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THE ABSOLUTE CHRONOLOGY OF THE BRONZE AGE IN TRANSYLVANIA

PhD Thesis Summary

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Key words

Bronze Age, radiocarbon C14, radiocarbon dating, absolute dating, Transylvania, AMS, Bayesian modeling, Early Bronze Age, Coțofeni culture, Schneckenberg culture, Copăceni group, Jigodin group, Iernut group, Middle Bronze Age, Wietenberg culture, Late Bronze Age, Noua culture, Deva-Bădeni group, Lăpuș group, Early Iron Age, Gáva culture.

INTRODUCTION

Establishing an Absolute Chronology for the Bronze Age in Transylvania is a major challenge for prehistoric archaeology in Romania. The region, densely populated with a complex and varied stratigraphy, requires reliable temporal benchmarks for a coherent interpretation of cultural evolution.

Until recently, the chronology was based on relative dating (ceramic typology, stratigraphy), but the introduction of the C14 method was also necessary. This allowed the correlation of archaeological discoveries with calendar years, providing a new framework for interpretation. This study aims to construct an absolute chronology of the Bronze Age in Transylvania by analyzing the available radiocarbon dates, complemented by three new C14 dates. Through Bayesian modeling of the chronological sequences, the study refines the dating and reduces error margins, integrating cultural and stratigraphic information.

METODOLOGY

From a methodological standpoint, after a brief presentation of the geographical framework, the study details the fundamental principles of the radiocarbon dating method, which involves several essential steps: the rigorous sampling of materials from archaeological contexts, the identification and isolation of suitable organic materials (primarily bones, wood, charcoal, and more rarely, seeds), the careful chemical treatment of these materials to remove contaminants, and the preparation of the samples for analysis. The technology predominantly used in this research is Accelerator Mass Spectrometry (AMS), which enables the analysis of very small samples (milligrams or micrograms) with high precision and reduced margins of error.

The core of the study is the presentation of the cultural content and absolute chronology of the main stages of the Bronze Age: the Early Bronze Age (including the Coțofeni and Schneckenberg cultures, and the Copăceni-Șoimuș, Jigodin, and Iernut groups), the Middle Bronze Age (Wietenberg culture), and the Late Bronze Age (characterized by the Noua culture and the Deva-Bădeni and Lăpuș groups). In the final part of the study, prior to the conclusions, a brief presentation is included on the Gáva culture, whose emergence marks the transition from the end of the Bronze Age to the beginning of the Iron Age.

Whenever conclusive results were obtained, Bayesian modeling of the absolute dates was included—often for the first time in the analysis of these particular cultures. Thus, this research not only updates the perspective on cultural succession and interactions among prehistoric communities but also supports the reconstruction of a more nuanced picture of the chronological development of the Bronze Age as a whole.

To substantiate the research theme, the study incorporates three new C14 dates, accompanied by a detailed description of the archaeological contexts from which they originate. These dates were obtained through the collaboration protocol between the National History Museum of Transylvania and the “Horia Hulubei” National Institute for Physics and Nuclear Engineering (IFIN-HH). Two samples come from the site at Sânpaul – Usturiș, attributed to the Wietenberg IIIb phase, and the third sample comes from site 11A at Nădășelu, attributed to the Wietenberg IIIa phase.

SYNTHETIC PRESENTATION OF THE DOCTORAL THESIS CHAPTERS

The structure of the thesis includes three main chapters, in addition to the Introduction, the Geographical Framework, and the Conclusions, the latter not being numbered.

Chapter I is dedicated to the theoretical and methodological foundation of the research. The first part outlines the main milestones in the history of the radiocarbon dating method and its impact on prehistoric archaeology. This is followed by a synthesis of the evolution of research on the Bronze Age in Transylvania, from the earliest attempts at chronological organization (based on typology and stratigraphy) to recent trends involving the use of absolute dating and modern statistical tools. The thesis analyzes the relevant specialized literature for each chronological stage of the Bronze Age, integrating both Romanian and international contributions.

