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Bayesian radiocarbon modeling and the absolute chronology of the Middle Bronze Age Thapsos facies in mainland Sicily: a view from St. Ippolito (Caltagirone)

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Abstract

One of the most debated and explored period of the prehistory of Sicily is the Middle Bronze Age (15th-13th century BCE), which is considered as a crucial moment for the development of local prehistoric social, economic, and cross-cultural dynamics. The local Thapsos culture is what best represents this chronological period and is characterized at some sites by the occurrence of datable ceramic imports from the Aegean alongside their local replicas. These have helped researchers with establishing a local relative chronology based indirect beacons with eastern Mediterranean contexts. However, when it comes to an independent absolute chronology for MBA context in mainland Sicily, no recent program of radiocarbon dating has been carried out so far. In this contribution, the authors devise a Bayesian model based on evidence from a stratified MBA context at St. Ippolito (Caltagirone, central-eastern Sicily) where a set of seven samples have been radiocarbon dated. The study aims to assess which part of the overall development of the MBA the analyzed context corresponds to, to absolute date the activities represented by the deposit's layers, and to lay the basis to tentatively bracket in time the use of some associated ceramic materials.

Keywords: Radiocarbon dating; Bayesian model; Middle Bronze Age; Thapsos; Sicily.

Résumé

Une des périodes les plus explorées et les plus débattues de la Préhistoire de Sicile est l'âge du Bronze moyen (XV^e^-XIII^e^ s. AEC), considérée comme un moment crucial du développement social et économique, en même temps qu'une période de dynamisme trans-culturel de la protohistoire locale. La culture de Thapsos est ainsi la meilleure illustration de cette période, caractérisée par la présence conjointe, sur certains sites, de céramiques datantes, importées de l'Égée, et de leurs répliques locales. Les chercheurs ont pu établir ainsi une chronologie relative basée sur ces éléments phares des contextes de la Méditerranée orientale. Par ailleurs, la réalisation d'une série de datations absolues indépendantes établies pour le Bronze moyen sicilien a permis d'affiner cette chronologie. Dans cette contribution, les auteurs proposent un modèle bayésien reposant sur le contexte stratifié Bronze moyen de St. Ippolito (Caltagirone, centre-est de la Sicile) pour lequel une série d'échantillons a été datée par le radiocarbone. Cette étude a pour but de préciser à quelle phase du Bronze moyen correspond la séquence analysée sur le site en question, de dater les différentes activités présentes au sein des niveaux de dépôts et de proposer un phasage chronologique pour le matériel céramique associé. (traduction : A. Hauzeur)

Mots-clés : Datation par le radiocarbone, modèle bayésien, âge du Bronze moyen, Thapsos, Sicile.

1. Introduction

Middle Bronze Age (hereafter MBA) in Sicily corresponds to the development of the so-called Thapsos culture, which features a distinctive pottery production, mainly dominated by the local grey hand-made impasto pottery, and settlement patterns and types (overview in LEIGHTON, 1999). Traditionally, this period has been dated between about 1400 and 1270 BCE on the basis of evidence of datable ceramic imports (BERNABÒ BREA, 1953, 1958). In fact, pottery from Late Bronze Age Greece, Cyprus, Malta and the Italian mainland were deposited in MBA domestic and funerary contexts as a result of maritime contacts (SMITH, 1987; VAGNETTI, 1999a, 1999b, 2001a, 2001b; TUSA, 2000; VAN WIJNGAARDEN, 2002; BIETTI SESTIERI, 2003; MILITELLO, 2004; VIANELLO, 2005; BLAKE, 2008). Among these imports, Mycenaean pottery has been long used as a tool to work out an absolute chronology for MBA (BERNABÒ BREA, 1953) since its chronology has been established - not without problems (see the contributions in

WARBURTON, 2009) - via crosslinks with Near Eastern and Egyptian contexts (WARREN, 2009; WARREN & HANKEY, 1989). Its use as a temporal marker has become more important throughout the years as an improved understanding of changes in style and typology has provided better grounds for dating finding contexts in the central Mediterranean (TAYLOUR, 1958, 1980; VAGNETTI, 1991; JUNG, 2005, 2006). As a result, the upper boundary of the MBA has been slightly extended upwards, falling somewhere between 1430 and 1400 BCE (BERNABÒ BREA & CAVALIER, 1991; LEIGHTON, 1999; VIANELLO, 2005; PACCIARELLI, 2006). Imports from Late Bronze Age Greece have also provided chronological beacons to date the typological development of the local hand-made ceramic repertoire from funerary (D'AGATA, 1987; ALBERTI, 2008), settlement (ALBERTI, 2008), or stratified contexts (LA ROSA & D'AGATA, 1988), and from a mixture of the above (ALBANESE PROCELLI *et al.*, 2004).

However, devising an absolute chronology on the basis of imports alone is not an easy endeavor due to an interplay of cultural and contextual factors that complicates the matter and can be synthesized as follows: ceramic styles can be difficult to identify in fragmented materials; some ceramic types/styles can span a wide time-period in terms of absolute chronology; in theory, a time lag may exist between production, circulation, actual use, and eventual deposition of pottery in overseas contexts (for contextual problems: VAN WIJNGAARDEN, 2002; ALBERTI & BETTELLI, 2005; JUNG, 2006; ALBERTI, 2013b; for the issue of time lags: VAN WIJNGAARDEN, 2005). These limitations also complicate a clear definition of the lower chronological boundary of the MBA in Sicily. According to whether or not ceramics dating to a particular Mycenaean ceramic style in Greece (namely, Late Helladic IIIB early, see: MOUNTJOY, 1999) are identified in Sicilian MBA contexts as the latest imports (compare BERNABÒ BREA, 1990; BERNABÒ BREA & CAVALIER, 1991; PERONI, 1996; DE MIRO, 1999a, 1999b; ALBANESE PROCELLI *et al.*, 2004; ALBERTI, 2004, 2008; ALBERTI & BETTELLI, 2005; JUNG, 2005, 2006; VIANELLO, 2005), the absolute chronology of the end of the MBA varies accordingly, swinging between about 1300 and 1270 BCE (for the historical dating of the Late Helladic IIIB see: WIENER, 2003; ASTON, 2011).

