Supplementary Material

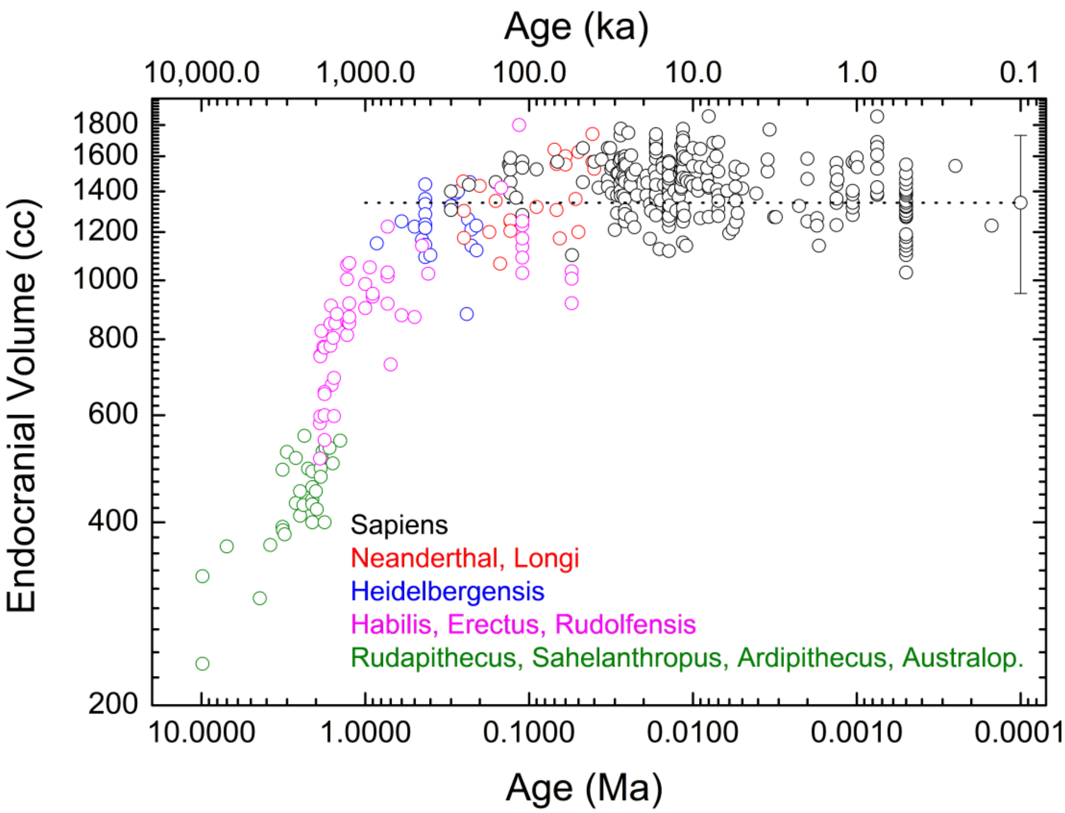

Figure S1. Data of cranial capacity in Rudapithecus (N = 2), Sahelanthropus (N = 1), Ardipithecus (N = 1), Australopithecus (N = 30), *H. habilis*, *H. erectus*, *H. rudolfensis* (N=56); *H. heidelbergensis* (N=26); *H. neanderthalensis* (N=26); *H. longi* (N=1); *H. sapiens* (N=276) over the last 10 million years. Data taken from (DeSilva et al., 2023), compiled by these authors from the literature. Each circle represents an individual fossil skull or osteological specimen, excepted the last point (age~0.1ka), obtained averaging the values of N=10,363 individuals (see main text for details). The dotted horizontal line represents this average value as reference for comparison with data corresponding to other ages. For the average value of the N=10,363 dataset (age~0.1ka), we have chosen an error bar of 3 standard deviations to graphically show the large variability of human endocranial volume. The few data corresponding to *H. naledi* (N=3) and *H. floresiensis* (N=1) have not considered. The endocranial volumes and the ages have been shown in log-scales.

