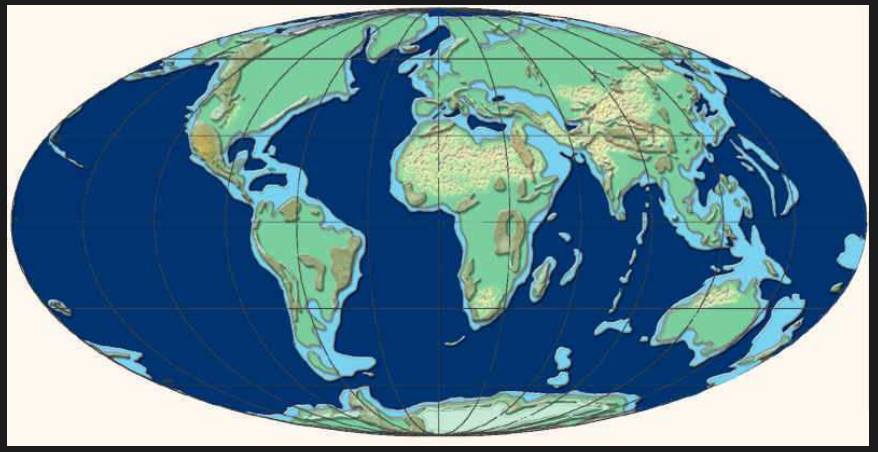
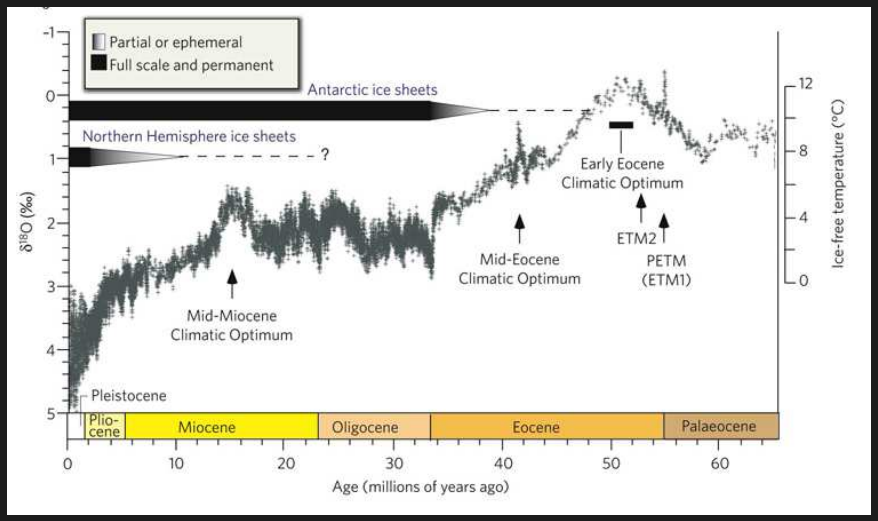
Hominina: vznik člověka

Vznik člověka

- kenozoikum: paleogén (paleocén, eocén, oligocén) + **neogén (miocén 23 Mya, pliocén 5.3 Mya) + kvartér (2.6 Mya: pleistocén, „holocén“)**





Vznik člověka

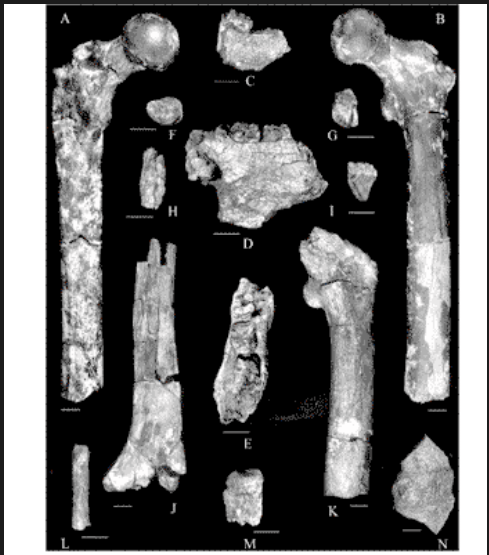
- všechno důležité se odehrálo v Africe („*out-of-Africa*“)

Fosilní záznam

Informal group	Taxa	Age (Ma)	Type specimen	Crania	Dentition	Axial	Upper limb	Lower Limb
Possible and probable primitive hominins	*S. tchadensis*	7.0–6.0	TM 266-01-060-1	X	X			
	Orronin tugenensis	6.0	BAR 1000'00		X		X	X
	Ar. ramidus s. s.†	5.7–4.5	ARA-VP-6/1	X	X		X	ff
Archaic hominins	*Australopithecus anamensis*	4.2–3.9	KNM-KP 29281	ff	X		X	X
	Australopithecus afarensis s. s.	4.0–3.0	LH4	X	X	X	X	X
	Kenyanthropus platyops	3.5–3.3	KNM-WT 40000	X	X			
	Australopithecus bahrelghazali	3.5–3.0	KT 12/H1		X			
	Au. africanus	3.0–2.4	Taung 1	X	X	ff	X	X
Megadont archaic hominins	*Au. garhi*	2.5	BOU-VP-12/130	X	X		?	?
	P. aethiopicus	2.5–2.3	Omo 18.18	X	X			
	P. boisei s. s.	2.3–1.3	OH 5	X	X		?	?
	P. robustus	2.0–1.5	TM1517	X	X		X	X
Transitional hominins	*H. habilis s. s.*	2.4–1.6	OH 7	X	X	X	X	X
	H. rudolfensis	2.4–1.6	KNM-ER 1470	X	X			?
Pre-modern *Homo*	*H. ergaster*	1.9–1.5	KNM-ER 992	X	X	X	X	X
	H. erectus s. s.	1.8–0.2	Trinil 2	X	X		X	X
	H. floresiensis‡	0.074–0.012	LB1	X	X	ff	X	X
	H. antecessor	0.7–0.5	ATD6-5	X	X			
	H. heidelbergensis	0.6–0.1	Mauer 1	X	X		ff	X
	H. neanderthalensis	0.2–0.03	Neanderthal 1	X	X	X	X	X
Anatomically modern humans	*H. sapiens s. s.*	0.19-present	None designated	X	X	X	X	X

Divergence člověk-šimpanz

- paleontologie: ~ 8 Mya
- molekulární biologie: 3-8, obvykle 5.5-6.5 Mya
- x nově (mutageneze): přes 8 Mya
- v Africe (ale ne podle Příkopové propadliny)
- v (opadavém?) lese (ne deštný prales × savana)



Orrorin tugenensis, the oldest hominid yet. Taken from Ref 8 in text.

Paleoekologie člověka

- radiokarbonová analýza vzorků půd v Awashi (Etiopie) a u jezera Turkana (Keňa)
- v zásadě potvrzeno: evoluce člověka tam probíhala v savanách
- i když vlastní vznik lidské linie byl asi v pralese

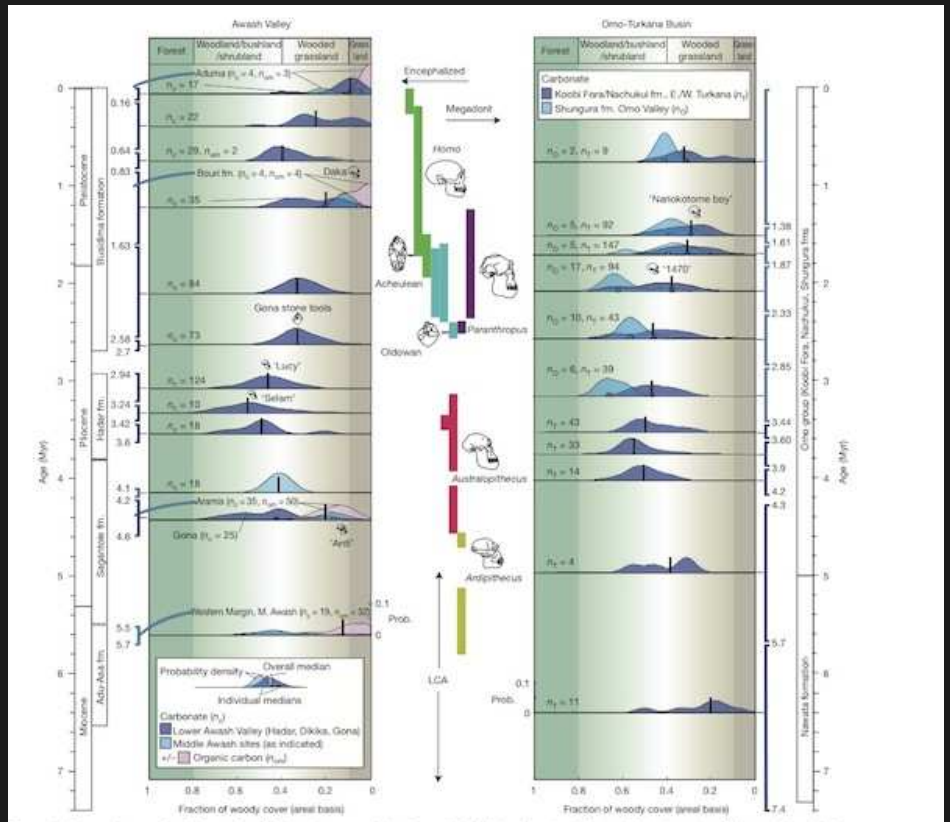
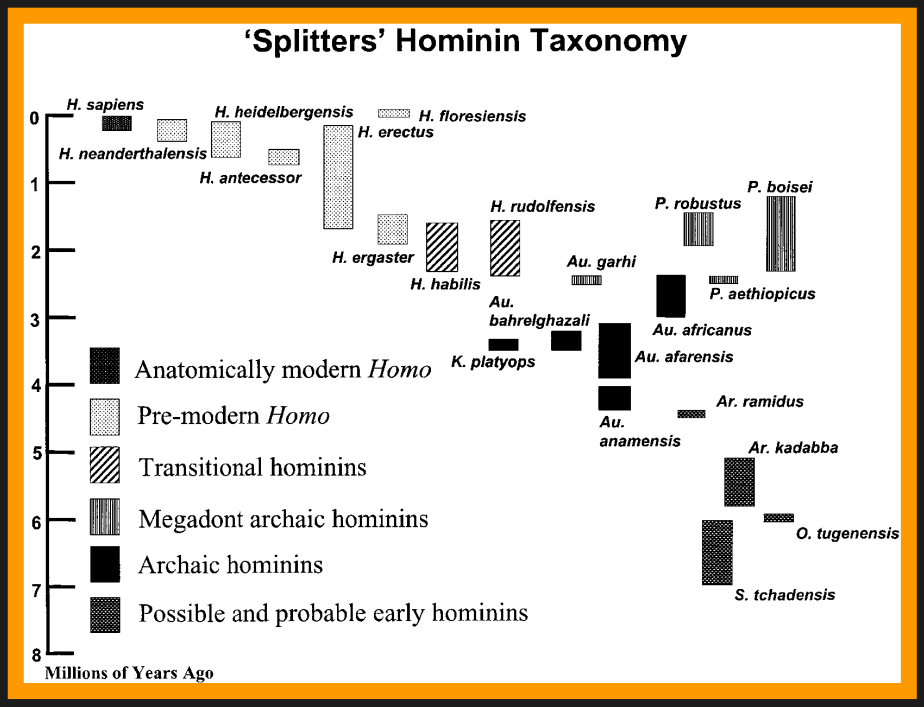
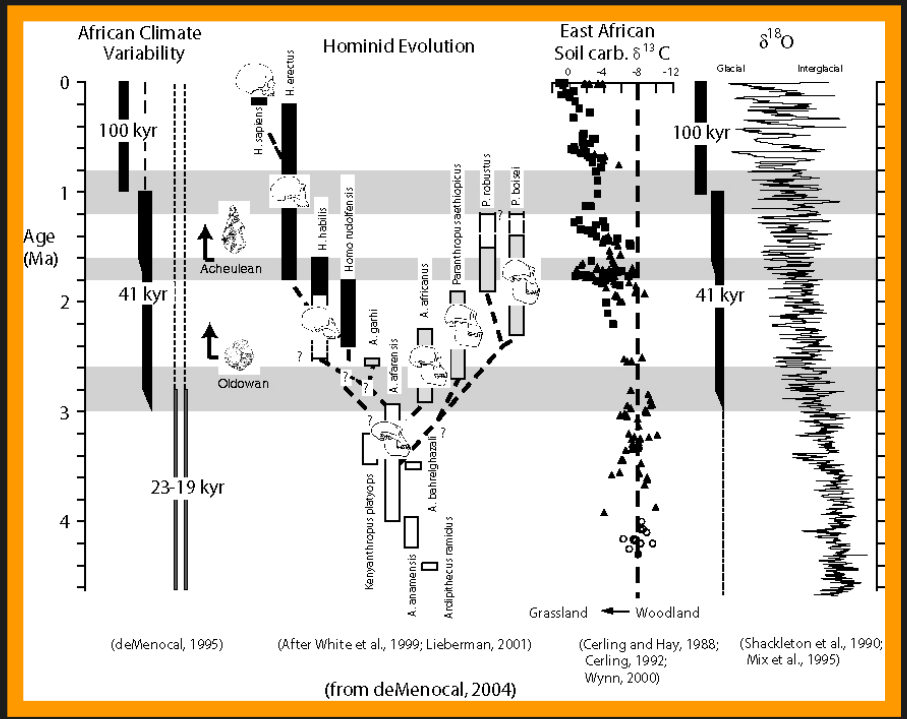
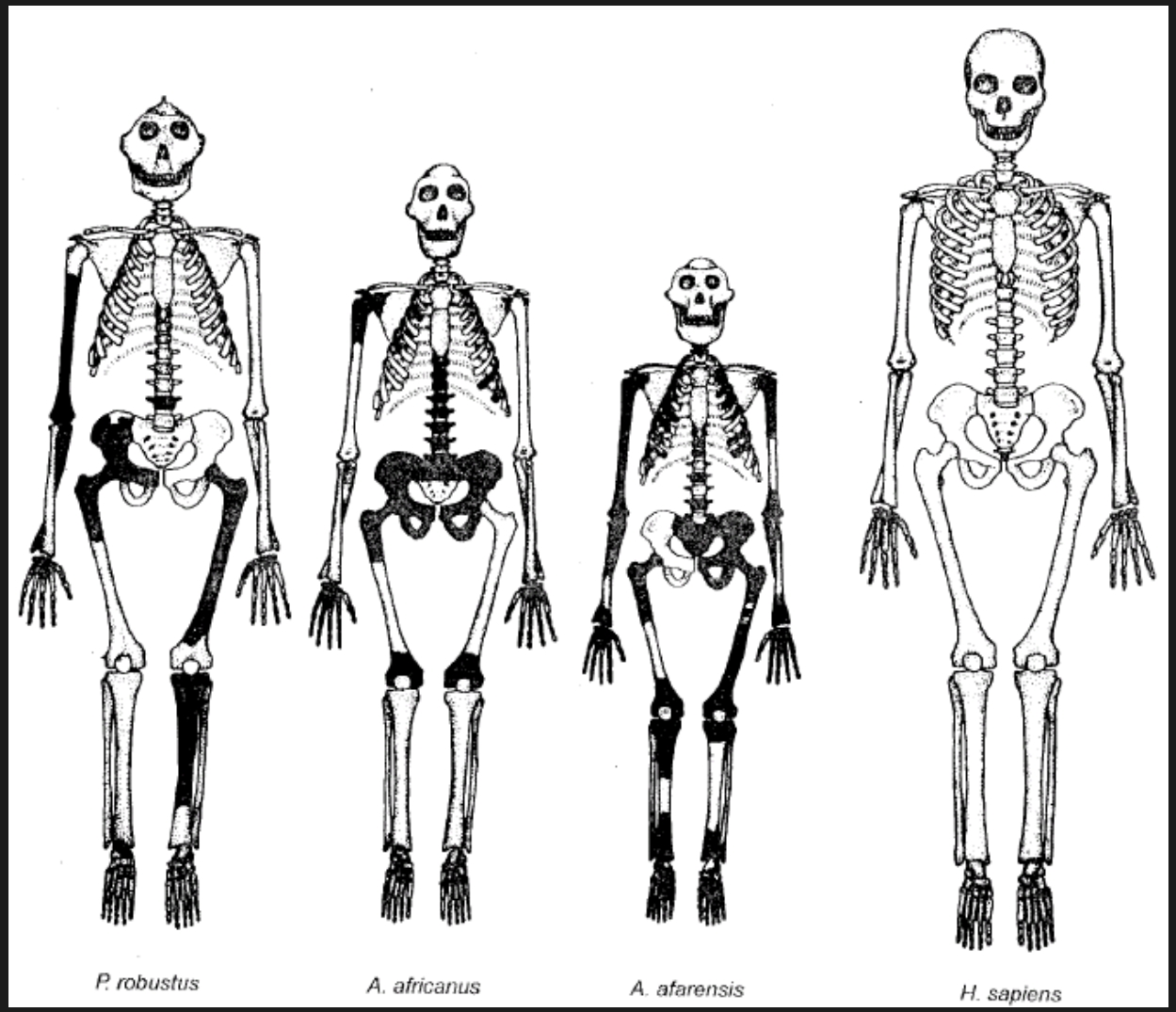


Figure 6 | Composite record of palaeosol stable isotopic composition from the Awash Valley, Ethiopia (left) and Omo-Turkana Basin, Kenya and Ethiopia (right). A hominin phylogram is shown at the centre (adapted from ref. 32). Stable isotope data are presented as normalized probability density functions of predicted woody cover determined for palaeosols in a series of temporal bins defined for each basin. Temporal bins are divided based on marker tephra in each sedimentary basin (see Supplementary Tables 3 and 4). The number of pedogenic carbonate analyses (n_c) and of organic matter analyses (n_{om}) are indicated for each temporal bin; the median value of woody cover for all data from each temporal bin is shown with a narrow white bar. Data from the Awash Valley include relatively continuous records from co-adjacent research areas at Hadar, Gona and Dikika, along with data from the Middle Awash region (Aduma, Daka, Aramis and Western Margin). Because the Shungura formation of the Omo River Valley preserves different environments from the remainder of the basin[36], data from this region are shown with probability density functions distinct from the remainder of the record (Koobi Fora and Nachukui formations, East and West Turkana). The number of analyses from the Omo Valley (n_{1C}) and the Lower Turkana Basin (n_{1T}) are indicated. Hominin species ranges are spread according to their age distribution (vertical axis) and roughly corresponding to their anatomical features (horizontal axis)[32]. Major archaeological innovations of early stone tool development are also indicated: Oldowan technology, first stone tools, 2.6 Myr ago; Acheulean technology, 1.7 Myr ago.

Fylogeneze pravých hominidů (Hominina)






P. robustus
A. africanus
A. afarensis
H. sapiens

Synapomorphies of the hominid clade:

1. Nasal bones projected and expanded above frontomaxillary suture.
38. Petrous orientation intermediate.
40. Inclination of nuchal plane intermediate.
41. Foramen magnum positoned at bi-tympanic line.
45. Mandibular symphysis orientation intermediate.
50. Incisors moderately reduced.
51. Canines somewhat reduced.
55. dM_1 mesial marginal ridge slight, with open anterior fovea, and protoconid set mesial to metaconid.
58. Well-developed P_3 metaconid infrequent.
59. Tooth enamel thick.

Synapomorphies of the *A. africanus*+*Homo*+"robust" clade:

5. Nasoalveolar clivus straight in coronal plane.
13. Index of palate protrusion is variably prognathic and mesognathic.
16. Cranial capacity increased to state 1 (approximately 500 cm^3).
21. Partial compound T/N crest.
22. Asterionic notch either variable or absent.
33. Postglenoid process size and position intermediate.
34. Tympanic crest with vertical plate.
40. Nuchal plane weakly inclined.
47. Hollowing above and behind mental foramen variable.
52. Prominence of median lingual ridge of mandibular canine is variable.
58. Well developed P_3 metaconid is frequent.

Synapomorphies of the *Homo*+"robust" clade:

38. Petrous orientation coronal.
42. Foramen magnum roughly horizontal.
45. Vertically oriented mandibular symphysis.
46. Mental foramen opens laterally.
47. No hollowing above and behind mental foramen.
51. Canines very reduced.
52. Weak median lingual ridge of mandibular canine.

Synapomorphies of the "robust" clade:

3. Infraorbital foramen low.
5. Nasoalveolar clivus concave in coronal plane (guttered clivus).
6. Incisor alveoli do not project beyond bicanine line (parallel with *H. rudolfensis*).
7. Smooth entrance to nasal cavity, with overlapping clivus and palate.
8. Thick palate.
10. Thick zygomatic arch.
11. Zygomatic projects anterior to piriform aperture (dished face).
14. Masseteric tubercle at or anterior to sellion (parallel with *A. afarensis*).
19. Strong anteromedial incursion of the temporal lines.
24. Extensive overlap of squamosal suture.
25. Mastoid process inflated lateral to the supramastoid crest.
26. Marked postorbital constriction.
28. Face halfted high.
29. Wide supraglenoid gutter.
44. Large mandibular cross sectional area at M_1 (parallel with *H. rudolfensis*).
48. Wide mandibular extramolar sulcus.
53. Premolar area increases to either state 3 or state 4.
55. dM_1 mesial marginal ridge thick, enclosing fovea anterior; protoconid even with metaconid.
57. Molar and premolar cusp apices narrowly separated.
59. Hyperthick enamel.

Synapomorphies of *A. robustus* and *A. boisei*:

18. O–M sinus frequently present (parallel with *A. afarensis*).
33. Postglenoid process small and fused to tympanic (parallel with *H. ergaster*+*H. sapiens* clade).
35. External auditory meatus laterally placed.
36. Vaginal process moderate to large.
41. Foramen magnum well anterior to bi-tympanic line.
50. Incisors reduced (parallel with *H. sapiens*).

Synapomorphies of the *Homo* clade:

1. Nasal bones do not project above frontomaxillary suture.
16. Cranial capacity increased to state 2 (510–675 cm^3).
19. Variable (moderate to weak) anteromedial incursion of the temporal lines (reversal).
27. Reduced pneumatization of temporal squama (parallel with *A. robustus*).

