PACEA Geo-Referenced Radiocarbon Database

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ABSTRACT

Numerous Paleolithic radiocarbon databases exist, but their geographic and temporal scopes are diverse and their availability variable. With this paper we make available to the scientific community a georeferenced database of radiocarbon ages for the late Middle Paleolithic, Upper Paleolithic, and initial Holocene in Europe. The PACEA radiocarbon database consists of conventional and AMS ^{14}C age determinations from archaeological sites in Europe that fall within Marine Isotope Stages (MIS) 3–1. In all, we have assembled 6,019 radiocarbon ages (conventional=3,820, AMS=2,176, unspecified=23) from a total of 1,208 sites, along with comprehensive contextual information on the dated samples.

INTRODUCTION

Since its inception as a discipline, archaeology has developed from local to regional and now to continental and inter-continental foci, albeit still reliant on study at the finer scales. The movement along this scale implies a need for the creation of, and access to, comprehensive and coherently recorded datasets. Through unfettered cooperation and willingness to share data, scientific collaborations can flourish and move the involved disciplines forward.

With this paper we make available to the scientific community a georeferenced database of radiocarbon ages for the late Middle Paleolithic, Upper Paleolithic, and initial Holocene in Europe. Most studies of the Middle and Upper Paleolithic archaeological records are reliant either directly, or indirectly, on radiocarbon ages obtained from cultural levels at archaeological sites. Working at the scale of a site, or group of sites, poses few problems with respect to gathering the relevant radiocarbon ages. However, as one expands the research scope to a regional or continental scale, or to a broad time span that encompasses an entire or multiple archaeological cultural entities and/or multiple climatic events, the assembly of comprehensive and accurate radiocarbon databases becomes an increasingly difficult, albeit critical, task. This is especially true in recent years as researchers have attempted to apply new methods to existing questions and data while also expanding the scope of investigations to human adaptation and cultural processes.

Archaeological radiocarbon databases have numerous and quite varied applications to anthropological investigations. Stratigraphic and geomorphic issues aside, one of the most basic is their use in understanding the temporal placement of a single site occupation and its broader archaeological cultural affiliation. Similarly, radiocarbon age determinations are critical for understanding the timing or emergence of specific cultural behaviors, such as particular burial practices (Jacobi and Higham 2008; Jacobi et al. 2010) or cave art (Pettitt 2007), as well as the appearance of highly diagnostic lithic technologies (e.g., Banks et al. 2009; Straus 1990) or bone tool production techniques (Szmidt et al. 2009) in the archaeological record. On a slightly broader level, ^{14}C data figure importantly in investigations of how a specific

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technocomplex relates temporally to others, as well as how a technocomplex fits within a paleoclimatic framework. An excellent case in point concerns the timing and mode of the Middle-to-Upper Paleolithic transition and Neanderthal extinction (Banks et al. 2008a; Blockley et al. 2008; Bocquet-Appel and Demars 2000a; Conard and Bolus 2003; d'Errico and Sanchez-Goni 2003; Higham et al. 2006; Jöris et al. 2003; Mellars 2006; Zilhão 2006; Zilhão and d'Errico 2003). More specifically, many studies have focused on the chronology of the late Mousterian and transitional technocomplexes (e.g. Chatelperronian, Uluzzian, Szeletian) and their temporal relationship to the Aurignacian in various regions of Europe (Adams and Ringer 2004; Conard 2006; Finlayson et al. 2006; Gravina et al. 2005; Higham et al. 2009; Higham et al. 2010; Peresani 2008; Zilhão and d'Errico 1999; Zilhão et al. 2006).

In the last decade, radiocarbon ages have figured importantly in attempts to identify demographic changes and related processes during the Upper Paleolithic (Bocquet-Appel and Demars 2000b; Bocquet-Appel et al. 2005; Straus et al. 2000; Vermeersch 2005; Verpoorte 2009). In a similar vein, numerous studies have focused on these dynamics from a genetic standpoint in order to establish a link between present day genetic variability and Paleolithic population processes (Pala et al. 2009; Semino et al. 2000; Torroni et al. 2001). Additionally, research has also focused on the initial expansions into high latitudes (Goebel 1999; Pavlov et al. 2001), the contraction of populations during the Last Glacial maximum (e.g., Straus 1991; Street and Terberger 1999), and the subsequent 'recolonization' of northern Europe (Barton 2000; Blockley et al. 2006; Gamble et al. 2005; Gamble et al. 2004; Housley et al. 1997). Finally, a new challenge has been to explore human-environment interactions (Gamble et al. 2005; d'Errico et al. 2006; Sepulchre et al. 2007). Radiocarbon databases are critical in the application of new methods, which integrate paleoclimatic, chronological, and archaeological data, and that have the aim of reconstructing the ecological niches occupied and exploited by Paleolithic populations, as well as cultural responses to millennial-scale climatic variability (Banks et al. 2006; Banks et al. 2008a; Banks et al. 2009).