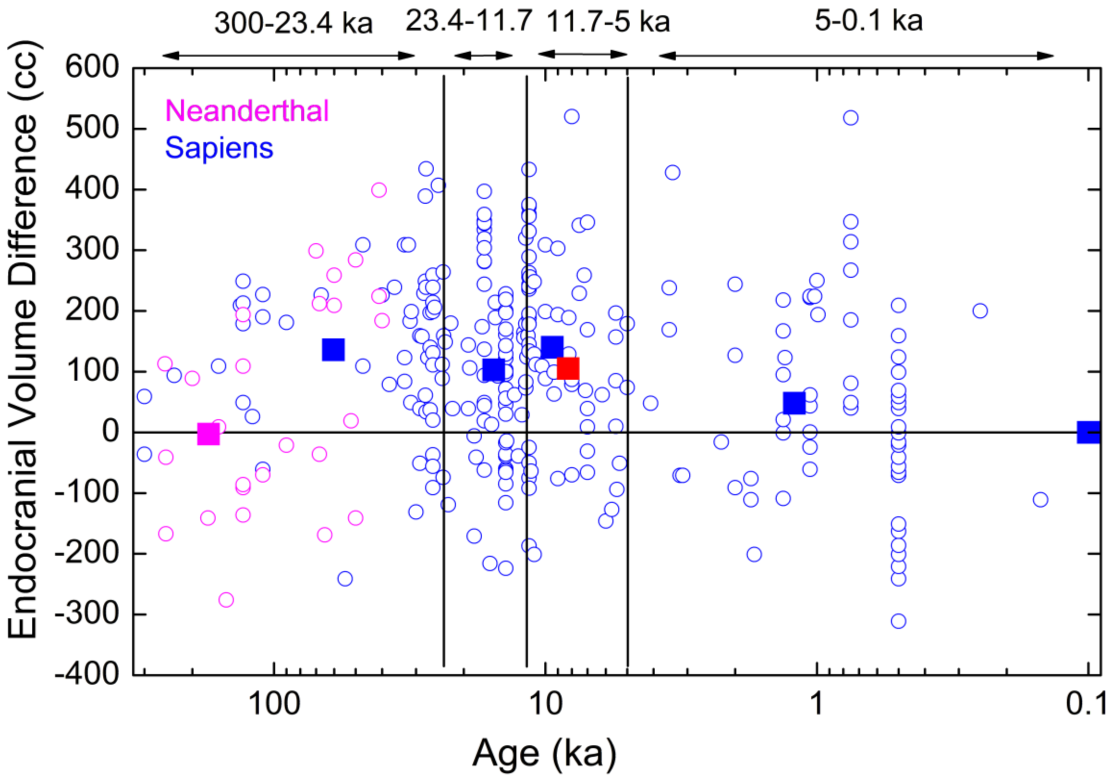

Figure S2. Differences of the endocranial volume in *H. sapiens* (blue circles) and *H. neanderthalensis* (magenta circles), reported by (DeSilva et al., 2023), with respect to the value for age~0.1ka, obtained averaging data of N=10,363 individuals. Vertical lines split time in four age intervals with a similar amount of data for *H. sapiens*: 0.1-5 ka (N=72), 5-11.7 ka (N=68), 11.7-23.4 ka (N=74), 23.4-300 ka (N=62). Squared points (blue for Sapiens, magenta for Neanderthalensis) are the mean cranial capacity's values obtained for data which fall in the considered intervals. The age coordinate of these mean values indicates the mean age for each subset of data. The red squared point is the mean value obtained for the subset of data of *H. sapiens* for 11.7ka≥age>5ka if we discard, in the calculation of the mean, the endocranial volumes corresponding to the age of 11.5ka (N=25), as discussed in the main text. The ages have been shown in a log scale. Table S1 below summarizes the mean values.

Table S1. Mean endocranial volumes versus mean age intervals shown in Figure S2. Data taken from (DeSilva et al., 2023). Data for *H. neanderthalensis* are missing for 40ka>age (extinction). The quantity ±std indicates the standard deviation of data around mean values.

