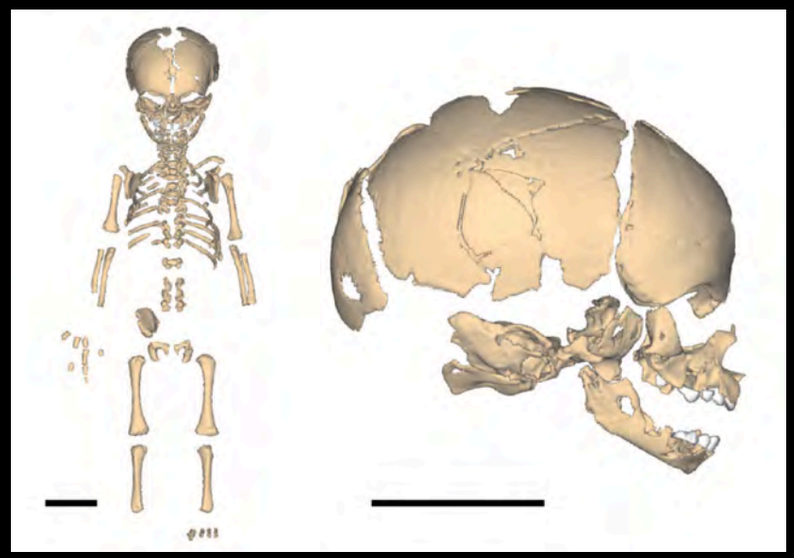
Growing Up Neanderthal

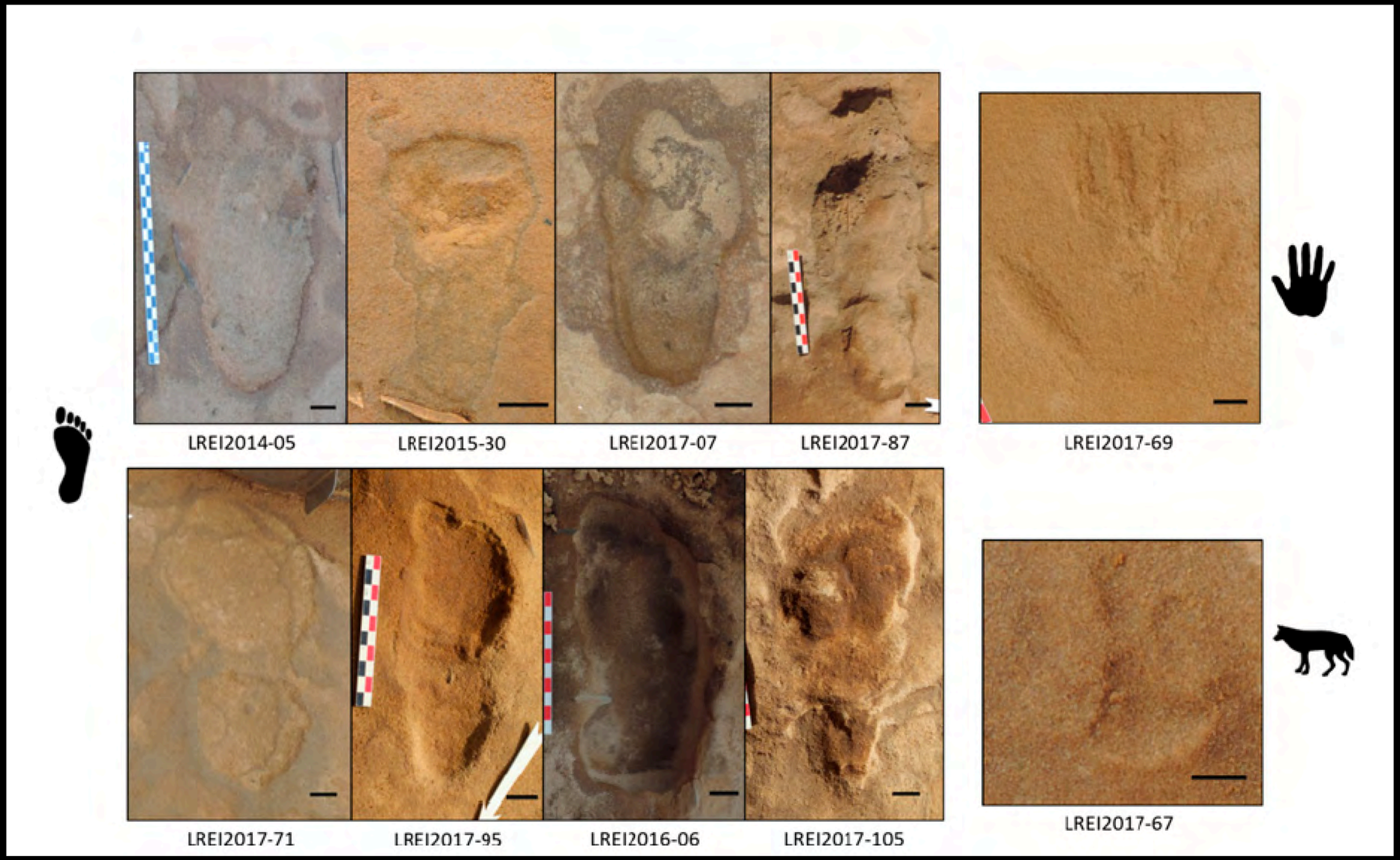


Professor Tanya M. Smith

Griffith UNIVERSITY

@DrTanyaMSmith

Last Week's News



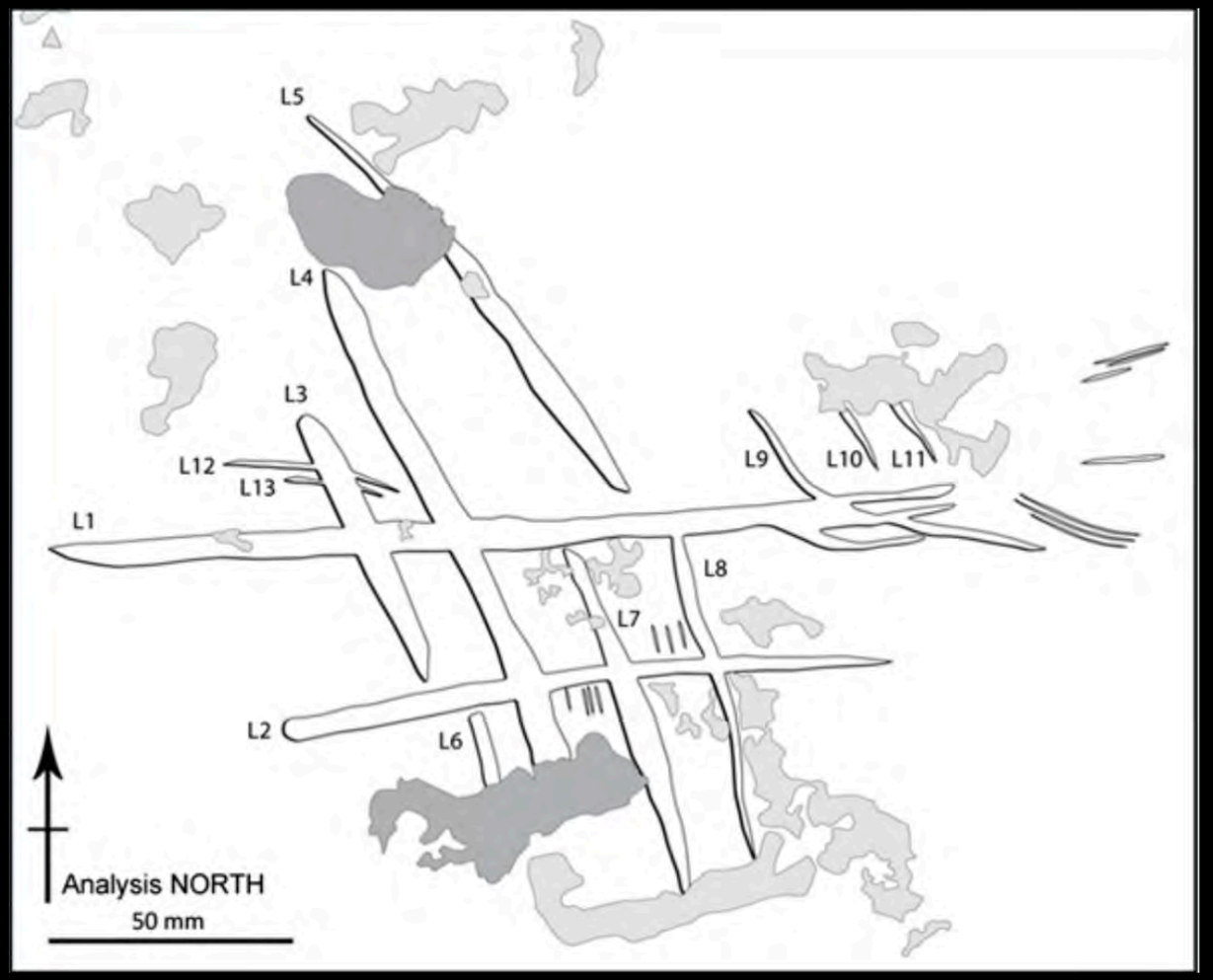
Duveau et al. 2019 *PNAS*

Last Year's News

The ladder-shaped figure on this cave wall in Spain dates back at least 65,000 years. Credit: P. Saura

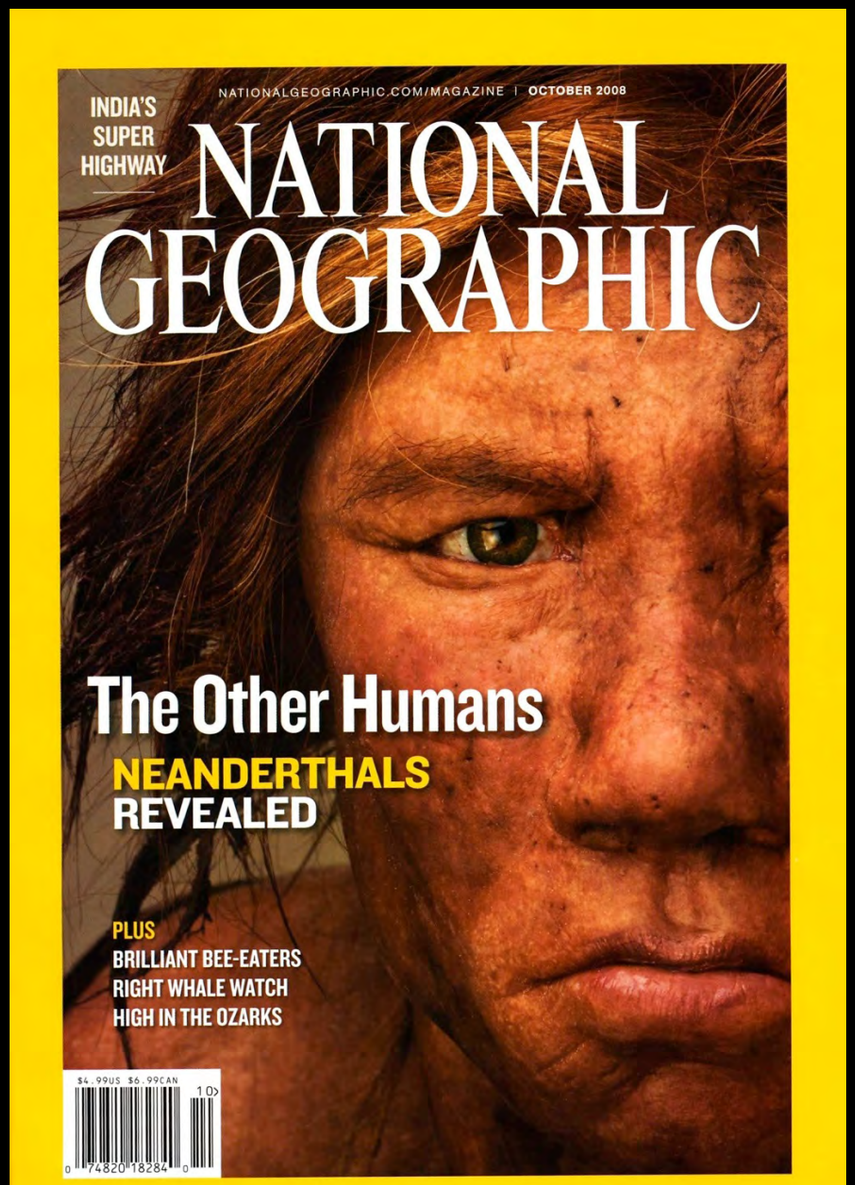
Hoffmann et al. 2018 *Science*

World’s First



Rodríguez-Vidal et al. 2014 *PNAS*


NUCLEAR WASTE
Yucca Is Dead. Now What?
CELIAC DISEASE INSIGHTS
Clues to Solving Autoimmunity
SCIENTIFIC AMERICAN
Surprises from General Relativity: "SWIMMING" IN SPACETIME
Mysteries of the Neandertals
We coexisted for thousands of years before they vanished. Here's what happened
A Way to Reduce Drug Side Effects
Could Iron Reignite Superconductors?


INDIA'S SUPER HIGHWAY
NATIONALGEOGRAPHIC.COM/MAGAZINE | OCTOBER 2008
NATIONAL GEOGRAPHIC
The Other Humans
NEANDERTHALS REVEALED
PLUS
BRILLIANT BEE-EATERS
RIGHT WHALE WATCH
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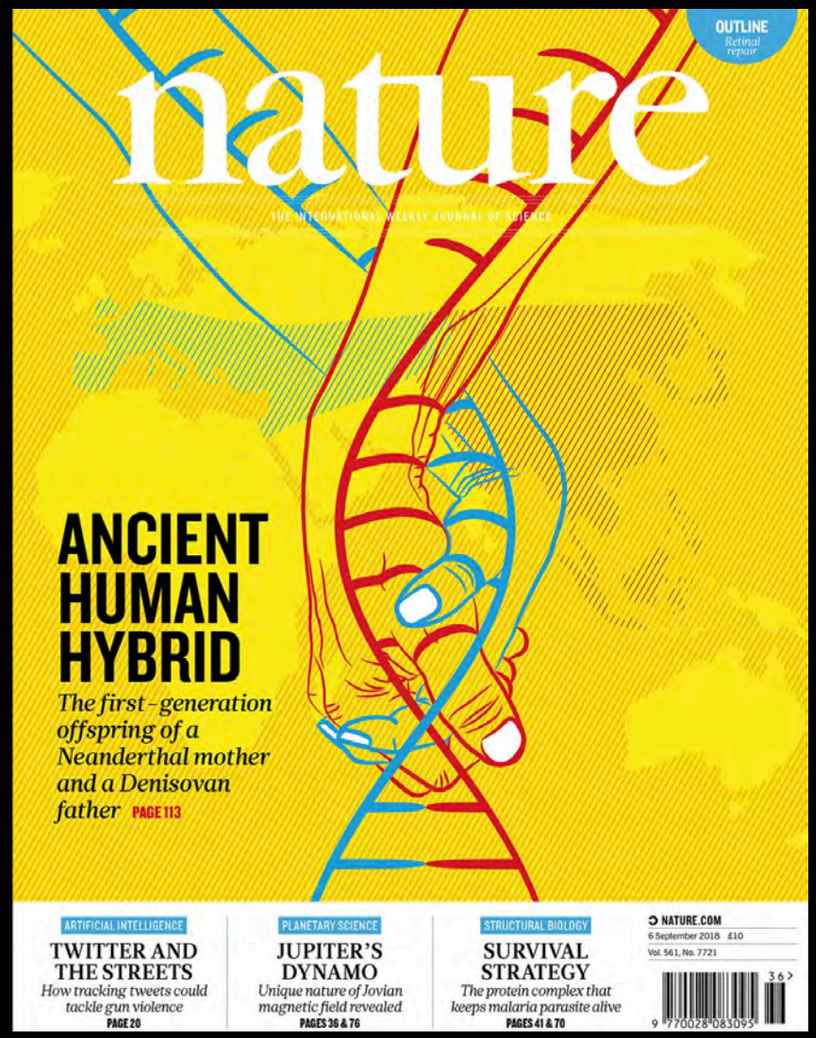
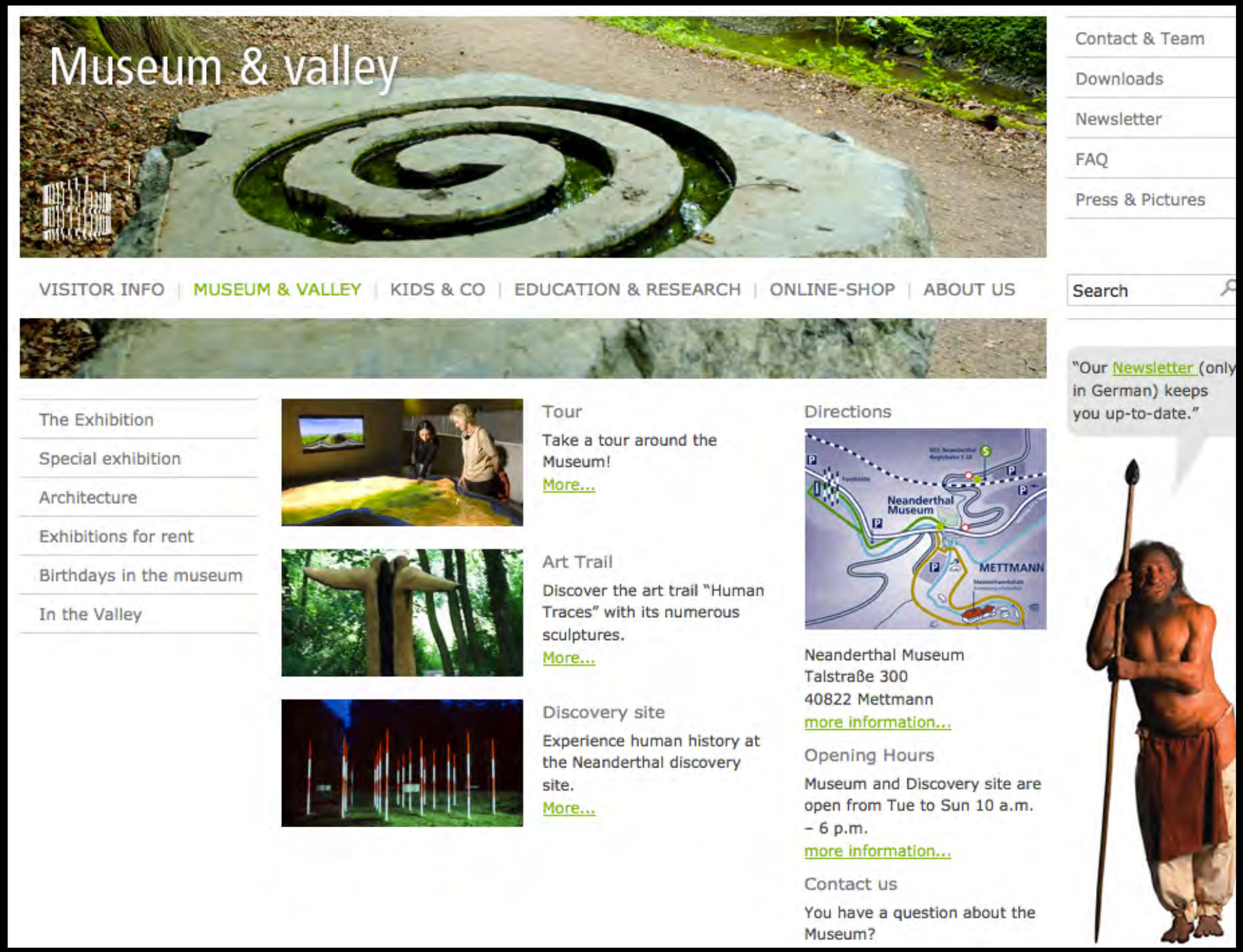

nature
THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE
OUTLINE
Retinal repair
ANCIENT HUMAN HYBRID
The first-generation offspring of a Neanderthal mother and a Denisovan father PAGE 113
ARTIFICIAL INTELLIGENCE
TWITTER AND THE STREETS
How tracking tweets could tackle gun violence
PAGE 20
PLANETARY SCIENCE
JUPITER'S DYNAMO
Unique nature of Jovian magnetic field revealed
PAGES 36 & 76
STRUCTURAL BIOLOGY
SURVIVAL STRATEGY
The protein complex that keeps malaria parasite alive
PAGES 41 & 70
NATURE.COM
6 September 2018 £10
Vol. 561, No. 7721

Who Were the Neanderthals?

