Erasmus+

Laurea Magistrale in Quaternario, Preistoria e Archeologia
International Master in Quaternary and Prehistory

FERRARIAE UNIVERSITAS · 13 91 · EX LABORE FRUCTUS

Homo sapiens origin and evolution

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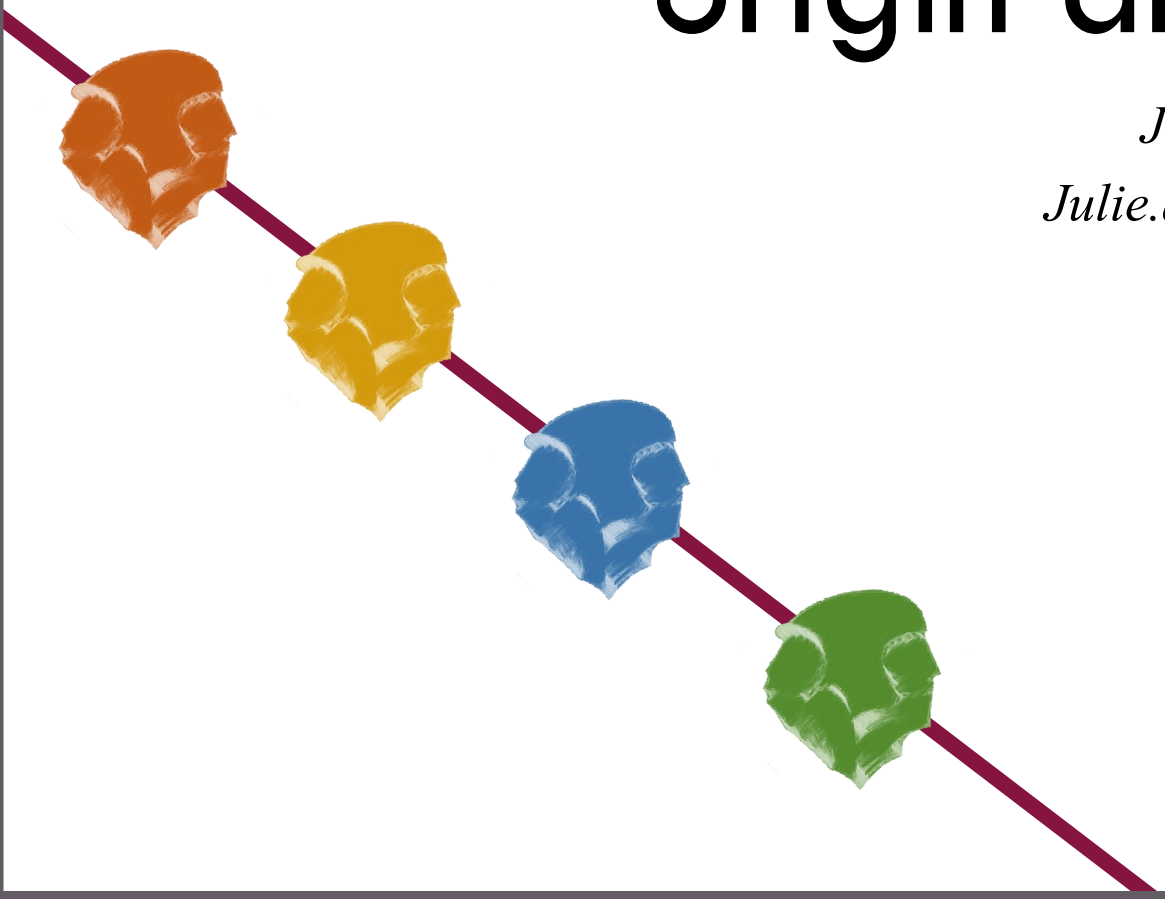
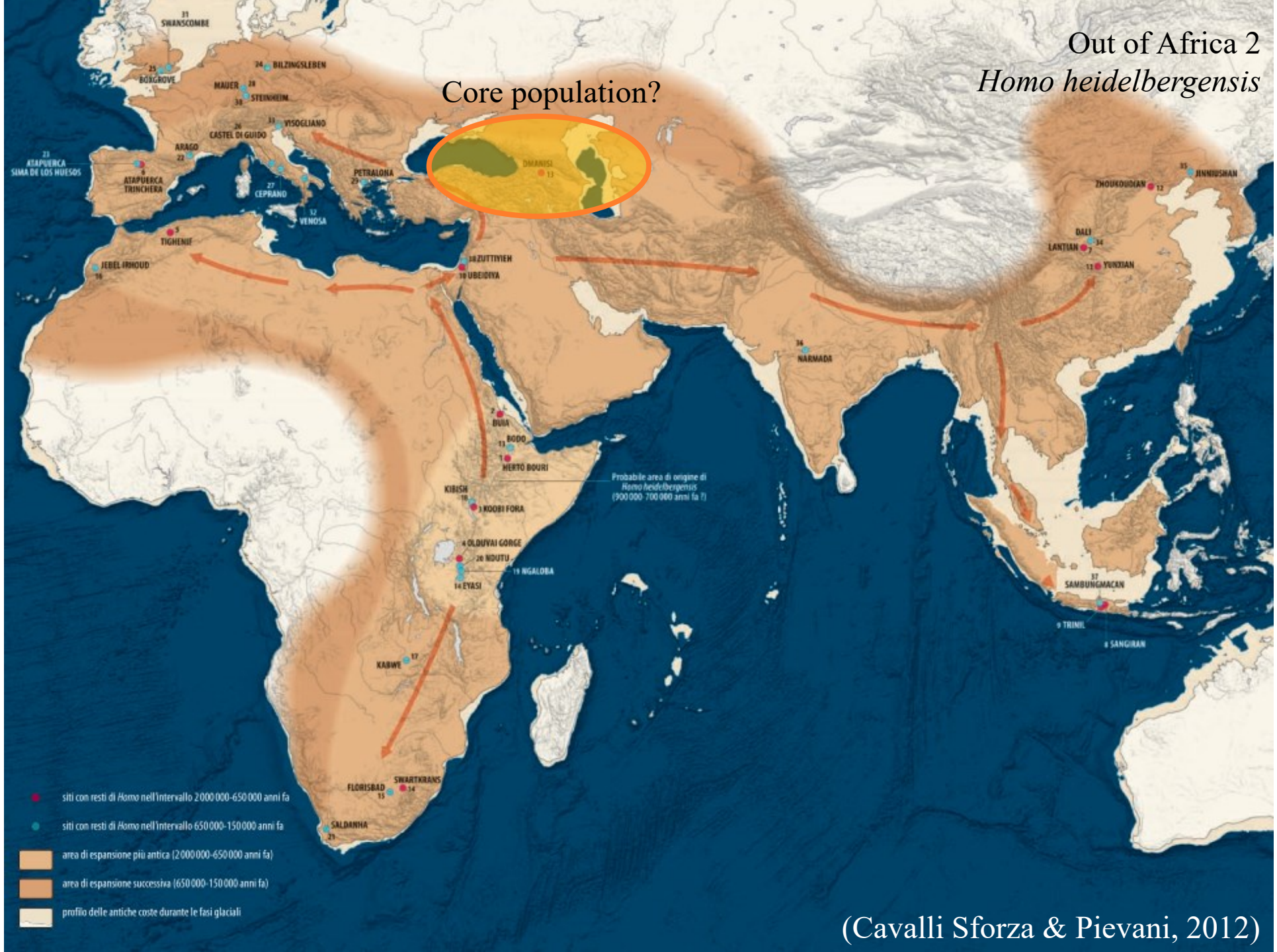
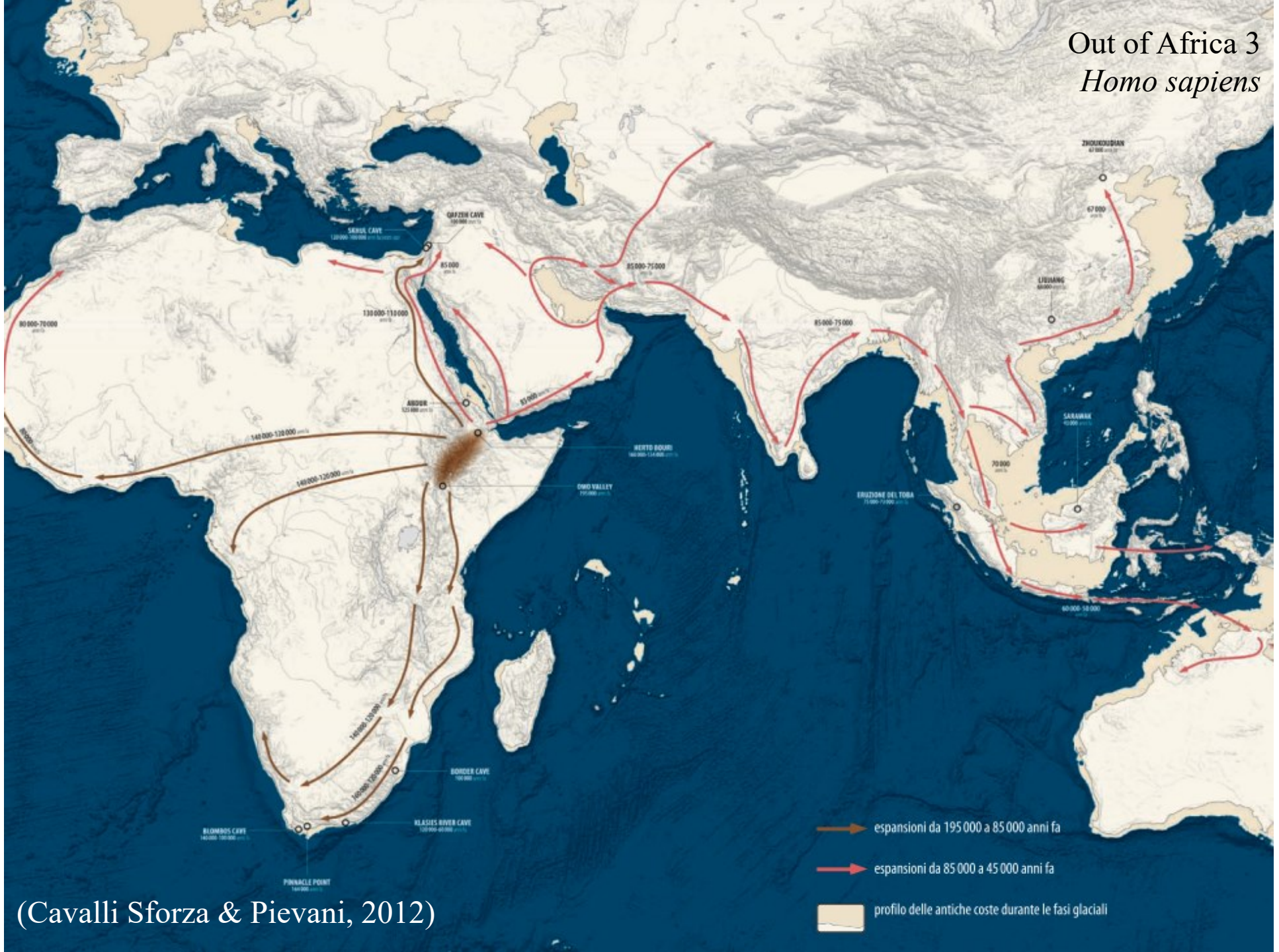


(Cavalli Sforza & Pievani, 2012)

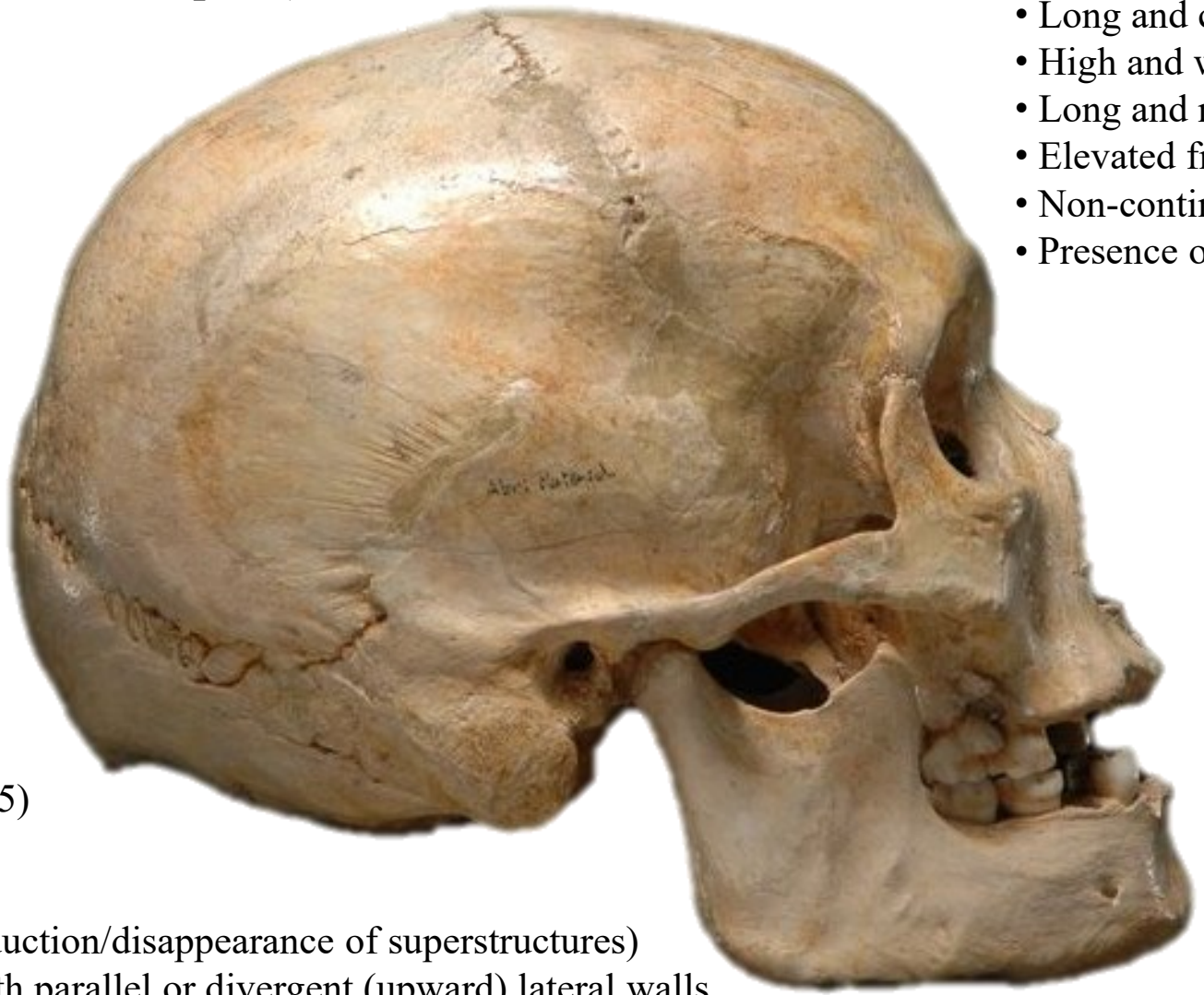


(Cavalli Sforza & Pievani, 2012)



(Cavalli Sforza & Pievani, 2012)

