For a long time the Bronze Age Chronology east of the Carpathians has depended on the research conducted in neighbouring areas, which inhibited the achievement of a chronological scale intrinsic to the area. In this way, the Early (EBA) and Middle Bronze Age (MBA) periods needed the results of the investigations from the Trans-Carpathian zone or from the Republic of Moldova in order to define the cultural representations as the Corded Ware or Globular Amphorae pottery types Komariw, Costișa and the like. However, even if for these sequences were initiated the first attempts to define the cultural content and clear chronological limits (Vulpe 2001) there are still many steps before establishing an internal chronology.

Although the study of the EBA in the area under investigation benefited from the particular attention through the research carried out by Bichir (1962), Floreșcu (1964; 1965), Roman (1964; 1969), Dinu (1968; 1980) have not evinced the requisite chronological explanations. After the contributions of Byzne (1961) or Roman (1986), adduced by Fl. Burtănescu, the latter one manage to develop a local chronological system and was constrained to consider the findings and the results from the outside areas of the workspace (Burtănescu 2002).

For the MBA, until recently, there were only some intentions of establishing a chronology based on the cultural synchronisms with similar phenomena from neighboring Southern Poland or Western Ukraine (Dumitroaia 2000; Floreșcu 1970; Byzne 1961; Vulpe 2001). For bettering the analysis of the period the research results from Sărata Monteoru were capitalized upon, particularly the results of the stratigraphic representations at the eponymous site. The stratigraphy of this site becomes the backbone of the chronology of the Bronze Age east of the Carpathians. It was disregarded, given the absence of conclusive results, that the stratigraphy from Sărata Monteroru actually represents the situation of just one site and not a prototype for construction of a supra-regional chronological scale. However, there were fine distinctions too, which recapitulate the extensive research conducted on the Bronze Age east of the Carpathians and there have been proposals for an areal understanding of the characteristics of the pottery groups in question.

Thus, Al. Vulpe chooses for a local facies of the Monteroru culture (Byzne 1961, 106–114, fig. 9) and M. Floreșcu for a particular phase sequencing of the Monteoru Ic3–Ic2, Ic1–Ib pottery (Floreșcu 1966, 44–46, 113). For a long time the territory located between the Buzău valley up to Bucovina benefited exclusively from the attempts of connecting to the chronostratigraphical units resulted in the archaeological site benchmark for the Bronze Age (for this topic see Vulpe 2001).

A major issue for understanding the Bronze Age chronology at the local level is the attempt to mitigate the discrepancies between the data provided by the stratigraphic and chronological analysis in the
field and the connection to the results of the historical and archaeological data (Weninger–Jung 2009, 373). Unfortunately, these differences are still present since there is no local dendrochronology scale, suitable stratigraphic information, or the possibility of using all the parameters represented in the $^{14}$C analysis report.

Prior to 1989, in the well-known conditions experienced by some of us, there were feeble attempts to call for the use of radiometric data. For the east of the Carpathians there were no radiometric dates for the period in question. Gradually, in recent years, we managed to identify financial sources and the appropriate colleagues, conditions that led to the formation of a radiometric data base for the workspace. Even if unevenly represented for the chronological, cultural, and geographic sequences, it may be a good start to refine the approach of the absolute chronology issue in the area.

**Methodology**

For the first stage of our approach we have defined a fairly generous area backed at the west by the Eastern Carpathians, to the south bounded by the Buzău valley, east and north by the river basin Tiligul and Chernivtsi region. As can be seen an area open to contacts with the steppe and forest-steppe world from the North Pontic area and the Podolian and Volhynian areas. These contacts will be observed in differentiated ratios along all three major chronological sequences of the Bronze Age.

The next step is represented by a brief attempt to identify and display some of the features specific for each of the cultural expressions that will provide support for content analysis, of the chronological connections and improving the chronology. In this context we have set two chronological limits placed in a 1.000 years range between 2500–1500 BC, which would mean, in other words, the period between the beginning of the MBA and the beginning of the LBA. This is only a model of study not a chronological sequence.