-thal or -tal ??

- 1856 Feldhofer Grotto find in Neander Valley (Germany)
- 1863 called *Neanderthal Man:* Joachim Neander + Thal (Valley)
- German modernization dropped use of “h” in “Tal,” but Latin name given in 1864 retains “h” *Homo neanderthalensis*

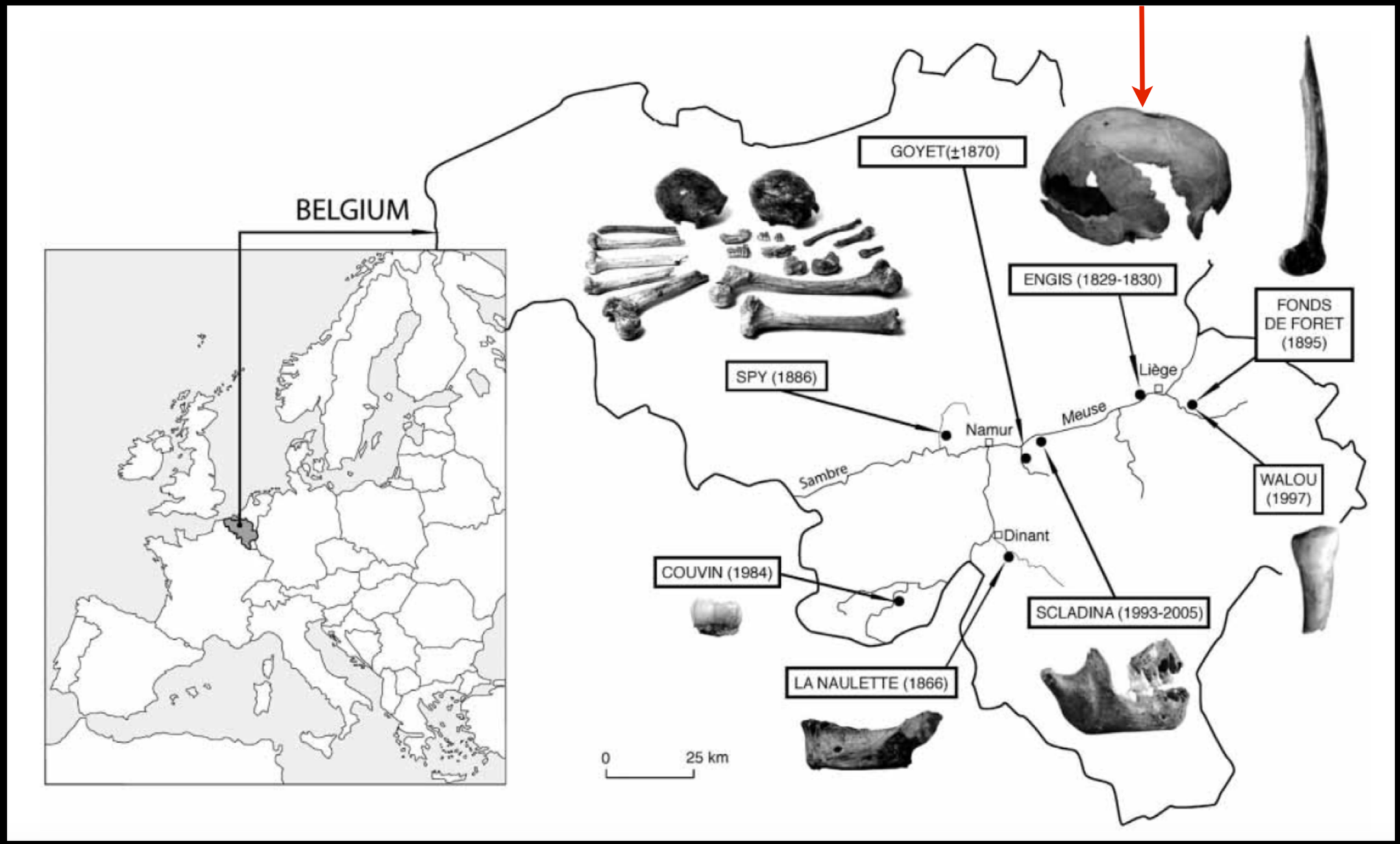
Heading to Germany?



https://www.neanderthal.de/en/home.html

First Hominin Discovery

Engis (1829-1830)



Toussaint & Pirson 2006 *Period Biol*

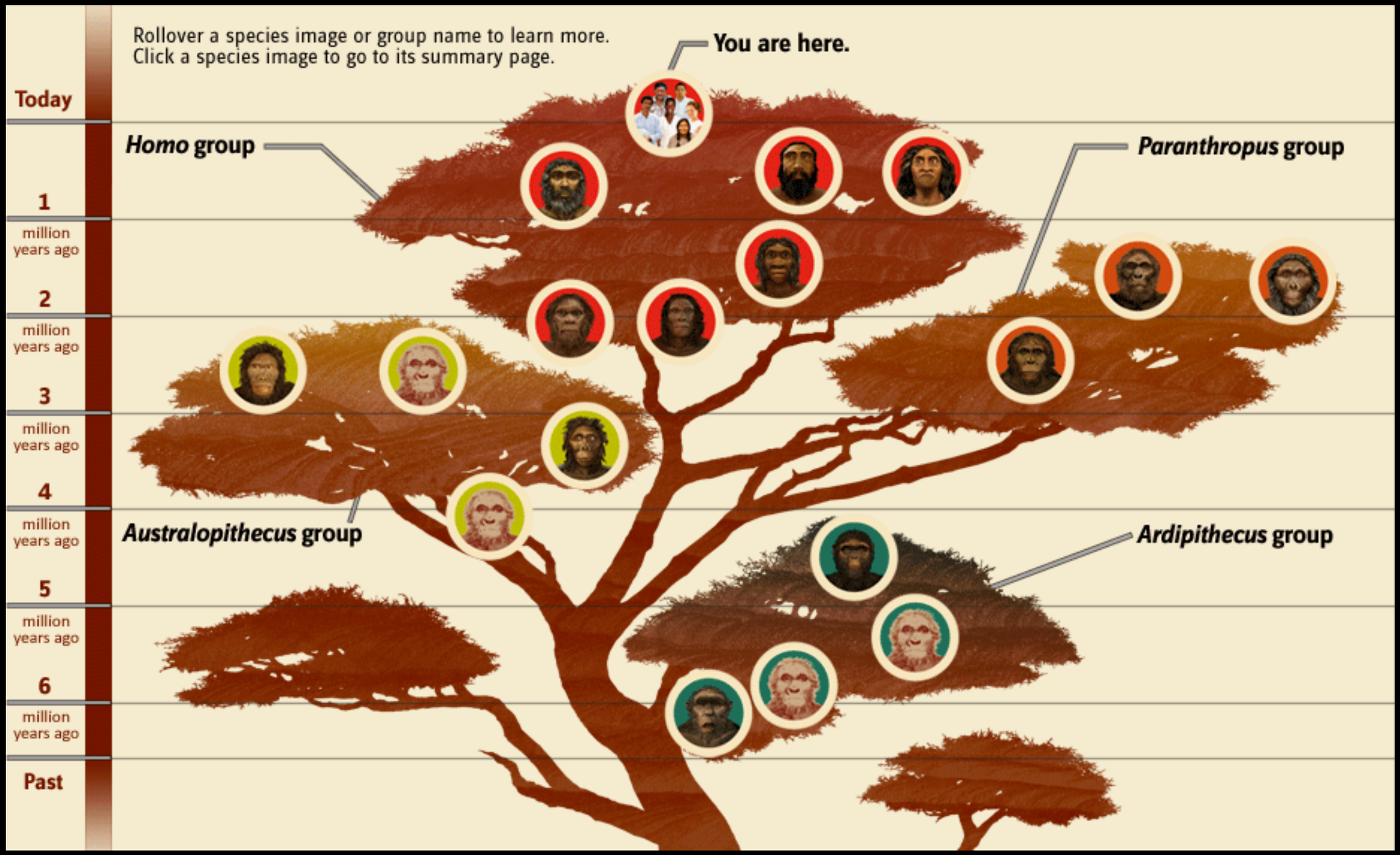
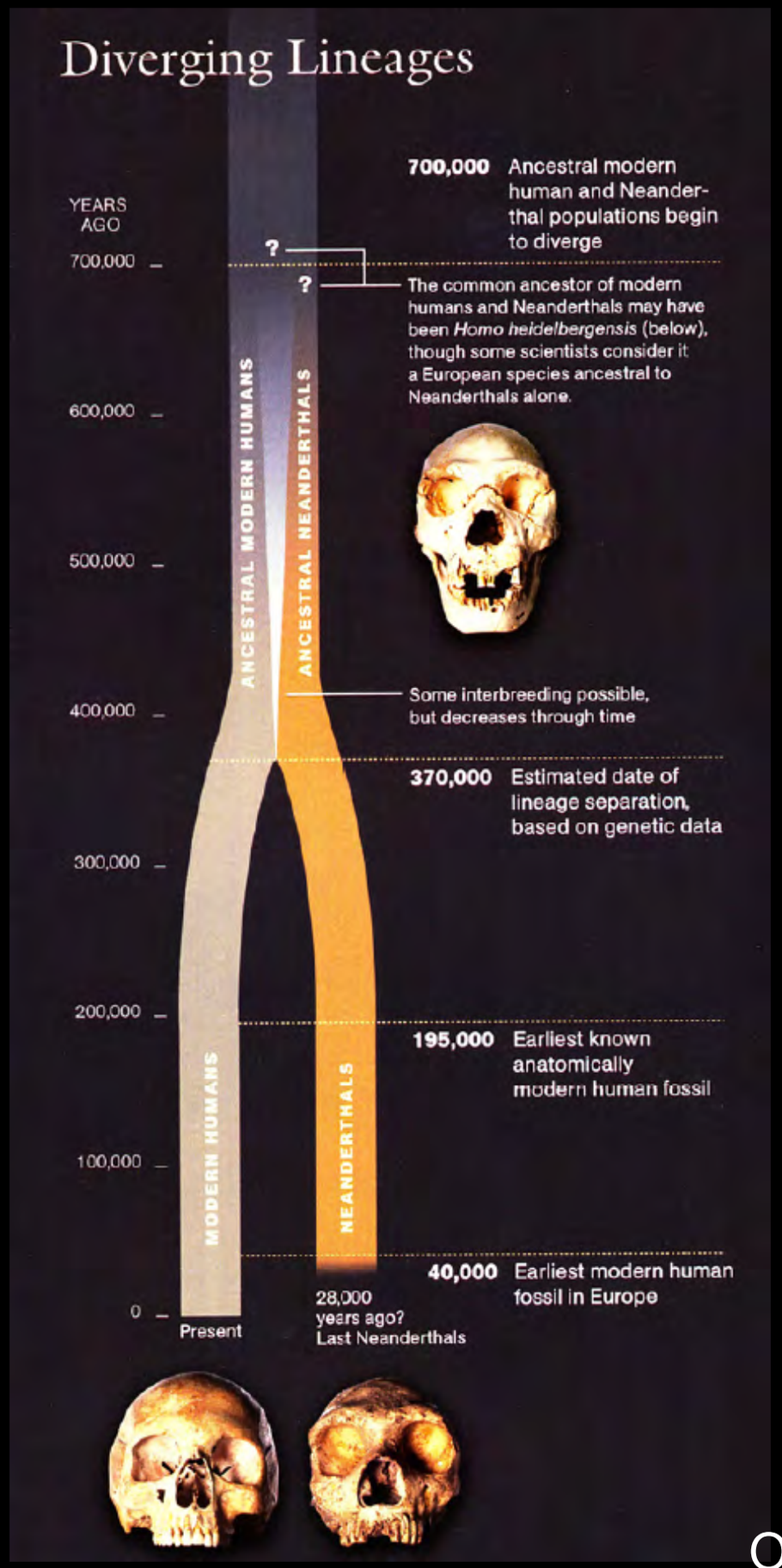
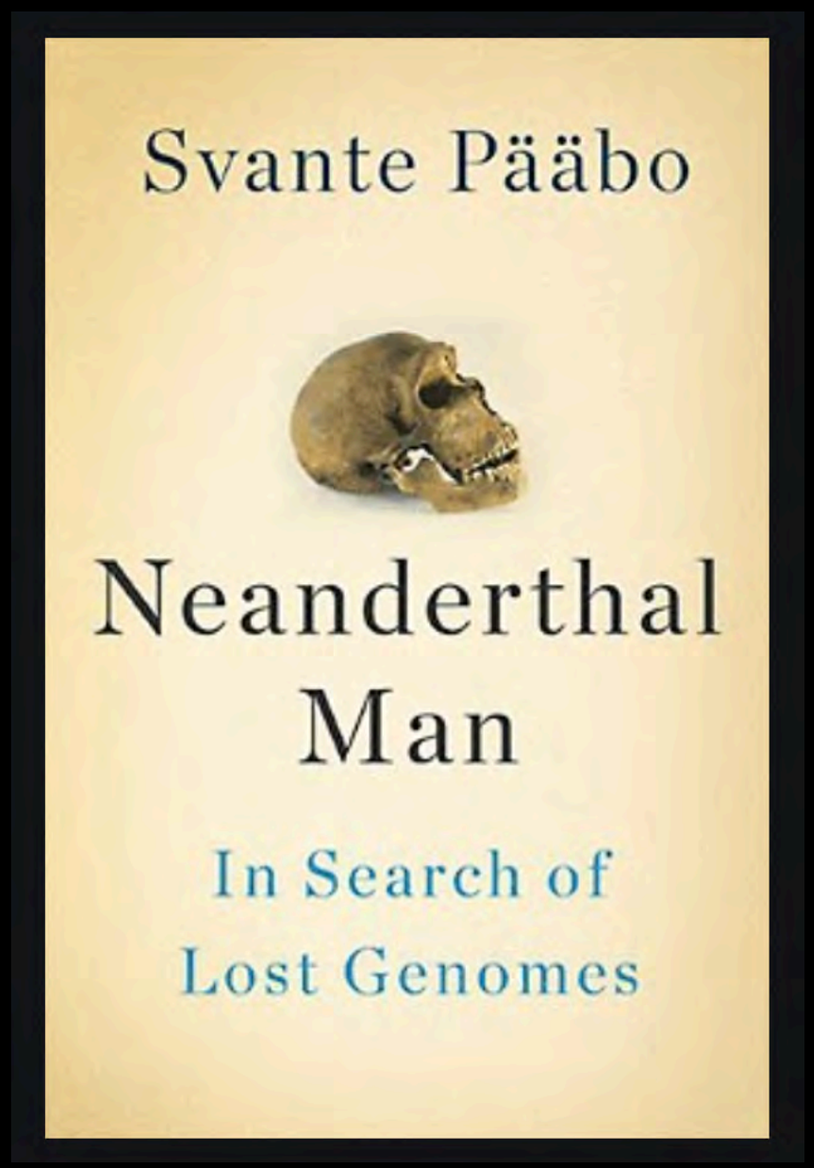


Image credit: Smithsonian Institution

Diverging Lineages



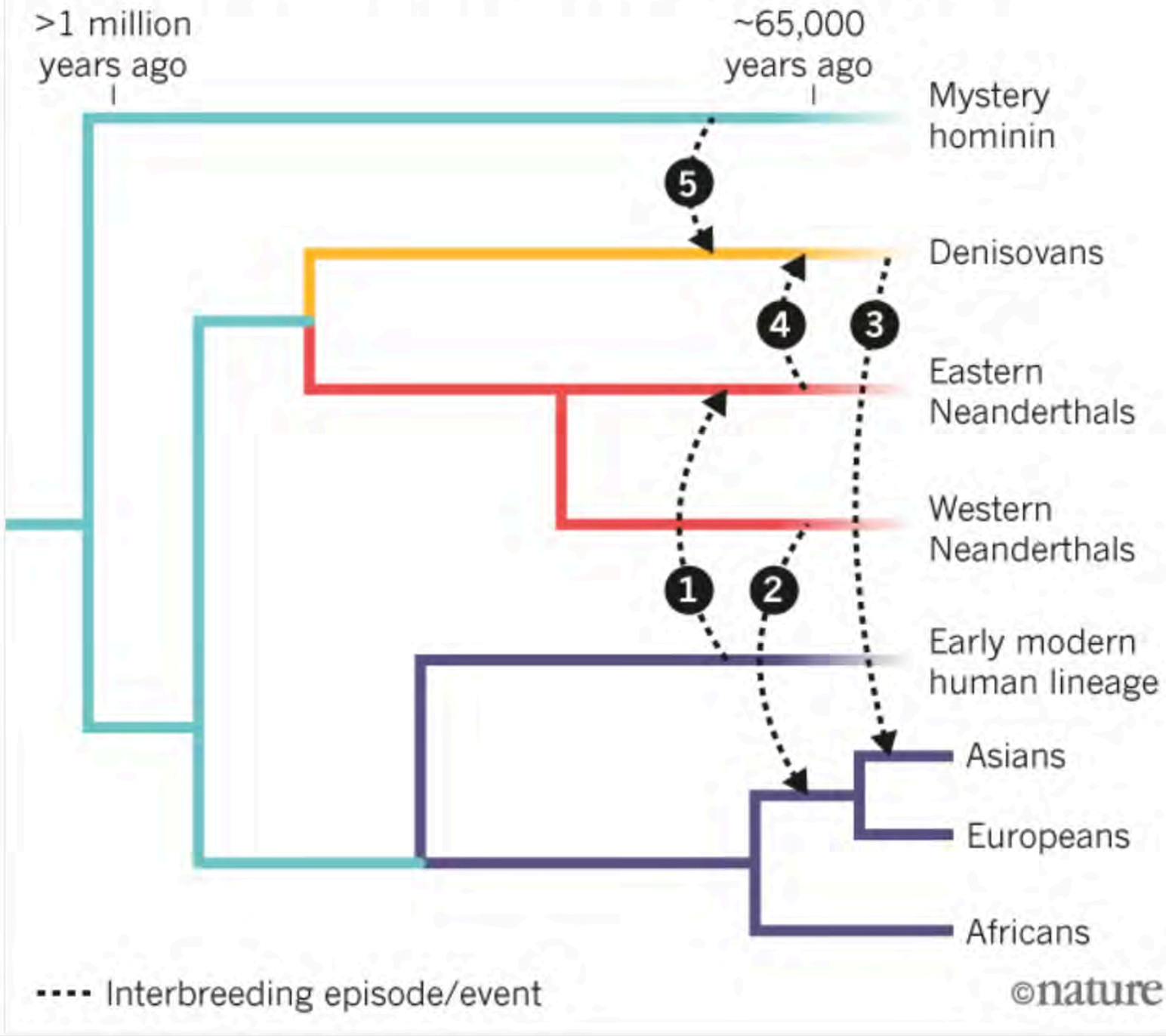
Oct 2008 *National Geographic*



Oct 2008 *National Geographic*

A HISTORY OF INTERBREEDING

Early modern humans, Denisovans, and Neanderthals all interbred with each other on multiple occasions in the past 100,000 years.



