evely, Helen Hughes-Brock, and Nicoletta Momigliano, editors, pp. 123–134. The British School at Athens, Oxford.

Johnson, Ian  
2004 Aorisitc Analysis: Seeds of a new approach to mapping archaeological distributions through time. In *[Enter the Past]. the E-Way into the Four Dimensions of Cultural Heritage. Caa 2003. Computer Applications and Quantitative Methods in Archaeology. Proceedings of the 31st Conference, Vienna, Austria, April 2003*, K Ausserer Fischer, W Börner, M Goriany, and L Karlhuber-Vöckl, editors, pp. 448–452. BAR International Series 1227, Oxford.

Jones, Donald W  
2000 *External Relations of Early Iron Age Crete, 1100-600 B.C.* Kendall/Hunt Publishing Company, Dubuque, Iowa.

Knappett, Carl  
2011 *An archaeology of interaction: network perspectives on material culture and society*. Oxford University Press, Oxford.

Knappett, Carl, Ray Rivers, and Tim Evans  
2011 The Theran eruption and Minoan palatial collapse: new interpretations gained from modelling the maritime network. *Antiquity* 85(329). September.

Kopytoff, I  
1986 The cultural biography of things: commoditization as process. In *The Social Life of Things: Commodities in Cultural …*, Arjun Appadurai, editor, pp. 64–92. Cambridge University Press, Cambridge.

Kotsonas, Antonis  
2002 The rise of the polis in Central Crete. *’Eulimene*(3):37–74.

Kotsonas, Antonis  
2006 Wealth and Status in Iron Age Knossos. *Oxford Journal of Archaeology* 2:149–172.

Kotsonas, Antonis  
2011a Saro Wallace, Ancient Crete: From Successful Collapse to Democracy’s Alternatives, Twelfth to Fifth Centuries BC. Cambridge/New York: Cambridge University Press, 2010. Pp. xxvi, 450; 6 p. of plates. ISBN 9780521112048. $99.00. *Bryn Mawr Classical Review* 4(52). <http://bmcr.brynmawr.edu/2011/2011-04-52.html>.

Kotsonas, Antonis  
2011b Quantification of ceramics from Early Iron Age tombs. In *Early Iron Age Pottery : A Quantitative Approach : Proceedings of the International Round Table Organized by the Swiss School of Archaeology in Greece (Athens, November 28-30, 2008)*, Samuel Verdan, Thierry Theurillat, and Anne Pfyffer Kenzelmann, editors, pp. 129–138. Archaeopress, Oxford.

Kotsonas, Antonis  
2016 Politics of Periodization and the Archaeology of Early Greece. *American Journal of Archaeology* 120(2):239–270.

Kotsonas, Antonis, Todd Whitelaw, Antonis Vasilakis, and Maria Bredaki  
2011 Early Iron Age Knossos: An overview from the Knossos Urban Landscape Project (KULP). In *Έ ο 11ο ούς κοοού ίο, ρέο, 21-27 οίο 2011*. Ρέο.

Marwick, Ben  
2017a Using R and related tools for reproducible research in archaeology. In *The Practice of Reproducible Research: Case Studies and Lessons from the Data-Intensive Sciences*, pp. 181–190.

Marwick, Ben  
2017b Computational Reproducibility in Archaeological Research: Basic Principles and a Case Study of Their Implementation. *Journal of Archaeological Method and Theory* 24(2). Springer US, June:424–450. <http://link.springer.com/10.1007/s10816-015-9272-9>.

Marwick, Ben, and Suzanne E. Pilaar Birch  
2018 A Standard for the Scholarly Citation of Archaeological Data as an Incentive to Data Sharing. *Advances in Archaeological Practice* 6:1–19.

Mauss, Marcel  
1954 *The gift: forms and functions of exchange in archaic societies*., editorIan Cunnison. Cohen & West, London.

Morris, I  
1987 *Burial and Ancient Society: The Rise of the Greek City-state*. Cambridge University Press, Cambridge.

Morris, I  
1997 Periodization and the Heroes: Inventing a Dark Age. In *Inventing Ancient Culture*, Mark Golden and Peter Toohey, editors, pp. 96–131. Routledge, London.

Musgrave, J.H.  
1996 The Human Bones. In *Knossos North Cemetery: Early Greek Tombs*, J.N. Coldstream and H W Catling, editors, pp. 677–702. The British School at Athens Supplement 28. Vol.II, London.

Nowicki, Krzysztof  
2000 *Defensible sites in Crete c.1200-800 B.C. : (LM IIIB/IIIC through early Geometric)*. Université de Liège, Liège.

Ratcliffe, Jerry H.  
2000 Aoristic analysis: the spatial interpretation of unspecific temporal events. *International Journal of Geographical Information Science* 14(7). October:669–679.