Upon the first publication of the $^{14}$C set of data from Siliştea–Pe Cetăţuie (Bolohan 2010) I was asked by A. Harding why I am not using a Bayesian approach for a better and diverse refinement of data for MBA in the east of the Carpathians. The negative answer was motivated by the scarcity of $^{14}$C data used for this site (only three $^{14}$C data in 2010) and the need to publish the consistent batch of $^{14}$C data from Costişa–Cetăţuie, which meanwhile has been achieved (Popescu 2013; Popescu–Băjenaru 2015). In the meantime we created a database that allows probabilistic approaches and extracting the outcomes. These allow estimating for the interpretation of the chronological intervals. For achieving the purposes we have used different software applications of the OxCal 4.2.4 and Bayesian applications without the possibility to include a number of corrections requested by some limitations regarding the use of summed probability plots of radiocarbon date (Williams 2012, 578–589). The Bayesian statistical analysis model was chosen in order to build an absolute chronological sequence for MBA east of the Carpathians.

To sum up, the objectives of the present attempt were:

1. The collection of the radiometric data and the organization of working groups.
2. The integral analysis of data through using the same system for radiometric calibration and statistical analysis programs.
3. The application of some Bayesian models to give greater precision of the data series used (Bronk-Ramsey 2009, 354–355).
4. The achievement of some models of chronological analysis structured on the data provided by archaeologists and use of these models to track the probability distribution of the $^{14}$C data in the proposed ranges.
5. Trying to establish the chronological interval for the MBA and for each of its sequences identified east of the Carpathians.
6. The onset of verifying the older proposals for fixing the Bronze Age chronology, proposals that have been set on the basis of ceramic typology and chronostratigraphical analysis.

**Radiocarbon dating using a Bayesian analysis approach**

Modern calibration methods for radiocarbon dating are based on statistical methods, more precisely on Bayesian analysis. The Bayesian analysis tools are already implemented on specific computer codes, such as OxCal, BCal etc. Although the most commonly used statistical methods in sciences are based on the frequentists (classical) approach, the Bayesian approach is the more appropriate choice when we are dealing with calibration, as it provides a better description of the uncertainty associated to the calibrated
radiocarbon ages. There are various excellent textbooks on Bayesian analysis (see for example Gelman et al. 2004; Ghosh et al. 2006) and its application to interpreting archaeological data (see for example Buck et al. 1996).

Usually, in Archaeology radiocarbon ages are not precisely calculated, but they are rather given as confidence intervals. Therefore, one of the main concerns of archaeologists is to transform these confidence intervals for radiocarbon ages into calendar dates. It may happen that more than one calendar date corresponds to a specific radiocarbon age, and so we are facing the problem of choosing the most probable date. Bayesian analysis is a useful tool for dealing with such problems; it will determine confidence intervals and probability distributions for the calibrated radiocarbon dates. We shall shortly review here how information about chronology can be transformed into explicit statistical estimates for the dates of past events.

For frequentists, the event of interest is a possible outcome of a random experiment that can be reproduced infinitely, each experiment being capable of producing independent results. The observed data is a repeatable random sample and, using specific inference methods, can be suitably fitted to a theoretic probability distribution, which may depend on one or more parameters. In the classical Statistics world, these parameters remain constant during the repeatable process and, if they are unknown, their real values can also be estimated using either point estimates or confidence intervals.

In the Bayesian analysis world, as opposed to the frequentist approach, the parameter(s) are no longer assumed to be some constants, but rather some random variables, having their own probabilistic distribution. A Bayesian analyst’s concern is to determine the posterior distributions of the unknown parameters, given available data or some prior information about these parameters. The determination of the posterior conditional distribution of the parameter is based on the information available and on the user’s belief about the parameter at that time. In Archaeology, the parameters are usually calendar dates of events and the data consists of some fixed observations, which we may want to use in estimating the parameters.

