

THE COPPER AGE MOUND NECROPOLIS IN SALVE, LECCE, ITALY: RADIOCARBON DATING RESULTS ON CHARCOALS, BONES, CREMATED BONES, AND POTTERY

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ABSTRACT. Archaeological surface surveys carried out near Salve in southern Italy led to the identification of about 90 stone mounds spread over an area of about 100 ha. Systematic archaeological investigations allowed to identify the mounds as funeral structures with some having megalithic features. In the necropolis, both the inhumation and cremation rituals are evident, in some cases within the same mound. This article presents the results of an accelerator mass spectrometry (AMS) radiocarbon dating campaign carried out on different kinds of samples recovered from several structures: unburned and cremated bones, charcoals, and organic residues extracted from pottery sherds. The results allowed to assess the chronology of the site and to shed new light on the different funeral practices in Copper Age southern Italy.

INTRODUCTION

In 2005, the paleoethnology group at the Department of Cultural Heritage, University of Salento, started a systematic archaeological investigation in Masseria don Cesare located near Salve (Lecce) in southern Italy (Figure 1). The archaeological surface survey of the area brought to light stone mounds distributed over a large area of about 100 ha. Systematic excavations revealed that most of the mounds are indeed the remains of funeral structures and contained diagnostic archaeological materials (mainly pottery) suggesting a Copper Age (3rd–4th millennium BC) date. The identification of a large number of buried individuals as well as the architectural features of the mounds led to the classification of the area as a necropolis. Interestingly, in the same area and in some cases even within the same mound, both the inhumation and the cremation rituals are testified by human remains and are closely associated with pottery stylistically attributed to two cultural aspects, Gaudio and Laterza (Cocchi Genick 2009), widely diffused in southern Italy during the Copper Age. The necropolis has become a key site in defining an absolute timeframe for the chronology of different cultural aspects of the southern Italian Copper Age. Furthermore, the ritual of cremation was never previously testified in this part of Italy (Apulia) for this period since earlier archaeological investigations only revealed the use of natural or artificial caves as collective burial sites such as in the Grotta Cappuccini cave in Galatone (Ingravallo 2002; Quarta et al. 2004). A ¹⁴C dating campaign was thus planned and carried out in order to establish an absolute chronology for the necropolis and address other open archaeological issues such as the dating of the occurrence of megalithism in this part of Italy, which had been dated to the more recent Middle Bronze Age (2nd millennium BC).

Another aim of the ¹⁴C analysis was to date the two testified burial practices, inhumation and cremation, in order to verify whether the two rituals coexisted or corresponded to two different moments of use of the necropolis. Various kinds of samples were thus selected and analyzed by accelerator mass spectrometry (AMS) ¹⁴C dating: cremated and unburned bones, charcoals, and organic residues from pottery.

ARCHAEOLOGICAL INFORMATION

The necropolis (39°50'N, 18°14'E) covers an area of approximately 100 ha and is located on the southern slopes of a ridge (Serra Spilogizzi) gently degrading from about 60 m above sea level towards the sandy littoral zone of the Ionian coast of the Salento Peninsula (Figure 1). The archaeological survey of the area has led, so far, to the identification of 90 mounds (numbered from 1 to 90)

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with a circular or oblong shape. The mounds, between 7 and 13 m long and 3–7 m wide, are usually delimited by large stone blocks and appear today covered by soil and stones with a height between 40 and 80 cm above the ground level. Currently, the mounds are also covered by local vegetation, making their identification difficult.