Time Intervals (ka)	**300≥age>23.4**	**23.4≥age>11.7**	**11.7≥age>5**	**11.7≥age>5 without 11.5 ka data (**)**	**5≥age>0.1**	**age~0.1**
Number of data (N)	Sapiens: 62 Neanderthal: 26	74	68	43	72	10,363 (*)
Average endocranial volume (cc)	Sapiens: 1,477±132 Neanderthal: 1,338±178	1,444±132	1,481±161	1,446±149	1,389±158	1,341±130
Average age (ka)	Sapiens: 60.4±61.2 Neanderthal: 173.9±51.1	15.5±2.6	9.44±2.23	8.24±1.98	1.21±1.08	0.1

(*) value obtained averaging data taken from different sources (see main text for details).

(**) 25 specimens of *H. sapiens* found at Afalou, Algeria (Vallois et al., 1952).

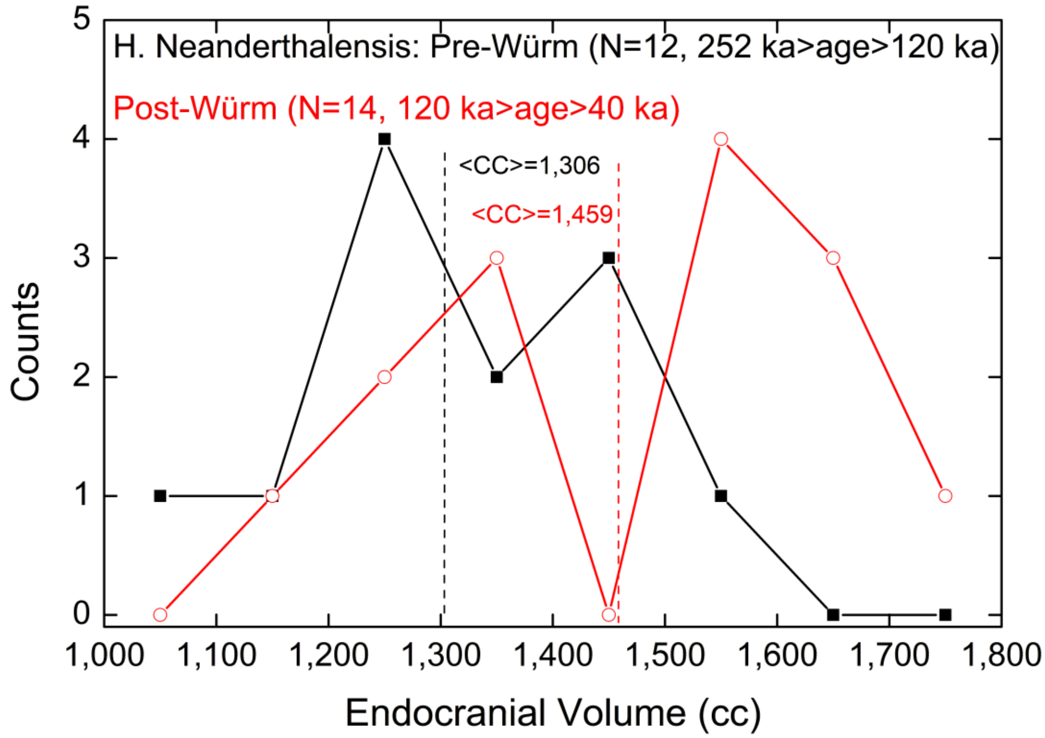

Figure S3. Histograms for the N=26 endocranial volumes of *H. neanderthalensis* reported by (DeSilva et. al, 2023), divided in pre-Würm (black) and post-Würm (red) ages. Dashed lines indicate the mean Cranial Capacity (<CC>). Both histograms are bimodal, although the pre-Würm data are slightly biased towards female data and post-Würm data are slightly biased towards male data. This finding implies that the increment of cranial capacity from pre-Würm to post-Würm periods for *H. neanderthalensis* could be overestimated, due to the limited set of data available and the not-fully balanced sex-representation of pre-Würm/post-Würm data. New discoveries of neanderthalensis' fossils will allow to have a better statistic and to determine a more reliable estimate of the increment of cranial capacity for *H. neanderthalensis* before and after that glaciation (set at 120 ka).