Schreiber, N  
2003 *The Cypro-Phoenician Pottery of the Iron Age*. Brill, Leiden/Boston.

Snodgrass, AM  
1996 Iron. In *Knossos North Cemetery: Early Greek Tombs*, J N Coldstream and H W Catling, editors, pp. 575–598. The British School at Athens Supplement 28. Vol.II, London.

Snodgrass, Anthony McElrea  
1971 *The Dark Age of Greece. An Archaeological Survey of the Eleventh to the Eighth Centuries BC.* Edinburgh University Press, Edinburgh.

Wallace, Saro  
2010 *Ancient Crete: From Successful Collapse to Democracy’s Alternatives, Twelth to Fifth Centuries BC*. Cambridge University Press#, Cambridge.

Watrous, L. Vance, Donald C Haggis, Krzysztof Nowicki, Natalia Vogeikoff-Brogan, and Maryanne Schultz  
2012 *An archaeological survey of the Gournia landscape: a regional history of the Mirabello Bay, Crete, in antiquity*. Prehistory monographs ; 37. INSTAP Academic Press, Philadelphia.

Whitley, James  
2002 Objects with Attitude: Biographical Facts and Fallacies in the Study of Late Bronze Age and Early Iron Age Warrior Graves. *Cambridge Archaeological Journal* 12(2). Cambridge University Press:217–232.

Whitley, James  
2011 Saro Wallace. Ancient Crete: From Successful Collapse to Democracy’s Alternatives, Twelfth to Fifth Centuries BC. (review). *American Journal of Philology* 132(4):667–670. <http://muse.jhu.edu/content/crossref/journals/american{\_}journal{\_}of{\_}philology/v132/132.4.whitley.html>.

Αίο, .  
1950 άς ούοος ί οώ ί Κής. *Κά Χοά* 4:294–318.

##### pagebreak

# Captions

*Figure 1 Map of the Knossos area, showing the locations of the various EIA tomb clusters and cemeteries, with EIA pottery distributions from the Knossos Urban Landscape Project marked in orange, giving an impression of the contemporary urban extent (underlying image credit: T. Whitelaw).*

*Figure 2 Relationship between known interments, counts of pithoi, and counts of pithoi, amphorae and kraters across both cemeteries. The straight line represents the mean estimate based on these three values.*

*Figure 3 Counts of pithoi across both cemeteries through time. Vessel dates have here been based on the midpoint (or mean) of the absolute date range accompanying their respective ceramic periods.*

*Figure 4 Aoristic sums of all vessels across both cemeteries. This represents a probabilistically weighted visualisation of depositional activity through time.*

*Figure 5 Aoristic sums of pithoi (left), as a proxy for cremation burials, and of all vessels (right). The sums are colour coded to show the values of the two cemeteries, and the total values*

*Figure 6 Tomb construction through time at both cemeteries. On the left are counts based on the earliest dated pottery in each tomb, while on the left are aoristic sums likewise based on the earliest ceramic-based assignations. In both cases, tombs lacking any securely dateable pottery are excluded.*

*Figure 7 Estimates of the number of tombs in use during each of the ceramic phases attested in both cemetaries, based on counts of tombs yielding vessels of each period.*

*Figure 8 Estimates of the number of tombs in use through time across both cemeteries. The grey background represents the total number of tombs in use, while the smaller coloured bars correspond to tombs built in each of the five centuries of EIA activity at the cemeteries.*

*Figure 9 Counts of vessels from all tombs in both cemeteries, arranged, on the left, by the century to which they are assigned based on their ceramic period and, on the right, by the centuries in which the tombs they come from were built.*

*Figure 10 Aoristic sums for the 12 tombs with the largest ceramic assemblages, arranged in decreasing order. Note, for the sake of better illustrating the relative temporal patterns, rather than absolute values, the scales on each plot are distinct.*

*Figure 11 Boxplots comparing various tomb dimensions, divided, in each case, by the century of tomb construction.*

*Figure 12 Scatterplots comparing tomb dimensions (chamber area and* dromos\* length) to the estimated total number of burials by tomb.\*

*Figure 13 Counts of vessels dating to the 9th, 8th and 7th centuries respectively, found in tombs built in the 10th or 9th century which yielded upwards of 50 vessels when excavated. The seven tombs with late peaks in burial activity (Group A) are shown in green, the remaining five of the largest 12 (Group B) in orange, and all other tombs (Group C) in blue.*

*Figure 14 Aoristic sums of imported ceramics through time across both cemeteries, colour-coded by the broad regional origin of the vessels, and overlain on the grand totals in pale grey.*

*Figure 15 Aoristic sums of imported vessels through time. The sums are colour coded as per Figure 13 (thoug here Group C represents all other tombs, not just those with 50+ vessels).*