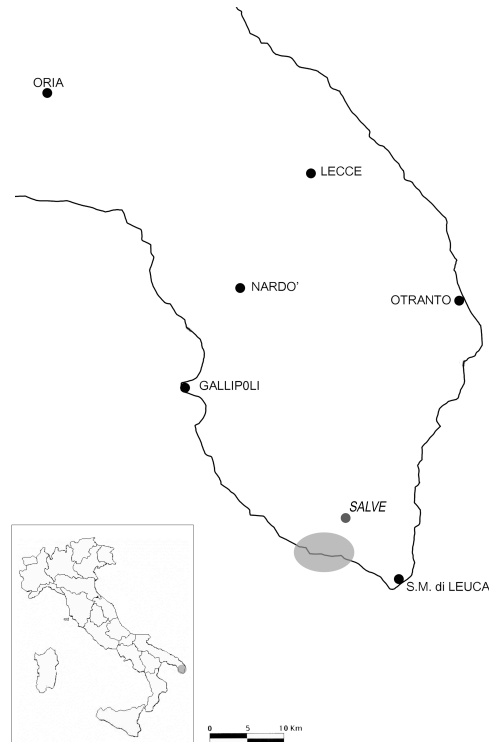


Figure 1 Location of the investigated area (gray ellipse) within southern Italy.

Of the 90 identified mounds, 11 underwent systematic archaeological excavations in the period between 2005 and 2013. Of these, four did not show archaeological evidence and are likely the results of recent agricultural works, two (mounds no. 2 and 4) have been identified as ritual monuments, and the remaining five (mounds no. 1, 6, 7, 9, 10, and 68) were classified as funeral monuments in which the ritual of cremation is testified. In one of the excavated mounds (no. 7), both the cremation and inhumation rituals are present.

A full description of the archaeological setting is reported elsewhere, together with the full stylistical analysis of the recovered pottery (Ingravallo et al. 2007, 2010; Ingravallo and Tiberi 2011). This article only discusses the main features of the mounds from which the samples submitted to ^{14}C dating were taken.

Mound no. 6

Mound no. 6 had a circular shape, ~60 cm high with a diameter of ~10 m. It showed a large basal structure, oriented along the east-west direction and formed by large stone boulders with an elliptical profile. Along the southern limit, three pots stacked one into the other were found. The first ovoidal pot contained a second cone-truncated pot with, inside it, another small pot. In the central part of the mound, two fragmented pots contained human teeth, which were also found scattered

all around, together with a human femur, pottery sherds, and fragment of combusted human bones.

Mound no. 7

Mound no. 7 is the largest mound so far excavated and surely the most interesting (and complex) from an archaeological point of view (Figure 2). It is located about 100 m to the north from mound no. 6 and is cut along one side by a modern road. Along the eastern limit of the mound, a 150-cm-deep cist (Figure 2d) made of stone slabs was uncovered. It had a rectangular shape with inner and outer dimensions of 160×135 and 230×200 cm, respectively. Inside the cist, uncombusted human bones belonging to at least 50 inhumated individuals were found in the uppermost layers. Together with the bones, different pottery forms belonging to the Laterza culture, very similar to those found in the Cappuccini cave in Galatone, were found together with a Gaudio-type pot. Ornamental items were also found such as pendants and beads of a necklace made of bone and marine shells.

Inside the cist, a 70-cm-thick sterile layer divided the buried individuals from the lower archaeological levels containing three Laterza and Gaudio pots with cremated human bones inside them. Behind the cist and below a large stone block, there was a 40-cm-deep circular pit with a diameter of 54 cm, formed by four rows of flat stone blocks (Figure 2c). The pit was filled with medium-sized stones and soil showing evidence of combustion such as cinereous soil, charcoals, and combusted stones. This pit was thus identified as a “combustion structure” probably involved in the cremation rituals.

