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ABSTRACT

We present here one recent CIRCE (Centre for Isotopic Research on Cultural and Environmental Heritage) – Caserta (Italy) project on cultural heritage field, analysing several mice bones, discovered in the Major Temple on the acropolis of Cumae (Napoli, Southern Italy). The bones were found in a vase linked to the holy context. In order to know their dating and formulate an hypothesis on their presence on the site, if it was an accidental rodent inclusion (believed on the base of archaeological context to have occurred during building abandonment periods (IV–V or XIII centuries AD)) or an intentional and ritual remain, the bones were ^{14}C dated by AMS at CIRCE. The results indicate that the mice bones date to the IV century BC and are contemporaneous with building construction. This dating seems to exclude an accidental rodent presence and it supports the hypothesis of Apollo veneration in the temple, based on the already known link between mice and Apollo worship rituals.

1. Introduction

One of the main AMS ^{14}C activities of CIRCE (Centre for Isotopic Research on Cultural and Environmental heritage) in Caserta (Italy) has always been the dating of archaeological findings and artistic monuments. In this study we investigate some bone remains discovered in the Major Temple in Cumae (Italy). The deity vowed to Major Temple is not known yet, despite several deity consecration proposals. It is known as Jupiter Temple since its first attribution [1]; other hypotheses proposed over the years were not accepted by scholars (e.g. the identification of the deity as Demeter, proposed by Pagano [2]). A new attribution recently proposed the hypothesis of consecration to Apollo, Artemis and Latona [3].

During the archaeological excavations of Cumae acropolis in 2011, a *dolium* (large *terracotta* vase used for containing dry foods, as grain and legumes, or liquids, as honey, oil, wine or milk) was found in a holy context, between the *pronaos* (vestibule) and *cella* (the inner chamber of a temple) of the Major Temple [4]. The bones of about twenty mice were discovered in the *dolium* and identified as belonging to *Apodemus* (*Sylvaemus*) *sylvaticus o flavicollis* genus [5,6].

The presence of the mice bones in the *dolium* could have been accidental or intentional. In this study some hypotheses have been formulated, only based on archaeological context information. If accidental, mice presence is supposed to be due to an intrusion of animals, attracted by the organic offerings: the mice, once inside, remained trapped in the vase, dying there. The intrusion was especially expected to have occurred in the Late Antiquity, when the temple was abandoned before its conversion in church (IV–V century AD), or during the XIII century AD, when the church was abandoned and the complex plundered. During the temple active use, the rodent intrusion hypothesis cannot be excluded, but it is supposed to be unlikely. In fact, at the undergrown level, the archaeological excavation shows that the *dolium* itself was equipped with a "closing system", consisting in the adhesion of the jar mouth with the limit of a dimple, which seems to support the desire to prevent animal intrusion (see Sections 2 and 3). Instead, at the temple level, the possibility of rodent intrusion from the cannula hole (see Section 2) cannot be entirely ruled out, but the temple was a sacred and controlled place and we can easily suppose closure and control systems practiced by the faithful.

The hypothesis that the presence of the mice was intentional is based on the idea that the animals could have been part of a specific ritual, sacrificed or raised in the site. Ancient sources (i.e. Claudius Aelianus, *De Natura animalium* XII, 5) mention that small

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mice were raised in Apollo Smintheus Temple in Asia Minor and some of Cumae ancient colonists came from Northern Asia Minor [7]. Moreover, in Asia Minor Sybil worship, attested also in Cumae, had religious traditions [8]. Her worship and the ritual use of white mice were associated with oracular practices [9]. Finally, the presence of Apollo Smintheus worship in Campania region is also attested from other evidences [9].

^{14}C measurements of mice bones from two US (Stratigraphic Unit) were performed at CIRCE in Caserta (Italy), in order to confirm the same dating time of the analyzed bones belonging to different US and to try to give hints with the dating about the nature of mice presence in the holy context (i.e. if their presence was accidental, during temple frequentation or temple abandonment periods, or if it was linked to an intentional ritual, during temple frequentation period).