In order to state the Bayes’ formula, we shall use the following notation:

- $\theta$ is the unknown parameter. If more than one parameter in to be estimated by the model, then $\theta$ is a vector.
- $X$ is the set of collected/observed data.
- $p(\theta)$ is a function representing the prior information that we have (or assume) about the parameter $\theta$, before any data is observed. In probabilistic terms, $p(\theta)$ is the probability distribution of the parameter values. The prior has a subjective nature and it is derived from the opinions or beliefs of the user before seeing the data. As the prior information is not obtained from the observations, the function $p(\theta)$ does not depend on $X$.
- $p(X|\theta)$ represents the conditional probability distribution of the data given the value (s) of the parameter $\theta$. More precisely, it is the likeliness of observing the data $X$, when some specific values of the parameter are given. This quantity is called likelihood.
- $p(\theta|X)$ is the conditional probability distribution of the parameters given the data. In simple terms, $p(\theta|X)$ is the amount of belief associated to specific values of $\theta$ after the data is observed. This probability distribution is called posterior.

Under this notation, the Bayes’ formula is usually written in the form:

$$ p(\theta|X) \propto p(X|\theta) \times p(\theta), $$

(1)

In the above formula, “$\propto$” is the proportional symbol. The proportionality constant (which is equal to $1/p(X)$) is not dependent on the parameter. The quantity $p(X)$ normalizes to $p(X|\theta) \times p(\theta)$; one, that is,

$$ p(X) = \int p(X|\theta) \times p(\theta) \, d\theta. $$

In simple terms, we may read the formula (1) as follows: “The posterior distribution of the parameter given the data is proportional to the likelihood function times the prior distribution of the parameter”. One can regard the Bayes’ theorem as a prescription for modifying one’s beliefs about the parameters (dates of events) in the light of new information. The prior beliefs about the parameter $\theta$ are updated after the data $X$ is observed, and this fact is reflected in the posterior distribution function. One can also read the Bayes’ formula (1) as follows:

$$ \textit{posterior} = \textit{constant} \times \textit{likelihood} \times \textit{prior}. $$

(2)
By applying the normal logarithm function to this equality, we obtain that

\[ \log(\text{posterior}) = \text{constant} + \log(\text{likelihood}) + \log(\text{prior}). \] (3)

By trying different types of priors, one can assess the dependence of the posterior on the prior. Should we manage to evaluate this dependence, the relation (3) could give us an indication about the amount of information on the unknown parameter values that is contained in the data. If the posterior is highly dependent on the prior, then the observed data likely provides little information about the parameter \( \theta \), while if the posterior is largely unaffected under different priors, the data values are likely to provide much information about \( \theta \). On the other side, if the data is sufficiently strong, then the prior will not greatly influence the posterior, as the likelihood will outweigh any prior probability distribution.

In the Bayesian analysis, the greatest controversy is related to the introduction of the subjective information (the prior) into the formula, as the prior might vary substantially from one user to another. The prior distribution is often chosen to facilitate the calculation of the posterior distribution. If one wishes to obtain a certain posterior conditional distribution for the parameter, then one should choose a prior distribution from the same distribution family. A prior that, for a given likelihood function, renders a posterior in the same distribution family as the prior is called conjugate prior.

In radiocarbon dating chronology, there are two types of models that one can use (for more details, see (Bayliss 2009; Bronk-Ramsey 2009):

- a stratigraphic order model, when there are strong reasons for considering a chronological order to a series of events. This information could come from historical records or from scientific evidence. Once a chronological order is set, this should strongly affect the outcome of the obtained calendar dates.

  - if no stratigraphic information is available, then the prior information is based on assumptions (beliefs) about the probability distribution of dates in a single phase of activity. Typically, the prior distribution should include all plausible values for the parameter \( \theta \).

In order to determine the functional form of the likelihood function, a common assumption is that the observations belong to some interval that we should prescribe (timescale), for which we must specify how likely the dates within the interval are. In this way, we obtain a probability distribution function for the data. In OxCal v4.2, one can use the Boundary to define the type of probability distribution used. We mention here a few choices for this probability distribution, which are usually used as a likelihood function for model parameters:

- uniform continuous distribution, when we have no reason to favour any particular parameter value over another. In this case, any parameter value (i.e., calendar date) within a given interval of time could be the real value of \( \theta \) (i.e., the real date for the occurrence of the event). Mathematically, we write \( p(X|\theta) \sim U(t_1, t_2) \), where \((t_1, t_2)\) is the interval of time in which the user believes that the observations belong.