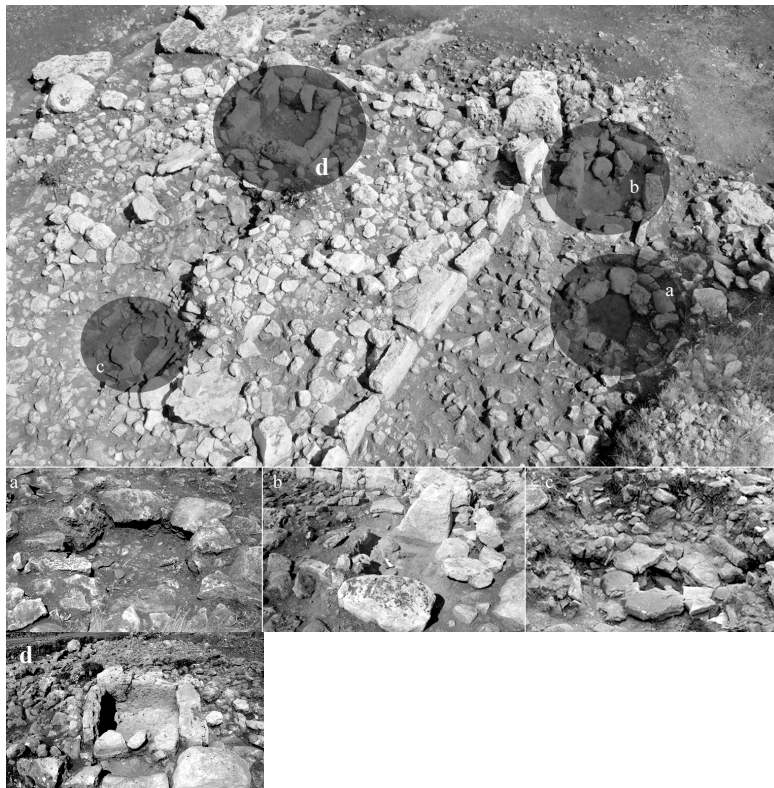


Figure 2 View of mound no. 7. The most relevant structures are indicated by gray ellipses: (a) cultural pit; (b) quadrangular structure; (c) combustion structure; (d) lithic cist.

The monument is delimited along the southern limit by a 14-m-long wall made of large stone blocks, at present interrupted by a modern road. Between the road and the wall there is a 50-m² surface covered by stones and containing a 45-cm-deep circular pit (outer diameter 150 cm, inner diameter 70 cm) delimited by eight stone slabs (Figure 2a). The “cultural pit” contained soil, charcoals, and an intentionally broken Gaudio-type pot. At about 1 m from the pit and attached to the wall, there is a quadrangular (110 × 170 cm) cist-like 45-cm-deep structure bounded by five stone blocks and on the same axis of the main lithic cist (Figure 2b). The structure was filled with stones and soil whose color was initially white-gray in the uppermost layers, becoming red at the base with evident signs of combustions and charcoal pieces. Inside the pit, a fragment of a human femur and various human teeth were found.

Mound no. 9

Mound no. 9 is the simplest structure so far identified and consisted of a platform made of large stone blocks laying on the base rock. This platform was then covered by a filling made of soil and smaller stones in order to obtain an elliptical shape bordered by large stone slabs, isolating the mound from the surroundings. In the filling, scattered in an apparently random way, there were pottery fragments and human bones belonging to two adults.

Mound no. 10

This mound had apparently, before excavation, a shape similar to those of the simplest mounds: an elliptical structure delimited by large stone slabs. Indeed, the excavation revealed a complex megalithic structure, comparable to that of mound no. 7. Mound no. 10 is oriented along the E-W direction; it is 10 m long and 5–6 m wide with a maximum height of ~1 m above the current ground level. Along the short, western side, two rectangular compartments were obtained. They were parallel to each other and separated by a row of vertical stone blocks, one of which was significantly taller than the others and had, likely, the function of making the mound visible and recognizable once covered. In the first, external compartment, in a position probably corresponding to the entrance, a pot was deposited next to a turtle plastron. In the second compartment, next to the central chamber of the mound, different ceramic fragments were scattered. The central chamber, mainly obtained in a large cavity of the base rock, was filled with red soil up to the planking level and had a massive floor formed by large, juxtaposed stone blocks. Along the east border, three stacked pots, containing cremated human remains, were found in a sort of niche made of stones. Nearby, a large slab covered other pots, one of which contained the remains on another cremation.