2. Site description

Cumae is one of the most ancient Greek colonies in Southern Italy, characterized by a fortress dominating the lowland before the Tyrrhenian Sea (Fig. 1). The acropolis is famous for its temples, the walls and a gallery, known as cave of Sybil (a priestess of Apollo cult [8]) and recently reinterpreted as a military walkway [10]. The Major Temple was discovered during the archaeological excavation carried out by Amedeo Maiuri in the decennia before the Second World War [11]. Three monumental phases characterize the complex: (I) an original Late Archaic building; (II) its renovation in Early Imperial age and (III) its transformation into a church during Christian time [4]. Since 2011 the Second University of Naples – Department of Letters and Cultural Heritage has investigated the area. Another phase of building renovation during the second half of IV century BC was also newly discovered during this 2011 excavation. During the excavation of the Late Antiquity and High Middle Ages cemetery, the *dolium* was discovered in a point apparently without tombs, located between the left jamb of the passageway to *pronaos* and *cella* and the Tomb 40 (Fig. 2). The *dolium* was turned upside down and holed on the bottom (Fig. 3). A cannula (small tube), formed in a negative within a nucleus of lime lumps and terracotta fragments, led to the *dolium* hole probably from the floor level. The *dolium* contained soft dark ground with organic remains (charcoals, vegetables and bones) and the vase mouth was fitting with the limit of a dimple excavated in the cineritic bench and lined with tufa stones. The position of the *dolium*, its content and its proximity to the *cella* led to assume the votive nature of the deposit. This assumption is also drawn from the excavation context, which shows the intent of locating the *dolium* in that precise position and the stratification of organic remains inside the *dolium* occurred through the cannula from the higher floor level. This apparatus might be interpreted as part of a foundation rite, but its repetition in the time allows one to exclude this hypothesis. Another hypothesis considers it as temple altar for chthonic offerings, including the mice bones. These are the only bones found that were preserved in their entirety.

3. Materials and methods

Mice bones from two US (US786A and US786B) were analyzed. The vase was included into a dimple, with the mouth adhering to the dimple lining, creating a sealed context. During the archaeological excavations, once the vase was removed, the original unit was divided in two US: the part remained into the vase (US786A) and the part into the dimple (US786B). The indication from stratigraphic excavation suggested the two US being coeval.

Samples of about 1 g from each US were pulverized and chemically treated for the collagen extraction, performed by following standard procedures used at CIRCE and described by Passariello et al. [12].

Two sub-samples were prepared from US786A bones; the first had chemical preparation through the gelatinization (GEL), while a second portion had its collagen divided for two dating samples.

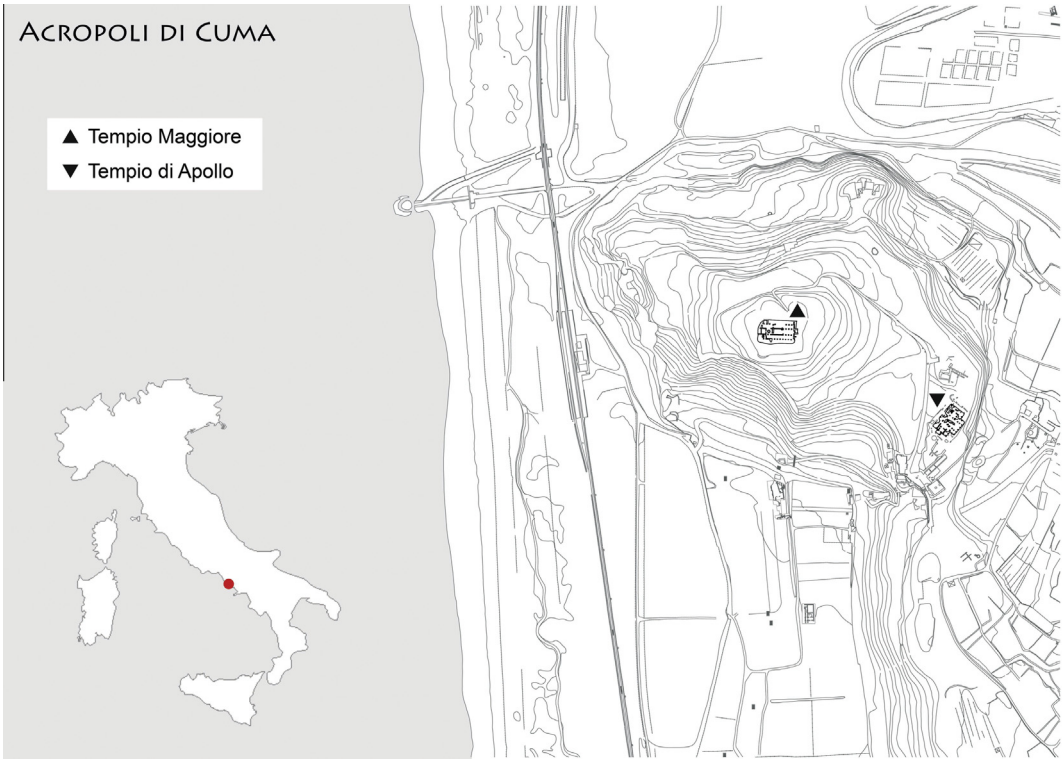

Fig. 1. Geographical location of Cumae (point in Italy map, on the left); on the right, location of Major Temple and Apollo Temple on the acropolis of Cumae.