- normal distribution, when we believe that the dates closer to the centre of an interval are more likely to be the calibrated date than the ones lying at the extremities.

- exponential distribution, when we believe that the calibrated date is closer to one end of an interval and very unlikely to be at the other end of the interval.

The area of study

It is represented by a diversified geographical zone which extends from the Eastern Carpathians, crossed by several routes of circulation that were probably used since prehistory (Fig. 1). The series of major axis of circulation oriented north-south is complemented by the Siret River and Prut River, which constituted a basis for subsistence and possible ways of circulation. In the frame of this scenario must be included some secondary watercourses alike Suceava, Moldova, Bistrița, Cracău, Trotuș, Jijia that offered the same favourable conditions for subsistence or even to facilitate approaching areas less frequented such as the Eastern Carpathians or the fords of large water courses. The next component can be considered as the one formed by the Sub-Carpathian and the Eastern Carpathian depressions, with traces of habitation in the period in question. The sub-area is protected from winds and offers very good visibility accompanied by interconnectivity. This is the area that contains most of the mineral sources like liquid and crystal salt exploited since prehistory (Alexianu et al. 2007; Weller et al. 2007, 121–184). The plateau and hills area is evenly represented, in which the watercourse basins (Jijia, Bahlui, Bârlad) gather human activity and have the most productive agriculture. The fifth sub-area is the plain and meadow, less preferred by
the communities and is more remarkable by the absence of the MBA sites.

Until now we can estimate, based on known archaeological discoveries, the focusing of human activity at the Carpathian foothills. It presents differentiated environmental conditions (surface and altitude), with representation starting in the immediate area of watercourses (Piatra Șoimului) and up to considerable heights (Siliștea–Pe Cetățuie, 448 m, maximum altitude).

**Middle Bronze Age in the area under study. A short review**

Throughout time, the MBA it was construed upon an image of a stable period with clearly defined cultural/pottery groups that maintain contact between themselves or with other groups at considerable distances. For the working area, the picture is clear and is apparently dominated by the predominance of two archaeological cultural units: Monteoru and Costișa. They were both partially contemporary and in succession. Thus, after a period of habitation in the area of the external curvature of the Carpathians some Monteoru communities advance along the lower basin of the Siret River toward Lower Bistrița River where they came into contact with Costișa communities. The result of this contact was that after phase Monteoru Ic3/lc2 the Costișa pottery group disappears from the lower basin of Bistrița River. If the Upper and Lower Country of Moldavia were divided for a period of time between Monteoru and Costișa communities we cannot exclude the presence of some foreign elements. West of the Eastern Carpathian area were some material items taken by Costișa communities (*Bessenstrich* pottery, some Wietenberg pottery elements maybe even some metal objects); from the east, we have no proven acquisitions; from the south there are sign of some cultural mixture alike Costișa cups with Monteoru type handles (Vulpe 2001, 255) or even cohabitation model alike at Siliștea. North of the area in question there were representations that come closer to Bialy Potik-Komariw cultures. However, the artefactual package (pottery, small objects, adornments, ornaments etc.) seems to be fairly similar between Costișa and Monteoru cultures. The major differences can be seen in the manner of treating the surface of the clay vessels. The Costișa pottery is remarkable by the preference for displaying the decor on the upper body, the prevalence of linear and triangular patterns, the low number of plastic motifs, and the overall simplicity. The Monteoru pottery is very diverse ornamented (displaying the decoration on almost the entire surface of many containers, the concentric and curvilinear motifs, the obsession for working the upper part of the handles, the diversity of decoration techniques etc.). Certainly, the laboriously achieved and useful typology of the Monteoru pottery will further support changes and updates that will reflect the amount and diversity of discoveries and the current investigation needs.