Synapomorphies of *H. rudolfensis*+*H. ergaster*+*H. sapiens*:

12. Palate deep anteriorly (shelved; parallel with *A. africanus* and *P. boisei*).
16. Cranial capacity increased to state 3 (750–875 cm^3).
19. Weak anteromedial incursion of the temporal lines.
20. Sagittal crest absent in presumptive males.
21. Compound T/N crest absent (parallel with *A. africanus* and *A. boisei*).
48. Mandibular extramolar sulcus narrow (reversal).

Synapomorphies of *H. ergaster*+*H. sapiens*:

13. Index of palate protrusion is orthognathic.
33. Postglenoid process small and fused to tympanic (parallel with *A. robustus*+*A. boisei* clade).
54. Molar area reduced to state 0 (smallest; reversal).
60. Dental development rate intermediate.

Apomorphies of *A. afarensis*:

14. Masseteric tubercle at or anterior to sellion (parallel with "robust" clade).
18. O–M sinus frequently present (parallel with *A. robustus*+*A. boisei* clade).

Apomorphies of *A. africanus*:

1. Projection of nasal bones variable.
4. Anterior pillars variable (parallel with *H. habilis*).
12. Palate deep anteriorly (shelved; parallel with *A. boisei* and *H. rudolfensis*+*H. ergaster*+*H. sapiens* clade).
21. Compound T/N crest absent (parallel with *H. rudolfensis*+*H. ergaster*+*H. sapiens* clade).

Apomorphies of *A. aethiopicus*:

13. Index of palate protrusion prognathic (reversal).
16. Cranial capacity reduced to state 0 (less than 500 cm^3; reversal).
21. Compound T/N crest extensive (reversal).
22. Asterionic notch present (reversal).
30. Flat cranial base (reversal).
32. Shallow mandibular fossa (reversal).

Apomorphies of *A. robustus*:

4. Anterior pillars present.
27. Reduced pneumatization of temporal squama (parallel with *Homo* clade).
37. Eustacian process present and prominent (reversal).

Apomorphies of *A. boisei*:

12. Palate deep anteriorly (parallel with *A. africanus* and the *H. rudolfensis*+*H. ergaster*+*H. sapiens* clade).
32. Deep mandibular fossa (parallel with *H. sapiens*).
34. Tympanic crest with inclined plate.
53. Premolar crown area increased to state 5 (largest).

Apomorphies of *H. habilis*:

4. Anterior pillars variable (parallel with *A. africanus*).
7. Variable entrance to nasal cavity.
35. M–L position of external auditory meatus variable.
41. Foramen magnum variably at or anterior to bi-tympanic line.

Apomorphies of *H. rudolfensis*:

6. Nasoalveolar contour does not protrude beyond bicanine line (parallel with "robust" clade).
11. Intermediate projection of zygomatic bone relative to piriform aperture.
44. Mandibular cross-sectional area at M_1 variable.
47. Variable hollowing above and behind mental foramen (reversal).

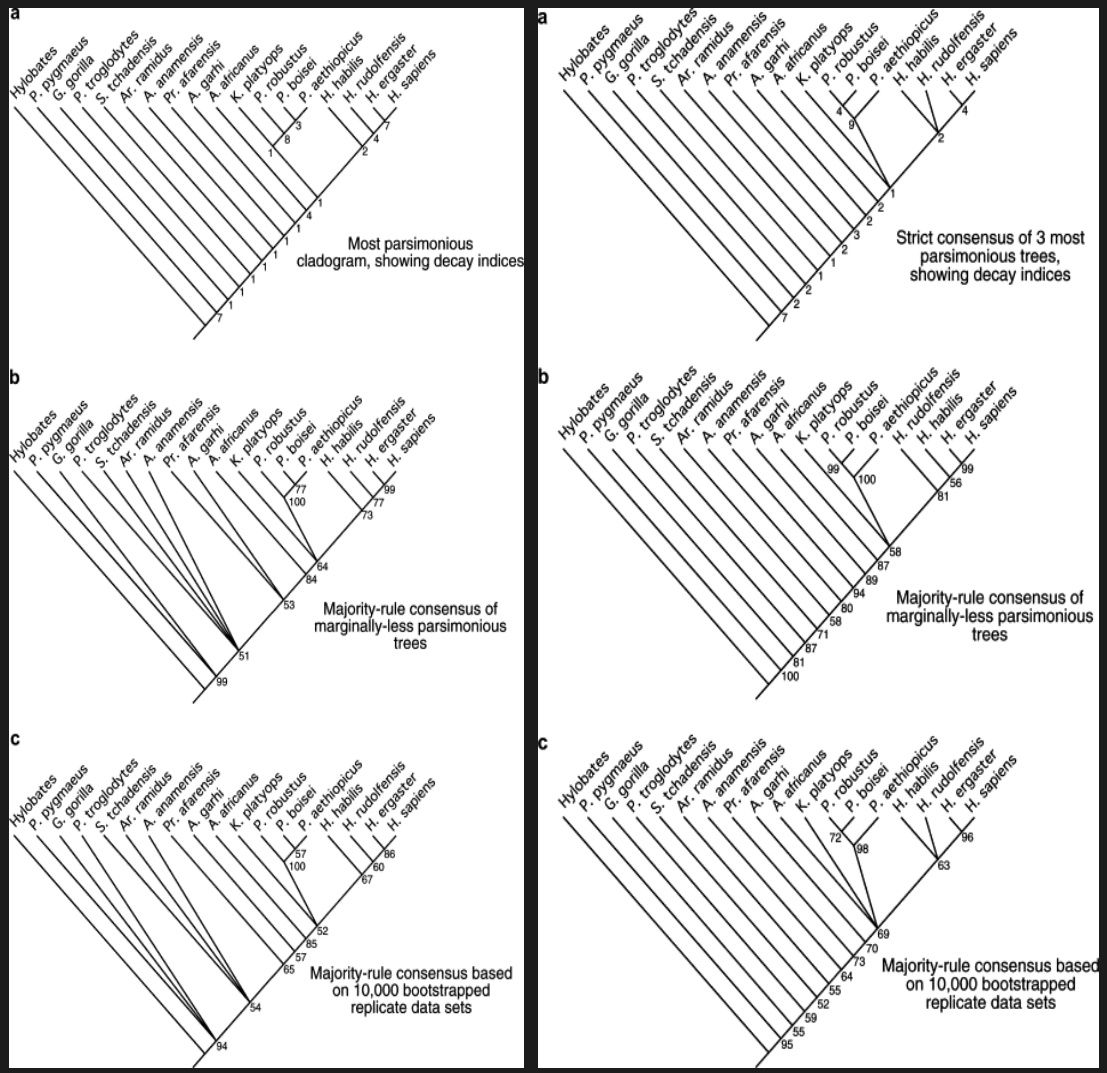
Apomorphies of *H. ergaster*:

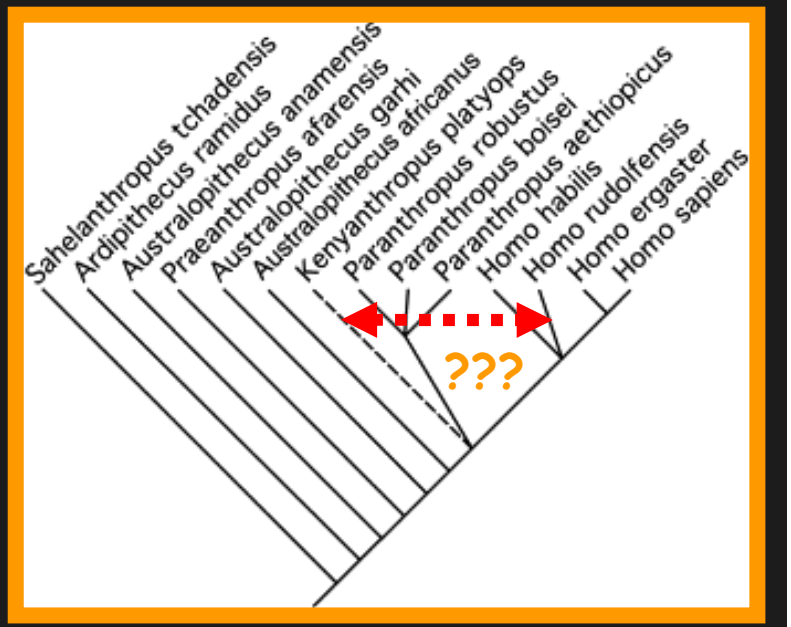
32. Mandibular fossa variably shallow and intermediate (reversal).
39. Heart shaped foramen magnum variable.
42. Foramen magnum strongly inclined anteriorly.

Apomorphies of *H. sapiens*:

5. Nasoalveolar clivus convex in coronal plane (reversal).
7. Smooth entrance to nasal cavity, without overlapping clivus and palate.
16. Cranial capacity increased to state 4 ($\sim$ 1400 cm^3).
26. Postorbital constriction slight.
32. Mandibular fossa deep (parallel with *A. boisei*).
46. Mental foramen opens posteriorly.
50. Incisors reduced (parallel with *A. robustus*+*A. boisei*).
53. Premolar crown area reduced to state 0 (smallest).

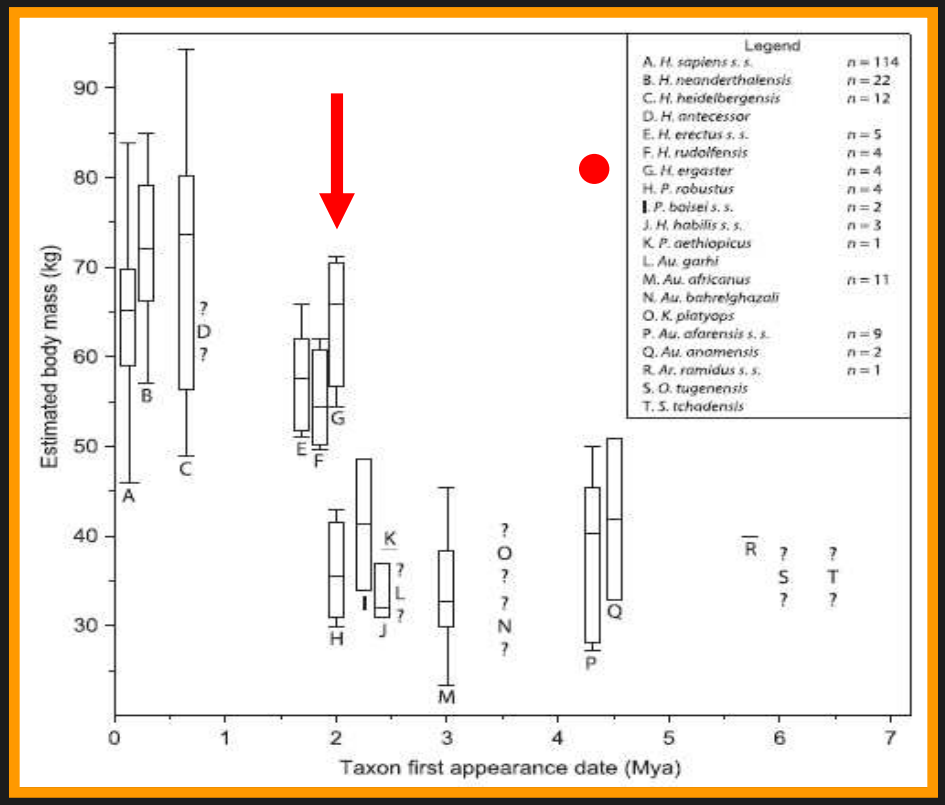
Fylogeneze hominidů

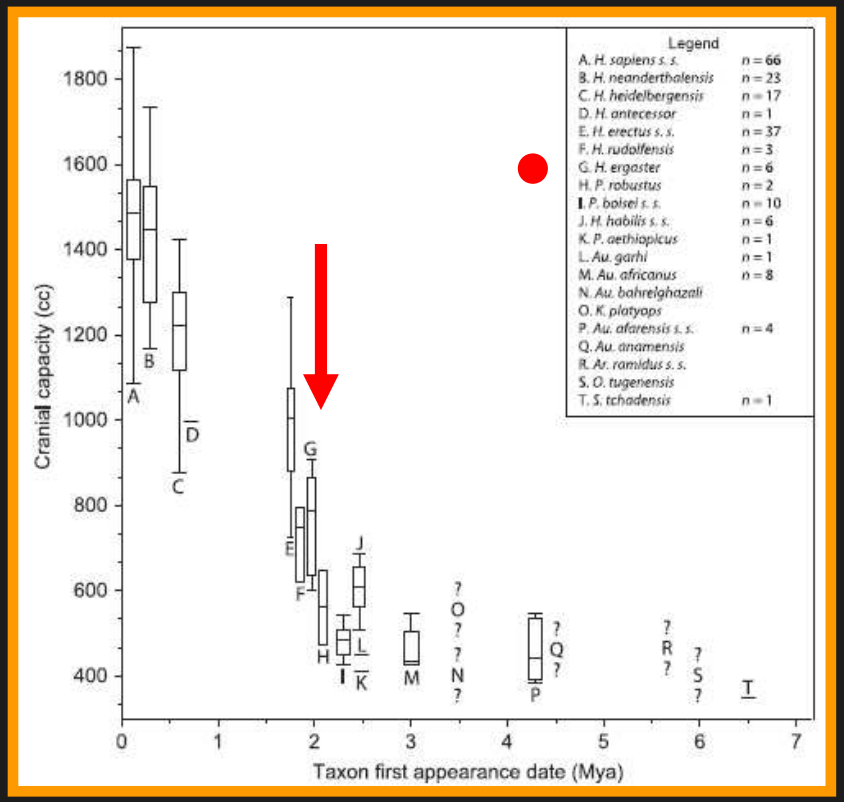




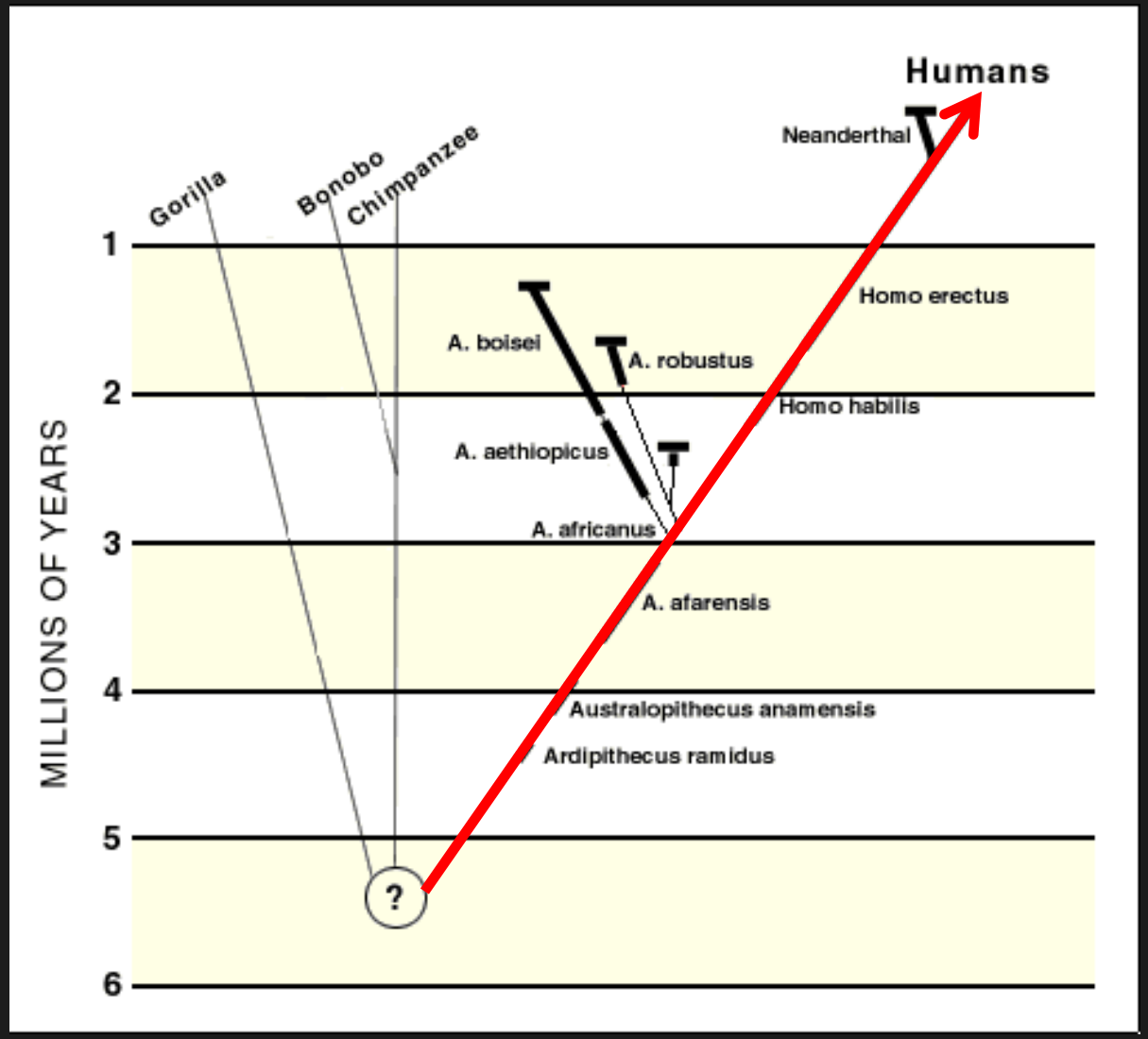
kraniometrické znaky vs. „tradiční znaky“

