

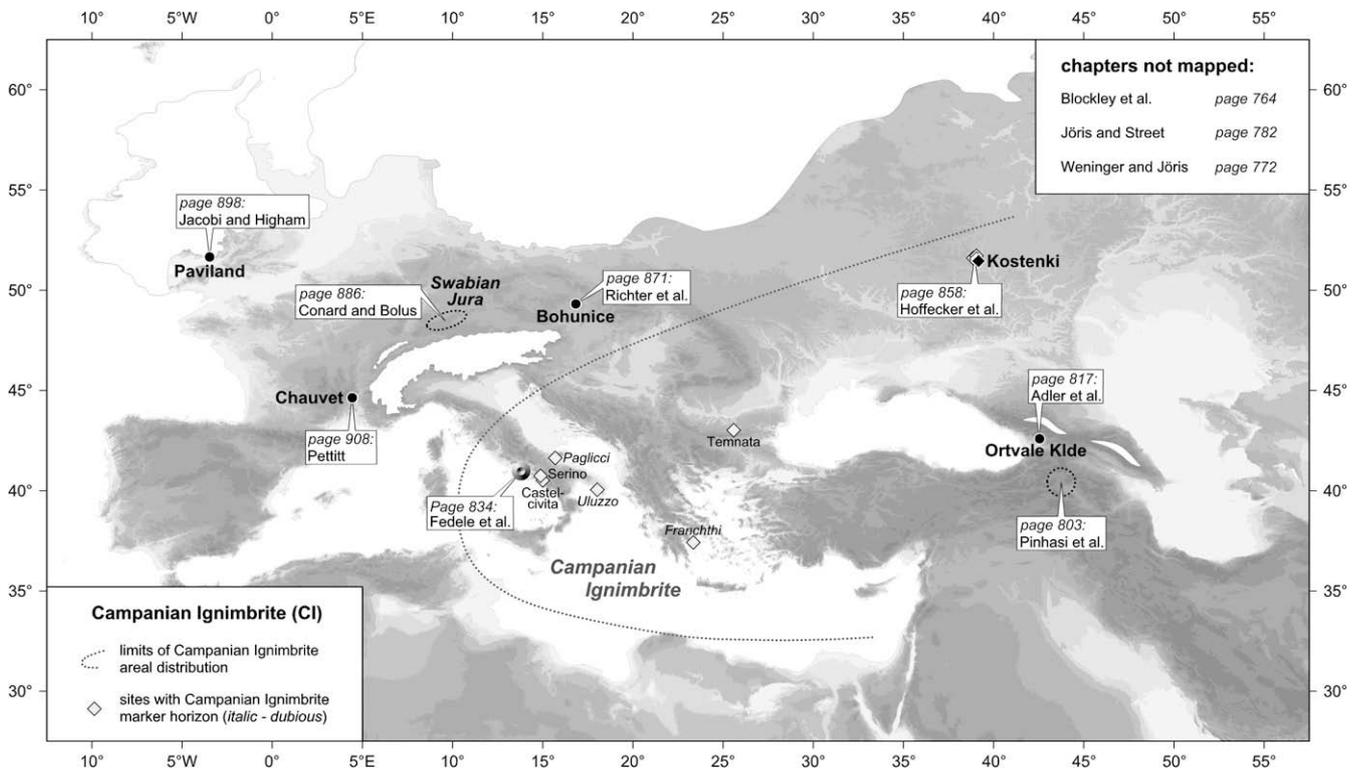


## Preface

## Setting the record straight: Toward a systematic chronological understanding of the Middle to Upper Paleolithic boundary in Eurasia

The Middle to Upper Paleolithic boundary marks an important threshold in human cultural and biological evolution with the establishment of Anatomically Modern Humans and the termination of Neanderthal settlement in Eurasia between 40–30 ka  $^{14}\text{C}$  BP. The demographic and cultural processes underlying this “transition” throughout Eurasia are among the most intensively debated issues in Paleolithic Archaeology and Human Paleontology. Of key importance to this debate are issues related to the last surviving Neanderthals and the end of the Middle Paleolithic (e.g., Adler et al., 2008) on the one hand, and the first appearance of modern humans (e.g., Jacobi and Higham, 2008), “modern human behavior” (e.g., Pettitt, 2008), and Upper Paleolithic industries (e.g., Adler et al., 2008; Conard and Bolus, 2008; Hoffecker et al., 2008; Pinhasi et al., 2008) on

the other. In recent years, scientists from a range of disciplines have investigated this “human revolution”, resulting in multi-disciplinary efforts that address both the demise of Old World archaic hominins and the expansion of modern humans across the globe (Mellars et al., 2007; cf. van Andel and Davies, 2003). While many of the investigations of the “human revolution” are demographic in nature and rely (sometimes to a large degree) on estimates of past hominin population size, age structure, and reproductive rates, they are also acutely concerned with the temporal scale of change. Since the available chronometric data can be interpreted in a variety of ways, researchers tend to perceive the “transition” as either a biological process of population replacement (in terms of a strict boundary) or as a true transition represented by fossils and/or