Archaeological sites within the range of radiocarbon dating methods are the main source of faunal remains in Western Europe and provide critical information on species' biogeography and association (Banks et al. 2008b; Pacher and Stuart 2008; Stewart et al. 2010). In order for such data to be used effectively, we need to have georeferenced radiometric databases with which these faunal data can be linked.

Naturally, there are numerous problems in using large radiocarbon databases when addressing the topics listed above. First, some authors (Surovell and Brantingham 2007) challenge the use of 'dates as data' for understanding demographic processes (Gamble et al. 2005; Kuzmin and Keates 2005; Steele 2010; but see Bocquet-Appel et al. 2005 for an opposing viewpoint) by highlighting the impact of taphonomic factors on site and dated sample preservation. Other authors focus on stratigraphy and the archaeological context of dated samples in order to critically assess the significance of individual sites and the validity of specific radiometric age determinations (Zilhão and d'Errico 1999, 2003; Zilhão 2006; Zilhão and Pettitt 2006; Zilhão et al. 2006). Others propose means to filter the data so that sampling biases may be identified and representative samples used in subsequent analyses (e.g., Steele 2010; Fort et al. 2004). Another problem concerns the fact that the validity of radiocarbon ages varies according to sample quality. For example, it has been shown that ^{14}C ages older than 23kyr BP often underestimate the true age of the sample and that new methods, such as ultrafiltration (Higham et al. 2006), provide more precise ages, even for more recent periods (Jacobi et al. 2006). Nonetheless, despite these constraints and limitations, one must have a comprehensive ^{14}C database in order to identify such problems and take them into account when conducting studies reliant on radiometric age determinations. Additionally, not all ^{14}C ages run decades ago are aberrant or inaccurate and thus we must be careful to not indiscriminately discard them nor restrict our investigations strictly to ages produced with the newest methods. This is especially true since these newer ages are still so few in number that we cannot yet adequately address population questions on a continental scale. Therefore, we must envision and elaborate research strategies that take into account recently obtained ages and use them to critically evaluate radiometric determinations made in previous decades in order to determine which of these ages are likely valid. Input from researchers who have developed these new measurement methods on how they perceive the best way to move forward would be instrumental (see Higham 2011).

Comprehensive ^{14}C databases are especially relevant in light of the application of statistical techniques to archaeological chronologies. The application and refinement of statistical methods, such as the Bayesian approach, allows one to refine these chronologies (e.g., Blackwell and Buck 2003; Bronk Ramsey 2009). Finally, the use of stratigraphic markers, such as microtephra, has been proposed as a means by which we can overcome some of the uncertainties in radiocarbon chronologies beyond 25kyr cal BP (RESET project; Barton et al. 2009; Giaccio et al. 2006). While such an approach is valuable for addressing the question of chronology and stratigraphic correlations, it is really complementary and its application highlights the need for and importance of exhaustive radiocarbon databases.

Some archaeological cultures have attracted more attention than others and consequently their associated sites have a greater number of radiocarbon ages regardless of the number of recorded sites. Comprehensive radiocarbon databases are instrumental in identifying such research biases and in stimulating the creation of research projects that can serve to fill these gaps.

PALEOLITHIC RADIOCARBON DATABASES: WHERE DO THINGS STAND?

A number of Paleolithic radiocarbon databases exist, but their geographic and temporal scopes are diverse and their availability variable. Almost all researchers involved in Paleolithic studies have a personal database that they augment and maintain in order to address their particular research interests. These databases can be quite large and extensive in scope. Other researchers are aware of their existence due to publications concerning these data, but access to such data may be restricted to personal communication or research collaborations (Bocquet-Appel et al. 2005; Demars 2008; Terberger and Street 2002; Housely et al. 1997). Some databases are the result of collaborations among different researchers, are formalized to varying degrees, and their existence is apparent in the published literature (e.g. OIS 3 Project, S2AGES: Gamble et al. 2005; Pettitt et al. 2003; Stringer 2006). However access to these data can be limited and is dependent on the researchers' willingness to share these data.