Some similarities can be found in the valorisation and control of the environment where were located the settlements. One can say it has followed a minimal standard of conditions (position on a height, the natural defence system, anthropic boundary/defence system, poor accessibility, good visibility and territorial dominance, proximity to water sources) for situation noticed upon at an appreciable number of researched sites: Adâncata–Sub Pădure (Nicuică et al. 2013), Costișa (Popescu–Băjenaru 2015), Siliștea (Bolohan–Asândulesei 2013).

Major differences can be seen for world of the dead. Very diverse as to quantity and representations in the area of Monteoru culture as shown by the numerous cemeteries from Sărata Monteoru, Pietroasa,
Cândești etc. (Bărzu 1989; Motzoi-Chicideanu–Chicideanu-Șandor 2010; Florescu 1980). Some data brought forth by the research at Adâncata, Costâna, Hârtop (Suceava County) and Prăjeni (Botoșani County) seem to allow the shaping of some preliminary thoughts concerning the funerary rite and ritual elements specific for this period in our northern workspace (Boghian et al. 2011; Niculică 2004–2005, 65; Niculică et al. 2004–2005; Ursulescu–Popovici 1987; Ursulescu et al. 1988). The research conducted at sites referred to it shows a preference for raising tumuli with inner delimited funerary spaces, the deposition in a crouched position of the corpses accompanied by a diverse inventory (see for example the funeral artifactual package in T1 from Costâna (Boghian et al. 2011), proving an increased mobility.

But for what we call the core of the Costișa culture situated in the Southern Cracău-Bistrița depression, we do not have such data, yet. The current chronology of the specific MBA pottery groups has experienced diverse contributions.

These rather expressed the stage and the content of the archaeological research and the manner in which some of us joined or not the ongoing efforts to update the methodological and theoretical approaches. Last but not least the convenience of knowing the Sărata Monteoru stratigraphy and the ceramic typology of the site has led to the extension of the observations for the whole East-Carpathian Bronze Age.

Actually, what do we know about the relative and absolute chronology of the MBA and about some of the specific cultural representations from the area?

The period started in 1990 brought a diversification of the discourse on the relative chronology and the first certain contributions on absolute chronology, as well. This possibility was triggered by the resumption or continuation of the research in older sites (Costișa, Lunca, Sărata Monteoru, Cârlomânești, Poduri) or by opening new research (Costâna, Adâncata, Silistea).

Before the recapitulation of the absolute chronology data there are needed some introductory notes on the relative chronology. The first of these was based on the analysis of a particular ceramic batch and the analysis of the data from Costișa–Cetățuie site. At that time it was estimated the existence of the Costișa culture in the north central area of the Eastern Carpathians covering the BrA2 phase (Bunne 1961, 119–122) or the 17th–14th centuries BC (Florescu 1970, 70–81). It develops between two great cultural centers, Monteoru in the south and Trzcienc in the north. The end of this culture was caused by the movement from the south, from the area of the Eastern Carpathians curvature, of the Monteoru culture. After Monteoru Ic3 phase the Costișa culture ended, at least in the Cracău-Bistrița basin (Bunne 1961). Later, in the 2000s A. Popescu and R. Băjenaru, resumed the research at Costișa. In this context it has been studied a batch of pottery fragments (Bessenstrich) coming from Costișa but also a contemporary and adjacent site located at Deleni, Neamț county. Thus, it was proposed an earlier date for the start of the Costișa culture which was in the range 2200–1950 BC, a very notable attempt of connecting to the Central European chronology (Popescu 2000, 204).

The first overview of the outcome from Silistea has led to the introduction of the first thoughts on a site absolute chronology, thoughts then extended to the entire area of the Costișa communities. The stratigraphic context, the pottery and especially the presence of some Noppenringe with a Central European origin, allow us to suggest a time interval that would have started by the end of the 3rd millennium and was continued until the middle of the 2nd millennium. The proposed dates were later confirmed by the first results of radiometric analyzes for Costișa and Silistea (Bolohan 2010; Popescu 2013, 184–187; Popescu–Băjenaru 2015). With some small differences these chronological assumptions proved their viability or have been integrated into the broader context of MBA east of the Carpathians (Vasilescu 2013).

