

Il simbolismo e la creatività nel cammino evolutivo dell'essere umano

 **QUANTA**

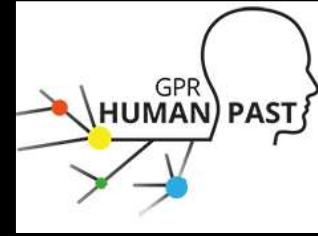
Evolution of Cognitive Tools
for Quantification



université
de **BORDEAUX**



Chauvet Cave, copyright
Ministère de la culture



Francesco d'Errico

CNRS, UMR PACEA, University of Bordeaux, France

Centre for Early Sapiens Behaviour, University of Bergen, Norway

Secondo Charles Sanders Peirce

- **Segno:** qualsiasi cosa che rappresenti qualcosa per qualcuno.
- **Icona:** segno che assomiglia o imita l'oggetto che rappresenta (ad esempio, una foto).
- **Indice:** segno che è fisicamente o causalmente legato all'oggetto (ad esempio, il fumo per indicare un incendio).
- **Simbolo:** segno la cui relazione con l'oggetto è arbitraria e basata su una convenzione o un accordo (ad esempio, parole in una lingua, numeri o la bilancia per indicare la giustizia).







1979



1996



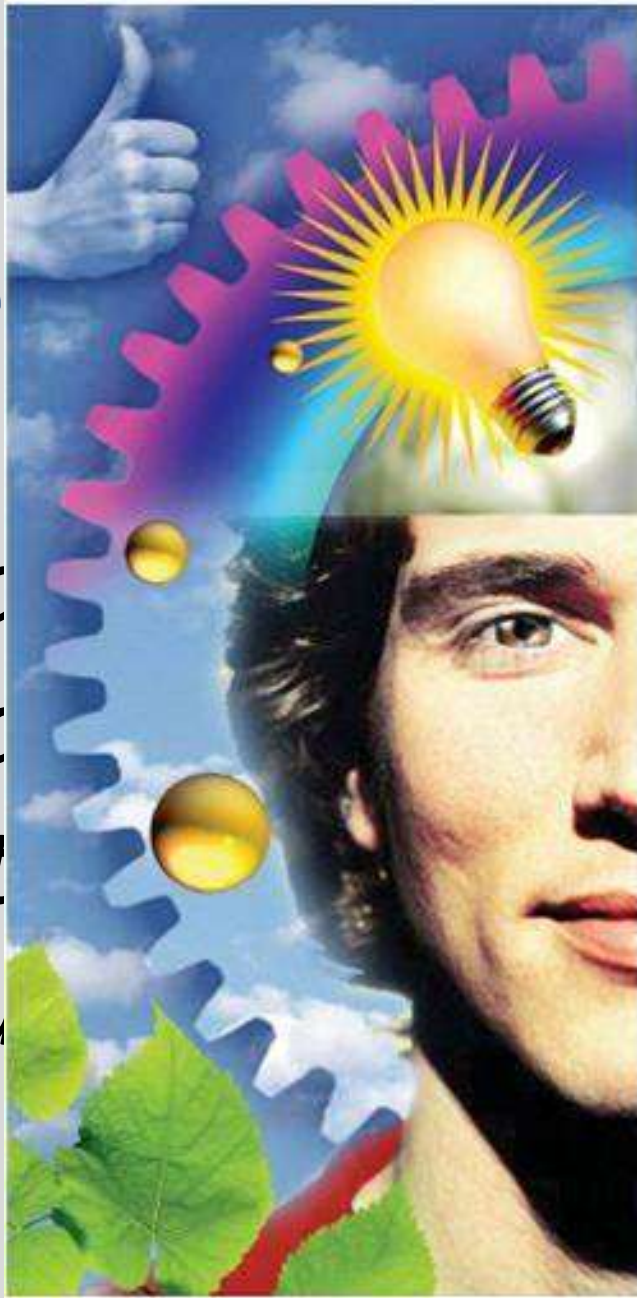
Washoe



Creativity

the ability to transcend traditional ideas, rules, relationships, to create valuable new ideas, forms, methods, interpretations, solutions, products

Cre
the
idea
crea
met
solu

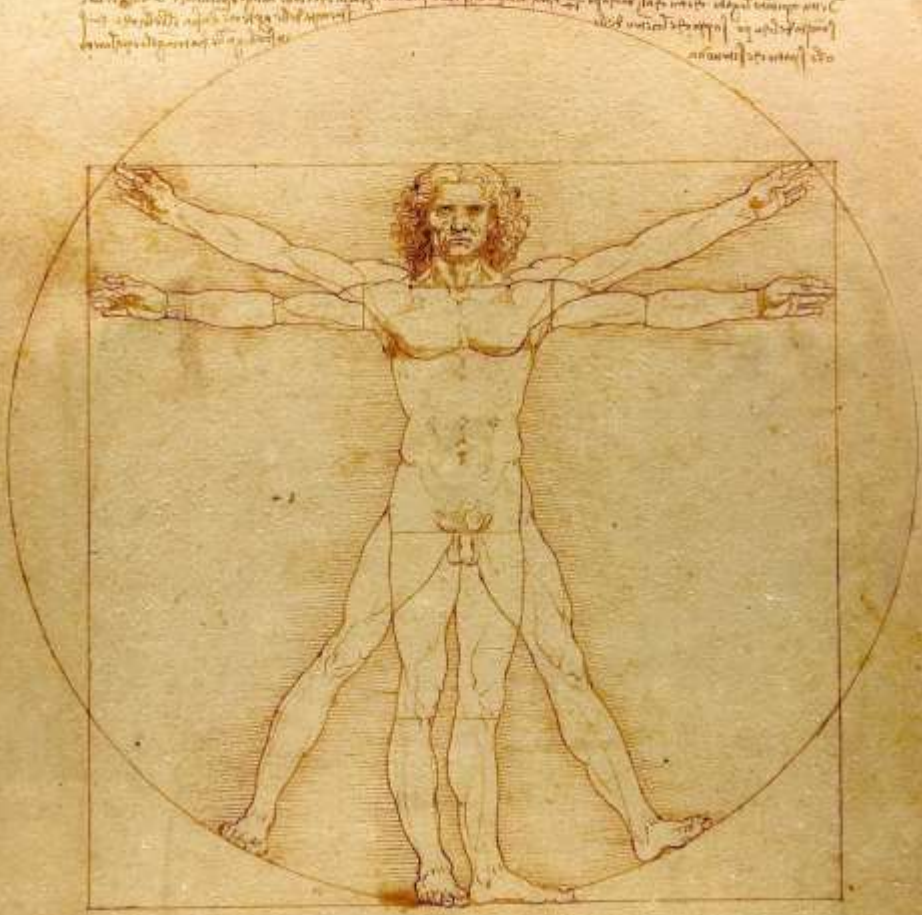


nal
ns,



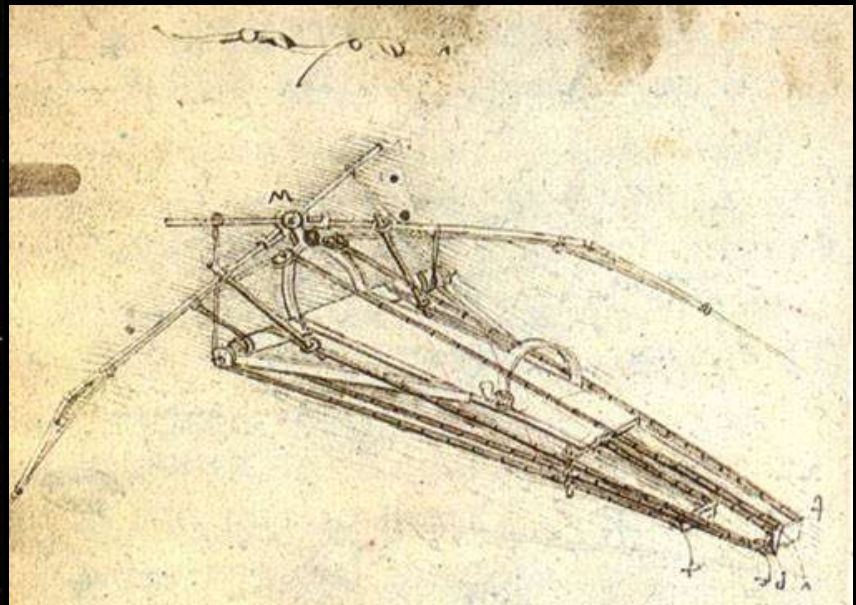
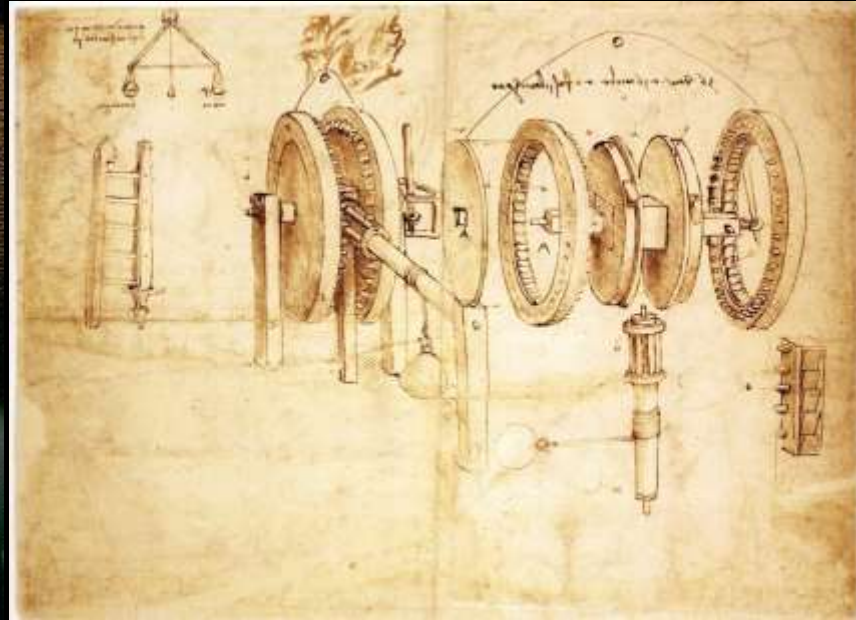


In nomine domini Amen. Hic describitur
 constructio huiusmodi machinae
 quae ad movendum ponderis
 et ad alia multa utilis
 est. Huiusmodi machina
 consistit in quatuor
 rotis quibusdam
 quae inter se
 sunt connectae
 et per unum
 eorum movetur
 et per alios
 movetur. Huiusmodi
 machina
 utilis est
 ad movendum
 ponderis
 et ad alia
 multa.