Numerous, but geographically or temporally restricted, radiocarbon databases have been made available in journal articles or provided as supplementary data upon publication (Banks et al. 2008a; Conard and Bolus 2003; d'Errico and Sánchez-Goñi 2003; Langlais 2010; Sommer et al. 2008; Teyssandier 2007; Zilhão 2006). Their use can be, however, somewhat limited because they were compiled around specific research questions. Additionally, they are often provided in formats that are not immediately usable or easily integrated into another database's structure.

Some researchers have constructed lists, consisting of dates that may or may not be published elsewhere, and made them available on the internet (e.g., Dujardin – Datations au radiocarbone: http://www.vdujardin.com/14C.html). Their availability to others is dependent on their author's ability to maintain the host website, and when conducting internet searches it is not uncommon to find references to databases on websites that are no longer maintained or accessible.

With respect to the internet, there exist databases that are more or less permanently maintained by institutions of higher learning or individual radiocarbon laboratories. The Department of Geography at the Katholieke Universiteit Leuven, maintains and makes available a radiocarbon database for Europe. This project is the result of an INQUA (International Union for Quaternary Research) commission on Palaeoecology and Human Evolution and is under the responsibility of P. Vermeersch. The Leuven database is regularly updated and the latest version is freely available for download. It covers the Middle and Upper Paleolithic and is made available in an MS ACCESS format, which can prove a limitation to those without this specific software. Similar databases (radiocarbon and faunal), created within the framework of the Stage 3 Project (van Andel and Davies 2003), are available on the website maintained by the Department of Earth Sciences at the University of Cambridge (http://wserv2.esc.cam.ac.uk/research/research-groups/oistage3/stage-three-project-database-downloads). The Stage 3 Project's databases are practical because they exist in an EXCEL format, but their scope is temporally limited. Another example is the ^{14}C radiocarbon CONTEXT database maintained by the University of Cologne. It covers the time span between 20–5k cal BP and is focused on the Near East (http://context-database.uni-koeln.de/index.php).

With respect to individual radiocarbon laboratories, various labs maintain on-line, searchable databases of radiocarbon ages performed in-house. Cases in point are the University of Lyon, France (BANADORA – BAnque NAtionale de DOnnées RAdiocarbone) and the University of Oxford. Many radiocarbon labs published from the 1960s through the early 1990s, on a fairly regular basis, datelists in the form of journal articles in which ^{14}C ages and their contextual information are briefly described (principally in *Radiocarbon*, *Archaeometry*, *Bulletin de la Société Préhistorique Française*; also see *Studia Praehistorica Belgica* [Gilot 1997]). These databases and publications are useful, but they cannot serve as a research tool in and of themselves because they only contain ages specific to a single laboratory. Thus, in order to collect radiocarbon ages for a specific region and time period, literally dozens of resources must be obtained and consulted, and even then, one is not guaranteed to have all of the pertinent data.

With this paper we wish to make available a geo-referenced database of radiocarbon ages from archaeological sites in Europe that span the period from the late Middle Paleolithic to the initial Mesolithic. We have assembled the data from published and unpublished databases in an attempt to produce an up-to-date database that is as exhaustive as possible. In so doing, we have attempted to move beyond geographic and temporal limitations present in many existing collections of dates. We have also included in this database contextual information that is not always directly associated with the raw ^{14}C ages in their original source. We made the choice to restrict our database to Europe, with an eastern boundary of ~60° longitude because dated archaeological sites beyond this boundary are more sparse, there are fewer radiocarbon ages relative to the western records, and the published literature often is difficult to access. It stands to reason, however, that our database would be greatly improved by adding data from these more eastern regions.

