Puzzling out the Middle-to-Upper Palaeolithic transition

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1 Archaeology: Puzzling out the Middle-to-Upper Palaeolithic Transition

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5 *Standfirst: Homo sapiens remains, molecular data and a revised chronology for the Bulgarian site of*
6 *Bacho Kiro document the earliest known presence of our species in Europe, representing an important*
7 *jigsaw piece in the Middle-to-Upper Palaeolithic transition.*

8 Sometime between 50,000 to 39,000 years ago, *H. sapiens* replaced autochthonous Neanderthal
9 populations, prompting two major questions for archaeologists today: when did *H. sapiens* enter the
10 European landscape and what processes were implicated in Neanderthals' disappearance? Both are
11 challenging to address via an ancient and fragmentary archaeological record, but timing our species'
12 entry into Europe would seem straightforward since it can be answered by dating human remains. This
13 has proven to be more complicated than it seems, which is why an early site with dateable materials and
14 good genetic preservation is such an important commodity. The Bulgarian site of Bacho Kiro offers just
15 this and is the subject of two studies published this week in *Nature* and *Nature Ecology & Evolution*: in
16 *Nature*, a paper by Hublin et al examines *H. sapiens* genetic material from the site, and on page XXX of
17 *Nature Ecology & Evolution*, a paper by Fewlass et al establishes this material as the earliest direct
18 evidence of our species in Europe.

19 Originally excavated in the 1970s, Bacho Kiro has long interested the archaeological community because
20 human remains (subsequently lost) associated its eponymous Initial Upper Palaeolithic (IUP) stone tool
21 industry--the "Bachokirian"--with *H. sapiens*. Hublin and colleagues¹ report *H. sapiens* mitochondrial
22 DNA sequences from excavated bone fragments that proteomic screening identified as hominin. Fewlass

et al² provide direct dates on these fragments, in the framework of an extensive dating campaign at the site targeting levels from which Bachokirian lithics and associated bone remains were recovered. This dating project is particularly important because previous radiocarbon measurements from Bacho Kiro are imprecise and stratigraphically inverted, rendering the site of limited use for dating *H. sapiens* arrival in Europe. Fewless and colleagues' study employs cutting edge dating methods and two different radiocarbon laboratories to obtain accurate and precise radiocarbon ages. They analysed these data using Bayesian age modelling methods to better constrain the chronological intervals of the IUP archaeological levels. First, via a simple application of Bayesian statistics, a ¹⁴C calibration curve is used to convert radiocarbon measurements into calendar dates. Of greater utility to archaeological investigations is the use of Bayesian modelling methods that combine probabilistic temporal information provided by calibrated radiocarbon dates with *a priori* information— that being the stratigraphic ordering of radiometrically dated archaeological events—to improve our understanding of the timing and duration of these archaeological events (Figure 1). With this approach, Fewlass et al demonstrate that the Bachokirian industry at the site dates to roughly 46–44 cal ka BP (calibrated kiloanni before present).

These modelled ranges of the newly obtained radiocarbon measurements agree with the molecular date ranges calculated by Hublin et al on the human bones. Thus, these human remains from Bacho Kiro currently reflect the earliest direct evidence of our species in Europe. Aside from Bacho Kiro, the directly dated human remains from the site of Peștera cu Oase (Romania) at ca. 41 cal ka BP represent the oldest known modern human presence in Europe³, although claims for early presence have been made based on human remains from Kent's Cavern (UK)⁴, and Grotta del Cavallo (Italy)⁵. These last two sites, however, are plagued with problems of archaeological association—meaning that the human remains themselves are not directly dated, and their associations with dated faunal and marine shell remains, respectively, are equivocal^{6,7}. The direct dates on human remains in a larger, well resolved chronology^{1,2}

from Bacho Kiro are of particular importance because they provide solid evidence that modern humans were present in south-eastern Europe by 46,000 years ago, and that these populations were responsible for IUP assemblages at this site.

This is not to say, however, that the site's levels containing the Bachokirian industry are free from the contextual problems with which archaeologists are often confronted. Fewlass et al explain that a small assemblage of IUP artefacts is contained in the upper portion of Layer N1-J and propose that modern human use of the cave began as early as 47k cal ka BP. However, the stratigraphic profile showing piece-plotted artefacts from the different levels (Supp. Fig. 4)² illustrates that the stratigraphic contact between Layers N1-J and N1-I is not as distinct as described¹, and thus the original context of the dated bones from N1-J, and their association with modern humans, is open to debate. Furthermore, the mtDNA from an undated *H. sapiens* molar, also recovered from the upper portion of N1-J¹, is genetically identical to one of the dated modern human bone fragments from the overlying Layer N1-I, suggesting that this tooth was originally associated with the level above. Therefore, when inferring the earliest modern human presence at Bacho Kiro, it is most prudent to focus on the lower age-modelled boundary for Layer N1-I, which is roughly 46 cal ka BP, rather than the older limits of the modelled age ranges from the upper part of underlying Layer N1-J or the unmodelled calibrated date for the oldest modern human bone fragment (CC7-335).

The results summarized and discussed above are important because we as archaeologists ultimately wish to understand the population and cultural dynamics implicated in the observed disappearance of Neanderthal populations in Europe around 40–39 cal ka BP. It is important to keep in mind, nonetheless, that some of the characteristics of the data we use to investigate these issues render the task challenging. For example, a precise and detailed understanding of the timing of *H. sapiens* entry into other regions of Europe is complicated by the fact that ¹⁴C ages for this period typically have standard errors of ca. 450 years meaning that at two standard errors (95%), our temporal window is almost 2000

years. This is not to say that we cannot effectively characterize our species' entry into other regions of Europe and understand if⁸ and how^{2,9} subsequent cultural interactions influenced the behaviours of culturally complex¹⁰ autochthonous Neanderthals, although such an undertaking will be a difficult one. These new results from Bacho Kiro provide us with an important piece of the puzzle, but many still remain to be put in place.

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Fig. 1. Hypothetical stratified archaeological sequence covering the late Middle and Initial Upper Palaeolithic periods. Contacts between archaeological levels are often porous with artefacts potentially migrating between levels as a result of post-depositional processes (freeze-thaw cycles, rodent burrowing, etc.) such that associations between dated items and cultural material are not always unequivocal. Radiocarbon age uncertainties can make it difficult to precisely discern archaeological chronology without Bayesian methods. The latter rely on stratigraphic information and calibrated radiocarbon dates to refine our understanding of the timing and duration of archaeological level formation.

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