Compared to historical dating, the use of radiocarbon determinations has increased only in recent times. With the exception of early limited dating programs (ALESSIO *et al.*, 1980; HOLLOWAY & LUKESH, 1995), the bulk of radiocarbon data currently available for different stages of Sicilian prehistory has been mainly acquired in the last decade (MARTINELLI, 2005, 2011; GIANNITRAPANI, 2009; LEIGHTON, 2011; MARTINELLI *et al.*, 2010; CATTANI *et al.*, 2012; CRISPINO, 2017). It must be noted, however, that Bayesian modelling (BUCK *et al.*, 1996) has been seldom used so far, in contrast to what has been done by archaeologists working in northern Italy (*e.g.*, VALZOLGHER & QUARTA, 2009; VALZOLGHER *et al.*, 2012). Few exceptions exist, like the Bayesian modelling of radiocarbon dates from a MBA settlement in the Aeolian Islands (ALBERTI, 2011, 2015) to understand its chronological position within the overall development of the MBA, and the use of radiocarbon data in a Bayesian framework to devise an independent absolute chronology for the Sicilian Early and MBA (ALBERTI, 2013a) and to shed some light on the transition between those two phases (ALBERTI, 2013b).

Within a Bayesian framework, this study aims to analyze a small set of seven radiocarbon determinations from a deposit unearthed on the Sant'Ippolito hill (Caltagirone) in central-eastern Sicily. It is for the first time in mainland Sicily that a group of radiocarbon determinations is available from a stratified context featuring MBA materials. This provides the so far unique (however tentative) opportunity to: a) add new data to the overall body of radiocarbon determinations from MBA contexts; b) to understand which part of the overall development of the MBA the context and its associated material are likely to represent; c) to gauge (in terms of posterior probability) the chronological relation between the context under study and another MBA settlement (namely, Portella on the island of Salina) for which recent studies have estimated the start and end boundaries via Bayesian analysis (ALBERTI, 2015); d) to lay the basis to set into chronological niches some stages of development of the local MBA ceramic repertoire without the aid of associated imported material; e) to shed light on the issue of the lower boundary of the chronology of the MBA.

2. The Sant'Ippolito site: cultural and archaeological context

The Hill of Sant'Ippolito at Caltagirone is not new to the archaeological literature, being strictly connected with the first discovery of an important eponymous Copper Age pottery style (CRISPINO, 2014). During excavations carried out in the 1990s, evidence of a Middle Bronze Age (1550-1250 BCE) settlement emerged (TANASI *et al.*, 2019). During that campaign two large trenches called 'Saggio A' and 'Saggio B' were opened in the lower terrace of the hill (Fig. 1). Saggio A featured materials related to an occupational phase dating to the Greek Archaic period. On the other hand, the archaeological