Feb 2016 *Nature* News

An Evolving Conceptualization

The ‘evolution’ of Neanderthals over the last 100 years says more about us

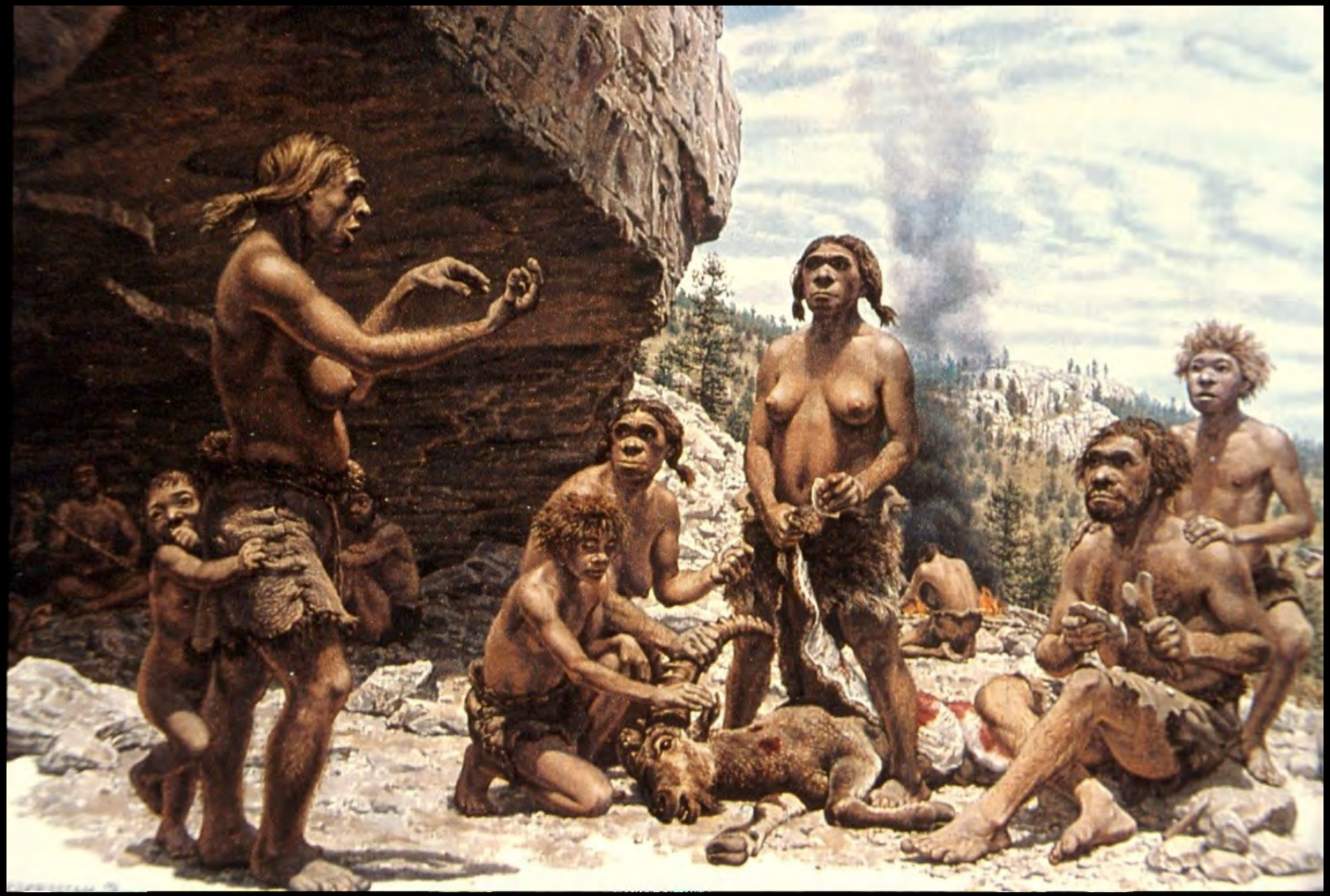
by Lee Rimmer for Ancestry - Genealogy & DNA

Share on Facebook

The dramatic change in our perception of the Neanderthals as a species since the discovery of their remains in the Neander Valley in 1856 is reflected in the following timeline of images.

http://www.abroadintheyard.com/evolution-of-neanderthals-over-last-100-years-says-more-about-us/

Historic Views



Robust Bodies Adapted to the Cold

MODERN HUMAN FEMALE

NEANDERTHAL SKELETON

Neanderthal skulls were long and low, but held brains slightly larger on average than those of living humans.

Wide bodies conserved heat in cold climates, while large, conical rib cages housed big lungs needed for high levels of activity.

Sturdy, heavily muscled limb bones evolved in response to a demanding lifestyle.

Large muscles positioned to maximize leverage resulted in exceptional strength.

Short limbs helped reduce surface area to retain body heat.

RECONSTRUCTION

The female Neanderthal illustrated in this story was created by assembling casts of fossil bones from several individuals, including rescaled male specimens.

- SPY 1 (BELGIUM)
- GIBRALTAR (U.K.)
- LA FERRASSIE 1 (FRANCE)
- KEBARA 2 (ISRAEL)
- TABUN 1 (ISRAEL) THE PELVIS PORTION ON THE LEFT WAS CREATED BY MIRRORING THE EXISTING FOSSIL ON THE RIGHT
- FELDHOFER 1 (NEANDER VALLEY, GERMANY)
- LA CHAPELLE-AUX-SAINTS (FRANCE)
- RECONSTRUCTED FROM MODERN HUMANS

DAILY CALORIC NEEDS

2,200 cal/day

** USDA recommendation for female of average size (5'4" tall, 138 pounds) who engages in light-to-moderate activity*

4,034 cal/day

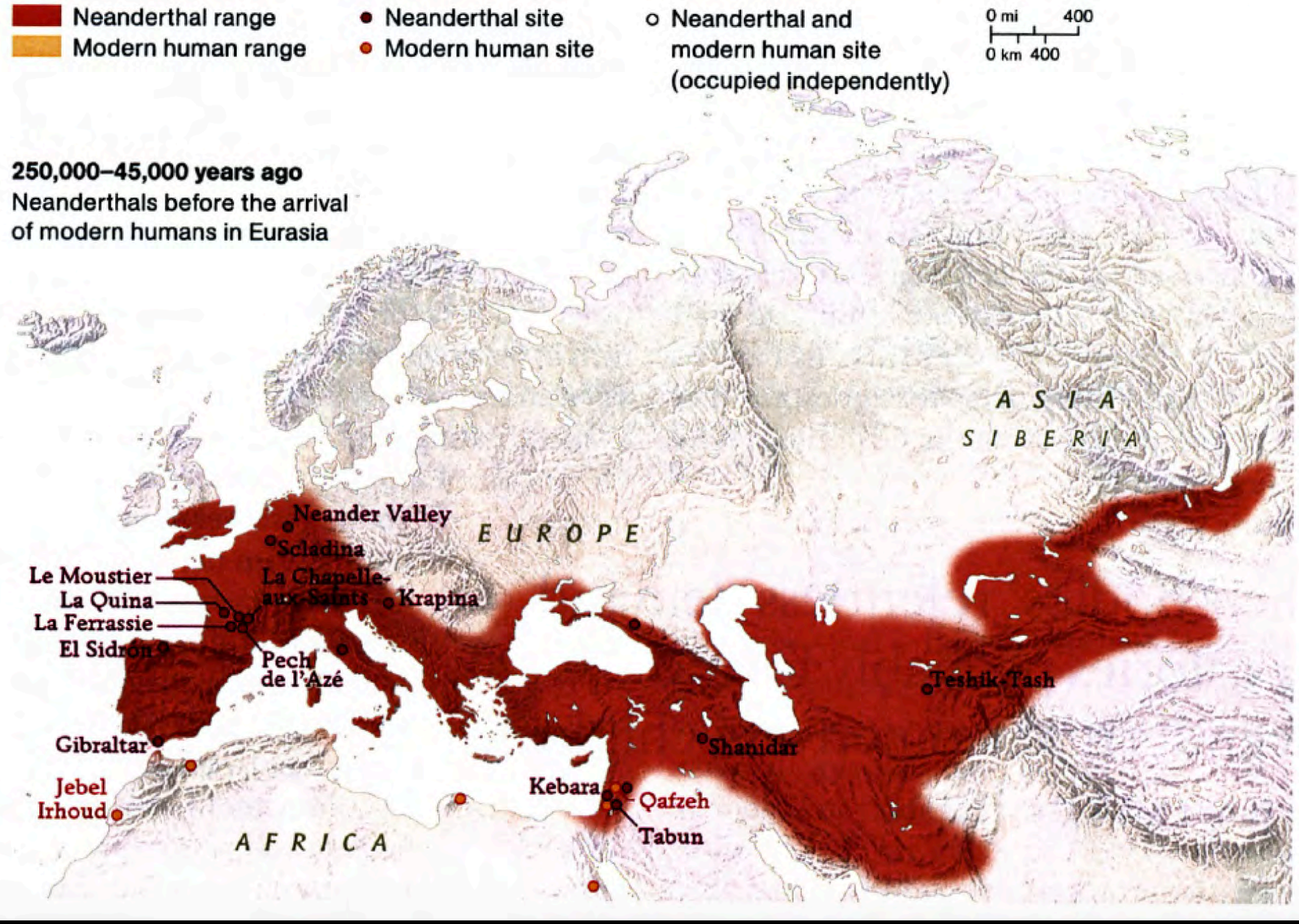
** Neanderthal female of average size (5'2" tall, 146 pounds)*

Oct 2008 *National Geographic*

Image credit: Philipp Gunz

Rise and Fall of Neanderthals

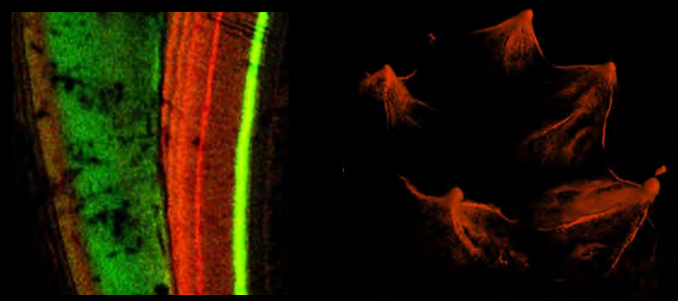
Recent genetic evidence reveals that Neanderthals occupied a wider swath of territory than previously thought, settling as far east as Siberia (top). Some 45,000 years ago, anatomically modern humans from Africa migrated into Eurasia (bottom). Climate swings and competition with the newcomers may have combined to push Neanderthals into a few outposts before they went extinct.



Oct 2008 *National Geographic*

Neanderthal Development

- Nearly 100 years ago argued to be faster than modern humans
- Life stages linked in primates, thus shorter childhood means early reproduction and shorter lifespan
- Childhood is a key time for cognitive and behavioural development

