ANTHROPOLOGIE • XXXVIII/2 • pp. 149–150 • 2000

PAUL B. PETTITT, ERIK TRINKAUS

DIRECT RADIOCARBON DATING OF THE BRNO 2 GRAVETTIAN HUMAN REMAINS

ABSTRACT: The human partial skeleton from Francouzská Street in Brno, Brno 2, was directly dated using accelerator mass spectrometry (AMS) radiocarbon dating using a fragment of rib. The resultant date, 23,680 ± 200 years B.P., makes it the latest of the known Moravian Gravettian human remains but still well within the age range of Gravettian sites in Moravia.

KEY WORDS: Human Palaeontology – Upper Palaeolithic – Radiocarbon dating

INTRODUCTION

During 1891 workmen exposed underneath Francouzská Street in Brno (Moravia) an Upper Palaeolithic burial, stained with red ochre and accompanied by a mammoth scapula, hundreds of *Dentalium* shells, other macrofaunal remains, and impressive movable art objects (Makowsky 1892, Jelínek 1959, Valoch 1959, Oliva 1996). Based on the morphology of the associated artifacts (especially the art objects) and the position of the remains relative to the Pleistocene fluviatile stratigraphy of the Brno region (Valoch 1959, Oliva 1996), the human burial has been assigned to the Mid Upper Palaeolithic / Gravettian, or Pavlovian, of the middle Danube region. However, there have been no radiometric dates available for this specimen, which includes one of the more complete European early modern human skulls and several postcranial elements, as well as exhibiting systemic periostitis (Jelínek 1959, Oliva 1996). Since this specimen and its burial context contribute morphologically, palaeopathologically, and palaeoethnographically to our understanding of earlier Upper Palaeolithic human populations of central Europe, it was decided (with the permission and encouragement of M. Oliva) to attempt to directly date the specimen using accelerator mass spectrometry (AMS) radiocarbon dating.

SAMPLE COLLECTION, PRETREATMENT AND MEASUREMENT

The Brno 2 human remains in the Moravské zemské muzeum consist of a calotte, a hemi-mandible, several postcranial elements, and a number of fragments. From among the fragments, we chose (in consultation with M. Oliva and K. Valoch) a proximal rib fragment which appeared not to have been treated with preservative.

The sample received the current standard Oxford pretreatment for bone samples. Because the conservational history of the sample was unknown, careful attention was paid to indicators of contamination resulting from either past conservational measures or handling over the years. The aim of the pretreatment process is to extract and purify collagen. Each sample was therefore demineralised in acid, washed, given an alkaline rinse to extract humic acids before being gelatinised by heating in a weak acid. Following this, each sample was evaporated before being freeze dried to facilitate combustion. The collagen yield was a respectable 11% of the original sample weight (*Table 1*).

Following pretreatment, the sample was loaded into a tin capsule and combusted at >1000°C in an oxygen atmosphere. The properties of tin under combustion are

TABLE 1. Results of direct AMS radiocarbon dating of the Brno 2 proximal rib fragment.

Sample weight (mg)	235
Collagen as % of use weight	10.97
Carbon as % of use weight	0.671
$\delta^{13}C$ (per mil)	–18.96
Resultant age (years B.P.)	23,680 ± 200
Lab number	OxA-8293

such that this material raises the temperature even higher, facilitating the oxidation of molecular fragments, and thereby improves the precision of the isotopic measurements. After combustion, the gas stream passes into a gas chromatograph where the components of interest are separated. A small proportion of the resulting carbon in the form of CO_2 was fed into a mass spectrometer in order to measure the $\delta^{13}C$ ratio. The greater part of this was stored in a glass ampoule ready for dating in the accelerator. The yields of carbon was in the region of 0.7% of the original sample weight (*Table 1*).

The $^{14}C/^{13}C$ ratios for the samples were measured using the accelerator mass spectrometer at Oxford. With this technique the CO_2 gas is directly injected into the ion source of the spectrometer and the stable isotopes measured as ion currents while the ^{14}C atoms are counted using a gas filled detector. This technique is more sensitive by a factor of *ca* 1000 than the 'conventional' method and enables us to measure much smaller samples, like the human remains of concern here. In order to obtain an accurate and absolute measurement of the isotopic ratios, samples are run together with standards of known composition. Because several standards are run in each batch, including tree rings of known age, the reliability of the determinations can also be ensured.

RESULTS

The analysis provided a radiocarbon age of 23,680 ± 200 years B.P., or a probable (95% confidence interval) age between 23,280 and 24,080 years B.P. The chemistry of the sample provides a high degree of confidence in the determination.

DISCUSSION

This determination places the geological age of the Brno 2 human burial among the later occurrences of the Gravettian in Moravia and the Middle Danube basin (Svoboda *et al.* 1996). It is close in age to the Gravettian level of Petřkovice (23,370 ± 160 B.P.; GrA-891) and between the ages for the mammoth deposit D (22,100 ± 1,100 B.P.; GrN-14825) and feature D (25,220 ± 280 B.P.; GrN-14824) of Milovice. It is statistically later than the dates for the Gravettian levels of Aggsbach, Dolní Věstonice I and II, Pavlov I, Předmostí I and Willendorf II (layers 5 to 8). Although on average later than the one determination for Dolní Věstonice III (24,560 +660/–610; GrN-20392), the 95% confidence interval for the Brno 2 date remains within two standard deviations of that Dolní Věstonice III determination.

Consequently, the Brno 2 date is relatively but not exceptionally late for the Gravettian occupation of Moravia. Moreover, because neither Petřkovice, Milovice nor Dolní Věstonice III have yielded human remains, it becomes the most recent directly dated human specimen from this archeological complex (the slightly younger age for the Dolní Věstonice 35 femur – 22,840 ± 200 B.P.; OxA-8292 (Trinkaus *et al.* 1999) – is due to contamination and that specimen from Dolní Věstonice I is probably close in age to the dated archaeological deposits).

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Paul B. Pettitt
Radiocarbon Accelerator Unit
Research Laboratory for Archaeology
& the History of Art
University of Oxford
6 Keble Road, Oxford OX1 3QJ, UK
E-mail: paul.pettitt@archaeology-research.oxford.ac.uk
Keble College
University of Oxford
Oxford OX1 3PG, UK

Erik Trinkaus
Department of Anthropology
Campus Box 1114
Washington University
St. Louis MO 63130, USA
E-mail: trinkaus@artsci.wustl.edu

U.M.R. 5809 du C.N.R.S.
Laboratoire d'Anthropologie
Université de Bordeaux I
33405 Talence, France