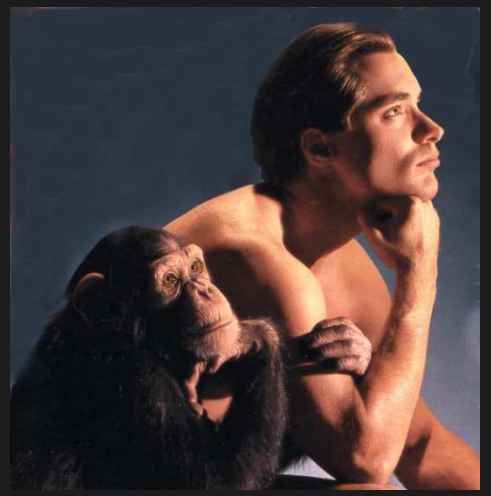
Evoluce hominidů
růst těla a mozku

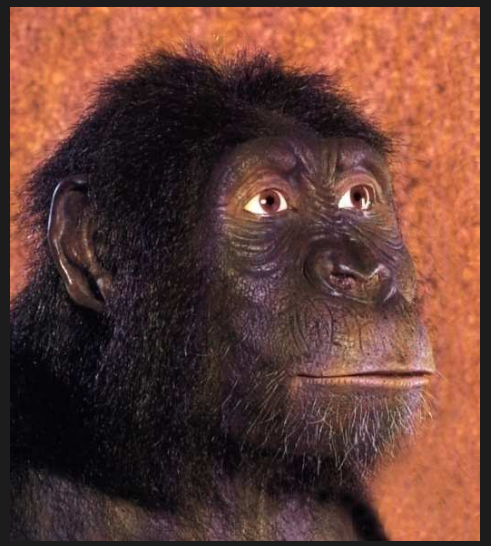




Hominina: kladogeneze vs. anageneze

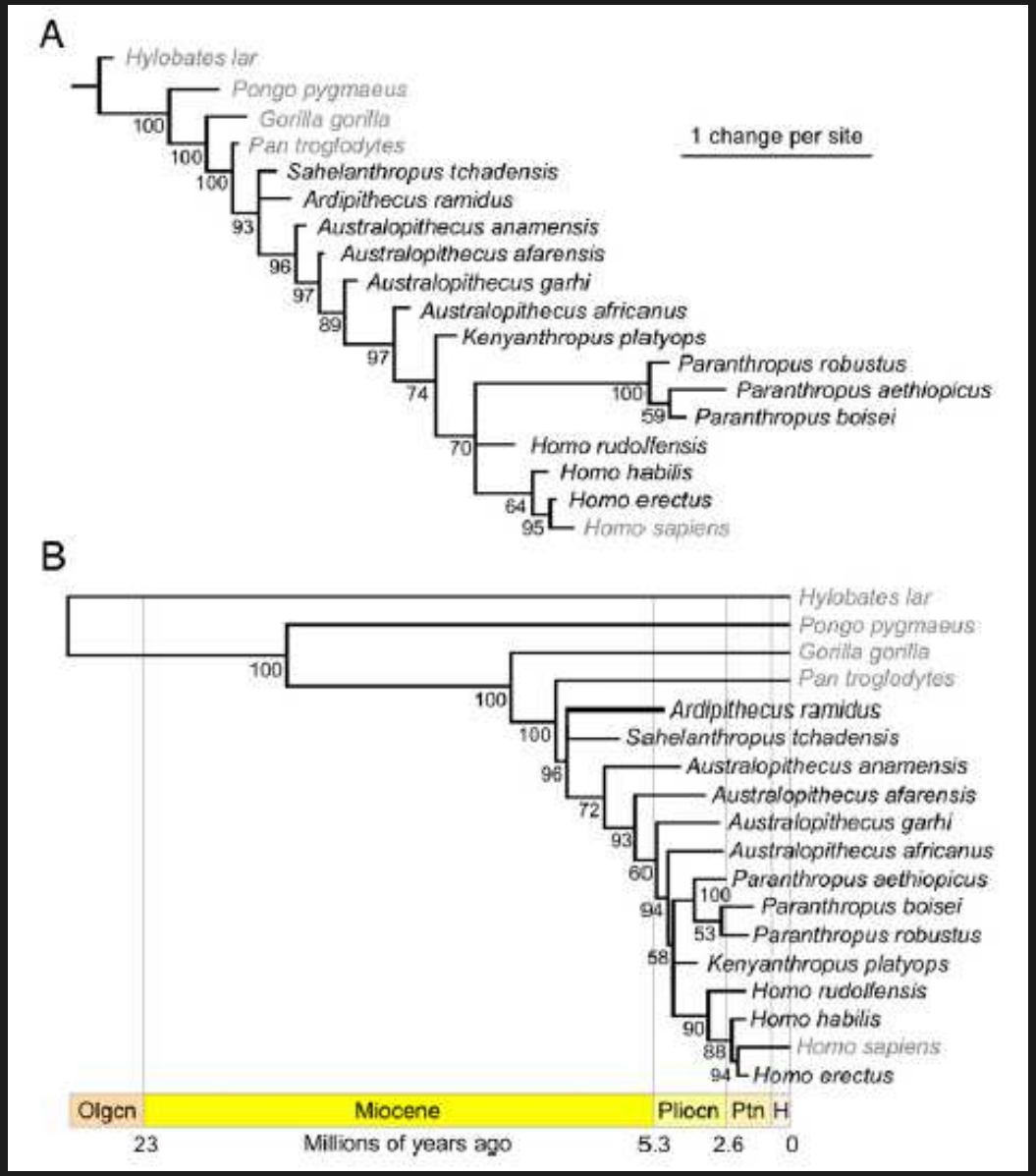




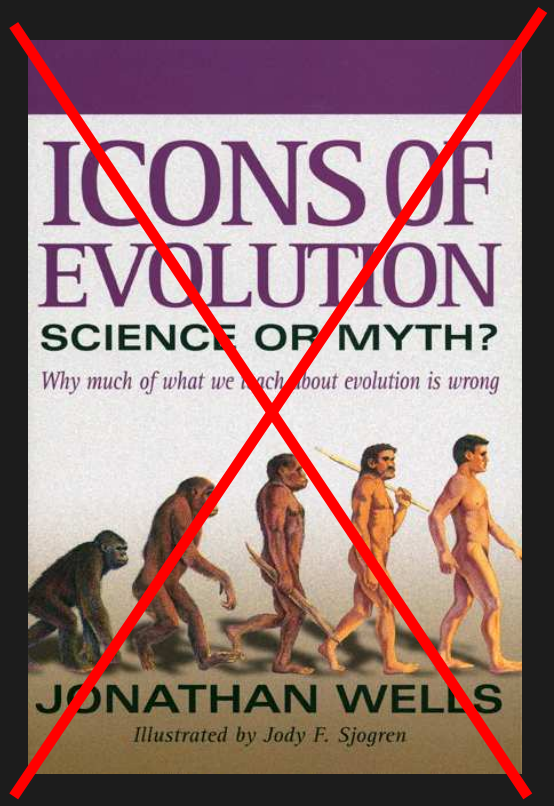


Hominina: kladogeneze vs. anageneze

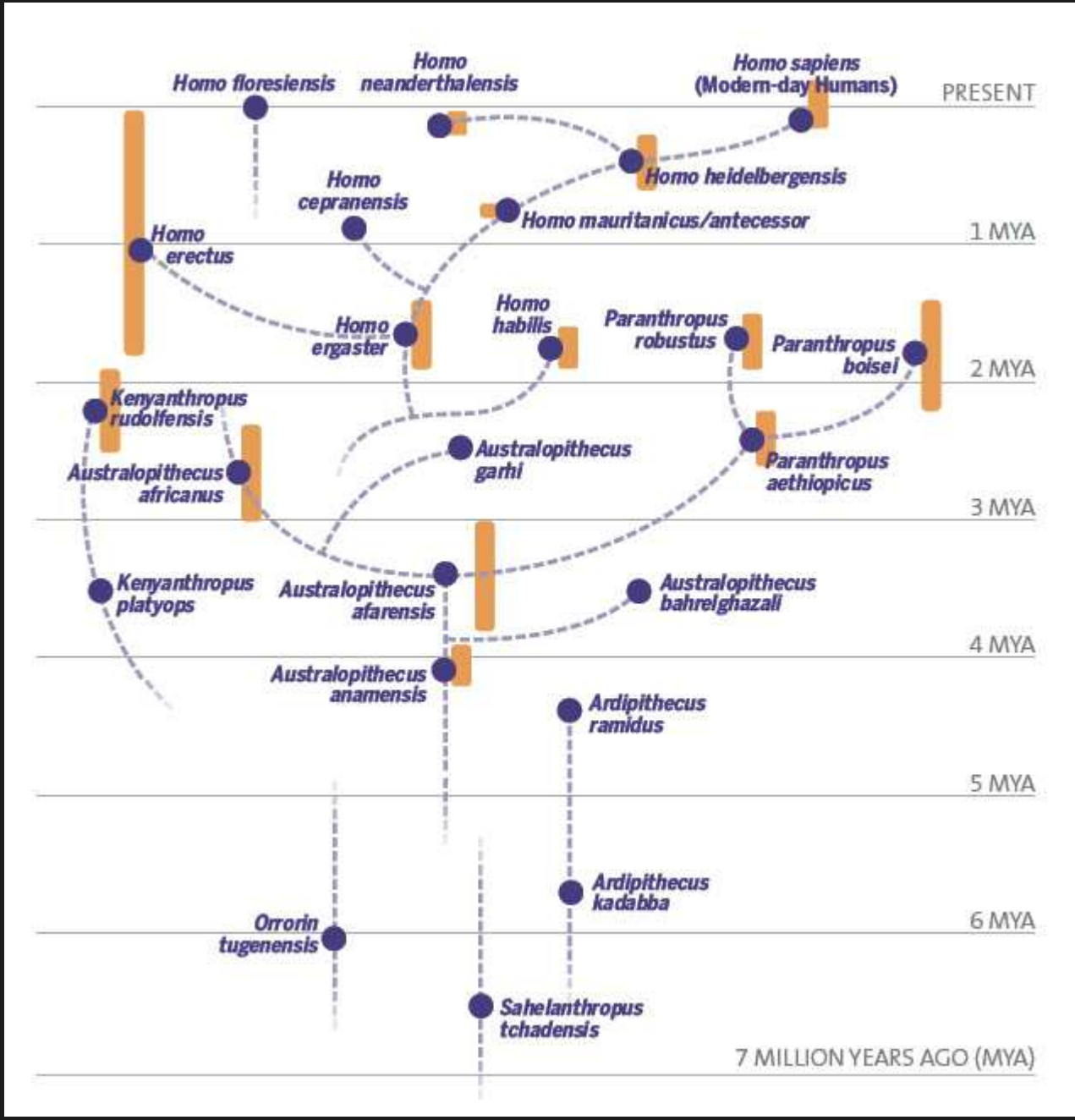
- analýza stejných morfologických znaků
- fylogram vs. chronogram



Předkové a potomci?

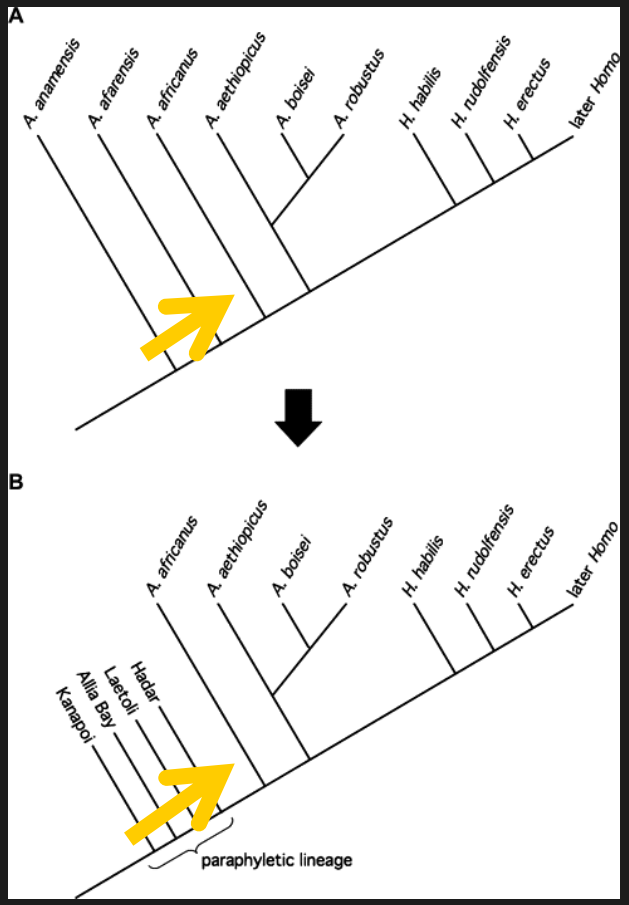


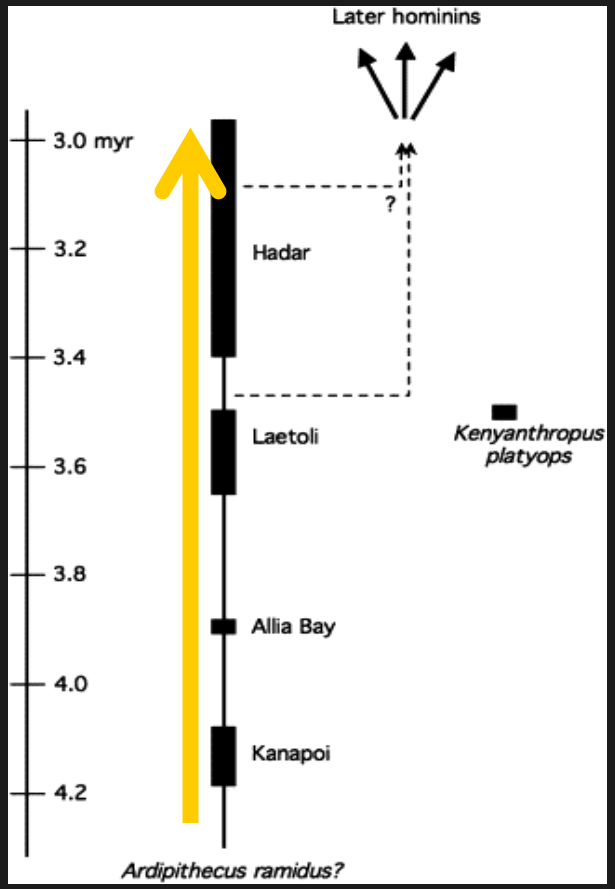
„Shuffling ape“ je matoucí schéma



Předkové a potomci?

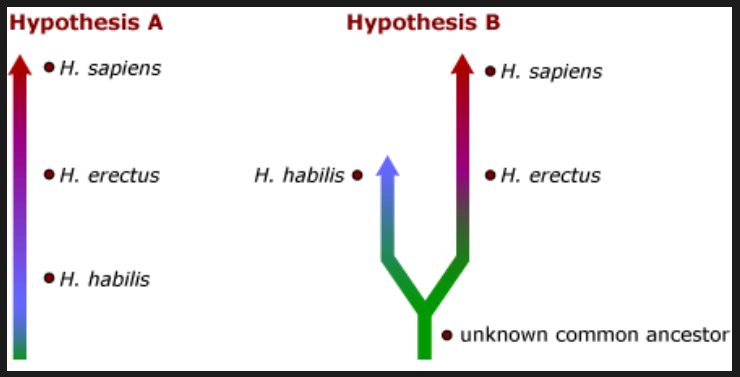
případ *Australopithecus anamensis* a *A. afarensis*





Předkové a potomci?

- *Homo habilis* x *H. ergaster* (~ "*erectus*") ve východní Africe
- *H. erectus* x *H. sapiens*



- 4-1 Mya: vždy aspoň dva sympatrické druhy lidí
- 4-3: *A. afarensis* + *K. platyops*
- 3-2,5: "*A*"*. garhi* + *P. walkeri*
- 2,5-2: *P. walkeri* + *H. habilis* + *K. rudolfensis*
- 2-1,5: *P. boisei* + *H. habilis* + *H. ergaster*
- 1,5-1: *P. boisei* + *H. ergaster*

Kolik druhů lidí?

- sympatrických druhů lidí je víc než u jiných savců téže velikosti těla
- ← taxonomický artefakt, anebo vyšší rychlost speciace???

Splitting taxonomy	Lumping taxonomy
S. tchadensis	*Ar. ramidus s.l.*
O. tugenensis	
Ar. ramidus s.s.	
Ar. kadabba	
Au. anamensis	*Au. afarensis s.l.*
Au. afarensis s.s.	
K. platyops	
Au. bahrelghazali	
Au. africanus	*Au. africanus*
Au. garhi	
P. aethiopicus	*P. boisei s.l.*
P. boisei s.s.	
P. robustus	*P. robustus*
H. habilis s.s.	*H. habilis s.l.*
H. rudolfensis	
H. ergaster	*H. erectus s.l.*
H. erectus s.s.	
H. floresiensis	
H. antecessor	
H. heidelbergensis	
H. neanderthalensis	
H. sapiens s.s.	*H. sapiens s.l.*

Intra-/interspecifická variabilita x taxonomie

- Dmanisi (2013): variabilita odpovídá AMH, šimpanzům a bonobům
- obdobná je i variabilita afrických homininů cca 1,8 kya → jeden druh? (*H. erectus*)

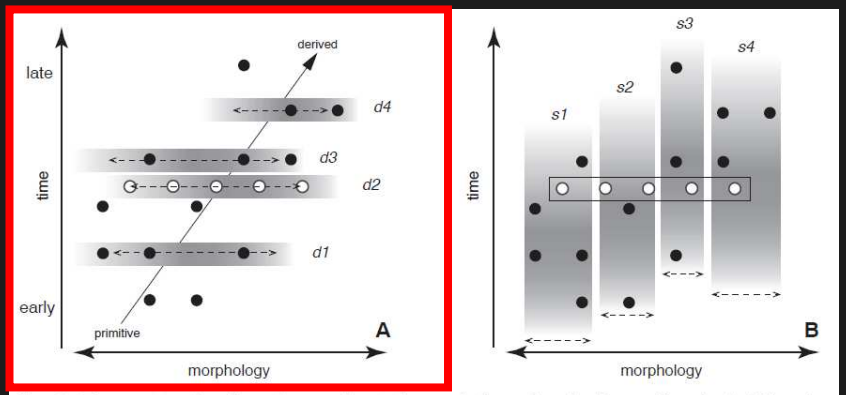


Fig. 3. Two contrasting hypotheses about the evolution of early *Homo*. Hypothesis (**A**) posits that the fossil record samples paleodemes (horizontal bands, *d1* to *d4*) of a phyletically evolving early *Homo* lineage, each with a separate geographic focus but overlapping in time and morphology. Selection and drift result in an overall morphocline from early generalized to late derived forms (diagonal arrow). This hypothesis is compatible with a wide range of variation within paleodemes of a lineage (dashed double arrows) and is most compatible with the evidence of morphological variation in the Dmanisi deme (white dots). Hypothesis (**B**) posits that the fossil record [same dots as in (A)] samples distinct paleospecies (vertical bands, *s1* to *s4*) overlapping in time and space. This hypothesis predicts that morphological variation within each lineage is restricted (dashed double arrows), which is incompatible with the combined evidence of multiple contemporary but morphologically disparate crania from Dmanisi (white dots).

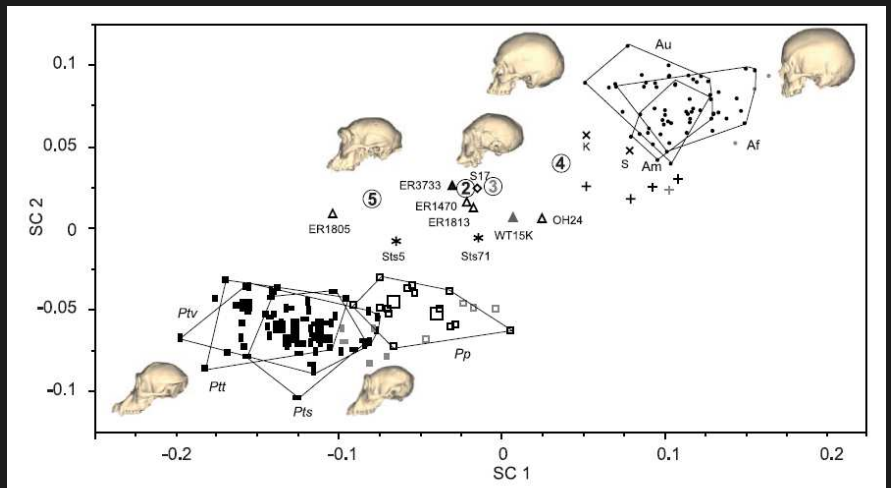
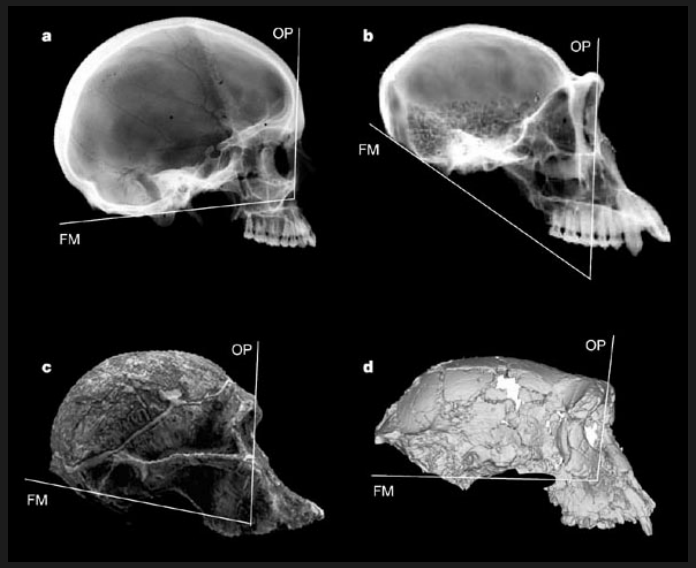
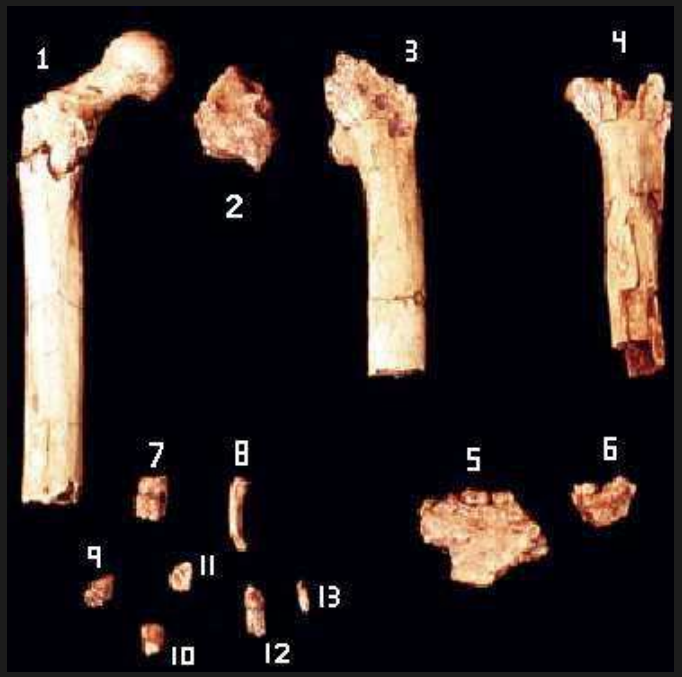


Fig. 4. Shape variation of the Dmanisi crania in comparative context. Dmanisi crania [2:D2282 (skull 2), 3:D2700 (skull 3 and picture), 4:D3444 (skull 4), 5: D4500 (skull 5 and picture)]; African early *Homo* (triangles with specimen names); *A. africanus* (asterisks); *H. erectus* Java (diamond); Kabwe and Steinheim (crosses); *H. neanderthalensis* (plus signs); *H. sapiens* (dots and pictures; populations from Africa, Australia, and America); *P. troglodytes*: *P. t. troglodytes* (solid squares and pictures), *P. t. verus* (vertical rectangles), *P. t. schweinfurthii* (horizontal rectangles); *P. paniscus* (open squares). Black symbols indicate adult individuals; gray symbols indicate subadult individuals. Large symbols indicate male and female averages. Shape component SC1 captures within-group cranial variation from large-faced/prognathic to small-faced/orthognathic individuals; SC2 captures shape change associated with grade shifts in neurocranial size between taxa.

