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New radiocarbon dates for the Neolithic period in Bosnia & Herzegovina

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Introduction

Nearly a century ago, Gordon Childe coined the expression "Neolithic Revolution" to account for the shift from a foraging to a farming lifestyle.[1] If the social, cultural, economic and demographic implications of this change indeed had a profound and inalterable impact upon the fate of humanity[2], this process was by no means sudden, as the term Revolution would imply. On the contrary, the process of domestication of plants and animals took several millennia to be completed, from the earliest occurrences of domesticates by c. 8500–8000 cal. BC in the Fertile Crescent, to the general presence of farming practices by 7000 cal. BC across the Levant.[3] Likewise, the very process of crop domestication can take up to several millennia to be fully completed.[4]

Wild predecessors for Neolithic plant domesticates are absent in Europe, while the contribution of the European wild fauna to animal domesticate populations appears to be overall limited.[5] All categories of data thus indicate that farming practices were introduced into Europe from the Near East. Although the precise mechanisms of this process are a matter of contention, its chronology is well known thanks to the accumulation of radiocarbon dates across Europe and the application of various statistical tools.[6] It is now established that that the spread of farming practices in Europe lasted three to four thousand years, from its earliest occurrences in the Greek peninsula at the turn of the 8th and the 7th millennia cal. BC to its inception in Britain and Ireland during the first centuries of the 4th millennium cal. BC. Another significant recent result is that the diffusion of farming practices is not a continuous process, but is rather structured by alternating episodes of dispersion and stasis.[7] Such local delays were previously suspected.[8] The rate of dispersal changes significantly from region to region, being much faster for instance in the Mediterranean and comparatively much slower in central and north-western Europe.[9] Several factors account for these chronological differences, including climate change[10], ecological constraints[11], the nature of early farming practices[12] and, notably, the most difficult variable: the density and role of local foraging populations.[13]

[1] Childe 1925.
[2] Barker 2006.
[3] Aurenche et al. 2001; Zeder 2008.
[4] Fuller 2007.
[5] Bollongino / Burger 2007; the situation for pigs is however more complicated: Larson *et al.* 2007; Ottoni et al. 2013.
[6] e. g. Gkiasta et al. 2003; Pinhasi et al. 2004; Bocquet-Appel et al. 2009; 2012; Fort et al. 2012.
[7] Bocquet-Appel et al. 2009; 2012; Isern et al. 2012.
[8] e. g. Ammerman / Cavalli-Sforza 1971; Zvelebil / Rowley-Conwy 1986; Guilaine 2003.
[9] Bocquet-Appel et al. 2012.
[10] Weninger et al. 2006; Berger / Guilaine 2009.
[11] Bocquet-Appel et al. 2012.
[12] Conolly et al. 2008.
[13] Isern et al. 2012; see Vander Linden 2011 for a review of these various factors.

Identifying and filling gaps in the evidence

The chronology of the diffusion of farming practices across Europe thus rests upon solid foundations. Although Europe is arguably one of the most intensively covered areas in the world in terms of archaeological field activity, several regions still remain under-documented. One of these gaps corresponds to the modern-day territory of Bosnia & Herzegovina. This situation is unfortunate for several reasons. Firstly, Bosnia & Herzegovina lies at the crossroads between the two major European streams of diffusion, that is inland the Starčevo-Körös-Criş culture followed by the LBK culture in central Europe, and the Impresso-Cardial complex in the Mediterranean basin. Secondly, the publication of the sites of Obre I and II in the mid-1970s by Marija Gimbutas and her team was at the forefront of the radiocarbon method. A total of twenty-two radiocarbon dates were indeed obtained for both Obre I and II[14], at a time when dating of sites by a single sample was often the norm. However, this pioneering study did not have any local offspring and the use of the radiocarbon method for the Neolithic of Bosnia & Herzegovina has since remained limited. Only recently has the situation improved, thanks especially to an intensive research project conducted in the Visoko basin under the aegis of the University of Kiel.[15] A survey of the literature identified a total of 68 dates for eight sites, seven of which are located in the upper Bosna river valley (Table 1). The number of dates per site is highly variable, from two dates (e. g. Kundruci; Butmir, Gornja Tuzla) to 30 for Okolište.

It is in this context that a dating programme was launched in 2010 in collaboration between the University of Leicester and the Museum of the Republika Srpska. An appeal was made to museums across Bosnia & Herzegovina to submit suitable bone samples from existing collections for ^{14}C dating, and several institutions responded favourably to this call. The actual choice of samples and sites was left to the local curators, who were only instructed to provide samples thought to be of Neolithic date. If possible, preference was given to – at least – two samples per site and/or chronological unit (e. g. stratigraphic level). A total of 49 samples from 23 sites was eventually submitted. Samples were processed by the Research Laboratory for Archaeology and Art History, University of Oxford, and were subject to standard chemical treatments in order to extract collagen and to remove any possible modern contamination. The results are summarised in Table 2. Nine samples did not yield sufficient collagen to provide reliable dates, whilst a few samples point to other periods: two dates from Lazaruša belong to the Early Bronze Age, four samples are dated to the Iron Age, and two samples proved to be sub-recent and/or modern. Despite these minor drawbacks, inescapable when working with museum collections, the majority of the samples belongs to the Neolithic period, with 32 dates for 14 sites. Radiocarbon dates were previously available for three of these sites (Obre I, Obre II and Gornja Tuzla) and our goal in these cases was to check the coherence of the older determinations against the new ones. Dates were thus obtained for 11 new sites, more than doubling the number of sites for which radiocarbon dates now exist (Fig. 2).

Figure 1 presents the geographical distribution of Neolithic sites in Bosnia & Herzegovina, as gathered from the published literature, compared with the distribution of sites for which radiocarbon dates are available. Whilst the state of the documentation is excellent in central Bosnia, as a direct result of the aforementioned work in the Visoko basin, elsewhere the situation is much more variable. In Herzegovina, about a third of known sites are now dated, all for the first time thanks to the present programme. At a more detailed level, however, much remains to be done as it was not possible to date any entire sequence (see below). The situation is worse in the northern half of the country with only a handful of dated sites, three of them located along the Vrbas river valley.

Central Bosnia

Obre I / Obre II

The stratified sites of Obre I and II were excavated in 1967 and 1968 by a joint Bosnian-Ameri-

[14] Gimbutas 1974b, Tab. 1-2.
[15] e. g. Hofmann et al. 2009; Hofmann 2012; Müller et al. 2013; Hofmann in press.

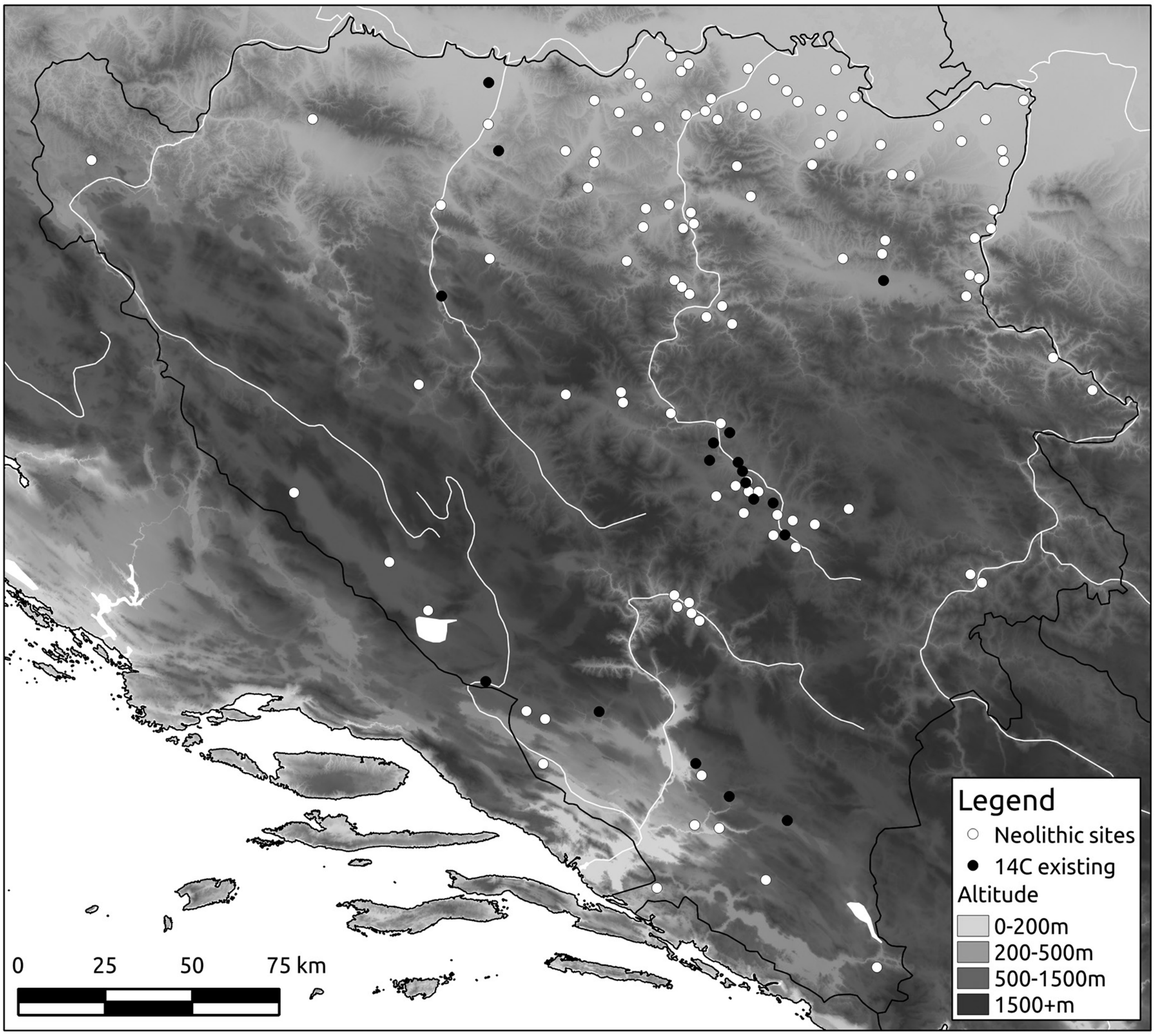

Fig. 1. *distribution of known Neolithic sites in Bosnia & Herzegovina* (white dots), *with indication of sites for which* ^{14}C *information is available* (black dots)

can team, co-directed by Alojz Benac and Marija Gimbutas.[16] Both sites, only a couple of hundred meters apart, lie on the bank of the Trstionica river in the Bosna valley. Excavations in Obre I were organised in seven trenches, covering 700 m^2, and for Obre II in 12 trenches covering 928 m^2. As previously mentioned, the existing radiocarbon record is satisfactory, especially given the age of the excavations, with six dates for Obre I, and 16 dates for Obre II.[17] Although both series of dates are internally coherent, we decided to obtain measurements for new samples in order to check for possible discrepancies related to advances in radiocarbon dating technique. Four new dates are now available for Obre I, and a further three for Obre II.

Obre I is the oldest site, with a Starčevo base level dated by two ^{14}C samples to the first half of the 6th millennium cal. BC. The original report also mentions a third date pointing to the last two centuries of the 7th millennium cal. BC, but its validity was questioned by Gimbutas herself.[18] Unfortunately, as part of this new dating programme, it was not possible to get new bone samples from this early phase in the collections of the Zemaljski Muzej. The four new samples all come from sonda IV, layers 11 and 12, which are attributed to Gimbutas' second chronological phase for Obre I.[19]

[16] Benac 1973a; Benac 1973b; Gimbutas 1974a.
[17] Gimbutas 1974b, Tab. 1.
[18] Gimbutas 1974a, 19; see below general discussion.
[19] Gimbutas 1974b, 17.