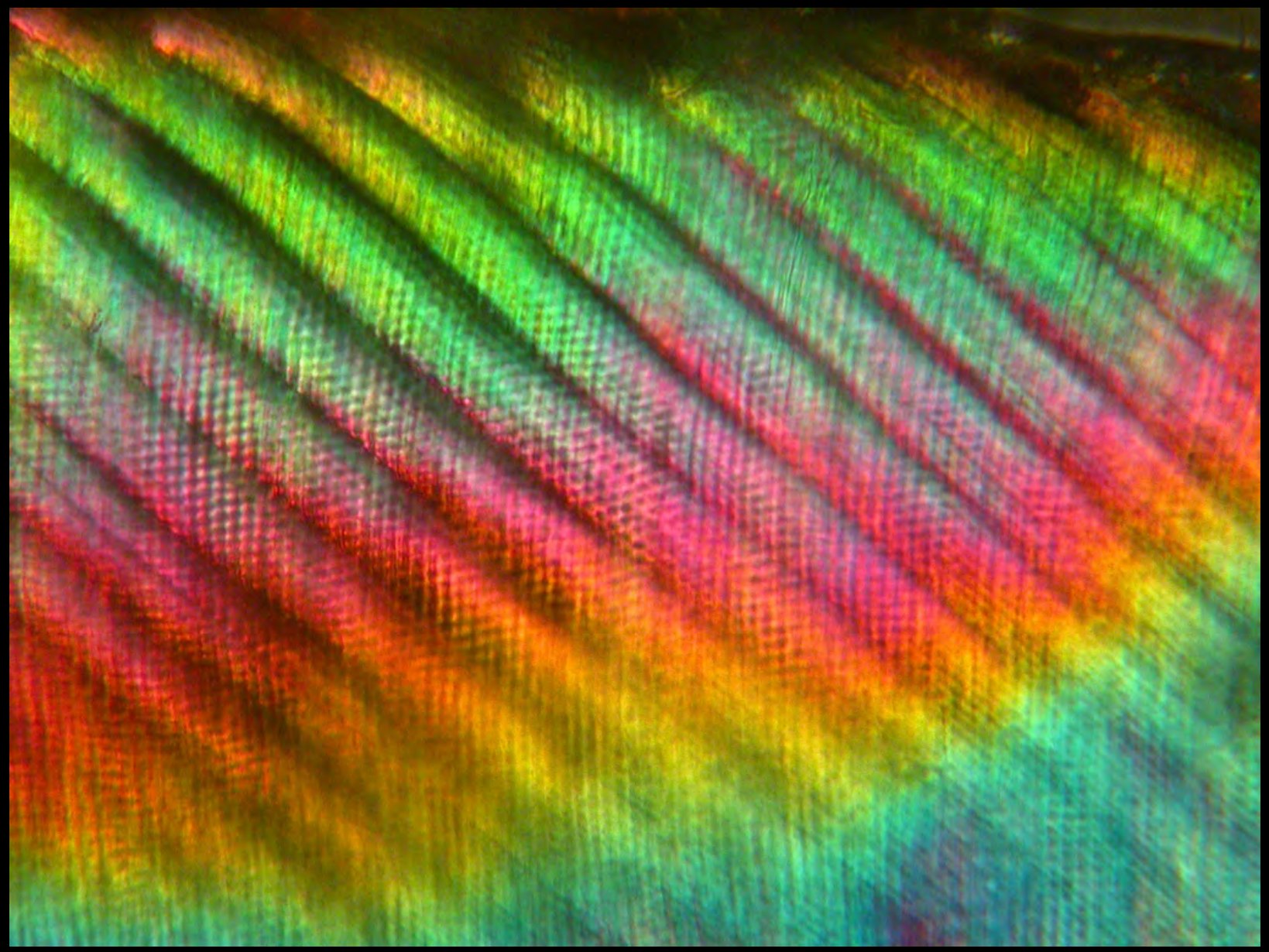


Development

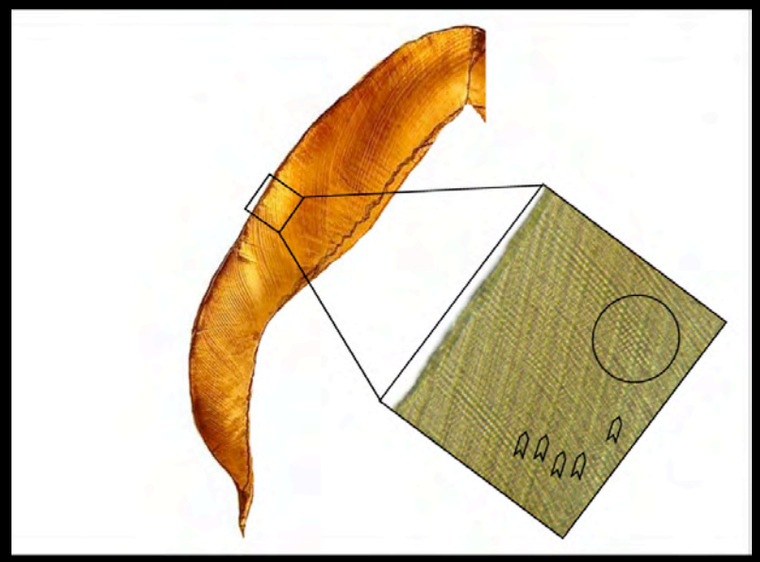
Behaviour

Evolution

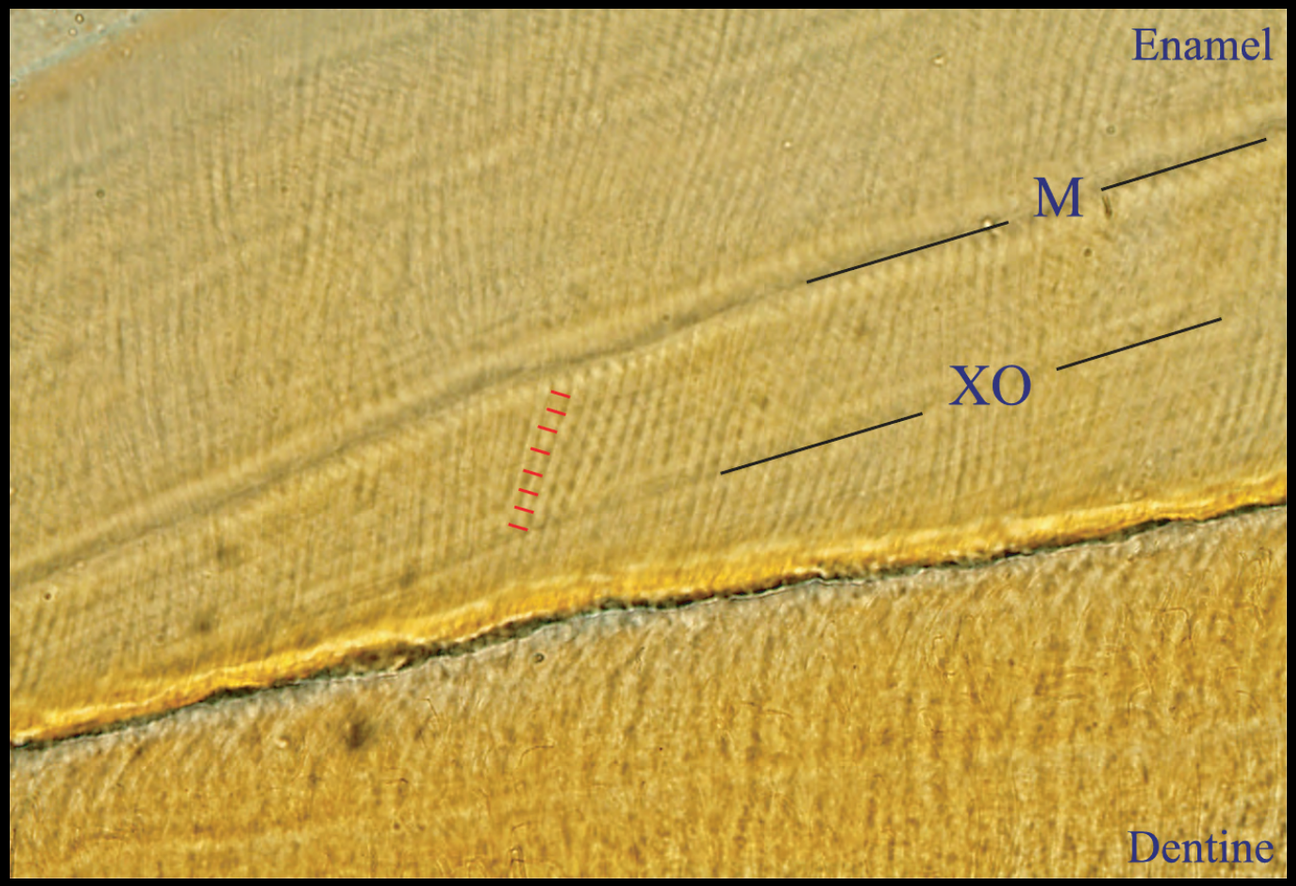
Teeth Have Tiny Time Lines!

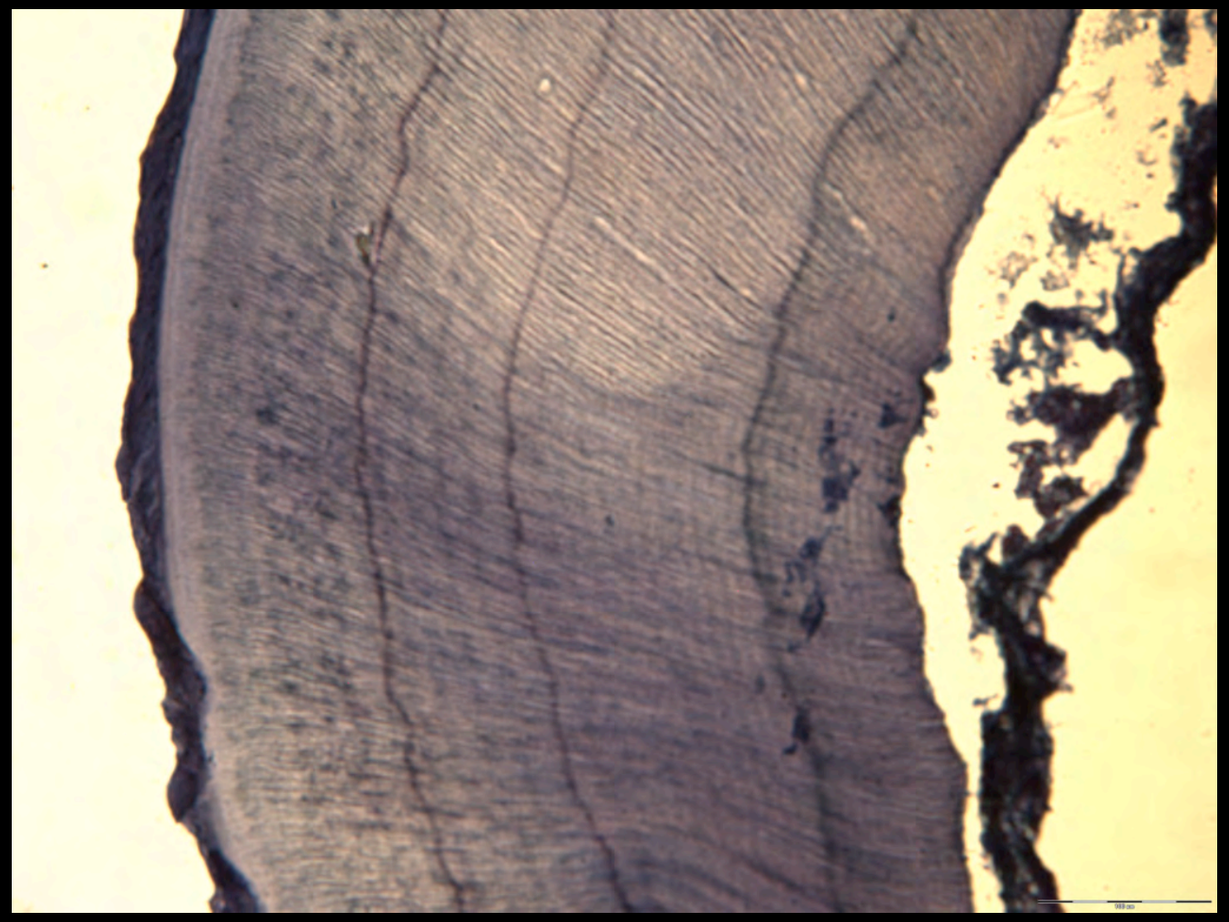


Smith 2018 *Tales Teeth Tell*



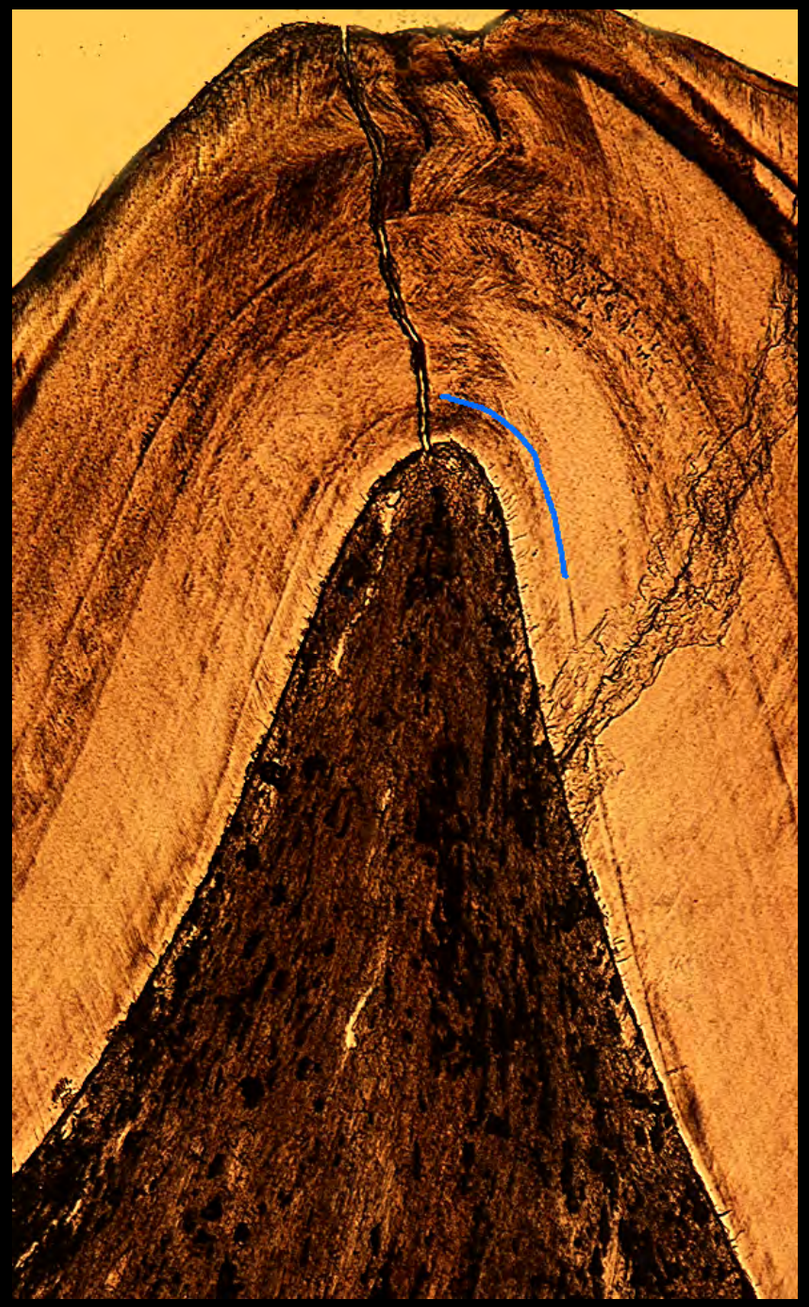
Smith & Tafforeau 2008 *Ev Anthro*

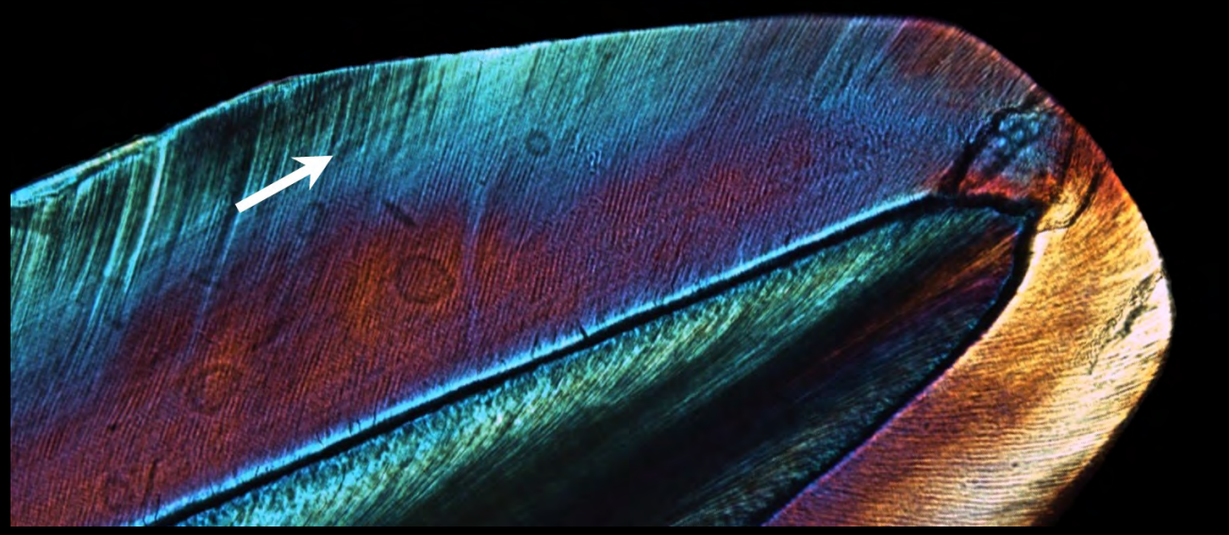




Smith 2006 *J Anat*; Papakyrikos in prep *J Anat*

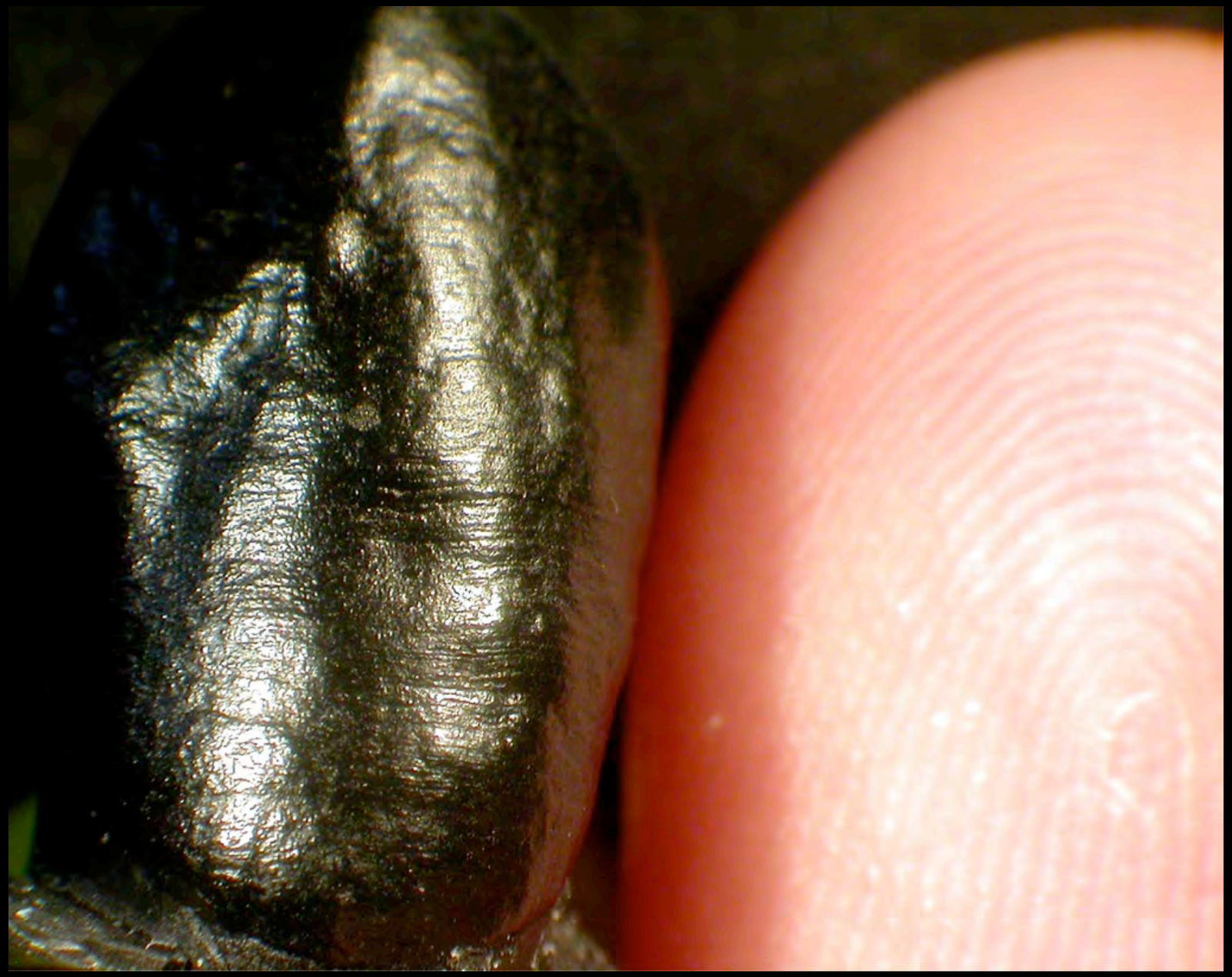
Birth Records!



