Supporting Information

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SI Methods

Collagen was extracted using the methods outlined by Bronk Ramsey et al. (1), Higham et al. (2), and Brock et al. (3). All collagen was obtained using a final ultrafiltration step after Brown et al. (4). This method has been shown to improve the reliability of the ages obtained by more effectively removing low-molecular weight contaminants (4, 5). Radiocarbon (^{14}C) ages are given as conventional ages BP after Stuiver and Polach (6). The ^{14}C ages have been corrected for laboratory pretreatment background using a bone-specific background correction (main text and ref. 7).

There is variability in the sequence of ^{14}C determinations throughout the site. In layer 3, for instance, Ua-14512 (29,195 ± 965 BP) was dated in the same layer as two dates published here of >45.2 and >46.1 ka BP. There are at least two explanations. The difference may be due to contamination for the former and improved pretreatment chemistry for the latter measurements. Higham et al. (2) show using material dated from several sites that ultrafiltration is a more effective method in most instances for removing low-level contaminants than other methods, such as the Longin collagen (gelatinization) method. There is a growing realization of the challenge and difficulties associated with reliable dating in the 30–60 ka BP window (e.g., 8). The differences, then, may therefore reflect residual contamination in the younger measurement. A perusal of the other determinations from higher layers unfortunately shows several similar cases. For example, in layer 2A, two determinations from Beta Analytic differ by several thousand years from two other determinations in the same layer, and appear young compared with results from higher layers.

A note of caution is required regarding the calibration of ages close to the maximum dating limit of the Oxford laboratory, the limit of the IntCal09 curve, and similarly to the curve itself, which is unlikely to be the final iteration. The curve is based on an amalgamation of datasets, most of which are marine records. We have yet to obtain a firm terrestrial-based sequence for age calibration, although the Lake Suigetsu record of Japan is expected to produce that sequence within the next few years (9). We use this curve in the interim, recognizing that updated records may require us to undertake further modeling work. Calibrated ages BP for the determinations from layer 2 and from the Mez 2 specimen are shown in Table S1.

Results of the Bayesian modeling, as discussed in the main text, are shown in Figs. S1 and S2.

1. Bronk Ramsey C, Higham TFG, Bowles A, Hedges REM (2004) Improvements to the pretreatment of bone at Oxford. *Radiocarbon* 46:155–163.
2. Higham TFG, Jacobi RM, Bronk Ramsay C (2006) AMS radiocarbon dating of ancient bone using ultrafiltration. *Radiocarbon* 48:179–195.
3. Brock F, Ramsey CB, Higham T (2007) Quality assurance of ultrafiltered bone dating. *Radiocarbon* 49:187–192.
4. Brown TA, Nelson DE, Vogel JS, Southon JR (1988) Improved collagen extraction by modified Longin method. *Radiocarbon* 30:171–177.
5. Jacobi RM, Higham TFG, Bronk Ramsey C (2006) AMS radiocarbon dating of Middle and Upper Palaeolithic bone in the British Isles: Improved reliability using ultrafiltration. *J Quarter Sci* 21:557–573.
6. Stuiver M, Polach H (1977) Discussion: Reporting of ^{14}C data. *Radiocarbon* 19:355–363.
7. Wood RE, Bronk Ramsey C, Higham TFG (2010) Refining the ultrafiltration bone pretreatment background for radiocarbon dating at ORAU. *Radiocarbon* 52:600–611.
8. De Torres T, et al. (2010) Dating of the hominid (*Homo neanderthalensis*) remains accumulation from El Sidrón cave (Piloña, Asturias, north Spain): An example of a multi-methodological approach to the dating of Upper Pleistocene sites. *Archaeometry* 52:680–705.
9. Staff RA, Bronk Ramsey C, Nakagawa TA (2010) A re-analysis of the Lake Suigetsu terrestrial radiocarbon calibration dataset. *Nucl Instrum and Meth B* 268:960–965.