*Figure 16 Boxplot showing the aoristic sums of all vessels across both cemeteries through time, colour-coded by ceramic period. Boxes represent the interquartile range, horizontal lines the median value, whiskers values within 1.5 times the interquartile range, and points outliers beyond this. Note, the Y axis has been limited to 20 to aid readability, meaning the outliers Tomb G in the EG period, and Tomb P in the late EO-LO period are excluded, with values ranging from 29-34, and 36-44 respectively.*

*Figure 17 Gini coefficient values through time based on the aoristic sums for all vessels across both cemeteries. Background colours correspond to ceramic periods.*

*Figure 18 The composition of the total pottery assemblage for each century across both cemeteries, and among the 7 notable tombs (Group A) drawn out earlier in the analysis.*

*Figure 19 Histograms corresponding, first, to counts of non-ceramic artefacts, metal objects, and imported items by tomb across both cemeteries and, secondly, to those counts divided by the estimated number of burials in each tomb.*

##### pagebreak

# Figures

##### pagebreak

# Tables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tombs** | **Date of pithoi (burials)** | **No. of pithoi (burials)** | **Number of tombs represented** | **Burials per tomb** |
| *10th century tombs* |  |  |  |  |
|  | 10th century | 8 | 4 | 2 |
|  | 9th century | 46 | 17 | 2.71 |
|  | 8th century | 59 | 12 | 4.92 |
|  | 7th century | 32 | 8 | 4 |
| *9th century tombs* |  |  |  |  |
|  | 9th century | 54 | 19 | 2.84 |
|  | 8th century | 184 | 29 | 6.34 |
|  | 7th century | 167 | 15 | 11.13 |
| *8th century tombs* |  |  |  |  |
|  | 8th century | 34 | 15 | 2.27 |
|  | 7th century | 46 | 15 | 3.07 |
| *7th century tombs* |  |  |  |  |
|  | 7th century | 5 | 2 | 2.5 |

*Table 1 The number of pithoi (as a proxy for burials) deposited in tombs dating to the 10th, 9th, 8th and 7th centuries, through each of the centuries they were in use, as well as the number of tombs from which these burials came, allowing calculation of the changing rate of burial through time.*

##### pagebreak

### Colophon

This report was generated on 2019-06-03 11:58:25 using the following computational environment and dependencies:

