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AMS radiocarbon dating of *Cervus elaphus* from layers M3, Trench M, San Teodoro Cave Acquedolci, Messina, Sicily

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Frontal view of the two faces and lateral view of the broken stone pendant, showing numerous traces of polishing on the profile face. Photo: Gerlando Vita.

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AMS radiocarbon dating of *Cervus elaphus* from layers M3, Trench M, San Teodoro Cave Acquedolci, Messina, Sicily

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ABSTRACT
We report a new AMS radiocarbon date from layer M3 of Trench M, San Teodoro Cave. After three unsuccessful attempts due to poor collagen preservation (Vita *et al.* 2025), a *Cervus elaphus* bone yielded well-preserved collagen meeting established quality criteria. The sample (UBA-56409, 11,512 ± 66 BP) calibrates with IntCal20 to 11.55–11.29 ka cal BP (95.4%), providing a direct chronological constraint for the Epigravettian occupation of Trench M. The determination places the M3 assemblage in the early Holocene transition, immediately after the Younger Dryas, and provides the first direct absolute chronology for this stratigraphic sequence.
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KEY WORDS
Radiocarbon dating,
Epigravettian,
Cervus elaphus,
Sicily,
San Teodoro Cave.

RÉSUMÉ
Addendum : volume 24 (30) : 621-646, 19 décembre 2025. Datation au radiocarbone par la méthode AMS de spécimens de Cervus elaphus *Linnaeus, 1758 provenant des couches M3, tranchée M, de la grotte de San Teodoro à Acquedolci, Messine, Sicile.*
Nous présentons une nouvelle datation au radiocarbone par AMS provenant de la couche M3 de la tranchée M, dans la grotte de San Teodoro. Après trois tentatives infructueuses en raison d'une mauvaise conservation du collagène (Vita *et al.* 2025), un os de *Cervus elaphus* s'est révélé contenir du collagène bien conservé, répondant aux critères de qualité établis. L'échantillon (UBA-56409, 11 512 ± 66 BP) s'étalonne, selon IntCal20, à 11,55–11,29 ka cal BP (95,4 %), fournissant ainsi une contrainte chronologique directe pour l'occupation épigravettienne de la tranchée M. Cette datation situe l'assemblage M3 au début de la transition holocène, immédiatement après le Dryas récent, et fournit la première chronologie absolue directe pour cette séquence stratigraphique.
Cet article est un addendum de : https://doi.org/10.5852/cr-palevol2025v24a30

MOTS CLÉS
Datation au radiocarbone,
Épigravettien,
Cervus elaphus,
Sicile,
Grotte de San Teodoro.

INTRODUCTION

In a recent work, Vita *et al.* (2025) described the material culture of the Sicilian Epigravettian from Trench M in San Teodoro Cave. Trench M is a sub-vertical recess heterogeneously filled with archaeological remains and represents a new archaeological horizon identified during the reappraisal of the site undertaken in 2023. The trench analysis allowed the definition of three main stratigraphic units: a late infilling largely affected by modern contamination (M1), an intermediate layer radiocarbon-dated to the Eneolithic (M2) (Vita *et al.* 2025), and a deeper Epigravettian stratigraphic unit (M3), characterised by quartzite and flint industries, butchered bones, charcoal, marine and continental shells, and prehistoric phyllite ornaments.

Three AMS dating attempts were previously made on faunal remains from layer M3: two *Cervus elaphus* and *Sus scrofa* femur fragments analysed at Innova SCaRl, Naples, and one *Cervus* astragalus analysed at Beta Analytic, Miami (Vita *et al.* 2025). None yielded reliable results because of poor collagen preservation, with collagen yields below 1% and C/N ratios outside the generally accepted range of 2.9-3.6 (DeNiro 1985), indicating substantial diagenetic alteration. These results are consistent with the taphonomic conditions observed in Trench M.

The cultural attribution of M3 to the Epigravettian is fully documented by Vita *et al.* (2025) on the basis of lithic typology, faunal remains and personal ornaments. We therefore refer to that publication for a detailed description of the assemblage, while the present contribution focuses on establishing its first direct absolute chronology.

TABLE 1. — New AMS ^{14}C determination from the butchered *Cervus elaphus* bone recovered from Trench M (layer M3). Calibration performed using OxCal v4.4 and IntCal20 (Reimer *et al.* 2020). Dates rounded to the nearest 10 years following Millard (2014).

Variable	Result
Species	*Cervus elaphus*
Sample/Lab code	M3 / UBA-56409
Material	Bone, cut-marked, layer M3
$\delta^{13}C$ (‰)	–21.4
$\delta^{15}N$ (‰)	4.7
%C	27.75
%N	9.23
C/N	3.0
Collagen quality	Very good
^{14}C age (BP)	11,512 ± 66
cal BP, 1σ (68.3%)	11,500-11,375
cal BP, 2σ (95.4%)	11,550-11,290

Here we present a new AMS ^{14}C determination obtained from a butchered *Cervus elaphus* bone from layer M3 and discuss its chronological significance for the Epigravettian occupation of Trench M.