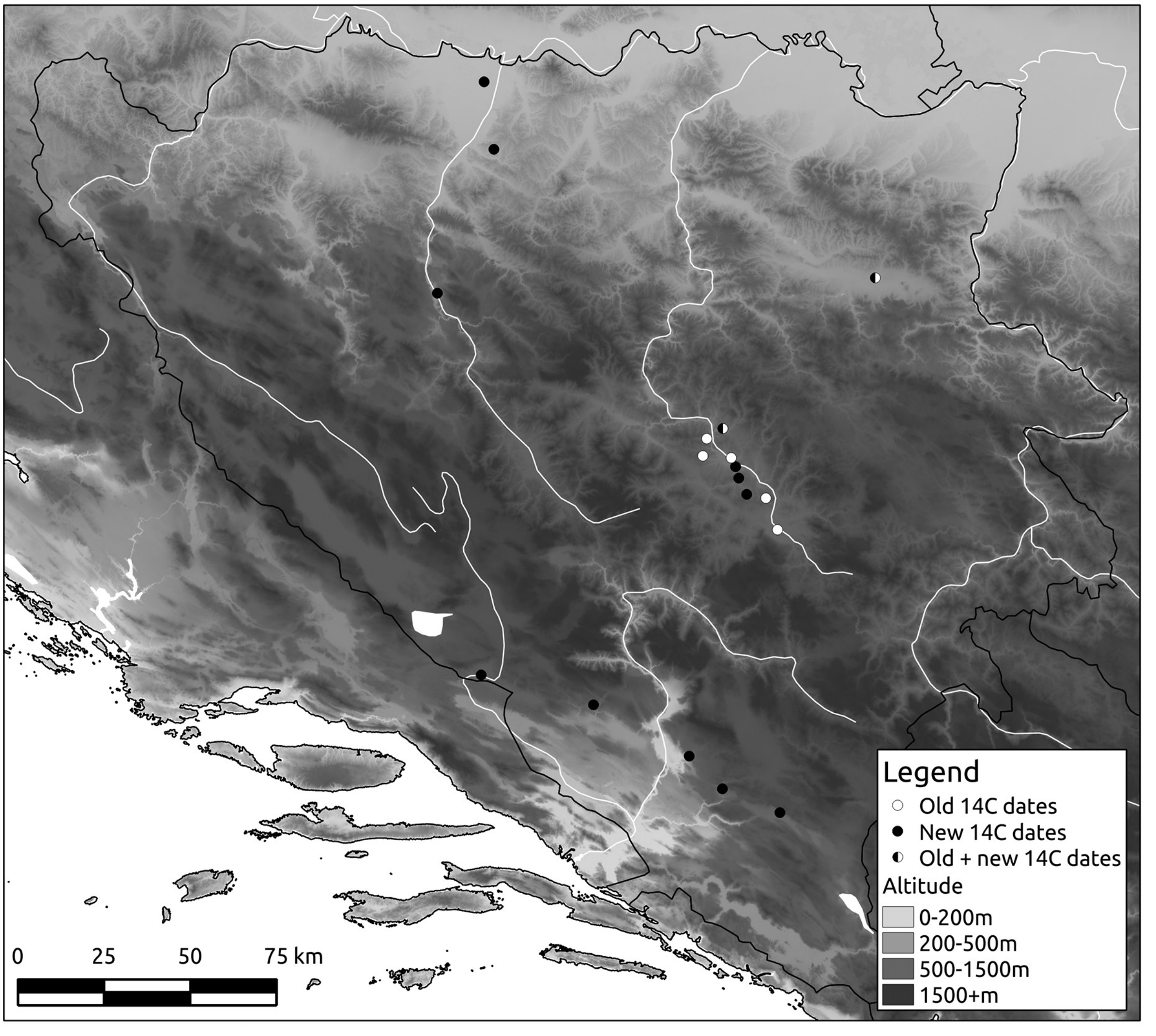

Fig. 2. *distribution of Neolithic sites in Bosnia & Herzegovina for which* ^{14}C *information is available. White dots:* ^{14}C *dates taken from the literature. Black and white dots:* ^{14}C *dates taken from the literature and supplemented by new dates. Black dots: newly dated sites.*

In order to maximise the potential offered by the relatively large number of available ^{14}C dates, we decided to use Bayesian modelling. Without going into the details[20], this statistical procedure combines radiocarbon dates with so-called prior information in order to constrain and reduce the range of ^{14}C probabilities. This prior information corresponds to independent data regarding the relative chronology of the dates (e. g. stratigraphic relationship between the samples). In the present case, we modelled all ^{14}C dates on the basis of the three phases devised by Gimbutas.[21] We use the software Oxcal which offer various statistical tests, their choice depending upon the nature of the archaeological information at one's disposal.[22] Here, preference was given to the function BOUNDARY, which assumes that all dates for a phase belong to a single uniform range bounded by a given start and end. Despite its simplicity, this model proves to be very useful and efficient. It is important to recognise that, in this model, boundaries do not come as set dates, but still as probability distributions.

Gimbutas recognised three successive phases for Obre I, respectively named Obre IA, IB and IC.[23] In our model, presented in Fig. 3, Obre IA

[20] e. g. Bronk Ramsey 2009.
[21] Gimbutas 1974b.
[22] see Bronk Ramsey 2009.
[23] Gimbutas 1974b.

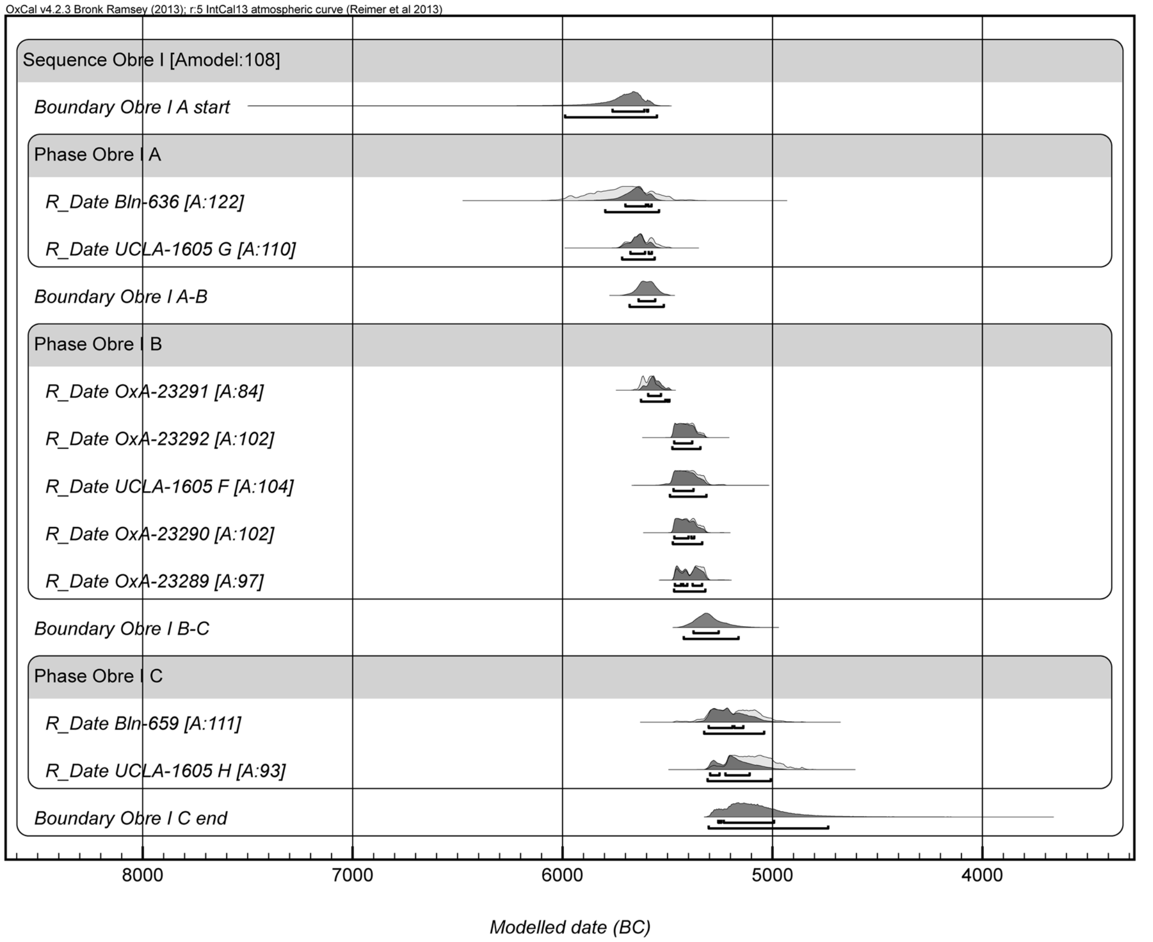

Fig. 3. *Bayesian modelling of radiocarbon dates for the site of Obre* 1

includes two dates[24], Obre IB six dates (including four new ones), and Obre IC two dates. The Bayesian modelling suggests that phase Obre IA lasts between 5965–5579 cal. BC (68.2%) and 5694–5369 cal. BC (68.2%). Obre IB is bounded between 5666–5536 cal. BC (68.2%) and 5410–5278 cal. BC (68.2%). Lastly, Obre IC occurs between 5482–5062 cal. BC (68.2%) and 5210–4787 cal. BC (68.2%)[25]. The overlap between the end and the beginning of successive phases should not be regarded as a problem. The phases occur in clear succession, but, on the basis of the existing evidence, it is impossible to pinpoint with further precision their chronological limits. The number of available radiocarbon dates plays a major role in this exercise, as is further made clear by the results for Obre II.

The stratigraphic and cultural situation for Obre II presents, in Gimbutas' scheme, three phases, each with their own sub-divisions. Gimbutas reports six dates for Phase Butmir 1a, and no corresponding samples could be retrieved for the present dating programme. There are four existing dates for phase Butmir 1b, including a new sample, OxA-23293 which was obtained from a human femur from sonda VI, layers 17-18, at a depth of 250 to 280 cm. Although this depth is compatible with phase Butmir Ib, the recorded provenance of this human bone is in contradiction with the original bone report, which states that all human remains were found in sonda V (Nemeskéri 1974). Yet, the corresponding date of 5016–4832 cal. BC (94.9%) is compatible with other dates for the same phase (see below), and also older than dates from the upper levels from the same sonda: there is therefore no reason to

[24] A third date UCLA 1605 I was reported by Gimbutas, but proves too old and, following Gimbutas' original position, was not considered here.

[25] Dates obtained thanks to Bayesian modelling are reported here within a single confidence interval. By comparison, single calibrated dates are reported with a double confidence interval, unless specified otherwise.

doubt its validity. Phases Butmir IIa and IIb have four dates each, while Butmir III was not directly dated in Gimbutas' publication. This gap is now filled by date OxA-23294, which was obtained from sonda III, at a depth of 0.3-0.5 cm, which corresponds to the latest Butmir 3c phase.

Let us also mention that a third new sample, OxA-23295, was obtained for sonda IV, layer 14, and gives a date of 5001–4826 cal. BC (93.2%). The new date is coherent with date Bln-639 obtained for layer 25 of the same sonda. This stratigraphic concordance indicates that both dates are valid. However, in the absence of full publication of all stratigraphic records, it is not possible to attach this new date to any of Gimbutas' phases and therefore it is not included in the modelling.

Bayesian modelling of the aforementioned dates is reported on Fig. 4. Phase Butmir IA is bounded between 5128–4953 cal. BC (68.2%) and 4981–4821 cal. BC (68.2%), with phase Butmir IB between 4976–4854 cal. BC (68.2%) and 4884–4740 cal. BC (68.2%). Phase Butmir IIA lasts between 4865–4728 cal. BC (68.2%) and 4778–4626 cal. BC (68.2%) and Butmir IIB occurs between 4770–4586 cal. BC (68.2%) and 4646–4467 cal. BC (68.2%). Lastly, Butmir III is only dated by OxA-23294, between 4706 and 4535 cal. BC (95.4%). As for Obre I, the Bayesian modelling is therefore in broad agreement with Gimbutas' early results, with only one major discrepancy. In the absence of ^{14}C dates, Gimbutas considered for phase Butmir III that a duration of "400 to 500 years seem[s] to be plausible".[26] The date reported here rather suggests that phase Butmir 3 lasted only a century and a half. Overall, the modelling thus points to a relatively short sequence at Obre II, lasting for approximatively five centuries. With the exception of Butmir III, for which only one date is available, all phases are ordered in a clear sequence, with limited overlap between them.

Okolište

The site of Okolište lies in the northern part of the Visoko basin. This large site, covering 7ha, has been recently investigated by a German-Bosnian team.[27] A combination of geomagnetic prospection and archaeological excavations has demonstrated that the site was surrounded by a complex system of ditches with several episodes of construction, and incorporated numerous rectangular houses, often built over each other. In total, using this stratigraphic information as well as ^{14}C dates and pottery seriation, the excavators recognise no less than nine successive phases.[28]

Following Robert Hofmann's analysis, we have grouped several of these phases together in order to match comparisons with existing typo-chronological schemes for central Bosnia.[29] When possible, stratigraphic information was also taken into consideration in the elaboration of the Bayesian modelling (Fig. 5). Only one date, KIA-41403, is available for Phase I, and places it between 5231 and 5038 cal. BC (90.7%). Following Hofmann[30], we have then grouped together phases 2-3, which last between 5226–5086 cal. BC (68.2%) and 5114–4918 cal. BC (68.2%). Phases 4-6 are bounded between 5190–5071 cal. BC (68.2%) and 4805–4710 cal. BC (68.2%). Phases 7-8 are dated between 4928–4768 cal. BC (68.2%) and 4779–4570 cal. BC (68.2%), whilst the sequence ends with phase 9 between 5024–4738 cal. BC (68.2%) and 4776–4477 cal. BC (68.2%). It must be noted that the chronology presented here is in overall agreement with Hofmann's own calculations. The present modelling is however more conservative, as it stresses the probability associated with each boundary, and does not incorporate information from material culture seriation. From a radiocarbon point of view, it is for instance noticeable that phases 1 and 2-3 present a major overlap, as do phases 7-8 and 9. The limited number of ^{14}C dates available for these phases is partly responsible for this situation.

Kundruci

Kundruci is a small settlement of around 0.2ha, located about 80m above the Visoko basin on the Pleistocene terrace of a side valley.[31] Previously known from road construction work[32], the site was surveyed and excavated in 2008. Excavations covering around 140m^2 revealed seven occupation horizons (Layers 2-8), all but the oldest of

[26] Gimbutas 1974b, 35.
[27] e. g. Hofmann et al. 2009.
[28] Hofmann 2012, Figs 6-7.
[29] Ibid., Tab. 1.
[30] Ibid., Tab. 1.
[31] Furholt 2012; Furholt 2013.
[32] Perić 1995.