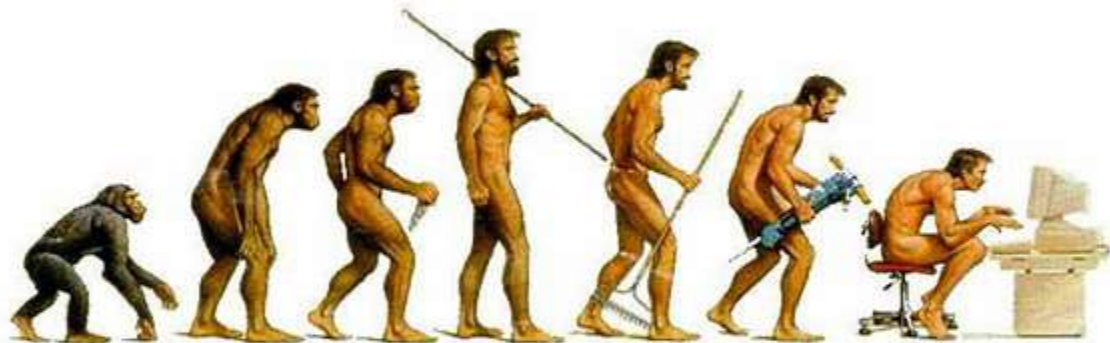
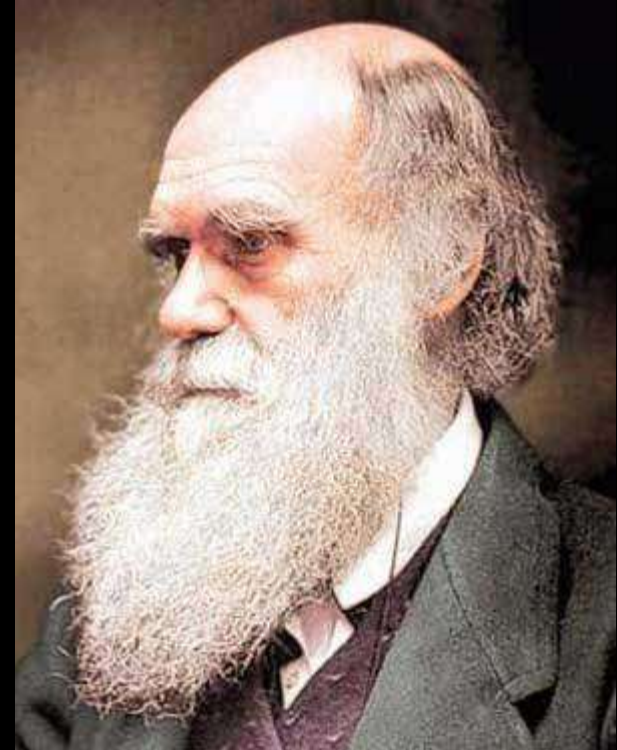


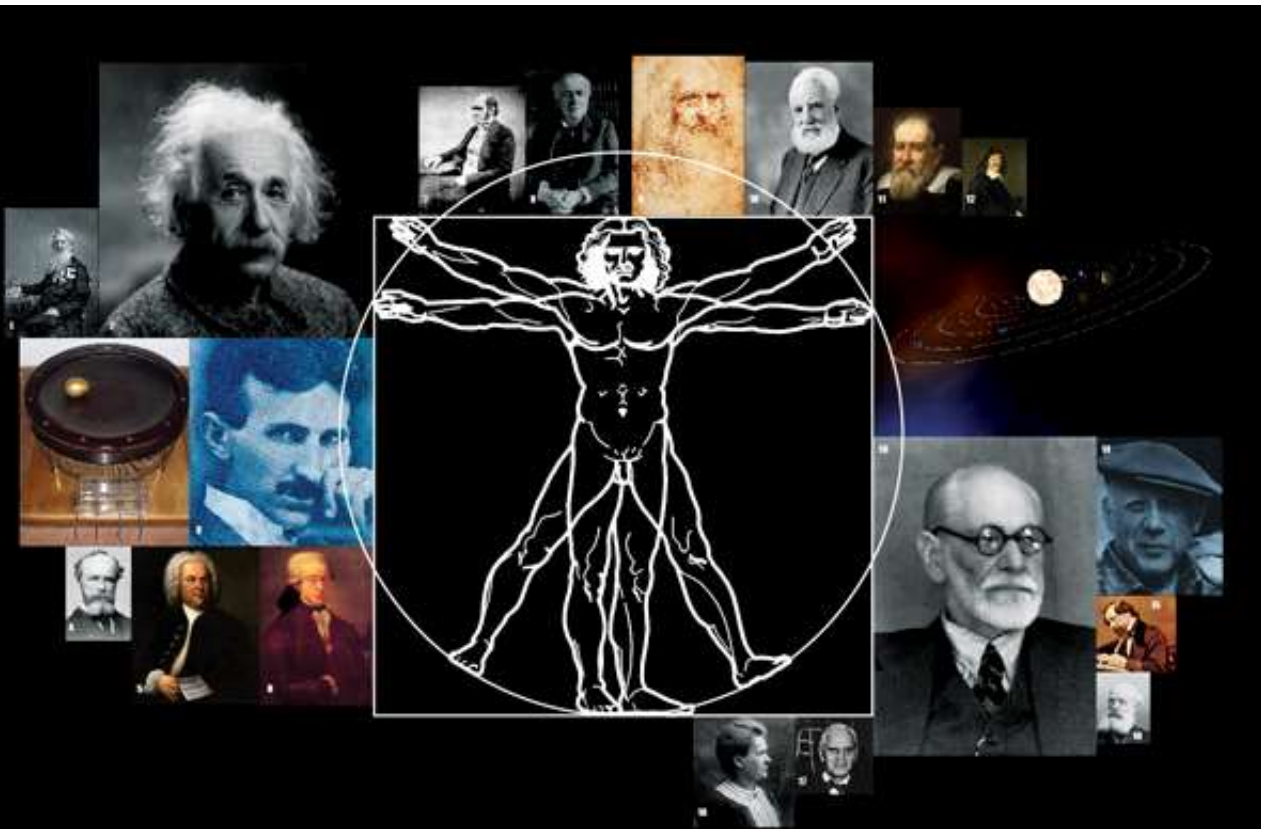
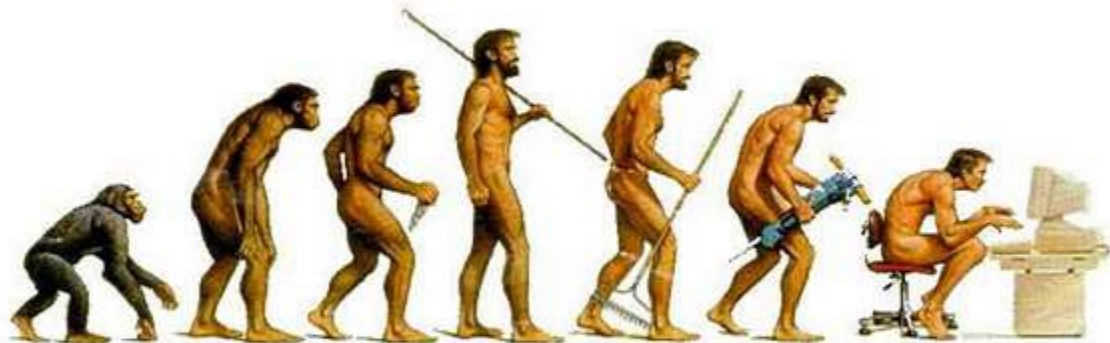
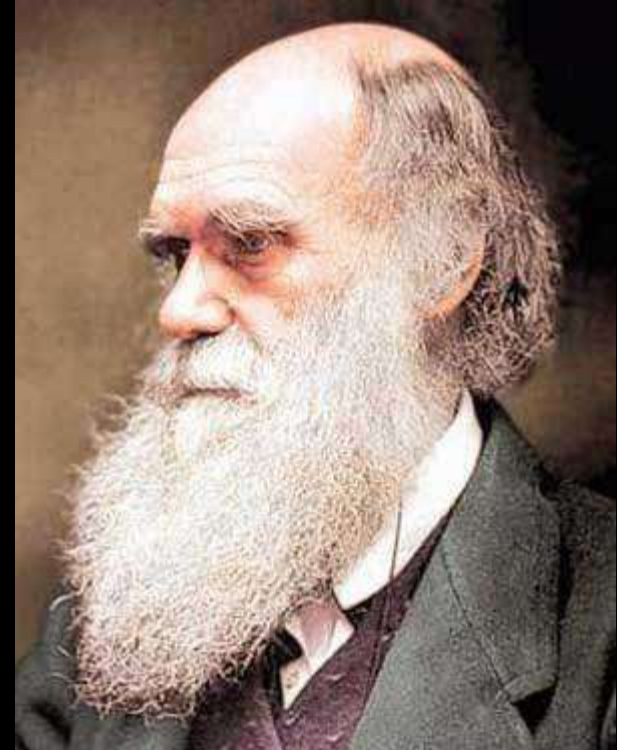
Hic describitur constructio huiusmodi
 machinae quae ad movendum
 ponderis et ad alia multa
 utilis est.

Hic describitur constructio huiusmodi
 machinae quae ad movendum
 ponderis et ad alia multa
 utilis est.



Hic describitur constructio huiusmodi
 machinae quae ad movendum
 ponderis et ad alia multa
 utilis est.