SAMPLE SELECTION AND METHODS

Nine samples were selected from mounds no. 6, 7, 9, and 10 for AMS radiocarbon analyses at CEDAD (Centre for Dating and Diagnostics), University of Salento (Calcagnile et al. 2004). Different type of samples (burned and unburned human bones, charcoals, and pottery) were selected from different mounds and from different stratigraphic units within the same mound. The selected samples were stored in plastic bags and sent directly to CEDAD for ¹⁴C dating.

The strategy for the selection of the samples was aimed at solving different issues: defining the general site chronology, establishing the chronological relationships between the different mounds, and dating the two different funeral practices testified in the necropolis (inhumation and cremation) by checking whether they did correspond to the same chronological phase or to different periods of use of the mounds. Direct dating of pottery was also attempted since microscopic examination pointed towards the use of temper with a high organic content, mixed into the clay before firing, which could be seen both in particulate forms such as vegetal remains and small clusters of indistinguish-

able black residues (Hedges et al. 1992). The motivation for this attempt resides in the possibility to obtain a direct dating of the pottery and not indirectly from associated organic material. Indeed, previous studies have shown how organic temper embedded in archaeological pottery can be used as a reliable material for ^{14}C dating (Hedges et al. 1992; Kuzmin et al. 2001).

Table 1 lists the selected samples and the corresponding sample locations within the necropolis. From mounds no. 6 and 10, two fragments of cremated bones found within pots were selected for the analyses: LTL1687A and LTLT10, respectively. Mound no. 7, as already discussed, revealed a quite complex structure and different samples were selected from the different stratigraphic units. From the quadrangular structure, a charcoal fragment (*Rhamnus/Phillyrea*) (LTL3736A) was selected. Two charcoals were sampled from the combustion structure (LTLG2 and LTLG3). These samples were also identified, through anthracological analysis, as young branches of *Rhamnus/Phillyrea*, a typical plant of Mediterranean evergreen vegetation. From the lithic cist, both unburned and cremated bones were sampled at different depths. Two samples (LTL4456A and LTL4458A) were taken from cremated bones of two different individuals found within two Gaudo pots placed at the base of the pit (Figure 3). Ten unburned bones were also sampled from the 50 individuals inhumated in the upper layers of the pit. Unfortunately, as will be detailed in the following, only one of them (LTL2464B) had a collagen state of preservation good enough to allow accurate ^{14}C measurement. The last sample was obtained from a pottery sherd found at the base of mound no. 9 (LTL4535D).

Table 1 Summary of the analyzed samples, their provenance within the necropolis, and the obtained ^{14}C ages. All samples were archaeologically dated to the Copper Age, and in particular to the two cultural aspects of Gaudo and Laterza.

Lab code	Sample material	Provenance	^{14}C age (BP)
LTLT10	Cremated bone	Mound 10 – Inside pot	4261 ± 45
LTL4456A	Cremated bone	Mound 7 – Lower levels – Lithic cist	4209 ± 45
LTL4458A	Cremated bone	Mound 7 – Lower levels – Lithic cist	4212 ± 45
LTL1687A	Cremated bone	Mound 6	3941 ± 50
LTL2464B	Bone collagen	Mound 7 – Lithic cist	3905 ± 35
LTL3736A	Charcoal	Mound 7 – Quadrangular structure	4265 ± 40
LTLG2	Charcoal	Mound 7 – Combustion structure	4348 ± 45
LTLG3	Charcoal	Mound 7 – Combustion structure	4392 ± 45
LTL4535D	Pottery sherd	Mound 9	4063 ± 45

Sample Processing and AMS Measurements

The selected samples underwent different chemical processing procedures depending on the sample material. Charcoals (between 30–50 mg) were treated by following the standard acid-alkali-acid (AAA) procedure used at CEDAD (Calcagnile et al. 2004). The extracted purified material was then combusted to carbon dioxide together with silver wool and copper oxide in quartz tubes flame-sealed under vacuum (D'Elia et al. 2004). The CO_2 was then cryogenically purified and transferred to the graphitization lines to be converted at 600°C to graphite by using hydrogen as the reducing agent and iron powder as the catalyst.