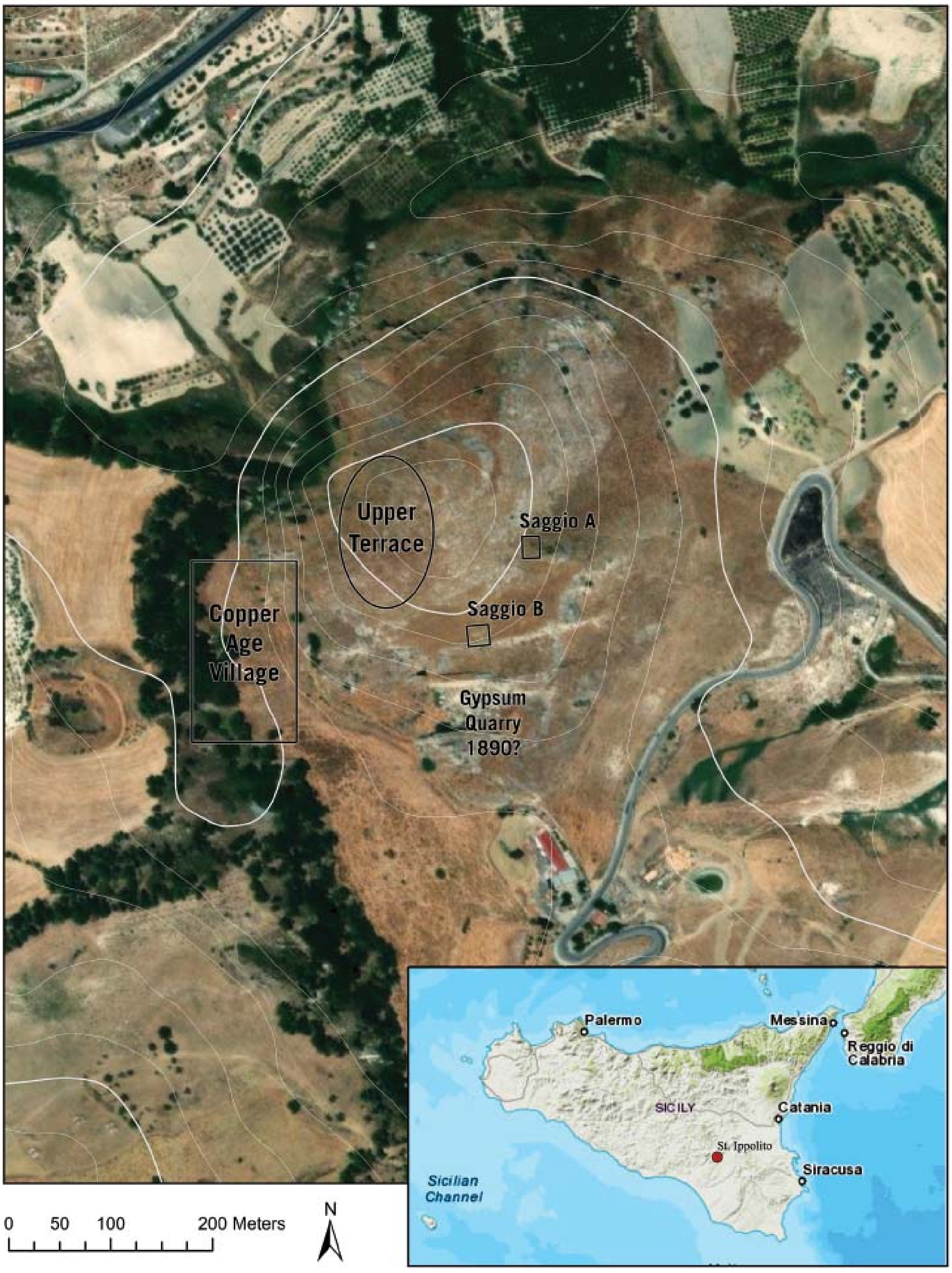

Fig. 1 – Aerial view of St. Ippolito Hill with indication of the two main excavation areas

evidence from Saggio B suggests an overall older chronology according to what is left of two complex structures and large amounts of pottery remains, which would date the context back to the MBA. Smaller groups of samples also indicate a further phase of use within the same context dating to the Late Bronze Age (LBA) and the Early Iron Age (EIA) (12th-10th centuries BCE).

Out of the 17 quadrants in which Saggio B was subdivided, only five (B4, B5, B8, B10, B17) have provided diagnostic prehistoric evidences of human occupation although the dynamics related to its duration and spatial extension are, yet, highly unclear (Fig. 2). The most prominent discovery was the superimposition of two Bronze Age structures from quadrant B4, which also provided the most reliable and documented stratigraphic sequence of the entire trench. The ceramic repertoire here recovered dates back to the MBA, and includes shapes and types that are commonly identified throughout Eastern Sicily among all three sub-phases (I, II, and III) of the Thapsos production, whose classification for the south-eastern side of Sicily only relies on typological studies. Quadrants B10, B8, B5, and B17 offered instead evidence of a less intense occupation of the area in later phases dated to the LBA and the EIA (TANASI *et al.*, 2019).

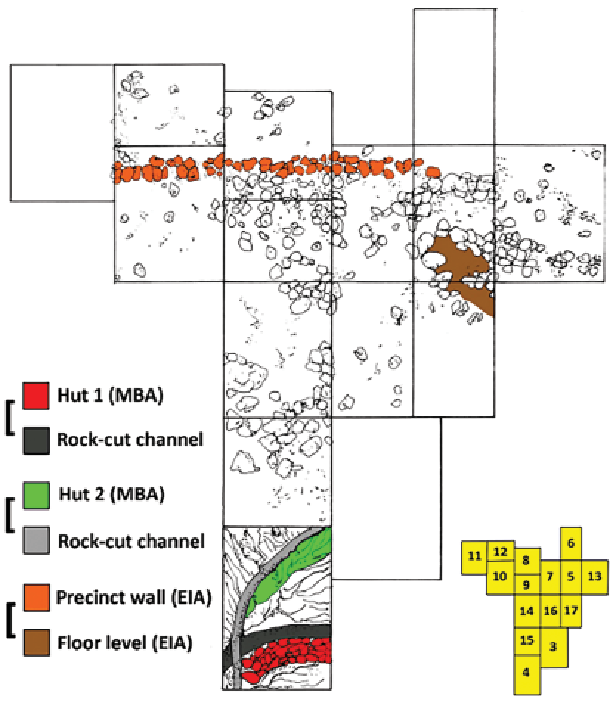

Fig. 2 – Schematic plan of the main chronological phases of the structured uncovered in Saggio B (TANASI *et al.*, 2019).

Although the excavation was not carried out according to current standards but through progressive cuts of standard depth into ground layers, contexts corresponding to actual stratigraphic units were identified on the basis of cultural features and stratum characteristics observed in the various layers subject to those cuts. The critical revision of the textual, graphic and photographic data recorded during the excavation and the meticulous analysis of the materials collected and the way in which they are associated cut by cut, has confirmed the veracity of the internal organization of the deposit and offered further interpretative data for those contexts.

While 'cuts into layers' (hence layers) 1 through 8 revealed a stratigraphic sequence that had been considerably damaged by post-depositional events, the sequence from layer 9 down to layer 16 highlighted the presence of a series of anthropogenic contexts called in the excavation notebooks US (Unità Stratigrafica = Stratigraphic Unit) XII, XIII and XIV (Fig. 3).