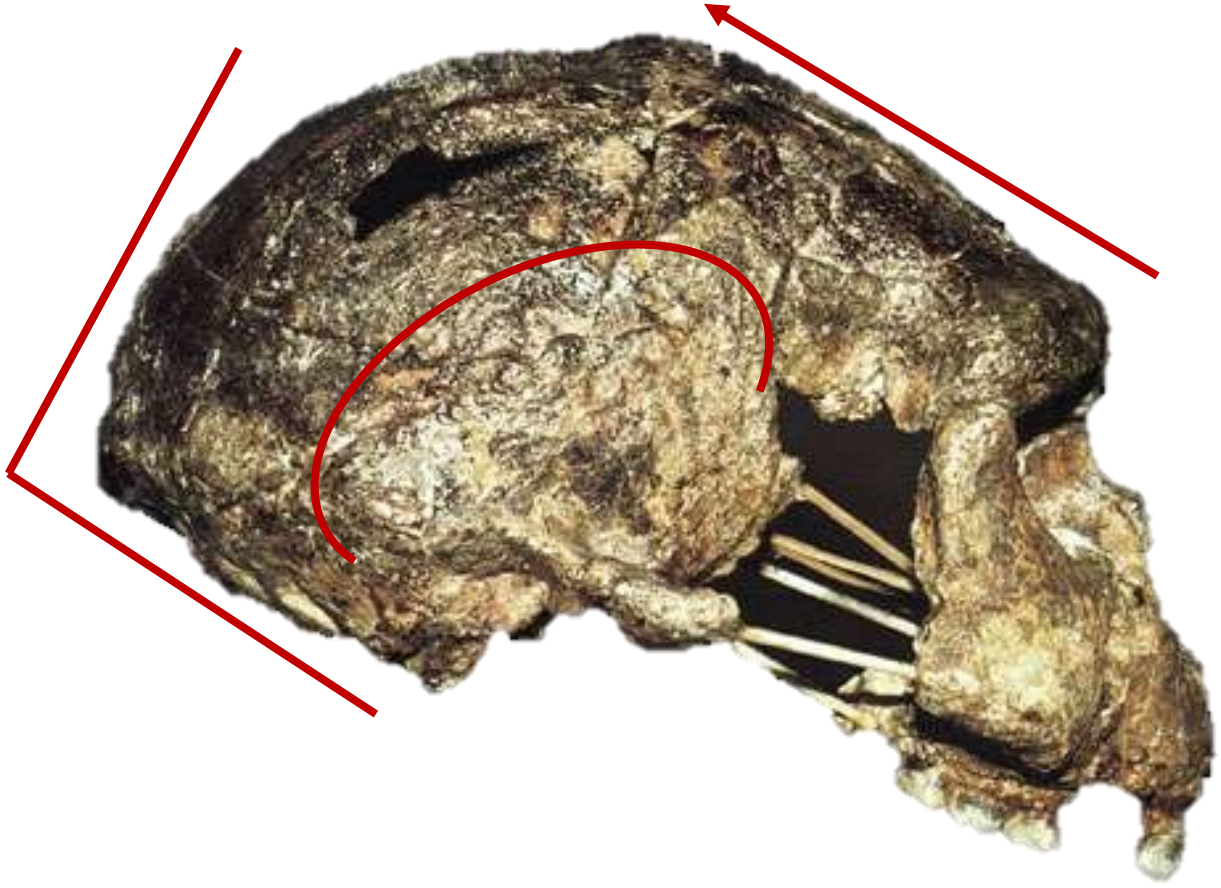
Homo sapiens morphological features (paleontological definition of the specie)



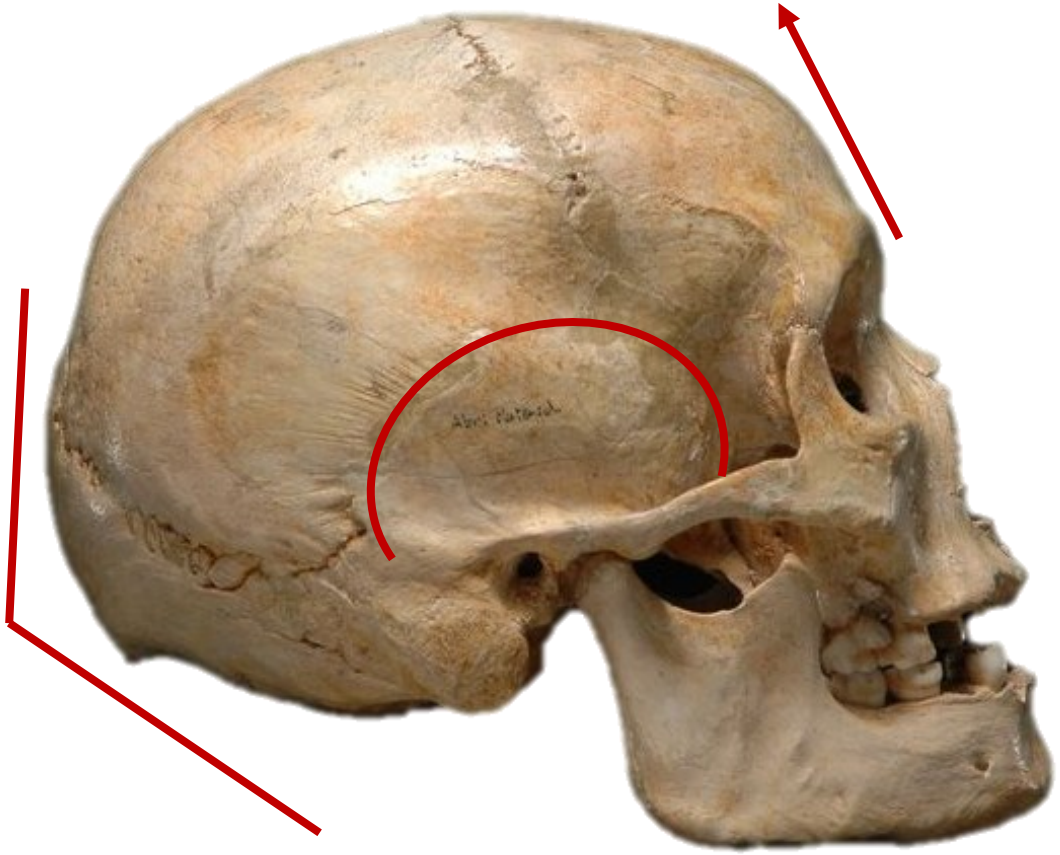
Day & Stringer (1982)
- Short and elevated cranial vault
- Long and curved parietal bones in the sagittal plan
- High and wide biparietal vault in the coronal plan
- Long and narrow occipital bone, without projection
- Elevated frontal bone
- Non-continuous supra-orbital complex
- Presence of a canine fossa

Vandermeersch (1981, 2005)
- rounded cranial shape
- large cranial capacity
- decreased robustness (reduction/disappearance of superstructures)
- elevated cranial vault, with parallel or divergent (upward) lateral walls
- regularly rounded occipital bone
- short face
- teeth-size reduction tendency

Homo erectus
Sangiran 17

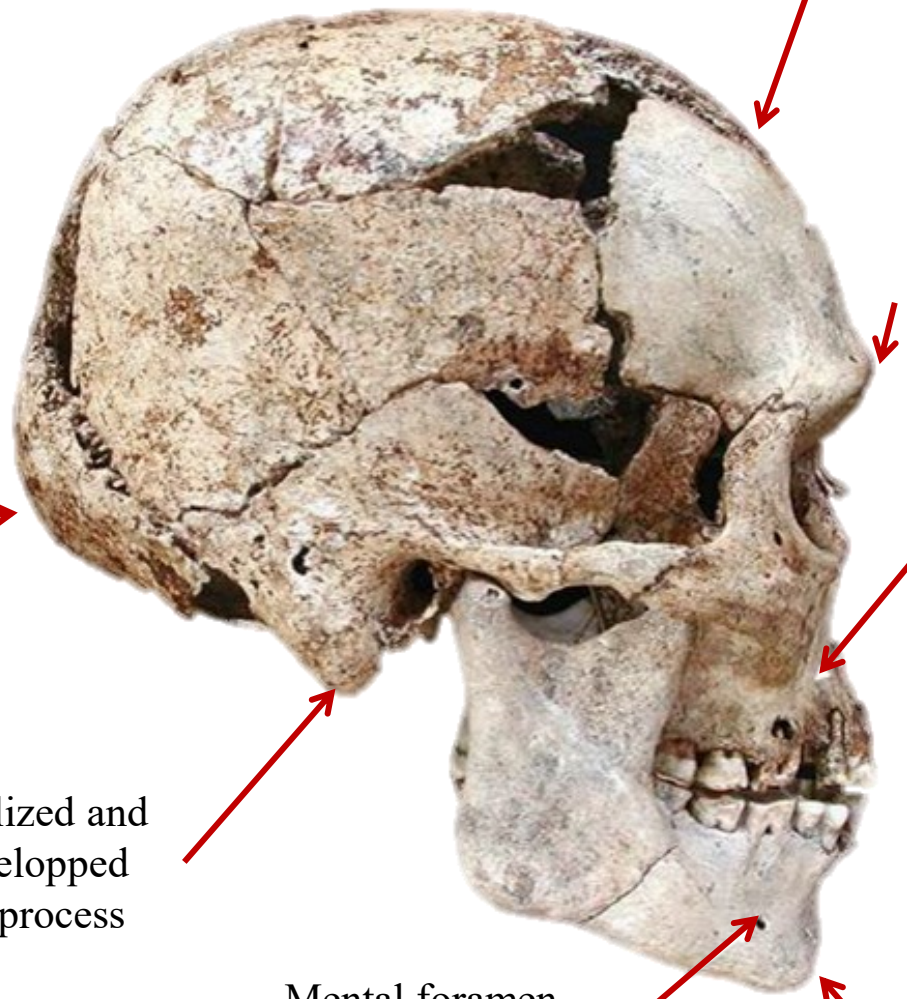


Homo sapiens
Pataud 1



Short and rounded vault
Elevated frontal bone
Rounded occipital bone
Reduced face, placed under the braincase

Global decrease of robustness



Reduced relief of nuchal lines

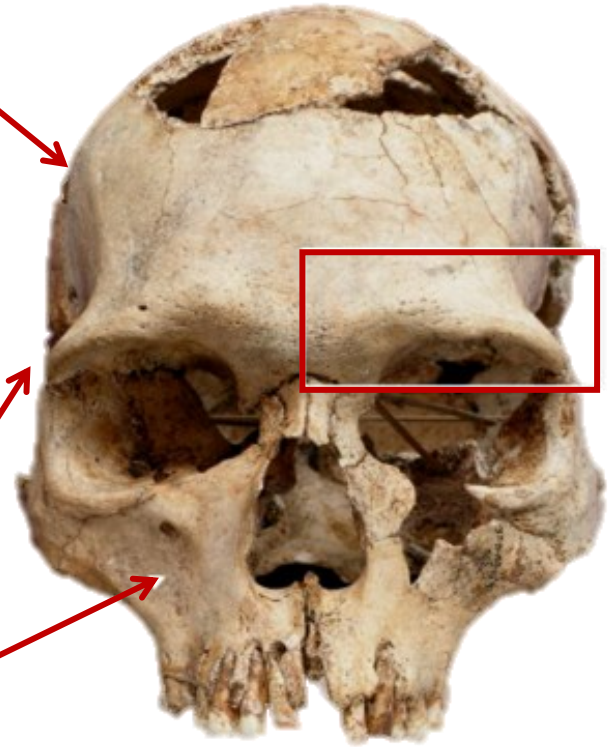
Individualized and well developped mastoid process

Mental foramen located under the premolar

Elevated and convex frontal bone

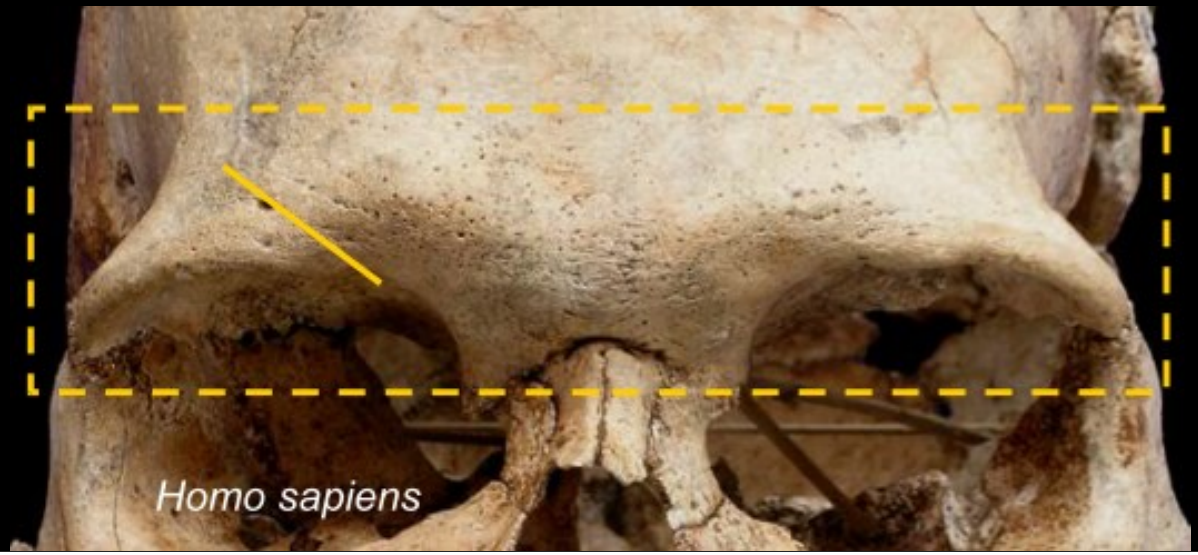
Reduced supra-orbital relief (separated elements)

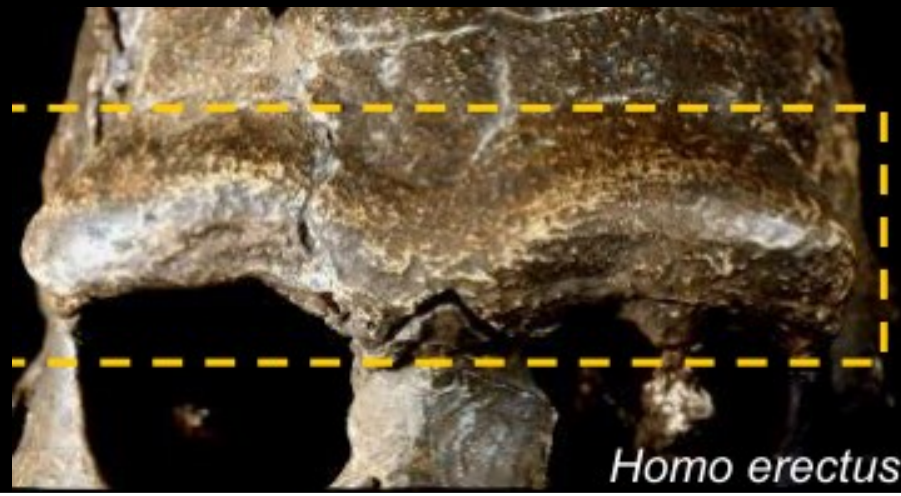
Canine fossa

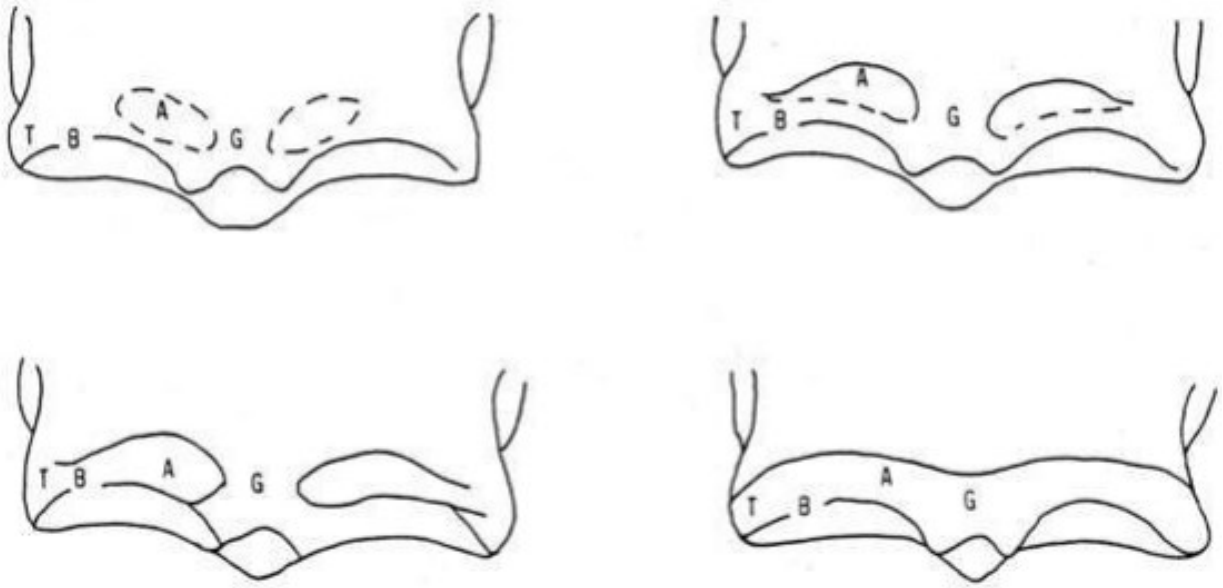


Marked chin (mental trigone)

Dental crowns reduced in size (particularly anterior teeth)