Bone samples were classified according to their macroscopic features and color (Shipman et al. 1984) in unburned, charred, and calcined bones. Only unburned (ivory) and calcined bones (white and with typical fractures) were selected for this study. Indeed, different studies have shown how the



Figure 3 Pots with cremated bones from the lower levels of the lithic cist of mound no. 7. Samples LTL4456A and LTL4458A were taken from the two pots indicated respectively with (a) and (b) in the figure.

combustion to high temperatures (above 600–700°C) induces structural changes in the bone apatite structure, making it more resistant to diagenesis and allowing reliable ^{14}C dating results through the extraction of the carbonate fraction (Lanting et al. 2001; Quarta et al. 2013).

From unburned bones, ~1 g of material was selected and collagen was extracted by following the standard Longin (1971) protocol. An initial prescreening protocol was applied in order to assess the preservation status of the extracted collagen by means of attenuated total reflection-Fourier transform infrared (ATR-FTIR) analyses as described in detail elsewhere (D'Elia et al. 2007; Gianfrate et al. 2007). ATR-FTIR analyses were carried out at the Chemistry-Physics laboratory of the University of Salento by using a PerkinElmer SpotlightTM FTIR spectrometer. The samples for which a good preservation status of the collagen fraction could be assessed were then combusted to CO_2 and then graphitized as described earlier.

Concerning combusted bones, only those for which a combustion temperature above 600–700°C could be expected (calcined bones) were processed by following the Lanting protocol (Lanting et al. 2001; Quarta et al. 2013). Samples were first treated with sodium hypochlorite (1.5%, 48 hr, 20°C) in order to remove organic residues, then with acetic acid (1M, 24 hr, 20°C) to remove exogenous carbonates and the less crystalline fraction of apatite, and finally oven-dried at 60°C. Structural carbonate was then released as CO_2 by an orthophosphoric acid digestion (20 mL, 85%, 85°C) under vacuum. The extracted CO_2 was then reduced to graphite as previously described. Typically, 500 mg of sample material were used, yielding ~0.5 mg of graphite with an overall yield of ~0.1%.

For pottery sherds, the uppermost layer was mechanically removed and ~15 g of material were crushed to powder by pestle and mortar and processed by following a modified acid-alkali-acid (AAA) protocol as detailed in the following. The first acid attack was significantly longer and stronger than for standard organic samples in order to achieve a better removal of the expected carbonatic contamination coming from the clay matrix. Thus, the first acid attack was carried out

by keeping the sample at pH = 1 in a 37% HCl water solution for 5 days at room temperature. The pH was continuously monitored during the process and kept at pH = 1 by adding 37% HCl when necessary. After this step, the sample was rinsed to neutral pH with deionized water and submitted to the following alkali (NaOH) and acid (HCl 1%) steps.

The sample material was then rinsed with deionized water to neutral pH and underwent a further treatment comprising centrifugation at 3000 rpm in deionized, ultrapure water for 15 min. Through this additional step, the organic fraction, characterized by a lower specific weight than the clay matrix, was concentrated in a supernatant fluid, which was then sampled after oven-drying for 48 hr at 60°C. The purified material (10 mg) was then subjected to the standard process of combustion and graphitization.

AMS ^{14}C measurements were carried out at the AMS beamline at CEDAD (Calcagnile et al. 2005, using a 3MV HVEE Tandem accelerator. The measured $^{14}\text{C}/^{12}\text{C}$ isotopic ratios were corrected for machine and processing background and isotopic fractionation by using the $\delta^{13}\text{C}$ term measured on-line with the AMS system. Measurement uncertainty was conservatively estimated as the larger between the ^{14}C counting statistic error and the data scattering of the 10 measurements repeated for each sample.