Although research on the Bronze Age in Transylvania has a solid tradition and has produced a significant volume of archaeological data, the general chronology of the period has remained, until recently, largely relative—dependent on formal analogies and local stratigraphic sequences. The absence of a coherent absolute dating system has hindered the correlation of Transylvanian cultures with those of neighboring regions and their integration into a pan-European chronological framework.

In recent years, technical advancements and interdisciplinary collaborations have enabled a reassessment of the Bronze Age chronology through the direct testing of materials from well-documented archaeological contexts. The present study aligns with this direction, aiming to shift from a relative chronology to an absolute one, statistically validated and calibrated using dendrochronological curves. Previously published radiocarbon data have also been reinterpreted within an updated methodology, alongside new results obtained through collaboration with specialized research institutions.

Chapter II is dedicated to the methodological framework of the research, with a focus on integrating radiocarbon (C14) dating into a coherent approach necessary to achieve the main objective of the thesis: establishing an absolute chronology of the Bronze Age in Transylvania. Without aiming for an exhaustive technical analysis, the chapter provides a synthesis of the main concepts and stages involved in the dating process, which is essential for understanding the proposed interpretations.

The C14 method, developed by Willard Libby, is based on measuring the radioactive carbon isotope remaining in an organic material after it ceases to exchange carbon with the atmosphere. The results, expressed in years BP (Before Present, with 1950 as the reference year), are then calibrated using dendrochronological curves to obtain calendar dates (cal BC/AD).

Material selection is crucial for dating accuracy. The most commonly used materials are bones, wood, charcoal, and occasionally seeds, each with its own characteristics and limitations—for example, wood from old trees can generate significant errors (the so-called “old wood effect”).

To refine the interpretations, Bayesian modeling was applied where the data and archaeological context allowed it. This method enables a more precise delimitation of the

chronological ranges relevant to the analyzed cultures; however, its effectiveness depends on the quality and consistency of the available archaeological contexts.

Chapter III. The division of prehistory into distinct periods is a convention based on a multitude of factors and remains subject to ongoing revisions. While these periods were initially defined by the predominant materials used for crafting tools and weapons, today additional criteria are also considered, such as economic changes, settlement structures, and funerary practices.

The chronological system used in this thesis is the tripartite division of the Bronze Age proposed by M. Rotea: Early, Middle, and Late Bronze Age. This system has been nuanced in light of the new radiocarbon C14 dates presented for Phase III of the Wietenberg culture. In addition, Bayesian modeling of the data was introduced (where possible and with certain limitations stemming from the quality of the dataset analyzed), and this modeling was integrated into existing chronological frameworks.

For the Early Bronze Age, characterized by significant cultural diversity (Coțofeni, Schneckenberg, Copăceni-Șoimuș, Jigodin, Iernut), the main difficulties stemmed from the fragmentary nature of the archaeological discoveries and the limited number of absolute dates. However, through the correlation of available data and the application of statistical models, clearer benchmarks were obtained regarding the transition from the Eneolithic to the beginning of the Bronze Age.

The Coțofeni culture is represented by a significant number of radiocarbon dates from various contexts, allowing the establishment of a general chronological range between approximately 3550/3500 and 2800 BC. Bayesian modeling supports this placement, indicating an average start date around 3420 cal BC for the culture's emergence. In the absence of reliable samples for Phase Coțofeni I, these dates should be regarded as indicative.

For the Schneckenberg culture, the period of existence was confirmed between approximately 2850–2550 BC, highlighting an overlap with the final phases of the Coțofeni culture. The Copăceni and Jigodin groups, analyzed through a set of absolute dates and typological correlations, were placed in the ranges of 2800–2200 BC and 2500–2200 BC, respectively. The Șoimuș group, lacking direct datings, was considered chronologically parallel with Copăceni, with an estimated development between 2800 and 2200 BC.

For the Iernut-type finds, no certain absolute dates were available; however, their chronological placement is estimated between the end of the Copăceni group and the beginning of the Wietenberg culture.