Layer 9, interpreted as a floor level by the excavators, did not provide any materials except a few small fragments of adobe, which could be embedded into it or be part of its substructure, and an intact miniature andiron typical of the Thapsos *facies* (ORSI, 1895: tav. IV.4; Fig. 4a). Such an artefact marks the occupation of such a floor level which not necessarily must have been related with any built structure. Underneath layer 9, layer 10, which offered a very significant amount of adobe fragments, Thapsos type pottery (Fig. 4b-d) and lithic implements were identified as related with a likely wattle and daub structure, named Hut 2, associated with a canal carved in the bed rock. The simultaneous presence of what seems to be the deposit of the collapsed structure and an array of well-preserved artifacts apparently in situ suggest that the layer cut was comprised to separate archaeological

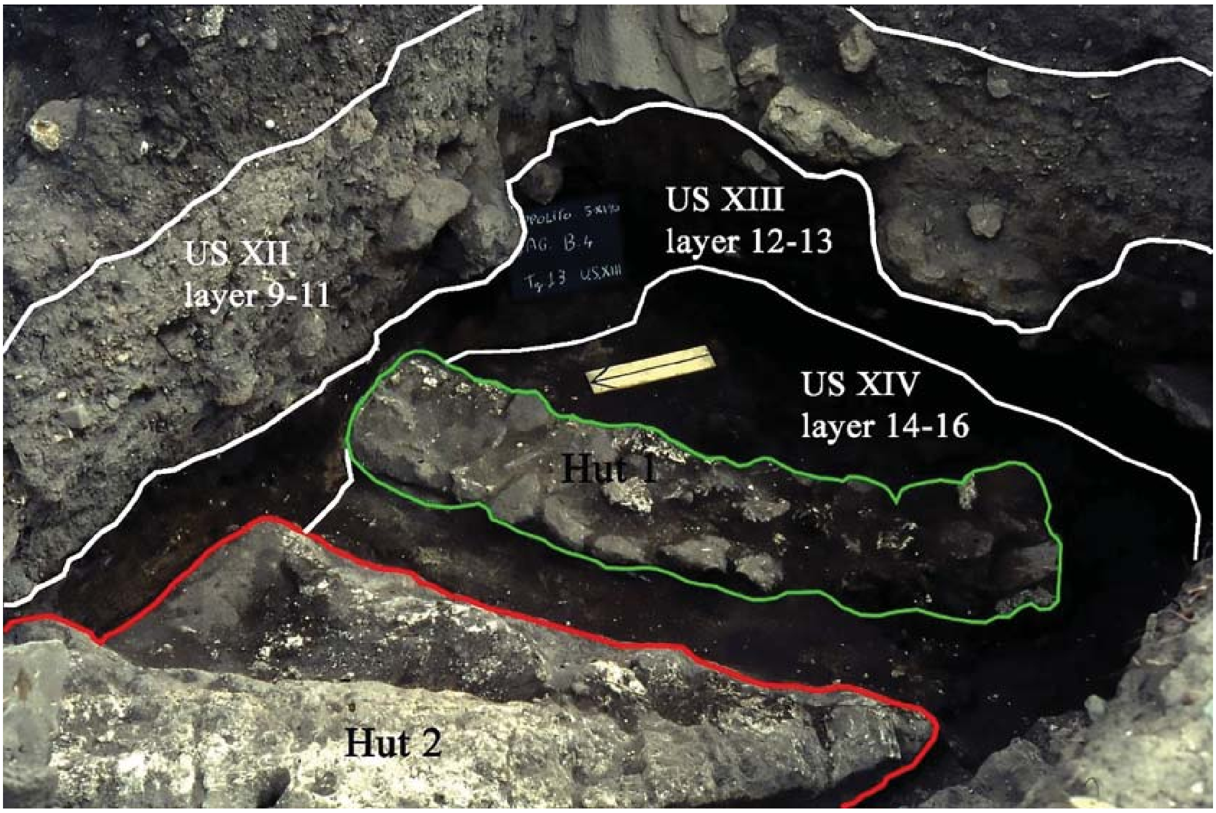

Fig. 3 – Saggio B, quadrant 4 at the end of the excavation with indication of the layers grouped in stratigraphic contexts US XII, US XIII, US XIV and structures "Hut 1" and "Hut 2".

strata, a collapsed layer set above a distinguished floor level. Layer 11, found right below layer 10, bore no findings was substantially negative and possible to be interpreted as the substructure of that floor level. The sequence of layers 9/10/11 can be interpreted as related with the phase of use and abandonment of the Hut 2, and justifies its identification by the excavators as a homogenous cultural context, named US XII.

Underneath layer 11, layers 12 and 13 were observed, whereas 12 produced just animal bones and 13, set right above the level of the bedrock, produced a significant number of ceramics of Thapsos type (Fig. 4e-f) and some adobe fragments and animal bones. It is hard to provide a clear definition of layers 12 and 13 but it seems likely that they were part of the same stratum excavated through two progressive cuts, which could have been the remnant of a badly preserved and not clearly identified older floor level, or perhaps a deposit preceding the installation of Hut 2. The discovery of several fragments of a large *pithos* confirms the hypothesis of a floor level. In any case, even in the interpretation of the excavators, they belonged to that same cultural context, called US XIII.

The lowest part of the stratigraphic sequence appears to be rather problematic for the paucity of data recorded during the excavations. Three further layers, labelled as 14, 15 and 16, were identified as related with a portion of a curvilinear wall built with irregular stone blocks arranged in two courses, oriented north-south. Such a curvilinear wall, stratigraphically older than the structures of Hut 2, can be provisionally attributed to an older Hut 1. All three layers provided animal bones and pottery commonly identified as of an earlier stage of Thapsos facies (Fig. 4g) including a fragmentary example of a large pedestal basin. In this case, on the basis of the homogenous cultural features, the sequence 14/15/16 was identified as US XIV.