We have restricted our data collection to radiocarbon ages (conventional and AMS) because we think that other dating methods provide data that differ significantly in their accuracy and their comparability to radiocarbon ages. Also, many of the questions that we have mentioned above, such as the time spans of individual Upper Paleolithic archaeological cultures, chronological relationships between different technocomplexes, and correlations between human adaption and millennial scale climatic variability, are already difficult to assess with radiocarbon ages, and these limitations are amplified when relying on other, less precise, dating methods (i.e., ESR, OSL, TL, etc.). These latter methods provide calendar ages and until only very recently, with the correlation of data from Hulu Cave (Wang et al. 2001) with existing records (Hughen et al. 2006; Weninger and Jöris 2008) as well as the publication of the IntCal09 curve (Reimer et al. 2009), there was no consensual calibration (comparison) curve with which to effectively transform radiocarbon ages to calendar dates. Thus, it was difficult to reliably merge these differing sources of data.

This paper not only describes and makes available an 'exhaustive' radiocarbon database, but also serves to announce our intention to make available a regularly updated version of it on the webpage of the authors' host institution. We realize that compiling an exhaustive database is by definition impossible since new radiometric age determinations are run every day. We also acknowledge that this database invariably contains errors, but it is by making it widely and freely accessible and by inviting reader feedback that such errors can be corrected and that a better degree of exhaustiveness eventually can be attained.

DATABASE FIELDS

The PACEA radiocarbon database (Supplement 1 available with this article at: http://www.paleoanthro.org/journal/contents_dynamic.asp) consists of conventional and AMS ^{14}C age determinations from archaeological sites in Europe that fall within Marine Isotope Stages (MIS) 3–1 (i.e., Middle Paleolithic to Mesolithic). In all, we have assembled 6,019 radiocarbon ages (conventional=3,820, AMS=2,176, unspecified=23) from a total of 1,208 sites.

The database fields are described in Table 1 and were designed to be as self-explanatory as possible in order to avoid the need to create a linked metadata file. Nevertheless, we think that the reader may find some clarifications to be useful. Town refers to the population center nearest the site. In many instances the coordinates of these population areas were used in place of the actual site coordinates when precise locations were not provided in the literature, which is often the case since site locations are not always made available in the public record. For many research endeavors such a lack of precision is not detrimental, especially when the research focus is at the regional or continental scale. There were instances for which the published description of its location was so vague that approximate geographic coordinates could not be deduced and the reader will note that a handful of sites are not geo-referenced. One also will note that there are cases for which a site's coordinates are given yet there is no associated commune and/or region. As time permits, we intend to fill in these missing fields, but to-date we have focused our time on gathering more pertinent information to prepare this database for publication. Likewise, many sites are lacking information with respect to altitude and orientation. While orientation may be difficult to ascertain, we intend to use the geographic coordinates to obtain altitude measurements, as time permits.

For the archaeological fields, the least precise is site function, and it is sub-divided into very broad categories, the most common designation being habitat or some variation of it. Obviously, designations such as workshop, kill site, processing locale, etc. have not been used but certainly could be. As time goes by, and with reader/user feedback, we anticipate that this database field will become more precise, or at least less generalized. Archaeological culture designation has been divided into three classes (Cultural Attribution 1–3) going from general to precise. The field 'Cultural Attribution 1' refers to the broadest archaeological culture classification, such as Middle Paleolithic, Upper Paleolithic, etc. When possible, this is further divided into specific technocomplexes in the 'Cultural Attribution 2' field. This class contains entries such as Mousterian, Aurignacian, Solutrean, etc. When it has been possible, archaeological cultural attribution is further sub-divided and finer-scale designations are provided in the field 'Cultural Attribution 3' (e.g. Aurignacian I, Middle Solutrean, Middle Magdalenian, etc.). Subdivisions within Upper Paleolithic technocomplexes have significantly changed in the last couple of decades, often becoming less specific or taking into account newly identified regional variations. We have updated cultural attributions for dated assemblages that have been reappraised but have left the original attributions in instances for which we know of no new studies.

