ESRF	**Experiment title:** Did They Grow Up Faster? Neanderthal Enamel Seen Through Synchrotron Light	**Experiment number**: EC 143
Beamline: ID 19	**Date of experiment**: from: 10/3/2007 to: 10/7/2007	**Date of report**: 26/11/2010
Shifts: 12	**Local contact(s)**: PAUL TAFFOREAU	*Received at ESRF:*

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Primary Report:

Smith, T.M., Tafforeau, P., Reid, D.J., Pouech, J., Lazzari, V., Zermeno, J.P., Guatelli-Steinberg, D., Olejniczak, A.J., Hoffman, A., Radovčić, J., Masrour, M., Toussaint, M., Stringer, C., Hublin, J-J. (2010) Dental evidence for ontogenetic differences between modern humans and Neanderthals. Proc. Natl. Acad. Sci. USA 107 (page numbers forthcoming)

Abstract:

Humans have an unusual life history, with an early weaning age, long childhood, late first reproduction, short interbirth intervals, and long lifespan. In contrast, great apes wean later, reproduce earlier, and have longer intervals between births. Despite 80 y of speculation, the origins of these developmental patterns in *Homo sapiens* remain unknown. Because they record daily growth during formation, teeth provide important insights, revealing that australopithecines and early *Homo* had more rapid ontogenies than recent humans. Dental development in later *Homo species* has been intensely debated, most notably the issue of whether Neanderthals and *H. sapiens* differ. Here we apply synchrotron virtual histology to a geographically and temporally diverse sample of Middle Paleolithic juveniles, including Neanderthals, to assess tooth formation and calculate age at death from dental microstructure. We find that most Neanderthal tooth crowns grew more rapidly than modern human teeth, resulting in significantly faster dental maturation. In contrast, Middle Paleolithic *H. sapiens* juveniles show greater similarity to recent humans. These findings are consistent with recent cranial and molecular evidence for subtle developmental differences between Neanderthals and *H. sapiens*. When compared with earlier hominin taxa, both Neanderthals and *H. sapiens*

have extended the duration of dental development. This period of dental immaturity is particularly prolonged in modern humans.

Figure:

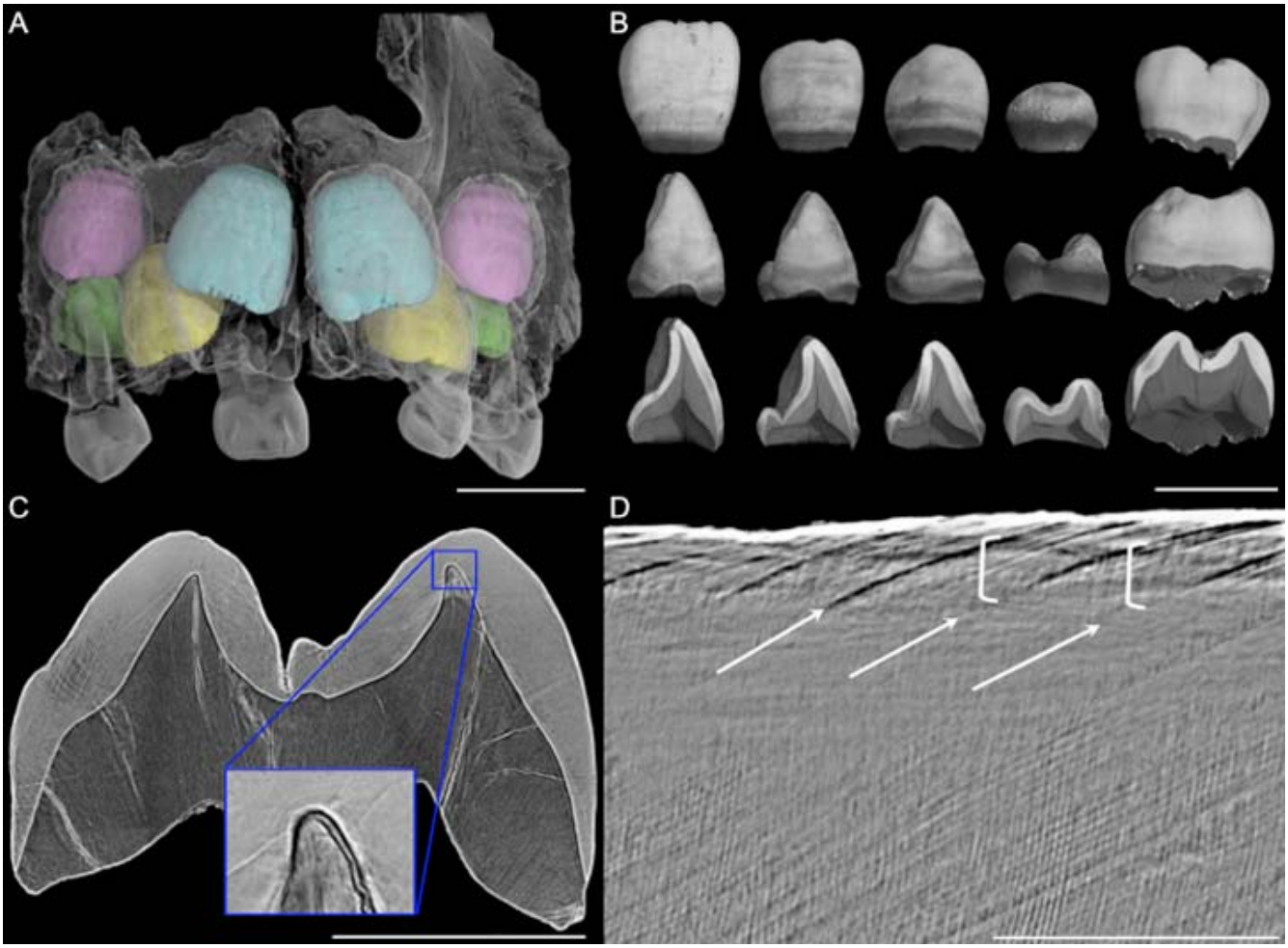

Figure 1. Age at death determination of the Engis 2 Neanderthal using synchrotron virtual histology. A) Virtual model (31 micron voxels). B) Cross-sectional slices. The scale bar in A & B is 10 mm. C) Phase contrast image (5 micron voxels). Scale bar is 5 mm. Inset shows the neonatal (birth) line, estimated to begin forming 17 days prior to birth. D) Phase contrast image (0.7 micron voxels): 8 daily lines (in brackets) between long-period Retzius lines (arrows). Scale bar is 0.2 mm. From Smith et al. (2010).

Related Publications:

Smith, T.M., Olejniczak, A.J., Zermeno, J.P., Tafforeau, P., Skinner, M.M., Hoffmann, A., Radovčić, J., Toussaint, M., Kruszynski, R., Menter, C., Moggi-Cecchi, J., Glasmacher, U.A., Kullmer, O., Schrenk, F., Stringer, C., Hublin, J-J. (in review) Remarkable variation in enamel thickness within the genus *Homo*. Proc. Roy. Soc. B.

Other Notes:

- Featured in ESRF Press release November 16, 2010 and on www.esrf.eu
- Numerous international scientific press reports, including Nature, Science NOW (online), Discover, BBC Radio, NPR Radio, Washington Post, UK Inquirer, etc.
- Will be featured in ESRF Newsletter and ESRF Highlights 2010
- Full length report with images and animations are available here:

http://www.heb.fas.harvard.edu/Press/