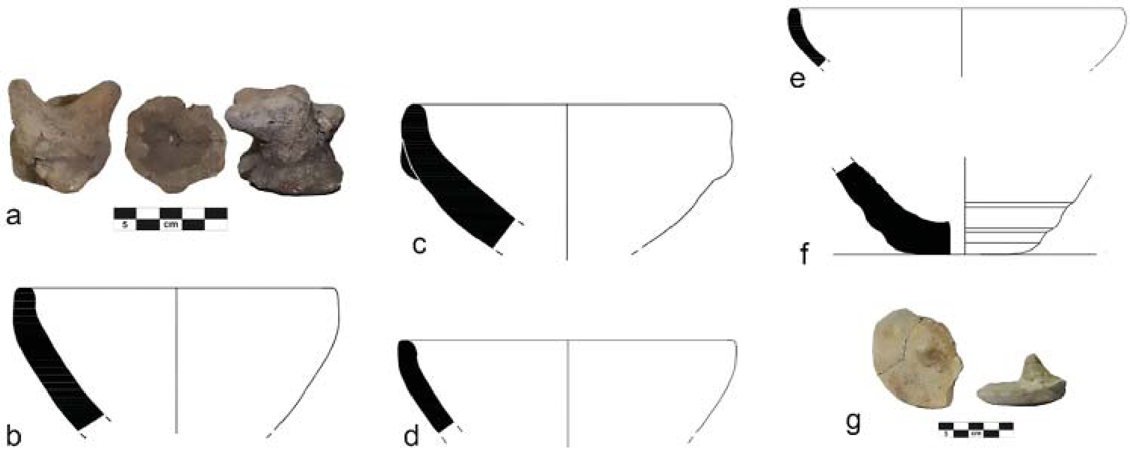

Fig. 4 – Thapsos *facies* materials from B4: a) Terracotta andiron B4/9/8 from layer 9; b) Cup B4/10/4 from layer 10; c) Cup B4/10/6 from layer 10; d) Cup B4/10/3 from layer 10; e) Cup B4/13/2 from layer 13; f) Base of pithos B4/13/6 from layer 13; g) Lid of pyxis B4/14/2 from layer 14 (photos by authors, drawings by C. Veca).

3. Materials and the Bayesian model

In the frame of an overall reappraisal of the archaeological evidence from this site, whose excavation is still ongoing, a research project with a strong archaeometric component has recently been carried out (TANASI *et al.*, 2019). It has also led to the reappraisal of the stratigraphic deposit and of the related ceramic materials. As an advanced stage of such a project, seven animal bones have been sampled from the several layers of the three main contexts of B4 at the Musei Civici "Luigi Sturzo" of Caltagirone in 2017 and 2018, according to the archaeological association between known typological attributes of ceramic artifacts, the stratigraphic relations between the layers, and the current condition of the specimens available. Six were identified as bone fragments of ungulates, which are often represented among several archaeological prehistoric contexts of Sicily by the local deer, while only one sample is a portion of the right maxilla of a local *sus scrofa* (Tab. 1).

The samples were processed at the Laboratory for Archaeological Science of the University of South Florida's Department of Anthropology and then submitted to the University of Georgia's Center for Applied Isotope Studies for AMS radiocarbon dating.

Sample ID	*UGID*	*Sample type*	*Layer*	*Anthropogenic context*
36338	31492	Cervus Lumbar Vertebra	B4/9	US XII
33689	31493	Cervus Right Tibia	B4/9	US XII
36339	31494	Cervus Left Femur	B4/12	US XIII
33688	37911	Cervus Left Humerus	B4/13	US XIII
33690	37912	Cervus Right Tibia	B4/14	US XIV
36340	37913	Cervus (left radius)	B4/15	US XIV
36341	37914	Sus Scrofa (right maxilla)	B4/16	US XIV

Tab. 1 – USF sample ID, UGID, animal species, provenance and context of the bone samples submitted for radiocarbon analysis. UGID refers to the laboratory code from the University of Georgia, Center for Applied Isotope Studies.

The collagen samples were combusted at 575° C in evacuated/sealed ampoules in the presence of CuO. The resulting carbon dioxide was cryogenically purified from the other reaction products and catalytically converted to graphite using the method of Vogel *et al.* (1984). Graphite $^{14}C/^{13}C$ ratios were measured using the CAIS 0.5 MeV accelerator mass spectrometer. The sample ratios were compared to the ratio measured from Oxalic Acid I (NBS SRM 4990). The sample $^{13}C/^{12}C$ ratios were measured separately using a stable isotope ratio mass spectrometer and expressed as $\delta^{13}C$ with respect to VPDB, with an error of less than 0.1‰. The quoted uncalibrated dates have been given in radiocarbon years before 1950 (years BP), using the ^{14}C half-life of 5568 years. The error is quoted as one standard deviation and reflects both statistical and experimental errors. The dates have been corrected for isotope fractionation (Fig. 5, Tab. 2).