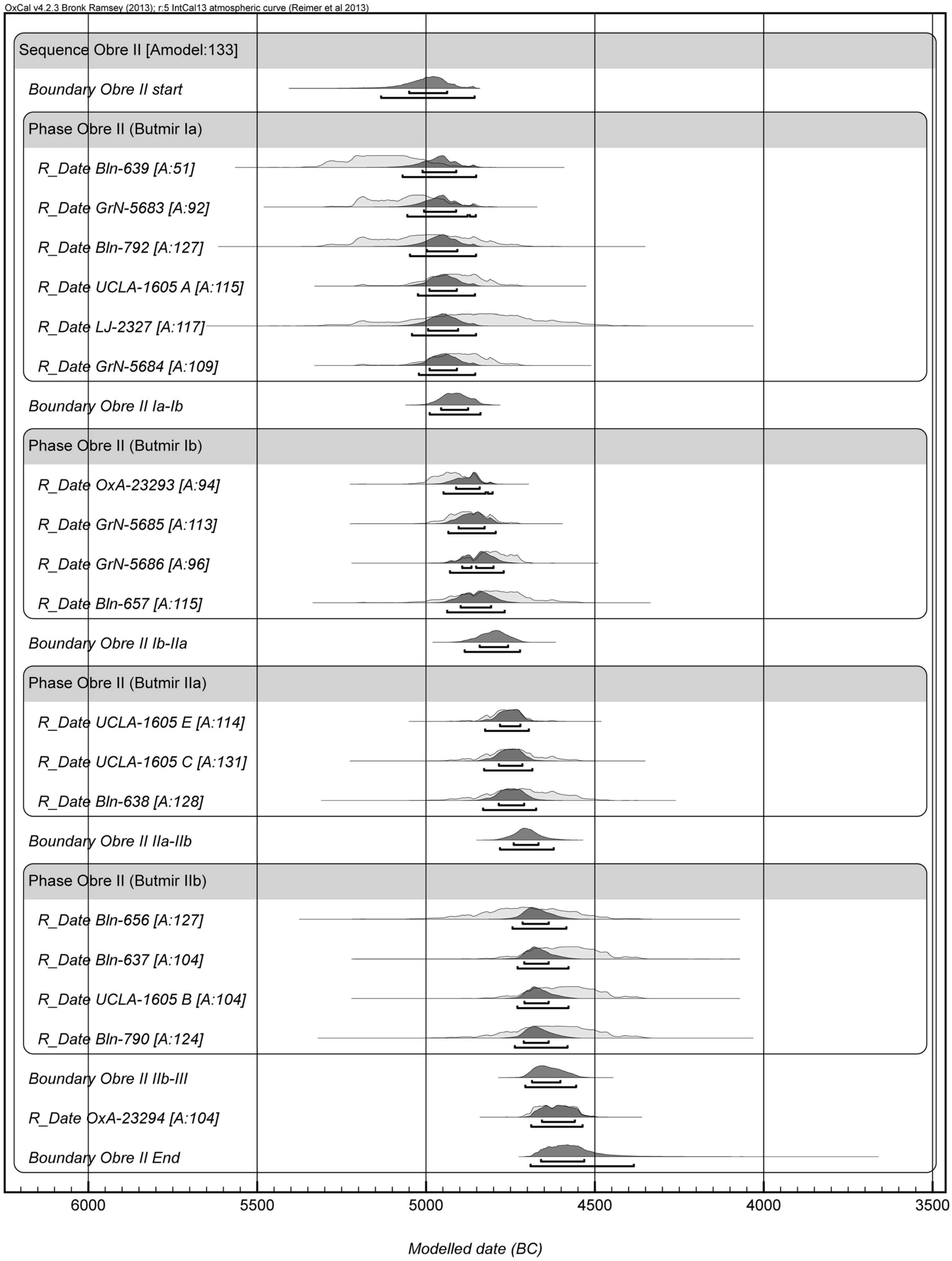

Fig. 4. *Bayesian modelling of radiocarbon dates for the site of Obre* 2

which contained remains of unburnt houses. The latest of these – House 1/2 from Layer 2 – is an extensive (14x6 m) structure identified from a series of large postholes. The occupation horizons were grouped by the excavators into five layer-formations[33]: Kun1/2 (Layer 2), Kun 1/3 (Layer 3), Kun 1/4 (Layers 4-5), Kun 1/5 (Layers 6-7), and Kun 1/6 (Layer 8).

[33] Furholt 2012, Tab. 1.

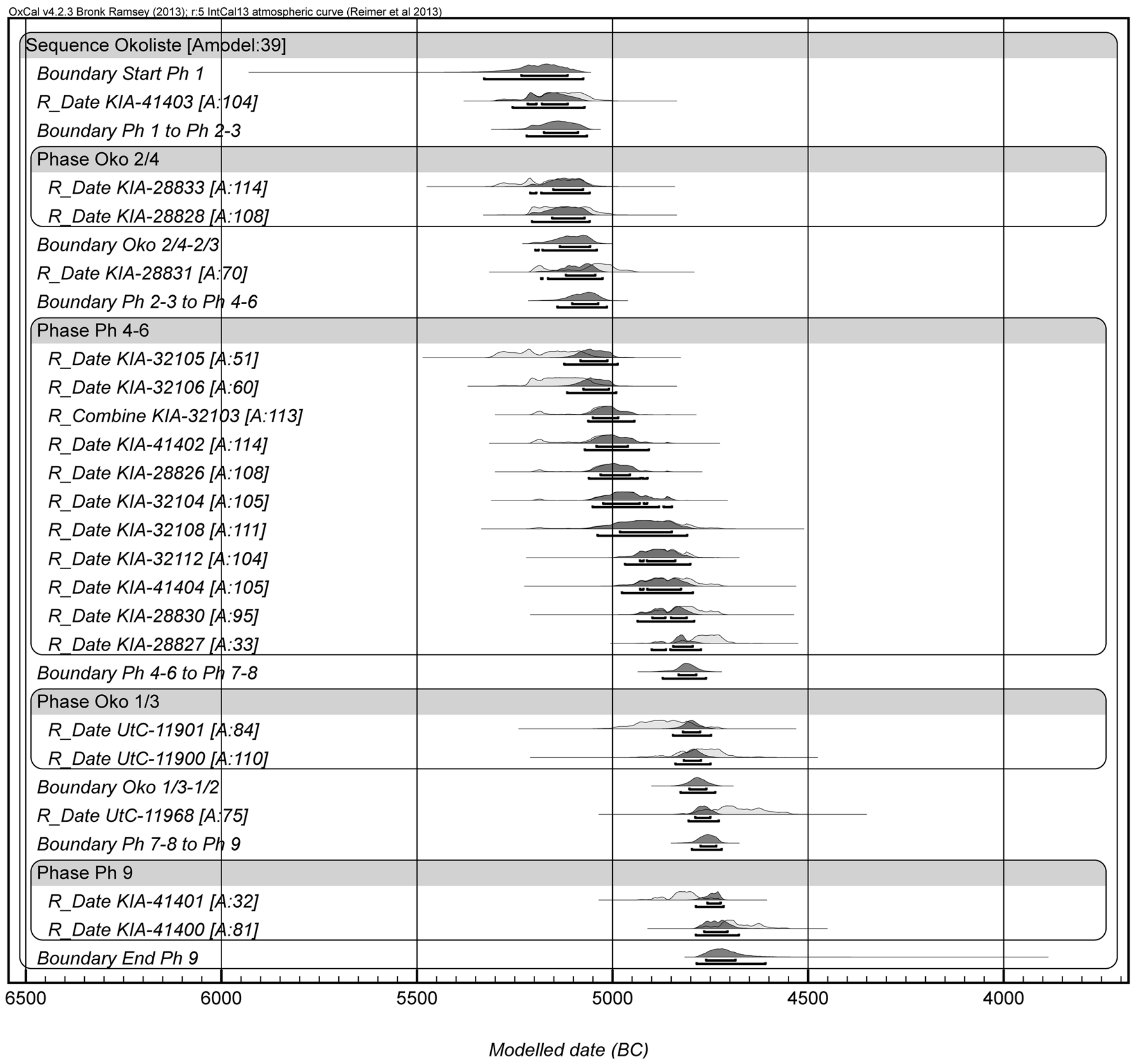

Fig. 5. *Bayesian modelling of radiocarbon for the site of Okolište*

The pottery from Kundruci appears to correspond to late Butmir material from the Visoko basin, e. g. Phase 9 at Okolište, albeit with some elements that are closer to Butmir itself, and some entirely distinctive traits.[34]

Three ^{14}C dates were obtained for Kundruci, all on charcoal.[35] Of these, KIA-39639 from Kun 1/3 calibrates to 4836–4696 cal. BC (95.4%), while KIA-39638 from Kun 1/4 works out as 4933–4746 cal. BC – both broadly supporting the excavators' suggested occupation range of 4900–4700 cal. BC. A third sample, KIA-43947, was an unidentified charcoal fragment from the lowermost occupation deposits (Kun 1/6) and gave an anomalously early date of 5976 to 5717 cal. BC (95.4%). Given its disagreement with the associated late Butmir pottery, plus the potential for residuality/old-wood effects, this date was rejected by the excavators[36] and is not considered further here.

Donje Moštre

This is a large site (c. 3.5ha) situated on the left bank of the River Bosna in the Visoko basin, less than a kilometre south of Okolište. Following geomagnetic survey, an area of approximately 100m² was excavated in 2008 by the University of Kiel, Zemaljski Museum of Bosnia & Herzegovina, Bosnian Academy of Sciences, and Heritage Museum in Visoko.[37] Area 1, located

[34] Ibid., 207.
[35] Ibid.; Furholt 2013.
[36] Furholt 2012, 207; 2013, 181-182.
[37] Müller-Scheessel / Hofmann 2013.

just above the bank of the Bosna, consisted of a single trench, while the bulk of the exposed area was towards the centre of the site in Area 2. Four building horizons were identified in Area 1 and six in Area 2.

The site was originally identified on the basis of surface finds typologically assigned to late Kakanj, suggesting occupation roughly contemporaneous with Arnautovići and the beginning of occupation at Okolište.[38] The earliest levels encountered in the 2008 excavations, however – mainly in Area 1 – appear closer to the *end* of the Okolište sequence, with ceramic forms corresponding to Butmir III.[39] Accordingly, Donje Moštre is suggested to have been (re?)founded roughly contemporaneously with the abandonment of Okolište, around 4650 cal BC, perhaps representing a shift in settlement location.[40] This is broadly supported by two ^{14}C dates on short-life plant materials from the earliest excavated layers[41]: Erl-15197 and Erl-15196, from Dom 1/6 and Dom 1/5 respectively, are almost identical and calibrate to within 4679–4458 cal. BC at 95.4%. An additional sample from Dom 1/6 (KIA-39512) gave a mid-4th millennium cal. BC date and was rejected by the excavators as an outlier.

The bulk of excavated deposits from Area 2, meanwhile, are described as early Copper Age – with the ceramics showing greater links to the central Balkans than seen in the late Neolithic of the Visoko basin – while there is some Vučedol material mixed into the uppermost layers, suggesting re-occupation after a hiatus.[42] Three dates from this area (Erl-15200, Erl-15199, KIA-39513) fall a couple of centuries later than those from Area 1, calibrating to around 4450–4250 cal. BC at 95.4%.

Zagrebnice

This is a small site located on the left bank of the Bosna to the far south of the Kakanj basin, where the river starts to emerge from the narrow section of valley downstream from the Visoko basin. Originally discovered during road construction in the 1970s, the site was excavated in 2008 by a joint German-Bosnian team. Around 30 m^2 were exposed, the bulk of this in Area 2 while Area 1 consisted of a single small trench.[43]

The foundation of Zagrebnice has been suggested to represent a relocation of Plandište.[44] Ceramic finds from the lowest two layers in Area 1 (Zag 1/5 and Zag 1/4) are described as having similarities with both late Kakanj and 'classic' Butmir material from Okolište, while the overlying Zag 1/3 is equated with the end of the Okolište sequence (i.e. Phases 8 and 9.[45] In Area 2, the lowest excavated layers – Zag 2/7 – appear to correspond to Zag 1/3.

Five dates were obtained for Zagrebnice following the 2008 excavations, all on short-life plant remains (Müller-Scheessel / Hofmann 2013, Table 1). Of these, three from Zag 2/7 accord with the typochronology, falling within the 4900–4600 cal. BC range (KIA-45629, KIA-45630, KIA-41405).

The two dates from Area 1, however, are earlier than expected. KIA-45627 from Zag 1/5 calibrates to 5607–5477 cal. BC (95.4%), a middle Neolithic date that is at odds with the Butmir pottery recovered from this layer. Erl-15195 from Zag 1/3 is more problematic, giving an early date of 5507–5357 cal. BC (95.4%) while the layer corresponds typologically with Zag 2/7.

While the excavators express some doubt about the reliability of these determinations, which would imply a much earlier development of Butmir pottery than seen elsewhere[46], it is difficult entirely to dismiss them given their internal coherence as the only dates from Trench 1, and the fact that they are on short-life samples. Given the presence of earlier 'Kakanj' pottery amongst surface finds from Zagrebnice, the excavators' interpretation in terms of mixing from earlier (unexcavated) layers seems reasonable – especially for Erl-15195 – hence the dates are included in table 2. Two additional dates from the underlying alluvium are not considered here.

Butmir

The type-site for the late Neolithic of central Bosnia, Butmir is located in the Sarajevo basin, 10 km from the centre of the city. The site lies

[38] Perić 1995.
[39] Müller-Scheessel / Hofmann 2013, 218.
[40] Hofmann 2012, 192.
[41] Müller-Scheessel / Hofmann 2013, Tab. 1.
[42] Ibid., 219-220.
[43] Ibid.
[44] a. k. a. Kakanj; Hofmann 2013, 191.
[45] Müller-Scheessel / Hofmann 2013, 159.
[46] Müller-Scheessel / Hofmann 2013.

close to the Željeznica, a tributary of the Bosna. It was originally excavated on a grand scale in the 1890s, by Vaclav Radimsky and Franz Fiala. Extensive excavation again took place in the 1970s, but the only radiocarbon dates derive from a single small sondage (around 5 m^2) dug in 2002 by a joint German-Bosnian team (Hofmann et al. 2009). Four phases were defined on the basis of the trench, with the first two (layer-groups 1-2) attributed to Butmir I or II and the later two to Butmir III, although the excavators note that limited ceramic material was available for this analysis.[47]

Although a series of animal bone samples were taken for dating, only two were successful, both from contexts within layer-group 2, corresponding to the upper fill of a pit. UtC-11969 calibrates to 4934–4720 cal. BC (95.4%), while UtC-12039 works out as 4796–4584 cal. BC (95.4%), both broadly consistent with the typochronology.