#> - Session info ----------------------------------------------------------  
#> setting value   
#> version R version 3.5.1 (2018-07-02)  
#> os Windows 10 x64   
#> system x86\_64, mingw32   
#> ui RTerm   
#> language (EN)   
#> collate English\_United Kingdom.1252   
#> ctype English\_United Kingdom.1252   
#> tz Europe/London   
#> date 2019-06-03   
#>   
#> - Packages --------------------------------------------------------------  
#> package \* version date lib source   
#> assertthat 0.2.0 2017-04-11 [1] CRAN (R 3.5.2)  
#> backports 1.1.3 2018-12-14 [1] CRAN (R 3.5.2)  
#> bookdown 0.9 2018-12-21 [1] CRAN (R 3.5.2)  
#> callr 3.1.1 2018-12-21 [1] CRAN (R 3.5.2)  
#> cli 1.0.1 2018-09-25 [1] CRAN (R 3.5.2)  
#> colorspace 1.4-0 2019-01-13 [1] CRAN (R 3.5.2)  
#> cowplot 0.9.4 2019-01-08 [1] CRAN (R 3.5.3)  
#> crayon 1.3.4 2017-09-16 [1] CRAN (R 3.5.2)  
#> data.table \* 1.12.0 2019-01-13 [1] CRAN (R 3.5.3)  
#> desc 1.2.0 2018-05-01 [1] CRAN (R 3.5.2)  
#> devtools 2.0.1 2018-10-26 [1] CRAN (R 3.5.3)  
#> digest 0.6.18 2018-10-10 [1] CRAN (R 3.5.2)  
#> dplyr \* 0.8.0.1 2019-02-15 [1] CRAN (R 3.5.2)  
#> evaluate 0.13 2019-02-12 [1] CRAN (R 3.5.2)  
#> extrafont \* 0.17 2014-12-08 [1] CRAN (R 3.5.2)  
#> extrafontdb 1.0 2012-06-11 [1] CRAN (R 3.5.2)  
#> farver 1.1.0 2018-11-20 [1] CRAN (R 3.5.3)  
#> fs 1.2.6 2018-08-23 [1] CRAN (R 3.5.2)  
#> ggforce \* 0.2.2 2019-04-23 [1] CRAN (R 3.5.3)  
#> ggplot2 \* 3.1.0 2018-10-25 [1] CRAN (R 3.5.2)  
#> ggpubr \* 0.2 2018-11-15 [1] CRAN (R 3.5.2)  
#> glue 1.3.1 2019-03-12 [1] CRAN (R 3.5.3)  
#> gridExtra 2.3 2017-09-09 [1] CRAN (R 3.5.3)  
#> gtable 0.2.0 2016-02-26 [1] CRAN (R 3.5.2)  
#> highr 0.7 2018-06-09 [1] CRAN (R 3.5.2)  
#> htmltools 0.3.6 2017-04-28 [1] CRAN (R 3.5.2)  
#> ineq \* 0.2-13 2014-07-21 [1] CRAN (R 3.5.2)  
#> knitr 1.21 2018-12-10 [1] CRAN (R 3.5.2)  
#> labeling 0.3 2014-08-23 [1] CRAN (R 3.5.2)  
#> lazyeval 0.2.1 2017-10-29 [1] CRAN (R 3.5.2)  
#> magrittr \* 1.5 2014-11-22 [1] CRAN (R 3.5.2)  
#> MASS 7.3-50 2018-04-30 [2] CRAN (R 3.5.1)  
#> memoise 1.1.0 2017-04-21 [1] CRAN (R 3.5.2)  
#> munsell 0.5.0 2018-06-12 [1] CRAN (R 3.5.2)  
#> pillar 1.3.1 2018-12-15 [1] CRAN (R 3.5.2)  
#> pkgbuild 1.0.2 2018-10-16 [1] CRAN (R 3.5.2)  
#> pkgconfig 2.0.2 2018-08-16 [1] CRAN (R 3.5.2)  
#> pkgload 1.0.2 2018-10-29 [1] CRAN (R 3.5.2)  
#> plyr \* 1.8.4 2016-06-08 [1] CRAN (R 3.5.2)  
#> png \* 0.1-7 2013-12-03 [1] CRAN (R 3.5.2)  
#> polyclip 1.10-0 2019-03-14 [1] CRAN (R 3.5.3)  
#> prettyunits 1.0.2 2015-07-13 [1] CRAN (R 3.5.2)  
#> processx 3.2.1 2018-12-05 [1] CRAN (R 3.5.2)  
#> ps 1.3.0 2018-12-21 [1] CRAN (R 3.5.2)  
#> purrr 0.3.0 2019-01-27 [1] CRAN (R 3.5.2)  
#> R6 2.4.0 2019-02-14 [1] CRAN (R 3.5.2)  
#> RColorBrewer \* 1.1-2 2014-12-07 [1] CRAN (R 3.5.2)  
#> Rcpp 1.0.0 2018-11-07 [1] CRAN (R 3.5.2)  
#> remotes 2.0.2 2018-10-30 [1] CRAN (R 3.5.2)  
#> reshape \* 0.8.8 2018-10-23 [1] CRAN (R 3.5.3)  
#> reshape2 1.4.3 2017-12-11 [1] CRAN (R 3.5.2)  
#> rlang 0.3.1 2019-01-08 [1] CRAN (R 3.5.2)  
#> rmarkdown 1.11 2018-12-08 [1] CRAN (R 3.5.2)  
#> rprojroot 1.3-2 2018-01-03 [1] CRAN (R 3.5.2)  
#> Rttf2pt1 1.3.7 2018-06-29 [1] CRAN (R 3.5.2)  
#> scales 1.0.0 2018-08-09 [1] CRAN (R 3.5.2)  
#> sessioninfo 1.1.1 2018-11-05 [1] CRAN (R 3.5.2)  
#> stringi 1.3.1 2019-02-13 [1] CRAN (R 3.5.2)  
#> stringr 1.4.0 2019-02-10 [1] CRAN (R 3.5.2)  
#> tibble 2.0.1 2019-01-12 [1] CRAN (R 3.5.2)  
#> tidyselect 0.2.5 2018-10-11 [1] CRAN (R 3.5.2)  
#> tweenr 1.0.1 2018-12-14 [1] CRAN (R 3.5.3)  
#> usethis 1.4.0 2018-08-14 [1] CRAN (R 3.5.2)  
#> withr 2.1.2 2018-03-15 [1] CRAN (R 3.5.2)  
#> xfun 0.5 2019-02-20 [1] CRAN (R 3.5.2)  
#> yaml 2.2.0 2018-07-25 [1] CRAN (R 3.5.2)  
#>   
#> [1] C:/Users/dcpol/R/win-library/3.5  
#> [2] C:/Program Files/R/R-3.5.1/library

The current Git commit details are:

#> Local: master C:/Users/dcpol/domproject  
#> Remote: master @ origin (https://github.com/DCPollard94/knossoscemeteries.git)  
#> Head: [98c7bd0] 2019-05-30: Final writing and first edits