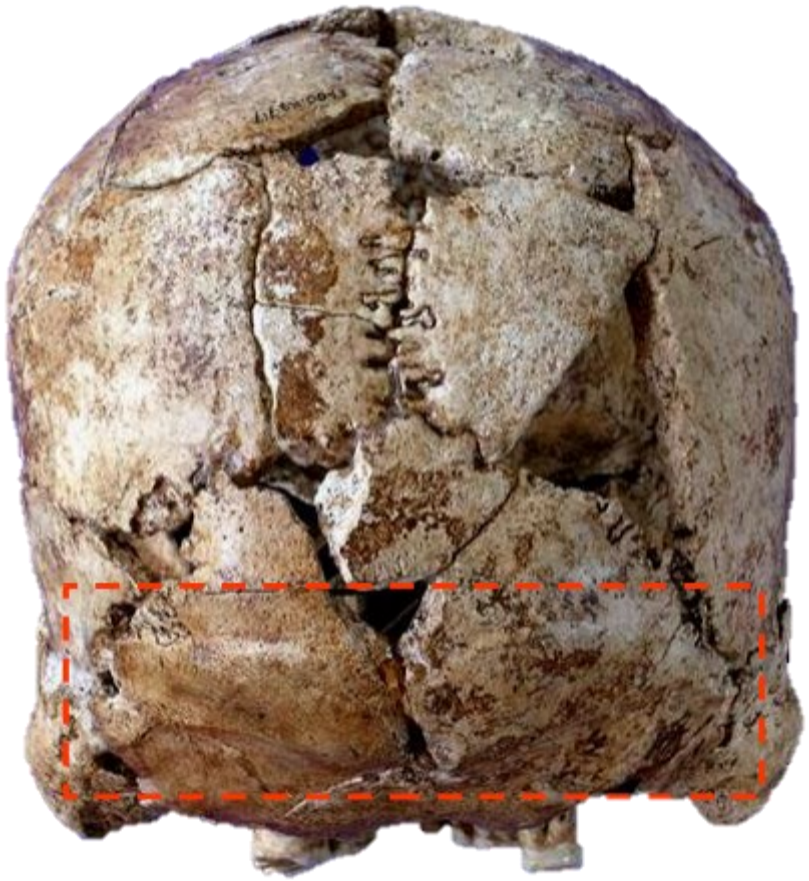




G: Glabella
A: Superciliary arch
B: Upper border of the orbit
T: Lateral trigone

Transverse occipital torus

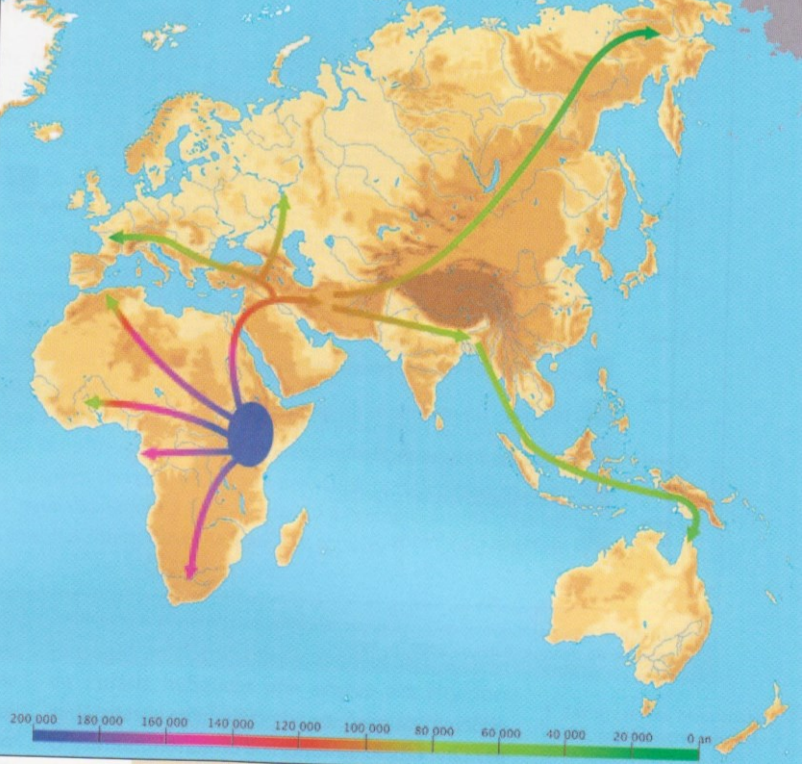
Homo erectus



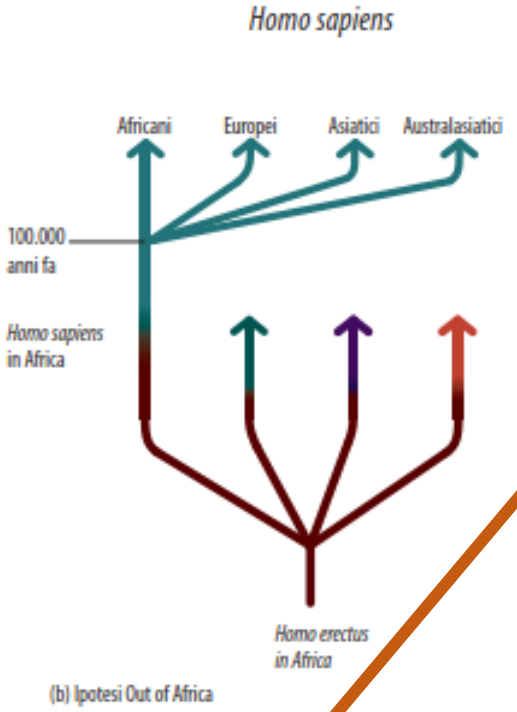
Homo sapiens

- Narrow trunk and pelvis
- Low body mass compared to stature
- Center of gravity at the level of the 2° sacral vertebra
- vertebral column with marked secondary convexities
- Long limbs compared to trunk
- Robust and lengthened lower limbs
- Lengthening of the distal segments of the limbs
- Reduced thickness of cortical bone and large medullar cavity (compared to *Homo erectus*)

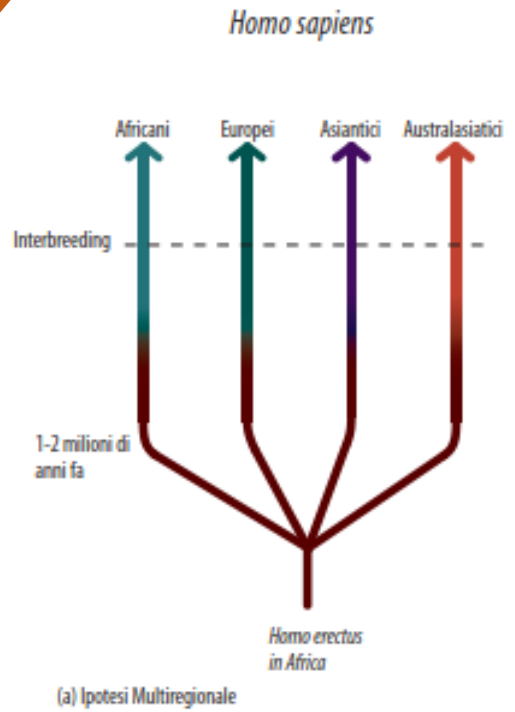
Origin Evolutionary hypothesis



Out-of-Africa Model or substitution model

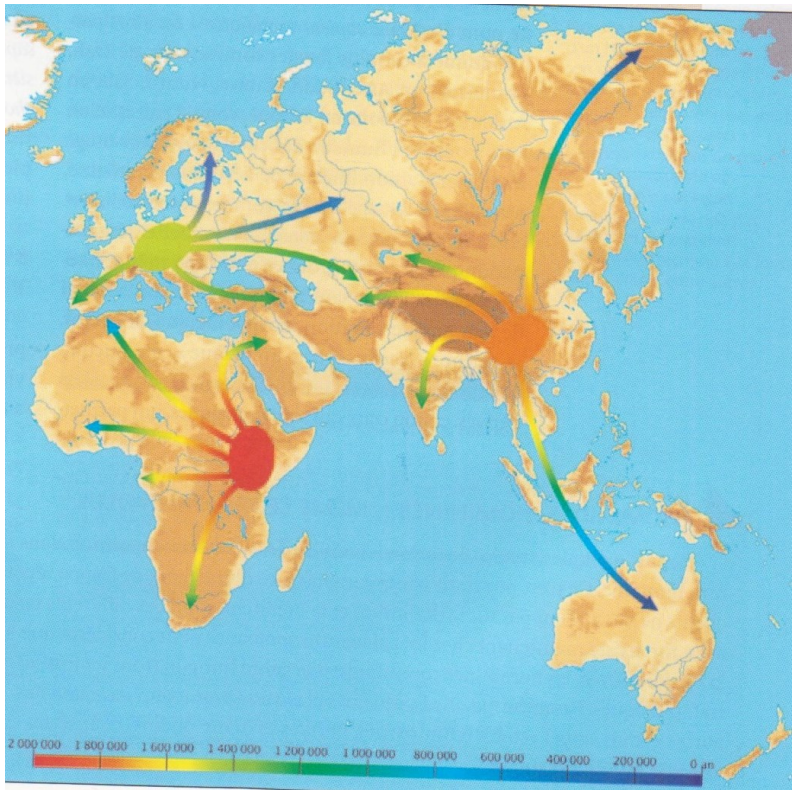


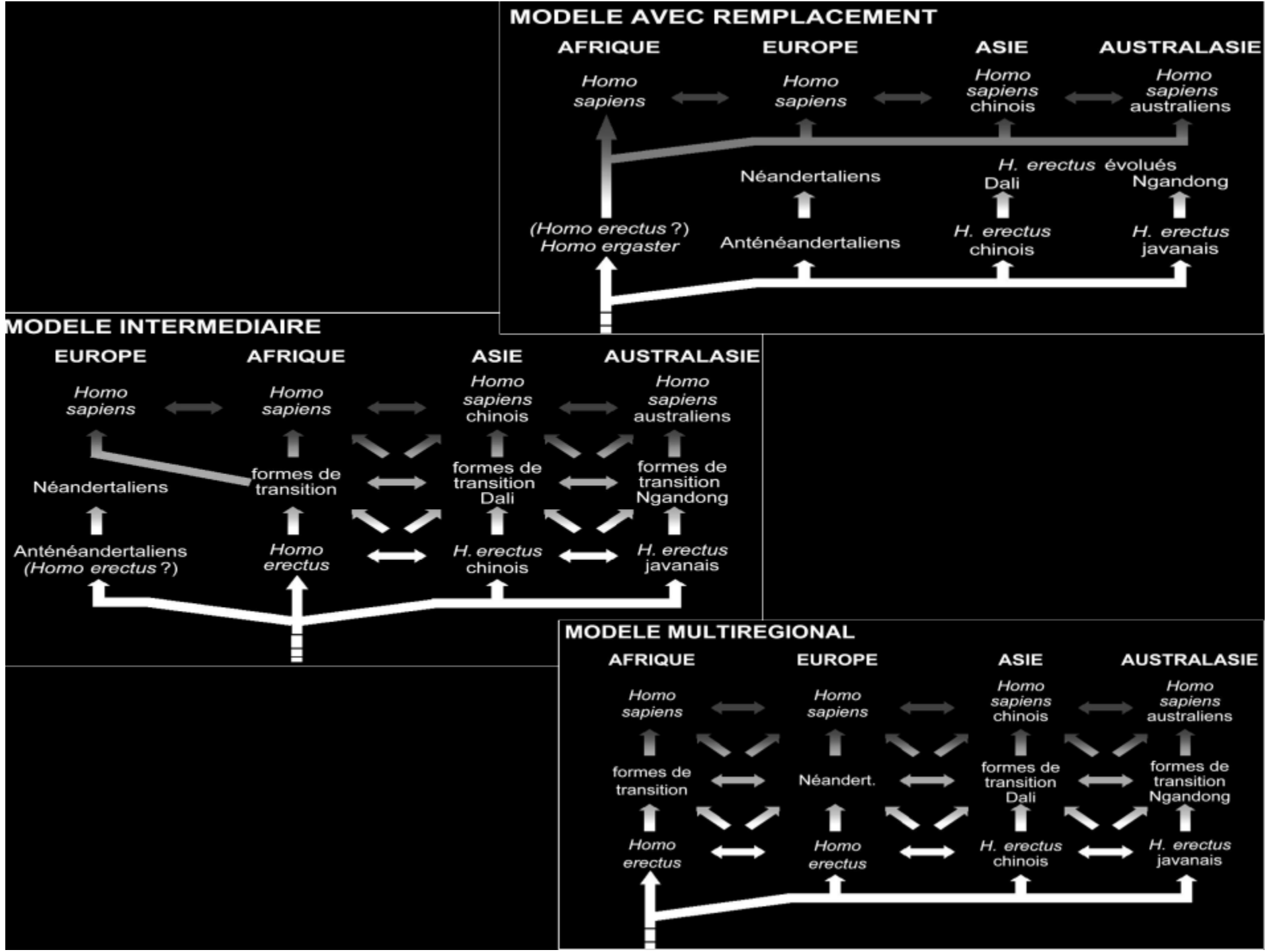
(b) Ipotesi Out of Africa



(a) Ipotesi Multiregionale

Multiregional model




MODELE AVEC REMPLACEMENT
AFRIQUE
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Homo sapiens
Homo sapiens chinois
Homo sapiens australiens
Néandertaliens
H. erectus évolués
Dali
Ngandong
(Homo erectus ?)
Homo ergaster
Anténéandertaliens
H. erectus chinois
H. erectus javanais
MODELE INTERMEDIAIRE
EUROPE
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AUSTRALASIE
Homo sapiens
Homo sapiens
Homo sapiens chinois
Homo sapiens australiens
Néandertaliens
formes de transition
formes de transition Dali
formes de transition Ngandong
Anténéandertaliens
(Homo erectus ?)
Homo erectus
H. erectus chinois
H. erectus javanais
MODELE MULTIREGIONAL
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ASIE
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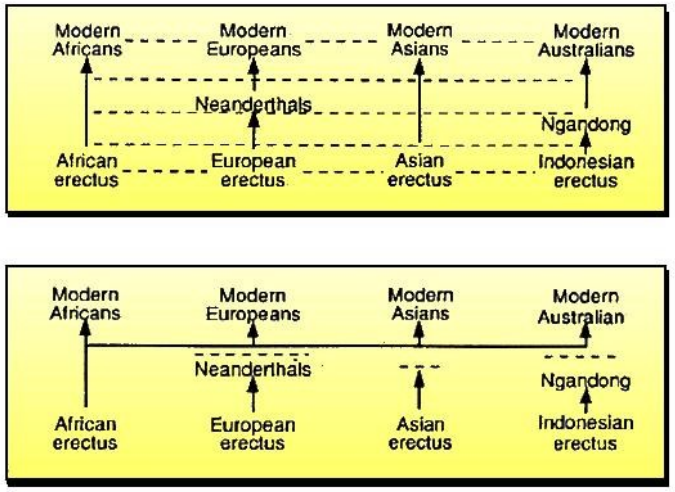
Homo sapiens
Homo sapiens
Homo sapiens chinois
Homo sapiens australiens
formes de transition
Néandert.
formes de transition Dali
formes de transition Ngandong
Homo erectus
Homo erectus
H. erectus chinois
H. erectus javanais

Multiregional model

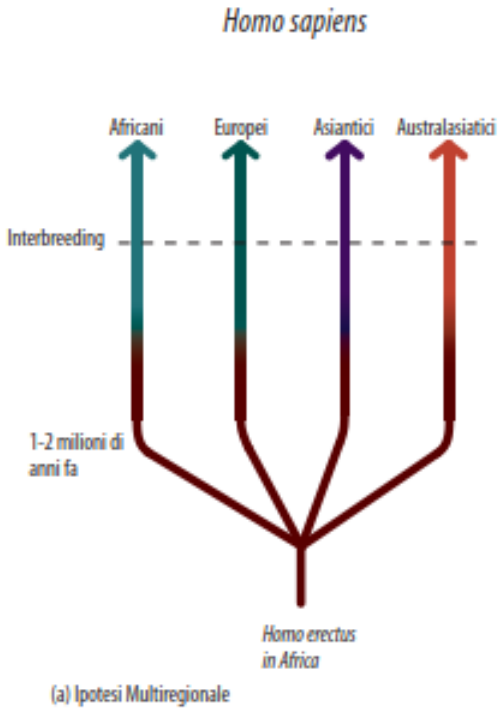
<u>The principal bases of the multiregional theory are:</u>
- Specific regional similarity between archaic *Homo sapiens* and modern one;

<u>Principal criticism :</u>
- Lack of transition shape in Asia and Europe
- Genetical proof
- This theory request a continuous gene flow between the regional population