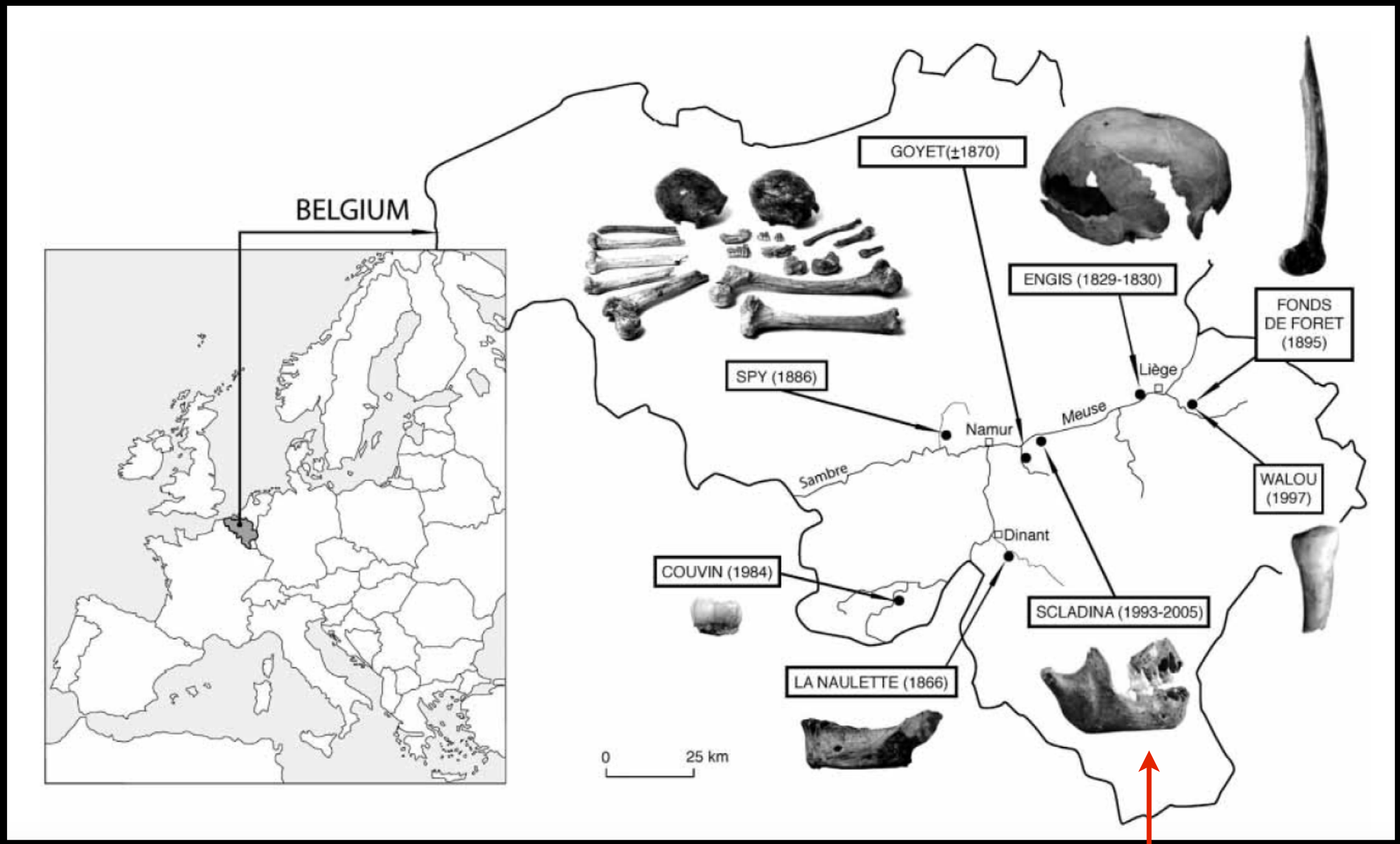


Smith 2018 *Tales Teeth Tell*

A Boon For Dental Detectives



Another Belgian Discovery

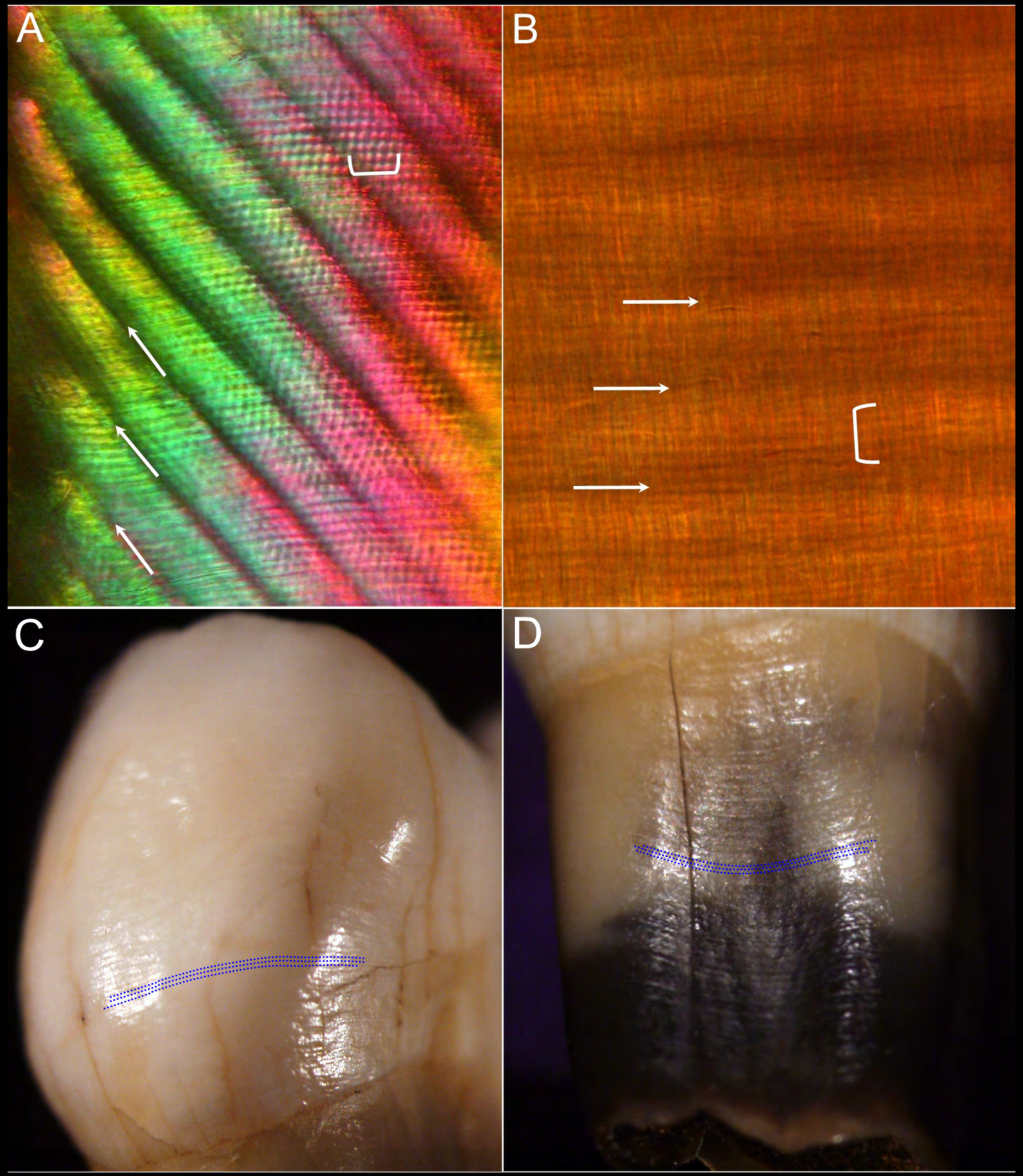


Scladina (1993-2005)