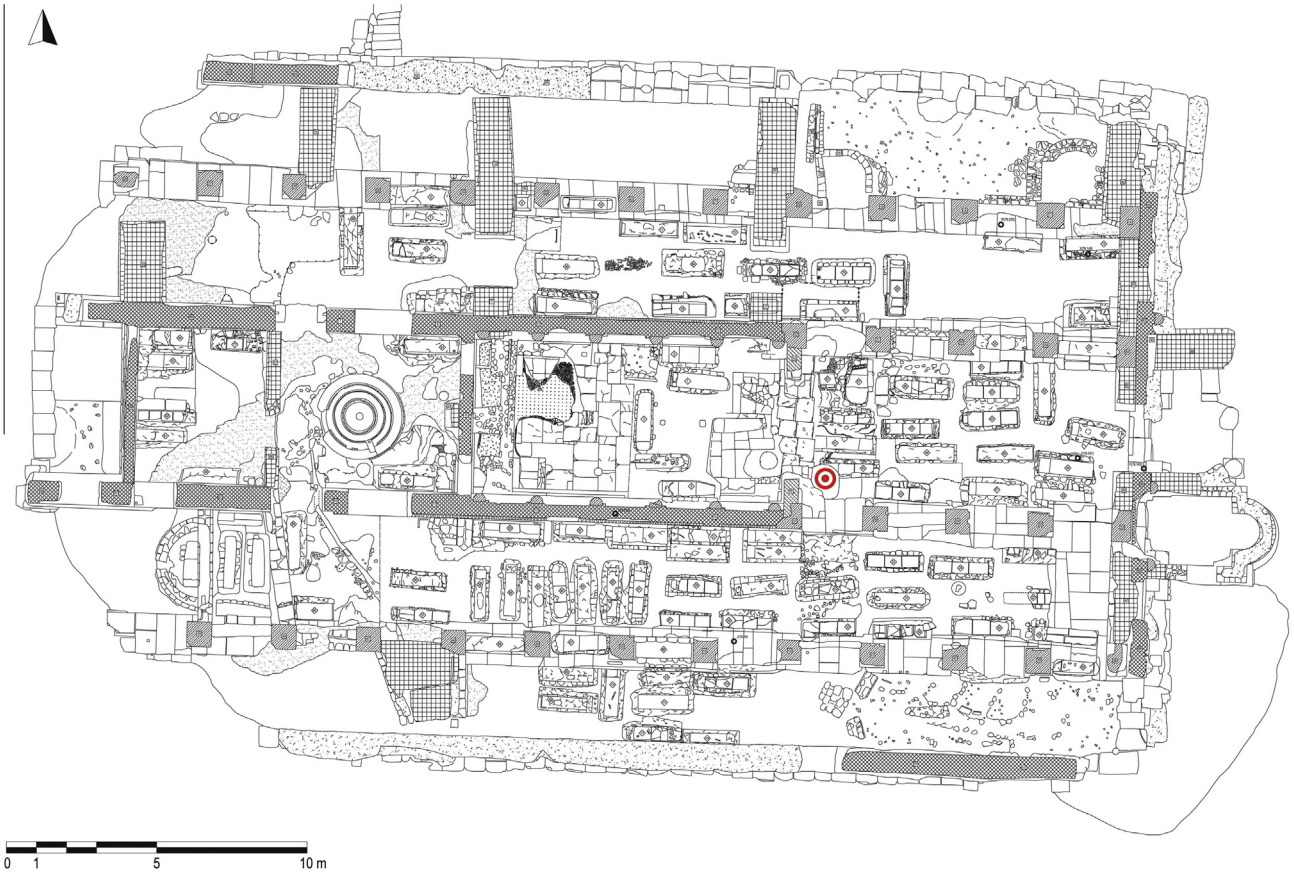

Fig. 2. Map of the Major Temple: the point indicates the location where the *dolium* was discovered.

Fig. 3. In the center of the picture the *dolium* as discovered in the excavation: it is turned upside down and holed on the bottom (the cannula is visible); in the lower right (white box) the *dolium* drawing.