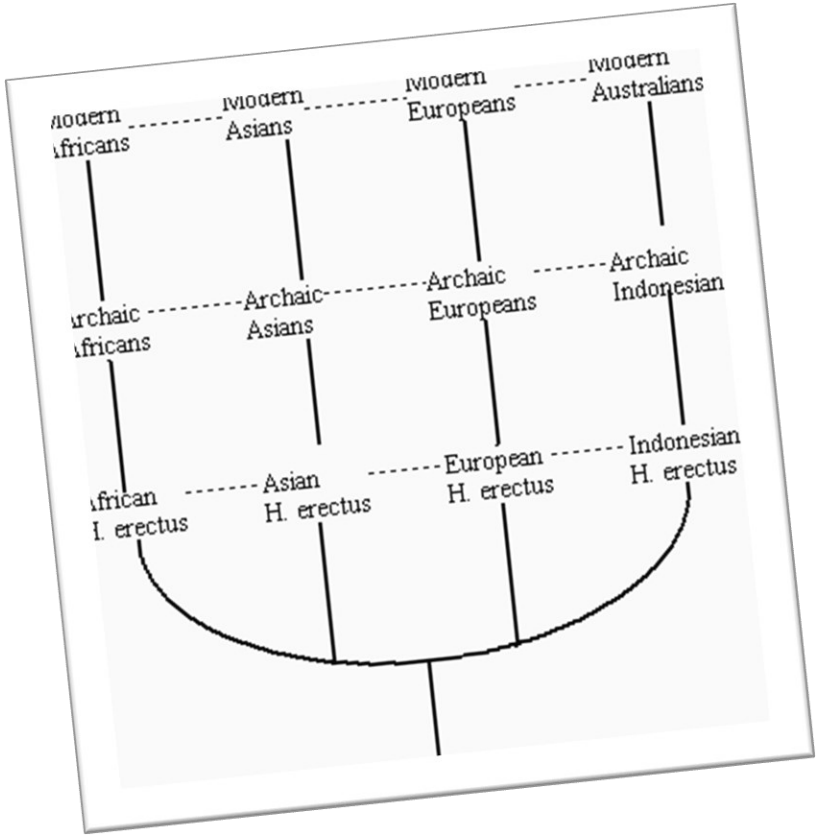


Two views of the origins of modern humans: the multiregional model (top) and the "Out of Africa" model. Each interprets the same fossil evidence in a radically different way

Stringer, 1990



(a) Ipotesi Multiregionale

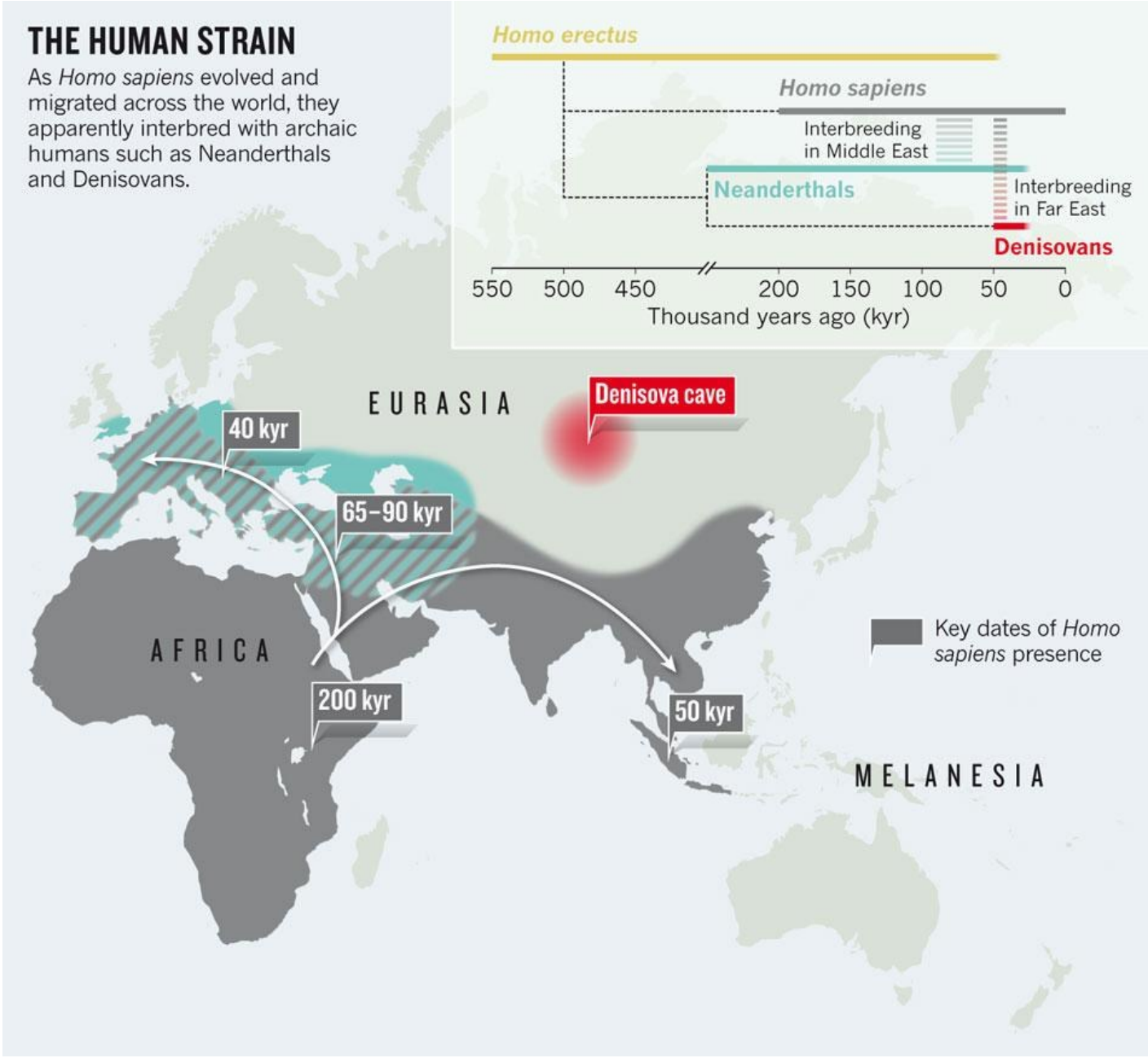


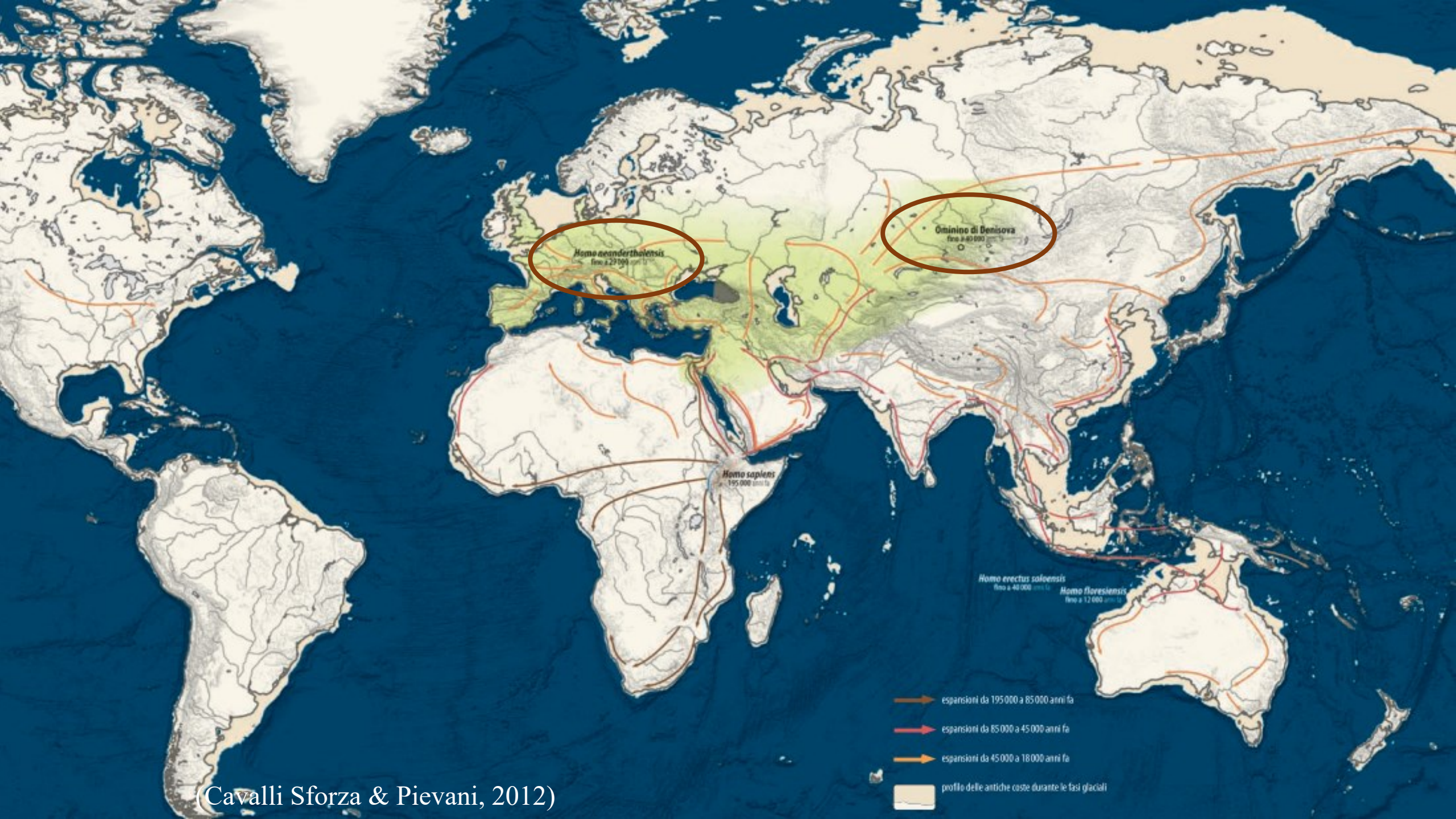
Partial substitution model

Theory of integration (Smith, 1987) or partial replacement:
Integration from European population of the genetic patrimony of modern human, by genetic flow*. Paleontological proof: fossils from eastern Europe (Vindija).

Hybridation theory (Trinkaus):
Interbreeding in the various geographic area of modern human and preexisting population

*Genetic flow is the diffusion of gene between population, by migration of individual in reproductive age. The genetic flow can introduce in a population new allele and can change the allelic frequency. The global genetic effect is the reduction of genetic differences between population and then limit the evolution. In another hand, genetic flow can increase the internal variability of a population, increasing the polymorphism.





(Cavalli Sforza & Pievani, 2012)