THE WEIRDEST PEOPLE IN THE WORLD



HOW THE WEST BECAME
PSYCHOLOGICALLY PECULIAR AND
PARTICULARLY PROSPEROUS

JOSEPH HENRICH

20 years ago

The path leading to the typically human creativity was short, abrupt and exclusively associated with Anatomically Modern Humans

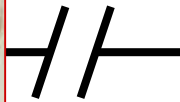


40 ka

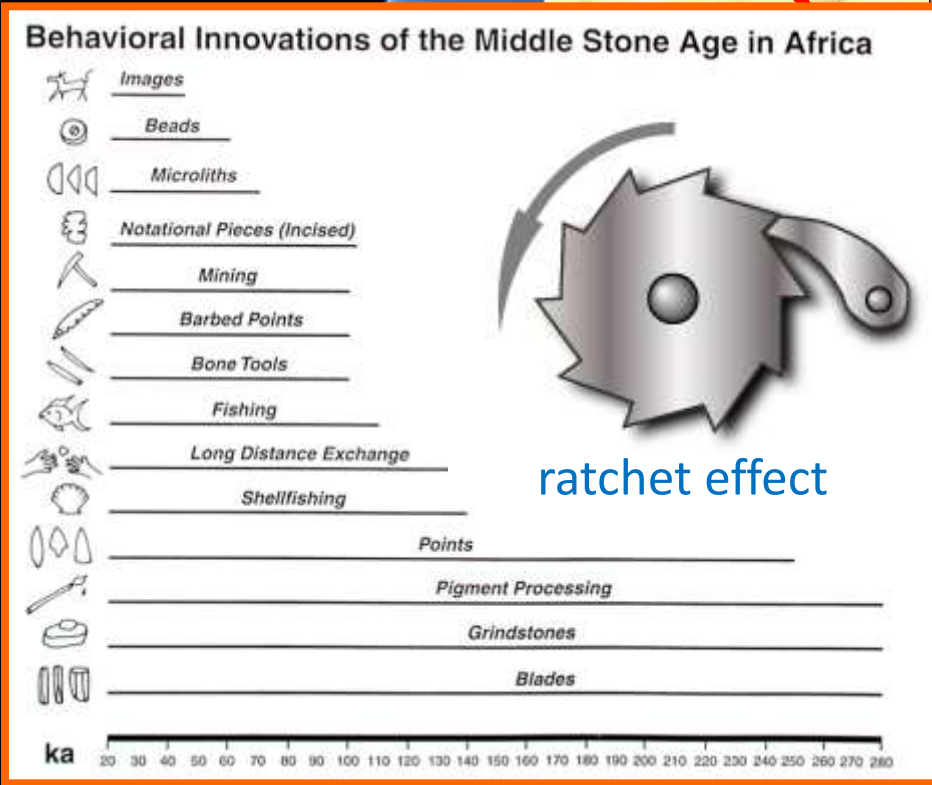
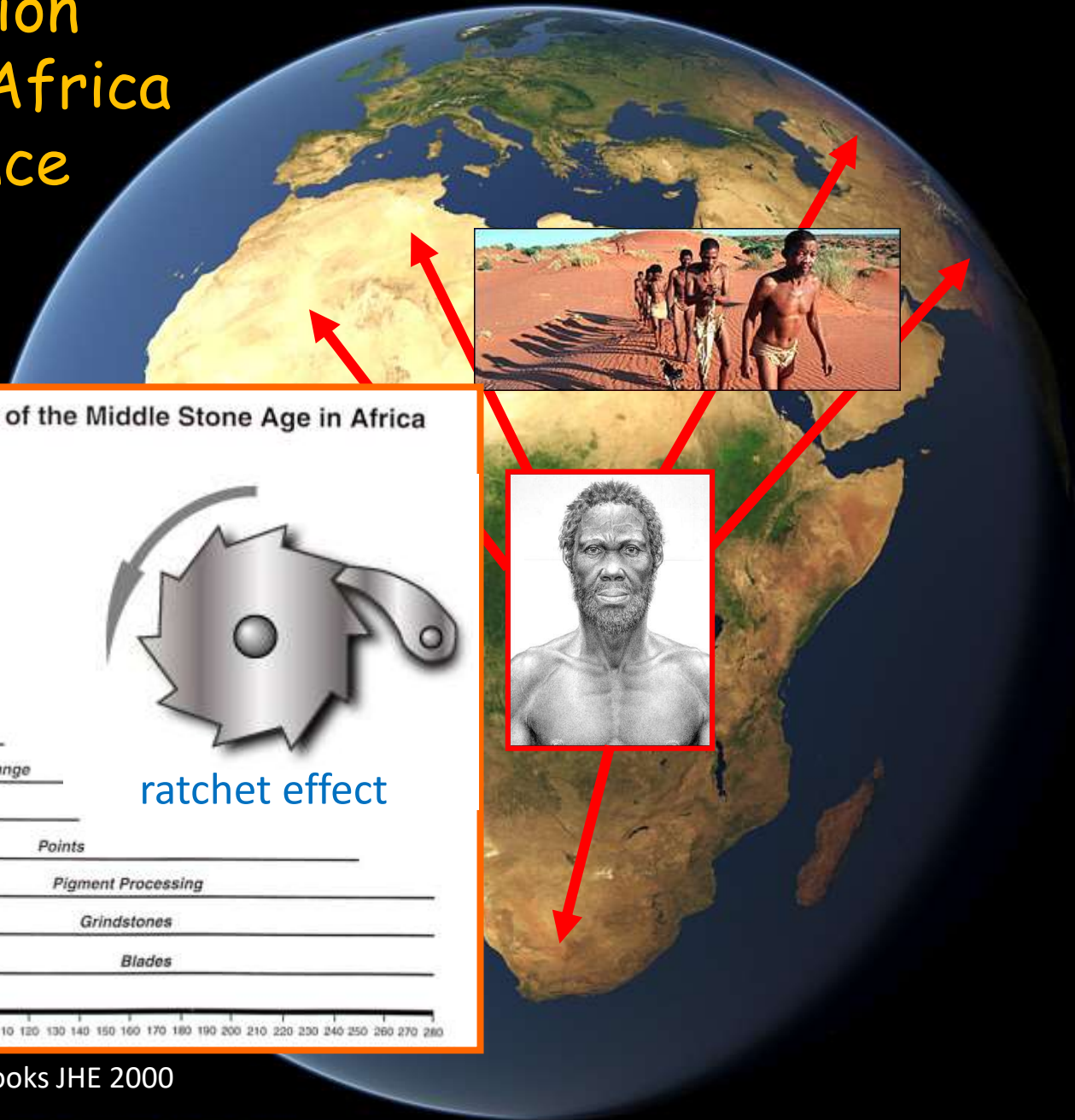


Noam Chomsky view

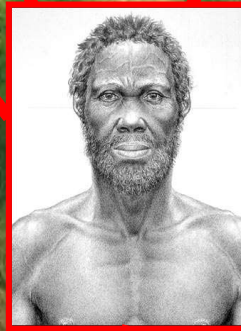
Human language is an innate and specific competence.
It did not evolve from any previous animal communication system



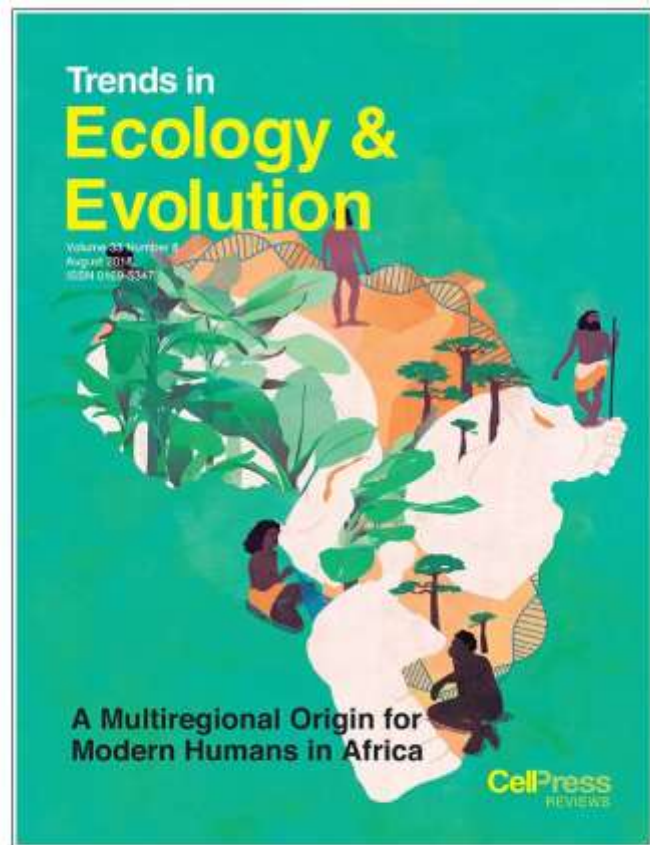
Modern cognition exclusively in Africa as a consequence of a biological event