Toussaint & Pirson 2006 *Period Biol*

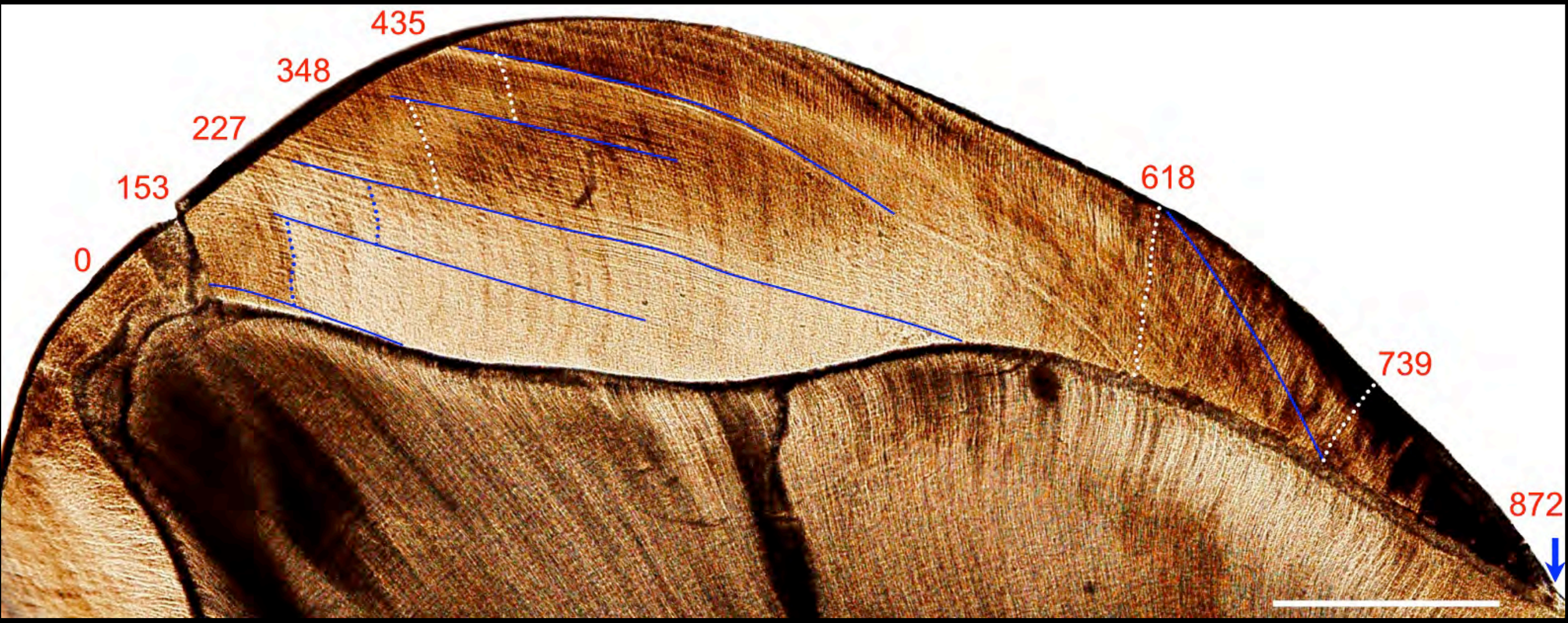
The Tale of the Scladina Child


OLYMPUS

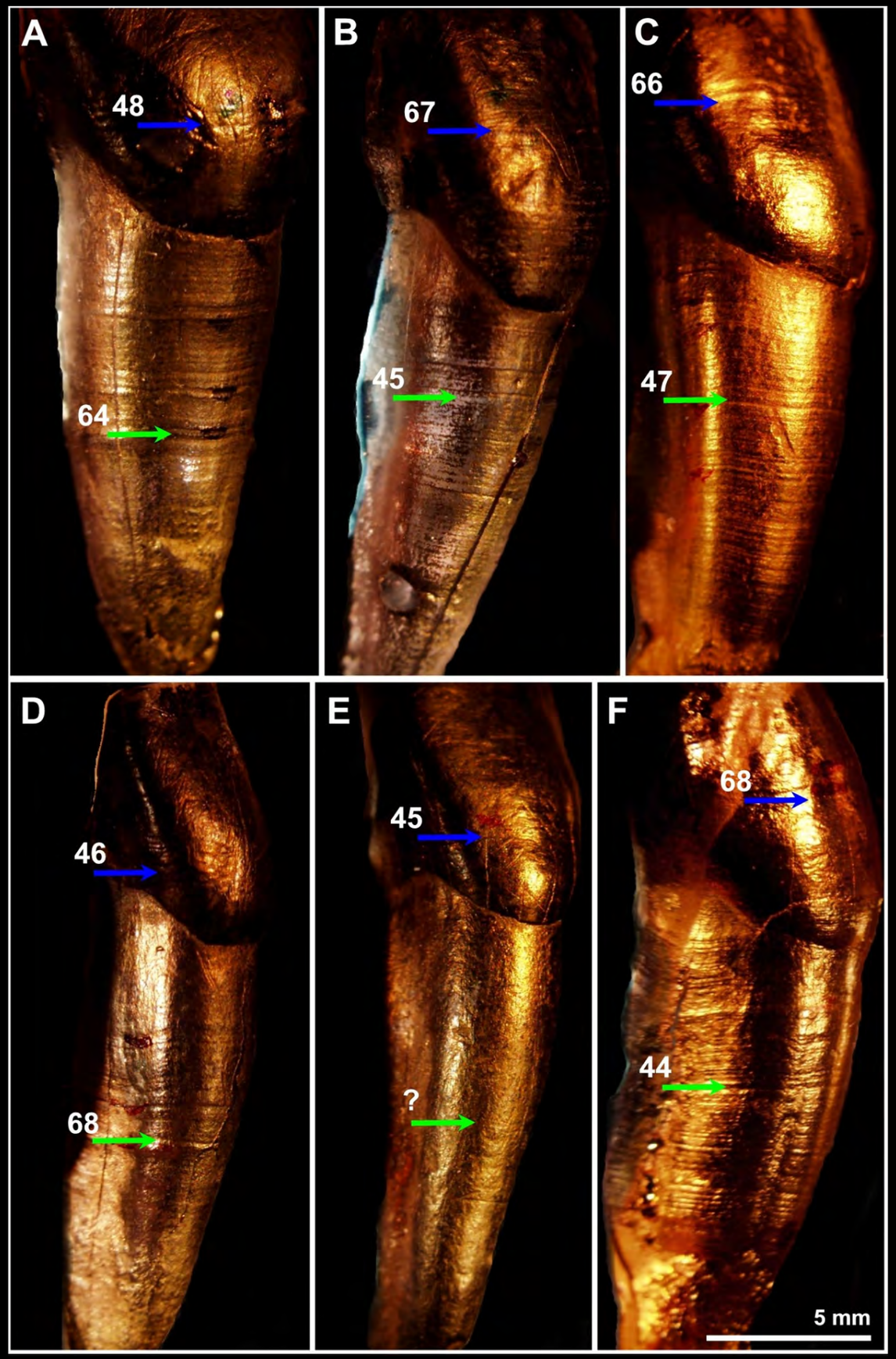


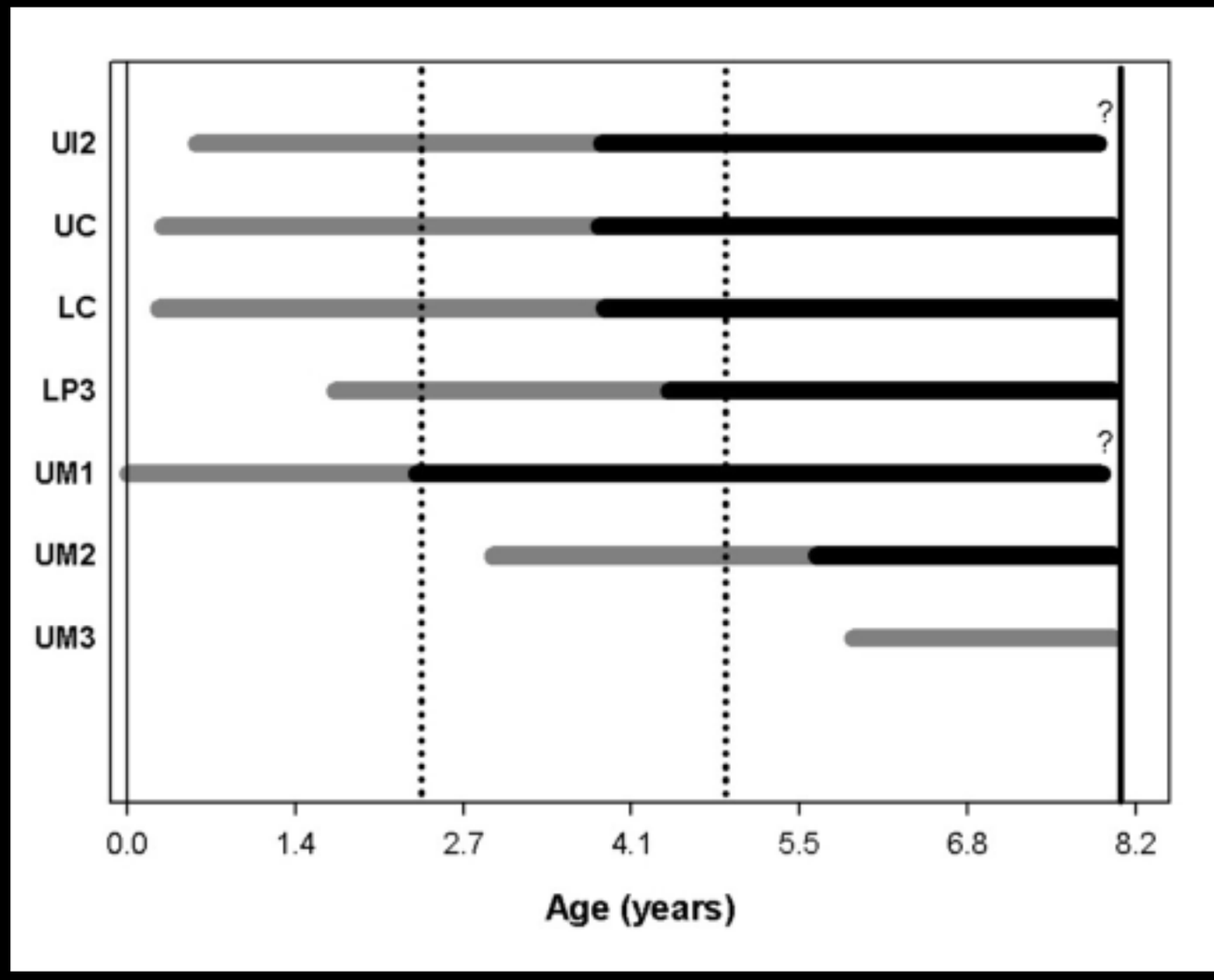
Smith &
Tafforeau 2008
Ev Anthro

Mapping Infancy



Marked developmental stress @ 1.2 & 2.4 years





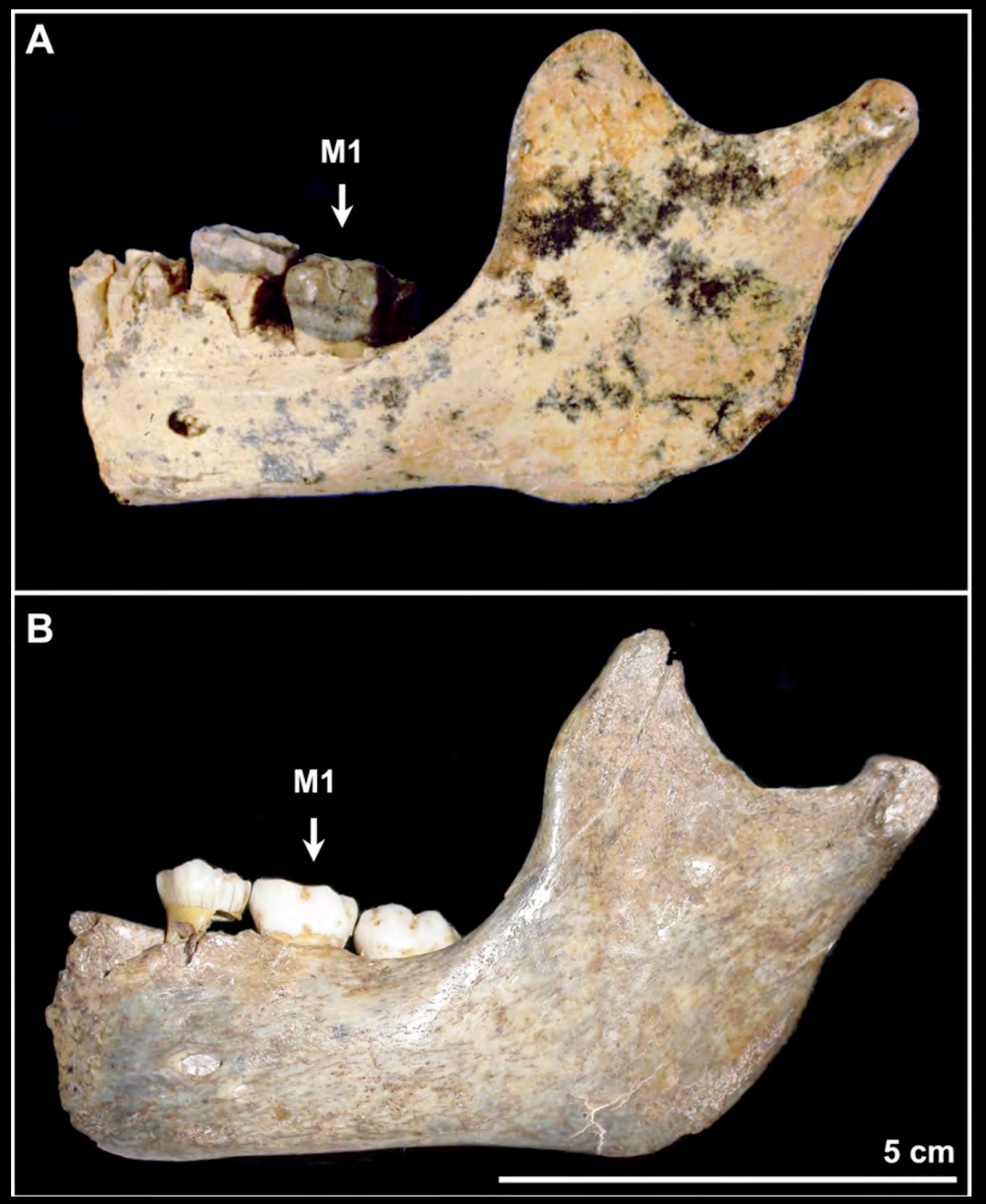
Age at death: 8.0 years

Development Variation

H. sapiens (top) age: 7.8 years

Scladina (bottom) age: 8.0 years

Advanced dental development in the juvenile Neanderthal



Smith et al. 2007a,b *PNAS*

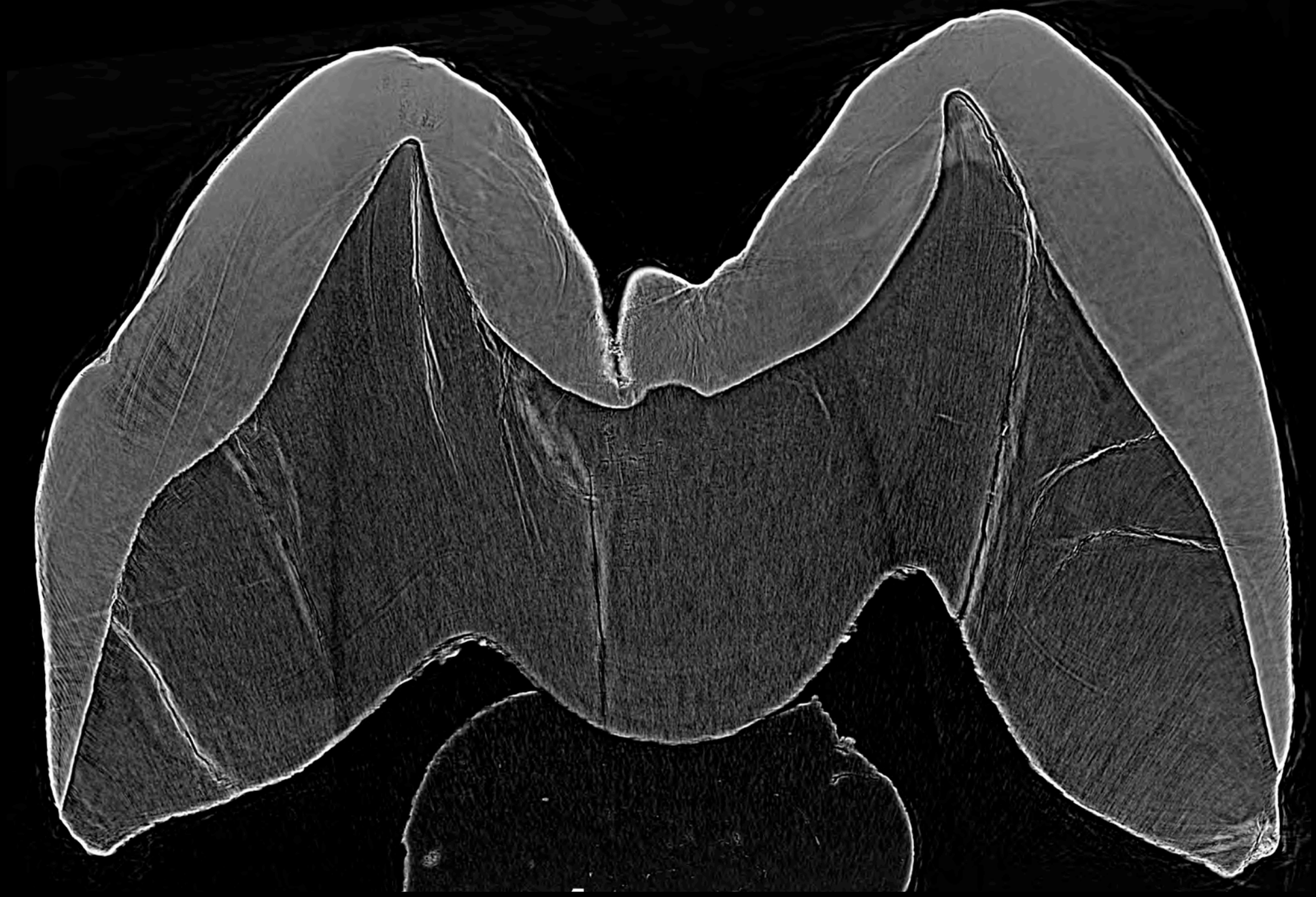
Not Unique

Smith et al. 2010 *PNAS*

Url of Video:

https://www.youtube.com/watch?v=Ni3PTAfp0-s&t=9s

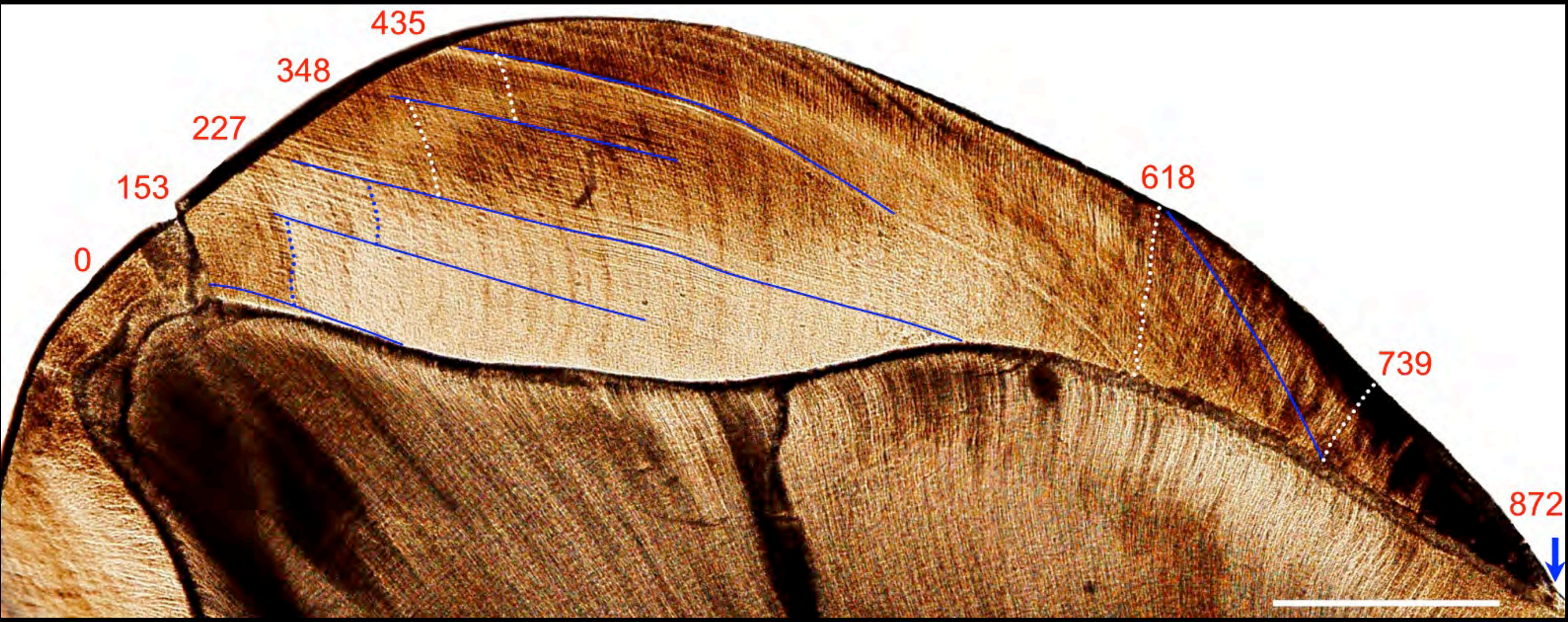
First Hominin Discovery



Engis’ age at death: 3.0 years old

Smith et al. 2010 *PNAS*

Back to Scladina…



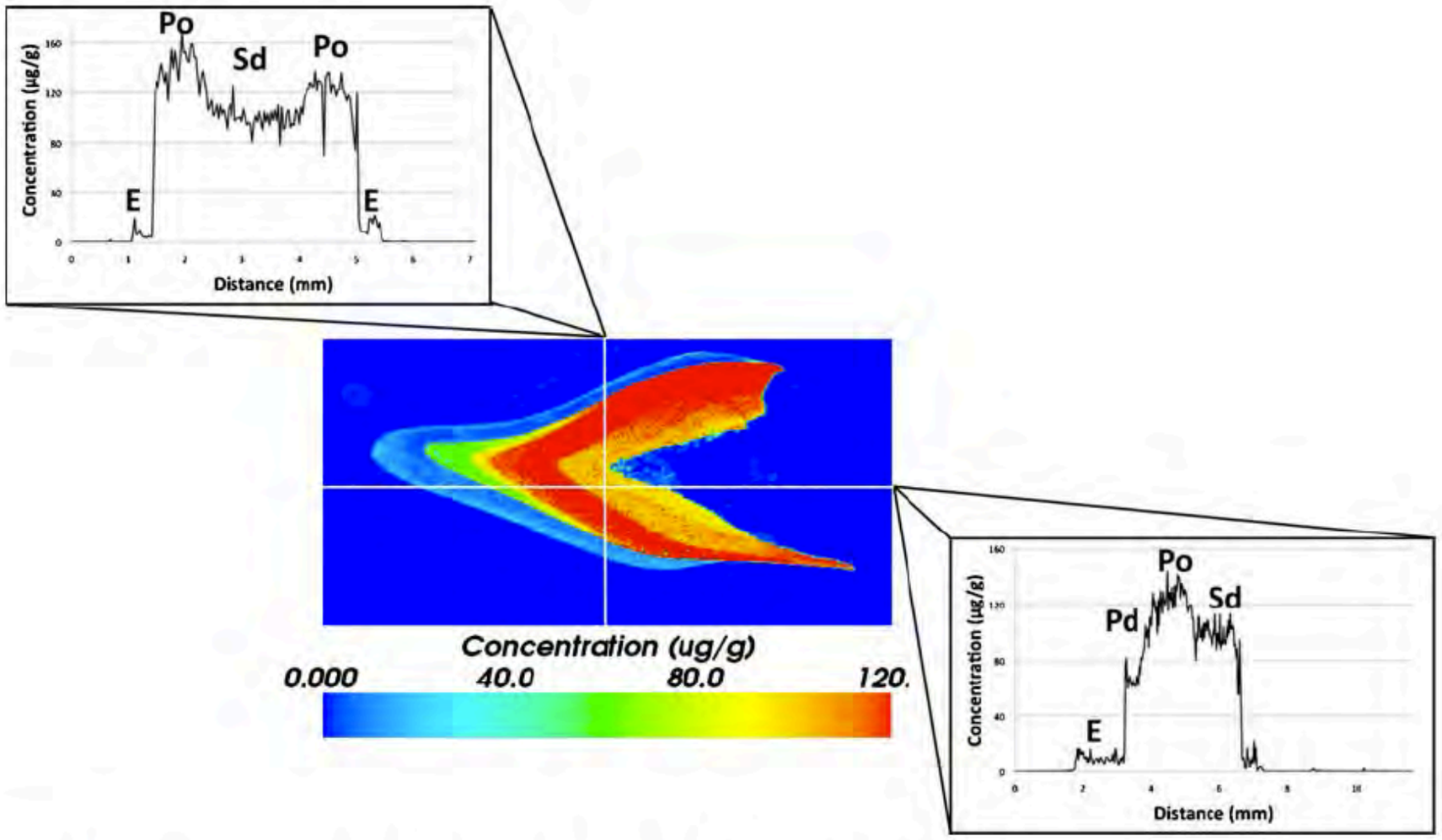
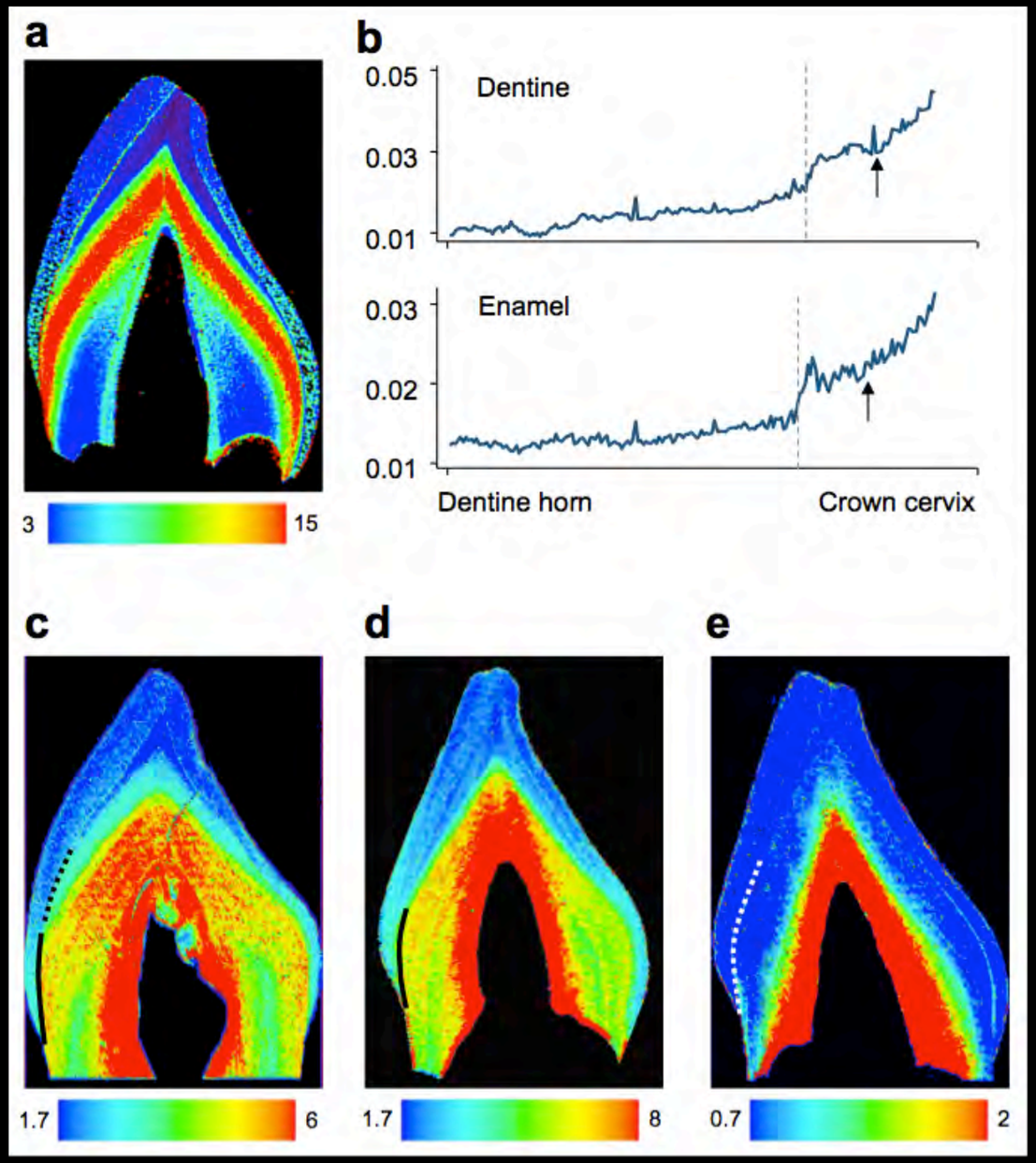


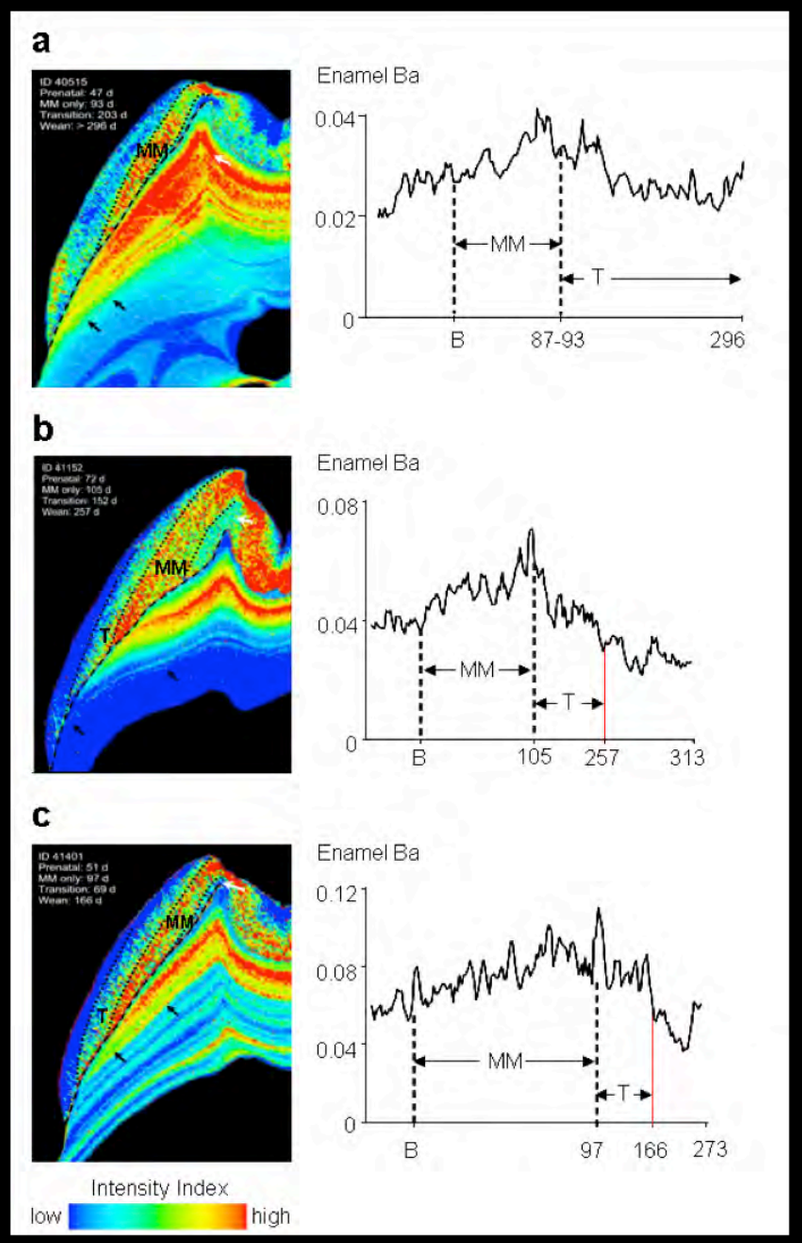
Fig. 1 – Two-dimensional concentration vs distance plots for horizontal and vertical lines in ^{88}Sr image. Enamel (E), prenatal dentine (Pd), postnatal dentine (Po) and secondary dentine (Sd) are shown on the horizontal and vertical line plots.