The database

The database (Table 1–3) was formed by including the findings from the area for which we have selected a set of standard criteria (place of discovery, toponym, type of site, cultural framing, periodization, and content, context of the extraction and analysis of the C content results). Setting up the database has facilitated the next step that was the identification of the chronological or cultural approximations and connections. There were collected a total of 23 radiocarbon dates that represent the various stages of the MBA east of the Carpathians. We selected only those discoveries that have benefited from the 14C analyses. To the data from the area of study have been added other 14C data of the sites situated in close proximity (the Carpathians’ basin, the area of external curvature of the Carpathians),1 which will serve to better the

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1 In the present contribution we will refer only to the data extracted from sites with pottery characteristics specific for the Monteoru and Costișa sites located in the area between the external curvature of the Carpathians and the Neamț basin. The
chronological and cultural assignments. In this context, by the time of drafting the current contribution the following archaeometric datasets (\(^{14}C\)) extracted from MBA sites are available: 1. Middle Bronze Age 1 (MBA 1); 2. Middle Bronze Age 2 (MBA 2); 3. Middle Bronze Age 3 (MBA 3). All data were levelled by entering them into the OxCal v.4.2.3 calibration system. After many and varied attempts to use the data from Sărata Monteou (BLN–4619, 3919±48 BP, from the Ic2 Monteou level) it was excluded from the final analysis as the index Agreement was distorted (Popescu 2013, 186 and footnote 25) and we have considered it as an outlier.

Given the lack of specific technical means we failed to study any differences arising from the use of different types of samples and different measuring techniques (Weninger–Jung 2009, 375). The diversity of the raw material from which samples originate (plant seeds, human bone, archaeozoological bone, wood, burned wood/coal) is another factor that does not allow a consistent approach to the results. In this regard see the difference between the lives of the different types of raw materials. Finally, in most cases there are no data relating to the presence of \(\delta^{13}C\) stable isotopes that would have provided the opportunity for more cohesive analysis of the age samples or of the exogenous factors impact (Beavan et al. 2012, 9–10) and the analysis of the differences or similarities between the communities.

**The analysis model**

The database was designed as a unified sequence comprising only data from the east of the Carpathians (Sărata Monteou–Cetățuia, Pietroasa Mică–Gruiul Dârri, Cărlomânești–Cetățuia, Cărlomânești–La Arman, Năeni–Zănoaga Cetatea I, Lunca,Vănători–Poiana Slătinei, Costișa–Cetățuie, Siliștea–Pe Cetățuie). In order to streamline our approach we used the model of Multiple Phases in a Sequence in which we have used two types of data groupings.

The Phase Contiguous (M1) has considered the linear continuity of data and the absence of any kind of gap between data or groups of data (Fig. 2). By contrast, between the Sequence phases are located Boundary Transition. This model would correspond to the following matrix: [- Phase1 – Boundary Transition – Phase 2 – Boundary Transition – Phase 3 -] (Fig. 3). This hypothesis does not preclude a parallel existence for a period of some Costișa and Monteou findings as well cultural overlaps due to a possible shifting to the north of the Carpathian curvature culture.

The Phase Overlapping model (M2) in which the identified phases that do not follow each other or one phase does not end with the beginning of another phase has the following representation: Phase [...1...] Phase [...2...] Phase [3] (Fig. 4–5). This model corresponds to the assumption of parallelism of the two MBA cultures from the area. The Costișa pottery style had for a couple of time a side by side development with Monteou pottery style. Ceramic style Costișa would not cease to exist after first

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2 N. Bolohan personally thanks Ch. McNutt for the agreement to use the handbook that includes the introductory notes regarding the application of Bayesian statistical analysis models in archaeology (personal communication sent on 29 October 2015 and 3 November 2015).
We have used the Boundary and Phase commands to set the start, the end and the duration of each group of data and the relationship between data groups. The data were divided, according to the analysis model into phases named: MBA I, MBA II, MBA III. The Outlier command was used to interrogate the data which were below the overall agreement index of 60. Since there were quite a few available data originating from a generous workspace, we did not permit the exclusion of the data found as outliers.