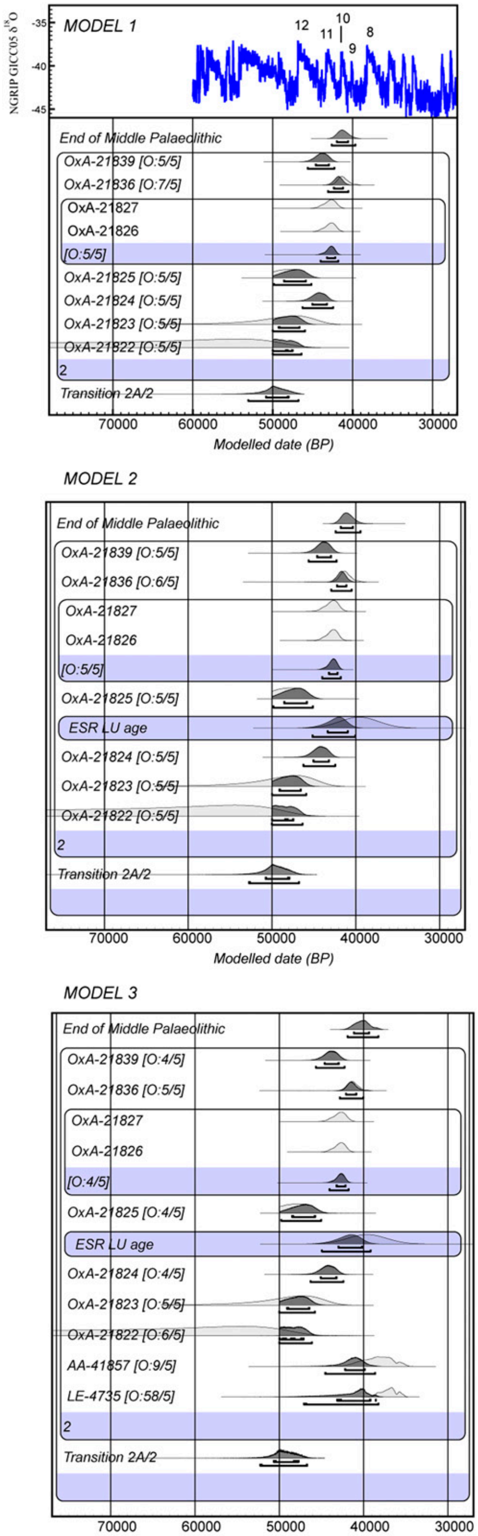

Fig. S1. Comparison of three age models for the chronology of the layer 2 occupation at Mezmaiskaya. The three models are described in the text. Modeling was undertaken using the IntCal09 curve of Reimer et al. (1) and OxCal 4.1 software (2). The individual radiocarbon likelihoods are the lighter-shaded distributions. The darker outlines represent the posterior probability distributions, namely the results of the Bayesian modeling. The outlier probabilities are shown in brackets (O:posterior probability/prior probability). One determination in model 3 has a high outlier probability of 58%. The prior outlier probability was set at 0.05 using a *t*-type outlier model. An SSimple model was used in the modeling of meaned data (2). The data are compared against the NGRIP GICC05 $\delta^{18}O$ record. Greenland interstadials are numbered where they are relevant and are discussed in the text (data from refs. 3 and 4). Note that synchroneity has yet to be demonstrated between Greenland paleoclimate and other parts of the world, so this is a tentative comparison.

1. Reimer PJ, et al. (2009) IntCal09 and Marine09 radiocarbon age calibration curves, 0–50,000 years cal BP. *Radiocarbon* 51:1111–1150.
2. Bronk Ramsay C (2009) Bayesian analysis of radiocarbon dates. *Radiocarbon* 51:337–360.
3. Svensson A, et al. (2006) The Greenland ice core chronology 2005, 15–42 ka. Part 2: Comparison to other records. *Quat Sci Rev* 25:3258–3267.
4. Andersen KK, et al. (2006) The Greenland ice core chronology 2005, 15–42 ka. Part 1: Constructing the time scale. *Quat Sci Rev* 25:3246–3257.