Teeth rasterized with laser to produce ~30 micron voxels representing elemental compositions

Hare et al. 2011 *J Dent*

Methodological Validation (Barium)



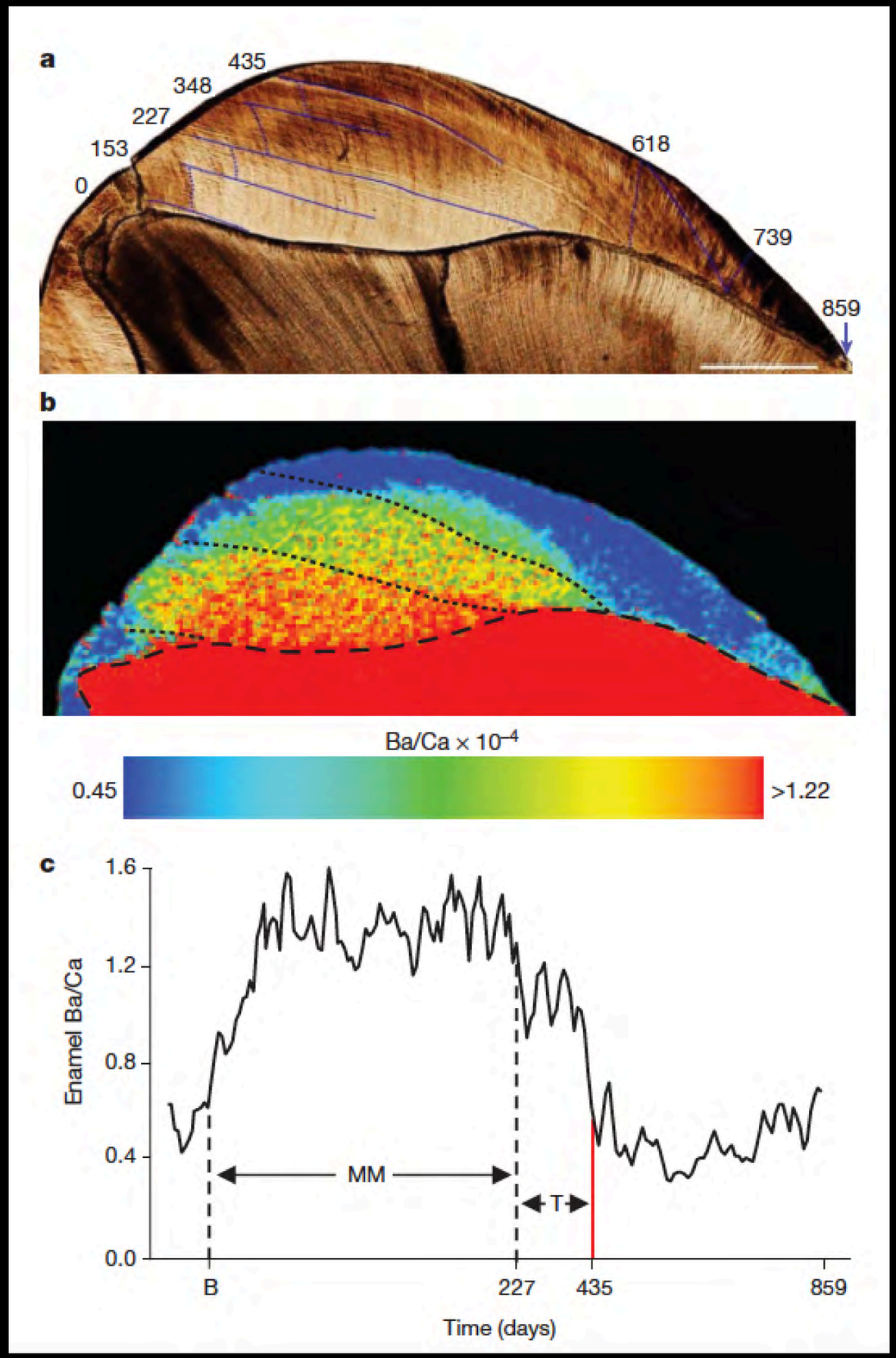


Austin et al. 2013 *Nature*

Neanderthal elemental and temporal maps show:

prenatal zone (13 d)
exclusive milk (227 d)
transition (208 d)
and return to baseline prenatal levels at 1.2 years of age

Pattern fits that of abrupt weaning transition



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journal homepage: http://www.elsevier.com/locate/jas

Extraction and sequencing of human and Neanderthal mature enamel proteins using MALDI-TOF/TOF MS

Christina M. Nielsen-Marsh [a], Christin Stegemann [b], Ralf Hoffmann [b], Tanya Smith [a,c], Robin Feeney [a], Michel Toussaint [d], Katerina Harvati [a], Eleni Panagopoulou [e], Jean-Jacques Hublin [a], Michael P. Richards [a,f,*]

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[b] Institute of Bioanalytical Chemistry, Center for Biotechnology and Biomedicine, Leipzig University, Deutscher Platz 5, 04103 Leipzig, Germany
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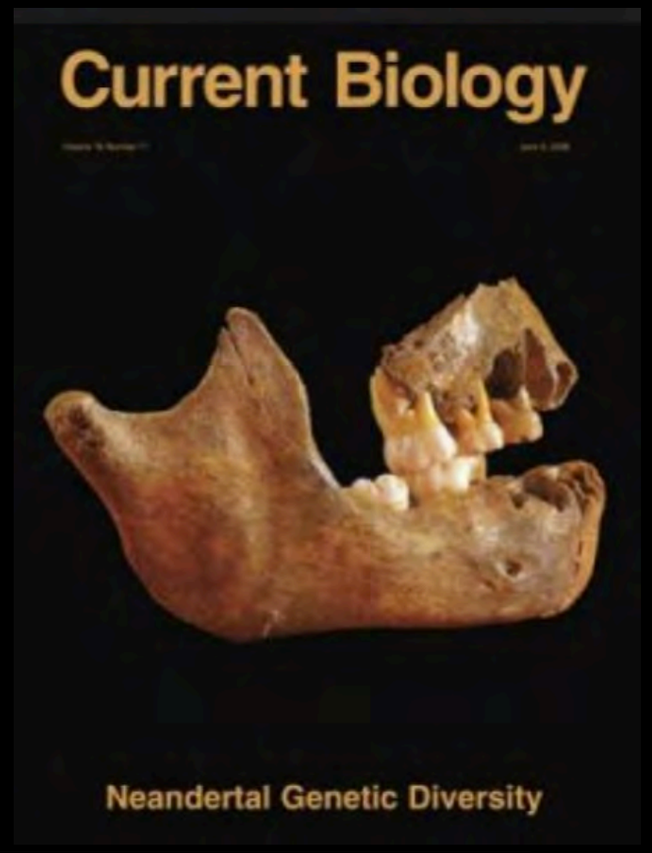


SCIENCE ADVANCES | RESEARCH ARTICLE

EVOLUTIONARY BIOLOGY

Nuclear DNA from two early Neandertals reveals 80,000 years of genetic continuity in Europe

Stéphane Peyrégne[1]*, Viviane Slon[1], Fabrizio Mafessoni[1], Cesare de Filippo[1], Mateja Hajdinjak[1], Sarah Nagel[1], Birgit Nickel[1], Elena Essel[1], Adeline Le Cabec[2], Kurt Wehrberger[3], Nicholas J. Conard[4], Claus Joachim Kind[5], Cosimo Posth[6], Johannes Krause[6], Grégory Abrams[7], Dominique Bonjean[7], Kévin Di Modica[7], Michel Toussaint[8], Janet Kelso[1], Matthias Meyer[1], Svante Pääbo[1], Kay Prüfer[1,6]*

Little is known about the population history of Neandertals over the hundreds of thousands of years of their existence. We retrieved nuclear genomic sequences from two Neandertals, one from Hohlenstein-Stadel Cave in Germany and the other from Scladina Cave in Belgium, who lived around 120,000 years ago. Despite the deeply divergent mitochondrial lineage present in the former individual, both Neandertals are genetically closer to later Neandertals from Europe than to a roughly contemporaneous individual from Siberia. That the Hohlenstein-Stadel and Scladina individuals lived around the time of their most recent common ancestor with later Neandertals suggests that all later Neandertals trace at least part of their ancestry back to these early European Neandertals.

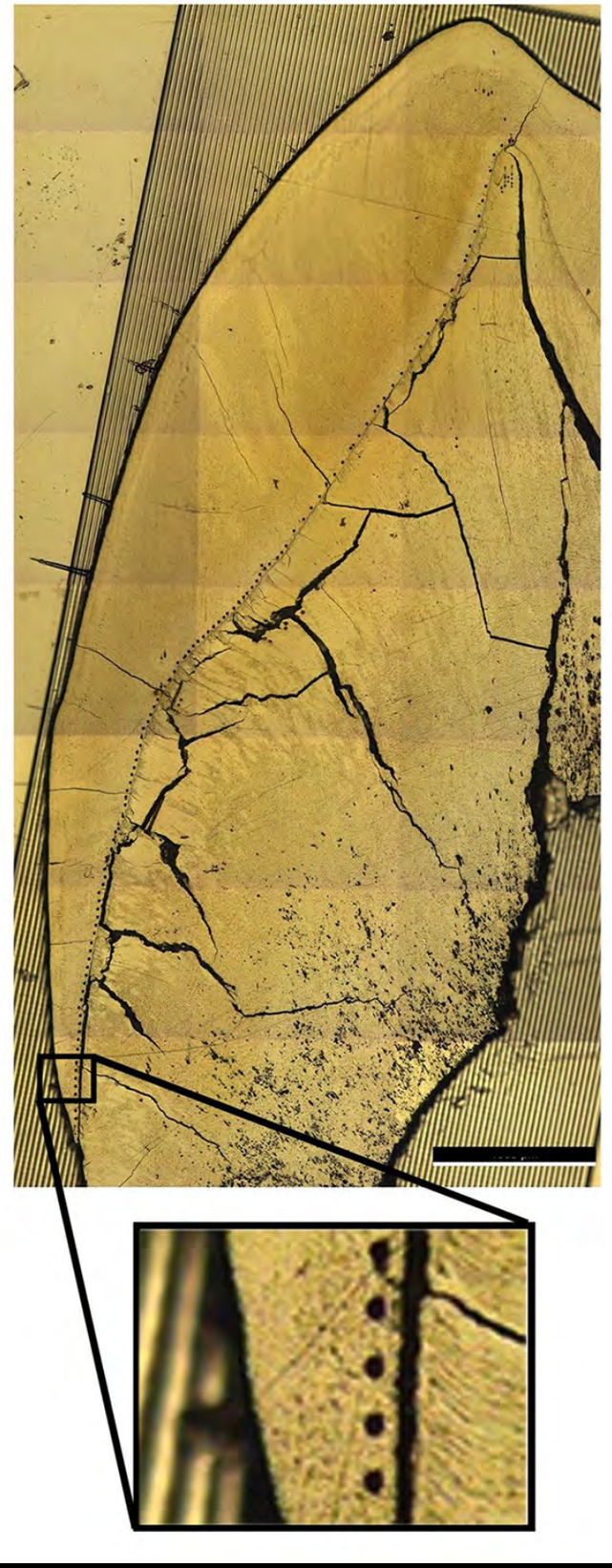
One Last Childhood Tale

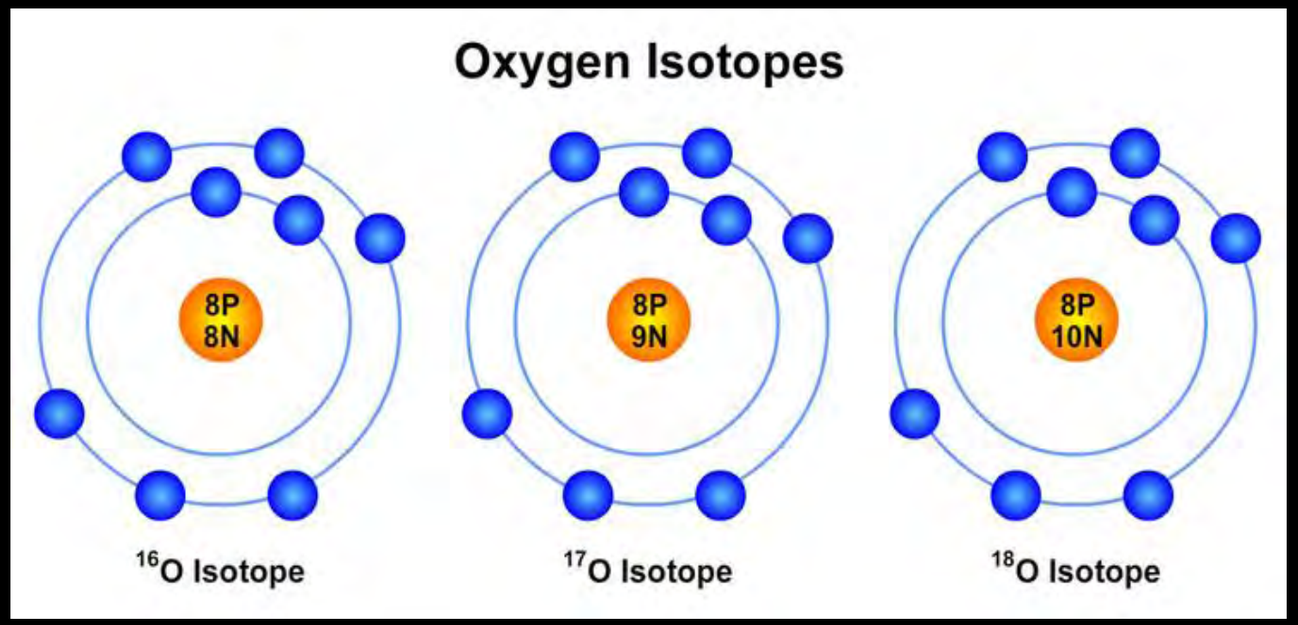
Climate Records!

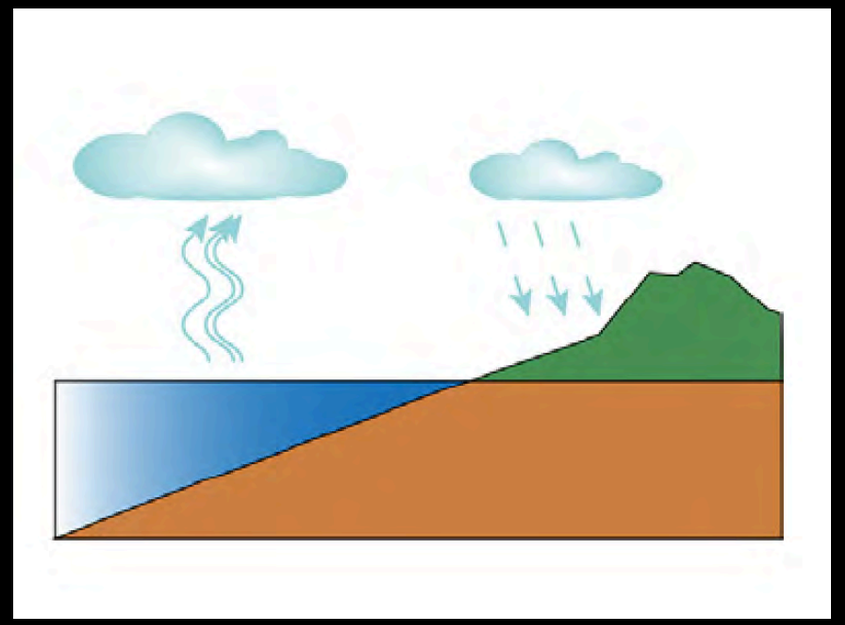
Two Neanderthal (250 kya) and one modern human (5 kya) molar from France were sectioned and temporally mapped

Two mass spectrometry methods used to quantify oxygen isotopes and trace element distributions

Sensitive High Resolution Ion Microprobe (SHRIMP)