Arnautovići

The site of Arnautovići is located in the Visoko basin. Despite the relatively thin cultural layer (c. 60 cm, from 0.50 to 1.10 m deep), the recovered pottery assemblage is rather extensive and, despite presenting several affinities with Obre, unique in Bosnia & Herzegovina. From a stylistic point of view, the ceramic assemblage is indeed characterised by a wide combination of traits, including Starčevo-Impresso ones; vases on high, hollow conical pedestals decorated with spiral and so-called 'musical notes' motifs, strongly reminescent of the central European LBK as well as the Vinča culture; 'cult vessels'[48], as well as dark grey / black biconical bowls and cups with a well-polished surface. On this basis, it has been suggested that the site comprises two distinct chronological periods of use, the second one being marked by the appearance of black surface treatment and spiral decorative motives.[49] This second phase would be parallel to Phase IV from Obre I, following Perić's scheme.[50] Perić also points out potential similarities between the pottery assemblage of Arnautovići and the Cakran culture, especially the site of Kolsh in Albania.

[47] Hofmann et al. 2009, 155.
[48] Benac 1966b.
[49] Perić 1995, 21-24.
[50] Ibid., Tab. 3.

A single sample was dated for this site, coming from test trench 3, in the upper half of the cultural layer. The corresponding date, OxA-23339, presents an age of 5321–5207 cal. BC, which is in agreement with Obre I phase C.[51]

Zbilje

The site of Zbilje lies in the Visoko basin. The pottery assemblage is remarkable because of the proportion of fine ware, exhibiting several influences including black and gray surface decoration and typological connections with Lisičić and north-eastern Bosnia.[52] These elements point to parallel developments in Obre II, associated with the final phase of the Butmir culture.[53] Another notable typological influence concerns the presence of Vinča traits (especially Vinča-Pločnik phase), a phenomenon observed across several regions, including central Bosnia but also Montenegro.[54]

Only one sample has been dated as part of this project. This sample, OxA-23340, indicating use of the site around 4692–4522 cal. BC (95.4%), directly compares with the Obre II chronology and confirms the typological date.

Dvor

The site of Dvor is located on the left bank of the Kraljušnica river, in the Visoko basin. As for Zbilje, Lisičići traits are numerous, both in the lithic technology (flint saw blades) and pottery (e. g. use of calcite sand as temper). A Vinča component is also noticeable.[55] On this basis, Perić has suggested parallels between phase I at Dvor and phase III at Obre II.

A single sample, OxA-23342, is available for the site and gives a date of 4802–4686 cal. BC (93.8%). The sample was taken from sonda 2, at a depth of 1.2 m; because of the lack of contextual information we cannot attribute this sample with certainly to either phase I or II, and the ^{14}C age overlaps with both the Butmir I and Butmir II phases from Obre II.

[51] in Gimbutas' scheme: Gimbutas 1974b.
[52] Perić 1995, 41-42.
[53] phase II in Obre II, phase III in Okolište; Perić 1995.
[54] Ibid.
[55] e. g. dark-brown bowls with black surface decoration: Perić 1995, 26-28.

Northern Bosnia

Gornja Tuzla

The site of Gornja Tuzla is located on a small hill next to the river Jala. Small-scale excavations were orginally conducted in the 1950s under the direction of A. Benac.[56] These investigations revealed several stratified cultural layers, the lowest levels belonging to the the early Neolithic Starčevo culture, including the remains of a house – unique for the area. The upper levels date to the Vinča culture, constituting one of the westernmost points of this archaeological culture, otherwise centered upon modern-day Serbia. Two early ^{14}C samples date the Starčevo and Vinča levels to 5674–5475 cal. BC (93.6%) and 4534–4335 cal. BC (95.4%) respectively.

Field activities have resumed on the site since 2007, in the form of a collaborative project between the Museum of Eastern Bosnia and the Prehistoric Institute from Vienna (Austria). A complex stratigraphy spanning eighteen layers was brought to light, but according to the excavator Mirsad Bakalović the subsoil was not reached. A control trench was dug along the eastern profile and reached the subsoil at a depth of 2.70 meters. A rich archaeological assemblage was recovered, comprising pottery, grindstones, lithic and bone tools, and a female figurine pointing to an attribution to the Vinča culture.

Four samples were dated as part of our new dating programme, all coming from the latest round of excavation. OxA-23296 comes from the lowest point of the control trench and dates to 5574–5482 cal. BC (75%). This sample compares directly with the previous Starčevo date and confirms the use of the site in the mid 6th millennium cal. BC. Sample OxA-23297 comes from layer 15 and dates to 5216–5011 cal. BC (early Vinča). Lastly, both OxA-23298 and OxA-23299 come from layer 8 and date respectively to 4786–4590 cal. BC (95.4%) and 4687–4502 cal. BC (95.4%), which suggest an attribution to the late Vinča period.

Bijelića Glavica

The site of Bijelića Glavica, Gornji Drugovići, was initially surveyed in 1983 and then excavated in 1984 and 1985. Finds included several hearths, as well as floor and house daub fragments, the latter showing traces of wood components. The excavator of the site, Orhan Jamaković interprets it as a small settlement, possibly destroyed by fire. Despite a high degree of fragmentation, the pottery assemblage includes bowls, pots, jars and cups, showing traits belonging to both Late Vinča and Sopot cultures.[57]

Samples OxA-23303 and OxA-23304 were obtained from trial trench 3, at depths of respectively 1.9 m and 1.5 m. Both dates fall within the early 5th millennium cal. BC and calibrate at 4783–4583 cal. BC (94.2%) and 4618–4456 cal. BC (94.0%) respectively. These confirm the chronological attribution to the late Vinča / Sopot period.

Kočićevo

The site of Kočićevo is located in the alluvial plain of the Vrbas river, 5 km to the south of the confluence with the Sava river. The site was surveyed and tested in 2010, and further excavations were carried out in March 2012. This recent fieldwork has confirmed the suspected presence of a Neolithic settlement, indicated by overlapping pits, set on the riverbank of a palaeochannel of the Vrbas.[58] Extensive material culture has been collected over the course of these two field seasons and preliminary typological study points to comparison with the Sopot culture, which covers the earlier part of the 5th millennium cal. BC in inland Croatia.[59] Samples OxA-23300 and OxA-23301 were obtained from the same layer, at a depth of 80 to 100 cm under the base of the plough horizon. These dates calibrate respectively to 4846–4707 cal. BC (95.4%) and 4786–4590 cal. BC (95.4%) and confirm the typological attribution to the Sopot culture.

Bočac

The site of Bočac (Mrkonjić Grad) was discovered in 1986 during building work. An archaeological layer yielding Neolithic material culture (e. g. potsherds and house daub) was observed, in addition to two graves. Two different sectors were tested and, although both yielded Neo-

56 Benac 1966.

57 Jamaković, unpublished documents of the Museum of Republika Srpska

58 Marriner et al. 2011.

59 Obelić et al. 2004.

lithic material culture, only the first one had an intact stratigraphic sequence. Following Orhan Jamaković's description, the first four excavation layers (I to IV) presented mixed material, probably corresponding to colluvial deposits from the Gradina plateau above the site. A Neolithic level, 1.3 m thick, was identified in excavation layers IV to VIII, the assemblage from layer IV having a mixed Neolithic and Eneolithic character. Typological analysis suggests that the site was in use during the Neolithic, Copper, Bronze and Iron Ages, until the La Tène period. Pottery production is characterised by three main categories of fabric (coarse, medium and fine). Because of the high level of fragmentation, only a few characteristic forms could be reconstructed, including pithoi (coarse fabric, decorated by plastic cordons under the rim or embossed edges), pedestal cups and biconical bowls (medium fabric, with fingernail impressions), and cups with cylindrical bases (fine fabric, with the rare occurrence of fingernail impressions). Lithic finds include axes, maces and retouched scrapers. Typological comparison of the ceramic assemblages suggests, for the basal Neolithic level, connections with phase II of Obre II and with Butmir I[60], that is, following Perić's periodisation, the transitional phase between Middle and Late Neolithic, or proto-Butmir phase.

Three samples were submitted for radiocarbon dating. The first two samples, OxA-23305 and OxA-23306, come from sonda 1, the former at a depth of 0.3-0.6 cm, the latter having no avialble depth information. Both dates are coherent and calibrate to 4708–4538 cal. BC (95.4%) and 4790–4594 cal. BC (95.4%). A third sample, OxA-23307, coming from sonda 2, was dated to 4789–4610 cal. BC (95.4%). All three dates are thus coherent and confirm the presence of a phase of occupation contemporaneous with the Butmir 1 period.

Rastuša

The cave site of Rastuša pećina is located about 12 km south-west of Teslić, in the Republika Srpska, at an altitude of 370 m. The first excavations were carried out in the 1970s under the direction of M. Malez. On this occasion Palaeolithic artefacs were found, attributed either to the Mousterian or the Aurignacian. The site was recently excavated by a joint Bosnian-British team directed by Dr. Preston Miracle (University of Cambridge) and Ms. Ivana Pandzić (Museum of the Republika Srpska). As part of this work, a Neolithic level was observed towards the entrance of the cave, just underneath the modern surface (depth: 0.25-0.30 cm). The assemblage is very small, but included a typical Late Neolithic arrowhead.

Several samples have been dated for this cave, covering the Neolithic, Mesolithic and Palaeolithic periods. These will all be reported in the final publication of the site. Here, we only discuss sample OxA-23602, which was taken from the uppermost level. It is dated to 4606–4449 cal. BC (95.4%), confirming the late Neolithic attribution suggested by the typology.

Herzegovina

Žukovička pećina

The site of Žukovička pećina is located near Vir in Herzegovina and was tested by Marijanovic in 1977. This small rockshelter yielded a thin archaeological layer only preserved to a maximum depth of 50 cm. There was no coherent stratigraphy, perhaps corresponding to colluvial deposits. The ceramic assemblage points to an Early Neolithic date, in particular the middle phase of the Impresso culture. This typological attribution is confirmed by the two available ^{14}C dates (OxA-23599, OxA-23600) which respectively point to 5478–5340 cal. BC (95.4%) and 5486–5361 cal. BC (95.4%).

Zelena pećina

The site of Zelena pećina is located near Blagaj and overlooks the Buna river. There are actually two rock shelters, Velika Zelena pećina and Mala Zelena pećina, but only the former is of interest here. Excavations were conducted in 1955. The stratigraphy comprised three layers. The deepest – and also richest – level (Zelena Pecina III; 0.4-0.9m deep) is associated with Impresso ware, as well as monochrome black and brown ware. This co-occurrence suggests a date towards the end of the Early Neolithic / beginning of the Middle Neolithic. The middle layer (Zelena pećina

[60] Jamaković, unpublished documentation of the Museum of the Republika Srpska.

II) belongs to the Lisičići culture, whilst the upper layer (Zelena pećina I) is dated to the Early Bronze Age.

Animal remains suitable for ^{14}C analysis are rare in the assemblage, and mostly come from the middle layer. However, human remains belonging to a young child were found at 0.6m deep in Trench C, that is within the Early Neolithic level. Two fragments of human skull were thus dated. Both dates are consistent and, when combined, point to a date of 4343-4260 cal. BC (82.9%). This date is in disagreement with the general stratigraphic position of the bones but, although admittedly set relatively late, are not incompatible with the Late Neolithic attribution of the middle layer. As Benac admits himself, the stratigraphy of the site was complex and, in the absence of published drawings, we cannot rule out that Benac did not identify the cut of a grave dug during the Late Neolithi through the summit of the Early Neolithic layer.

Lazaruša

The Lazaruša cave is located near the town of Stolac, in the canyon of the Radimlja river. Excavations were conducted from 1984 to 1988 over approximatively 80% of the surface of this small cave and yielded an archaeological sequence up to 2.2 m thick. Marijonovic distinguished two phases, the younger one being further subdivided in two. Pottery typology suggests that the ealier phase belongs to the Late Neolithic / Early Eneolithic, and the later one to the Eneolithic.

Two samples, both from layer 10 of sonda B, were dated. OxA-23534 dates to 4341–4227 cal. BC (86.8%) and OxA-23535 to 4450–4327 cal. BC (94.1%), both being compatible with an attribution to the Late Neolithic / Eneolithic. Two further samples were dated, both coming from sonda A layer 6 and pointing to a period of use of the site early in the 3rd millennium cal. BC (OxA-23532, 2696–2568 cal. BC, 73.3%; OxA-23533, 2760–2572 cal. BC, 72%).

Hateljska pećina

The site of Hateljska pećina lies close to the village of Berkovići in eastern Herzegovina. Excavations undertaken in 1984, 1987 and 1988 revealed a clear stratigraphy with five distinct phases dated to, on the basis of their respective ceramic assemblages, the Early Neolithic (Late Impresso – Early Danilo), Late Neolithic (Hvar – Lisičići culture), Eneolithic, and Early and Middle Bronze Age (plus a few Medieval finds).

Four samples have been dated for this site: two come from Quadrant V, layer 11 and two from Quadrant VI, layer 11. The precise stratigraphic relationship between these layers is, in the absence of complete published recording, impossible to assess. Both dates from Quadrant VI are in agreement (OxA-23538, 4715–4548 cal. BC, 95.4%; OxA-23539, 4709–4540 cal. BC, 95.4%) and point to the Late Neolithic phase recognised on the site. Dates from Quadrant IV, despite coming from the same layer, are markedly different, with OxA-23536 dating to 4259–4046 cal. BC (95.4%) and OxA-23537 to 4689–4504 cal. BC (95.4%). All dates point to the Late Neolithic / Eneolithic phase. Unfortunately, no samples potentially belonging to the Early Neolithic were dated as part of this programme.