To address the questions elicited in the introduction, a Bayesian model has been built in OxCal v. 4.3 (BRONK RAMSEY, 2009; BRONK

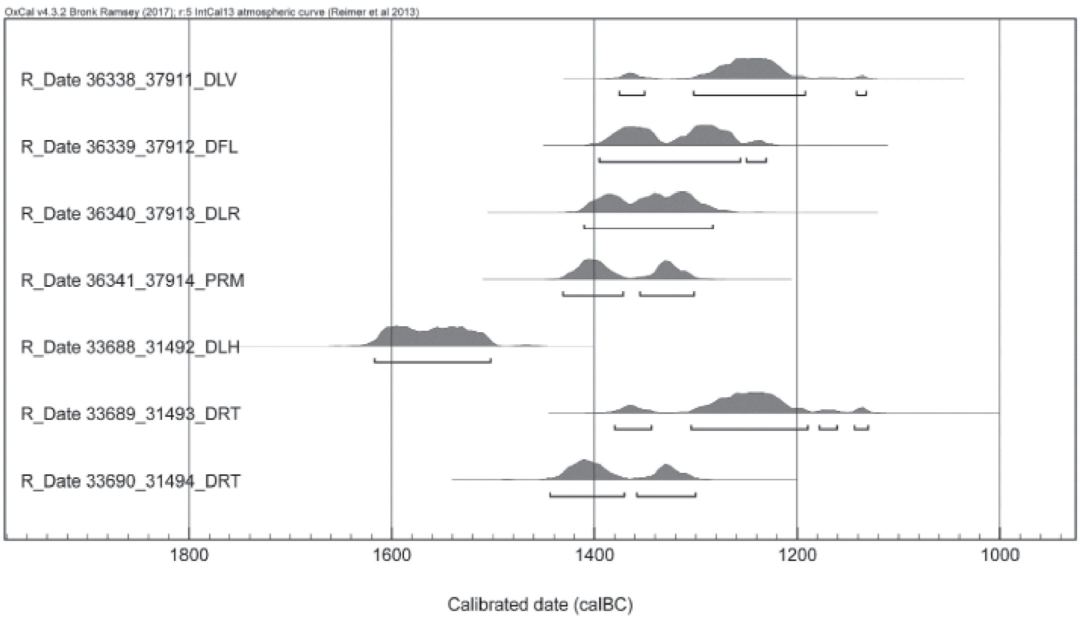

Fig. 5 – Calibrated radiocarbon dates of the seven faunal samples used in this study.

SampleID	*UGID*	*Material*	*δ13C, ‰*	*δ15N, ‰*	*C/N*	*14C age, years BP*	±	*pMC*	±
33688	31492	Collagen	-20.39	4.81	3.33	3280	25	66.45	0.20
33689	31493	Collagen	-20.43	4.65	3.36	3010	25	68.78	0.21
33690	31494	Collagen	-20.69	4.15	3.37	3120	25	67.83	0.20
36338	37911	Collagen	-19.46	4.99	3.34	3010	20	68.76	0.17
36339	37912	Collagen	-19.48	5.55	3.30	3050	20	68.40	0.17
36340	37913	Collagen	-20.48	5.18	3.29	3080	20	68.13	0.17
36341	37914	Collagen	-19.97	5.50	3.31	3110	20	67.89	0.18

Tab. 2 – Carbon (δ13C) and nitrogen (δ15N) isotope values, carbon-to-nitrogen ratios, and AMS uncalibrated radiocarbon dates of the collagen from well-preserved faunal remains from the quadrant B4 at St. Ippolito.

RAMSEY & LEE, 2013). The latest calibration curve IntCal20 (REIMER *et al.*, 2020) has been used throughout the analysis. We tried to strike a balance between model complexity and the sheer number of radiocarbon dates available so far. The model consists of two phases defined as sequential, that is allowing for a gap between them (BRONK RAMSEY, 2009; Fig. 6). The older phase (in terms of relative chronology) includes the radiocarbon dates from cut 14 through 16 (US XIV); it has been labelled "below layer 10" (*i.e.*, chronologically earlier than layer 10) since it features determinations coming from below layer 10. The later phase, which includes radiocarbon dates from cut 9, has been labelled "above layer 10" (*i.e.*, chronologically later than layer 10) (a similar approach in EGAN *et al.*, 2015). One determination (33688), coming from layer 13, has been preliminarily flagged as an outlier in OxCal since it was apparently older than the radiocarbon dates coming from lower layers. The posterior probability of that sample to lie in its position within the model will be nonetheless estimated via OxCal's diagnostic that is returned in lieu of individual agreement index (BRONK RAMSEY, 2009). The activity represented by layer 10, which cannot be directly dated, is bracketed between the lower boundary of the older phase ("below layer 10") and the upper boundary of the later one ("above layer 10").

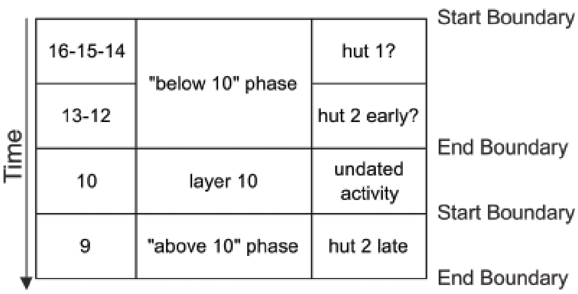

Fig. 6 – Schematic representation of the Bayesian model used in this study; layers (left column) are ordered in stratigraphic sequence and grouped into phases (center); the archaeological interpretation of the layers is also indicated (right). Phases are modelled as sequential to allow for a gap between them, represented by the undated activity corresponding to layer 10.

In defining the two phases, uniform start and end boundaries have been employed since we have no substantive basis as to the distribution of the events within each phase. Uniform boundaries assume "that all of the events within the group are equally likely to occur anywhere between the start and the end" (BRONK RAMSEY, 2009). The OxCal *Interval* query has been used to calculate the posterior probability density (ppd) of the duration of each phase. We used the same query to estimate the ppd of the time interval between the lower boundary of the older phase and the upper boundary of the later one. This interval is assumed to correspond to the time slot for the activity represented by layer 10. The *Order* query (BRONK RAMSEY, 2009) has been employed to calculate the posterior probability for the order of the start and end boundaries of the Portella phase (ALBERTI, 2015) and of the Sant'Ippolito MBA phase as whole (*i.e.*, start boundary of the "below layer 10" phase and ending boundary of the "above layer 10" phase). The underlying rationale is that we make no assumption about the relation between the two phases, and we aim at calculating the posterior probability for them to be in any given order (BUCK *et al.*, 1992).