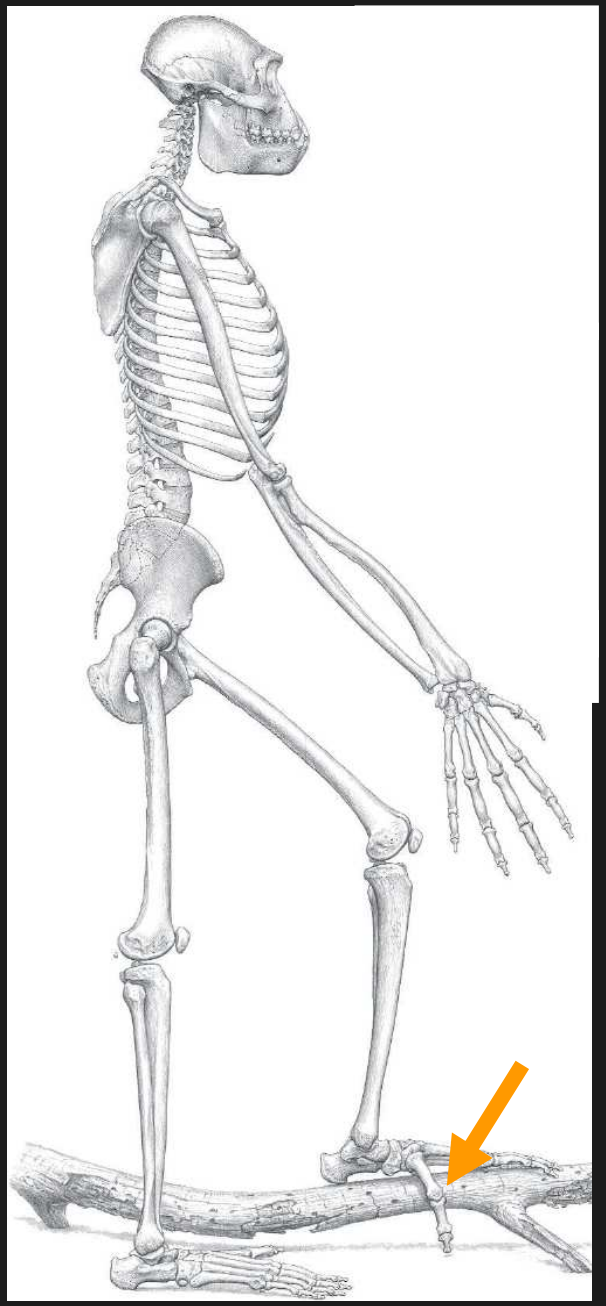
Hominina

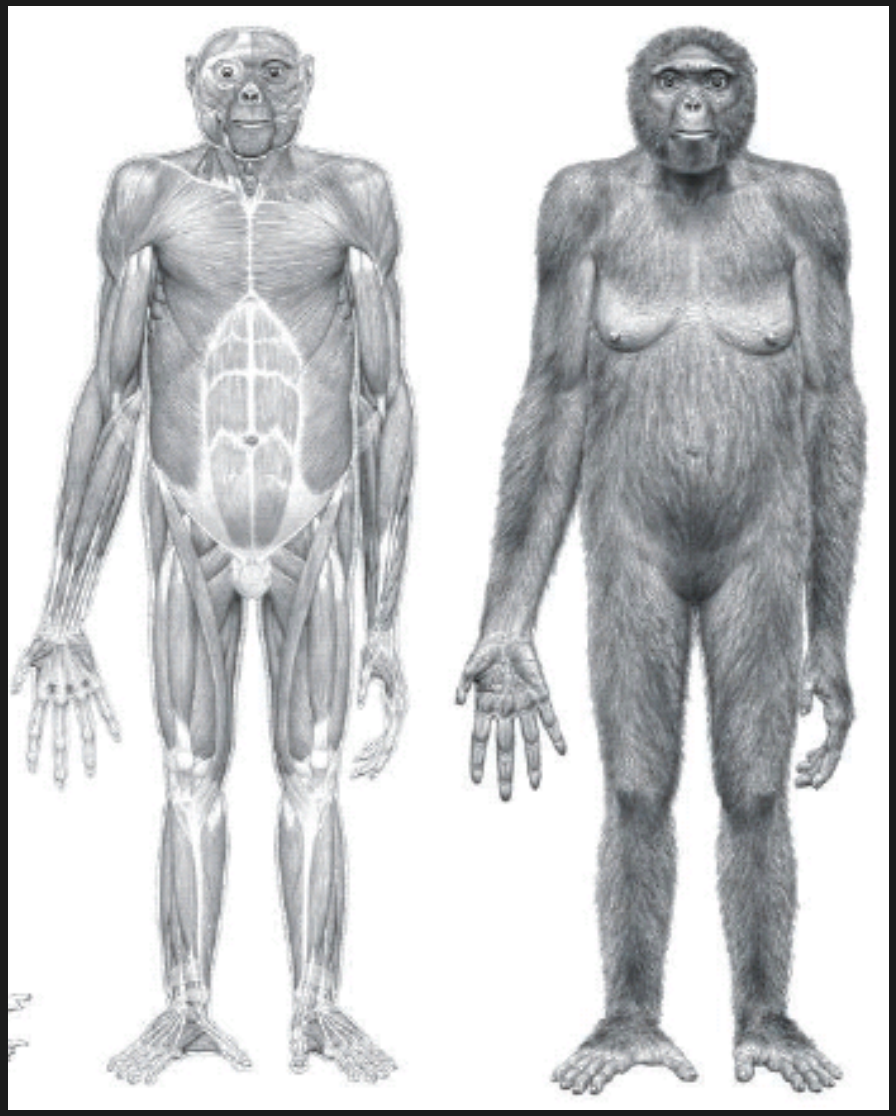
- bazální miocénní formy
- ***Sahelanthropus*** 7 Mya („*Toumaï* “), ***Orrorin*** 6 Mya (lesní a stromové formy × počátek bipedie)
- lidská, šimpanzí nebo kmenová linie?





Ardipithecus



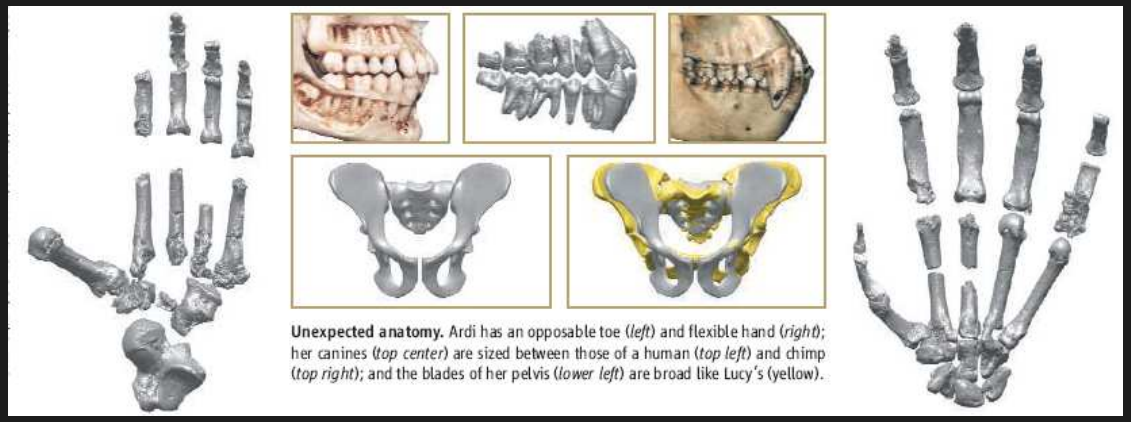


Ardipithecus

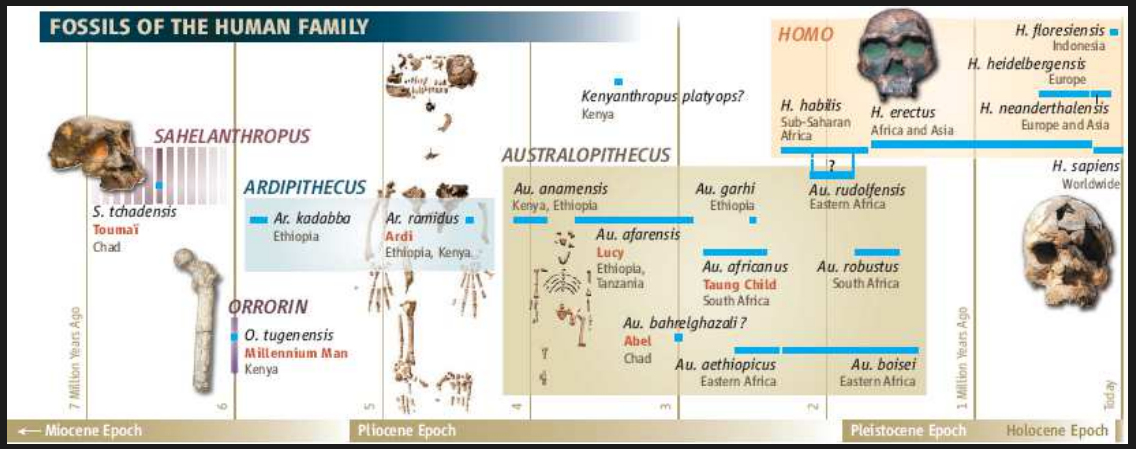
A. kadabba

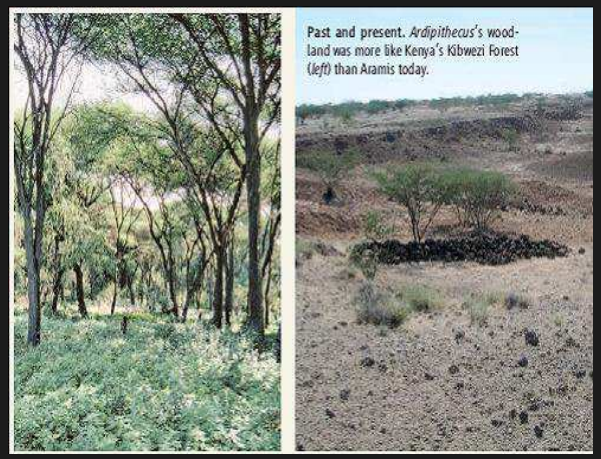
A. ramidus *(*Etiopie, pliocén – lokality vzdálené 22 km, 4.4-5.5 Mya)

2009: publikovány kompletní nálezy *A. ramidus* (110 jedinců)

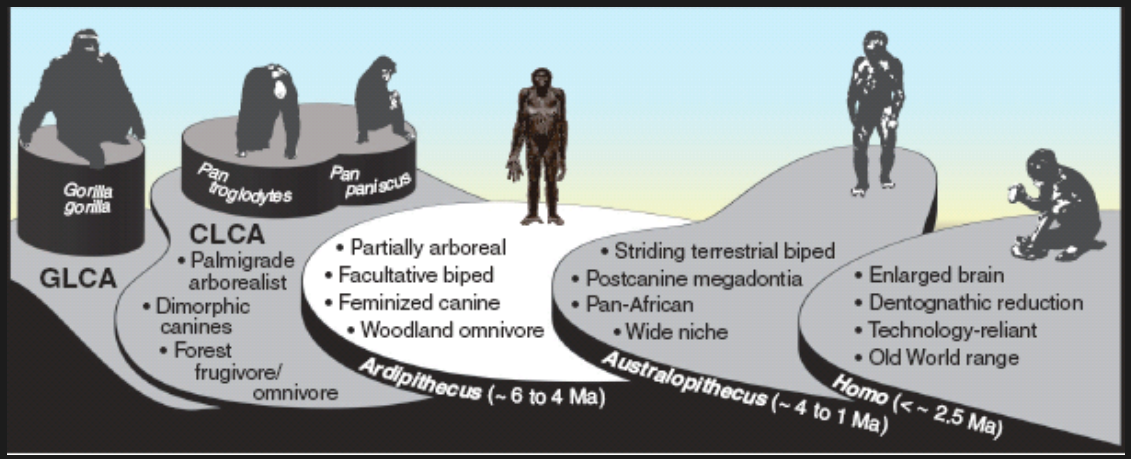


Unexpected anatomy. Ardi has an opposable toe (*left*) and flexible hand (*right*); her canines (*top center*) are sized between those of a human (*top left*) and chimp (*top right*); and the blades of her pelvis (*lower left*) are broad like Lucy's (yellow).





Past and present. *Ardipithecus*'s woodland was more like Kenya's Kibwezi Forest (*left*) than Aramis today.



Ardipithecus

- primitivní bipedie spojená s výraznou arborealitou (změny nohy a pánve x pohyblivý palec na noze, svalstvo) x ani brachiace, ani vertikální šplhání, ani *knuckle walking*
- *"If you wanted to find something that moved like these things, you'd have to go to the bar in Star Wars"*
- lebka (mozek 300-350 ccm) podobná sahelantropovi (ne lidoopům či australopitékům) – málo vyvinutá prognáthie
- omnivor-frugivor (C_3)
- nepatrný velikostní sexuální dimorfismus (i ve velikosti špičáků) → malé konflikty mezi samci
- bipedie bez pozdějších adaptací → malý energetický zisk (→ reprodukční výhody?)

Craniomandibular characters	Chimp/human LCA (INFERRED)	*Ar. kadabba/Sa. tchadensis/ O. tugenensis*	*Ar. ramidus*	*Au. anamensis*	*Au. afarensis*
TMJ articular eminence	flat	flat	flat	TMJ with defined eminence	TMJ with defined eminence
Mandible corpus breadth	indeterminate	mandibular corpus broad	mandibular corpus broad	mandibular corpus broad	mandibular corpus broad
Mental foramen	indeterminate	circum mid-corpus ht	circum mid-corpus ht	circum mid-corpus ht	secondarily lowered
Mandibular lateral prominence	weak	weak	weak	intermediate	lateral prominence developed
Ramus root/ extramolar sulcus	root posterior, sulcus narrow	root posterior, sulcus narrow	root posterior, sulcus narrow	intermediate	ramus root anterior and wide extramolar sulcus
Symphyseal inclination	strong	strong	strong	strong	bulbous (Laet.) to vertical (AL, MAK)
Basion position	slightly posterior	anterior	anterior	indeterminate	anterior
Cranial base flexion	moderate midsagittal flexion, orbital kyphosis minimal	advanced?	advanced	indeterminate	advanced
Midfacial breadth	not extreme	not extreme	not extreme	indeterminate	midfacial breadth greater
Zygomatic root	zygomatic root c. M1	zygomatic root c. M1	zygomatic root c. M1	zygomatic root more anterior	zygomatic root more anterior
Incisor/lower canine step	present	indeterminate	present	absent	absent

Dental characters	Chimp/human LCA (INFERRED)	*Ar. kadabba/Sa. tchadensis/ O. tugenensis*	*Ar. ramidus*	*Au. anamensis*	*Au. afarensis*
Sectorial C/P3 shearing	present, strong in males	sometimes present? in reduced expression?	absent	absent	absent
Canine size dimorphism	dimorphic	reduced C size dimorphism	further reduction?	further reduction	further reduction
Female relative canine size	moderate	moderate	moderate	slightly smaller	slightly smaller
Upper canine shape feminization	males unfeminized, higher crowned, modally lower shoulder	male C feminized in shape	male C feminized in shape	male C feminized in shape	male C feminized in shape
shoulder height	females mostly mid to low	mostly mid to low?	mid to high	mid to high	sometimes extremely high
shoulder flare	weak	weak	distinct flare	distinct flare	distinct flare
lingual marginal ridge	weak	intermediate?	fold-like	fold-like	fold-like
main mesial lingual ridge	strong (secondarily weak in *Pan*)	strong	basally broad	less prominent	more spatulate
crown height	males tall, females moderate	indeterminate	UC height differentially reduced	reduced	reduced
Lower canine shape feminization	males higher crowned, modally low mesial shoulder, weak/ no distal tubercle	feminized	feminized	feminized	feminized
mesial shoulder height	females vary from low to high	varies from low to high	intermediate?	intermediate?	LC with high mesial shoulder
lingual marginal ridge	weak or none	intermediate?	fold-like	fold-like	fold-like
distal crest	usually weak or none	weak	weak	intermediate	distinct
distal tubercle	weak	developed	developed	variable	distal tubercle less distinct merges with distal crest
Canine enamel thickness	thin	thin	thin	intermediate	thicker
Lower third premolar					
wear	hones UC	rarely hones, distal UC wear steep	No hone, distal UC steep	horizontal wear more dominant?	horizontal wear more dominant
basal crown size/shape	obliquely elongate	intermediate?	elongation weaker, relatively smaller size	basally expanded and large	tends to be BL broader
height	tall, with MB cervical extension	intermediate?	MB cervical extension weaker	low, squat, weak extension	weaker extension
metaconid	absent or rudimentary	rudimentary	rudimentary	rudimentary	variably developed
transverse crest	tall, near-transverse to posteriorly directed	near-transverse	near-transverse	near-transverse	more clearly transverse
mesial marginal ridge	weak or none	intermediate?	distinct	distinct	tends to form developed anterior fovea
Upper third premolar					
anterior fovea	not developed, steep anterior face	weak delineation	better defined	better defined	tendency for more horizontal fovea
asymmetry	weak to moderate	weak to moderate	weak to moderate	weak to moderate	symmetry more frequent

← LCA → ← Hominid clade →

Key: Primitive condition | Intermediate derived condition | Derived condition

table continued

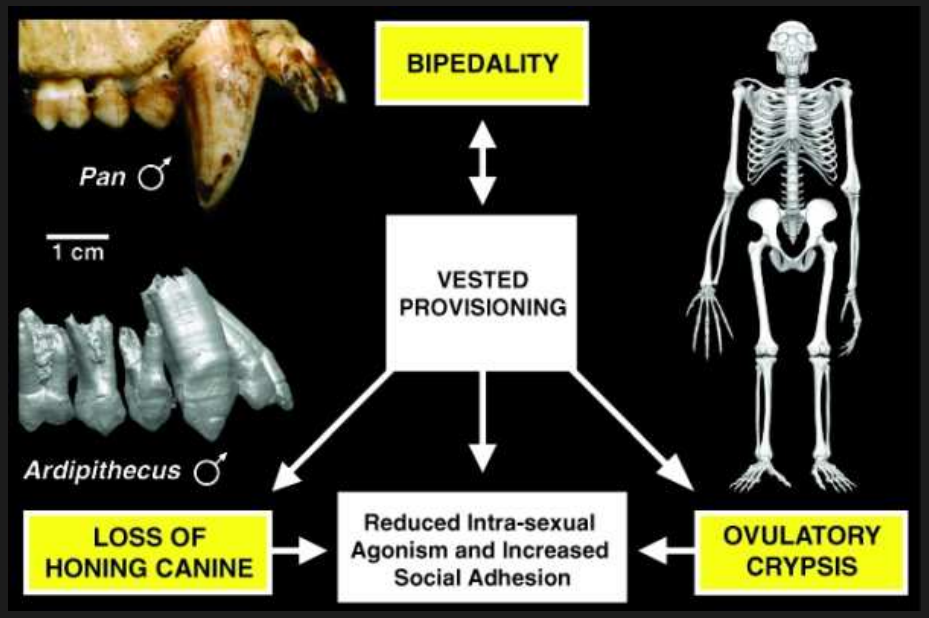
Dental characters *(continued)*	Chimp/human LCA (INFERRED)	*Ar. kadabba/Sa. tchadensis/ O. tugenensis*	*Ar. ramidus*	*Au. anamensis*	*Au. afarensis*
Lower deciduous molar					
crown shape	buccolingually narrow	indeterminate	buccolingually narrow	intermediate	broad, with developed anterior fovea
protoconid dominance	strong	indeterminate	strong	intermediate	larger metaconid
talonid	little developed	indeterminate	little developed	intermediate	posterior cusps well defined
Molars					
lower molar shape	indeterminate	relatively broader	relatively broader	relatively broader	tends to be very broad
molar row length	moderate	moderate	moderate	size increase	further increase
lower M3 development	variable, usually weak distal crown	variable, usually weak distal crown	variable, usually weak distal crown	large M3 with better developed distal crown	further LM3 complexity
occlusal foveae	moderately broad	moderately broad	moderately broad	narrower (increased basal flare)	narrower (increased basal flare)
crown height	low	low	low	intermediate?	taller M1 crown height
Molar enamel thickness	intermediate, variable	intermediate, variable	intermediate, variable	tends to be thicker	thicker
Canine eruption	males with delayed canine eruption	indeterminate	lacks delayed canine eruption	lacks delayed canine eruption	lacks delayed canine eruption
Premolar to molar wear gradient	slow P3 wear	indeterminate	slow P3 wear	increase of apical P3 wear	increase of apical P3 wear

Postcranial characters	Chimp/human LCA (INFERRED)	*Ar. kadabba/Sa. tchadensis/ O. tugenensis*	*Ar. ramidus*	*Au. anamensis*	*Au. afarensis*
Iliac isthmus	superoinferiorly long	indeterminate	short	indeterminate	short
Pubic symphysis outline	superioinferiorly long	indeterminate	short	indeterminate	short
Ilium/iliac isthmus orientation	coronal	indeterminate	sagittal	indeterminate	sagittal
Iliac breadth	moderately broad	indeterminate	slightly broadened	indeterminate	further broadened with expanded sciatic notch
Anterior inferior iliac spine	not developed	indeterminate	strong, formed by separate ossification center	indeterminate	strong, formed by separate ossification center
Pubic ramus	mediolaterally short	indeterminate	mediolaterally short	indeterminate	elongated
Ischium	long	indeterminate	long	indeterminate	abbreviated
Ischial tuberosity	not angulated	indeterminate	not angulated (INFERRED)	indeterminate	angulated
Greater sciatic notch	not developed	indeterminate	weak	indeterminate	well-developed
Femoral hypotrochanteric fossa	lacks true fossa	lacks true fossa	lacks true fossa	intermediate?	true fossa
Third trochanter and gluteal ridge	strong/rugose 3rd trochanter leading to laterally placed gluteal line	strong/rugose 3rd trochanter leading to laterally placed gluteal line	3rd trochanter weaker but same pattern	3rd trochanter weaker but same pattern	3rd trochanter localized, gluteal line angles medially
Femoral linea aspera	widely spaced med and lat lips	widely spaced med and lat lips	widely spaced med and lat lips	widely spaced med and lat lips	usually true linea aspera
Femoral neck cortical distribution	superior cortex relatively thick	superior cortex relatively thick	indeterminate	indeterminate	superior cortex relatively thin
Hallux	fully abductable, no dorsal doming	indeterminate	fully abductable, no dorsal doming	indeterminate	permanent adduction of hallux, dorsal doming
Second metatarsal	not robust	indeterminate	shaft and base robust	indeterminate	secondary gracilization
Metatarsal heads (rays 2–5)	limited dorsal doming	indeterminate	dorsally domed (Mt3 known)	indeterminate	dorsally domed
Proximal foot phalangeal cant	proximal orientation	indeterminate	upwardly canted	indeterminate	upwardly canted orientation
Trapezoid	mediolaterally narrow	indeterminate	mediolaterally narrow	indeterminate	broader
Capitate	head located palmarly	indeterminate	head located palmarly	head dorsalized and broader	head dorsalized and broader
Metacarpal heads	moderate dorsal constriction	indeterminate	weak, but constriction still seen	indeterminate	constriction lacking
Metacarpal distal end	moderate/strong proximal collateral ligament facets	indeterminate	intermediate?	indeterminate	weak collateral ligament grooves
Skeletal size dimorphism	weak	indeterminate	weak	indeterminate	moderate
Megadontia relative to body size	weak	indeterminate	weak	expressed (INFERRED)	distinct

Key: Primitive condition | Intermediate derived condition | Derived condition

- 1. šimpanzi jsou odvození, nejsou vhodnými modely pro počátky lidské evoluce (lokomoce) – společný předek byl „lidštější“
- 2. odvozené lidské znaky (lokomoce, redukce špičáků) už na začátku lidské evoluce (nejde o adaptace spojené s australopitekoidní úrovní – změny molárů, užívání nástrojů apod.)
- 3. společný předek lidí a šimpanzů se podobal miocénním hominoidům (~ *Sivapithecus*???)
- x nepatří *Ardi* před divergenci *Pan* x *Homo*???