Discussion

Despite the scarcity of dates, especially when compared to the overall number of known Neolithic sites in Bosnia & Herzegovina, some elements are worth pointing out. The earliest Neolithic in Bosnia, at least from a strict radiocarbon point of view, is represented by the Starčevo levels in Gornja Tuzla and Obre I. Both sites are located on the western fringe of the distribution area of this culture and, in terms of absolute chronology, postdate by a couple of centuries the earliest dates available from neighbouring regions.[61] For Herzegovina, the earliest existing dates come from Žukovička pećina and point to the 55-54th centuries cal. BC. This date is markedly later than Impresso dates available for Adriatic Croatia.[62] Two hypotheses can account for this discrepancy: either this is simply a by-product of the documentation since, for instance, it was not possible to obtain samples from the earliest layers in several caves; or, as suggested by Forenbaher & Miracle[63], there is a real delay between the neolithisation of the Adriatic coast and its hinterland.

[61] e.g. Minichreiter / Bronić 2006; Whittle et al. 2002; see also Orton 2012.
[62] Forenbaher / Miracle 2005; Forenbaher et al. 2013.
[63] Forenbaher / Miracle 2005; see also Forenbaher et al. 2013.

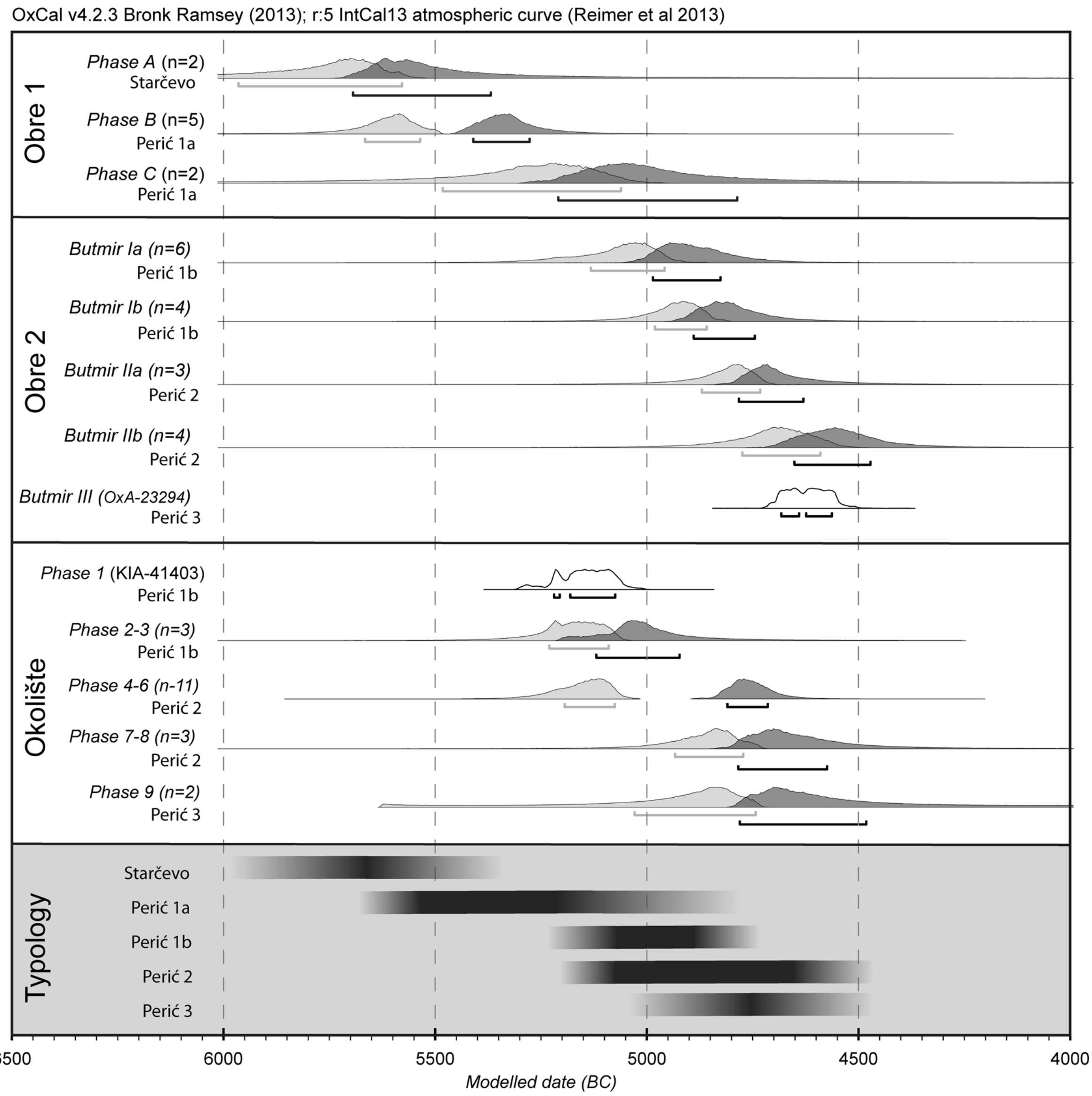

Fig. 6. *approximate temporal spans for cultural phases in central Bosnia and Herzegovina*

In this model, the earliest Neolithic stage would correspond to a phase of maritime exploration, noticeable across the entire eastern Adriatic, followed by a later stage of expansion of the settlement pattern in potentially more attractive areas. It must be noted that a similar two-stage process has recently been put forward for the western Mediterranean basin.[64]

In central Bosnia, the quality of the information is such that it is possible to outline a chronological scheme for the entire duration of the Neolithic period. Several competing schemes, based upon typology and/or radiocarbon dates, are available.[65] Figure 6 summarises existing information for the reference sequences of Okolište, Obre I and II. Radiocarbon dates are available for the Starčevo culture and from the succeeding phases 1 to 3 from Perić's classification, which encompass the older Kakanj – Butmir terminology.[66] Here, we adopt a methodologically more conservative approach, highlighting the potential chronological overlaps between cultural phases. The earliest Neolithic phase in this area corresponds to the Starčevo culture, and lies between 5965–5579 cal. BC (68.2%) and 5694–5369 cal. BC (68.2%). This Starčevo phase is fol-

[64] Guilaine / Manen 2007.

[65] see review in Hofmann 2012.

[66] Perić 1995, Tab. 3.

lowed by Perić's Phase 1, for which we have kept the original subdivision into sub-phases 1a and b. Sub-phase 1a lasts from 5666–5536 cal. BC to 5210–4787 cal. BC (68.2%), while sub-phase 1b is dated between 5231–5038 cal. BC (90.7%) and 4884–4740 cal. BC (68.2%). Sub-phase 1b is thus clearly more recent than the start of sub-phase 1a, but their respective ends cannot currently be distinguished from a strict radiocarbon point of view. A similar conclusion can be reached for both Perić's phases 2 and 3: Phase 2 is dated between 5190–5071 cal. BC (68.2%) and 4646–4467 cal. BC (68.2%), and Phase 3 between 5024–4738 cal. BC (68.2%) and 4776–4477 cal. (68.2%). This situation is partly related to the limited number of dates available for Phase 3 (two dates from Okolište and one from Obre II). This modelling does not challenge the validity of the overall typological sequence, as each phase chronologically follows the previous one. It must however be stressed, given the current state of the documentation, that the precise timing of the transition from one phase to the next remains elusive. New radiocarbon dates, especially associated with precise stratigraphic information, will hopefully allow refinement of this absolute chronology. This being said, we would like to point out that, taken individually, all radiocarbon determinations obtained for previously undated sites confirm the pre-existing typological and chronological attribution. This concordance needs to be further tested but has potential implications for the general re-assessment of the Neolithic period in Bosnia & Herzegovina.

A last point deserves some attention. The dataset presents a clustering of ^{14}C dates between c. 4800 and c. 4500 cal. BC[67]. Indeed, 14 out of 19 dated sites fall within these narrow time-brackets (see table 3). In Herzegovina, this period corresponds to the beginning of the Late Neolithic (4800–4000 cal. BC, Hvar pottery style in Dalmatia: Forenbaher et al. 2013) and only one site is concerned (Hateljska pećina). The patterning is much more interesting in central Bosnia as it corresponds to the decline in size and eventual abandonment of Okolište, and the concomitant foundation of several new sites in peripheral areas.[68] It is tempting to link this regional sequence to the situation further West in the Vrbas valley where, at least from a radiocarbon point of view, the period 4800–4500 cal. BC appears to be associated with the local introduction of farming practices. Given the limited extent of the documentation, this change in settlement pattern and landscape use must remain a working hypothesis, but this is definitely an avenue worth exploring in future research.

Conclusion

In conclusion, the – admittedly still limited – evidence indicates that the neolithisation of Bosnia & Herzegovina was not a single event. As for the Near East and for the rest of Europe, there was not a single 'Neolithic Revolution' in Bosnia & Herzegovina, but rather a suite of regional episodes distributed over several centuries. The introduction of domesticates in Bosnia & Herzegovina is linked to the two major European streams of diffusion of the Neolithic, that is the Starčevo culture inland and the Impresso culture on the Adriatic Sea. In both cases, a temporal delay when compared to other regions must be pointed out. A second episode of neolithisation, parallel to a wider restructuring of the settlement pattern in previously Neolithic areas, seems to intervene towards the early-mid 5th millennium cal. BC. The reality of this sequence, and the corresponding archaeological and ecological signatures, remains to be investigated and is the subject of an ongoing international research project undertaken by the present authors (Vander Linden et al. 2013). This new work, which involves another extended dating programme, will address these key questions and contribute positively to a better understanding of Neolithic period in Bosnia & Herzegovina and surrounding areas.

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[67] It should be noted that this concentration is not related to any major wiggles in the radiocarbon calibration curve for this period

[68] Hofmann 2012, 191-2.

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Резиме

Нови радиокарбонски датуми неолита у Босни и Херцеговини

Нашем тренутном разумијевању хронологије неолитизације Европе увелико је допринијело кориштење нових регионалних програма датовања, компарација постојећих датовања и примјене различитих статистичких алата. Сада је утврђено да је ширење пољопривредне праксе у Европи трајало три до четири хиљаде година, од својих најранијих појава на грчком полуострву на прелазу из 8. у 7. миленијум калц. пр. н. е. све до његовог ширења у Великој Британији и Ирској, током првих вијекова 4. миленијума калц. пр. н. е. Други значајан недавни резултат јесте закључак да ширење пољопривредне праксе није континуиран процес, али је прилично структурисан у наизмјеничним епизодама дисперзије и стагнације. Степен ширења се значајно мијења од региона до региона, који је много бржи на примјер на Медитерану, док је релативно спорији у централној и сјеверозападној Европи. Неколико фактора утиче на наведене хронолошке разлике, укључујући климатске промјене, еколошка ограничења, врсту ране пољопривредне праксе и, прије свега, најтеже промјењљиве – густину и улогу локалне популације.

Иако хронологија дифузије пољопривредне праксе широм Европе почива на чврстим темељима, неколико региона и даље остаје слабо документовано. Једна од празнина одговара савременој територији Босне и Херцеговине. Ова ситуација на жалост има неколико разлога. Први разлог представља чињеница да Босна и Херцеговина лежи на раскршћу између два главна европска тока ширења, која у унутрашњости обухвата Старчево – Кереш – Криш културу праћену ЛБК културом у централној Европи, те комплекс импресо – кардиум у медитеранском базену. Други разлог проистиче из чињенице да се, у вријеме када су Марија Гимбутас и њен тим публиковали материјал о локалитетима Обре I и Обре II средином 70-их година двадесетог вијека, тек почињало радити с радиокарбонским методама. У периоду када је норма датовања локалитета била најчешће један узорак по локалитету, за Обре I и Обре II укупно су добијена двадесет два радиокарбонска датума. Међутим, ова пионирска студија није имала учинак на локалном нивоу те је кориштење метода радиокарбонске анализе неолита Босне и Херцеговине остало ограничено, с примијетним изузетком истраживачког пројекта спроведеног у Високом под окриљем Универзитета из Кила. Истраживањем литературе идентификована су укупно 68 датума за осам локалитета, од којих се седам налазе у горњој долини ријеке Босне. Број датума по локалитету је веома промјенљив, од два датума до тридесет за локалитет Околиште.

У циљу рјешавања ове географске неравнотеже, године 2010. покренут је програм датовања неолитских локалитета сарадњом Универзитета у Лестеру и Музеја Републике Српске. Позив за сарадњу упућен је музејима широм Босне и Херцеговине да из постојећих збирки доставе одговарајуће узорке костију за ^{14}C датовање, на који је позитивно одговорило неколико институција. Избор узорака и локалитета препуштен је локалним кустосима, којима је само сугерисано да обезбиједе узорке за које сматрају да су неолитског датума. Када је то било могуће, предност је дата локалитетима који су могли обезбиједити барем два узорка по локацији и/или хронолошкој јединици (нпр. стратиграфском нивоу). Укупно 49 узорака с 23 локалитета је на крају послано на анализу. Узорци су обрађени од стране Истраживачке лабораторије за археологију и историју умјетности Универзитета у Оксфорду, а који су били у складу са стандардним хемијским третманима да би се извукао колаген и отклонила било каква могућа модерна контаминација. Девет узорака није дало довољно колагена да се обезбиједе поуздани датуми, док је неколико узорака указивало на друге периоде (рано бронзано доба, метално доба, недавно и/или модерно доба). Упркос овим мањим недостацима, неизбјежним када се ради с музејским збиркама, већина узорака припада неолиту, с 32 датума за 14 локалитета. Радиокарбонски датуми су раније били доступни само за три од наведена локалитета (Обре I, Обре II и Горња Тузла) и наш циљ у овим случајевима био је да се

провјери кохерентност старијих детерминација према новима. Датуми су тако добијени за 11 нових локалитета, што значи да је сада више него удвостручен број локалитета на којима постоје радиокарбонски датуми. С географске тачке гледишта, док је стање документације у централној Босни одлично, на другим мјестима ситуација је доста промјенљива. У Херцеговини је тренутно око трећина познатих неолитских локалитета датована први пут захваљујући овом програму. Детаљније гледано још много остаје да се уради, јер није било могуће да се датира свака секвенца комплетно. Ситуација је још гора у сјеверном дијелу земље гдје је само неколико локалитета датовано, од којих су три у долини ријеке Врбас.