Ancestors evolve into Neanderthals and first modern humans

Neanderthals die out

Researchers looked at five groups of modern humans

French

Han-Chinese

Papuan

Some Neanderthal and *Homo sapiens* interbreeding

Neanderthal

Common ancestor with Neanderthal

Some modern humans leave Africa

Yoruba

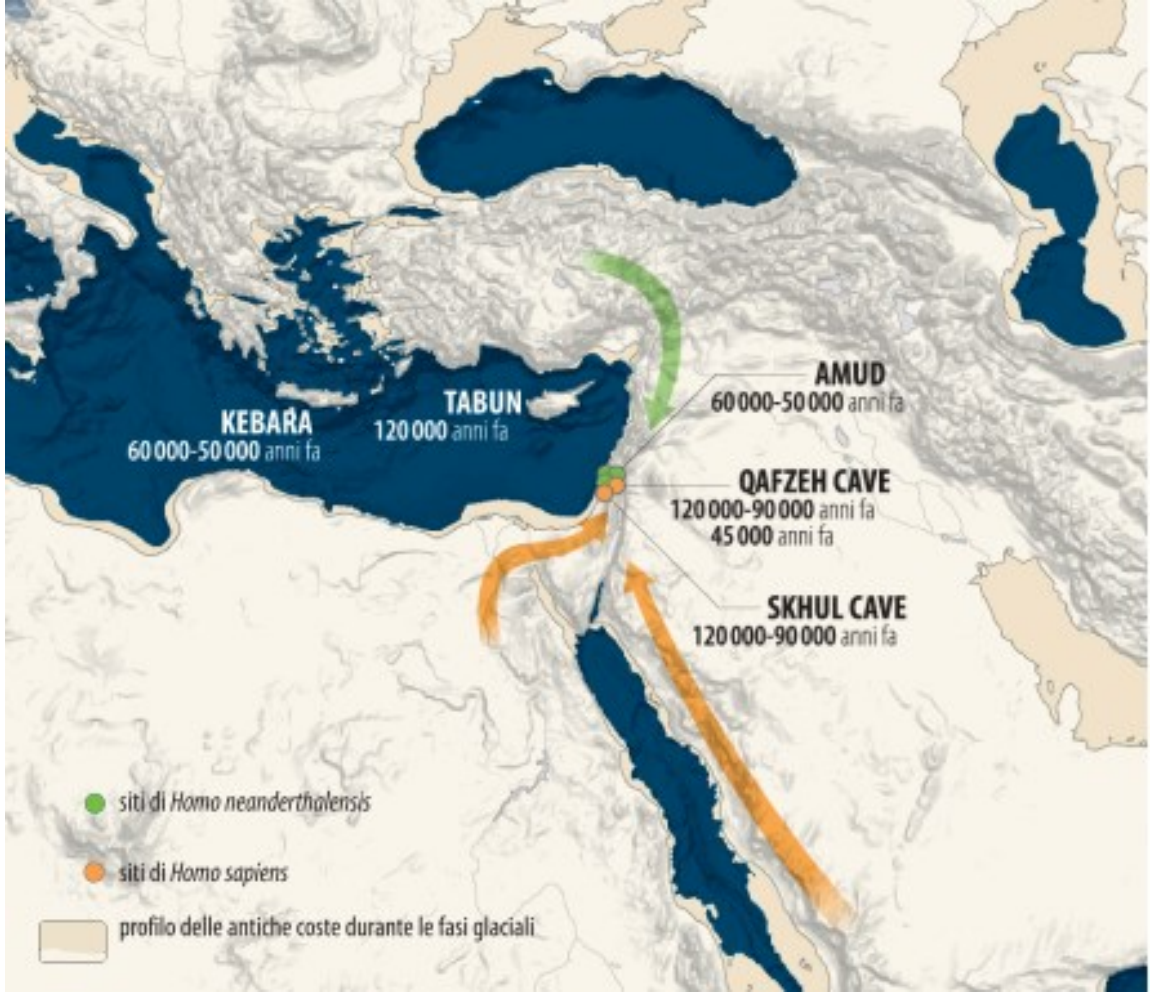
Homo sapiens

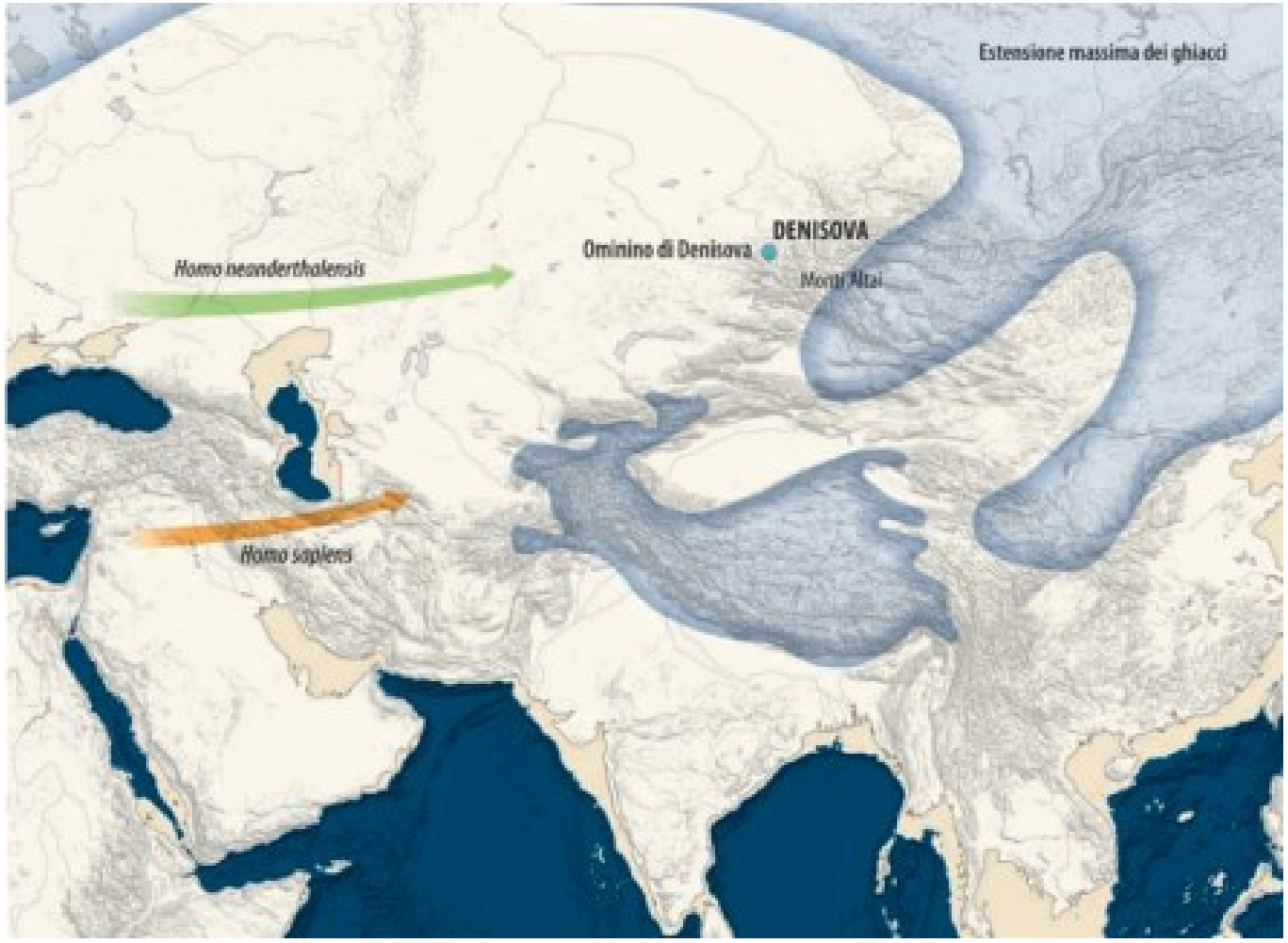
San

Source: Science journal

Note: Time periods not to scale

Possible interbreed area





LETTER

doi:10.1038/nature14558

An early modern human from Romania with a recent Neanderthal ancestor

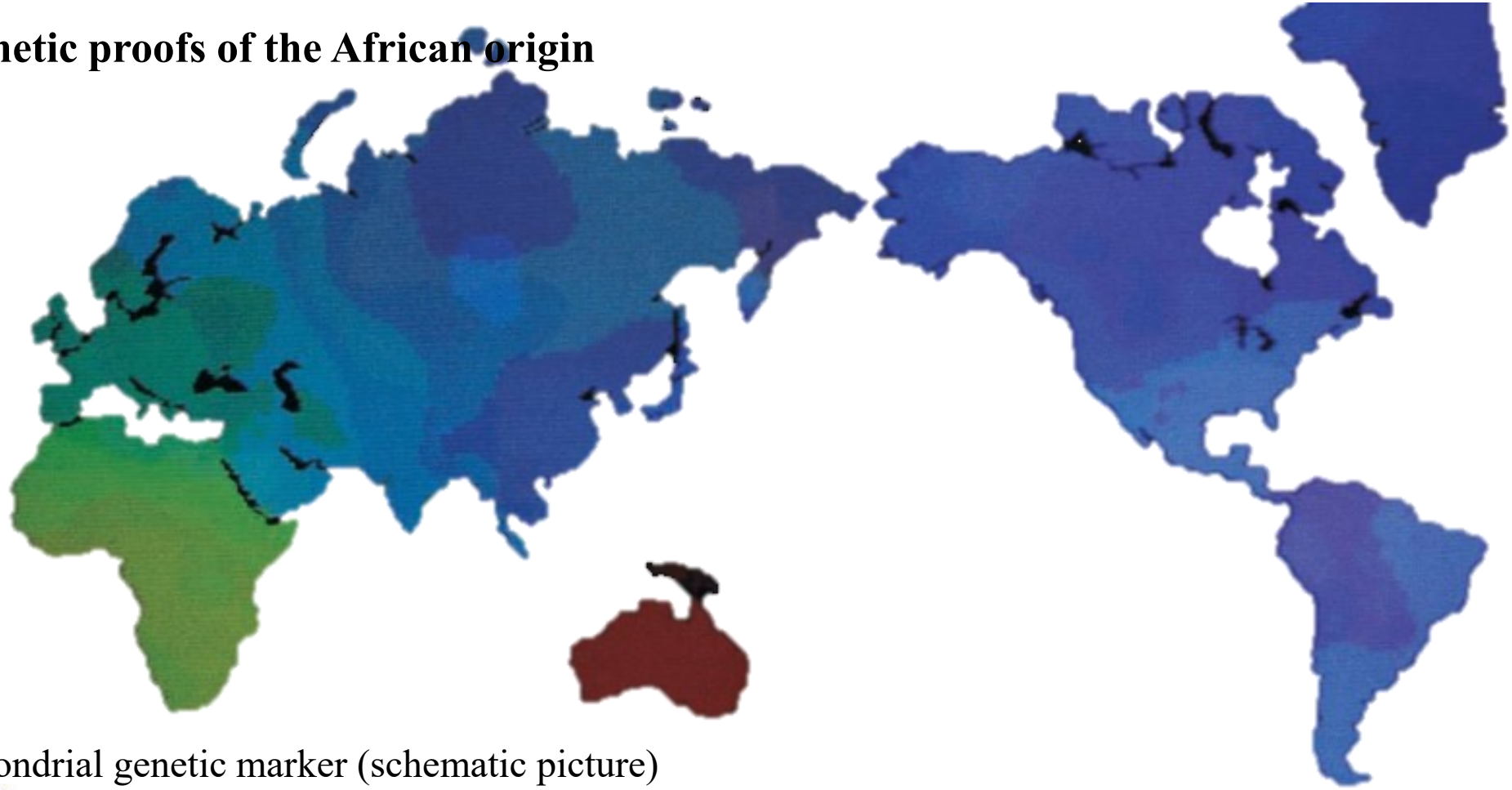
Qiaomei Fu[1,2,3]*, Mateja Hajdinjak[3]*, Oana Teodora Moldovan[4], Silviu Constantin[5], Swapan Mallick[2,6,7], Pontus Skoglund[2], Nick Patterson[6], Nadin Rohland[2], Iosif Lazaridis[2], Birgit Nickel[3], Bence Viola[3,7,8], Kay Prüfer[3], Matthias Meyer[3], Janet Kelso[3], David Reich[2,6,9] & Svante Pääbo[3]

Neanderthals are thought to have disappeared in Europe approximately 39,000–41,000 years ago but they have contributed 1–3% of the DNA of present-day people in Eurasia[1]. Here we analyse DNA from a 37,000–42,000-year-old[2] modern human from Peştera cu Oase, Romania. Although the specimen contains small amounts of human DNA, we use an enrichment strategy to isolate sites that are informative about its relationship to Neanderthals and present-day humans. We find that on the order of 6–9% of the genome of the Oase individual is derived from Neanderthals, more than any other modern human sequenced to date. Three chromosomal segments of Neanderthal ancestry are over 50 centimorgans in size, indicating that this individual had a Neanderthal ancestor as recently as four to six generations back. However, the Oase individual does not share more alleles with later Europeans than with East Asians, suggesting that the Oase population did not contribute substantially to later humans in Europe.

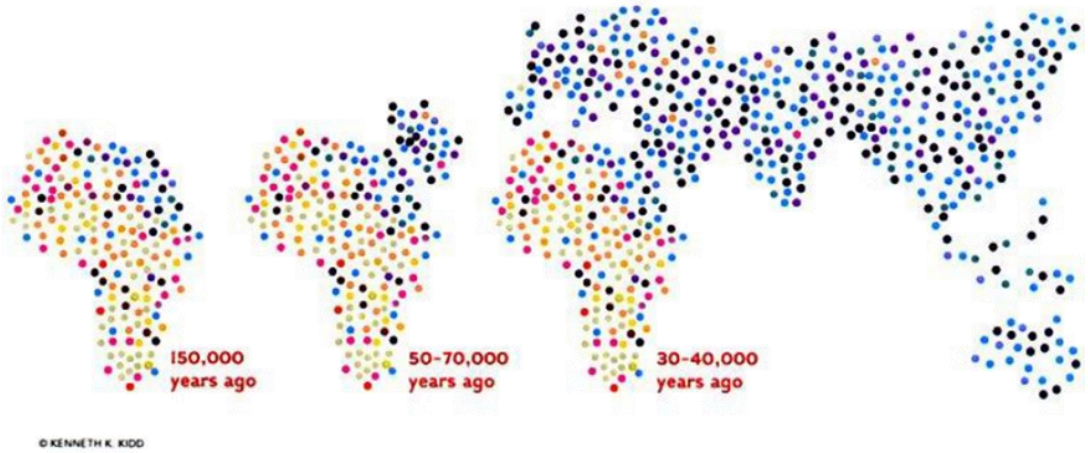
Putative recent Neanderthal ancestry

«Out of Africa» Model – Genetic proofs of the African origin

The African origin of modern human evidenced by the study of actual mitochondrial DNA



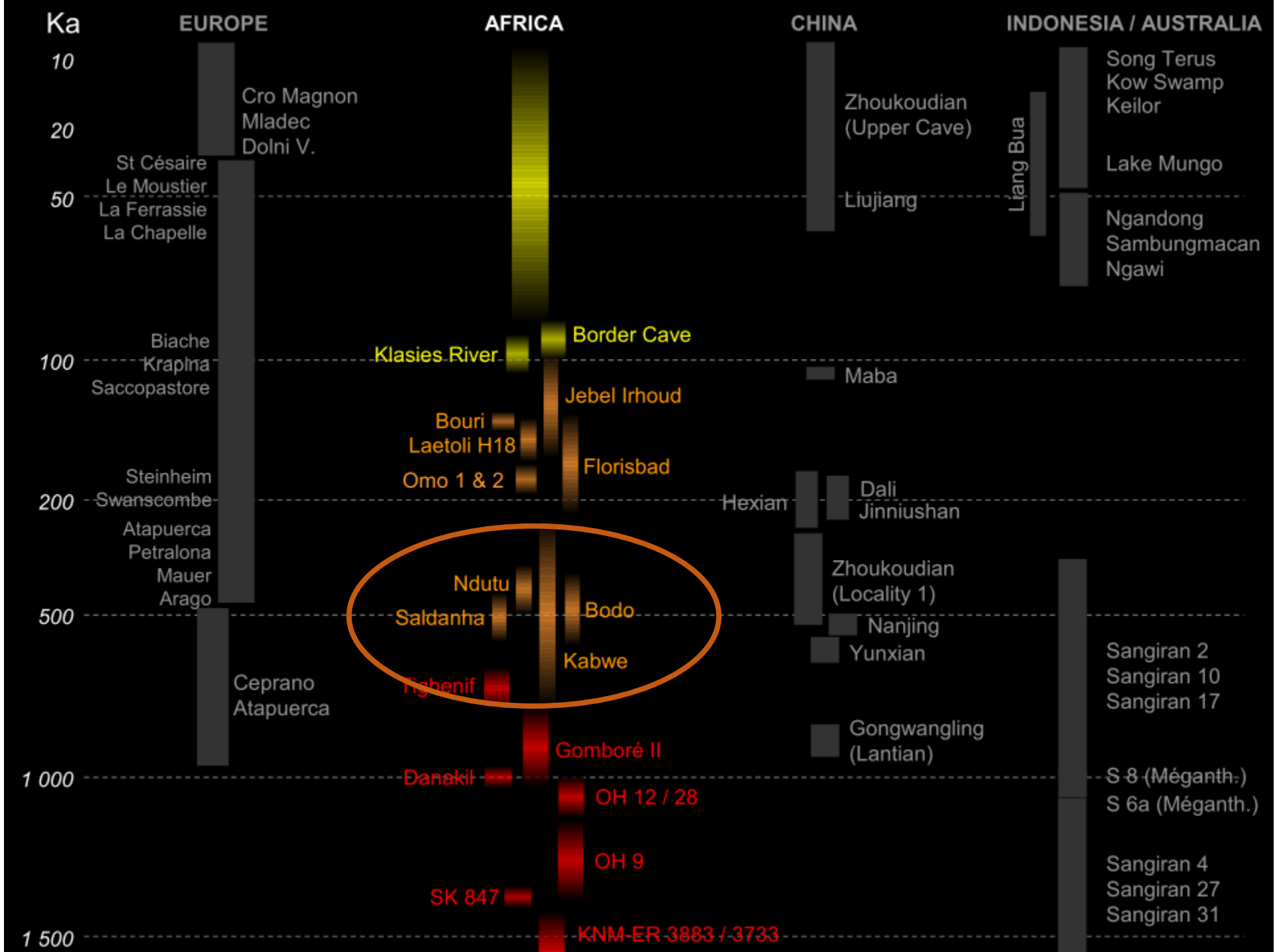
Diversity of one imaginary mitochondrial genetic marker (schematic picture)



Present variability mtDNA

« all the contemporary and worldwide human mtDNA variability is also present in Africa (East Africa), thus it is the most probable place of origin of the species *Homo sapiens.* »

Fossil proofs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St Césaire
Le Moustier
La Ferrassie
La Chapelle
Biache
Krapina
Saccopastore
Steinheim
Swanscombe
Atapuerca
Petralona
Mauer
Arago
Ceprano
Atapuerca
Klasies River
Border Cave
Jebel Irhoud
Bouri
Laetoli H18
Omo 1 & 2
Florisbad
Ndutu
Saldanha
Bodo
Kabwe
Ighenif
Gomboré II
Danakil
OH 12 / 28
OH 9
SK 847
KNM-ER 3883 / 3733
Zhoukoudian
(Upper Cave)
Liujiang
Maba
Hexian
Dali
Jinniushan
Zhoukoudian
(Locality 1)
Nanjing
Yunxian
Gongwangling
(Lantian)
Liang Bua
Song Terus
Kow Swamp
Keilor
Lake Mungo
Ngandong
Sambungmacan
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S 6a (Méganth.)
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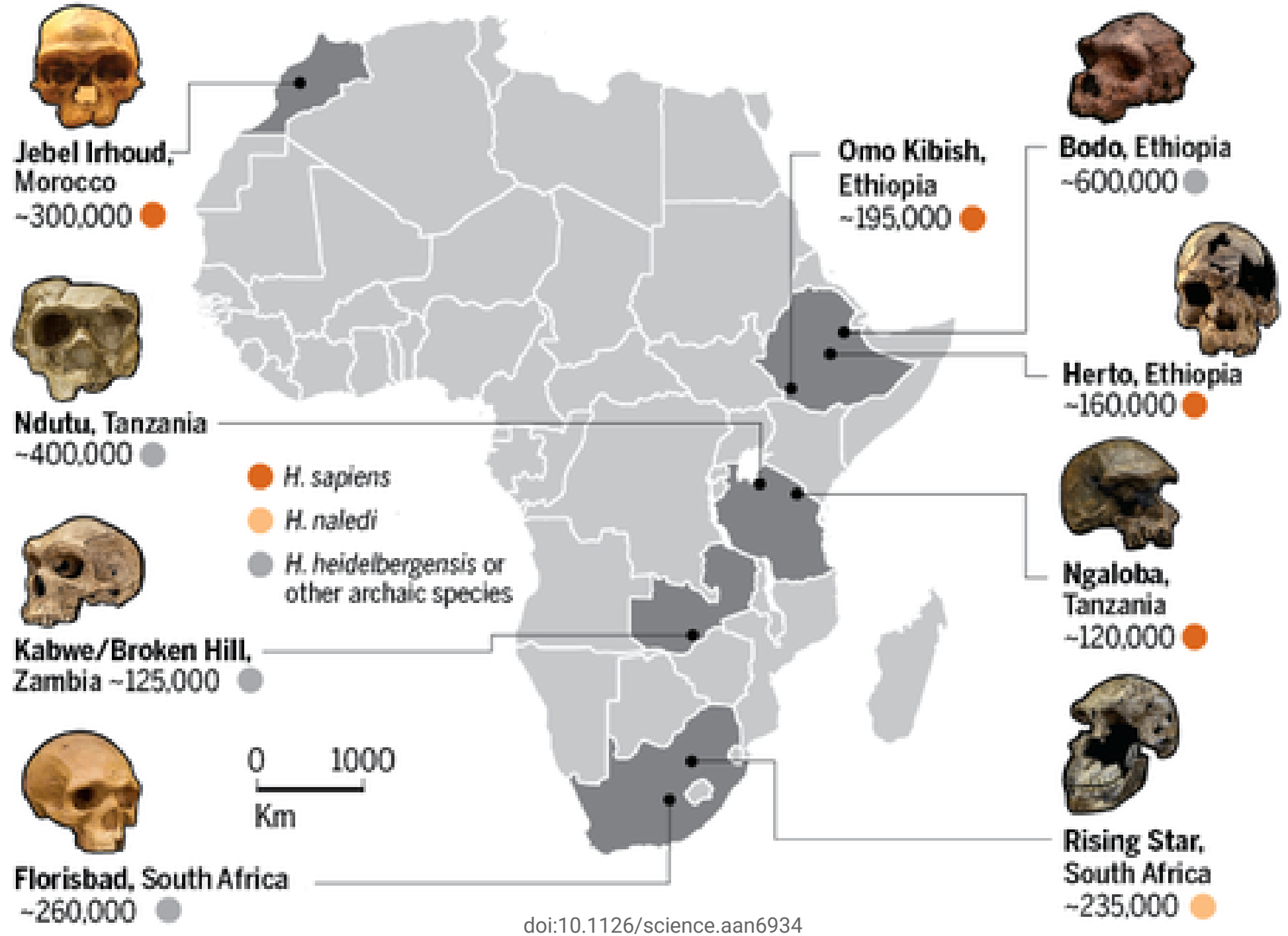
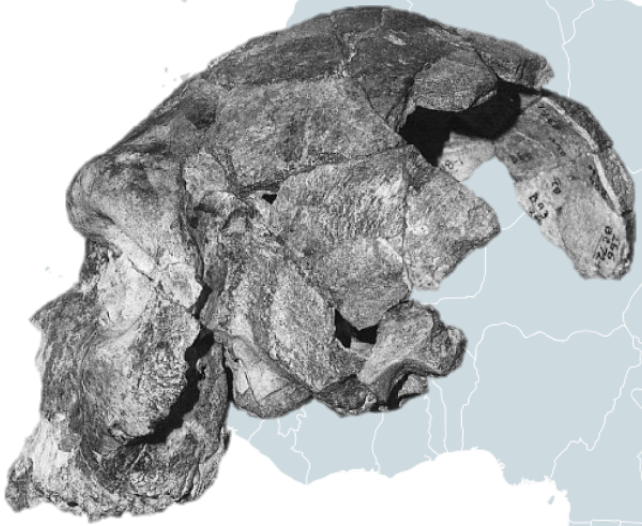
Sangiran 27
Sangiran 31