4. RESULTS

Upon completion, the analysis produced good agreement indices (A_{model}: 103 and $A_{overall}$ 103, both rounded to the nearest integer), which indicate that the model agrees with data (Bronk Ramsey, 2009). The radiocarbon determination that has been preliminarily flagged as outlier is associated to a very low posterior probability of lying in that position within the model (0.4). The analysis indicates that the duration of the older phase is in the range 0-59 or 0-145 years (68% and 95% respectively), while the duration of the later phase falls somewhere in the range 0-56 or 0-152 years.

The model dates the start of the older phase in the range 1450-1306 cal BCE (Fig. 7a). If we were to employ a point estimate (in the light of the whole 95% ppd) as a frame of reference that may prove useful in interpreting radiocarbon chronologies (ZEIDLER *et al.*, 1998),

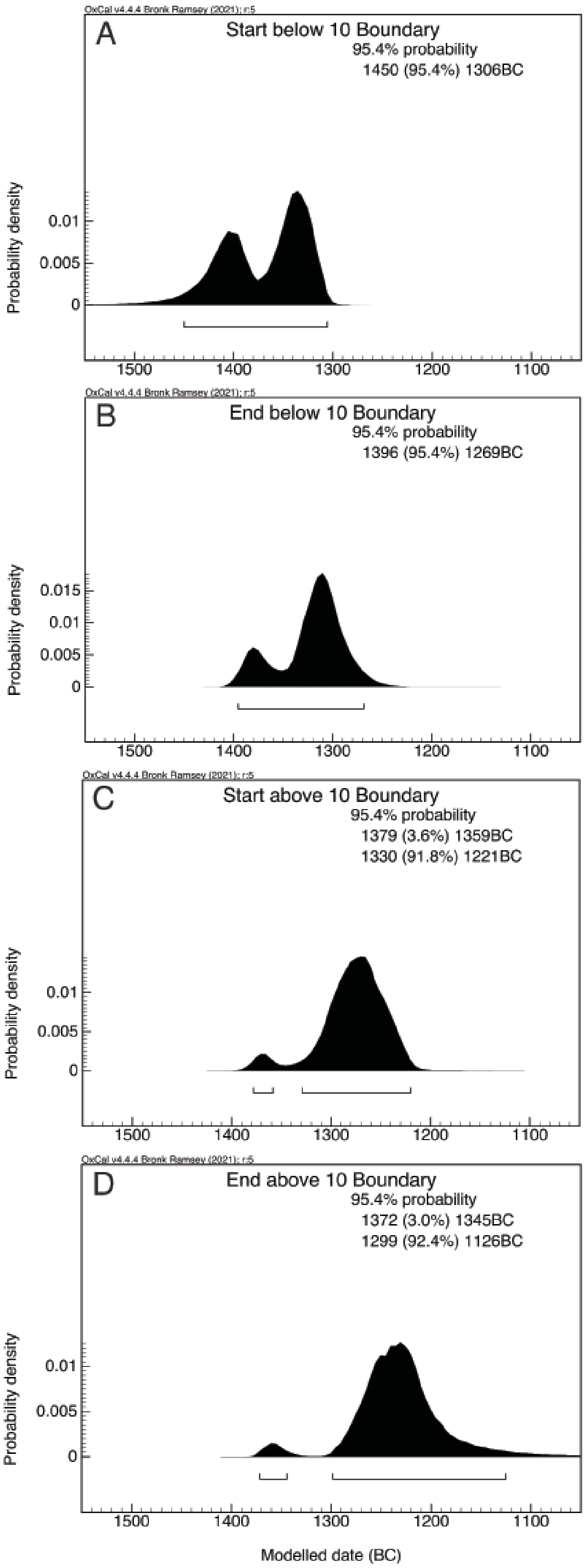

Fig. 7 – Posterior Probability density for the calendar date of the start (A) and end (B) of the "below 10" phase, start (C) and end (D) of the "above layer 10" phase.

the most likely date (CHRISTEN, 1994; NEEDHAM *et al.*, 1997; ANDERSON *et al.*, 2001; BUCK *et al.*, 2003; BACHAND, 2008; LEVY *et al.*, 2008; PETRIE & TORRENCE, 2008; GRECO & OTERO, 2015) is around 1340 cal BCE. The end of this phase (which corresponds to the upper ceiling of the activity represented by layer 10) is in the range 1396-1269 cal BCE, with the most likely date around 1310 cal BCE (Fig. 7b). The start of the later phase (which corresponds to the lower ceiling of the chronology of layer 10) is dated in the range 1330-1221 cal BCE (91.8%), with 1265 cal BCE as the most likely date (Fig. 7c). The end is dated in the range 1299-1126 cal BCE (92.4%), with a most likely date at 1230 cal BCE (Fig. 7d). The duration of the time slot corresponding to layer 10 is in the range 0-56 or 0-113 years, with 25 years as most likely value. Overall, if we consider the difference between the start of older phase and the end of the later one, the duration of the MBA as represented by the deposit as a whole can be anything between 63-189 or 18-276 years (68% and 95% respectively), with 100 years as most likely value.