With respect to the ages themselves, the reader will notice that for a few ages the published literature does not indicate whether they are conventional or AMS and in many instances a code is not available. We anticipate that over time, with feedback and supplementary work on our end, their frequency will be reduced. The data field 'Age' contains the sample's age in radiocarbon years BP and the age's 1-sigma error is contained in the field 'S.D.'. Ages were calibrated using both a comparison curve and the recently published IntCal09 calibration curve. For the former, we used the Hulu Cave dataset available in CalPal (Weninger and Jöris 2008). The 'CalTable' feature in CalPal provides a calendar age and 1-sigma standard error, which are presented in the fields 'cal BP' and 'cal s.dev.', respectively. This comparison curve lacks some of the precision available with IntCal09, and CalTable does not provide a calibrated age range, which is not ideal. Therefore, we also calibrated each age with IntCal09 (Reimer et al. 2009) using a 95.4% confidence interval. The calibrated date range is provided in the fields 'IntCal09 max BP' and 'IntCal09 min BP'. Finally, references are provided in the 'Biblio' column and listed in full in Supplement 2 (available with this article at: http://www.paleoanthro.org/journal/contents_dynamic.asp), although some entries are still lacking and one will also note that the reference cited is not always the original reference. Such is the case when a more recent published article references an age but does not cite the original source. Again, this information can be added or corrected during future maintenance activities.

THE DATABASE: GENERAL DESCRIPTIVES

First, we provide some general statistics and description of the database. While the majority of countries within the geographic scope of the database are represented, those with over 100 radiocarbon ages are presented in Figure 1. One will note that France is the country with the most entries, followed by Germany and Spain in distant second and third places, respectively. In fact, Germany and Spain combined still do not equal the number of entries

TABLE 1. PACEA RADIOCARBON DATABASE FIELDS

Database Field	Description
Site Name	
Longitude	Decimal degrees
Latitude	Decimal degrees
Commune	Nearest commune, city, or population center
Region	Geographic department or region
Country	
Biogeography	Continental or Mediterranean
Altitude	(m)
Orientation	
Site Type	Cave, shelter, open-air
Site Function	General - could be made more precise
Cultural Attribution 1	Broad cultural category (e.g. Upper Paleolithic)
Cultural Attribution 2	Broad archaeological technocomplex (e.g. Solutrean)
Cultural Attribution 3	Archaeological sub-technocomplex (e.g. Upper Solutrean)
Level	Archaeological level
Date Type	Conventional (labeled as 14C), AMS
Sample	Dated material (charcoal, bone, etc.)
Code	Unique laboratory code
Age	Radiocarbon years BP
S.D.	Standard error of age (1 sigma)
cal BP	Obtained using Hulu Cave curve in CalPal
cal s. dev.	Obtained using Hulu Cave curve in CalPal
IntCal09 max BP	Obtained using IntCal09 calibration curve
IntCal09 min BP	Obtained using IntCal09 calibration curve
Biblio	Bibliographic reference - not always the original source
Notes	General notes - occasional

for France. This is due to the fact that the latter has historically been the focus of Paleolithic research, especially with respect to the southwestern region of Aquitaine. Tables 2 and 3 present a breakdown of the age totals by major archaeological periods and culture respectively. The total in the latter represents a bit more than half of the database's entries because many radiometric ages are not assigned to a specific archaeological culture in the literature. One notes a marked increase in the number of ages for the early part of the Upper Paleolithic, a decrease during the Last Glacial Maximum (e.g., Solutrean and Badegoulian), and a relative explosion in the number of ages for the Magdalenian. While this trend can in part be explained by population increases and decreases associated with climatic and environmental changes during the Upper Paleolithic (Demars 2003; Gamble et al. 2005), one must also take into account