RESULTS AND DISCUSSION

Unfortunately, the ATR-FTIR prescreening of selected unburned bones revealed that all samples except one showed a high degree of diagenesis, preventing reliable ^{14}C determinations. Figure 4 shows a comparison between the spectrum (a) obtained for the acid-insoluble fraction of a well-preserved bone (LTL2464B) and of a highly degraded bone (b). It can be noted that while the spectrum (a) clearly shows the characteristic IR absorption bands (indicated by arrows in the figure) characteristic of collagen, these are much less intense or even not visible in the spectrum (b) of the badly preserved bone. This indicates high degradation of the collagen fraction and discouraged the use of these samples for dating.

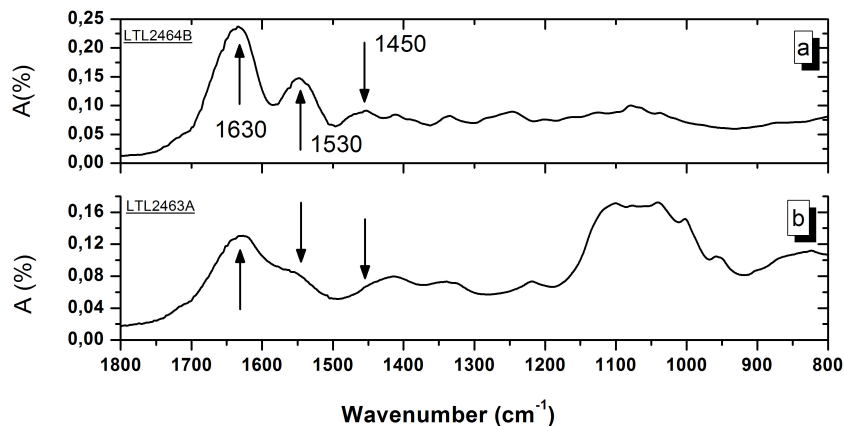


Figure 4 ATR-FTIR spectra obtained from two unburned bones from the upper level of the lithic cist of mound no. 7. Spectrum (a) was obtained for a well-preserved bone (LTL2364B) and spectrum (b) from a highly degraded bone. The arrows indicate the position of the infrared absorption bands characteristic of collagen, with the numbers on the x axis the positions of the peaks in cm^{-1} .

Conventional ^{14}C age results from the samples are summarized in Table 1. The obtained ages were then calibrated to calendar years by using the IntCal13 atmospheric calibration data set (Reimer et al. 2013) and the software OxCal v 4.2 (Bronk Ramsey and Lee 2013).

Analysis of the results (Figure 5) confirms the dating of the necropolis to the Copper Age and suggests that it was established between the end of the 4th and beginning of the 3rd millennium BC as testified by the two results obtained for the two charcoal samples from the combustion structure of mound no. 7 (LTLG2 and LTLG3). The necropolis was in use until the second half or the 3rd millennium BC (LTL2464B from the lithic cist of mound no. 7 and LTL1687A from mound no. 6). The results obtained from the samples taken from the other dated mounds (no. 9 and 10) all fall within the indicated time range and seem to point towards an uninterrupted use of the necropolis during this period. Nevertheless, the currently available data also point towards a relationship between the architectural features of the mounds and their dating. Indeed, the two mounds with a megalithic, monumental shape (mounds no. 7 and 10) were established earlier than the simpler structures (mounds no. 6 and 9).