As for the relation with the start (95%: 1554-1432 cal BCE) and end (95%: 1386-1187 cal BCE) of the Portella phase (ALBERTI, 2015), if we consider the whole time period expressed by the deposit, the difference between the start of Portella and the start of the older phase falls between -175 and -70 or -217 and -10 years (68% and 95% respectively), with -120 as the most likely value (negative values indicating that the former phase is older than the latter). The difference between the end of Portella and the end of the later phase falls between -140 and -8 or -210 and 79 years, with -80 as the most likely value. The posterior probability for the order of the mentioned boundaries is reported in table 3 (Tab. 3) Those figures allow to calculate that there is 0.83 probability that for the start of the older San Ippolito phase to fall within the Portella phase, and that there is 0.67 probability for the end of Portella to fall within the MBA as represented by our deposit (*i.e.* between the start of the older phase and the end of the later phase). Overall, there is 0.69 posterior probability that the Portella phase is overlapping/older than the MBA as represented by the deposit as a whole.

	Start below 10	*End above 10*	*Start Portella*	*End Portella*
Start below 10	0	1	0.0187	0.8480
End above 10	0	0	0	0.1519
Start Portella	0.9813	1	0	1
End Portella	0.1521	0.8481	0	0

Tab. 3 – Posterior probabilities for the order of the stard and end boundaries of San Ippolito and Portella phases, as calculated by the OxCal's Order query. The probability figures refer to the events in the row to be earlier than the events in the column.

5 .DISCUSSION: CHRONOLOGICAL AND ARCHAEOLOGICAL IMPLICATIONS

In spite of the limited body of measurements and of the limitations inherent in the excavated stratigraphy, the preceding analysis allows to shed light on the position of the Sant'Ippolito context within the overall development of MBA in Sicily. The activities represented by the deposit as a whole would correspond to a mature and advanced stage of the Sicilian MBA sequence. Compared to the evidence from the site of Portella, which provides the earlier MBA start known so far, with the most likely date falling somewhere between 1490 and 1460 cal BCE (ALBERTI, 2013a; 2015), the start of the MBA at Sant'Ippolito turns out to be later by about 100 years. The Portella phase is likely (0.69 probability) to be overlapping/older than the San Ippolito one. This information, gained through Bayesian analysis, proves interesting for different reasons. First, because they disclose a picture that could not have been achieved using traditional historical dating, especially in archaeological contexts lacking of any evidence of datable ceramic imports. Secondly, because they allow one to discover and gauge (however tentatively) the existence of a site-wise variability in the start of the MBA (see also ALBERTI, 2013b). Thirdly, because the very existence of a time differential in the start of the MBA can provide grounds for future research to explore if a time factor may account for differences in the ceramic repertoire between sites.

While the Sant'Ippolito deposit as a whole is likely to represent a mature and advanced stage of the overall development of the MBA, the analysis provides grounds to bracket different chronological horizons within the same deposit. The older phase (1340-1310 cal BCE, in terms of most likely dates) would correspond to a mature stage of the MBA, while the later phase (1265-1230 cal BCE, again in terms of most likely dates) would represent an advanced stage of the overall MBA development. Importantly, these chronological niches can provide grounds to tentatively pin down the use of some MBA ceramic types that have been dated elsewhere in Sicily only on the basis of either direct or indirect association with ceramic imports in a variety of contexts (see references in § 1). For instance, the local grey hand-made pedestal bowl with round inverted profile (Fig. 4e), that has been ascribed on typological grounds to a mature/advanced stage of MBA ceramic development (ALBANESE PROCELLI *et al.*, 2004; ALBERTI, 2008), is documented in the older phase. The latter, as shown by the analysis, is likely to represent a mature stage of the MBA from a chronological perspective, and may help pinning down the use of that particular ceramic type somewhere between 1340-1310 (most likely dates for the older phase). By the same token, the lower boundary of the later phase, estimated to fall somewhere between 1295-1121 cal BCE (most likely date at about 1230 cal BCE), may provide a *terminus post quem* for the ceramic types from upper levels (cuts 7 and 8).

The chronology of the lower boundary of the later phase provides grounds to also shed light, from a radiocarbon perspective, on the issue of the end of the MBA in mainland Sicily. While future research might improve the proposed model by acquiring new radiocarbon determinations that could constraint the lower boundary of the model, the available evidence from Sant'Ippolito turns out to be in contrast with the current understanding of the end of MBA, which has been traditionally set on a historical basis somewhere between 1300 and 1270 BCE. Layers featuring MBA ceramic types are documented above layer 9 which, in our model, corresponds to the later phase. It would seem that the use of MBA ceramic types continued for some time after the later phase. However, on current evidence, there is no ground for establishing how long the use of MBA ceramic types lingered on after 1230 cal BCE.

6. Conclusions

In conclusion, the AMS radiocarbon dates from the settlement at St. Ippolito have provided grounds to shed light on some aspects of the absolute chronology of the MBA in mainland Sicily. In spite of some acknowledged limitations, the new data seem to suggest that the MBA deposit at St. Ippolito represents a mature and advanced stage of the overall MBA development. Data seem to also indicate that the use of MBA materials at the site was still underway between 1265-1230 cal BCE, whereas according to the traditional chronological sequence 1270/50 BCE would mark the beginning of the North Pantalica facies, which represents the Sicilian Late Bronze Age culture. It would be interesting to know if the radiocarbon evidence from Sant'Ippolito hill may prove compatible with the evidence from Cannatello, which is one of the key MBA sites in southern Sicily unfortunately still unpublished. It would seem that ceramic imports later than 1200 BCE are documented at that site (De Miro, 1999,; 1999b; Vagnetti, 2001a), but no further contextual information is as yet available regarding, for instance, the presence and type of associated (if any) local MBA materials.

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