**Fig. 1.** The “transition”/replacement period in Western Eurasia as addressed in this issue. Map based on Space Radar Topography Measurements (SRTM), with LGM (Last Glacial Maximum) ice cover and sea levels lowered by 120 m to adjust for LGM paleogeography (compiled after various sources). During most of OIS 3, ice sheets were significantly smaller and sea levels were in the range of 60–70 m below those of today.

**Table 1**  
Age scales and nomenclature used within this issue<sup>a</sup>

Method	Non-calendar scale	Non-calendar format	Calendar age scale	Calendar age format	Type of time scale
Radiocarbon	<sup>14</sup> C BP	30,000 <sup>14</sup> C BP or 30.0 ka <sup>14</sup> C BP	cal BP	30,000 cal BP or 30.0 ka cal BP	'Calibrated' years
U-series			BP <sub>U/Th</sub>	30.0 ka BP <sub>U/Th</sub>	Solar years
ESR			BP <sub>ESR</sub>	30.0 ka BP <sub>ESR</sub>	
TL/OSL			BP <sub>TL/OSL</sub>	30.0 ka BP <sub>TL/OSL</sub>	
Age models underlying paleoclimate records			BP <sub>GRIP/GISP2/etc</sub>	30,000 BP <sub>GRIP/GISP2/etc</sub> or 30.0 ka BP <sub>GRIP/GISP2/etc</sub>	Age model 'calendar' years

<sup>a</sup> ka = kilo annum, as refers to thousands of years before present; BP – before present, i.e., before 1950.

material culture intermediate between the Middle and the Upper Paleolithic (Richter et al., 2008; cf. discussion in Zilhão and d'Errico, 2003; Bar-Yosef and Zilhão, 2006).

In the present issue of the *Journal of Human Evolution* (2008, 55[5]) we assemble a series of 11 papers that assess chronological questions that are of paramount importance to our understanding of the Middle to Upper Paleolithic “transition”/replacement in Western Eurasia (Fig. 1). The papers emanate from session C57 “Setting the Record Straight: Toward a Systematic Chronological Understanding of the Middle to Upper Palaeolithic Boundary in Eurasia” of the 15th meeting of the International Union for Prehistoric and Protohistoric Sciences (UISPP), held on the 5th of September 2006 in Lisbon, Portugal. The session was dedicated to recent advances in radiometric dating and interpretation and to the construction of a sound chronological framework against which available Middle and Upper Paleolithic records can be referenced. To these we add the perspective paper by Roebroeks (2008), which provides a broad overview of the larger implications of these works. This issue of JHE is published in tandem with a special issue of *Eurasian Prehistory* that includes eight additional papers from session C57 (Jöris and Adler, 2008). This second group of papers offers regional, site-based data that highlight major temporal and cultural differences between the Middle and Upper Paleolithic of Eurasia. While spanning a range of research traditions and geographic regions, from Siberia to Western Europe, these two journal issues highlight and recast several important issues related to specific sites and chronologies that so often dominate debates on the Middle to Upper Paleolithic “transition”/replacement.

Although many temporal and demographic questions still remain unanswered following the Lisbon conference (cf. Roebroeks, 2008), common ground was identified, particularly concerning the refinement and adjustment of different time scales used to build reliable chronologies. Such work is of extreme importance since the radiocarbon method, although widely applicable and of high analytical accuracy, requires age-calibration before its results can be compared to calendar age estimates in terms of solar years (as provided by other dating techniques such as U-series, ESR, TL/OSL). Such age-calibration is complicated by past fluctuations in atmospheric <sup>14</sup>C/<sup>12</sup>C ratios. Other radiometric dating techniques, such as U-series, ESR, and TL/OSL, are still far less frequently applied in Middle and Upper Paleolithic research, and the degree of uncertainty associated with these results often exceeds by an order of magnitude the comparatively high precision and accuracy of most radiocarbon estimates. Additionally, since the Middle to Upper Paleolithic “transition”/replacement lies at the lower limits of reliability of the radiocarbon method (4.5–6.0 half-lives), sample contamination is of considerable concern for chronologies (Blockley et al., 2008; Jöris and Street, 2008; cf. Jöris et al., 2003; Richter, 2004). Although discrepancies between dates most likely result from the unsuccessful removal of contaminants from individual radiocarbon samples during the pretreatment phase of sample analysis, progress continues in sample pretreatment techniques (Jacobi and Higham, 2008).