Ardipithecus

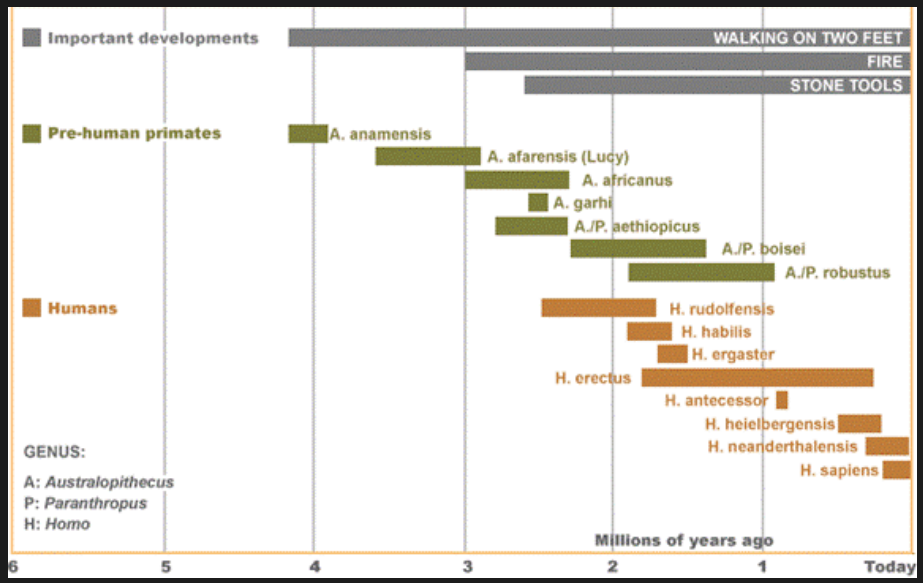


autoři zjevně zapomínají, že nejen šimpanz, ale i *Ardi* mají svou vlastní evoluci!

→ každá podobnost šimpanz-gorila (např. prognathie) podle nich musí být konvergentní

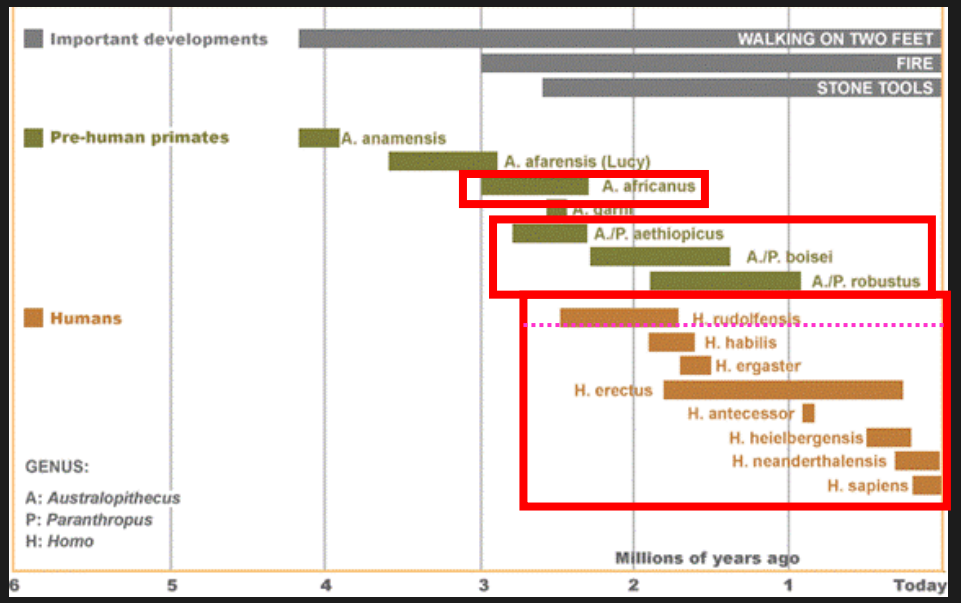
„*Australopithecus*“

- určitě parafyletická skupina
- velké časové rozpětí: nejstarší *A. anamensis* přes 4 Mya, někteří koexistovali s *Homo*
- bipedie (*A. afarensis*: „*Lucy*“) x různý stupeň arboreality (víc u *A. africanus*), ale žádné arboreální adaptace zadních nohou (palec)
- malý mozek (tj. „nejdřív postava, potom myšlení“)
- nástroje srovnatelné se šimpanzími
- velký sexuální dimorfismus (???)



„*Australopithecus*“

- *A. africanus* a *Paranthropus* pravděpodobně příbuzní rodům *Kenyanthropus* + *Homo*
- „*A.*“ *garhi*, *A. afarensis*, „*A.*“ *anamensis* patrně bazálnější “kmenová linie” (*stem lineage*)
- „*A.*“ *bahrelghazali* z Čadu nejasný (*A. afarensis*???)

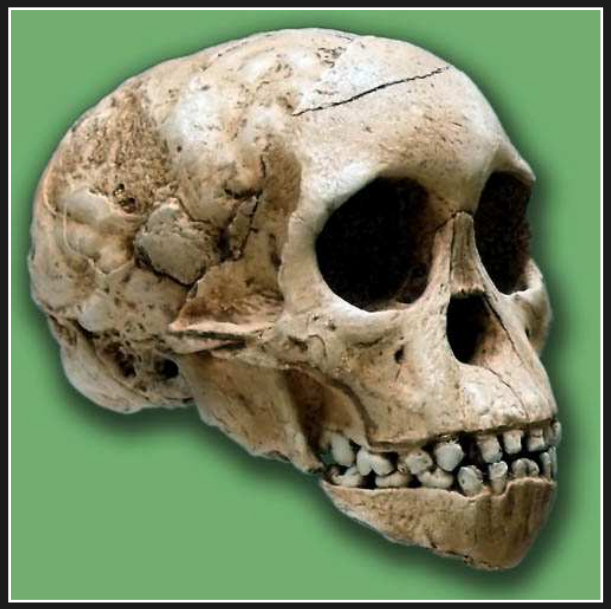


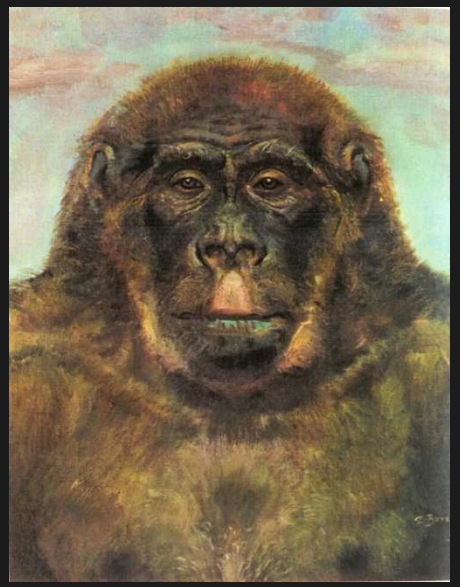
„Praeanthropus“ afarensis („*Lucy*“)

- *Meganthropus africanus* (1950), jméno *Praeanthropus* (1948, *nomen nudum*) dodatečně připojeno k druhu *africanus* (→ *P. africanus*)
- později intepretován jako nový druh *Australopithecus* („*A. africanus*“ preokupováno) → *A. afarensis*
- jenže kladisticky to není *Australopithecus* → *P. africanus* (druhové jméno *africanus* je v rodě *P.* volné)
- ICZN: rozhodnuto zachovat *afarensis*

Édouard Manet
1877

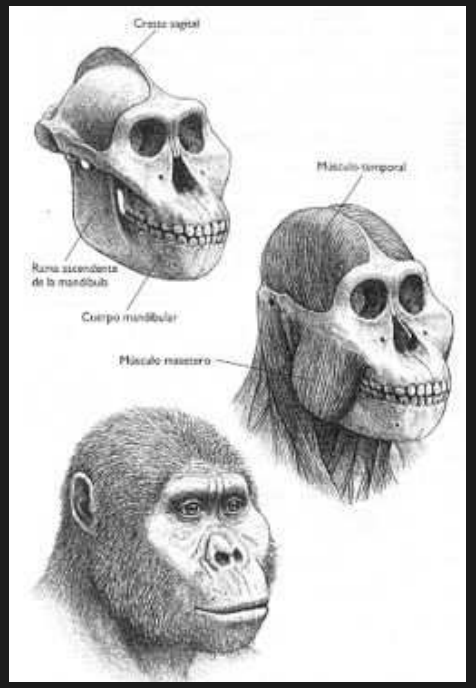
Australopithecus africanus

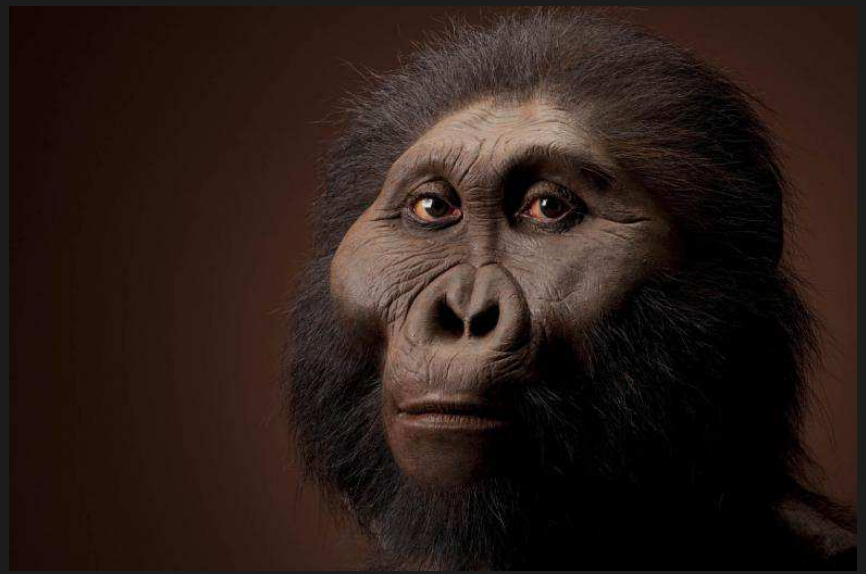




Paranthropus

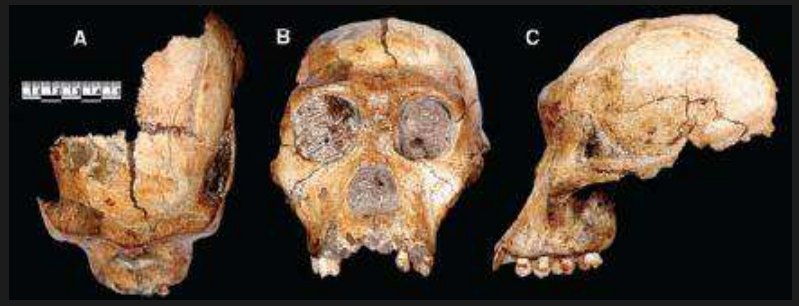
- *P. walkeri* (= *aethiopicus*?), *P. boisei*, *P. robustus*
- relativně velcí, bipední býložravci
- žili společně s rodem *Homo*
- „gorilí“ sociální systém





"*Australopithecus*" (*Homo*?) *sediba*

- objeven 2010
- Jižní Afrika, 2-1,75 Mya (překryv s *H. habilis*)
- blízký rodu *Homo*?



Homo x *Kenyanthropus*

- *H. habilis, H.* (*K*.?) *rudolfensis, K. platyops* – nejstarší druhy nejasného postavení (*Homo*?)
- 2010: + *H. gautengensis*? (2-1 Mya, jižní Afrika)
- "oldowanská technologie"
- rozhodně nejde o „přímé předky lidí"
- *H. habilis* koexistoval s *P. boisei* i s *H. ergaster* (~ „*erectus*") (~ 500 tis. let u j. Turkana)

Fylogeneze rodu *Homo*

- klíčové postavení *H. ergaster* (Afrika)
- tři fylogenetické linie, každá opustila Afriku:
- 1. → *H. erectus* (+ *H. pekinensis*)
- 2. → *H. georgicus* (+ *H. floresiensis*???)
- 3. → *H. antecessor* + → *H. heidelbergensis* + *H. neanderthalensis* + → *H. sapiens*

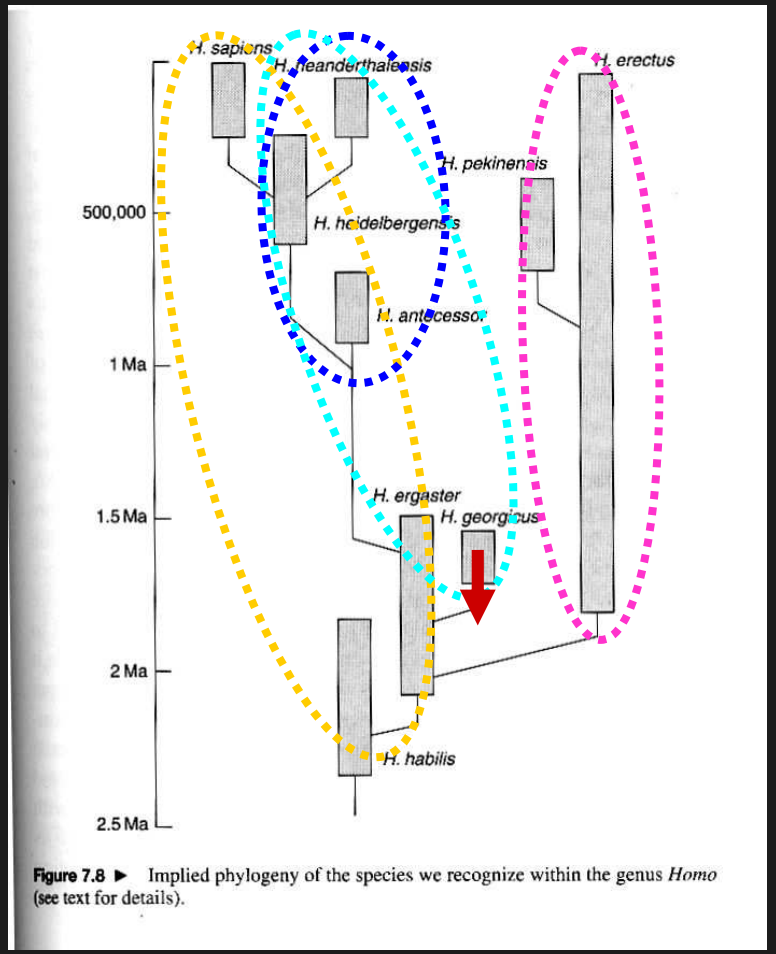


Figure 7.8 ▶ Implied phylogeny of the species we recognize within the genus *Homo* (see text for details).

„Velcí lidé“

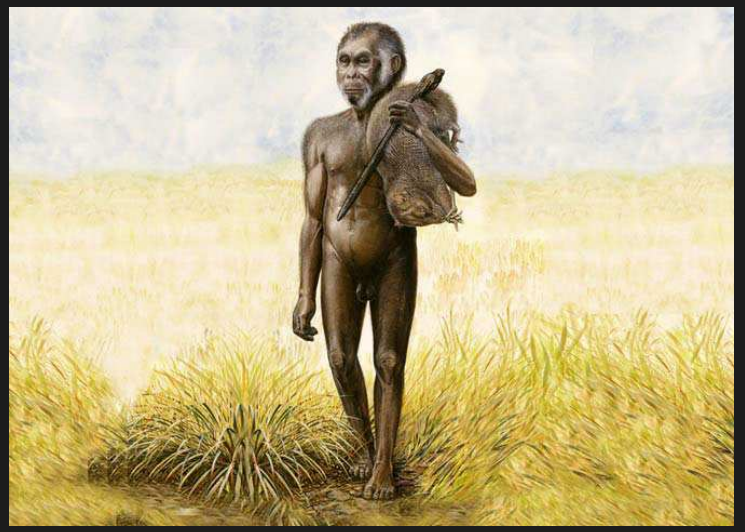
- mimořádně nestabilní taxonomie (2 druhy *H. erectus* a *H. sapiens* nebo cca 10?)
- *Homo ergaster* 1.5-2 Mya
- *Homo georgicus* (???) 1.7 Mya

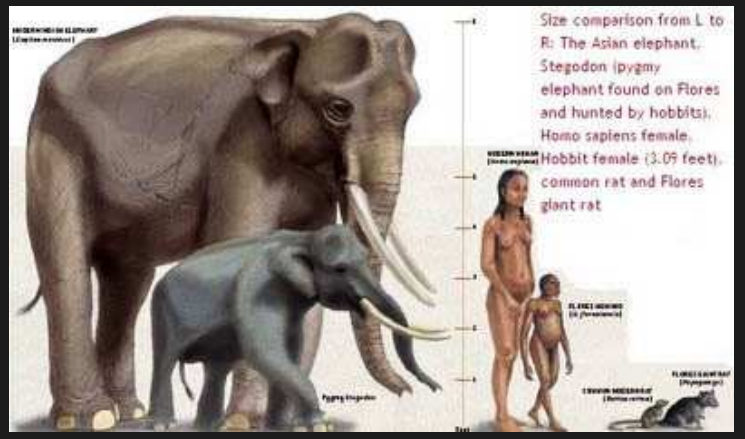
- *Homo erectus* 1.8 Mya
- *Homo pekinensis* (???) 800 kya
- *Homo cepranensis* (???)
- *Homo floresiensis* (*incertae sedis*)

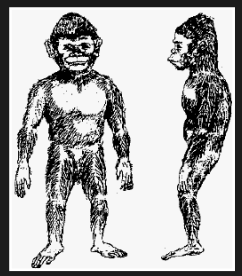
- *Homo antecessor*
- *Homo heidelbergensis*
- *Homo* sp. „Denisovans“
- *Homo steinheimensis* (???)
- *Homo neanderthalensis*
- *Homo rhodesiensis* (???)
- *Homo sapiens*

Homo floresiensis („hobit“)

- dlouhodobě koexistoval s *H. sapiens* (vymřel 12-18 kya, možná i později – „Ebu Gogo“???)
- mimořádně malý mozek (← podezření na patologickou mikrocefalii) x většina miniaturizovaných savců má naopak relativně velké mozky (výjimka: madagaskarští hroši)