In the last stage of the analysis we have tried, where we had the opportunity, to gather the δ¹³C data and some general inferences (Fig. 6).

Under the conditions described above the M1 model (Fig. 2–3) seems to lack the applicability expected by most of us. The subsequent distribution of the probabilities showed the placement of the PTR 28110 and SM 3065 MBA data at the beginning of the MBA I. Then, the entire phase is continued by a package of data from the Costișa pottery style area (Costișa, Siliștea). The MBA Phase I appears to be the most consistent phase, covering a range situated between PTR 28110 located between 2191–2033 (median 2068) and COS 28034 located between 1878–1733 (median 1776). The fairly consistent transitional period between the MBA I and MBA II, 1770–1696 (median 1738) could be explained by a lack of data from some areas (Vrancea, Bacău), which provide the connection between the two cultural representations. For Phase MBA II, according to the proposed model, the 12 input data lines up very well in a range that starts with LV 8152, placed between 1755–1672 (median 1712), situated between 1741–1646 and 8153 LV (median 1693). For this data package can be recognized and good correlation between the proposed model and the result of the data's statistical distribution. Moreover, the A_{model} of 103.9 and A_{overall} of 97.8 indexes support a consistent connection of the two models. Finally, the data COS 27933 located between 1677–1543 (median 1623) and CRL 27971, placed between the 1658–1535 (median 1611), which are part of MBA Phase III represent the end of the period. Certainly for this phase is needed the augmentation of the data in order to link better the southern and northern area of the workspace. The entire model is situated between 2250–2042 (median 2106) and 1660–1341 (median 1558).

For the second analysis model M2, Phase overlapping (Fig. 4–5) it was use the same data package but with a differentiated internal distribution. It was kept the same number of three phases (MBA I, MBA II, MBA III). The proximity of the A_{model} (86.1) and A_{overall} (77.1) indexes is very good which provides encounter with the Monteoru culture in the Crăciu-Bistrița Basin.
a stronger consistency for the proposed model. The data distribution looks as follows. The MBA Phase I include only the data from the curvature of the Carpathians, from the emergence area of the Monteoru culture, lying between PTR 28110, 2202–2038 (median 2125) and 28858 N.ZNG placed between 1880–1687 (median 1765). It follows the MBA Phase II which includes only the data from the area of Costișa culture lying between COS 27904, 1940–1775 (median 1886) and COS 27933 situated between 1730–1608 (median 1655). The relatively large amount of the data included (18) resulted in a good approximation between the model proposed and the final distribution of the probabilities. The Phase MBA III is currently represented by a single data CRL A 27971 situated between 1645–1527 (median 1580) and a very good 98.7 index of Agreement. This latter date also corresponds to its overall assignment in a late phase of the Monteoru culture and should reopen the discussion on the framing of the discovery (Motzoi-Chicideanu 2012, 49, fig. 1). In this context we may understand the history and the different nuances of the regional pottery styles (Motzoi-Chicideanu 2003, 48–51; Vasilescu 2013, 176–177, Tab. 1, fig. 4/3–4; Popescu 2013, 187–188). An amplification of data from the third phase will gives a greater strength to the proposed model. The higher degree of independence of this analysis model allowed a better folding on the cultural pattern resulting from the archaeological research. For example, the median time for N.ZNG 28858 from the end of Phase MBA I framed within the Monteoru Ia phase (Vasilescu 2013, 176) meets with the median time of some of the findings from Siliştea (SLS 29027) Costișa (COS28034) and the Lunca, Vânătări–Poiana Slatinei (LV 8152), assigned on the account of the pottery styles to the Monteoru IC3-IC2 phase (Table 1–3). These distortions between the historical-cultural model and the statistical model show the need to resume the discussions concerning the ratio of the internal phases pertaining to the MBA in the Eastern Carpathians.

Fig. 6. Conventional radiocarbon ages (CRAs) on bone and wood from Siliştea and Costișa versus $^{13}$C.