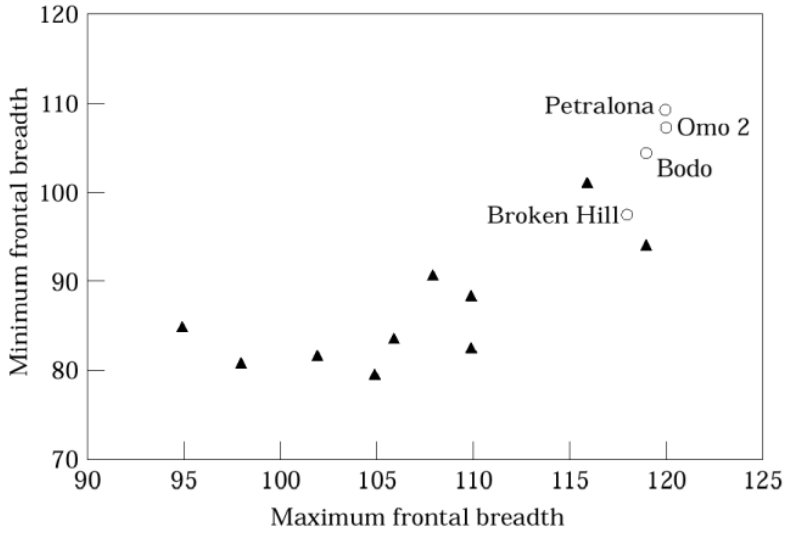


doi:10.1126/science.aan6934

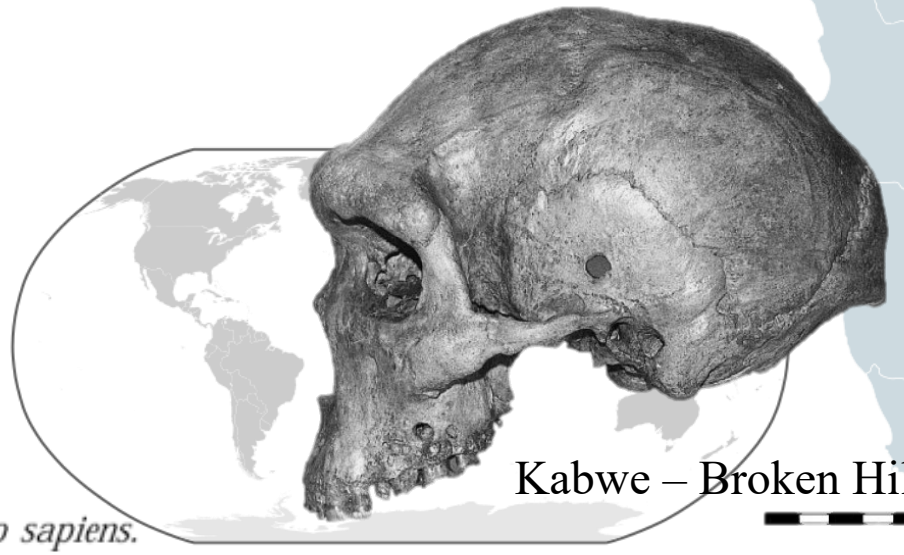
Bodo (600 ka, Ethiopia) and Kabwe (300 ka, Broken Hill, Zambia)



Bodo (Rightmire, 1995)



(▲), *Homo erectus* (Africa and Asia); (○), "archaic" *Homo sapiens.*



Kabwe – Broken Hill

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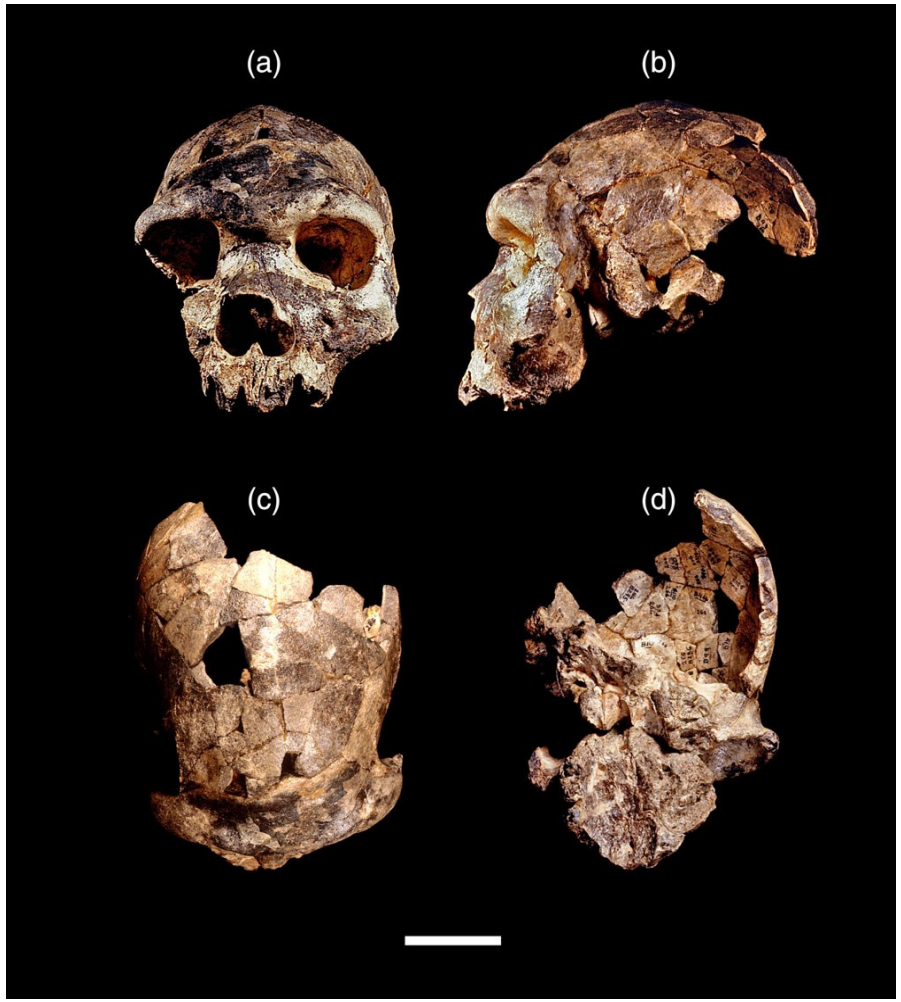
DOI: 10.1002/evan.21929

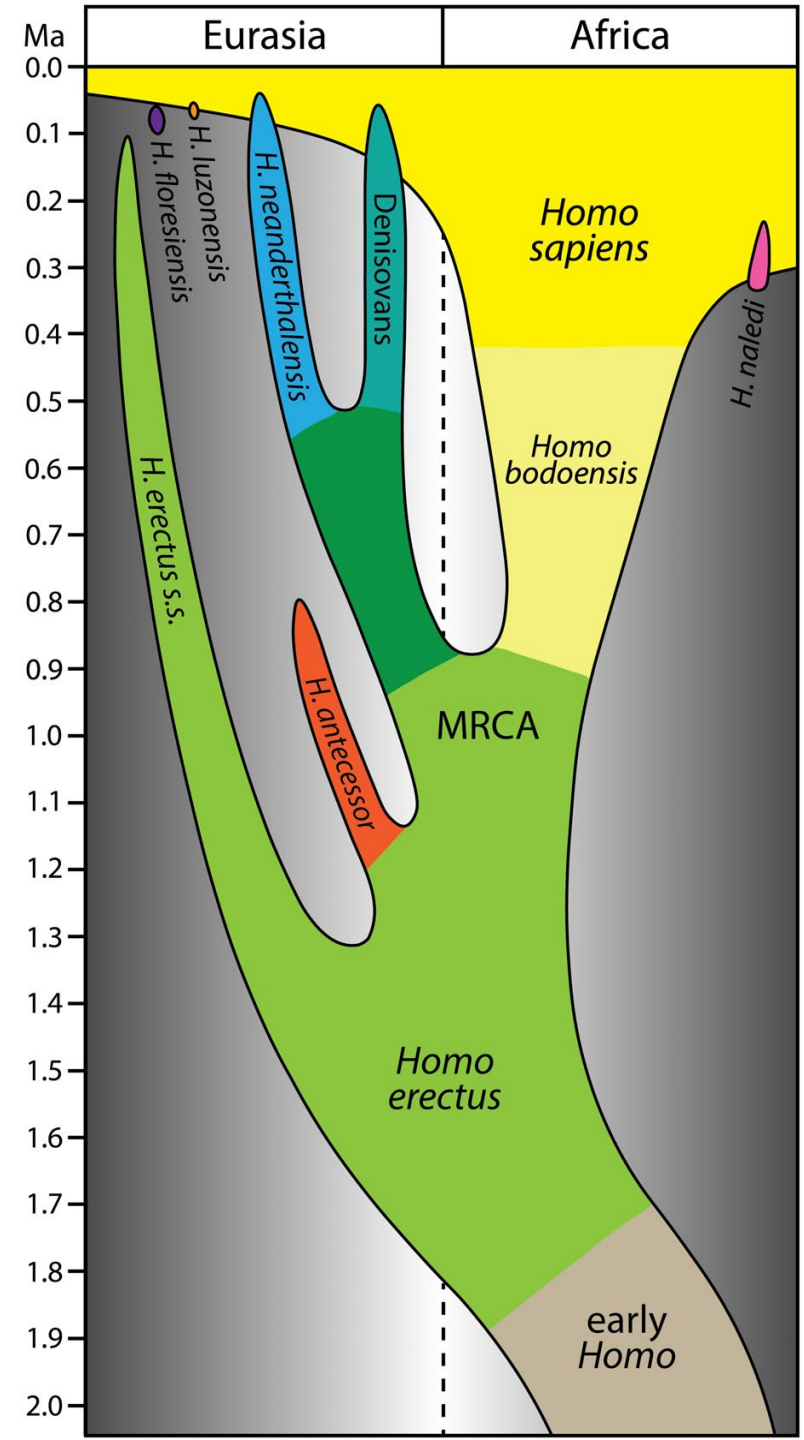
ISSUES

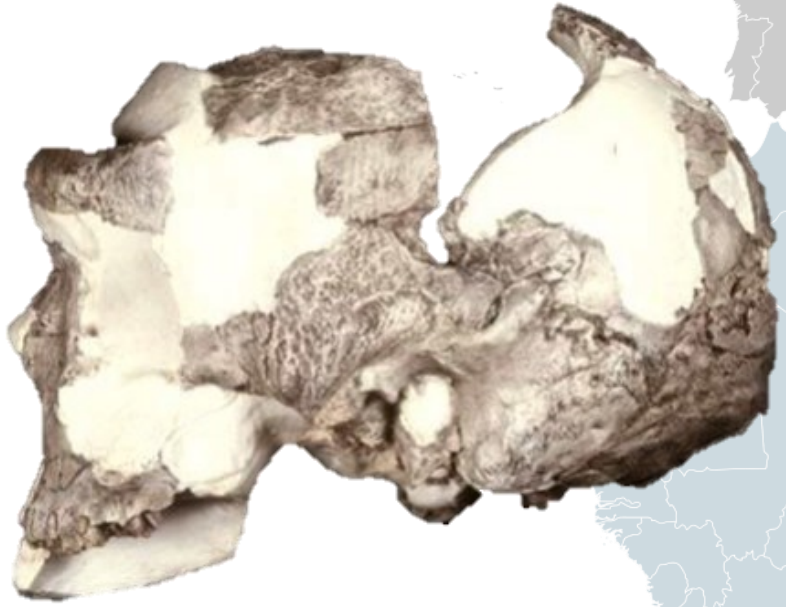
Evolutionary Anthropology ISSUES, NEWS, AND REVIEWS WILEY

Resolving the "muddle in the middle": The case for *Homo bodoensis* sp. nov.

Mirjana Roksandic[1,2] | Predrag Radović[3,4] | Xiu-Jie Wu[5] | Christopher J. Bae[6]



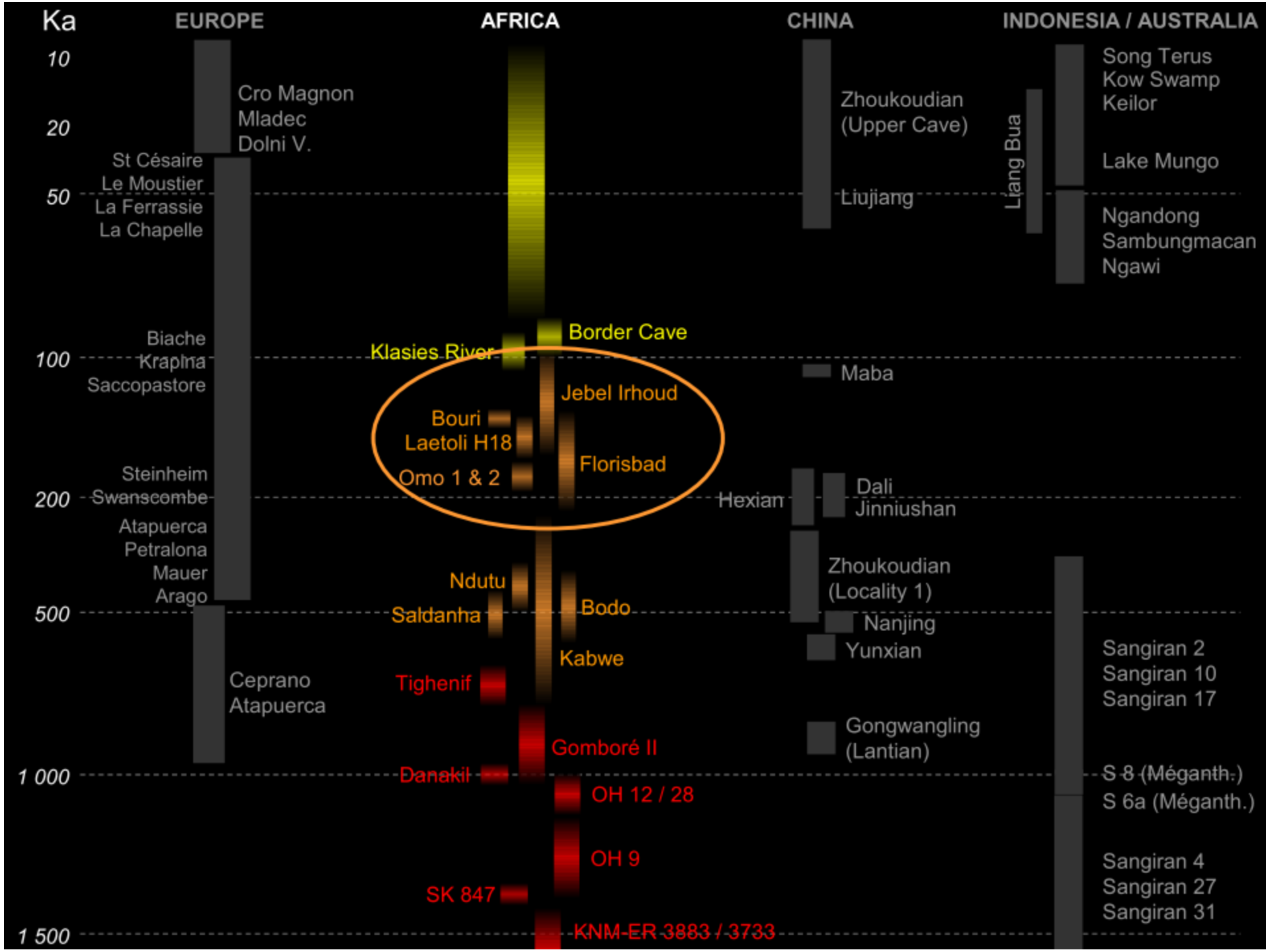




Ndutu, Tanzania
400 000 y BP

H. erectus: Dimensions of the cranium, thickness of the vault bones.

Archaic *H. sapiens*: Occipital and mastoid morphology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Dolni V.
St Césaire
Le Moustier
La Ferrassie
La Chapelle
Biache
Krapina
Saccopastore
Steinheim
Swanscombe
Atapuerca
Petralona
Mauer
Arago
Ceprano
Atapuerca
Border Cave
Klasies River
Jebel Irhoud
Bouri
Laetoli H18
Omo 1 & 2
Florisbad
Ndutu
Saldanha
Bodo
Kabwe
Tighenif
Gomboré II
Danakil
OH 12 / 28
OH 9
SK 847
KNM-ER 3883 / 3733
Zhoukoudian
(Upper Cave)
Liujiang
Maba
Hexian
Dali
Jinniushan
Zhoukoudian
(Locality 1)
Nanjing
Yunxian
Gongwangling
(Lantian)
Liang Bua
Song Terus
Kow Swamp
Keilor
Lake Mungo
Ngandong
Sambungmacan
Ngawi
Sangiran 2
Sangiran 10
Sangiran 17
S 8 (Méganth.)
S 6a (Méganth.)
Sangiran 4
Sangiran 27
Sangiran 31