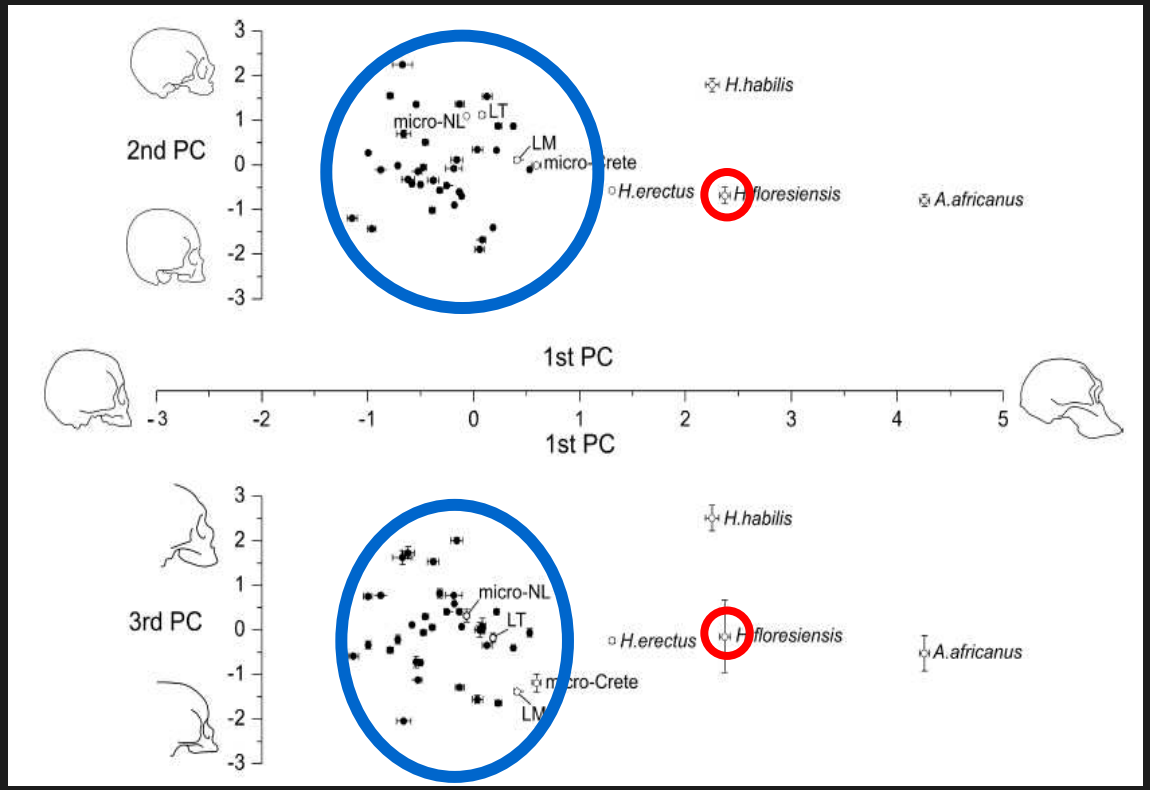


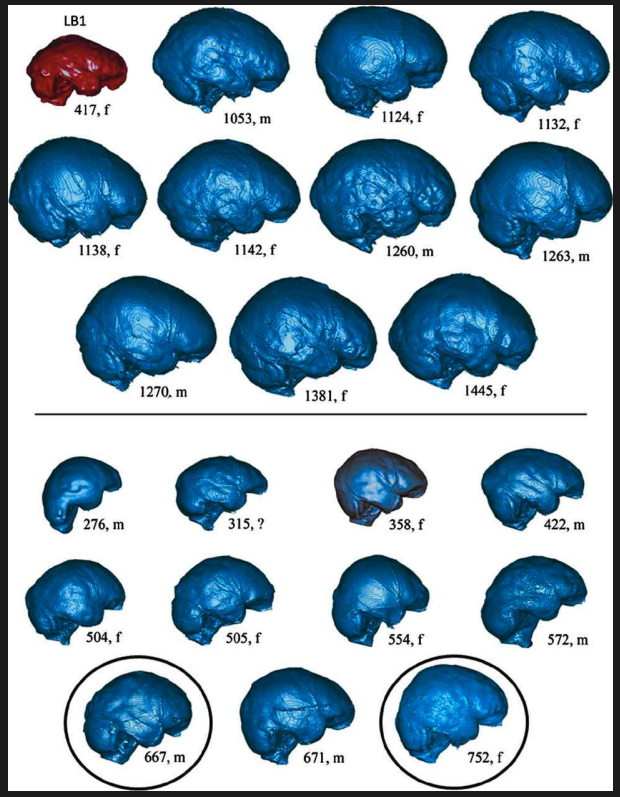




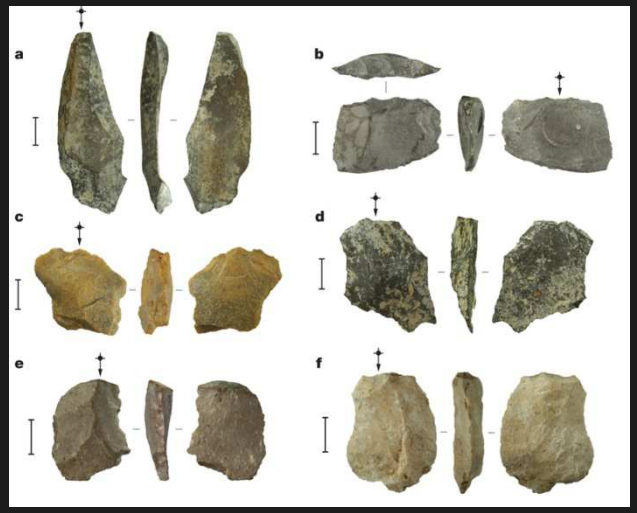
Homo floresiensis

H. floresiensis jako patologický *H. sapiens*???

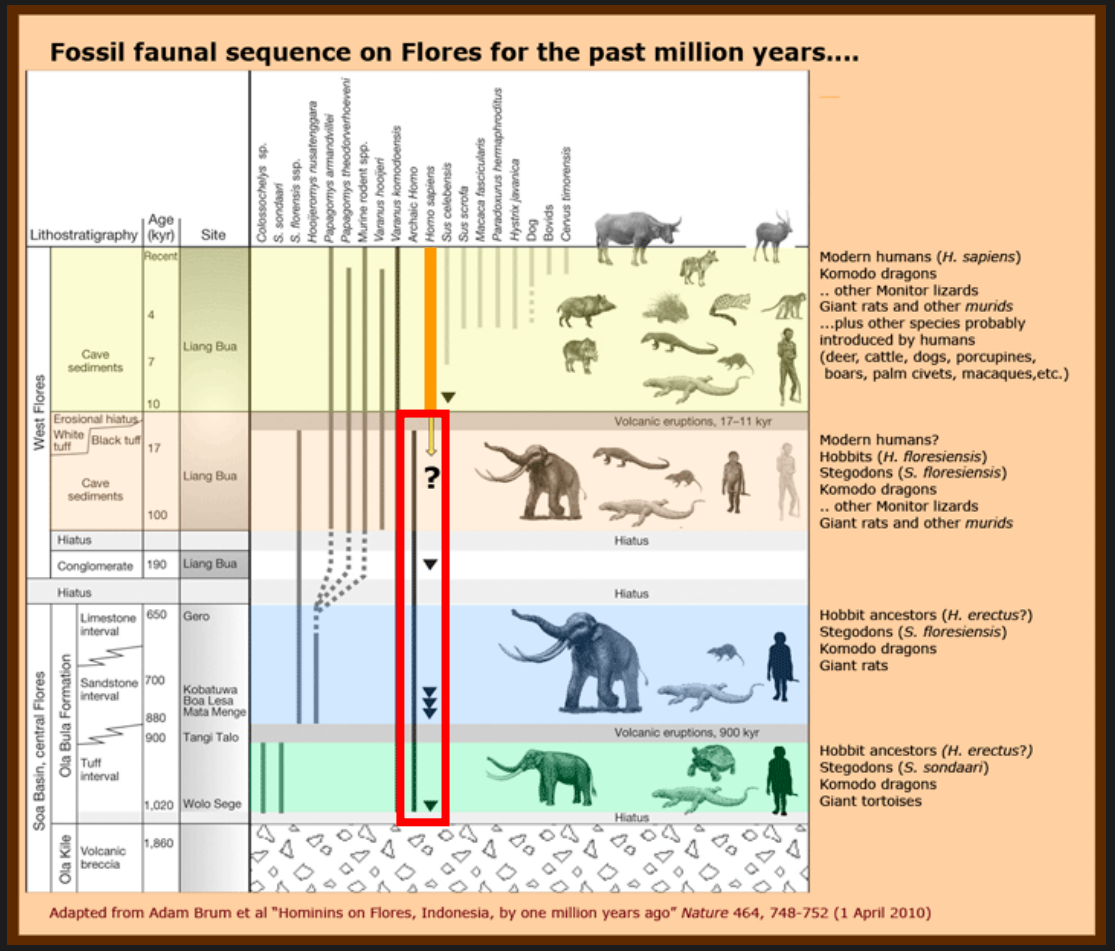


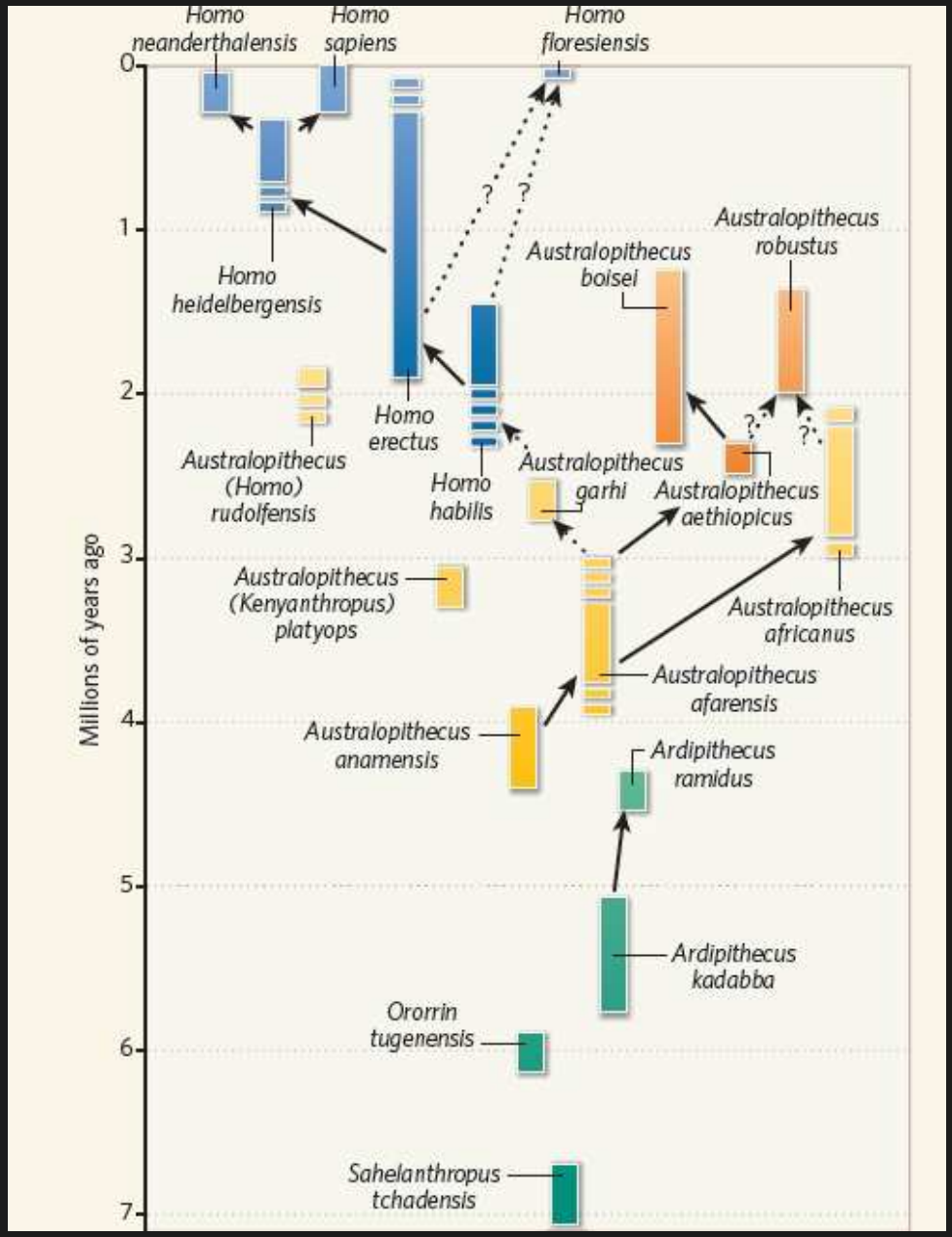


Lidské nástroje na Floresu



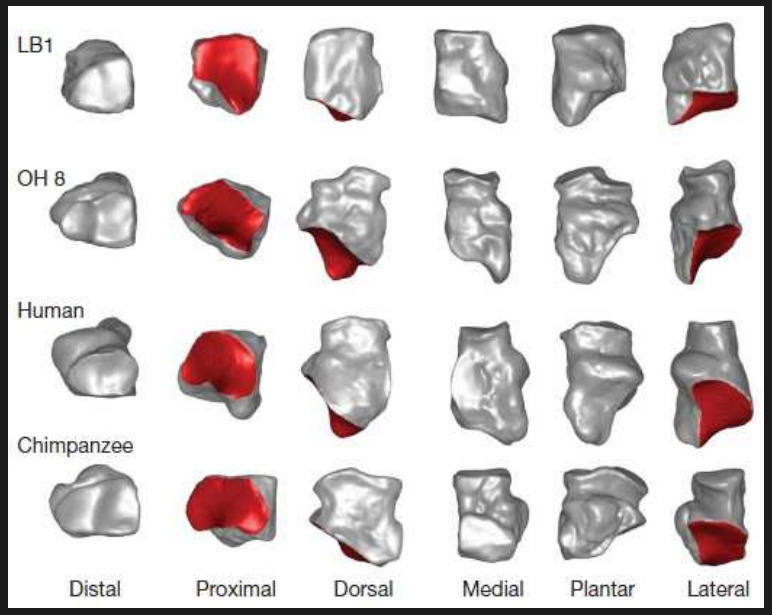
- cca 1M staré
- dávno před *H. sapiens*
- + populace na Floresu nejmíň 50 ky → „patologická hypotéza“ extrémně nepravděpodobná



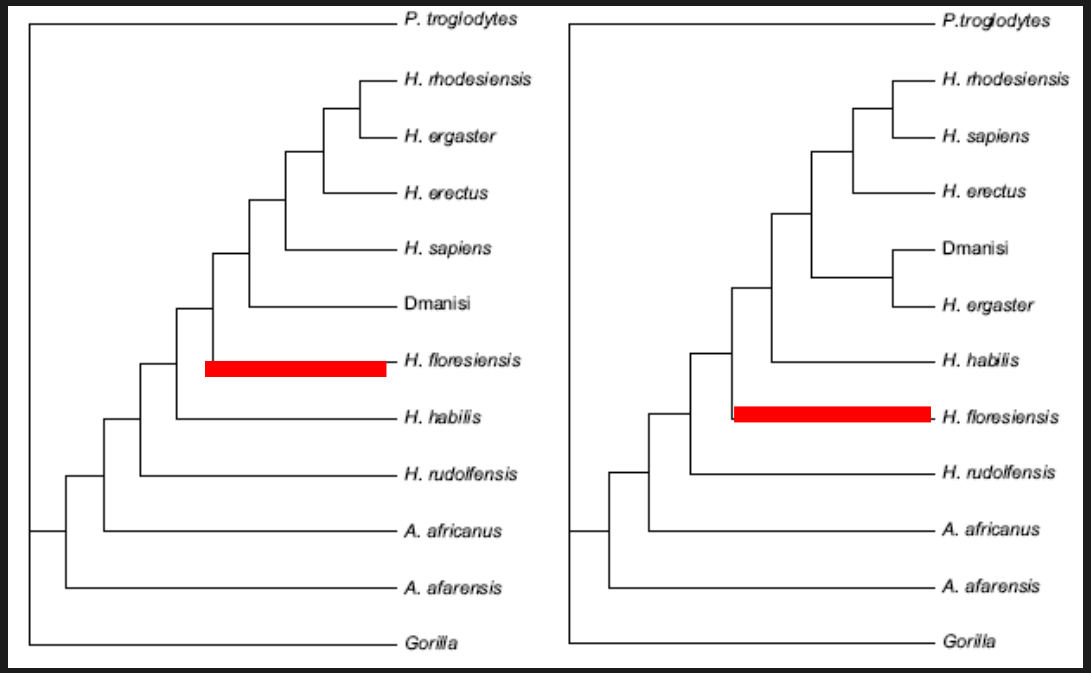


Homo floresiensis

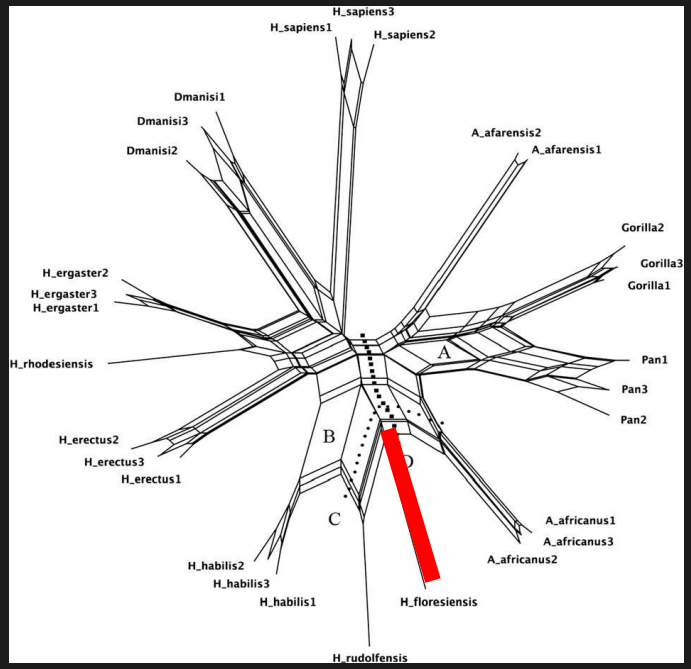
- *os cuboideum*
- potvrzeno i rozsáhlou geometrickou morfometrií



Homo floresiensis



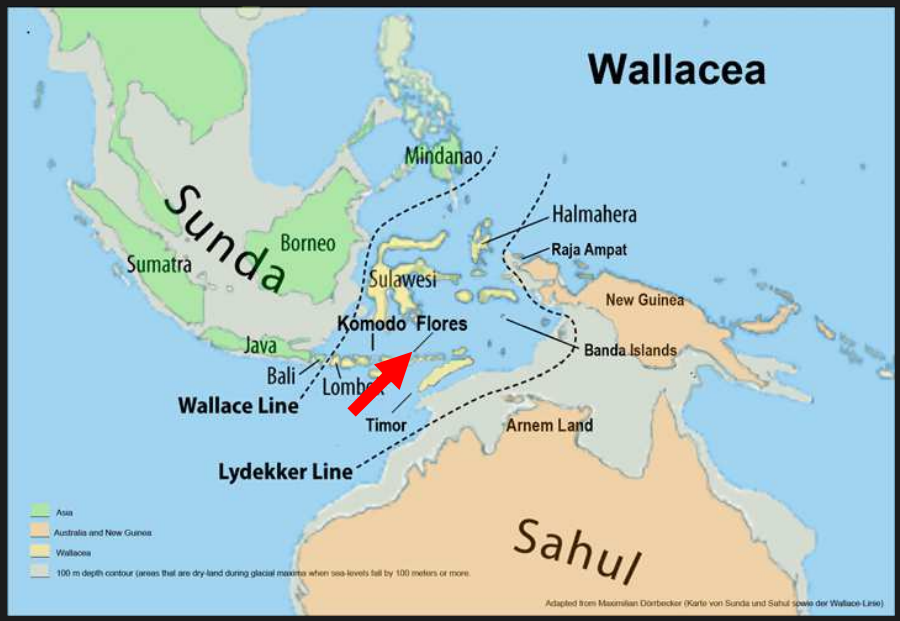
kladistická analýza 60 znaků (2009)

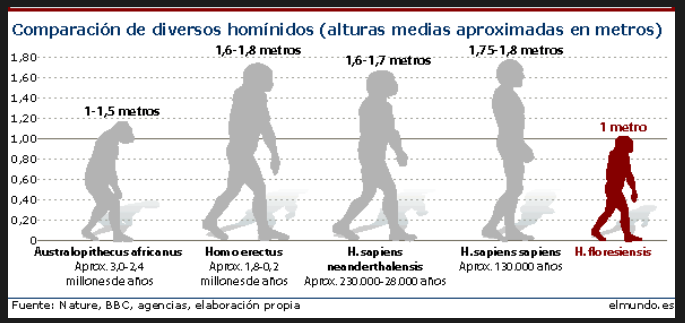


spektrální analýza stejných znaků (2010)

Homo floresiensis

- záhada – kde se tam vzal???
- Flores není součástí asijského šelfu
- dosud neznámá expanze bazálních lidí (~ *H. habilis*, *H. ergaster*?) z Afriky do Asie (*H. georgicus*?) ???
- → možná ani není tolik druhotně miniaturizovaný





Kraniofaciální morfologie *H. floresiensis* (2011)

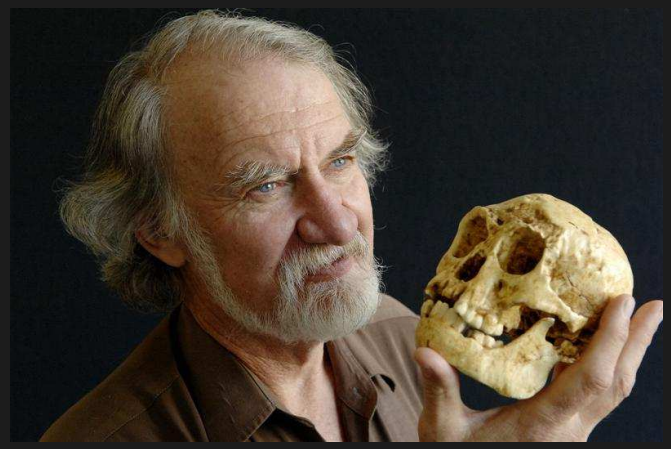
- srovnání hobitích znaků s *H. habilis* (Hh), různými erektiny, *H. georgicus* (Dm) a *H. ergaster* (erg)
- 3 hypotézy: I. hobit je něco jako *habilis*, II. něco jako *georgicus*, III. něco jako raný *erectus* (S supported, N nonsupported, C compatible, ? unclear/unknown)

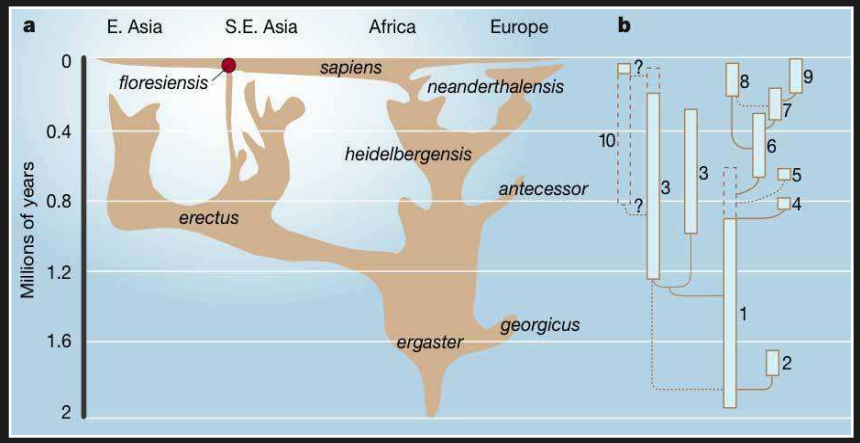
Major craniofacial characteristics of LB1 and their distribution among comparative.