Упркос оскудици датума, посебно у односу на укупан број познатих неолитских локалитета у Босни и Херцеговини, неопходно је истакнути поједине елементе. Најранији неолит у Босни, бар са строгог радиокарбонског гледишта, представљају нивои старчевачке културе у Горњој Тузли и Обра I. Обе локације се налазе на западном рубу дистрибутивне области наведене културе и, у смислу апсолутног датовања, настале по неколико вијекова касније у односу на најраније датуме које имамо на располагању, а потичу из сусједних региона. За Херцеговину, најранији постојећи датуми долазе из Жуковичке пећине и указују на 55–54. вијек калц. пр. н. е. Овај датум је знатно каснији од импресо датума расположивих за јадранску Хрватску. Две хипотезе могу да објасне ову разлику: или је ово једноставно нус-производ документације јер, на примјер, није било могуће добити узорке ранијих слојева неколико пећина, или постоји стварно кашњење између неолитизације јадранске обале и његова залеђа. У овом моделу, најраније фазе неолита би одговарале фази поморског истраживања, примијетног у цијелом источном Јадрану, које је касније пратила фаза ширења насеобина на потенцијално атрактивним подручјима.

У централној Босни, квалитет података је такав да је могуће скицирати хронолошку шему за све вријеме трајања неолита, с посебним нагласком на Околиште, Обре I и Обре II. Радиокарбонски датуми доступни су за старчевачку културу и за фазе 1-3 Перићеве класификације, која обухвата старију терминологију Какањ – Бутмир. Ова студија усваја методолошки конзервативан приступ, наглашавајући потенцијална хронолошка преклапања између културних фаза. Најранија фаза неолита у овој области одговара старчевачкој култури, а налази се између 5965–5579 калц. пр. н. е. (68,2%) и 5694–5369 калц. пр. н. е.(68,2%). Ова фаза Старчева праћена је фазом 1 према Перићу, за коју смо задржали оригиналну подјелу у подфазе 1а и 1б. Подфаза 1а траје од 5666–5536 калц. пр. н. е. до 5210–4787 калц. пр. н. е. (68,2%), док је подфаза 1б датована између 5231–5038 калц. пр. н. е. (90.7%) и 4884–4740 калц. пр. н. е. (68,2%). Јасно је да је подфаза 1б стога новија у односу на почетак подфазе 1а, али њихов реципрочни завршетак се не може тренутно разликовати са строге радиокарбонске тачке гледишта. Сличан закључак је донесен и за фазе 2 и 3 према Перићу: фаза 2 је датирана између 5190–5071 калц. пр. н. е. (68,2%) и 4646–4467 калц. пр. н. е. (68,2%), а фаза 3 између 5024–4738 калц. пр. н. е. (68,2%) и 4776–4477 калц. пр. н. е. (68,2%). Наведена ситуација дјелимично је зависна од ограниченог броја расположивих датума за фазу 3 (два датума из Околишта и један са локалитета Обре II). Наведено моделовање не оспорава валидност укупне типологије, с обзиром на то да свака фаза хронолошки прати претходну. Међутим, мора се нагласити да, с обзиром на тренутно стање документације, прецизно вријеме транзиције из једне фазе у сљедећу остаје недокучиво. Надамо се да ће нови радиокарбонски датуми, посебно они за које имамо прецизне стратиграфске информације, омогућити утврђивање апсолутне хронологије. Оно што желимо да истакнемо јесте да, гледајући појединачно, свака радиокарбонска детерминација, добијена за локалитете који нису имали претходно датовање, потврђује већ постојећу типологију и хронологију. Ово усаглашавање се мора додатно тестирати, али има потенцијалне импликације за општу поновну процјену неолитског периода у Босни и Херцеговини.

Посљедња ставка заслужује посебну пажњу. Скуп података представља груписање ^{14}C датума између око 4800. и 4500. калц. пр. н. е. Уистину, 14 од 19 локалитета припадају уском временском периоду (видјети табелу 3). У Херцеговини овај период одговара почетку млађег неолита (4800–4000. калц. пр. н. е, керамичког стила Хвара), а само један локалитет је обухваћен (Хатељска пећина). Образац је много интересантнији у централној Босни, с обзиром на то да одговара опадању величине и евентуалног напуштања локалитета Околиште, а прате га оснивање неколико нових локација у периферним подручјима. То је занимљиво зато што даје могућност повезивања наведене регионалне секвенце са ситуацијом у западном дијелу, у долини Врбаса, гдје, с тачке гледишта радиокарбонског датовања, изгледа да се период 4800–4500 калц. пр. н. е. везује са локалним увођењем пољопривредне праксе. Имајући у виду ограничен обим документације, ова промјена у насеобина и пејзажу мора остати радна хипотеза, али је дефинитивно пут којим се треба водити током будућих истраживања.

Докази, који су још увијек ограничени, указују на то да неолитизација Босне и Херцеговине није био јединствен догађај. Што се тиче Блиског истока и за остатак Европе, није било „неолитске револуције“ у Босни и Херцеговини, већ низ регионалних епизода дистрибуције током неколико вијекова. Увођење доместификације у Босни и Херцеговини повезано је с два велика европска тока дифузије неолита, старчевачке културе у унутрашњости и импресо културе на Јадранском мору. У оба случаја, привремено кашњење у односу на друге регионе мора да буде истакнуто. Друга епизода неолитизације очигледна је у раном и средњем 5.-ом миленијуму калц. пр. н. е., паралелно са ширим реструктурисањем насеобина претходних неолитских области. Како би се провјерила наведена хипотеза, остаје да се подузму даљи радови, а посебно да се ураде нови радиокарбонски датуми.

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Table 1: *Existing 14C dates for the Neolithic of Bosnia & Herzegovina*

Site name	Lab. Ref.	Date BP	Standard deviation	Sample	Delta 13C	68.2% probability	95.4% probability	Context	Culture	References
Butmir	UtC-12039	5830	50	animal bone (Bos)	–17.9	4770BC (7.0%) 4752BC 4746BC (61.2%) 4613BC	4796BC (95.4%) 4548BC	Unit 3, layer-group 2 (upper fill of pit)	Butmir	Hofmann et al. 2009
Butmir	UtC-11969	5938	44	animal bone (Bos)	–20.2	4893BC (1.8%) 4888BC 4884BC (6.1%) 4868BC 4850BC (51.1%) 4766BC 4756BC (9.3%) 4728BC	4934BC (95.4%) 4720BC	Unit 9, layer-group 2 (upper fill of pit)	Butmir	Hofmann et al. 2009
Donje Moštre	Erl-15197	5716	32	grain	-22,8	4594 (68.2%) 4501BC	4679 (9.0%) 4636BC 4620 (86.4%) 4464BC	Unit 10027. Layer-formation 1/6, cultural layer over lowermost building horizon 1/I		Hofmann & Müller-Scheessel 2013
Donje Moštre	Erl-15196	5705	37	hazelnut shell	-23,7	4591 (68.2%) 4490BC	4679 (7.2%) 4636BC 4620 (88.2%) 4458BC	Unit 10024. Layer-formation 1/5, levelling layer over building horizon 1/II		Hofmann & Müller-Scheessel 2013
Donje Moštre	Erl-15200	5549	33	grain	-23,1	4446 (26.1%) 4420BC 4399 (42.1%) 4351BC	4452 (95.4%) 4343BC	Unit 41037. Layer-formation 2/4, open area NW of unburnt houses (building horizon 2/I)		Hofmann & Müller-Scheessel 2013
Donje Moštre	Erl-15199	5486	29	charcoal	-22,6	4359 (68.2%) 4327BC	4442 (2.6%) 4423BC 4372 (75.5%) 4316BC 4300 (17.2%) 4262BC	Unit 40032. Layer-formation 2/3. 'with fire debris by foundation trench of building horizon 2/V'		Hofmann & Müller-Scheessel 2013
Donje Moštre	KIA-39513	5573	31	grain	-21,83	4447 (30.7%) 4417BC 4403 (37.5%) 4366BC	4458 (95.4%) 4352BC	Unit 42020. Layer-formation 2/2. Unsecure stratigraphic context (presence of Vučedol material)		Hofmann & Müller-Scheessel 2013
Gornja Tuzla	GrN-2059	6640	75	charcoal		5628BC (68.2%) 5516BC	5705BC (1.8%) 5687BC 5674BC (93.6%) 5475BC	Pit dwelling in habitation layer depth 5m	Starčevo	Vogel & Waterbolk 1963
Gornja Tuzla	GrN-1974	5580	60	wood		4457BC (68.2%) 4356BC	4534BC (95.4%) 4335BC	Habitation layer depth 3.5m	Vinča	Vogel & Waterbolk 1963
Kundruci	KIA-39639	5888	32	charcoal (Cornus sp.)	-25,74	4789 (68.2%) 4722 BC	4836 (95.4%) 4696BC	Unit 24003. Layer-formation 1/3, House 3 floor, quadrant H/31	Butmir	Furholt 2013
Kundruci	KIA-39638	5956	27	charcoal (Populus sp.)	-26,84	4892 (1.5%) 4890BC 4883 (9.3%) 4869BC 4849 (57.4%) 4792BC	4933 (94.5%) 4769BC 4753 (0.9%) 4746BC	Unit 24099. Layer-formation 1/4 House 7, post 14002, quadrant I/32	Butmir	Furholt 2013
Obre I	UCLA-1605.H	6150	70	animal bone no id.		5210BC (68.2%) 5017BC	5299BC (94.8%) 4932BC 4920BC (0.6%) 4912BC	quadrant I level 8	Kakanj	Gimbutas 1974
Obre I	Bln-659	6230	80	charcoal		5302BC (34.6%) 5202BC 5175BC (33.6%) 5070BC	5370BC (95.2%) 4982BC 4968BC (0.2%) 4964BC	quadrant I level 7	Kakanj	Gimbutas 1974
Obre I	Bln-636	6795	150	charcoal		5844BC (61.4%) 5606BC 5595BC (6.8%) 5560BC	5985BC (95.4%) 5480BC	quadrant IIIa level 8	Starčevo	Gimbutas 1974
Obre I	UCLA-1605.F	6430	60	charcoal		5472BC (68.2%) 5366BC	5509BC (0.6%) 5500BC 5491BC (94.8%) 5302BC	quadrant VI/2 level 9	Butmir	Gimbutas 1974
Obre I	UCLA-1605.G	6710	60	animal bone no id.		5702BC (3.0%) 5694BC 5673BC (46.0%) 5608BC 5594BC (19.2%) 5561BC	5723BC (95.4%) 5528BC	quadrant II level 11	Starčevo	Gimbutas 1974

Site name	Lab. Ref.	Date BP	Standard deviation	Sample	Delta 13C	68.2% probability	95.4% probability	Context	Culture	References
Obre I	UCLA-1605.I	6430	60	animal bone no id.		5472BC (68.2%) 5366BC	5509BC (0.6%) 5500BC 5491BC (94.8%) 5302BC	Quadrant II level 12	Starčevo	Gimbutas 1974
Obre II	Bln-790	5770	100	charcoal		4722BC (68.2%) 4500BC	4844BC (92.3%) 4442BC 4424BC (3.1%) 4370BC	sondage V/3 house	Butmir	Gimbutas 1974
Obre II	UCLA-1605.B	5740	80	charcoal		4686BC (68.2%) 4502BC	4784BC (93.5%) 4446BC 4420BC (1.5%) 4398BC 4381BC (0.4%) 4374BC	sondage VI/2 house	Butmir	Gimbutas 1974
Obre II	Bln-637	5740	80	charcoal		4686BC (68.2%) 4502BC	4784BC (93.5%) 4446BC 4420BC (1.5%) 4398BC 4381BC (0.4%) 4374BC	sondage I/1 house 15	Butmir	Gimbutas 1974
Obre II	Bln-656	5840	100	charcoal		4798BC (68.2%) 4554BC	4942BC (95.4%) 4463BC	sondage I/1 house 15	Butmir	Gimbutas 1974
Obre II	Bln-638	5850	80	charcoal		4826BC (2.3%) 4816BC 4800BC (65.9%) 4605BC	4932BC (0.6%) 4921BC 4911BC (94.8%) 4518BC	sondage IV/2 level 16	Butmir	Gimbutas 1974
Obre II	UCLA-1605.C	5875	60	charcoal		4834BC (68.2%) 4686BC	4901BC (3.9%) 4863BC 4856BC (90.5%) 4581BC 4570BC (1.0%) 4555BC	sondage VI/1 house 13	Butmir	Gimbutas 1974
Obre II	UCLA-1605.E	5890	60	charcoal		4837BC (68.2%) 4704BC	4933BC (95.4%) 4607BC	sondage VI/2 house 13	Butmir	Gimbutas 1974
Obre II	Bln-657	5925	80	charcoal		4908BC (68.2%) 4712BC	5006BC (95.4%) 4596BC	sondage II level 20	Butmir	Gimbutas 1974
Obre II	GrN-5686	5930	45	charcoal		4846BC (68.2%) 4726BC	4933BC (95.4%) 4714BC	sondage III/3	Butmir	Gimbutas 1974
Obre II	GrN-5685	5985	40	charcoal		4934BC (64.7%) 4830BC 4814BC (3.5%) 4807BC	4991BC (95.4%) 4781BC	sondage I/1	Butmir	Gimbutas 1974
Obre II	GrN-5684	6101	60	charcoal		5206BC (12.3%) 5165BC 5118BC (2.3%) 5108BC 5078BC (53.6%) 4936BC	5214BC (92.4%) 4894BC 4888BC (0.4%) 4884BC 4869BC (2.6%) 4850BC	sondage IV/4	Butmir	Gimbutas 1974
Obre II	LJ-2327	6020	150	charcoal		5204BC (4.7%) 5170BC 5073BC (63.5%) 4725BC	5304BC (95.3%) 4584BC 4564BC (0.1%) 4560BC	sondage V/1 level 12	Butmir	Gimbutas 1974
Obre II	UCLA-1605.A	6020	60	charcoal		4994BC (68.2%) 4840BC	5196BC (1.1%) 5179BC 5062BC (93.6%) 4768BC 4754BC (0.6%) 4744BC 4733BC (0.2%) 4730BC	sondage V/1 level 5	Butmir	Gimbutas 1974
Obre II	Bln-792	6075	100	charcoal		5206BC (8.3%) 5166BC 5117BC (1.3%) 5110BC 5077BC (58.6%) 4844BC	5291BC (1.2%) 5268BC 5228BC (92.7%) 4766BC 4756BC (1.4%) 4728BC	sondage VIII level 21	Butmir	Gimbutas 1974
Obre II	GrN-5683	6110	65	charcoal		5206BC (14.4%) 5162BC 5136BC (1.5%) 5130BC 5119BC (3.5%) 5106BC 5079BC (48.8%) 4944BC	5217BC (92.9%) 4880BC 4870BC (2.5%) 4848BC	sondage II/4 pit 1	Butmir	Gimbutas 1974
Obre II	Bln-639	6175	80	charcoal		5219BC (68.2%) 5010BC	5316BC (94.9%) 4932BC 4920BC (0.5%) 4912BC	sondage IV/3 level 25 pit 1	Butmir	Gimbutas 1974
Okolište	KIA-28835	6121	45		-21,52	5206BC (18.2%) 5162BC 5136BC (1.7%) 5130BC 5119BC (4.1%) 5106BC 5080BC (44.3%) 4986BC	5210BC (95.4%) 4944BC	Unit 71164, sample 71012. Area 2.	Butmir	Hofmann et al. 2009
Okolište	KIA-28834	6043	39	bone (Bos taurus)	-22,38	4998BC (62.0%) 4898BC 4865BC (6.2%) 4853BC	5049BC (95.4%) 4838BC	Unit 81041, sample 81014, layer-formation Oko 2/5. Fill of ditch stage 3.	Butmir	Hofmann et al. 2009, Hofmann in press