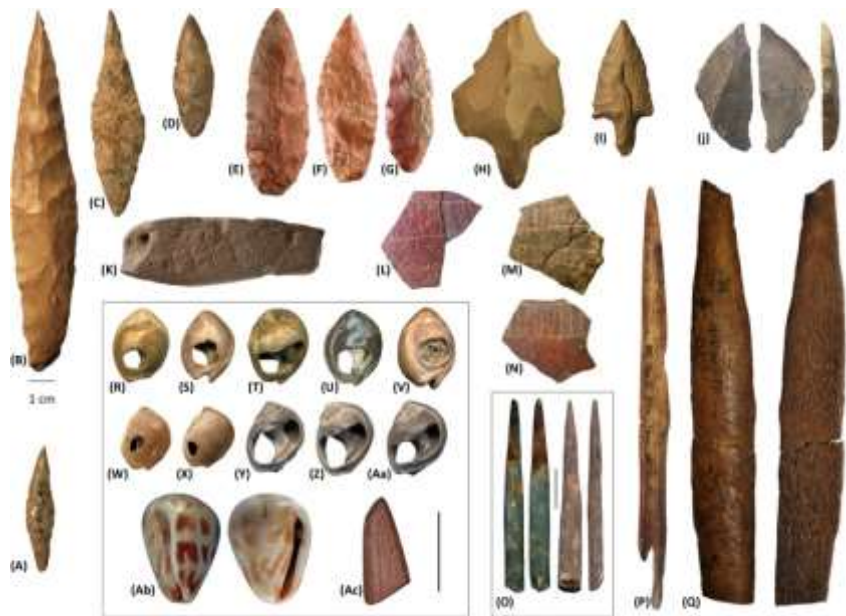
ratchet effect



McBrearty & Brooks JHE 2000



August 2018
Volume 33, Issue 8



Trends in Ecology & Evolution

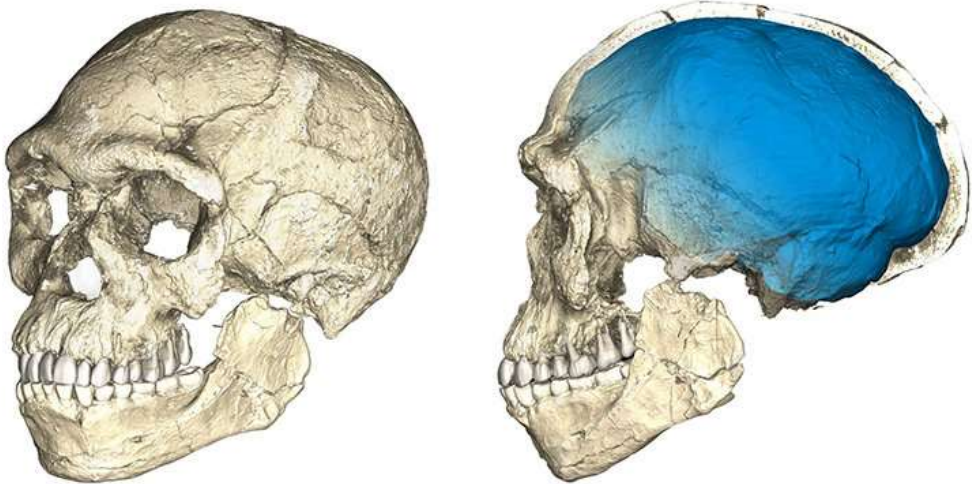


1 cm

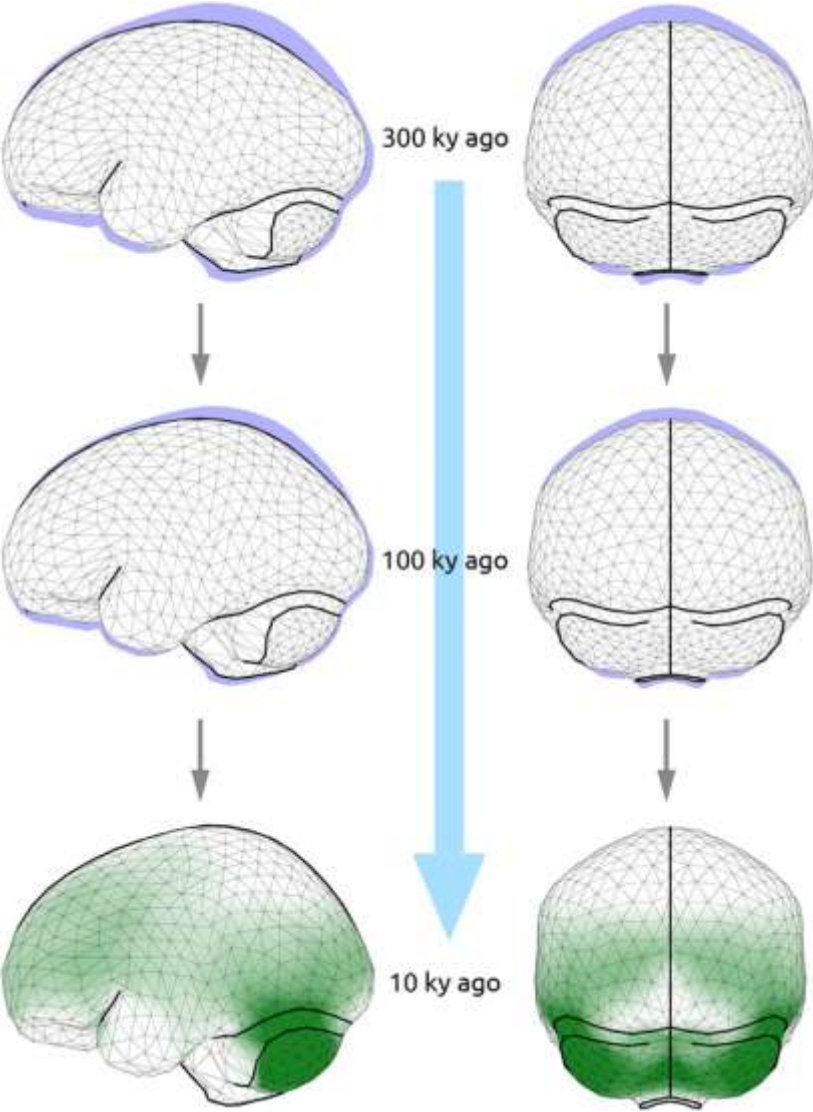
Trends in Ecology & Evolution

Scerri et al. 2018

Djebel Irhoud, Morocco, 300 ka

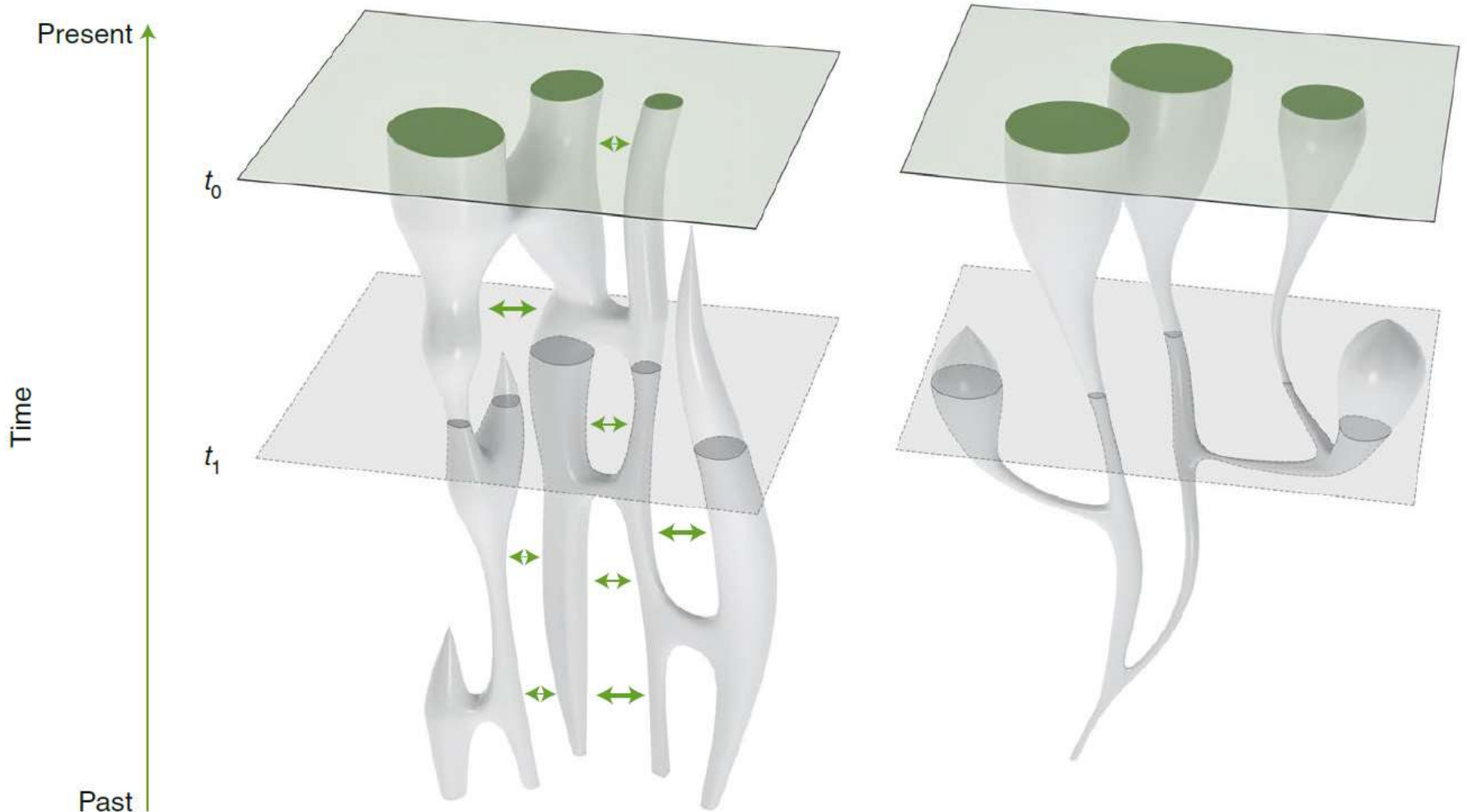


Hublin et al. 2018



Neubauer et al. 2018

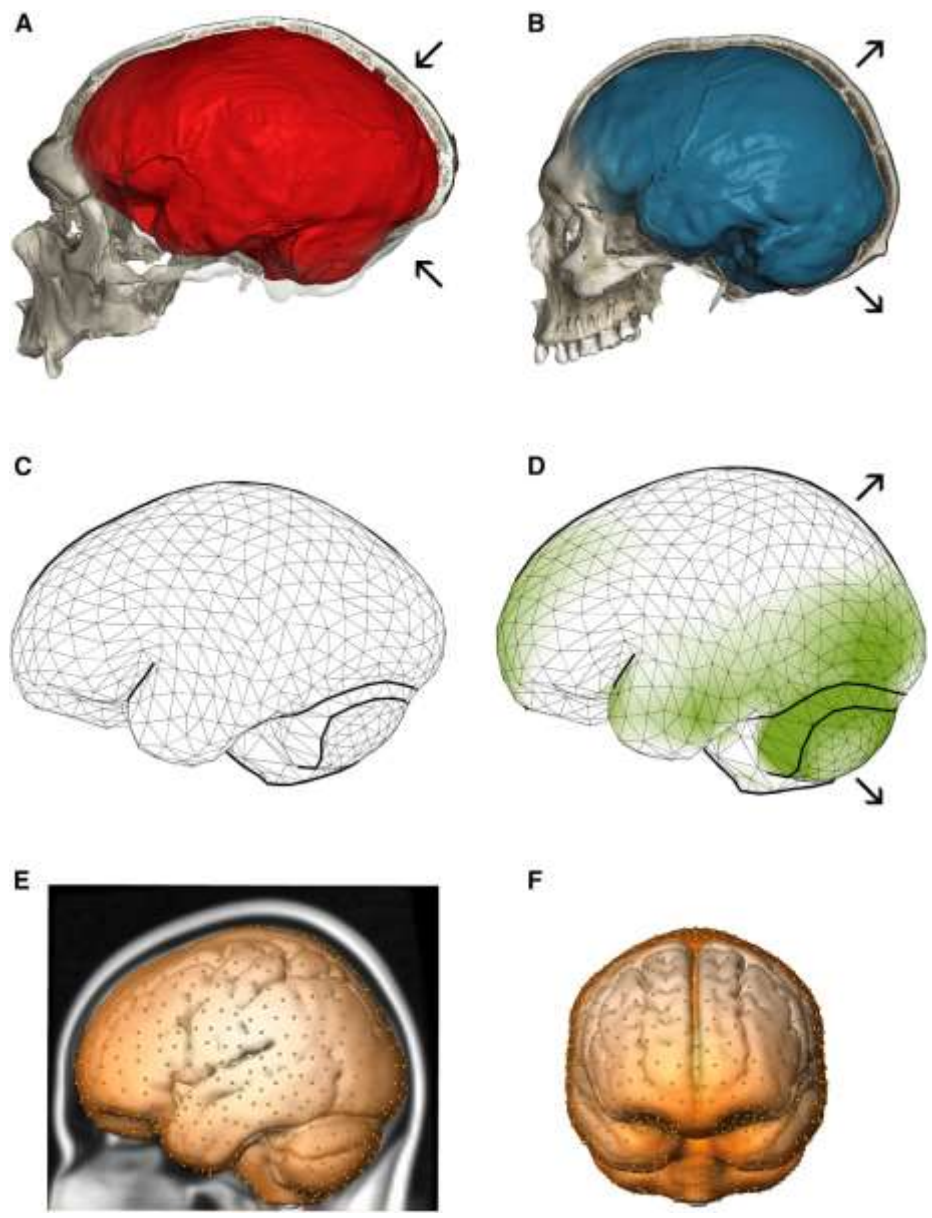
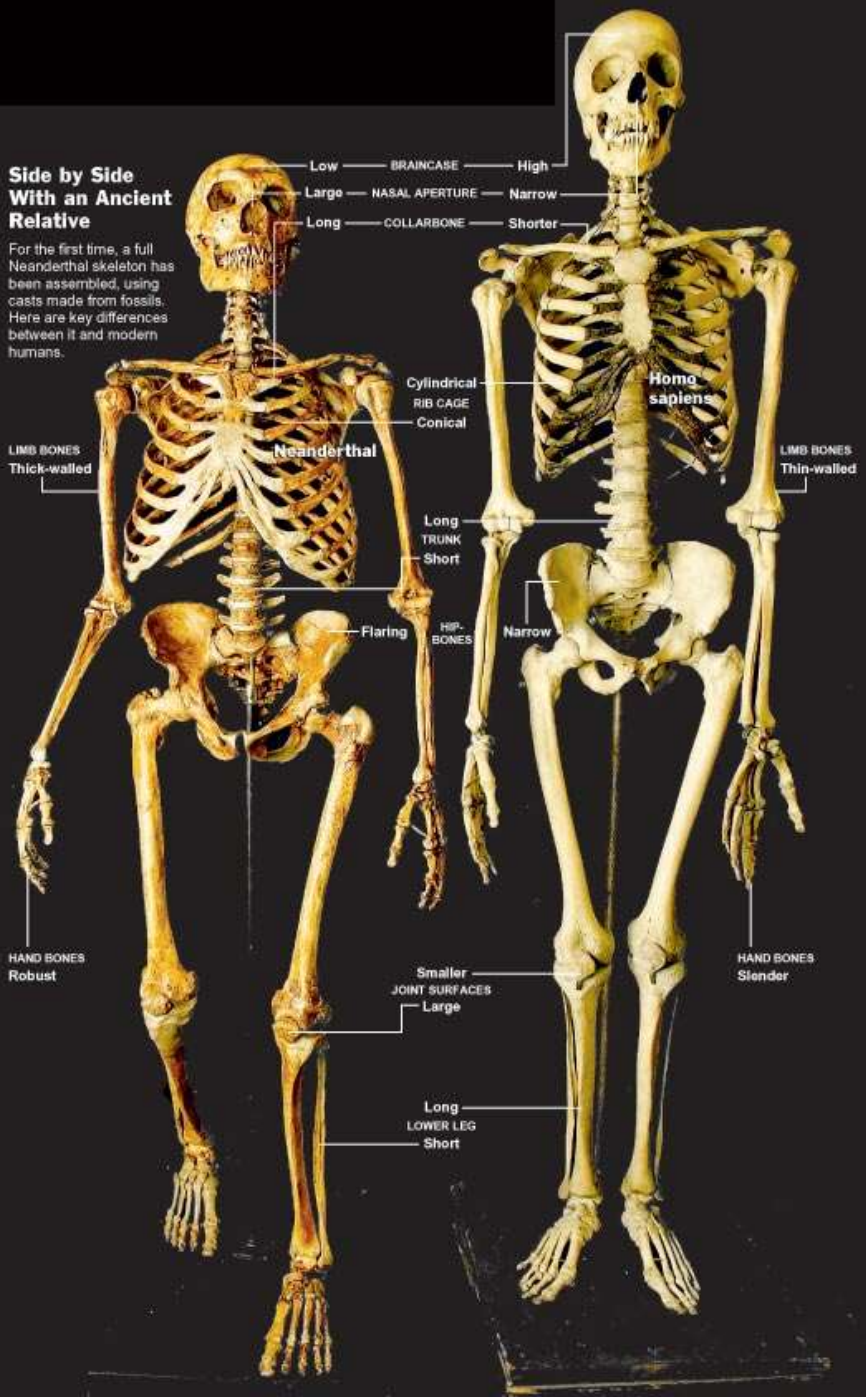
Modern human origin in structured populations



Scerri et al. 2019 *Trends Ecol. Evol.*

**Side by Side
With an Ancient
Relative**

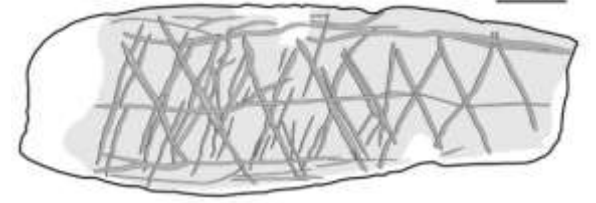
For the first time, a full Neanderthal skeleton has been assembled, using casts made from fossils. Here are key differences between it and modern humans.



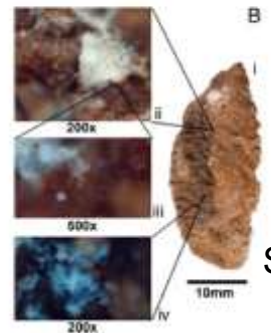
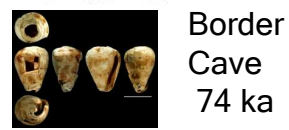