No.	Character state in LB1 (with the opposite state in the parentheses)	Character distribution[a]										Hypothesis[b]		
		Hh	Dm	erg	KB	ST	Sm	Ng	ZN	Dal	Mb	I	II	III
Overall size (absolute)														
S1	Cranial vault small (vs. large)	▲	x	x	x	x	x	x	x	x	x	S	N	N
S2	Facial skeleton small (vs. large)	x	x	x	x	x	x	x	x	x	x	N	N	N
Overall shape of the neurocranium (see also Fig. 15)														
C1	Anterior frontal squama narrow (vs. wide: Fig. 16H)	●	●	▲	x	●	x	x	●	x	?	S	S	S
C2	Cranial vault short relative to breadth (vs. long: Fig. 16A)	▲	▲	x	x	x	▲	x	x	x	?	S	S	C
C3	Parietals laterally expanded relative to the cranial base (vs. bell-shaped posterior vault profile: Fig. 16D–F)	x	x	●	●	●	●	●	●	●	●?	N	N	S
C4	Supramedial crest depressed medially (vs. protruded laterally: Fig. 16J)	x	x	●	●	●	●	●	x	●	?	N	N	S
C5	Cranial vault low relative to breadth (vs. high: Fig. 16B)	x	x	●	x	●	▲	x	▲	Δ	?	N	N	S
Ectocranial keelings														
C6	Coronal and sagittal keels poorly developed or absent (vs. well-developed)	●	x	●	●	▲	x	x	x	●	●?	S	N	S
C7	Frontal keel well-developed (vs. poorly developed or absent)	x	x	▲	Δ	▲	Δ	Δ	●	Δ	?	N	N	S
Temporal line and associated surface structures														
C8	Temporal line extends posteriorly toward the lamboid suture (vs. limited posterior extension: Fig. 17C)	●	●	●	●	▲	x	x	▲?	●	?	S	S	S
C9	Supramastoid crest more horizontally oriented (vs. swings superiorly)	●	●	●	●?	▲	x	x	●	●	?	S	S	S
C10	Medial incursion of the temporal lines weak on the frontal (vs. marked: Fig. 17A)	▲	●	●	●	●	●	●	●	●	●	S	S	S
C11	Angular torus restricted and weak (vs. large and well-developed)	▲?	●	●	●	▲	x	x	x	●?	?	S	S	S
C12	Temporal line relatively weak on the anterior frontal (vs. marked)	▲	x	x	x	●	x	x	●	●	x	S	N	S
C13	Supramastoid crest poorly developed (vs. well-developed)	▲	x	▲	●	x	x	x	x	x	?	S	N	N
C14	Temporal lines posteriorly divergent on the parietals (vs. medial incursion: Fig. 17B)	x	x	x	x	▲	●	●	●	x	?	N	N	S
Individual vault bones														
C15	Squamosal suture relatively straight (vs. arched)	●	●	●	x	●	●	●	●	x	?	S	S	S
C16	Temporal squama long and parietomastoid suture short (vs. short and long, respectively: Fig. 17F)	●	●	●	x	▲	x	x	x	x	?	S	S	S
C17	Occipital plane gently curved and inclined forward (vs. vertically set)	●	▲?	▲	x	●	x	x	●	x	?	S	S?	S
C18	Parietal rounded (vs. parasagittal flattening present)	●	x	▲	▲	x	●	●	x	x	●	S	N	C
C19	Occipital moderately flexed (vs. flexion weaker: Fig. 17I)	x	▲	●	●	●	●	■	■	●	?	N	S	S
C20	Frontal squama flat on each side with no marked eminence (vs. frontal eminence distinct)	x	▲	▲	▲	●	x	x	x	x	x	N	S	S
C21	Frontal squama strongly curved along the midline (vs. gently curved: Fig. 17D)	x	x	▲	x	x	▲	x	▲	x	●?	N	N	C
C22	Supratoral sulcus of the occipital straight and continuous (vs. discontinuous)	x	x?	x	●	●	●	●	●	Δ	?	N	N?	S
C23	Low, broad occipital squama (vs. high and narrow: Fig. 17G)	x	x	x	x	●	●	●	x	?	?	N	N	S
C24	Parietal sagittal curvature strong (vs. weak: Fig. 17E)	x	x	x	x	x	▲	x	x	x	x?	N	N	C
Cranial base														
C25	Nuchal plane strongly convex (vs. flatter)	●?	●?	▲	x	●	x	x	●	x?	?	S?	S?	S
C26	Root of the pterygoid plate extends posteriorly (vs. posterior extension restricted)	●	●	▲	x	?	●	●	?	?	?	S	S	?
C27	Mandibular fossa shallow (vs. deep: Fig. 18D)	●	●	▲	●	●	●	x	x	●?	?	S	S	S
C28	Postglenoid process present (vs. absent)	●	●	●	●	●	▲	x	●	●	?	S	S	S
C29	Tympanomastoid fissure not extensive (vs. extensive)	●	●	●	●	●	x	x	▲	●	?	S	S	S
C30	Postcondyloid tuberocity weak or absent (vs. marked)	●	●	●	●	●	x	x	?	●	?	S	S	S
C31	Midcranial base not extended anteroposteriorly (vs. extended)	●?	●?	●	●	●	x	x	?	?	?	S?	S?	S
C32	Bony styloid process absent (vs. present)	●	▲	x	x	●	●	●	●	?	?	S	S	S
C33	Tympanic tubular along its long axis (vs. flattened)	●	x	▲	x	▲	●	●	●	x	?	S	N	S
C34	Vaginal process absent or ill-defined (vs. well-developed)	▲?	x	x	x	x	x	x	x	x	?	S?	N	N
C35	Basiocciptal flat and located superiorly relative to the surrounding cranial base structures (vs. located relatively inferiorly)	x?	?	●	x	●	●	●	?	●?	?	N?	?	S
C36	External acoustic meatus medially set (vs. tympanic laterally extensive: Fig. 18F)	x	●?	●	●	●	●	●	▲	●	?	N	S?	S
C37	Mandibular fossa transversely narrow (vs. wide: Fig. 18E)	x	?	x	x	●	?	▲	?	x	?	N	?	S
C38	Anteromedial corner of the mandibular fossa flexed (vs. smoothly concave)	x	x	x	x	▲	x	x	▲	x	?	N	N	S
C39	Mastoid process small, pointed, and medially inclined (vs. large and bulbous and/or directs directly inferiorly)	x	x?	x	x	▲	Δ	x	●	Δ	?	N	N?	S
C40	Opisthionic recess incipient (vs. not developed)	x	x	x	x?	x	■	■	x	?	?	N	N	C
C41	Medial and lateral pterypoid plates fused extensively (vs. widely separated)	x	?	?	x	?	?	Δ	?	?	?	N	?	?
Cranial bone thickness														
C42	Mastoid portion not thickened (vs. thickened: Fig. 19E)	●	●	●	Δ	x	x	x	x	?	?	S	S	N
C43	Vault bone thick at the bregma and parietal eminence (vs. thin: Fig. 19B and C)	x	▲	●	●?	●	●	●	●	●	?	N	S	S
Facial size (relative) and morphology														
F1	Facial prognathism moderately strong (vs. weak: Fig. 21B)	●	●?	▲	▲	●?	?	?	?	?	?	S	S?	S?
F2	Supratoral plane with no distinct sulcus (vs. grooved)	●	▲	▲	●	●	●	●	x	●	●	S	S	S
F3	Supratoral plane restricted anteroposteriorly (vs. wide: Fig. 21F)	●	●	x	x	x	Δ	●	●	●	●	S	S	C
F4	Supraorbital torus (SOT) comparatively thin at the midorbit (vs. thick: Fig. 21D)	●	▲	▲	x	x	x	▲	x	x	x	S	S	C
F5	Infraorbital surface faces anteriorly (vs. anterolaterally)	●	●	x?	x	●	?	?	?	●	?	S	S	S
F6	Maxillary dental arch nearly parallel-sided (vs. parabolic)	●	●?	●	x	●	?	?	x	?	?	S	S?	S
F7	Nasal bridge moderately prominent (vs. flattened)[c]	x	●?	▲	●	●	?	?	●	●	●	N	S?	S
F8	Palate shallow (vs. deep: Fig. 21L)	x	●	x	x	●	?	?	?	?	?	N	S	S
F9	Maxillary body protruded forward distinctly beyond the infraorbital surface with a marked infraorbital sulcus (vs. more smooth junction between the two structures)	x	Δ	x	x	▲	?	?	●	●	?	N	?	S
F10	Lateral end of the SOT bulbous and protrusive laterally (vs. no lateral projection beyond the frontomalare temporalare)	x	x	▲	●	▲	●	●	●	●	●	N	N	S
F11	SOT strongly arched (vs. more straight)	x	x	▲	x	x	x	x	x	x	●	N	N	N

Kraniofaciální morfologie *H. floresiensis* (2011)

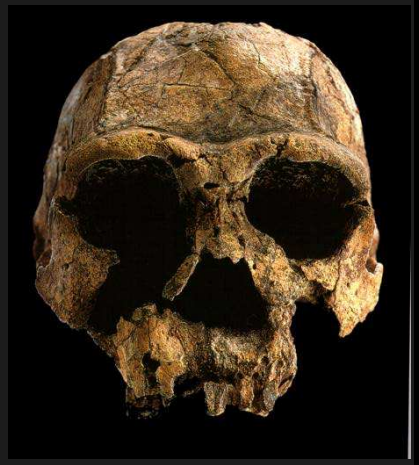
- → morfologická analýza nejlíp podporuje hypotézu, že hobit je druhotně zmenšený mikroinsulární *H. erectus*
- to odpovídá i biogeografii a stratigrafii (včetně stáří nástrojů na Floresu)
- → extrémní zmenšení těla a mozku, „návrat“ k „australopithekoidním“ tělesným proporcím

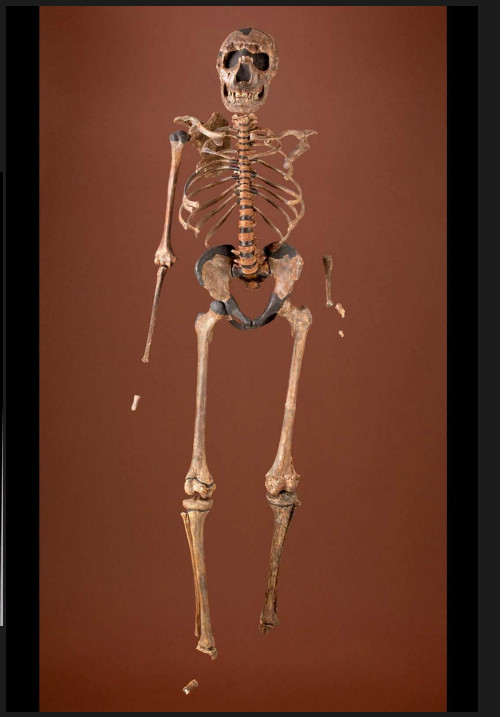




Homo ergaster

- Afrika (1,4-2 Mya)
- první „velký člověk“ (180 cm)
- oldowanská → acheuléenská technologie
- nejasná taxonomie (~ africká verze *H. erectus*???)
- první invaze z Afriky (→ „*H. georgicus*“ – oldowanská kultura)
- KNM-ER 1808: dlouhodobě přežívaná hypervitaminóza A (→ játra masožravců jako potrava, skupinová dynamika s výraznou kooperací a koordinací, lékařská péče)

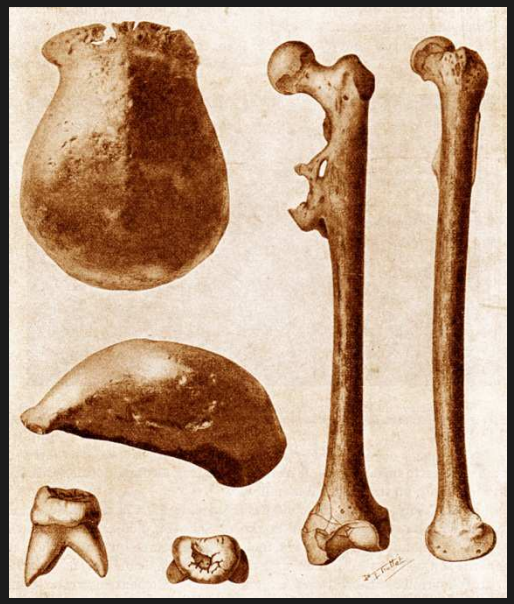




Homo erectus (+ *H. pekinensis*?)

- = *Pithecanthropus*, *Sinanthropus*

- asijské formy tvoří monofyletickou skupinu, (africké → *H. ergaster*)
- druhotná imigrace do Afriky (~ 1 Mya) a do Evropy (Ceprano 900 kya???)
- oldowanská technologie (?), kontrolované užití ohně, vory???
- nápadný sexuální dimorfismus (polygynie)
- na Jávě (Ngandong) prý přetrval až do cca 40 kya – nové datování podstatně starší



Fylogeneze rodu *Homo*

- klíčové postavení *H. ergaster* (Afrika)
- tři fylogenetické linie, každá opustila Afriku:
- 1. → *H. erectus s.str.* (+ *H. pekinensis*)
- 2. → *H. georgicus* (+ *H. floresiensis*???)
- 3. → *H. antecessor* + → *H. heidelbergensis* + *H. neanderthalensis* + → *H. sapiens*

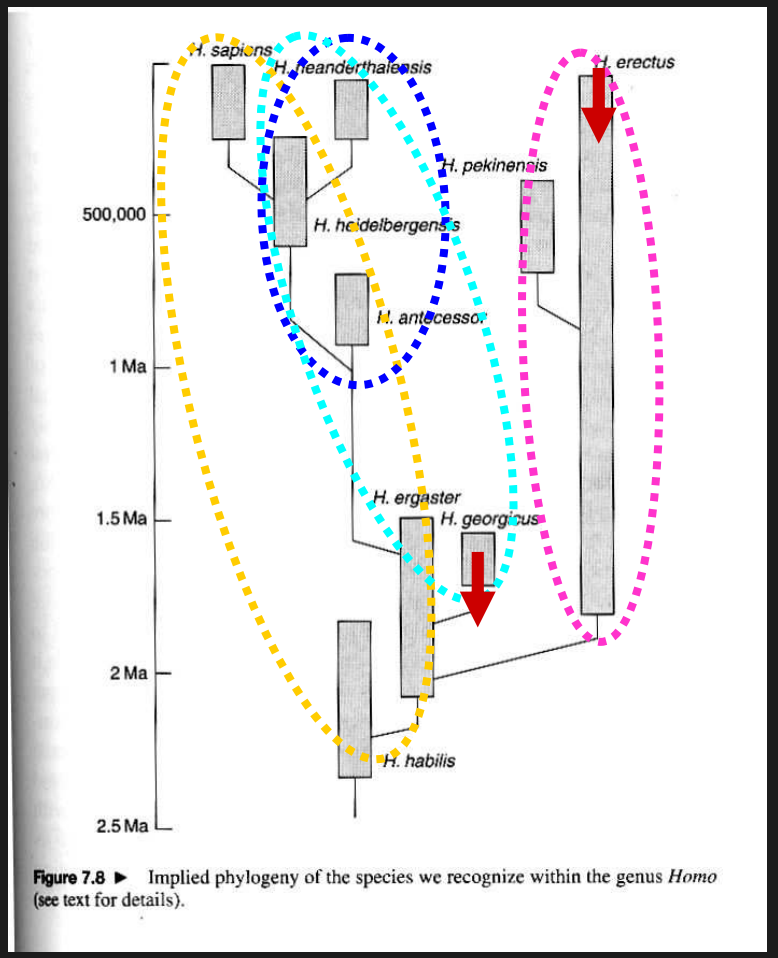
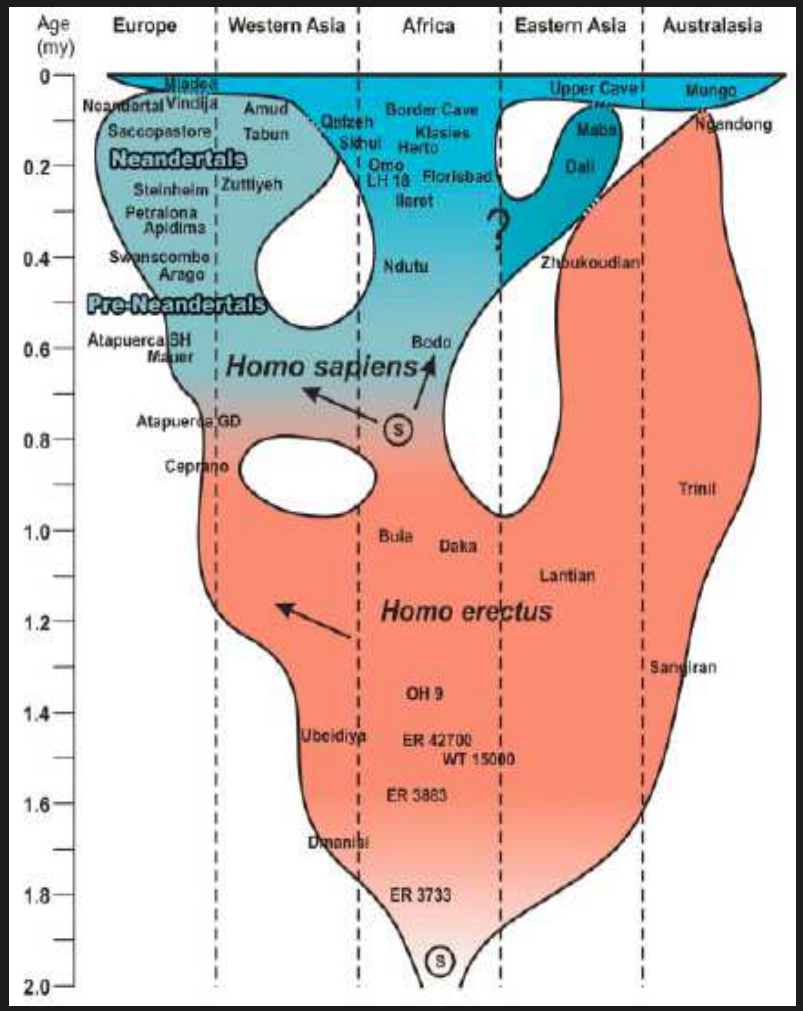


Figure 7.8 ▶ Implied phylogeny of the species we recognize within the genus *Homo* (see text for details).

„Velcí lidé“ a biogeografie

•záhadné fragmentární nálezy v Číně (250-100 kya) ~ *H. heidelbergensis* („Denisované“? soužití s *H. pekinensis*)
•Ngandong (Jáva): *H. erectus* ~ kontinuita s „robustními“ moderními Austrálci???
•Gawis (Etiopie, dosud nepublikováno): 200-500 kya, přechod mezi *H. ergaster* a *H. heidelbergensis* /*sapiens*???

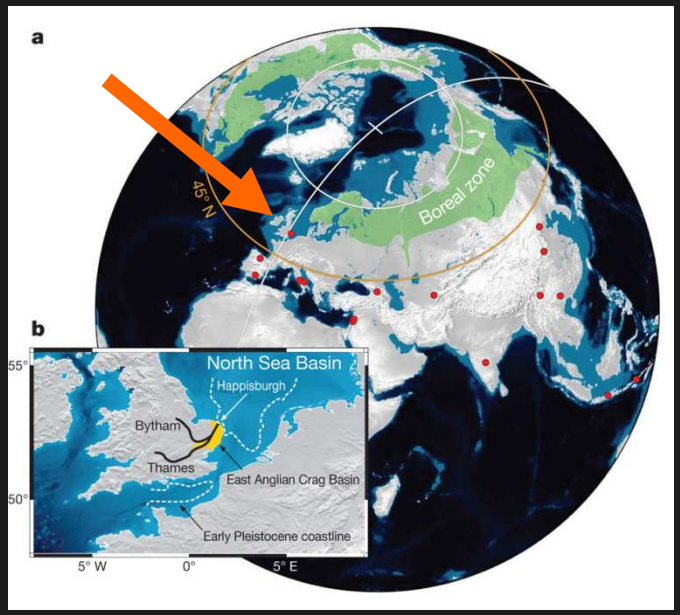


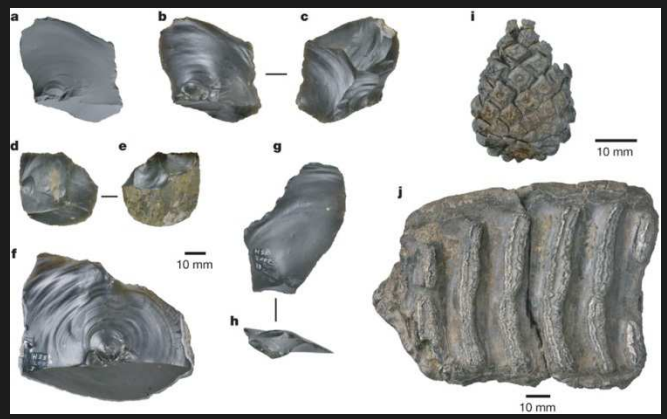
Homo sapiens a spol.

- několik nejasných bazálních taxonů *(H. cepranensis* – jižní Evropa – *H. heidelbergensis* nebo *erectus* z Asie???)
- ***H. antecessor*** – severní Španělsko (780 kya) – oldowanská kultura
- ***„H. heidelbergensis“*** – parafyl., Afrika, Evropa (600-250 kya) + migrace do Číny (+ Narmada, Indie??? x *H. erectus* s velkou hlavou x přechodná populace *H. ergaster-H. heidelbergensis* sahala do Asie???): pohřbívání mrtvých, jazyk? → “*H. steinheimensis*” – předek neandertálce (Evropa, Indie?)
- ***H*. sp. „Denisovans“**
- ***H. neanderthalensis***
- “*H. rhodesiensis*” /“*H. helmei*” (??? ~ africký *H. heidelbergensis* – předek *H. sapiens*)
- ***H. sapiens*** (vč. *H. s. idaltu*)
- „archaický *Homo sapiens*“ = *Ha + Hh + HD + Hr + Hn*

Rozšíření „sapientní“ linie v Eurasii

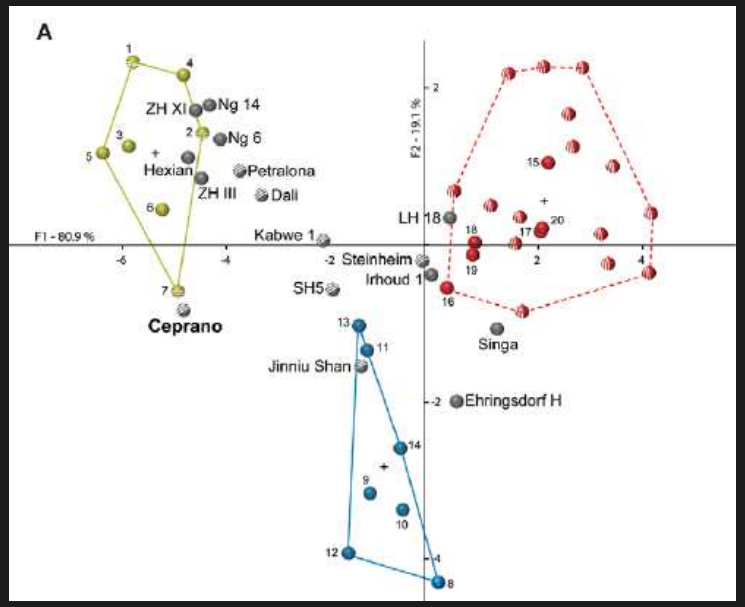
- 2010: archeologické nálezy v Anglii (Happisburgh) cca 780 kya (~ *H. antecessor*?)
- už raně pleistocénní lidé dosáhli okraje boreální zóny (~ odpovídající změny v ekologii, etologii ...)