It is useful to analyze the distribution of the $\delta^{13}$C values based on the $^{14}$C values. We had only the values for the samples from Costișa and Siliștea. From the graphical representation it results that all the...
evidence from animal bones are located between the following $\delta^{13}C$ values $-20.0\%$ and $-22.0\%$, a quite expected range for terrestrial herbivores primarily feeding upon C3 plants (Hakenbeck et al. 2010, 5, Table 1, fig. 3). The other samples with $\delta^{13}C$ values of $-24.0\%$ and $-26.00\%$ come from wood and appear to have been more exposed to exogenous factors and aging effect.

* * *

We wanted to benefit from the available radiometric data, the archaeological data and the Bayesian statistical methodology in order to obtain nuanced estimations concerning the absolute chronology of the MBA east of the Carpathians. At this stage we proposed to verify some Bayesian analysis models and their application to some of the absolute chronology data available in the workspace. We have not succeeded, in the absence of consistent data series for each site, to achieve clear stratigraphic and the chronological sequence for each site included, which would have allowed narrowing down the radiocarbon data ranges for each unit. Even in the adverse conditions described we managed to achieve a chronological model that will acquire consistency through the multiplication of the evidence, through setting standardized stratigraphic schemes and the like. By comparing the proposed models it seems that the Phase overlapping model has the greatest credibility. The observation is supported by posterior distribution of the data and by the Agreement indexes for model. To a large extent the model in question reflects the current knowledge about the history of the sites where data were extracted and about the MBA sequence from the area. Based on the current data and considering some of the reservations raised over the present contribution, the MBA east of the Carpathians can be set in a range between the Boundary Start 1 placed between 2766–2042 (median 2218) and the Boundary End 3 placed between 1619–1109 (median 1430). The latter very low median date was determined by a single probability distribution for the proposed range. We do not exclude a possible upward revision of its medians, which rather corresponds to CRL 27971 located between from 1645 to 1527, median 1580 (Pl. 5).

Certainly, by expanding the database we will be able to select the most viable analysis model and the determination of the internal stages. The Phase overlapping represents currently a possible working hypothesis. This explains the partial simultaneity of the two main cultural identities, the Costișa and Monteoro. The large number of the samples $^{14}C$ extracted and analyzed from Costișa, a site with a long period of occupation proves the necessity of following this model.

The use of two alternative models does not mean uncertainty but the possibility of permanent confrontation and verification of the data, the probability distribution, and the degree of agreement. When we will add to these hypotheses the data representing the materiality we will have complemented the images of place and places.

Obviously, the standardization of selecting the samples, the manner of collecting them, the manner of working with secure stratigraphic contexts, and the manner to release the $^{14}C$ data will improve our knowledge about the periodization and chronology of the Bronze Age. The assumptions proved to be correct. The proposed simulations may represent a good start for a constant and careful chronological refinement. For this we have at our disposal the media that can facilitate or further entangle our efforts.

Proof reading, Professor Ralph Rowlett

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Вулпе 1961
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List of figures

Fig. 1. The area of study. The dots and the numbers represent the archaeological sites from the database.
Fig. 2. Probability distribution of the MBA data Phase contiguous (M1).
Fig. 3. Probability distribution of the phases and boundaries within the Phase contiguous model (M1).
Fig. 4. Probability distribution of the MBA data (M2). Phase overlapping.
Fig. 5. Probability distribution of the phases and the boundaries within the Phase overlapping model (M2).
Fig. 6. Conventional radiocarbon ages (CRAs) on bone and wood from Siliștea and Costișa versus 13C.

List of tables

Table 1. 14C data for animal bones, seeds, wood, charcoal from the area of study. Carbon (13C) values are reported from the 14C measurement (CRA = conventional radiocarbon age).
Table 2. 14C data for animal bones, seeds, wood, charcoal from the area of study. Carbon (13C) values are reported from the 14C measurement (CRA = conventional radiocarbon age).
Table 3. 14C data for animal bones, seeds, wood, charcoal from the area of study. Carbon (13C) values are reported from the 14C measurement (CRA = conventional radiocarbon age).