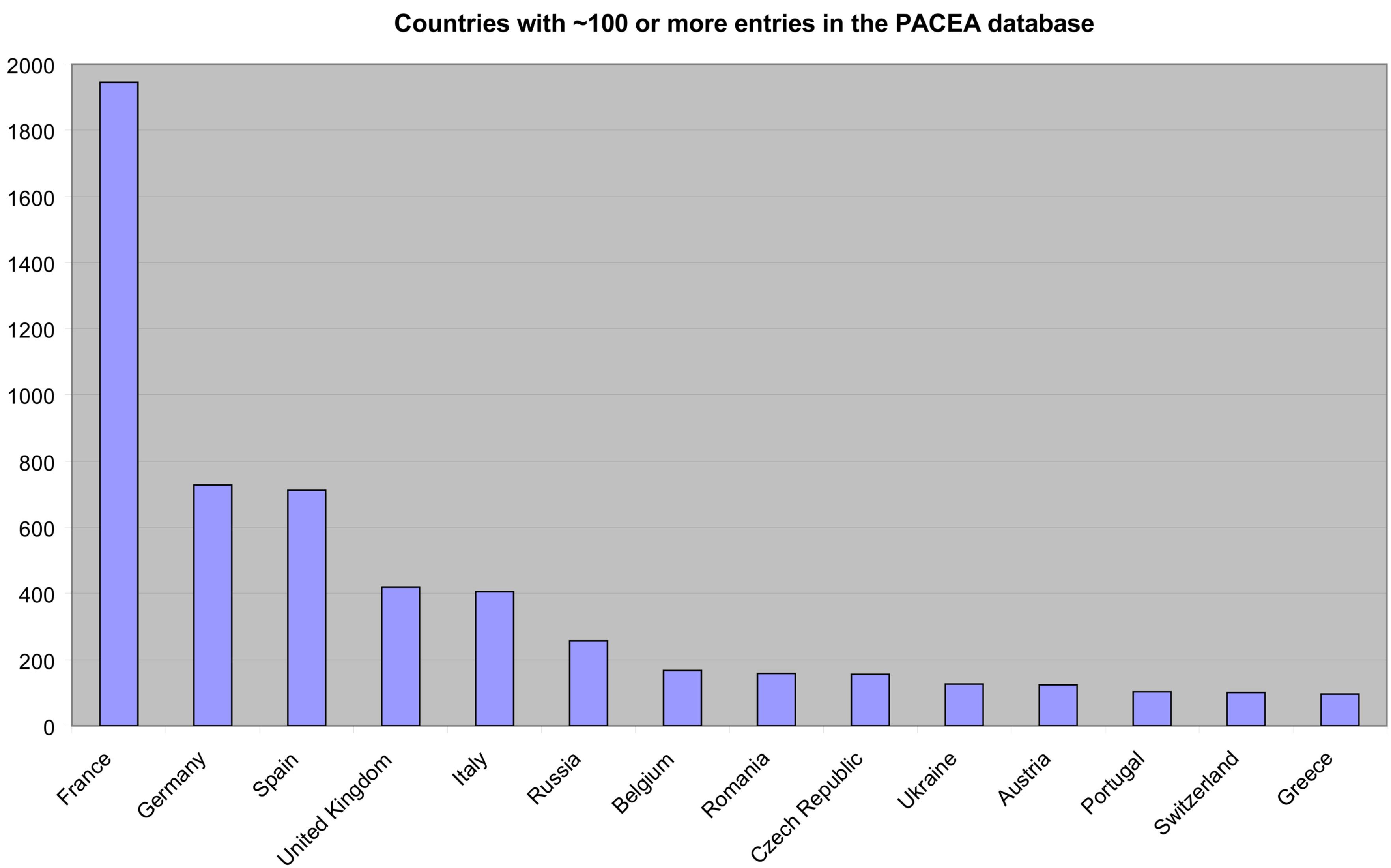

Figure 1. Histogram showing countries with > 100 entries in the PACEA database.

TABLE 2. 'CULTURAL ATTRIBUTION 1' DESIGNATION AND AGE TOTALS

Period Attribution	14C	AMS	Unspec.	Total
Middle Paleolithic	258	196	2	**456**
Middle/Upper Paleolithic	111	91	-	**202**
Upper Paleolithic	2225	1284	16	**3525**
Upper Paleolithic/Epipaleolithic	7	30	-	**37**
Epipaleolithic	355	193	5	**553**
Mesolithic	585	184	-	**769**
Unspecified	279	198	-	**477**
Totals	**3820**	**2176**	**23**	**6019**

factors related to the duration of specific technocomplexes, as well as issues related to preservation and archaeological visibility.

When evaluating conventional and AMS radiocarbon ages that belong to the same archaeological culture, one pattern that has been identified in the literature is that the conventional ages tend to have slightly greater associated errors than AMS ages, and also tend to be younger. This has been attributed to the fact that the methods used are not as effective in eliminating possible sources of contamination (i.e., sources of younger carbon) (d'Errico and Sánchez-Goñi 2003; Pettitt et al. 2003; Zilhão and d'Errico 1999). This is especially the case when conventional ages are compared to AMS ages produced via ultrafiltration on samples from the same archaeological levels or even the same archaeological artifact (Higham et al. 2006; Higham et al. 2009; Higham et al. 2010; Jacobi et al. 2006). With an earlier version of the PACEA radiocarbon database, this pattern was discussed for the late Middle Paleolithic and the Upper Paleolithic (d'Errico et al. 2006). With the more exhaustive version of the database presented here, we have repeated such an evaluation and the results are depicted in