Site name	Lab. Ref.	Date BP	Standard deviation	Sample	Delta 13C	68.2% probability	95.4% probability	Context	Culture	References
Okolište	KIA-28830	5943	38	bone (Bos taurus)	-26,07	4896BC (12.3%) 4867BC 4850BC (54.7%) 4770BC 4752BC (1.1%) 4748BC	4932BC (2.3%) 4920BC 4912BC (93.1%) 4724BC	Unit 82008, sample 82006, layer-group Oko 2/2. Fill of ditch stage 3.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	KIA-28831	6119	31	bone (Bos taurus)	-22,31	5202BC (15.1%) 5174BC 5071BC (53.1%) 4992BC	5208BC (23.0%) 5144BC 5139BC (9.4%) 5091BC 5082BC (63.0%) 4958BC	Unit 82012, sample 82008, layer-group Oko 2/3.'Wall renovation'	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	KIA-28827	5889	32	bone (unidentified)	-21,91	4790BC (68.2%) 4722BC	4837BC (95.4%) 4702BC	Unit 82009, sample 82010, layer-group Oko 2/2. Fill of ditch stage 3.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	KIA-28833	6209	37	bone (Bos taurus)	-22,79	5222BC (11.1%) 5202BC 5176BC (57.1%) 5070BC	5296BC (13.7%) 5240BC 5232BC (81.7%) 5055BC	Unit 82020, sample 82014, layer-group Oko 2/4. "Landfill wall"	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	KIA-28828	6166	31	bone (Bos taurus)	-20,59	5207BC (7.3%) 5194BC 5180BC (49.0%) 5090BC 5081BC (12.0%) 5060BC	5216BC (95.4%) 5023BC	Unit 82025, sample 82016, layer-group Oko 2/4. Fill of ditch stage 1.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	KIA-28829	5823	48	bone (Bos taurus)	-27,28	4766BC (3.6%) 4756BC 4728BC (64.6%) 4608BC	4788BC (95.4%) 4550BC	Unit 82018, sample 82019, layer-group Oko 2/4. Fill of ditch stage 1.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	KIA-28826	6086	31	bone (Bos taurus)	-21,83	5041BC (68.2%) 4951BC	5204BC (5.2%) 5171BC 5073BC (89.4%) 4906BC 4864BC (0.7%) 4856BC	Unit 82029, sample 82021, layer-group Oko 2/2. Fill of ditch stage 3.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	UtC-12038	5640	50	bone (Bos taurus)	−23.8	4536BC (55.8%) 4446BC 4420BC (9.7%) 4399BC 4381BC (2.7%) 4374BC	4584BC (95.4%) 4356BC	Unit 2090, sample 2053, layer-group Oko 1/3. 'Layer-packet' Oko 1/1	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	UtC-11920	5670	50	bone (unidentified)	−23	4581BC (2.6%) 4572BC 4556BC (65.6%) 4450BC	4667BC (0.4%) 4663BC 4653BC (1.4%) 4640BC 4618BC (93.6%) 4367BC	Unit 2003, sample 2053, layer-group Oko 1/2.House 16. Oven 1/1.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	UtC-11968	5830	50	bone (unidentified)	−23.1	4770BC (7.0%) 4752BC 4746BC (61.2%) 4613BC	4796BC (95.4%) 4548BC	Unit 6016, layer-group Oko 1/2. Open area 1/K-L.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	UtC-11900	5901	50	bone (Bos taurus)	−20.9	4832BC (9.7%) 4813BC 4808BC (58.5%) 4718BC	4932BC (0.9%) 4919BC 4912BC (93.5%) 4682BC 4634BC (0.9%) 4621BC	Unit 3043, sample 3062, layer-group Oko 1/3. Fired clay 1/3.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	UtC-11901	5980	50	bone (Bos taurus)	−20.7	4934BC (59.1%) 4824BC 4818BC (9.1%) 4800BC	4994BC (92.0%) 4766BC 4756BC (3.4%) 4728BC	Unit 5029, layer-group Oko 1/3. 'Layer-packet' Oko 1/5.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	UtC-11970	5975	44	bone (unidentified)	−20.8	4930BC (2.9%) 4924BC 4910BC (65.3%) 4798BC	4982BC (1.1%) 4971BC 4964BC (93.3%) 4769BC 4754BC (1.0%) 4744BC	Unit 2053, layer-group Oko 1/2. Open area 1/ nw A,J.	Butmir	Hofmann et al. 2009, Hofmann in press
Okolište	KIA-32103-A	6069	37	bone (unidentified)	-22,29	5037BC (68.2%) 4934BC	5196BC (2.0%) 5180BC 5063BC (93.4%) 4848BC	Unit 10010, layer-group Oko 3/2. Path 3/SW	Butmir	Hofmann in press
Okolište	KIA-32103-B	6147	42	bone (unidentified)	-18,32	5207BC (28.1%) 5146BC 5138BC (4.6%) 5127BC 5122BC (12.3%) 5093BC 5081BC (23.2%) 5033BC	5218BC (95.4%) 4984BC	Unit 10010, layer-group Oko 3/2. Path 3/SW	Butmir	Hofmann in press
Okolište	KIA-32104	6063	38	bone (unidentified)	-20,87	5028BC (63.8%) 4932BC 4922BC (4.4%) 4911BC	5193BC (1.1%) 5182BC 5059BC (94.3%) 4845BC	Unit 12023, layer-group Oko 3/2. House 11, unburnt clay.	Butmir	Hofmann in press
Okolište	KIA-32105	6220	47	bone (Bos taurus)	-22,4	5292BC (13.4%) 5256BC 5230BC (12.9%) 5203BC 5171BC (41.9%) 5073BC	5306BC (95.4%) 5052BC	Unit 13036, layer-group Oko 3/2. House 02-03.	Butmir	Hofmann in press

Site name	Lab. Ref.	Date BP	Standard deviation	Sample	Delta 13C	68.2% probability	95.4% probability	Context	Culture	References
Okolište	KIA-32106	6179	35	bone (Bos taurus)	-26,55	5209BC (4.3%) 5201BC 5177BC (63.9%) 5070BC	5224BC (95.4%) 5011BC	Unit 13161, layer-group Oko 3/2. House 01, post 16.	Butmir	Hofmann in press
Okolište	KIA-32108	6020	62	bone (Bos taurus)	-24,11	4997BC (68.2%) 4838BC	5198BC (1.3%) 5179BC 5065BC (92.9%) 4766BC 4757BC (0.9%) 4741BC 4735BC (0.3%) 4730BC	Unit 14047, layer-group Oko 3/2. House 01	Butmir	Hofmann in press
Okolište	KIA-32109	4935	40	bone (unidentified)	-21,71	3761BC (14.1%) 3741BC 3731BC (3.5%) 3726BC 3715BC (50.5%) 3657BC	3791BC (95.4%) 3646BC	Unit 15003, layer-group Oko 3/2. Path 3/SW.	Butmir	Hofmann in press
Okolište	KIA-32110-A	5814	48	bone (Bos taurus)	-16,14	4726BC (68.2%) 4596BC	4784BC (95.4%) 4547BC	Unit 17140, layer-group Oko 3/2. House 04.	Butmir	Hofmann in press
Okolište	KIA-32110-B	6351	48	bone (Bos taurus)	-21,01	5463BC (5.8%) 5447BC 5418BC (2.1%) 5411BC 5380BC (56.5%) 5296BC 5245BC (3.8%) 5233BC	5468BC (18.4%) 5402BC 5389BC (77.0%) 5225BC	Unit 17140, layer-group Oko 3/2. House 04.	Butmir	Hofmann in press
Okolište	KIA-32112	5987	34	bone (Bos taurus)	-24,84	4932BC (8.2%) 4919BC 4914BC (60.0%) 4836BC	4977BC (95.4%) 4788BC	Unit 12022, sample 12050, layer-group Oko 3/2. House 11.	Butmir	Hofmann in press
Okolište	KIA-41400	5826	32	charcoal (Cornus mas)	-25,85	4726BC (54.6%) 4652BC 4641BC (13.6%) 4616BC	4784BC (95.4%) 4592BC	Unit 31016, layer-group Oko 4/2. Path 4/SW.	Butmir	Hofmann in press
Okolište	KIA-41401	5943	27	charcoal (Cornus mas)	-25,52	4848BC (68.2%) 4781BC	4901BC (12.4%) 4863BC 4856BC (83.0%) 4727BC	Unit 31036, layer-group Oko 4/2. Path 4/SW.	Butmir	Hofmann in press
Okolište	KIA-41402	6095	37	Grain (Triticum monococcum)	-25,55	5056BC (68.2%) 4946BC	5207BC (11.5%) 5149BC 5137BC (0.8%) 5128BC 5121BC (2.5%) 5095BC 5081BC (80.3%) 4909BC 4862BC (0.2%) 4860BC	Unit 51104, layer-group Oko 6/3. Ditch 6/1, fill 2.	Butmir	Hofmann in press
Okolište	KIA-41404	5967	45	charcoal (Alnus sp.)	-27,92	4931BC (3.6%) 4922BC 4911BC (64.6%) 4791BC	4960BC (95.4%) 4726BC	Unit 52482, layer-group Oko 6/3. Ditch 6/1, fill 1.	Butmir	Hofmann in press
Okolište	KIA-41403	6194	36	Grain (Triticum dicoccum)	-23,39	5215BC (7.5%) 5202BC 5176BC (60.7%) 5070BC	5290BC (5.1%) 5246BC 5231BC (90.3%) 5039BC	Unit 51524, layer-group Oko 6/6. House 38.	Butmier	Hofmann in press
Zagrebnice	Erl-15195	6470	37	charred textile remains	-25,7	5480 (16.6%) 5463BC 5447 (23.0%) 5418BC 5411 (28.6%) 5380BC	5507 (0.5%) 5502BC 5493 (94.9%) 5357BC	Unit 10011. Layer-formation 1/3, House 1-2, quadrant B/2	Butmir?	Müller-Scheessel & Hofmann 2013
Zagrebnice	KIA-45627	6565	30	charred grain (Triticum dicoccum)	-25,7	5534 (68.2%) 5484BC	5607 (4.1%) 5595BC 5561 (91.3%) 5477BC	Unit 10081. Layer-formation 1/5, layer-group 1/1	Butmir?	Müller-Scheessel & Hofmann 2013
Zagrebnice	KIA-45629	5820	30	charred plant bulb	-29,98	4722 (53.3%) 4654BC 4639 (14.9%) 4617BC	4779 (95.4%) 4587BC	Unit 30004. Layer-formation 2/7, 'alley' 2/A-B, quadrant A/3	Butmir	Müller-Scheessel & Hofmann 2013
Zagrebnice	KIA-45630	5895	35	charred seeds (Linum usitatissimum)	-30,11	4796 (68.2%) 4721BC	4843 (95.4%) 4696BC	Unit 34060. Layer-formation 2/7, House 4, Wall 2, quadrant A-B/3	Butmir	Müller-Scheessel & Hofmann 2013
Zagrebnice	KIA-41405	5959	29	charred grain	-27,23	4896 (18.4%) 4867BC 4851 (49.8%) 4793BC	4936 (94.5%) 4769BC 4753 (0.9%) 4746BC	Unit 34010. Layer-formation 2/7, 'alley' 2/A-C, quadrant G/10	Butmir	Müller-Scheessel & Hofmann 2013