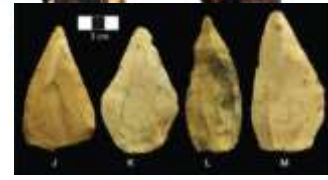
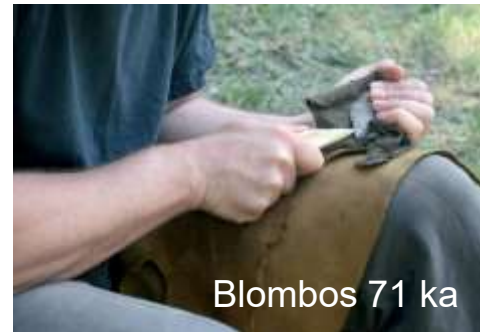
Gunz et al. 2019, *Current Biology*



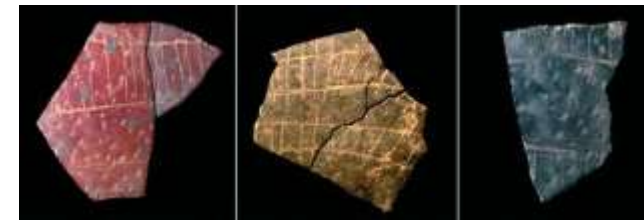
Taforalt, 80 ka



Klasies River, Blombos 100-71 ka



Blombos, 71 ka



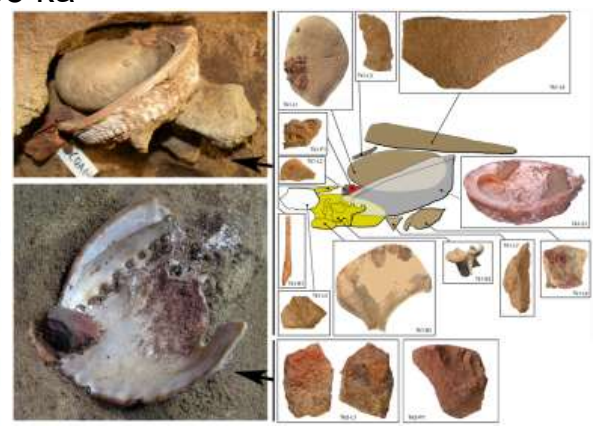
Diepkloof, Klipdrift, Apollo 11, 64 ka



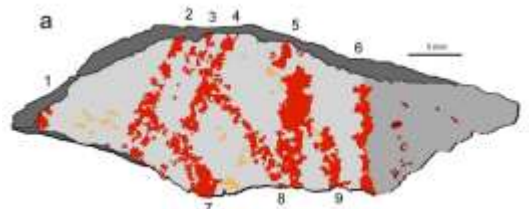
Katanda 95 ka



Blombos 71 ka



Blombos 100 ka



Blombos 73 ka



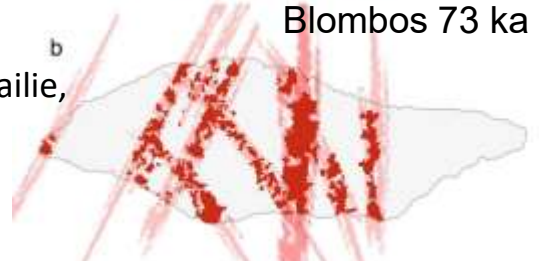
Sibudu Cave 80-40 ka



Twin Rivers 260 ka

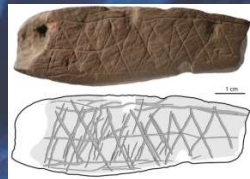
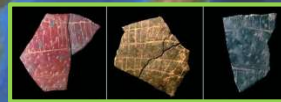


Olorgesailie, 320 ka



Earliest symbolic material culture in Africa





NA North Africa
SA South Africa
EA East Africa

Ochre
500-300 ka SA-EA
80 NA
Bone tools
110 ka NA
95 CA
80 ka SA
Beads
120 ka NA
80 ka SA
Engravings on
ochre
100 ka SA
Shaped beads
55 ka SA
Engravings on
OES
64-55 ka SA