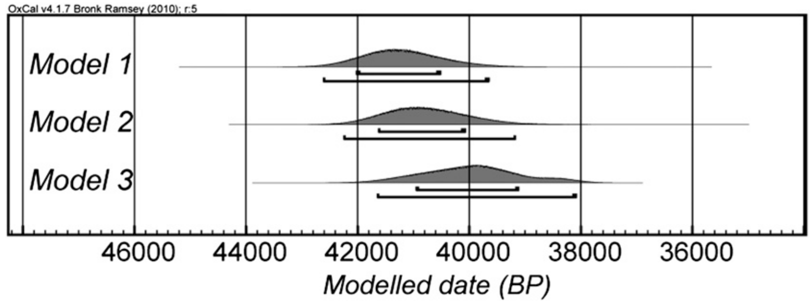

Fig. S2. Boundary distributions for the end of the layer 2 occupation (and therefore the latest Mousterian boundary) corresponding to the three Bayesian models analyzed based on the layer 1C and 2 determinations. See text for details. The three models are shown in Fig. S1.

Table S1. Calibrated age ranges for the Oxford determinations from layer 2, and the direct date of the Mez 2 Neanderthal. See text for details. OxA-21825, -21823, -21822, and -21828 are not included because they are either beyond the current calibration limit or may be beyond it

	Calibrated age ranges in years Cal BP (68.2% probability)		Calibrated age ranges in years Cal BP (95.4% probability)	
	From	To	From	To
OxA-21839	44,600	42,960	45,600	42,300
OxA-21836	41,950	40,660	42,530	39,640
OxA-21827	43,470	41,970	44,440	41,440
OxA-21826	43,370	42,020	44,270	41,560
OxA-21824	45,040	43,210	46,250	42,440
OxA-21829	46,380	43,990	48,650	43,130
OxA-21839	44,560	42,970	45,510	42,320

Table S2. Calibrated ^{14}C results for the Upper Paleolithic layers at Mezmaiskaya. These are calibrated using the IntCal09 dataset of Reimer et al. (1)

Layer	Sample (^{14}C age BP)	68.2% probability		95.4% probability	
1A	AA-41855 (28,510 ± 850)	33,950	31,800	34,750	31,350
	OxA-21814 (21,040 ± 120)	25,400	24,900	25,600	24,600
1B	OxA-21818 (14,970 ± 75)	18,500	18,000	18,550	17,950
	OxA-21817 (27,000 ± 250)	31,450	31,150	31,650	31,000
	OxA-21816 (23,310 ± 160)	28,400	27,950	28,550	27,750
	OxA-21815 (20,790 ± 120)	24,950	24,550	25,150	24,400
	CURL-5759 (split) (32,400 ± 230)	37,100	36,550	37,650	36,400
	CURL-5756 (split) (32,400 ± 240)	37,150	36,550	37,700	36,400
	CURL-5757 (split) (32,000 ± 250)	36,800	36,300	37,100	35,550
	Mean value of three above 32,284 ± 139	36,850	36,550	37,200	36,400
1C	OxA-21821 (27,070 ± 250)	31,500	31,150	31,700	31,050
	OxA-21820 (34,750 ± 650)	40,550	39,000	41,350	38,550
	OxA-21819 (20,640 ± 130)	24,900	24,450	25,050	24,250
	OxA-21105* (28,880 ± 140)	33,700	33,050	34,450	32,900
	OxA-21104* (28,510 ± 140)	33,250	32,650	33,400	32,150
	Mean value of * duplicates 28,701 ± 100	33,350	32,950	33,550	32,700
	AA-41856 (36,100 ± 2300)	43,330	38,750	46,700	36,630
	GIN-10946 (32,900 ± 900)	38,650	36,600	40,300	35,500
	CURL-5761§ (33,100 ± 270)	38,450	37,350	38,650	36,900
	CURL-5760§ (33,000 ± 240)	38,400	37,100	38,550	36,850
	CURL-5762§ (33,000 ± 260)	38,400	37,100	38,600	36,800
	Mean value of § duplicates 33,030 ± 148	38,400	37,200	38,550	36,950
	Beta-113536 (32,010 ± 250)	36,800	36,300	37,150	35,550

1. Reimer PJ, et al. (2009) IntCal09 and Marine09 radiocarbon age calibration curves, 0–50,000 years cal BP. *Radiocarbon* 51:1111–1150.