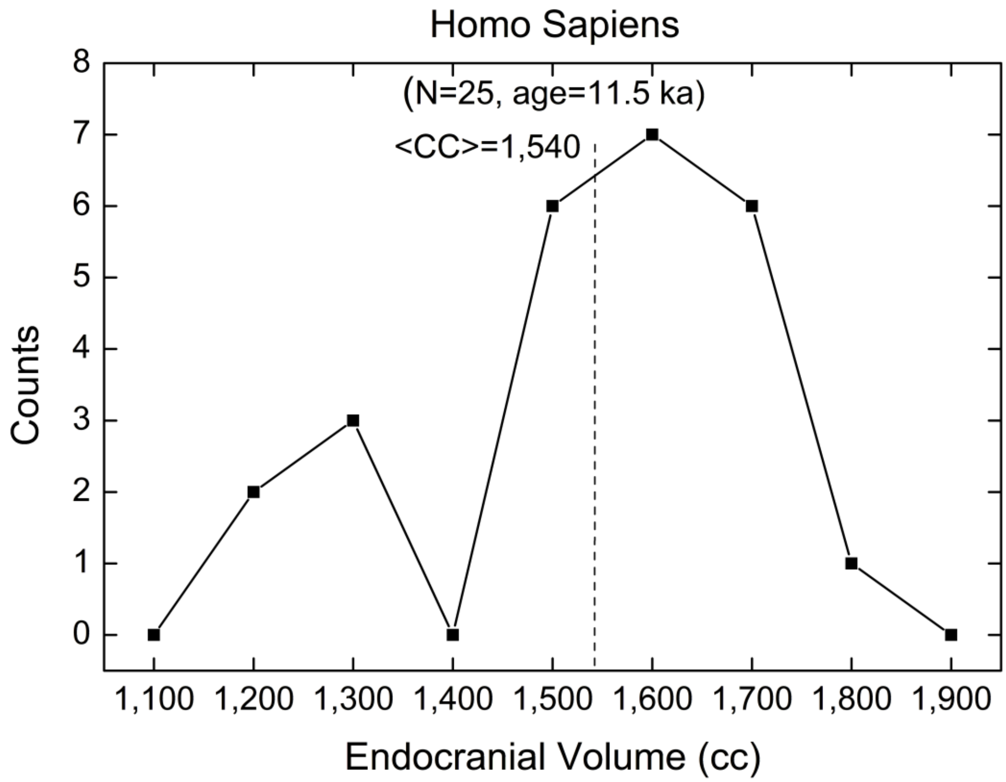

Figure S4. Histogram for the N=25 *H. sapiens*' Cranial Capacities (CC) reported by (DeSilva et. al, 2023), for the age=11.5 ka. Dashed line indicates the mean value <CC>, which falls within the male peak, indicating a strongly unbalanced set of data in terms of sex representation, confirmed also by the big difference of the two peaks' heights.

In Figure S4, the mean cranial capacity falls within the second peak of the distribution (male peak) and not between the two peaks, as it should happen for a balanced sex-representation of endocranial volumes. We could ask ourselves if this evident unbalance of the bimodal distribution for these N=25 data could be a result of a statistical fluctuation, due to the large variability of the human endocranial volume. We denote with *p* is the probability to have a contribution in the histogram in correspondence of the highest endocranial volume's peak. The probability to have $\mathrm{N_p}$ contribution of particularly high *female* endocranial volumes to the *male* peak, over a total of N data, can be estimated by the binomial distribution:

$$f_p\left(\mathrm{N_p}, \mathrm{N}\right) = \binom{\mathrm{N}}{\mathrm{N_p}} \mathrm{p}^{\mathrm{N_p}} (1-\mathrm{p})^{\mathrm{N}-\mathrm{N_p}}. \qquad \text{(S1)}$$