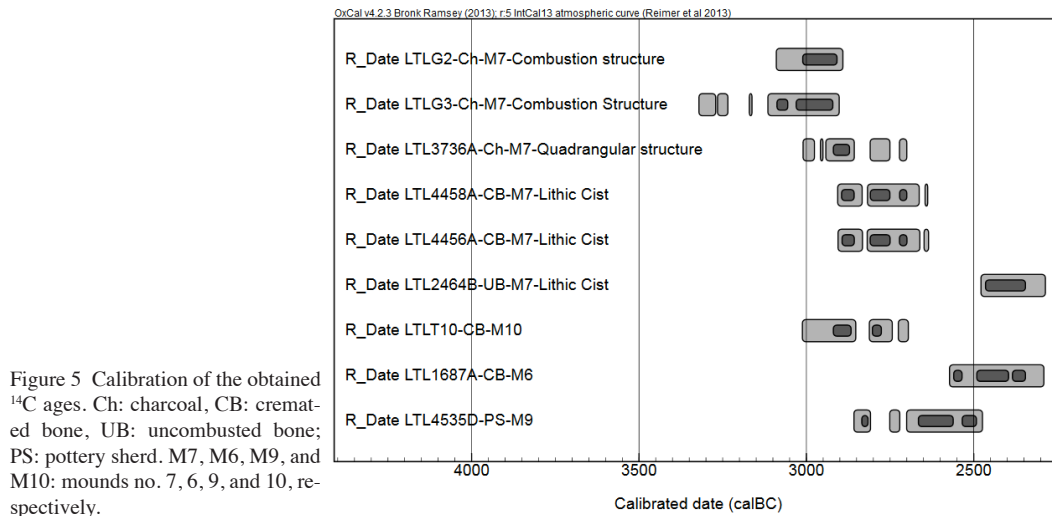


Figure 5 Calibration of the obtained ^{14}C ages. Ch: charcoal, CB: cremated bone, UB: uncombusted bone; PS: pottery sherd. M7, M6, M9, and M10: mounds no. 7, 6, 9, and 10, respectively.

Analysis of the ^{14}C data from mound no. 7 yields important information about the history of this monument. It was established between the end of the 4th to beginning of the 3rd millennium BC as can be inferred from the ^{14}C dating results of the two charcoals sampled from the combustion structure, which thus correspond to the oldest phase of the monument life. The results obtained for the charcoal from the quadrangular structure (LTL3736A) and for the two cremated individuals found within the Gaudo pots at the base of the lithic cist (LTL4456A and LTL4458A) are statistically indistinguishable and date to the first half of the 3rd millennium BC. The results obtained from the uncombusted bone from one of the inhumated individuals (LTL2464B) are consistent with its stratigraphic position within the upper levels of the cist and indicate that the same cist, previously used to depose cremated bones, was later (during the second half of the 3rd millennium BC) employed for inhumation. Interestingly, a date statistically indistinguishable from the one obtained for the inhumated individual from mound no. 7 was obtained also for the cremated bone from mound no. 6. This seems to point towards the coexistence of the two rituals (cremation and inhumation) throughout the existence of the necropolis. From the methodological point of view, the present study also clearly reveals the importance of performing systematic dating campaigns based on the selection of different kinds of samples from secure stratigraphic contexts.

CONCLUSIONS

The ^{14}C dating campaign carried out on different kinds of samples established a chronological framework for the recently discovered mound necropolis in Salve, Lecce, southern Italy. The AMS

^{14}C dating analyses conducted on various materials (charcoal, cremated and uncombusted bones, and organic residues extracted from pottery sherds) confirmed the dating of the necropolis to the Copper Age and the use of the site as a necropolis from the late 4th/early 3rd millennium BC up to the second half of the 3rd millennium BC. The analysis also revealed that the two rituals of cremation and inhumation coexisted in the same necropolis and that the same monument could be used, in different periods, to deposit both cremated and inhumated individuals, as in the case of mound no. 7.

It is thus not surprising that different rituals did coexist also on a larger, regional scale where the use of natural or artificial caves for the inhumation was already evident in different sites, ^{14}C dated to periods overlapping with Salve such as Grotta Cappuccini in Galatone (Lecce, southern Italy) (Ingravallo 2002; Quarta et al. 2004). Important information was also those obtained about the beginning of the Copper Age in this part of southern Italy, which can be now dated to the end of the 4th to beginning of the 3rd millennium BC. This is significantly earlier than what was believed so far on the basis, mainly, of the ^{14}C results obtained from Grotta Cappuccini (second half of the 3rd millennium BC). Similarly, also the use of large megalithic structures for ritual purposes is now significantly retro-dated in this part of Italy from the Bronze Age to the Copper Age.

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