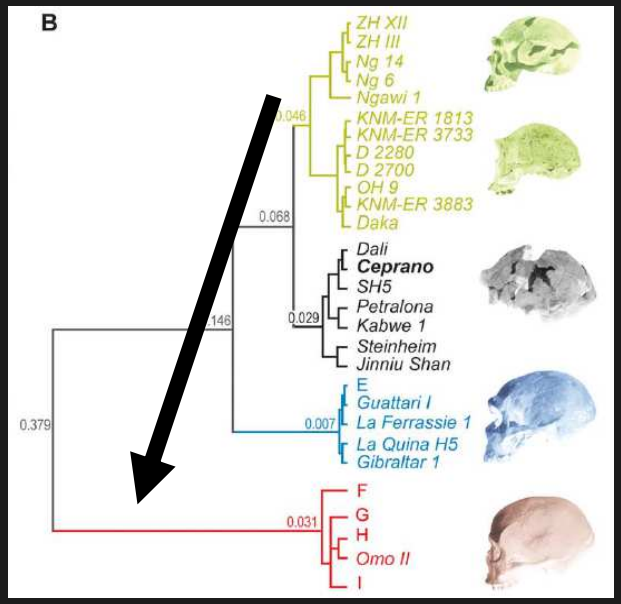




Homo heidelbergensis

- fenetická analýza kraniálních znaků ukázala, že *H. heidelbergensis* tvoří jednotnou formu (v Eurasii i Africe), odlišnou od AMH, neandertálce i staropleistocenních lidí (*H. habilis*, *H. ergaster*, *H. erectus*)
- „*H. cepranensis*“ (Itálie, 400 kya – původní datování dvojnásobné!) patří do tohoto druhu

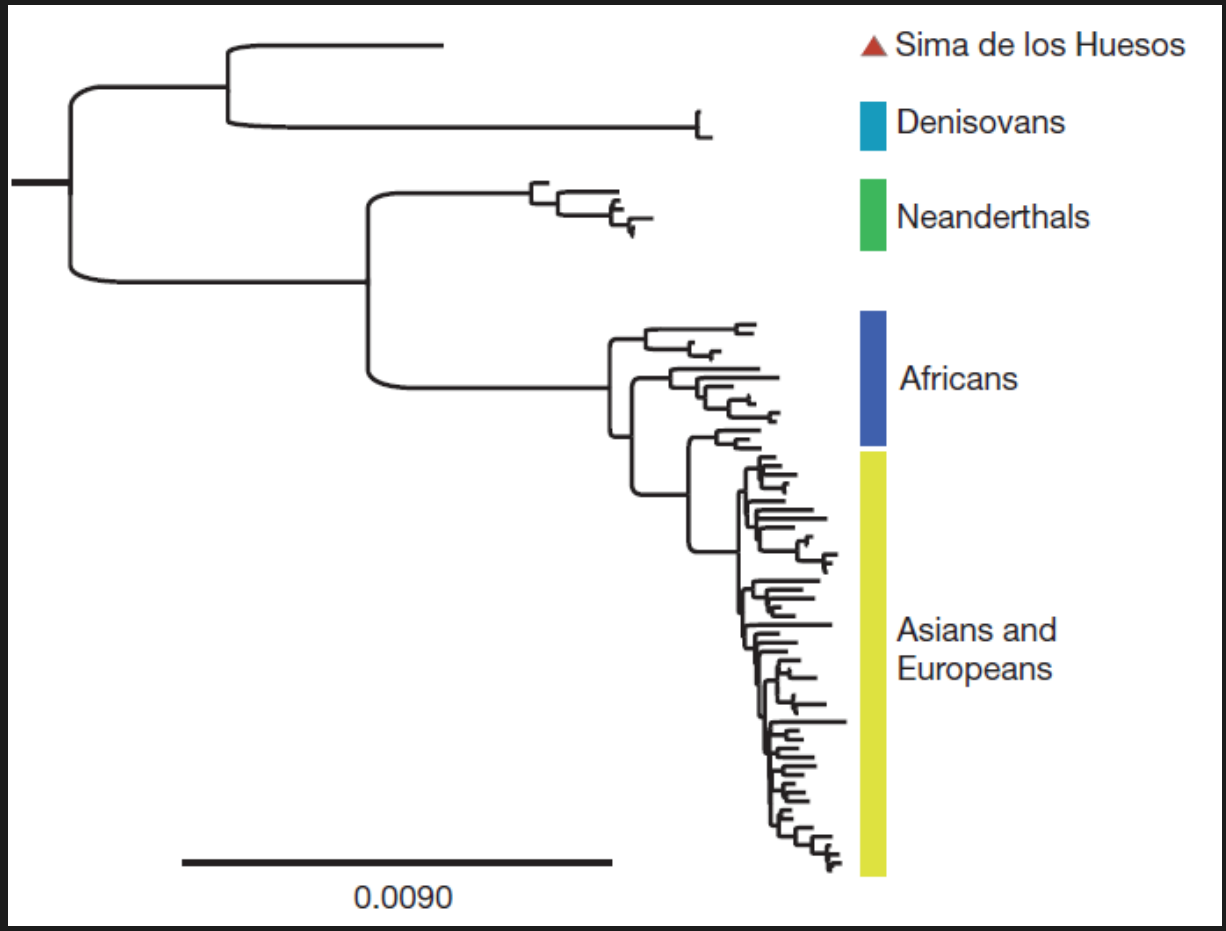




2013: mtDNA ze Sima de los Huesos

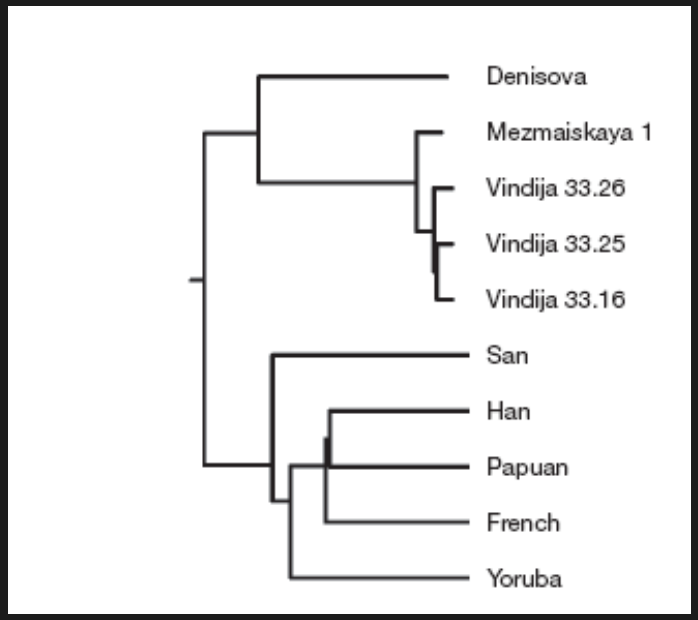
- Sierra de Atapuerca – lokalita Sima de los Huesos
- 400 kya
- *H. heidelbergensis*? (neandertaloidní morfologie)
- x jenom pár set metrů od Gran Dolina (*H. antecessor*)

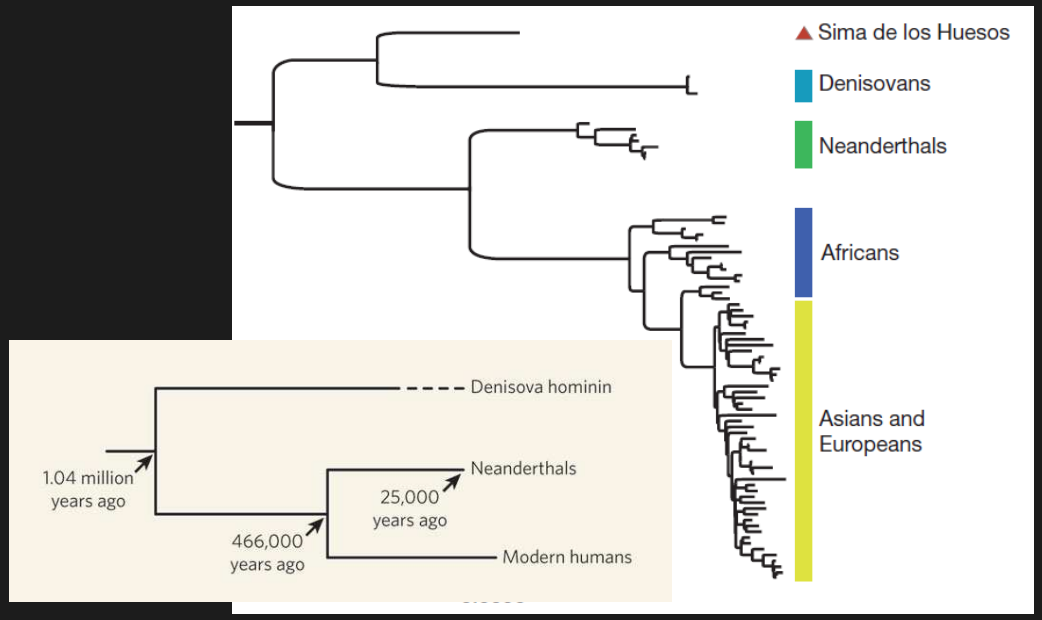
2013: mtDNA ze Sima de los Huesos



2013: mtDNA ze Sima de los Huesos

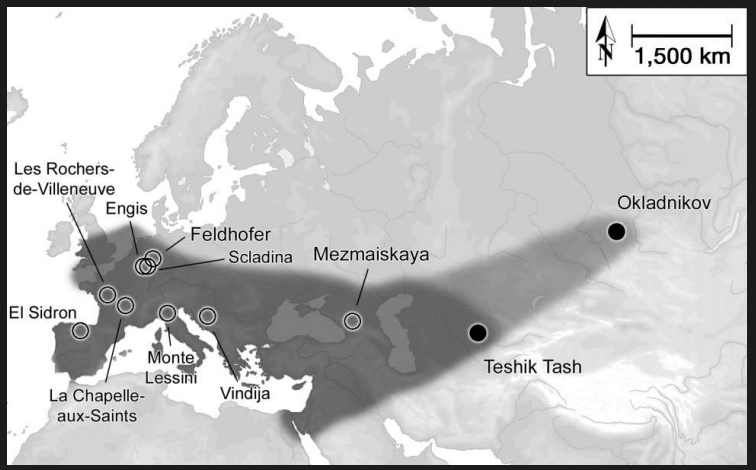
- rozpory mt a nuDNA u Denisovanů + stáří nálezu → podezření na míšení s dalšími, staršími formami (*erectus*?)



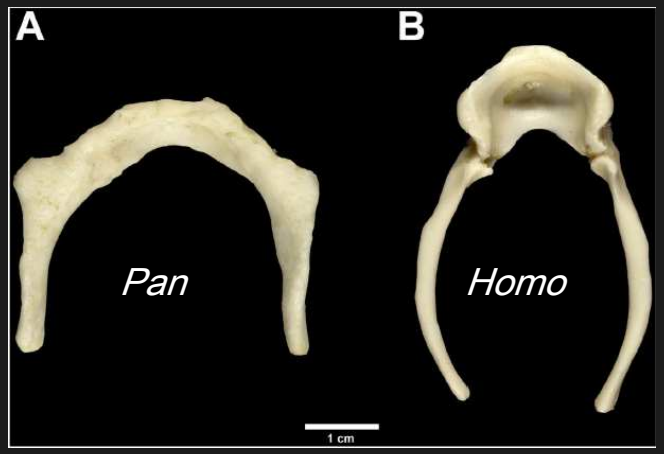


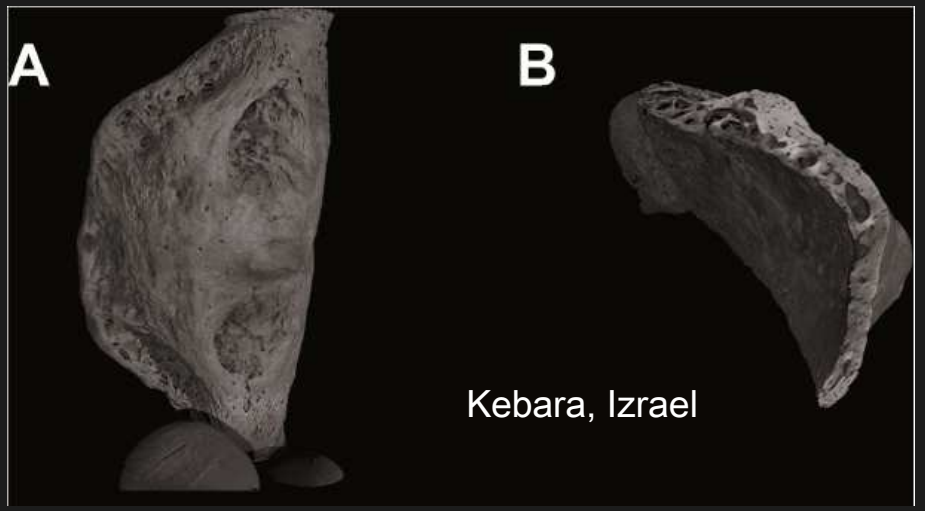
Homo neanderthalensis

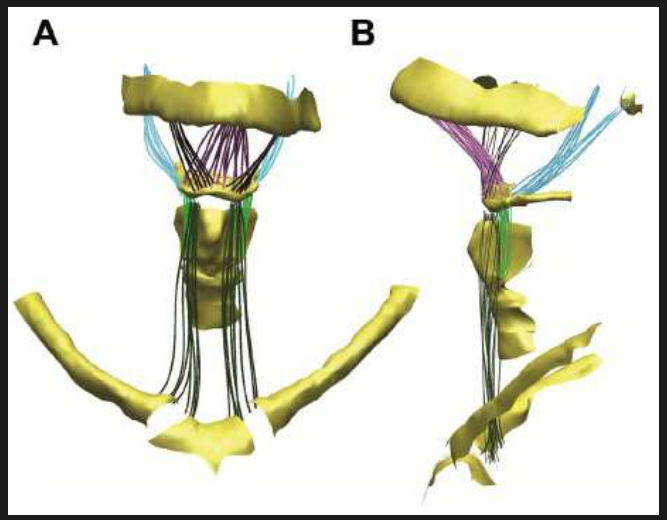
- 350 (270-440) až 30-40 (24?) kya, Evropa a Asie (na východ po Altaj, možná i Mongolsko a Guangxi) – původně temperátní, později glaciální forma
- moustierská kultura (později châtelperronská, možná inspirovaná *H. sapiens*)
- jazyk (šířka hypoglosálního a páteřního kanálu, „jazykový gen“ *FOX2P* x pochybnosti o stavbě vokálního aparátu vyvráceny)
- mutace v genu *MC1R*: aspoň někteří měli bledou pleť a červené vlasy
- polymorfismus v genu *TAS2R38* (schopnost chutnat fenylthiokarbamid)
- intolerance laktózy



Řeč neandertálců



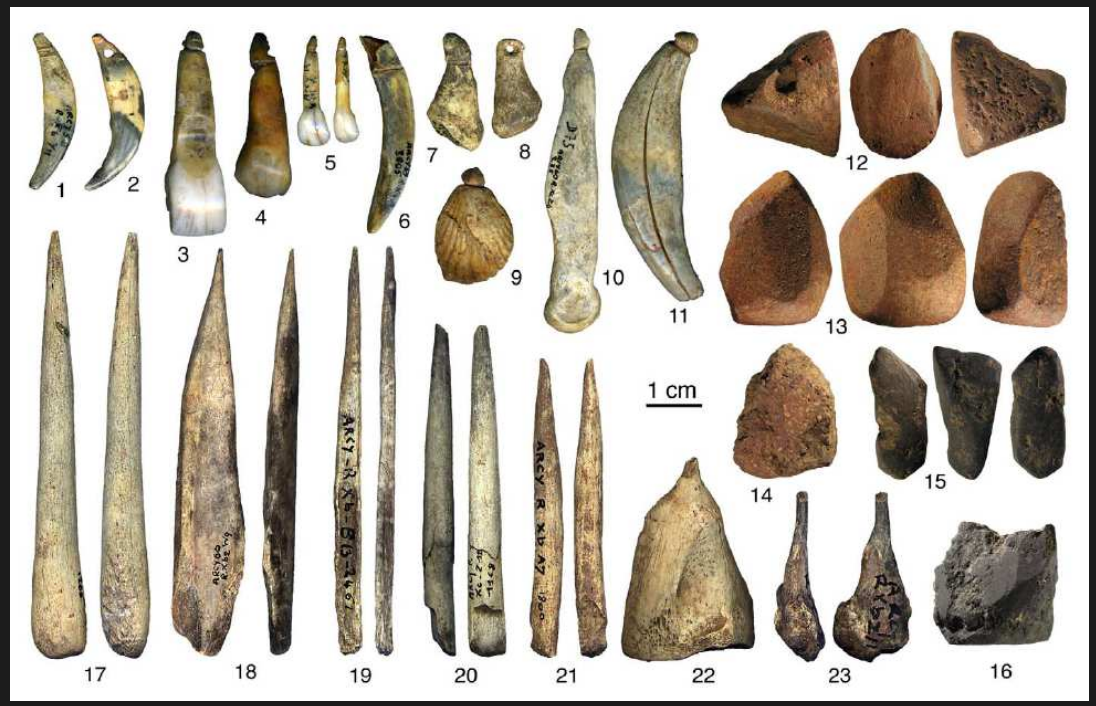




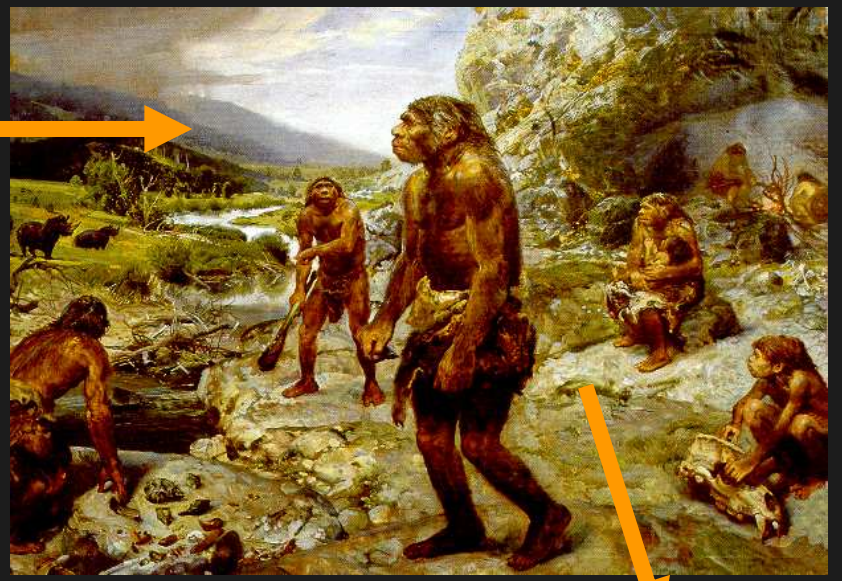
- morfologie vnějšího a středního ucha: neandertálci i heidelbergové stejní jako AMH
- vokální aparát: dtto
- mikro-biomechanika jazylky: neandertálci stejní jako lidé

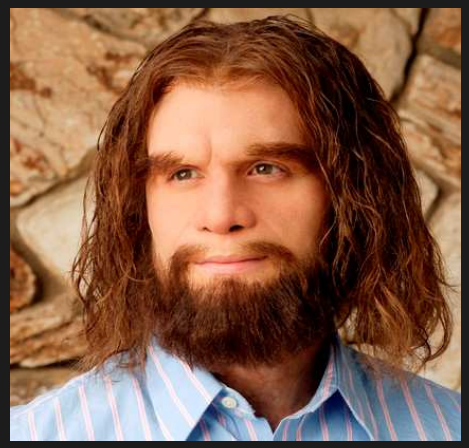
Symbolická kultura neandertálců

- châtelperronská kultura (osobní ozdoby, barvení etc.) je opravdu nenadertálská



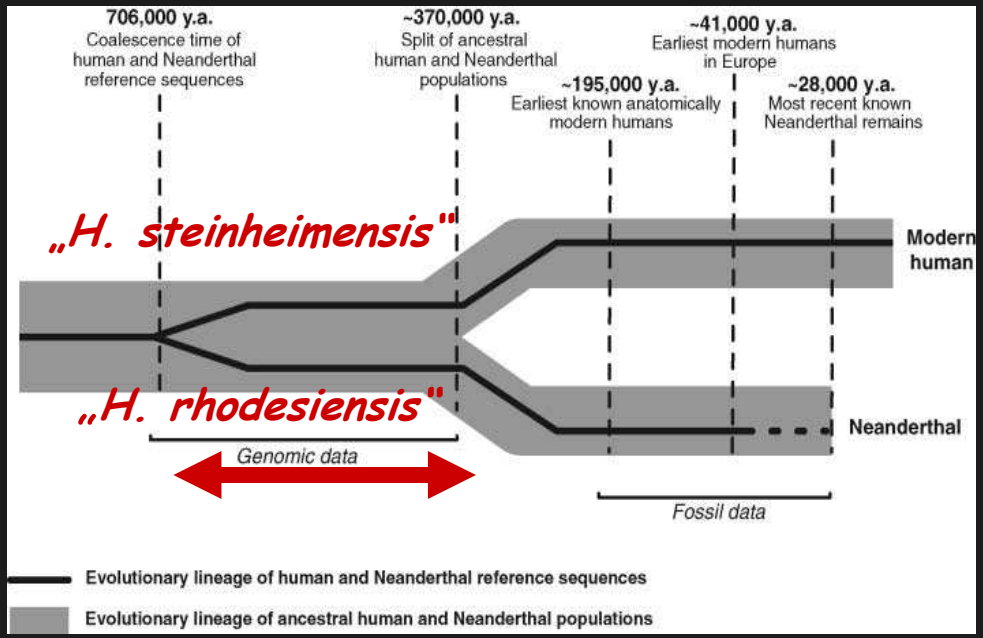
„Evoluce“ neandertálců

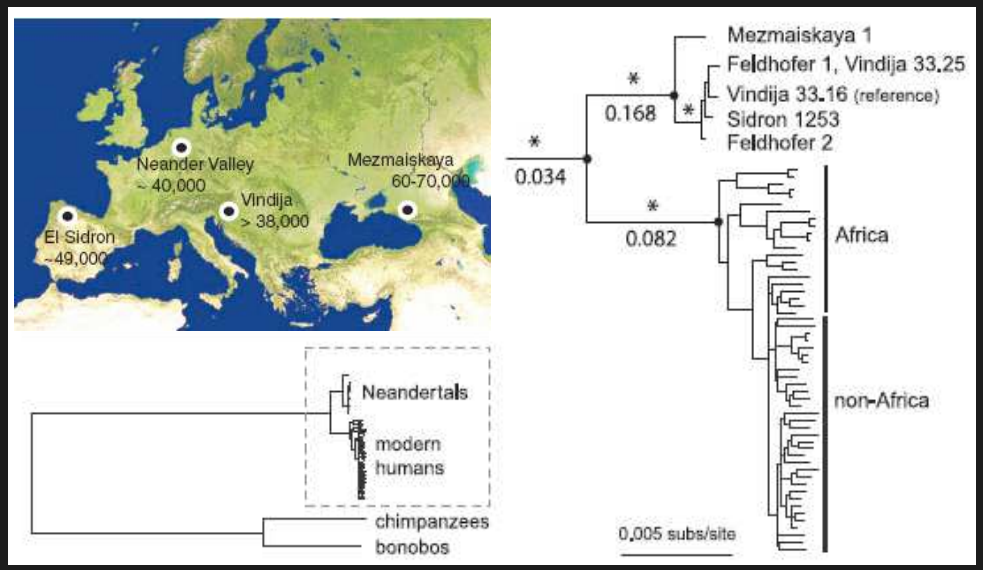




Homo neanderthalensis

- cca 1/3 genetické diverzity člověka (mtDNA) – dlouhodobě malé populace
- patrilokalita
- 2009: přečten kompletní genom





Fylogeneze
Homo sapiens a *H. neanderthalensis*

molekulární divergence *H. neanderthalensis* a *H. sapiens* (>500 kya) zahrnuje i jiné fosilní druhy