Site name	Lab. Ref.	Date BP	Standard dev	Sample	Delta13C	68.2% probability	95.4% probability	Context	Culture	Institution	
Obre I	OxA-23289	6390	34	*Bos taurus*	-20,56	5464BC (13.0%) 5445BC 5420BC (6.6%) 5409BC 5380BC (48.6%) 5320BC	5469BC (95.4%) 5314BC	Sonda 4, quadrant 2, layer 12		Sarajevo	Phase B
Obre I	OxA-23290	6421	35	*Sus scrofa (domestic?)*	-21,3	5468BC (51.6%) 5400BC 5390BC (16.6%) 5368BC	5472BC (95.4%) 5328BC	Sonda 4, quadrant 2, layer 12		Sarajevo	Phase B
Obre I	OxA-23291	6665	35	*Bos taurus (mature)*	-20,78	5628BC (25.1%) 5606BC 5596BC (43.1%) 5560BC	5642BC (95.4%) 5525BC	sonda IV, quadrant 3, layer 11, pit 4		Sarajevo	Phase B
Obre I	OxA-23292	6432	35	*Bos taurus (mature)*	-20,89	5468BC (6.4%) 5460BC 5452BC (61.8%) 5376BC	5476BC (95.4%) 5330BC	sonda IV, quadrant 2, layer 11, "control trench at point B"		Sarajevo	Phase B
Obre II	OxA-23293	6027	34	*Homo Sapiens Sapiens*	-20,74	4980BC (5.5%) 4971BC 4964BC (50.9%) 4896BC 4867BC (11.8%) 4850BC	5016BC (94.9%) 4832BC 4813BC (0.5%) 4808BC	sonda VI, quadrant 4, layers 17 and 18, depth 250-280		Sarajevo	Trust depth: Butmir Ib
Obre II	OxA-23294	5763	33	*Bos taurus (mature)*	-21,22	4681BC (28.9%) 4636BC 4619BC (39.3%) 4555BC	4707BC (95.4%) 4536BC	sonda III, quadrant 3, depth 0.30-0.50		Sarajevo	Butmir III – after end of published dating sequence
Obre II	OxA-23295	6017	35	*Bos taurus (adult)*	-21	4949BC (68.2%) 4846BC	5001BC (93.2%) 4826BC 4816BC (2.2%) 4801BC	sonda IV, quadrant 3, layer 14		Sarajevo	? phase
Safetova Bašča (Gornja Tuzla)	OxA-23296	6593	36	*Bos taurus / Bos primigenius (mature)*	-20,64	5605BC (7.6%) 5596BC 5559BC (50.6%) 5508BC 5502BC (10.0%) 5490BC	5616BC (20.4%) 5582BC 5574BC (75.0%) 5482BC	Control trench near east profile, depth 295cm, 20.06.2009	Starcevo-Impressa	Tuzla	
Safetova Bašča (Gornja Tuzla)	OxA-23297	6165	34	Large mammal (Bos? Equus?)	-20,97	5207BC (7.9%) 5193BC 5182BC (47.8%) 5090BC 5081BC (12.5%) 5059BC	5216BC (95.4%) 5011BC	Layer 15, west profile in south part, 17.06.2009	Starcevo-Impressa	Tuzla	
Safetova Bašča (Gornja Tuzla)	OxA-23298	5827	33	*Bos taurus*	-20,59	4726BC (54.5%) 4652BC 4640BC (13.7%) 4616BC	4786BC (95.4%) 4590BC	Sonda II, layer 8, 12.06.2009	Early Vinca?	Tuzla	
Safetova Bašča (Gornja Tuzla)	OxA-23299	5741	33	*Cervus elaphus*	-20,68	4668BC (3.6%) 4660BC 4654BC (8.2%) 4638BC 4618BC (56.5%) 4540BC	4687BC (95.4%) 4502BC	Sonda II, layer 8, 12.06.2009	Early Vinca?	Tuzla	
Kočićevo	OxA-23300	5904	33	*Sus scrofa (wild)*	-20,61	4798BC (68.2%) 4724BC	4846BC (95.4%) 4707BC	Sonda I, layer 9 (spit = 10cm), 18.03.2010	sopot?????	PLAS 10	
Kočićevo	OxA-23301	5827	33	*Bos taurus*	-19,08	4726BC (54.5%) 4652BC 4640BC (13.7%) 4616BC	4786BC (95.4%) 4590BC	Sonda I, layer 8 (spit = 10cm), 18.03.2010	sopot?????	PLAS 10	
Bijelica Glavica	OxA-23303	5822	35	*Bos taurus*	-21,85	4724BC (52.4%) 4651BC 4642BC (15.8%) 4616BC	4783BC (94.2%) 4583BC 4565BC (1.2%) 4556BC	Sonda 3, depth 1.9m	Sopot/Lasinje	Banja Luka	
Bijelica Glavica	OxA-23304	5697	34	Large mammal (Bos?)	-21,39	4578BC (2.0%) 4574BC 4555BC (58.5%) 4484BC 4479BC (7.7%) 4464BC	4652BC (1.4%) 4640BC 4618BC (94.0%) 4456BC	Quadrant 3, depth: 1.5-1.6m	Sopot/Lasinje	Banja Luka	

Site name	Lab. Ref.	Date BP	Standard dev	Sample	Delta13C	68.2% probability	95.4% probability	Context	Culture	Institution
Bočac	OxA-23305	5765	33	*Bos taurus*	-21,08	4682BC (31.9%) 4634BC 4620BC (26.6%) 4581BC 4572BC (9.7%) 4556BC	4708BC (95.4%) 4538BC	Sonda 1, quadrant 3-B, depth 0.3 (0.6)m	Butmir I?	Banja Luka
Bočac	OxA-23306	5832	34	*Bos taurus*	-21,96	4767BC (5.6%) 4755BC 4742BC (2.1%) 4736BC 4728BC (48.0%) 4669BC 4659BC (1.9%) 4654BC 4638BC (10.6%) 4618BC	4790BC (95.4%) 4594BC	Sonda 1, quadrant 1-A	Butmir I?	Banja Luka
Bočac	OxA-23307	5839	32	*Bos taurus*	-21,56	4777BC (63.2%) 4683BC 4633BC (5.0%) 4622BC	4789BC (95.4%) 4610BC	Sonda 2, quadrant C-4	Butmir I?	Banja Luka
Arnautovići	OxA-23339	6270	31	animal bone, no id.	-20,78	5299BC (55.6%) 5242BC 5235BC (12.6%) 5222BC	5321BC (95.4%) 5207BC	Sonda 3, depth 0.6-0.9m	More Vinca than Butmir	Visoko
Zbilje	OxA-23340	5755	30	animal bone, no id.	-21,42	4677BC (1.4%) 4674BC 4670BC (17.3%) 4638BC 4618BC (49.4%) 4548BC	4692BC (95.4%) 4522BC	Sonda 1, quadrant 1, depth: 0.8-0.9m	Late Neolithic	Visoko
Dvor	OxA-23342	5868	30	animal bone, no id.	-22,37	4779BC (68.2%) 4712BC	4827BC (1.6%) 4815BC 4802BC (93.8%) 4686BC	Sonda 2, depth 1.2m		Visoko
Žukovička Pećina	OxA-23599	6437	35	animal bone to be i.d.	-19,66	5470BC (6.8%) 5461BC 5451BC (61.4%) 5376BC	5478BC (95.4%) 5340BC			Sarajevo
Žukovička Pećina	OxA-23600	6466	34	animal bone to be i.d.	-19,84	5478BC (15.2%) 5464BC 5445BC (22.7%) 5420BC 5409BC (30.3%) 5380BC	5486BC (95.4%) 5361BC			Sarajevo
Zelena Pećina	OxA-23350	5476	33	fragment of human skull	-18,92	4354BC (49.9%) 4325BC 4286BC (18.3%) 4269BC	4438BC (1.6%) 4425BC 4370BC (93.8%) 4256BC			Sarajevo
Zelena Pećina	OxA-23351	5410	31	fragment of human skull	-19,01	4328BC (68.2%) 4256BC	4341BC (92.7%) 4231BC 4194BC (2.7%) 4176BC			Sarajevo
Lazaruša	OxA-23534	5402	34	animal bone to be i.d.	-19,86	4327BC (41.8%) 4282BC 4271BC (26.4%) 4241BC	4341BC (86.8%) 4227BC 4201BC (6.6%) 4168BC 4126BC (0.5%) 4120BC 4092BC (1.5%) 4078BC	Sonda B, layer 10		Sarajevo
Lazaruša	OxA-23535	5513	32	animal bone to be i.d.	-20,11	4441BC (12.0%) 4424BC 4370BC (56.2%) 4333BC	4450BC (94.1%) 4327BC 4280BC (1.3%) 4274BC	Sonda B, layer 10		Sarajevo
Hateljska Pećina	OxA-23536	5328	32	animal bone to be i.d.	-19	4236BC (6.4%) 4223BC 4208BC (27.1%) 4157BC 4132BC (34.8%) 4067BC	4259BC (95.4%) 4046BC	Quadrant V, layer 11		Sarajevo
Hateljska Pećina	OxA-23537	5746	33	animal bone to be i.d.	-19,95	4669BC (14.5%) 4638BC 4618BC (53.7%) 4543BC	4689BC (95.4%) 4504BC	Quadrant V, layer 11		Sarajevo
Hateljska Pećina	OxA-23538	5788	33	animal bone to be i.d.	-20,46	4702BC (68.2%) 4600BC	4716BC (95.4%) 4548BC	Quadrant VI, layer 10		Sarajevo
Hateljska Pećina	OxA-23539	5769	33	animal bone to be i.d.	-20,49	4684BC (62.9%) 4582BC 4568BC (5.3%) 4559BC	4709BC (95.4%) 4540BC	Quadrant VI, layer 10		Sarajevo

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Rastuša	OxA-23602	5678	33	animal bone	-21,8	4540BC (55.2%) 4486BC 4478BC (13.0%) 4464BC	4606BC (95.4%) 4449BC	test pit 2, quadrant A, feature 1, layer 3	Neolithic?	PTM
Non-Neolithic dates										
Lazaruša	OxA-23532	4083	23	animal bone to be i.d.	-19,44	2834BC (10.8%) 2818BC 2661BC (6.6%) 2650BC 2634BC (50.8%) 2576BC	2852BC (16.1%) 2812BC 2744BC (2.1%) 2727BC 2696BC (73.3%) 2568BC 2517BC (3.9%) 2499BC	Sonda A, layer 6	Impressa?	Sarajevo
Lazaruša	OxA-23533	4105	29	animal bone to be i.d.	-19,37	2848BC (16.6%) 2814BC 2737BC (1.2%) 2734BC 2692BC (1.0%) 2690BC 2678BC (34.6%) 2616BC 2612BC (14.8%) 2580BC	2864BC (23.0%) 2806BC 2760BC (72.0%) 2572BC 2510BC (0.4%) 2505BC	Sonda A, layer 6	Impressa?	Sarajevo
Vratnica-Njiva Skladovi	OxA-23341	2241	24	animal bone, no id.	-19,02	381BC (21.5%) 354BC 290BC (46.7%) 232BC	388BC (27.5%) 348BC 316BC (67.9%) 208BC	human skeleton found in grave		Visoko
Prnjavor Krčevine	OxA-23308	2402	28	*Sus scrofa (domestic?)*	-19,02	510BC (53.0%) 436BC 426BC (15.2%) 405BC	731BC (7.8%) 691BC 660BC (1.1%) 652BC 544BC (86.5%) 397BC	sonda 2, layer 5	Sopot	Banja Luka
Prnjavor Krčevine	OxA-23309	2531	28	*Sus scrofa (domestic?)*	-20,64	788BC (27.4%) 750BC 687BC (15.4%) 666BC 641BC (25.4%) 592BC	795BC (33.3%) 732BC 691BC (18.1%) 660BC 650BC (44.0%) 544BC	sonda 2, layer 5	Sopot	Banja Luka
Agino Selo	OxA-23310	2454	27	*Bos primigenius*	-23,01	747BC (24.5%) 688BC 665BC (7.8%) 645BC 588BC (1.9%) 581BC 554BC (20.3%) 501BC 496BC (2.7%) 486BC 462BC (3.5%) 450BC 441BC (7.3%) 417BC	753BC (26.7%) 685BC 668BC (11.3%) 631BC 626BC (2.6%) 610BC 597BC (54.8%) 412BC	Sonda 3	Late Neolithic/Eneolithic	
Grad Visoki	OxA-23338	363	21	animal bone, no id.	-20,19	1466AD (45.3%) 1519AD 1593AD (22.9%) 1619AD	1453AD (54.4%) 1524AD 1558AD (41.0%) 1632AD	Sonda 2, depth 0.4-0.6m	Late Neolithic	Visoko
Kovačica	OxA-23302	modern		*Ovis aries (probable)*	-21,33			sonda?, layer 1 or 3, depth 0.15-0.3m ?	Butmir II	Banja Luka
Failed dates										
Čitluk	failed			animal bone, no id.				Depth 0.9m		Visoko
Rogin Potok, Bare	failed			animal bone, no id.				Depth 1.3m		Visoko

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Badanj	failed			radius red deer?				Layer 1, sq. J8D1	Early Holocene?	PTM
Badanj	failed			Left zygomatic Equus asinus				Layer 1, J9B1	Early Holocene?	PTM
Badanj	failed			Bos primigenius, 3rd phalange				Layer 2a, K7-8/2A	Early Holocene?	PTM
Badanj	failed			fragment scapula, red deer?				Layer 2a, I6C2a	Early Holocene?	PTM
Badanj	failed			red deer, mandible				Layer 2a, I6C2a	Early Holocene?	PTM
Tomasovo Brdo	failed			*Bos taurus (or POSSIBLY primigenius)*				Sonda 2, layer 5		PLAS10
Tomasovo Brdo	failed			Large mammal				Sonda 2, layer 6		PLAS10