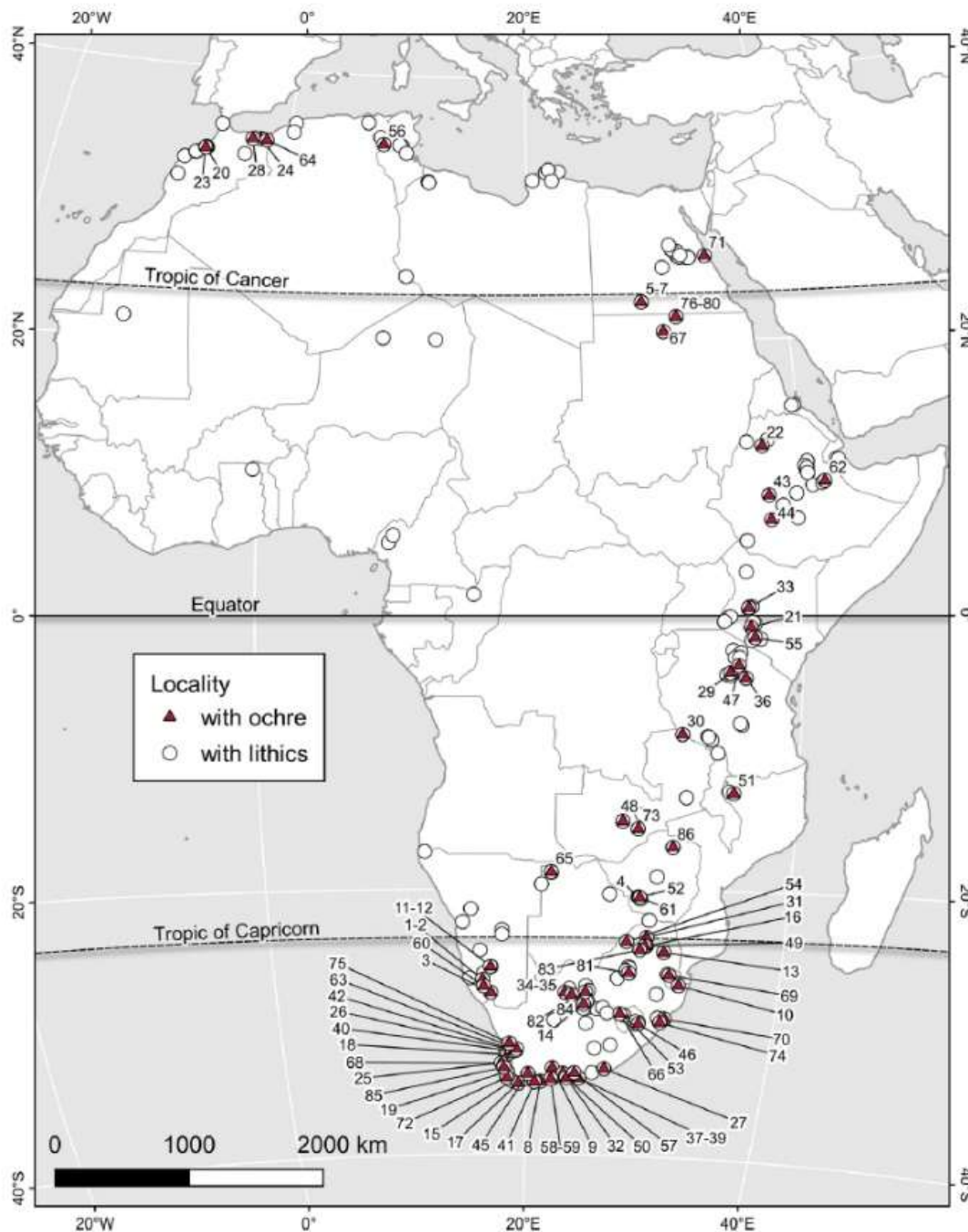
86 sites
25,000 ochre pieces

ROAD

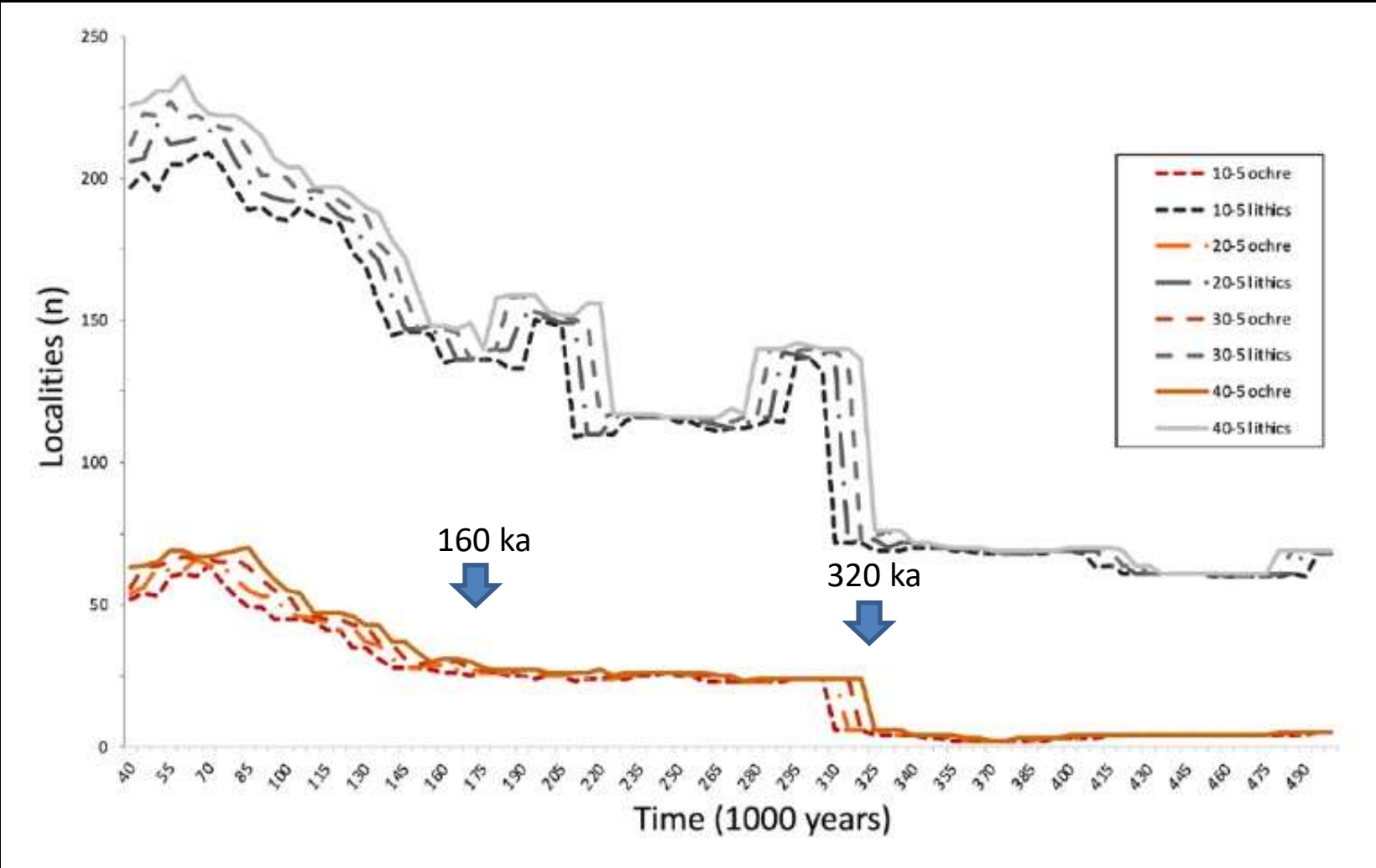
<http://www.roceeh.ne>



Dapschauskas et al.
J. World Prehist. 2022



Ochre use increase during the African Middle Stone Age





10 mm



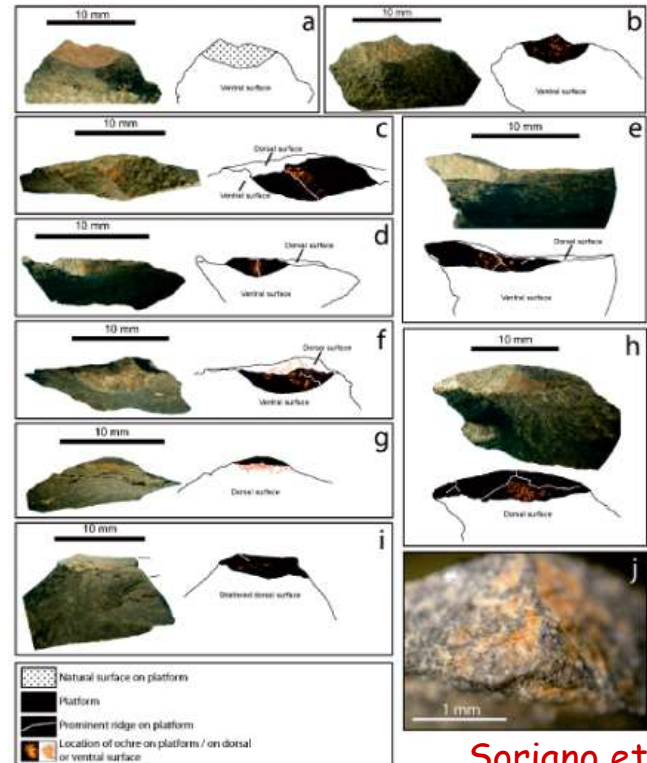
Wadley et al.
2008, 2009,
2010

Micrographs comparing ancient compound adhesive with modern replications.

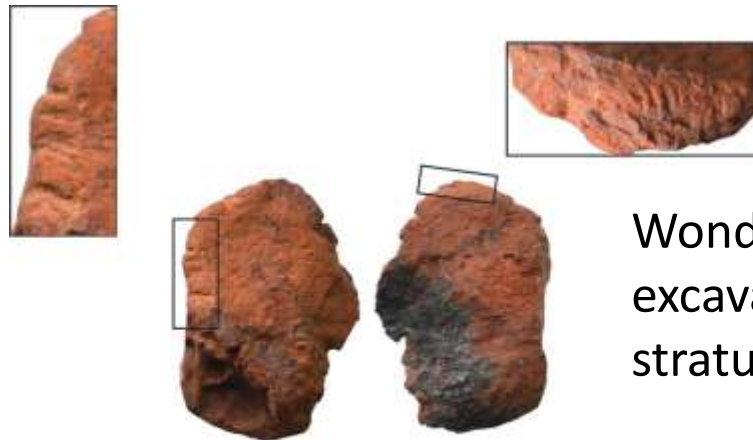
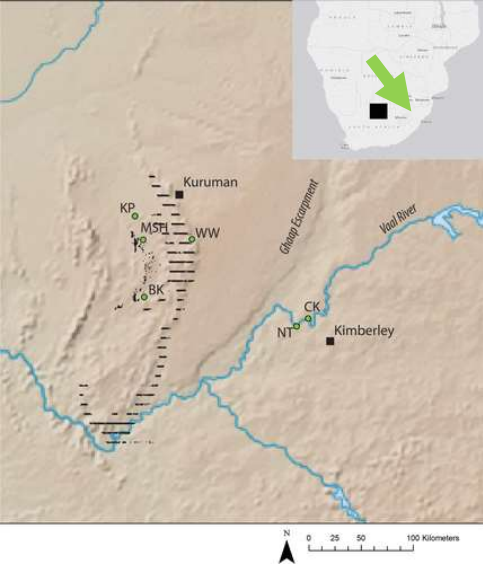
- a. Edge of a Sibudu MSA tool with traces of well-mixed plant gum and red ochre adhesive (photograph by G. Langejans).
- b. Micrograph of replicated adhesive made from ochre # 15 and *Acacia karroo* gum. 50x.
- c. Micrograph of replicated adhesive made from ochre # 15, *Acacia karroo* gum and beeswax. 50x.
- d. Micrograph of replicated adhesive made from *Acacia karroo* gum alone. 50x.