Because of the many unresolved questions related to the precise establishment of an integrative, absolute chronological framework, we have chosen to use in this special issue a standardized nomenclature that provides the most neutral differentiation of time scales and age models (Table 1). To do so, we have asked authors to follow age statements with an indication of the method from which the age is derived, and in the case of radiocarbon, whether those ages are calibrated or uncalibrated.

Each of the updates to the data sets used for radiocarbon age-calibration (1986, 1998, and 2004 IntCal04: Reimer, 2004, and references therein) has shown that *any* age-transferral of previous radiocarbon measurements are “calendar age approximations” or “comparisons” rather than a “*real*” calibration of the data. Since most of the discrepancies observed between potential calibration records likely result from diverging calendar age models (cf. discussion in Weninger and Jöris, 2008), we recommend the abandonment of the idea of “absolute time”, whether achieved via “calibration” or “comparison”.<sup>1</sup> Instead, we believe it is more productive to focus on the integration of time scales against a standardized calendar-age framework. Such a procedure can form the base for future temporal refinement in terms of a “*real*” radiocarbon age-calibration, measured in solar years.

Although the need of calibrated radiocarbon measurements is often seen as a disadvantage of the method, changes in radiocarbon production rates and its varying distribution within the different carbon reservoirs (i.e., the atmosphere, the biosphere, and the ocean), in combination with a relatively short half-life, make the <sup>14</sup>C-isotope an ideal tracer element for a wide range of processes in environmental physics and, thus, contribute to our understanding of the mechanisms that underlie past climatic and environmental changes. The radiocarbon time scale has been referenced against a diverse set of paleoclimate records produced during the last several decades (e.g. Zilhão et al., 2007; cf. Jacobi and Higham, 2008). Recent progress in the extension of the radiocarbon ‘age-calibration’ curve (Weninger and Jöris, 2008) produces age estimates that are in close agreement with dates obtained by other methods of dating (e.g. Richter et al., 2008), and allows researchers to directly compare ‘calibrated’ archaeological records with different records of paleoclimate change (see above; e.g. Adler et al., 2008; Jacobi and Higham, 2008; Jöris and Street, 2008; Richter et al., 2008). Such attempts are best represented by the dating of the Campanian Ignimbrite (CI) tephra that erupted roughly 40,000 years ago in the vicinity of Naples, Italy (Fig. 1), and that straddle the Middle to Upper Paleolithic

<sup>1</sup> “Calibration” should be understood as the conversion of one scale into another of higher (but not necessarily “absolute”) precision. The ‘calibration’ of a wrist watch, for example, against the radio-transmitted signals of an atomic clock gives a version of the time of day that is sufficiently precise for any of our daily requirements. Nevertheless, we will never know exactly what time we are really at, given the imprecision of the manual ‘calibration’ of our wrist watches, the temporal delay in signal transmission and the minimal, though extant, natural variation of radioactive decay underlying atomic time itself.

“transition”/replacement (Fedele et al., 2008; Hoffecker et al., 2008; Jöris and Street, 2008; cf. Weninger and Jöris, 2008). These tephtras form a wide-spread chronostratigraphic marker horizon that allows inter-calibration of regional archaeological records between different parts of Europe with marine and ice-core chronologies, where the CI-tephtras are stratigraphically well fixed.

It is the combination of the ‘calibrated’ radiocarbon time scale with a chronostratigraphic framework established for different paleoclimate archives that enables comparison with the results of other dating methods that are more rarely applied in studies of the Middle to Upper Paleolithic “transition”/replacement. Recent progress made within the latter dating techniques (e.g. Richter et al., 2008; Adler et al., 2008) provides hope for the more systematic and routine application of ESR and TL dating during the period in question.

Testing demographic hypotheses concerning the establishment of Anatomically Modern Humans and the termination of Neandertal settlement in Eurasia requires the systematic, comparative evaluation of age estimates (obtained by different methods) along a common calendar age scale. Whatever arguments future research may propose to explain the demise of the last Neandertals or the nature and tempo of change from the Middle to the Upper Paleolithic, they will require estimates of the duration of these processes, as measured in hominin generations (Zubrow, 1989; cf. Roebroeks, 2008). Such estimates can only be based on the calendar scale axis of solar (calibrated) years – and it is this work that is extended in this issue.

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