One portion of the collagen was treated to a GEL stage, and the second collagen portion underwent to gelatinization and then ultrafiltration (ULTR) to evaluate the possible differences introduced by different sample preparation methods (Table 1). Ultrafiltration was performed by means of Vivaspin™ 15–30,000 MWCO filters, after their cleaning with ultrapure water [12].

The US786B bones produced only enough collagen for treatment to a GEL fraction (Table 1). Four measurements of US786 bones were performed in order to get a high confidence level on the dating, considering the importance of this analysis for Cumae temple worship.

The pretreated samples from US786A and US786B were combusted and graphitized following the CIRCE standard procedures, together with standards and blanks [13,14]. Graphite was pressed in aluminum cathodes and ^{14}C measurement was performed at the AMS facility of CIRCE [15]. Radiocarbon ages were calibrated using OxCal v4.2.3 program [16] and the IntCal13 calibration curve [17].

In order to check the conservation state of collagen, the gel fractions of both US were analyzed by Flash EA1112 Elemental Analyzer (EA) at CIRCE in order to measure carbon and nitrogen percentages and calculate C/N ratio. Sample collagen was weighted in tin capsules and measured together with four EA standard (cyclohexanone 2–4 DNPH) samples of different weights, used for the calibration curve.

4. Results and discussion

Considering the range between 2.9 and 3.6 as the not damaged collagen C/N ratio of modern animals [18], the analyzed samples show a good state of conservation (see C/N ratios and their uncertainties in Table 1).

The three US786A samples (DSH4947, DSH5107 and DSH5108) ^{14}C dates, produced by different chemical pre-treatments, were not statistically different, indicating the lack of systematic differences in ^{14}C content in the collagen fractions prepared by different methods (Table 1).

The results from all dated fractions of US786A and US786B were statistically compatible within 2σ (Table 1 and Fig. 4). Based on the coeval age of the two US bones, supposed by archaeological data and confirmed by radiocarbon results, R_combine function of OxCal was used in order to combine the obtained ages and to reduce the associated uncertainty. The χ^2 test on the weighted

Table 1
List of analyzed samples: lab code, provenience US (Stratigrafic Unit), chemical extraction performed, % carbon, % nitrogen, C/N ratios, ^{14}C age in years BP, calibrated ^{14}C ages (1σ and 2σ ranges with the corresponding probabilities %).

Code	US	Chemical treatment	%C	%N	C/N	^{14}C age ± 1σ (BP)	^{14}C age cal. 1σ	^{14}C age cal. 2σ
DSH4947	US786A	GEL1	41.0 ± 0.6	15 ± 1	3.2	2263 ± 33	392–357 BC (33.5%) 285–235 BC (34.7%)	399–349 BC (40.4%) 313–208 BC (55.0%)
DSH5107	US786A	GEL2	–	–	–	2347 ± 32	472–464 BC (3.2%) 454–446 BC (3.5%) 430–382 BC (61.6%)	516–367 BC (95.4%)
DSH5108	US786A	ULTR	–	–	–	2302 ± 31	402–367 BC (68.2%)	408–356 BC (79.6%) 287–234 BC (15.8%)
DSH4948	US786B	GEL	42 ± 1	17 ± 2	2.9	2286 ± 39	401–357 BC (48.5%) 282–257 BC (15.9%) 244–236 BC (3.8%)	406–349 BC (53.8%) 312–209 BC (41.6%)