The Middle Bronze Age in Transylvania is dominated by the Wietenberg culture, one of the most well-defined and thoroughly studied prehistoric entities in the region. This culture is notable for its wide geographical distribution, elaborately decorated pottery, well-organized settlement structures, and an extensive interaction network that extended beyond the intra-Carpathian area. The Wietenberg culture is divided into four distinct phases. The first three phases belong to the Middle Bronze Age (approximately 2150/2100–1650/1600 BC), while the fourth is assigned to the Late Bronze Age Ia (circa 1650/1600–1550/1500 BC). This section also presents the new radiocarbon (C14) dates published in this study, along with the archaeological contexts from which the samples were taken, and descriptions of these contexts and the associated ceramic assemblages.

However, a significant number of C14 samples cannot be precisely correlated with specific phases or subphases of the Wietenberg culture, either due to the lack of well-defined stratigraphic contexts or because of cultural attribution issues (e.g., overlaps with levels belonging to the Deva-Bădeni group). Moreover, there is a noticeable underrepresentation of samples attributed to Phase Ia—a situation similar to that observed for Phase Ia of the Coțofeni culture or Phase II of the Noua culture. For this reason, the study proposes a critical evaluation of the samples used and emphasizes the importance of applying strict selection criteria in future research.

The Late Bronze Age in Transylvania marks a period of profound transition, characterized by transformations in cultural structure, settlement systems, and the interaction networks of prehistoric communities. The analysis focused on three main cultural entities: the Noua culture, the Deva-Bădeni group, and the Lăpuș group, which represent key markers for understanding the end of the Bronze Age and the transition to the Iron Age.

The Noua culture, one of the most widespread Late Bronze Age cultures in the east-Carpathian area, was analyzed based on a set of radiocarbon dates complemented by Bayesian modeling. The results allowed for the delineation of a coherent chronological sequence, placing the beginning of the culture around 1540 cal BC and its end near 1235 cal BC. The Deva-Bădeni group, contemporary with and partially overlapping the Noua culture chronologically, stands

out through its distinct cultural traits, reflected in ceramic styles, settlement patterns, and funerary practices. The radiocarbon dating results suggest an evolution concurrent with Noua but marked by specific regional characteristics.

The Lăpuș group, associated with the second phase of the Late Bronze Age (approx. 1450/1400–1200 BC), is treated more briefly due to the lack of a well-represented corpus of C14 dates in Transylvania. In the absence of new absolute results, chronological markers from the existing literature are used as provisional reference points.

Although the primary objective of the thesis was to establish the chronological framework of the Bronze Age in Transylvania, a brief analysis of the Gáva culture is also included, given its essential role in the transition to the Early Iron Age. This culture, with its distinct identity, is associated with significant changes in social organization, technology, and funerary ideology that clearly differentiate it from earlier Late Bronze Age manifestations. Based on available radiocarbon data, the Gáva culture is framed within a general chronological interval of approximately 1250/1200 to 850/800 BC. The Bayesian models applied support this timeframe, indicating a beginning around 1230 cal BC and an estimated end around 870 cal BC.

CONCLUSIONS

This study aimed to construct an absolute chronology for the Bronze Age in Transylvania by integrating available radiocarbon dates, publishing three new C14 results, and applying Bayesian modeling to refine existing chronological interpretations. This approach, building on the achievements of previous research, facilitated a transition from a relative and fragmented perspective on cultural succession to a more rigorous, statistically grounded temporal reconstruction of the main stages and cultures of the Bronze Age.

The contribution of this research lies both in providing clearer chronological benchmarks and in articulating an analytical methodology that may serve as a foundation for future similar endeavors. Thus, the study functions not only as a useful tool for establishing a more precise chronology, but also as a bridge between different archaeological approaches—both traditional and modern—contributing to a deeper understanding of social and cultural developments in prehistoric Transylvania. The results obtained have implications not only for defining the regional chronology but also for contextualizing it at a macro-regional and pan-European level.

The Thesis highlights the strategic role of Transylvania as a key hub within the cultural and economic networks of the Bronze Age. By clarifying aspects of absolute chronology, it becomes possible to compare and synchronize cultural developments in Transylvania with those of other European regions, emphasizing the importance of this area within large-scale comparative studies.

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