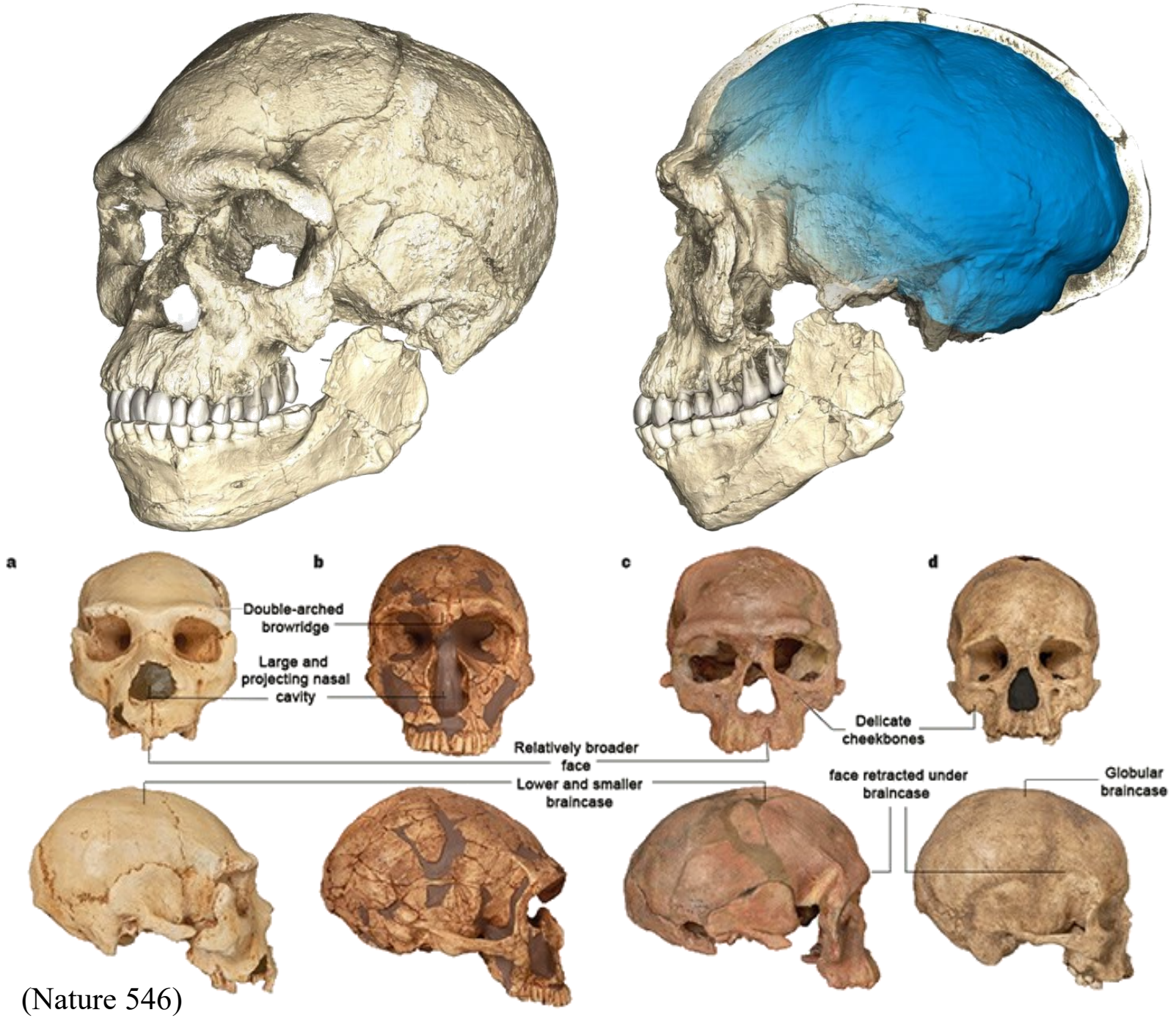
LETTER

doi:10.1038/nature22336

New fossils from Jebel Irhoud, Morocco and the pan-African origin of *Homo sapiens*

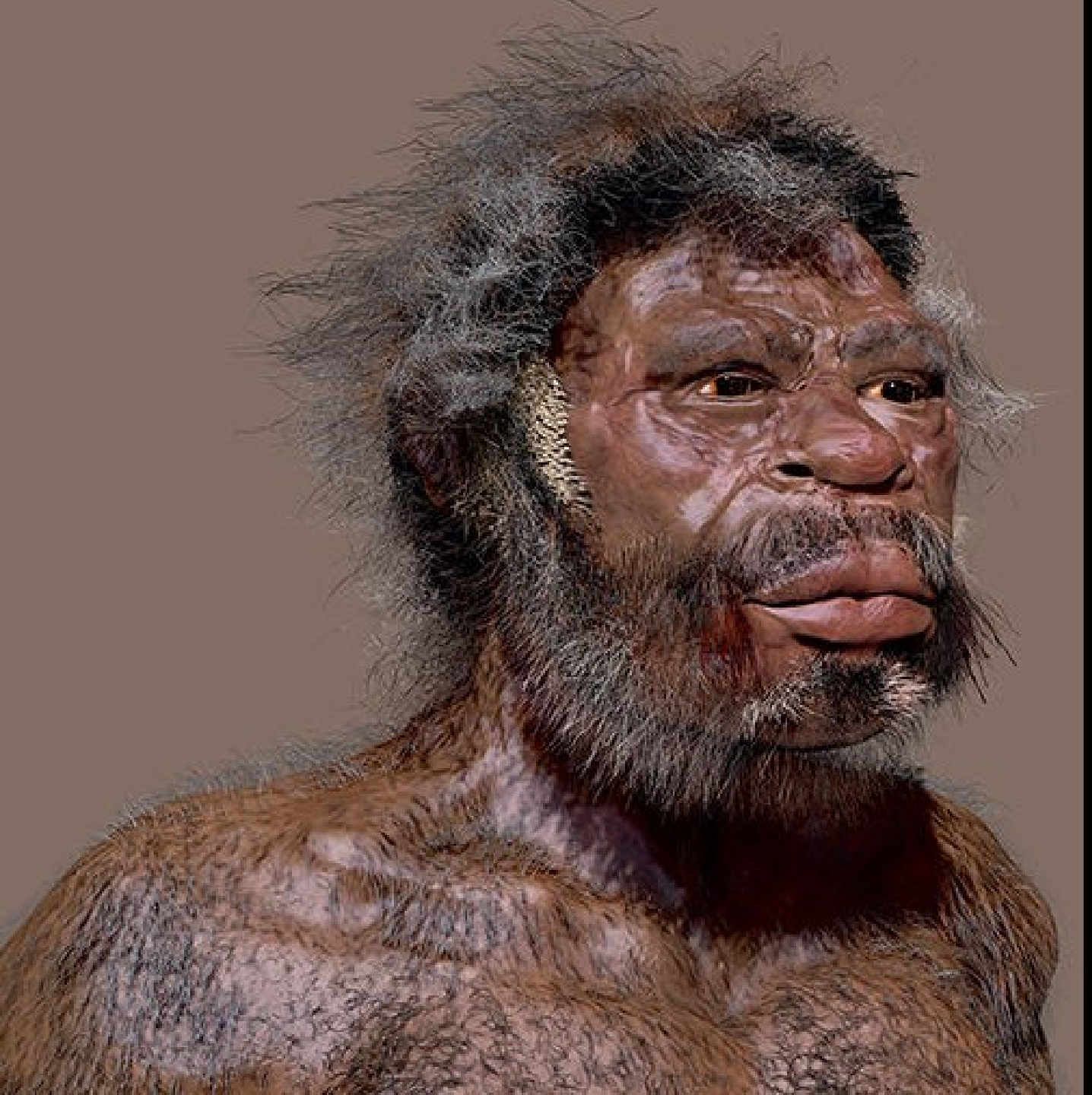
Jean-Jacques Hublin[1,2], Abdelouahed Ben-Ncer[3], Shara E. Bailey[4], Sarah E. Freidline[1], Simon Neubauer[1], Matthew M. Skinner[5], Inga Bergmann[1], Adeline Le Cabec[1], Stefano Benazzi[6], Katerina Harvati[7] & Philipp Gunz[1]

Fossil evidence points to an African origin of *Homo sapiens* from a group called either *H. heidelbergensis* or *H. rhodesiensis*. However, the exact place and time of emergence of *H. sapiens* remain obscure because the fossil record is scarce and the chronological age of many key specimens remains uncertain. In particular, it is unclear whether the present day 'modern' morphology rapidly emerged approximately 200 thousand years ago (ka) among earlier representatives of *H. sapiens*[1] or evolved gradually over the last 400 thousand years[2]. Here we report newly discovered human fossils from Jebel Irhoud, Morocco, and interpret the affinities of the hominins from this site with other archaic and recent human groups. We identified a mosaic of features including facial, mandibular and dental morphology that aligns the Jebel Irhoud material with early or recent anatomically modern humans and more primitive neurocranial and endocranial morphology. In combination with an age of 315 ± 34 thousand years (as determined by thermoluminescence dating)[3], this evidence makes Jebel Irhoud the oldest and richest African Middle Stone Age hominin site that documents early stages of the *H. sapiens* clade in which key features of modern morphology were established. Furthermore, it shows that the evolutionary processes behind the emergence of *H. sapiens* involved the whole African continent.



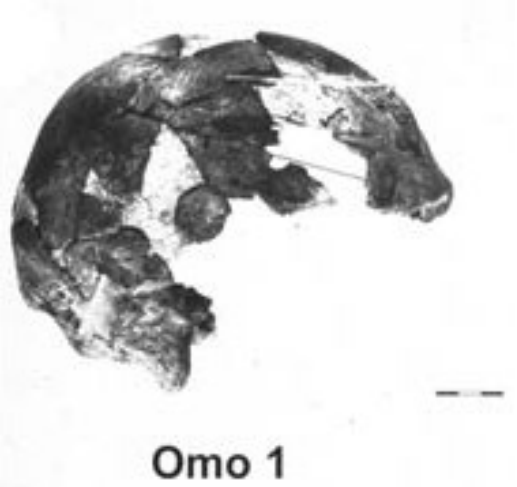
(Nature 546)

Modern face but archaic cranium.



J. BAVARO FINE ART/SPL/COSMOS

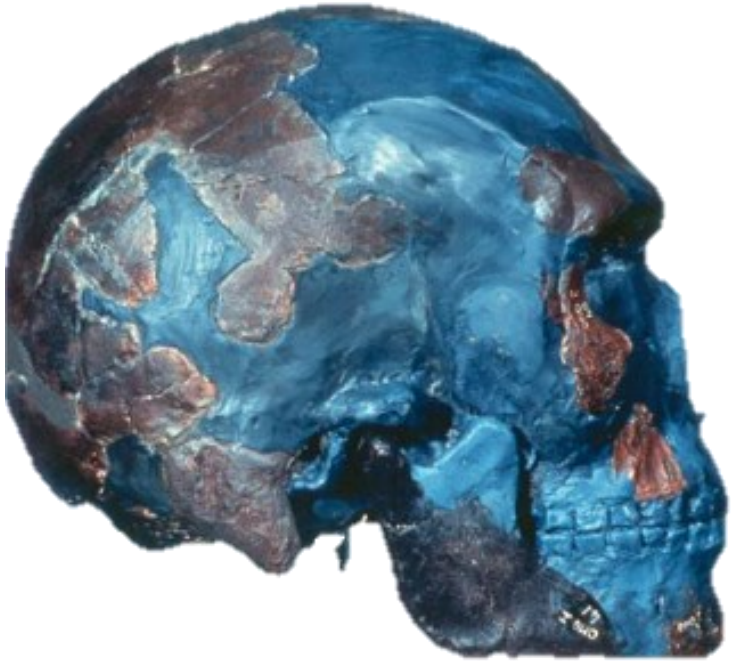
Omo Kibish, Ethiopia
195 000 - 130 000 y BP



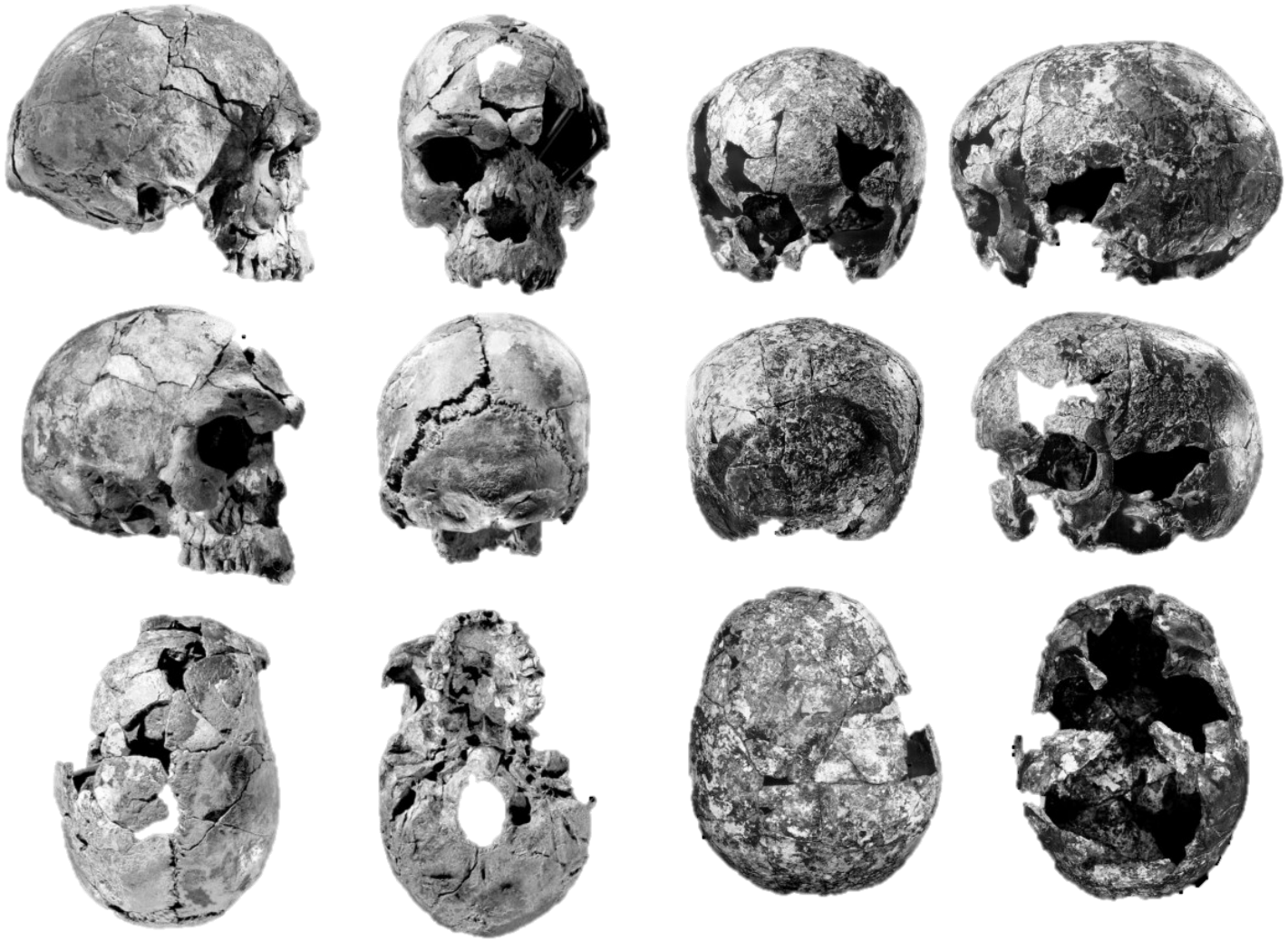
Omo 1

Omo 2

Bab El-Mandeb strait, the area where Africa and Saudi Arabia are close.