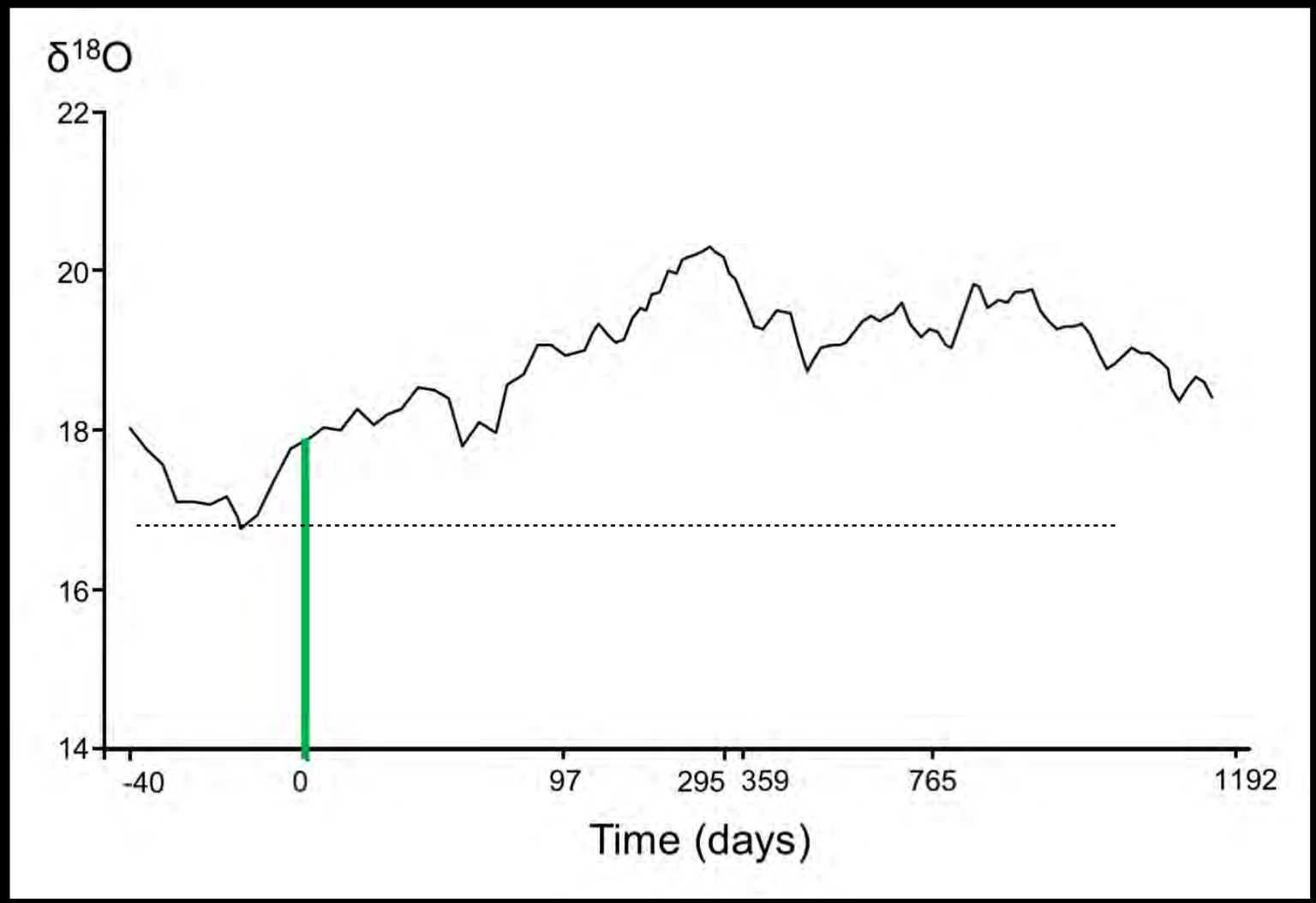


- ^{18}O is heavier than ^{16}O because it contains two additional neutrons

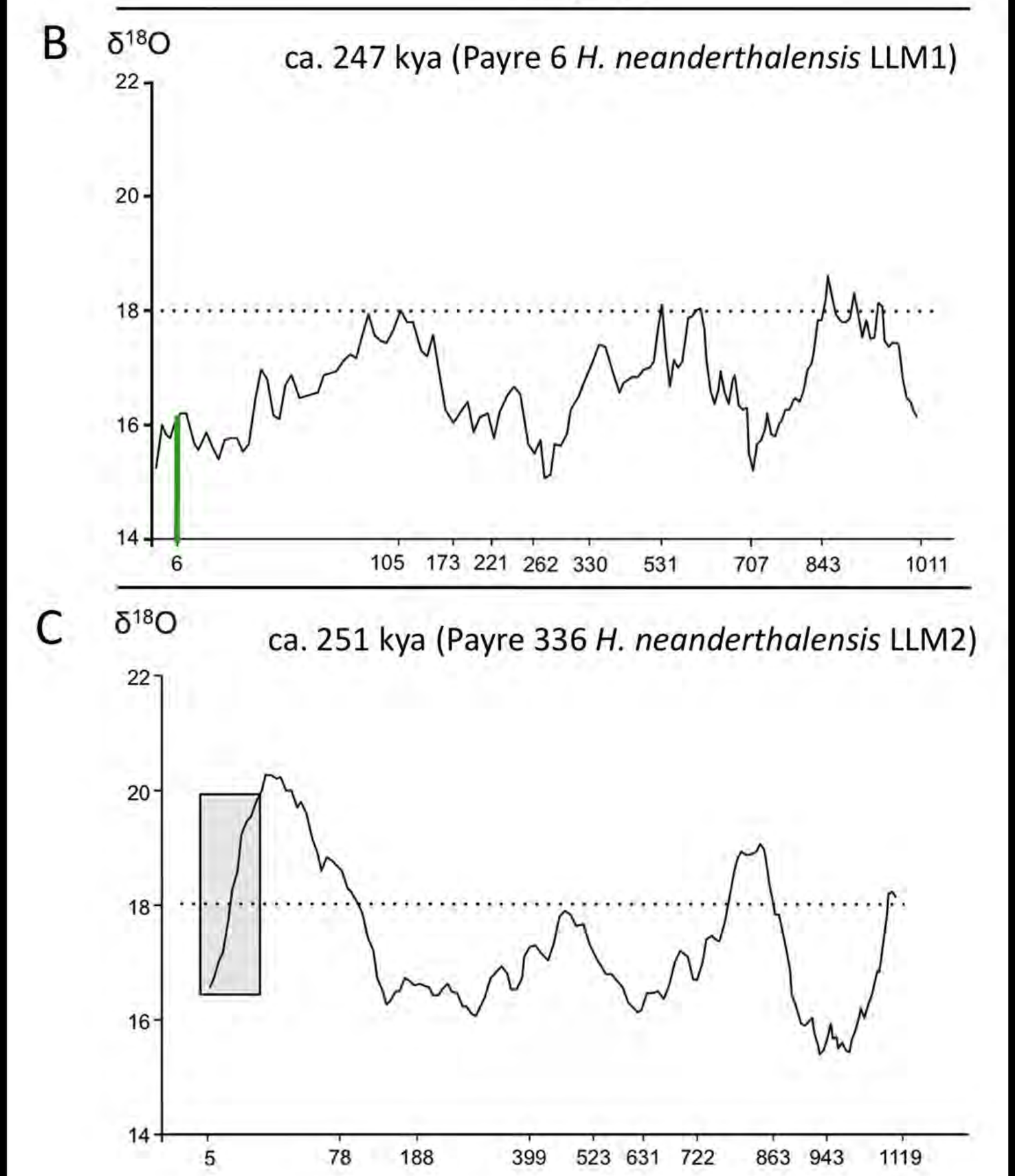
- Oxygen isotope composition of water varies with temperature and precipitation/evaporation cycles

- Surface water during warm/dry cycles: higher $\delta^{18}O$, during cool/wet cycles: lower $\delta^{18}O$

Oxygen Isotope Results

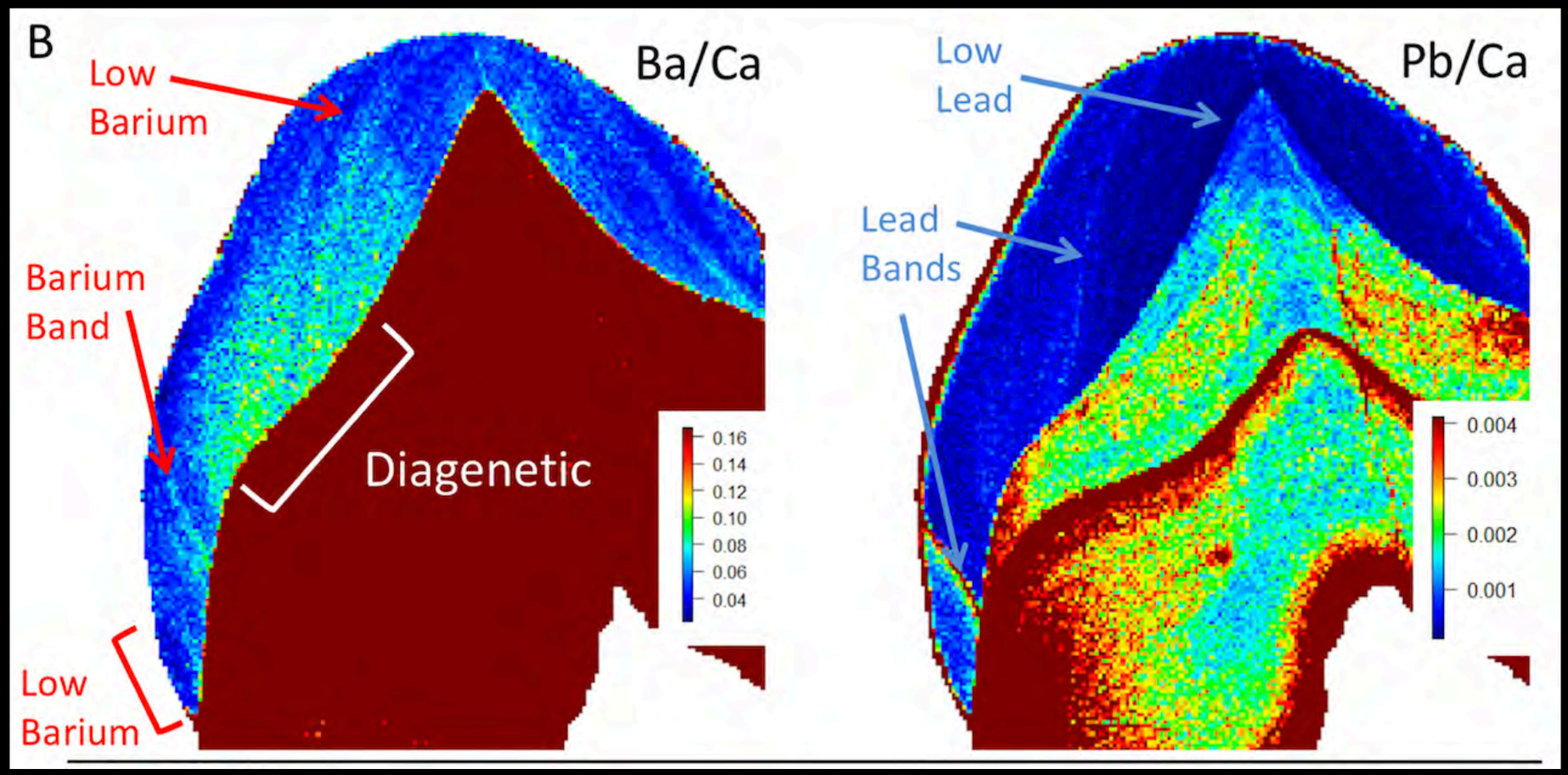


Modern human tooth ~5 kya



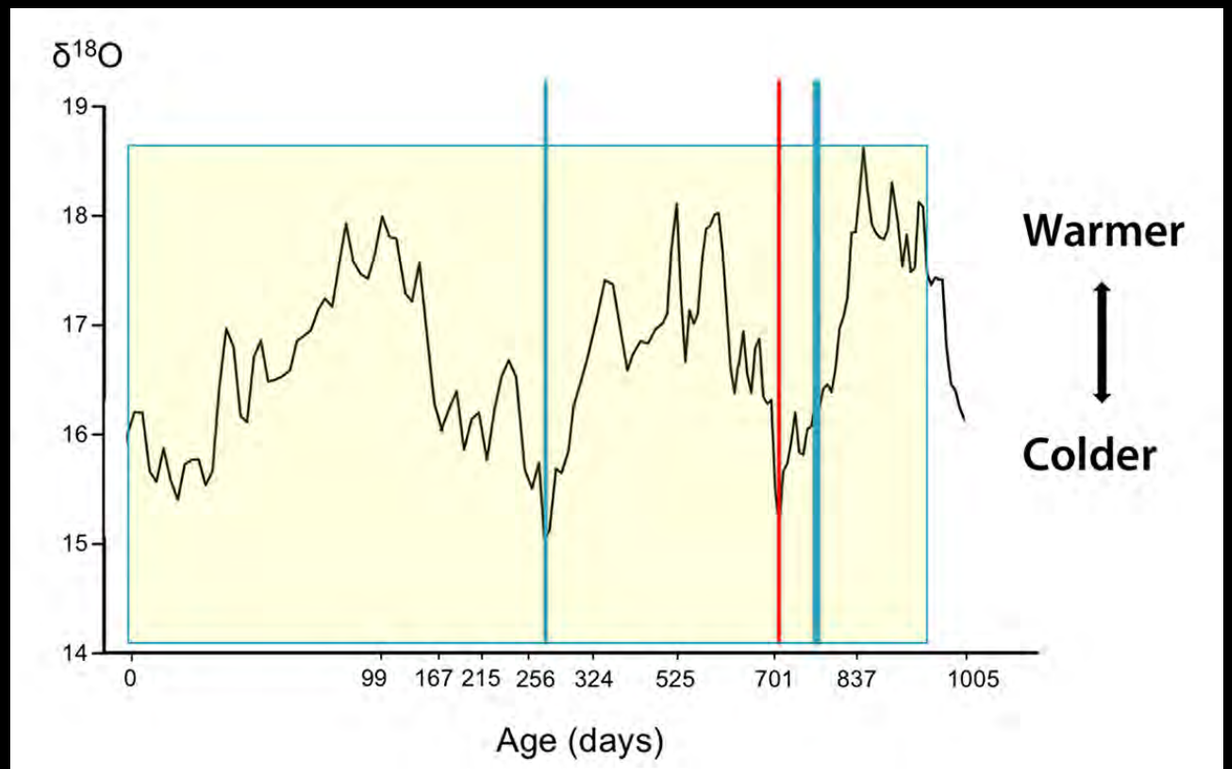
Cooler, more seasonal conditions ~250 kya

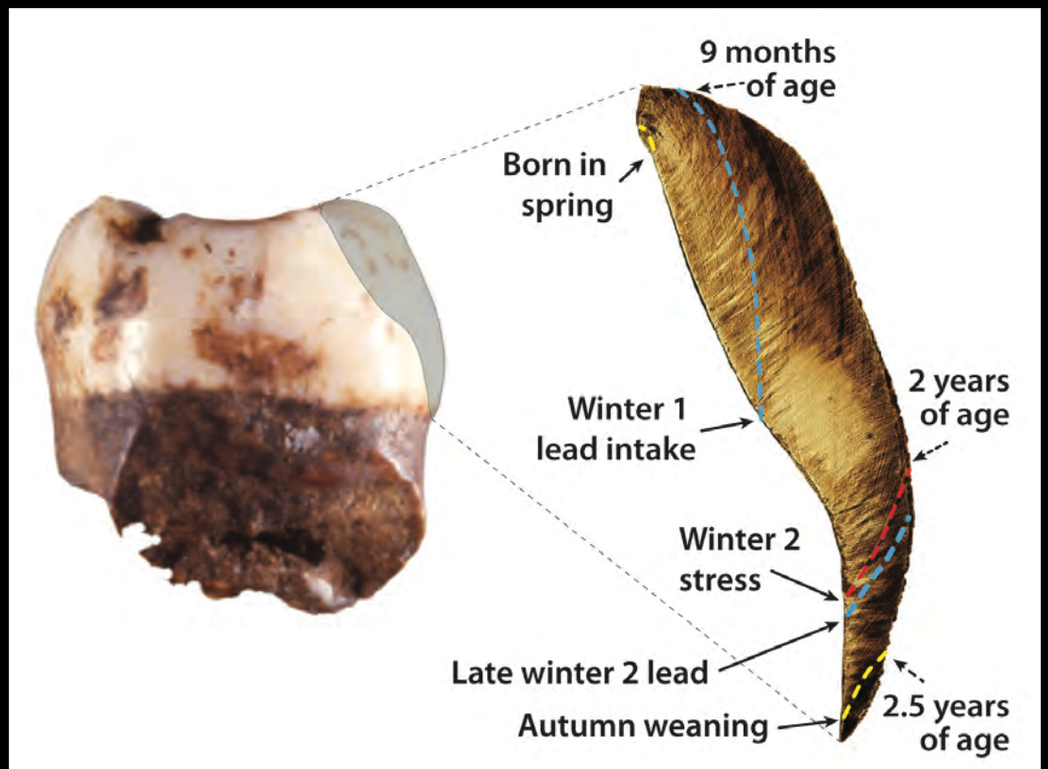
Trace Element Results



Second individual: no barium, two lead exposures

Big Picture





Smith et al. 2018 *Sci Advances*

The Tales Teeth Tell…

Diet → Stress → Climate → Evolution → Death → Birth → Diet

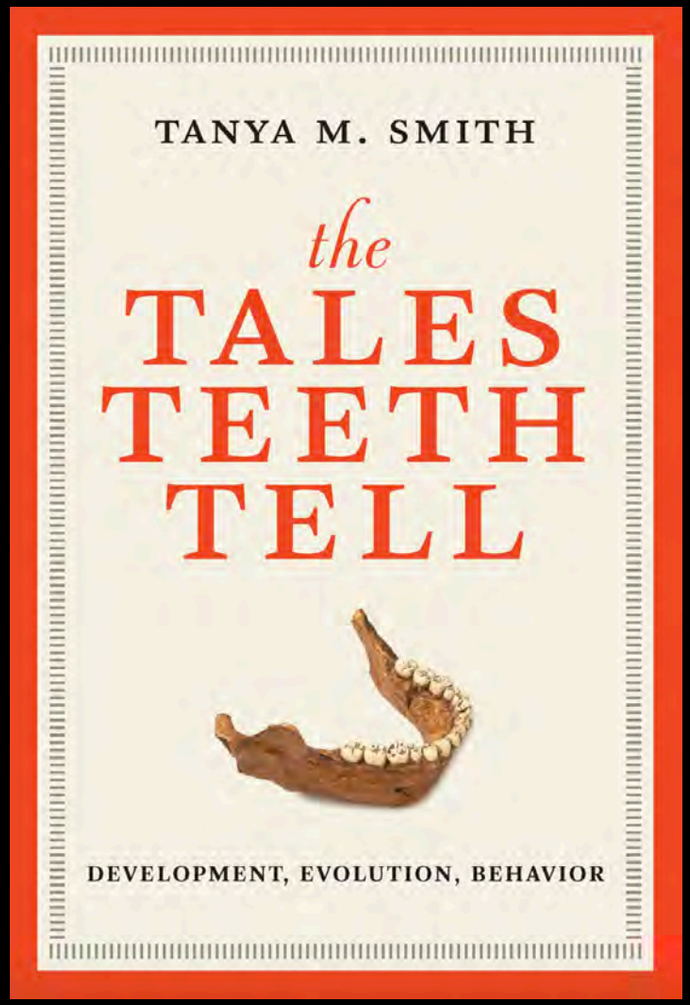
Deep Bow of Thanks!

Gold Coast Skeptics, especially Dr. Paulina Stehlik

Griffith University & Australian Research Centre for Human Evolution

Harvard University & Dental Hard Tissue Lab Members

Curators and Collaborators



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