MATERIAL AND METHODS

A new bone fragment of *Cervus elaphus* from layer M3 was submitted for radiocarbon dating at the 14CHRONO Centre, Queen's University Belfast, United Kingdom, where it was assigned laboratory code UBA-56409. The conventional radiocarbon age is expressed in years Before Present (BP),

TABLE 2. — Summary of published radiocarbon dates from Grotta di San Teodoro related to human presence and anthropogenic deposits. Calibrated age ranges are reported at the 95.4% probability level using the IntCal20 calibration curve (Reimer *et al.* 2020).

Sample	Material dated	Conventional age (BP)	Calibrated / estimated age	Dating method	Stratigraphic unit	Interpretation	Reference
San Teodoro 1	Human bone collagen	12,580 ± 130	15.2-14.1 ka cal BP (95.4%)	AMS ^{14}C	Layer E	Funerary occupation phase	Incarbona *et al.* (2010); Mannino *et al.* (2011)
Aurochs	*Bos primigenius* collagen	12,624 ± 59	15.2-14.7 ka cal BP (95.4%)	AMS ^{14}C	Layer PAL	Human domestic activity	Garilli *et al.* (2020)
Charcoal ST21-1	Charcoal	13,651 ± 50	16.1-15.7 ka cal BP (95.4%)	AMS ^{14}C	ST21	Earliest Late Epigravettian occupation	Forgia *et al.* (2025)
Charcoal ST21-2	Charcoal	13,251 ± 50	16.3-15.9 ka cal BP (95.4%)	AMS ^{14}C	ST21	Earliest Late Epigravettian occupation	Forgia *et al.* (2025)
Charcoal ST21-3	Charcoal	13,378 ± 50	16.7-16.3 ka cal BP (95.4%)	AMS ^{14}C	ST21	Earliest Late Epigravettian occupation	Forgia *et al.* (2025)
Vulture	*Gyps fulvus* bone	12,482 ± 70	15.0-14.3 ka cal BP (95.4%)	AMS ^{14}C	SU 5	Possible symbolic or anthropogenic deposition	Romano *et al.* (2026)
Red deer (USM2)	*Cervus elaphus* bone	4,660 ± 30	5.4-5.3 ka cal BP (95.4%)	AMS ^{14}C	Layer M2	Eneolithic / later reworking phase	Vita *et al.* (2025)

where "present" is defined as AD 1950. Calibration was performed using OxCal v4.4 (Bronk Ramsey 2009) and the IntCal20 calibration curve (Reimer *et al.* 2020). Results are reported at the 2σ (95.4%) probability range, with the 1σ (68.3%) range also provided.

Quality-control criteria for collagen follow DeNiro (1985) and Van Klinken (1999), while the reporting format follows Ruiz-Redondo *et al.* (2024).

RESULTS

The conventional radiocarbon age obtained for the *Cervus elaphus* bone from layer M3 (UBA-56409) is 11,512 ± 66 BP.

Calibration using OxCal v4.4 and the IntCal20 calibration curve yields a 68.3% (1σ) calibrated range of 11,499-11,374 cal BP and a 95.4% (2σ) calibrated range of 11,552-11,291 cal BP.

The calibrated result therefore places the dated specimen at approximately 11.55-11.29 ka cal BP (95.4%), rounded to the nearest 10 years (Table 1) following Millard (2014). This chronology is consistent with the regional framework for the final Epigravettian in Sicily (Mannino *et al.* 2012). This provides a direct chronological constraint on the M3 assemblage and is consistent with its attribution to the later Epigravettian, as proposed by Vita *et al.* (2025), based on lithic typology, faunal remains, anthropogenic traces, and the presence of a stone pendant.

DISCUSSION AND CONCLUSION

Three previous AMS dating attempts on faunal remains from layer M3 were unsuccessful because of poor collagen preservation, with collagen yields below 1% and C/N ratios outside the 2.9-3.6 range (*sensu* DeNiro 1985; Van Klinken 1999). The difficulty of obtaining reliable radiocarbon determinations from Late Pleistocene archaeological assemblages because of collagen preservation and stratigraphic reliability has also been highlighted in the Adriatic area (Ruiz-Redondo *et al.* 2024). The new determination of 11,512 ± 66 BP obtained from a butchered *Cervus elaphus* bone provides the first direct absolute chronological constraint for layer M3. The sample yielded well-preserved collagen, and calibration using OxCal v4.4 and IntCal20 (Reimer *et al.* 2020) produces a range of 11,499-11,374 cal BP at 1σ (68.3%) and 11,552-11,291 cal BP at 2σ (95.4%). The calibrated age places the dated specimen in the early Holocene, shortly after the end of the Younger Dryas, rather than at the end of the Younger Dryas itself. This chronological position is compatible with the Epigravettian attribution of the lithic industry, faunal assemblage and ornaments from Trench M, as discussed in detail by Vita *et al.* (2025). The result therefore provides an important chronological anchor for the M3 assemblage and contributes to the broader chronological framework of the Late Glacial-Early Holocene transition in Sicily.

The new determination complements the existing radiocarbon framework of San Teodoro Cave (Table 2), which documents human activity at the site from the Late Glacial through the Holocene. In particular, the M3 determination provides a chronological reference for an archaeological assemblage whose previous dating attempts were unsuccessful because of poor collagen preservation.

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