Wadley et al. 2009



Soriano et al. 2009



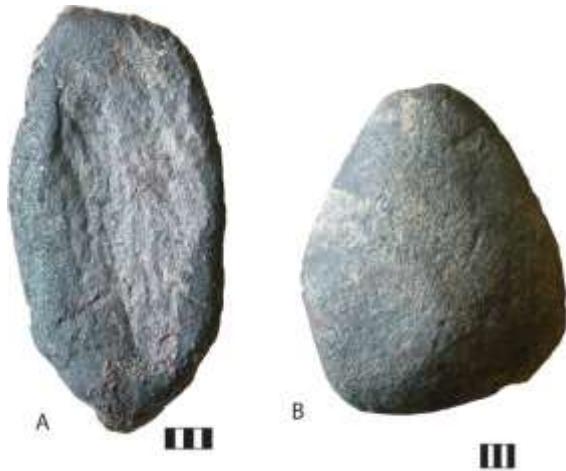
Wonderwerk Cave,
excavation 1,
stratum 8a,



Wonderwerk Cave
excavation 6
Fauresmith
pigments



Earliest evidence for the
use of red pigment in
Africa 500-300 ka



Kathu Pan 1

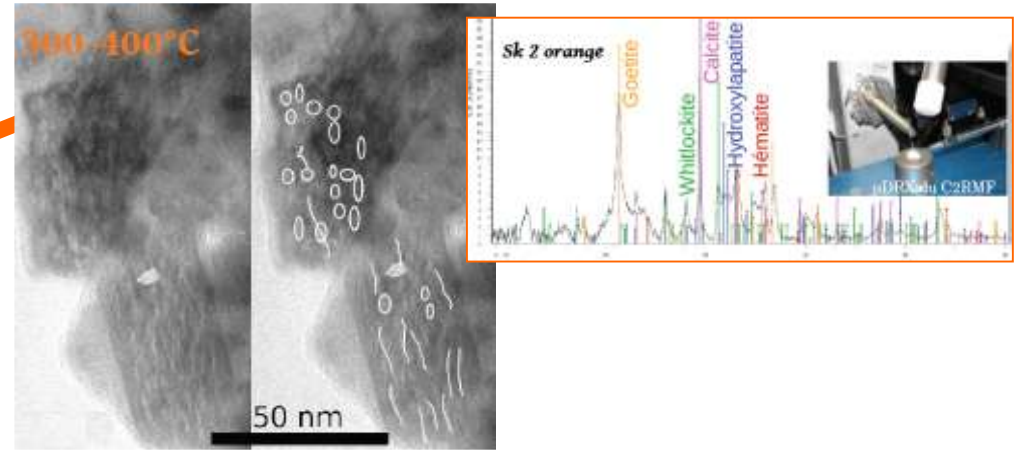
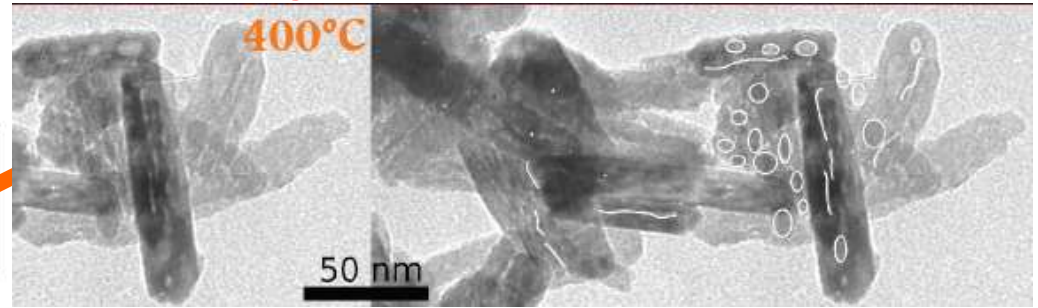
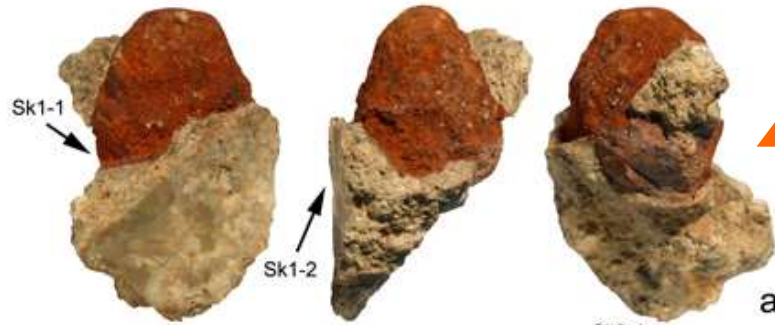


Watts et al. *Curr. Anthr.* 2014

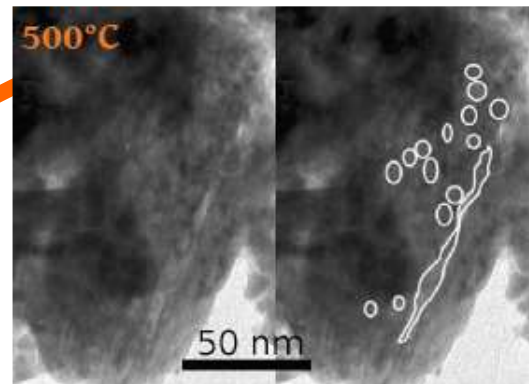


d'Errico Salomon, Vignaux, Stringer, *JAS* 2010
Salomon et al. 2012 *Archaeometry*

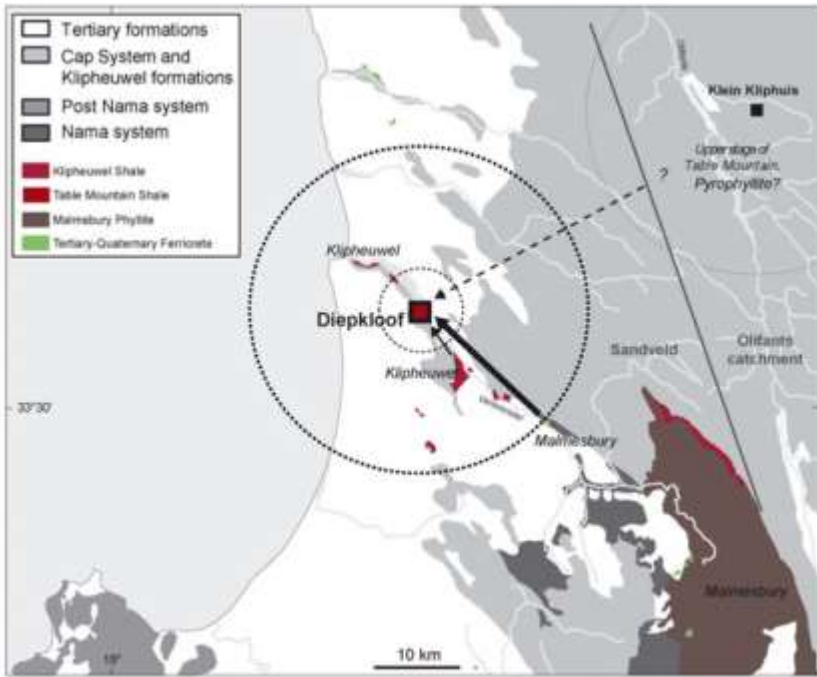
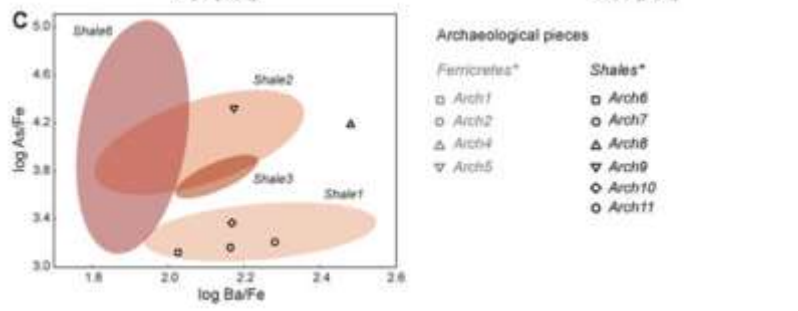
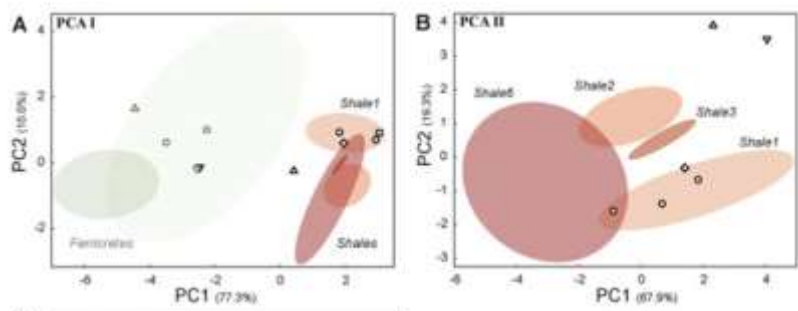
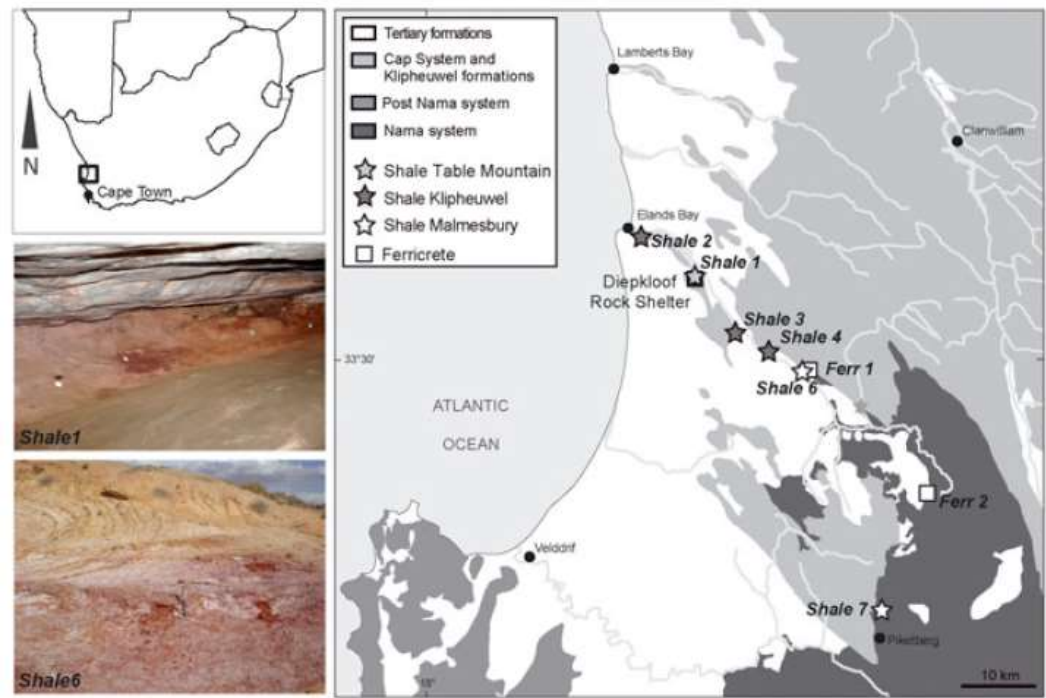
Skhul pigments from Mousterian levels