TABLE 3. 'CULTURAL ATTRIBUTION 2' DESIGNATION AND AGE TOTALS

Cultural Attribution	14C	AMS	Unspec.	Total
Mousterian	232	153	3	**388**
Transitional Industries *	68	64	-	**132**
Aurignacian	369	307	-	**676**
Gravettian	412	195	-	**607**
Solutrean	131	40	-	**171**
Epigravettian	227	43	-	**270**
Badegoulian	74	28	-	**102**
Magdalenian	730	431	16	**1177**
Azilian	173	42	-	**215**
Totals	**2416**	**1303**	**19**	**3738**

*includes the Chatelperronian, Szeletian, and Uluzzian

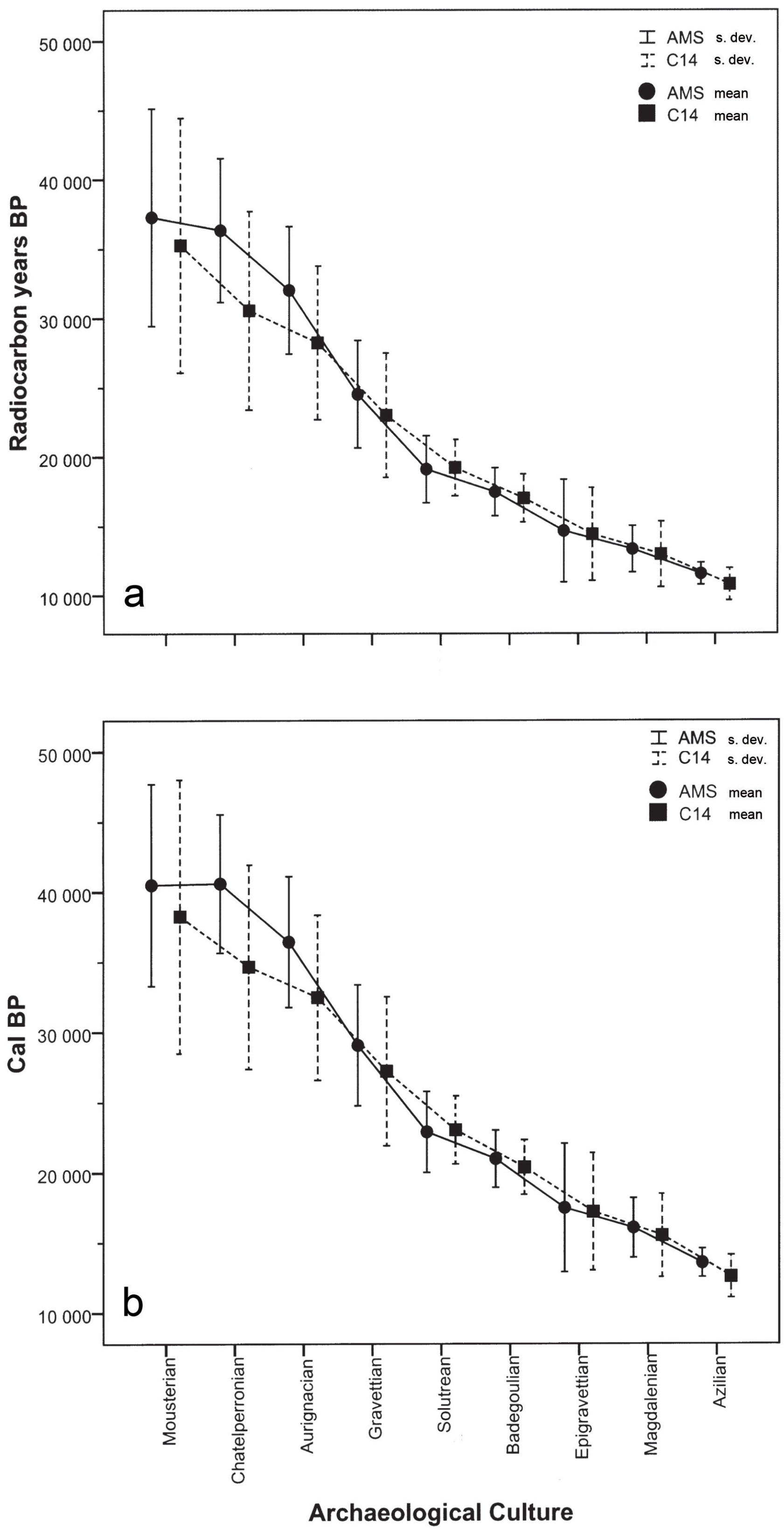

Figure 2. Plots of mean age and one standard deviation for each principal technocomplex: a) radiocarbon years B.P.; b) calendar years BP (based on calibrations derived from CalPal).