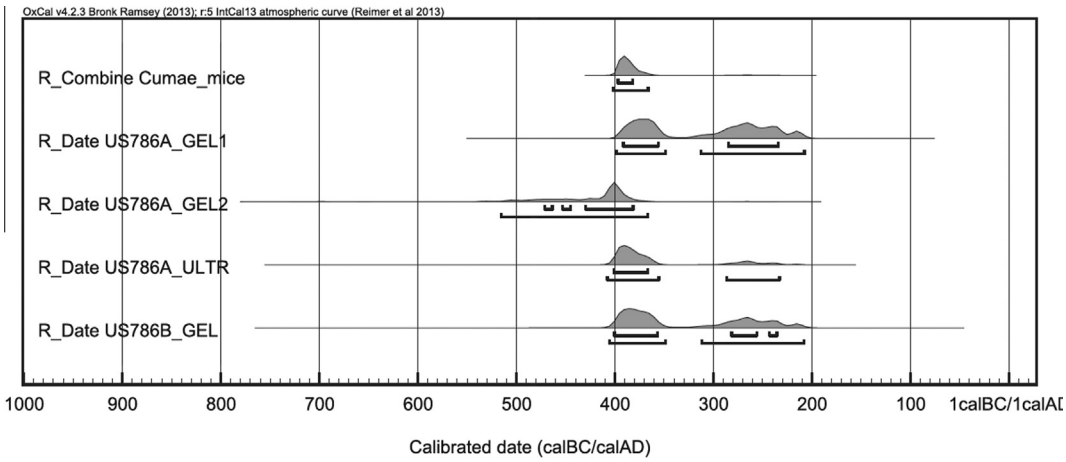

Fig. 4. US786A and US786B AMS dates are compared with their R-Combine value, calculated by means of a Bayesian model from OxCal13 v4.2.3 program.

average was successful (Fig. 5). The result shows the ^{14}C dating of mice death in the 1st half of IV century BC (398–383 cal BC in 1σ range; 402–367 cal BC in 2σ range; Fig. 5).

This dating does not allow to have a clear context reading, but some considerations can be formulated. First, the bone dating to the IV century BC, in a period of construction or first life of Major Temple, considering our initial speculations (see Section 1), seems to exclude the hypothesis of a rodent intrusion presence in the *dolium*, presumably occurred in a later period (see Section 1). In fact, the possibility of the accidental mice presence during the building construction phase is believed to be unlikely because of some archaeological considerations (e.g. the rituality of *dolium*

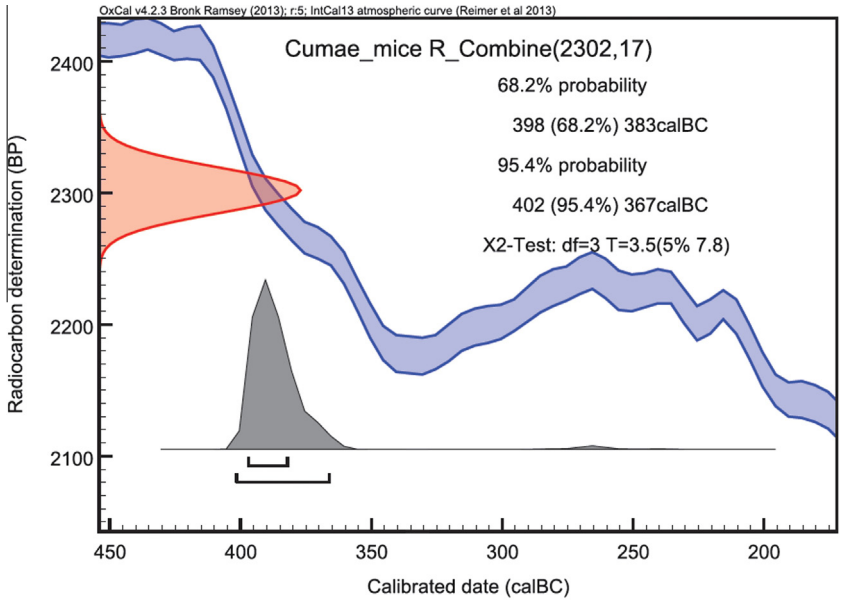

Fig. 5. R-Combine results of the four dated sample ages, obtained with OxCal13 program, with the indication of statistical data.

location and position in the temple, close to the *cella* access), which instead suggests the use of those animals for religious rites.

Nevertheless also accepting the hypothesis of the intentional presence of mice in the holy place, some doubts still persist about the role of mice: were they raised in the place or were they sacrificed and then placed in the pot? This is an interesting question not object of this study, which will be subject for further archaeological researches.

Finally, as discussed above, the deities venerated in this holy context are not known with certainty. The intentional presence of mice, known to be connected to Apollo Smintheus worship, can suggest the link of the context to this deity.

5. Conclusions

The mice bones discovered in a *dolium* in the Major Temple in Cumae were dated by means of ^{14}C analysis. The results highlighted the coeval death of the animals from two US, which occurred in the first half of IV century BC, in a moment of building construction or initial life phase.

On the base of this dating, we lean for the exclusion of the hypothesis of the accidental mice presence tied to an intrusion, believed to have occurred in a later period, also considering the available archaeological context information. So, in our opinion the intentional mice presence is connected with the deities venerated in the temple, not known with certainty. The evidences of connection between mice breeding and Apollo Smintheus worship from the ancient sources as well as the dating of mice death to the construction phase of the building (possible object of a religious rite) can support, but not confirm with certainty, the hypothesis concerning this temple consecration to Apollo deity.

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