Herto Bouri, Middle Awash, Ethiopia
154-160 000 y BP



(White, 2003)

Bab El-Mandeb strait, the area where Africa and Saudi Arabia are close.

Homo sapiens idaltu

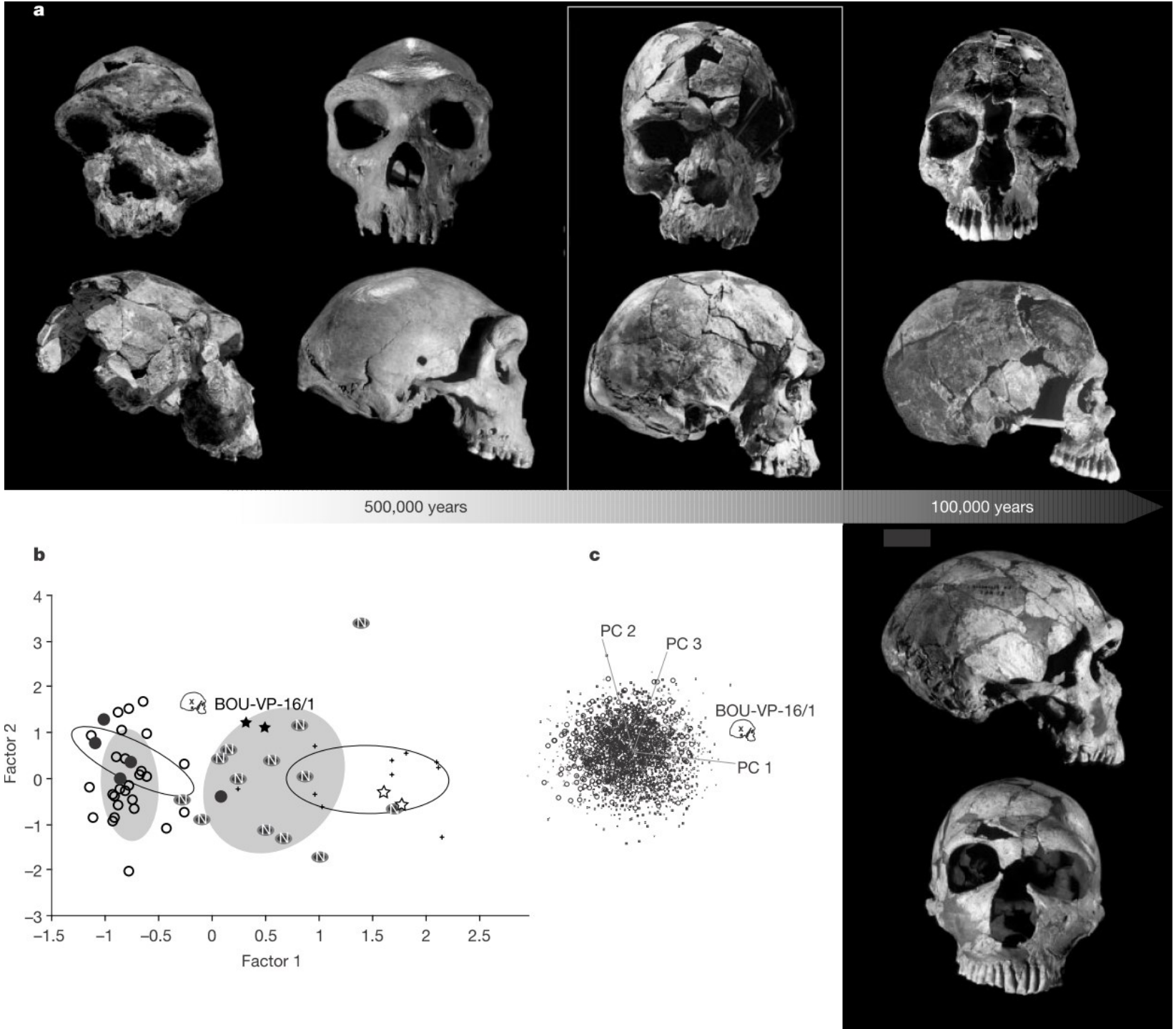
The remains were discovered for the first time in the site of Herto Bouri (Ethiopia) and have been dated to 160 ka BP.

Herto (Afar, Etiopia), 160.000 anni (White, 2003)

"Because the Herto hominids are morphologically just beyond the range of variation seen in AMHS [anatomically modern *Homo sapiens*], and because they differ from all other known fossil hominids, we recognize them here as *Homo sapiens idaltu*, a new palaeosubspecies of *Homo sapiens*".

Order Primates L., 1758
Suborder Anthropoidea Mivart, 1864
Superfamily Hominoidea Gray, 1825
Family Hominidae Gray, 1825
Homo sapiens idaltu subsp. nov.

Etymology. The subspecies name 'idàltu' is taken from the Afar language. It means 'elder'.
Holotype. BOU-VP-16/1 (Fig. 1), an adult cranium with partial dentition. Holotype and referred material are housed at the National Museum of Ethiopia, Addis Ababa. Holotype from Bouri Vertebrate Paleontology Locality 16 (BOU-VP 16); differentially corrected GPS coordinates: 10° 15.5484′ N and 40° 33.3834′ E.
Referred material. BOU-VP-16/2 cranial fragments; BOU-VP-16/3 parietal fragment; BOU-VP-16/4 parietal fragment; BOU-VP-16/5 child's cranium; BOU-VP-16/6 R. upper molar; BOU-VP-16/7 parietal fragment, BOU-VP-16/18 parietal fragments; BOU-VP-16/42 upper premolar, BOU-VP-16/43 parietal fragment.
Stratigraphy and age. Bouri Formation, Upper Herto Member. Dated by $^{40}Ar/^{39}Ar$ to between 160,000 and 154,000 years ago (ref. 6).
Diagnosis. On the limited available evidence, a subspecies of *Homo sapiens* distinguished from Holocene anatomically modern humans (*Homo sapiens sapiens*) by greater craniofacial robusticity, greater anterior–posterior cranial length, and large glenoid-to-occlusal plane distance. *Homo sapiens idaltu* is distinguished from the holotype of *Homo rhodesiensis* (Woodward, 1921) by a larger cranial capacity, a more vertical frontal with smaller face, and more marked midfacial topography (for example, canine fossa). We consider the holotypes of *H. helmei* and *H. njarasensis* too fragmentary for appropriate comparisons.



(White et al. 2003)

The african « evolutionary sequence » for *Homo sapiens*

Archaic *Homo sapiens*
Homo rhodesiensis?
Homo heidelbergensis?

→

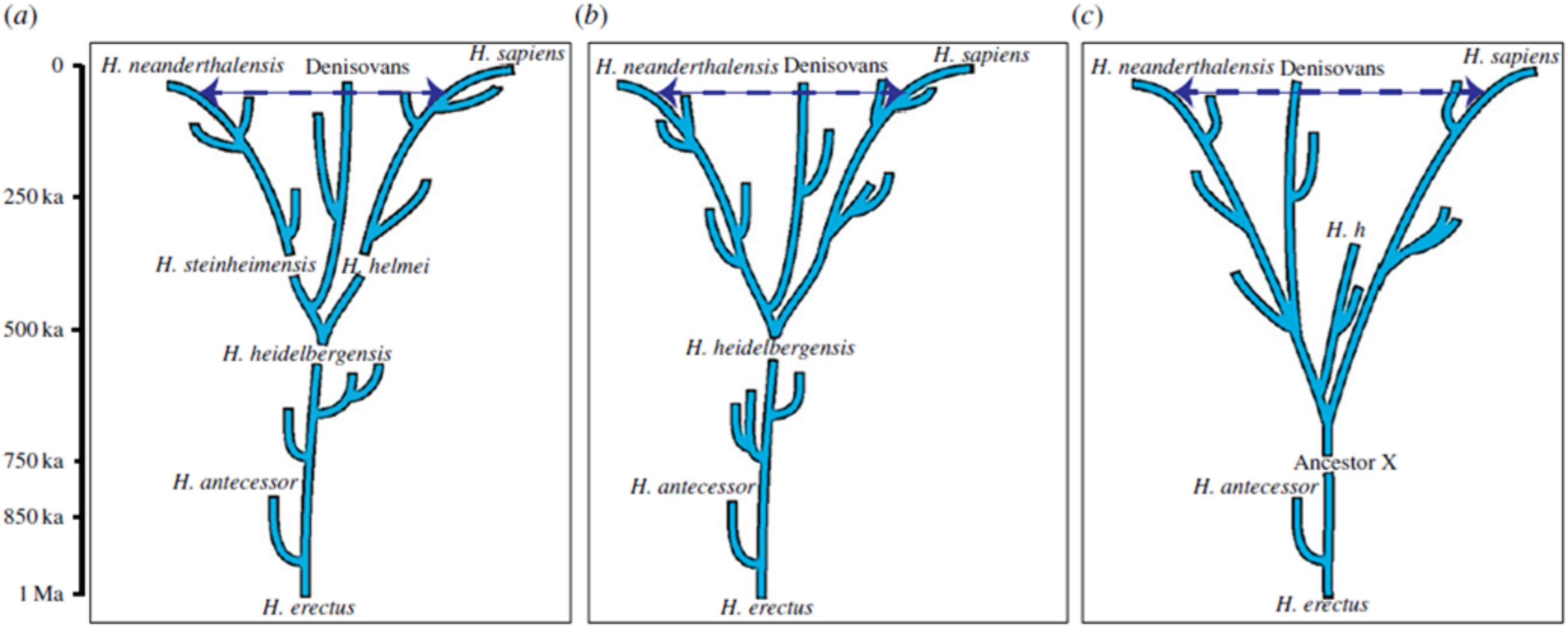
Anat. modern
Homo sapiens

Homo sapiens idaltu

Left lateral views of African and Israeli archaic and early modern *Homo sapiens* crania (Stringer 2016)

Florisbad | Jebel Irhoud 1 | Jebel Irhoud 2 | Eliye Springs | Guomde | Omo 2

Omo 1 | Herto | Ngaloba | Singa | Skhul 5 | Qafzeh 9



"Human fossils such as those from Jebel Irhoud, Florisbad, Eliye Springs and Omo Kibish 2 do represent early members of the species, but variation across the African later middle Pleistocene/early Middle Stone Age fossils shows that **there was not a simple linear progression towards later *sapiens* morphology**, and there was **chronological overlap between different 'archaic' and 'modern' morphs**. Even in the late Pleistocene within and outside Africa, we find *H. sapiens* specimens which are clearly outside the range of Holocene members of the species, showing the complexity of recent human evolution." Stringer, 2016

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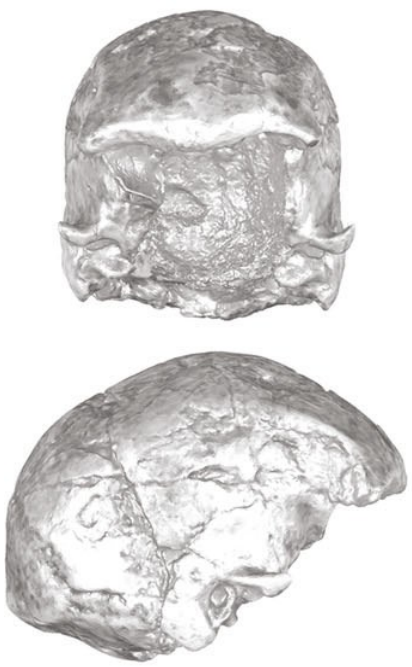
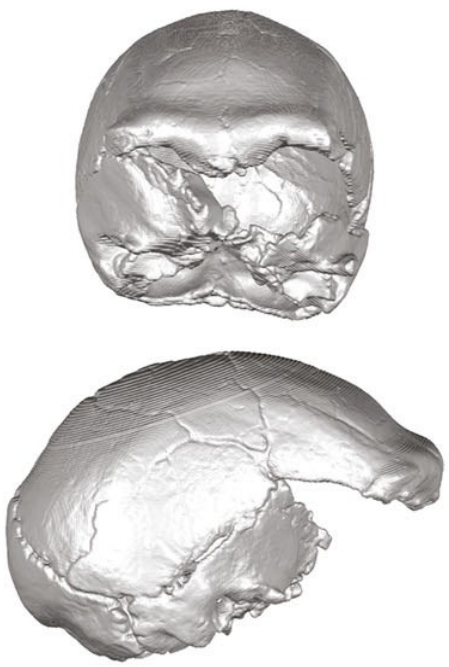
Deciphering African late middle Pleistocene hominin diversity and the origin of our species

Aurélien Mounier[1,2] & Marta Mirazón Lahr[2,3]



Omo II
Omo Kibish
(Ethiopia)
195 ka



LH 18
Laetoli (Tanzania)
200-300 ka

Florisbad
Bloemfontein
(south Africa)
259 ka

KNM-ES 11693
Eliye Springs
(Kenya)
270-300 ka

Irhoud 1
Jebel Irhoud
(Morocco)
315 ka

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Deciphering African late middle Pleistocene hominin diversity and the origin of our species

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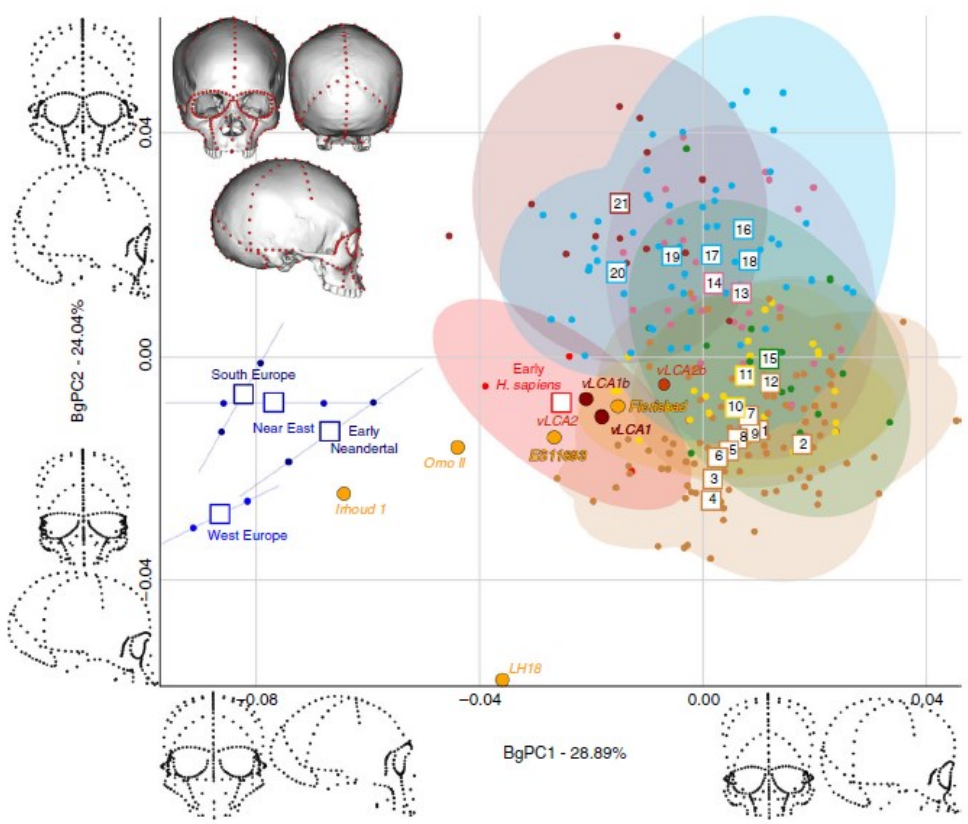

The origin of *Homo sapiens* remains a matter of debate. The extent and geographic patterning of morphological diversity among Late Middle Pleistocene (LMP) African hominins is largely unknown, thus precluding the definition of boundaries of variability in early *H. sapiens* and the interpretation of individual fossils. Here we use a phylogenetic modelling method to predict **possible morphologies of a last common ancestor of all modern humans**, which we compare to LMP African fossils (KNM-ES 11693, Florisbad, Irhoud 1, Omo II, and LH18). Our results support a complex process for the evolution of *H. sapiens*, **with the recognition of different, geographically localised, populations and lineages in Africa – not all of which contributed to our species' origin**. Based on the available fossils, *H. sapiens* appears to have originated from the coalescence of **South and, possibly, East-African source populations**, while **North-African fossils may represent a population which introgressed into Neandertals during the LMP.**