Figure 2. To produce these two graphs, we used all of the ages with a specific designation in the field 'Cultural Attribution 2,' and calculated a mean and standard deviation for conventional and AMS ages (see Figure 2a), or for their calibrated means calculated with CalPal (see Figure 2b). It should be pointed out that with respect to the transitional industries we only plotted values for the Chatelperronian because the samples of AMS ages for the Szeletian and Uluzzian are small.

One will note that the plots for radiocarbon years BP and calibrated BP are very similar. The major difference between the two is that there is virtually no difference between the calibrated date mean for the Mousterian and the Chatelperronian. We interpret this to be due to the fact that for the Mousterian we are at the temporal limits of the radiocarbon method as well as the calibration curve and, with respect to the Chatelperronian, are approaching those limits. As is also visible in the graph presented by d'Errico et al. (2006), the present analysis also indicates that for the Mousterian, Chatelperronian, Aurignacian, and Gravettian technocomplexes, AMS ages and their calibrated values are consistently older than those associated with conventional methods. The differences between AMS and conventional ages, as well as their calibrated dates, are much smaller for the technocomplexes that date to the Last Glacial Maximum (LGM; e.g., Solutrean) and the latter half of the Upper Paleolithic (e.g., Magdalenian). It is interesting that for the Solutrean the AMS mean is younger than the mean of conventional age determinations. This pattern is difficult to interpret but may be due to differences in sample size (AMS, n=40; conventional, n=131). As more AMS determinations are produced for the Solutrean, it is possible that this inversion will disappear.

Two immediate conclusions are evident with respect to these plots. First, for the time periods prior to the LGM, one cannot treat AMS ages and conventional ages the same and in our opinion, for analyses reliant on radiometric data, preference should be given to AMS age determinations as they are more likely to represent the true age of the archaeological level and associated industry. This does not mean that all conventional age determinations should be discarded or ignored, but they warrant closer scrutiny before being included in an analysis. Likewise, although the time ranges covered by conventional ages are broadly similar to those of AMS age determinations for archaeological cultures of the LGM and more recent periods, we should not assume that they are equal. For example, it would be necessary to statistically evaluate the distributions of conventional and AMS ages within a technocomplex to determine if they differ significantly from one another.

Additionally, despite their broad similarities, one notes that for these younger Upper Paleolithic technocomplexes, with the exception of the Solutrean, AMS age determinations are still slightly older than conventional ages. While these differences are small, they appear to be important and caution is warranted if one is interested in cultural processes during very limited spans of time. For example if the focus of study is demographic processes in northern Europe during a temporally restricted phase of the Late Glacial, or if the abrupt transition between a Heinrich Event and following Greenland Interstadial is targeted, each radiocarbon age determination should be closely scrutinized (e.g., archaeological context, stratigraphic inversion, etc.) with particular attention paid to those obtained with conventional methods before it is included in an analysis.

It is important to point out that this database allows such issues to be systematically addressed, which is becoming increasingly relevant in light of recent methodological advances and an apparent increase in the frequency of research questions related to culture-environment interactions.

CONCLUSIONS

While this database can be integrated into a wide range of archaeological studies, its value could be greatly improved by expanding its geographic focus to include Asia and Northern Africa. This seems a logical next step and is one that we hope to undertake in the future. With such an enlargement of scope, a broad spectrum of archaeological research questions could be addressed and fruitful comparisons between multiple geographic regions could be made. At present, though, such an undertaking remains hypothetical.

Again, we readily acknowledge that this database contains errors and we apologize beforehand for their inadvertent inclusion, but this is inevitable when a number of collaborators assemble such a large amount of information on a relatively long period of time (i.e., several years). We will continually update and correct this database as we use and modify it, but we also ask that readers/users of this database inform us of any errors that they identify so that we can improve our efforts to make corrections.

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