Putting $\mathrm{p} = 0.5$ for an unbiased male/female endocranial volume's dataset, for $\mathrm{N} = 25$ individuals the binomial distribution would have a mean value of about $\mathrm{p}\times\mathrm{N} = 12.5$ and a standard deviation of about $std = \sqrt{\mathrm{p}\times(1-\mathrm{p})\times\mathrm{N}} = 2.5$. Therefore, the a-priori probability to have $\mathrm{N_p} = 20$, for a total set of data $\mathrm{N} = 25$, can be evaluated approximately by $t = (20 - 12.5)/2.5 = 5$ with $p < 0.0001$. Therefore, the $\mathrm{N} = 25$ dataset can be considered strongly biased towards male endocranial volumes.

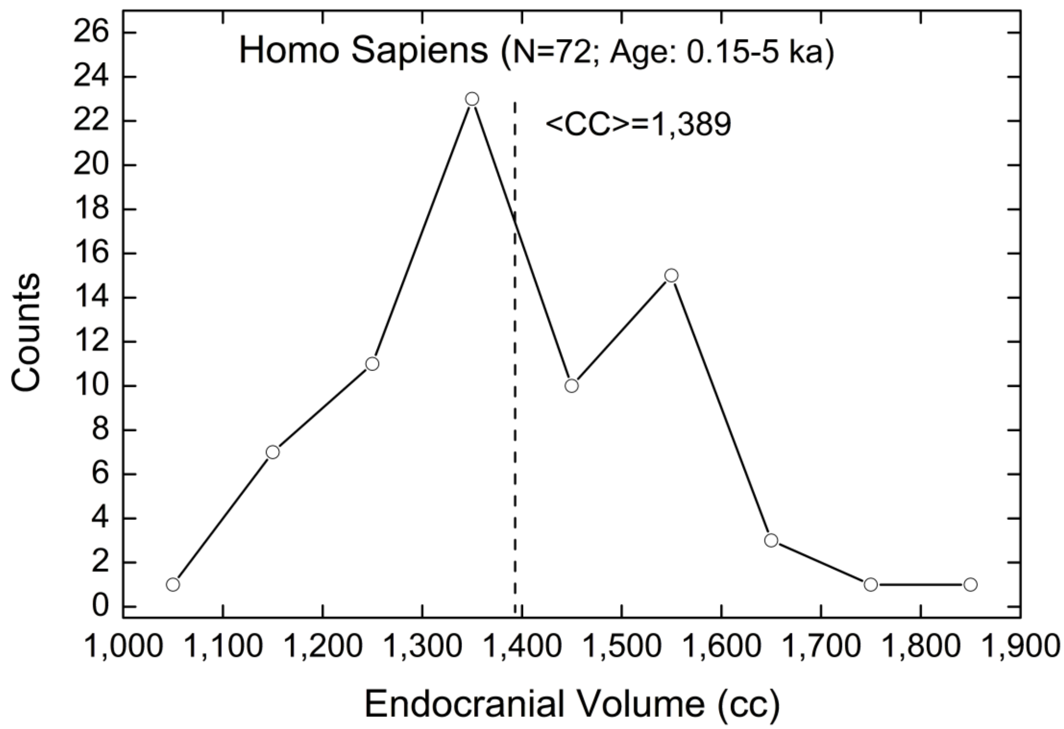

Figure S5. Histogram for the N=72 endocranial volumes of *H. sapiens* reported by (DeSilva et. al, 2023), for the 5 ka≥age>0.15 ka interval. The dashed line indicates the mean endocranial volume.

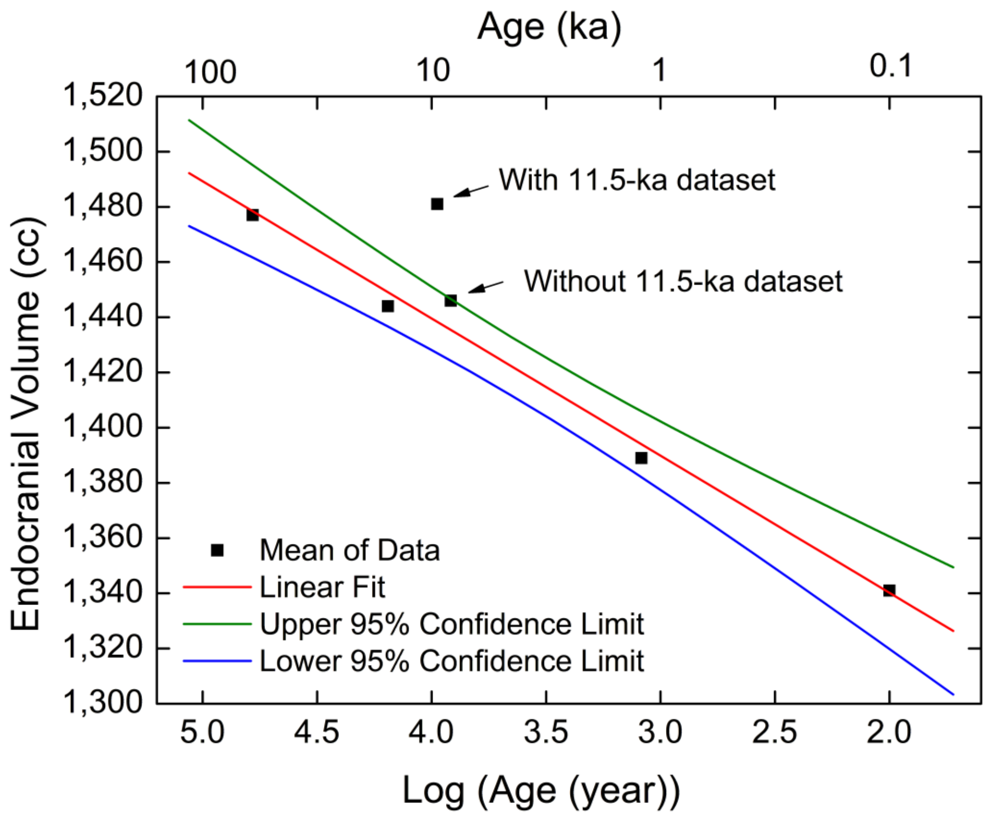

Figure S6. Linear regression of the mean endocranial volumes reported in Table 1 of the main text, as a function of the log of age. The adjusted R-square is 0.98, showing that these mean values follow just a linear regression as a function of the Log(age). It is shown also how the mean value for the interval 11.7ka≥age>5ka would be far from the 95% confidence interval due to the biased contribution of the (N=25) dataset at 11.5ka reported in (DeSilva et al., 2023).

If the 11.5ka dataset is not discarded by the calculation of the mean for the11.7ka≥age>5ka interval, the following linear regression is obtained:

$$\mathrm{CC} = 1{,}237.7 \pm 40.1 + (52.3 \pm 10.8) \times \mathrm{Log(age)}. \qquad \text{(S2)}$$

The adjusted R-square decreases to 0.85. Nevertheless, even by considering the 11.5ka biased dataset the linear regression of the mean data, as a function of the Log(age), indicates a gradual and continuous reduction of the endocranial volumes of *H. sapiens* from its origin, 300 ka ago, during all the Pleistocene and the Holocene, until now.

Instead, if we calculate a linear regression of all *H. sapiens*, *H. neanderthalensis* and *H. heidelbergensis*' endocranial volumes reported by (DeSilva et al, 2023) for the interval 300 ka≥age>0.1 ka, adding the mean value of 1,431 at age~0.1ka (N=10,363), the following result is obtained:

$$\mathrm{CC} = 1{,}394.7 \pm 50.0 + (9.2 \pm 12.2) \times \mathrm{Log(age)}. \qquad \text{(S3)}$$

Thus, a slope compatible with zero - no time evolution of the endocranial volume - is obtained, with t=0.8 and p=0.425.