← No heating



Diepkloof Rock shelter 90-40 ka



Dayet et al. 2012 *Archeometry*

20 years ago the earliest ornaments were 40,000 years old



Libor Balac



Oued Djebanna

35 ka BP

(90 – 60 ka BP)

Vanhaeren, d'Errico et al. *Science* 2006



Taforalt Ifri n'Ammar Contrebandier Rhafas L'Mnasra Bizmoune

145 – 60 ka BP

Bouzouggar et al 2008 *PNAS*
d'Errico et al. *PNAS* 2010,
Sehassseh et al. 2021

Blombos

75 ka BP

Henshilwood et al. 2004
Science, d'Errico et al.
JHE 2005



Cueva de los Aviones

50 ka BP

Zilhao et al. *PNAS* 2010



Skhul

135 - 100 ka BP

Vanhaeren, d'Errico et al. *Science* 2006



Qafzeh

92 ka BP

Bar-Yosef Mayer et al. *JHE* 2009

Panga Ya saïdi

67 ka BP

d'Errico et al. *JHE* 2020



d'Errico & Backwell
Border Cave 2015 *JHE*
74 ka



Klasies River

60 ka BP



Sibudu

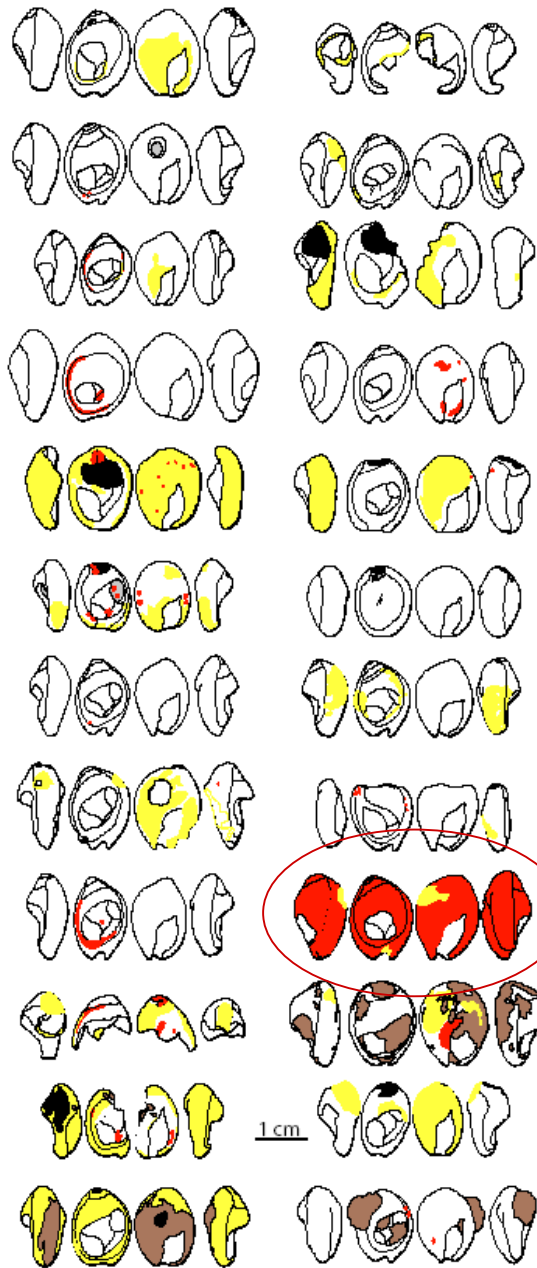
70 ka BP

d'Errico et al. *JAS* 2008



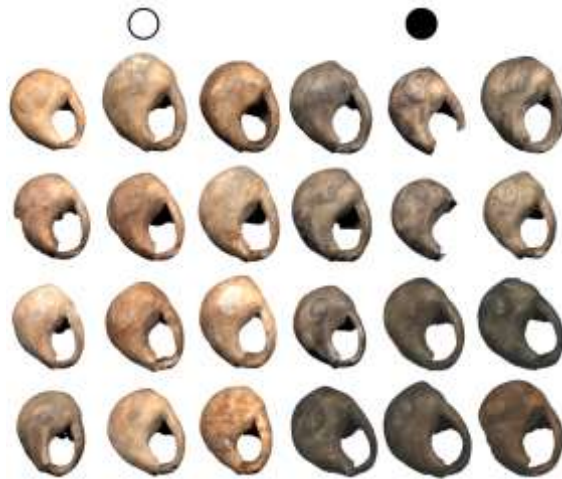
RED PIGMENT

Taforalt Grotte des Pigeons, 80 ka



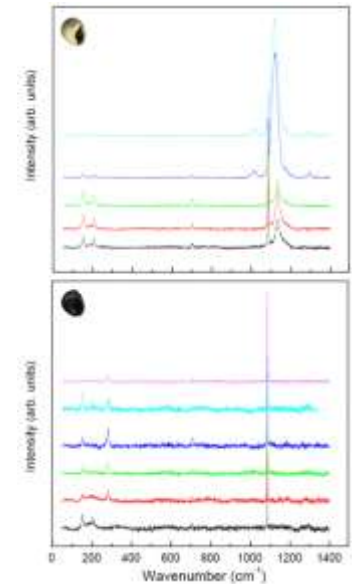
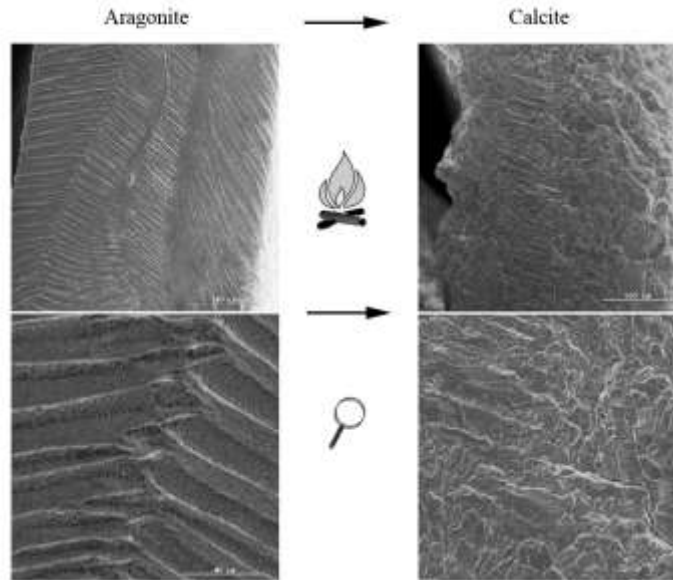
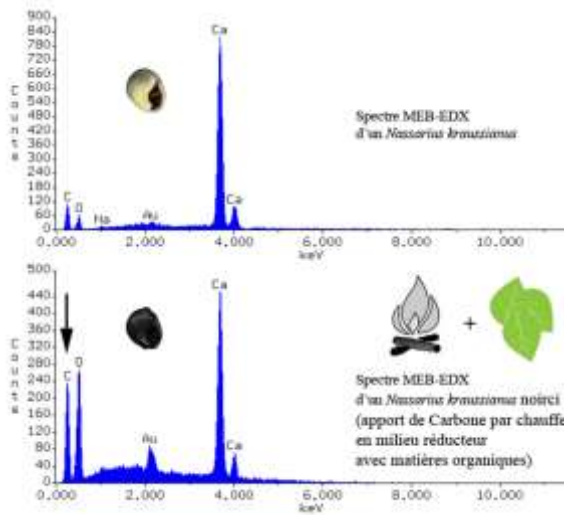
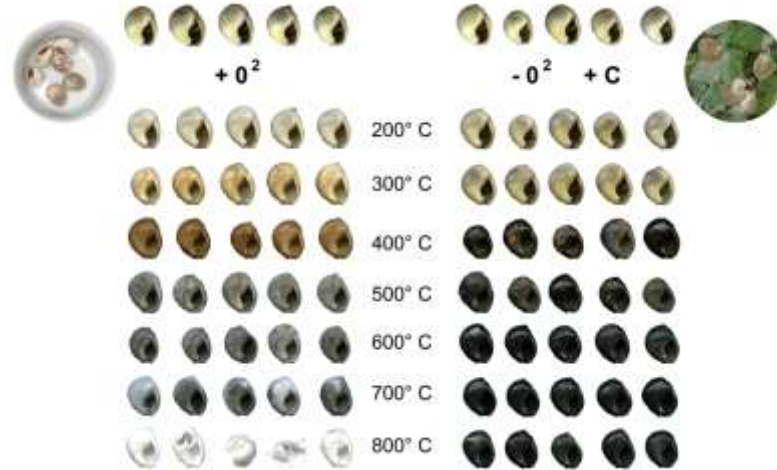
beads covered with pigments

Colour modification?



Oxidizing atmosphere

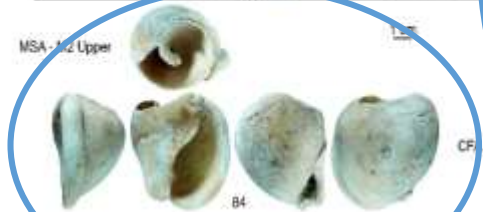
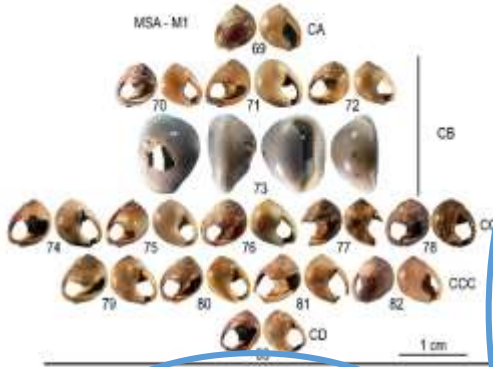
Reducing atmosphere



Blombos Cave, South Africa

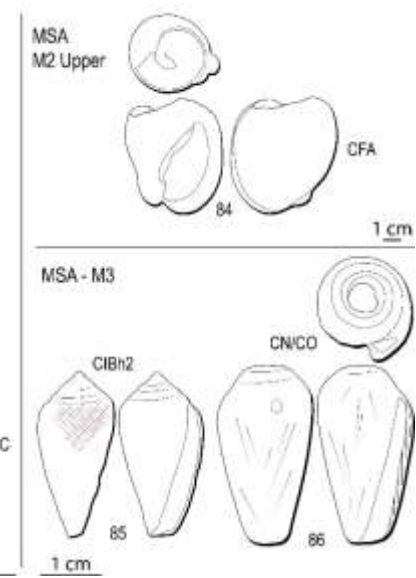
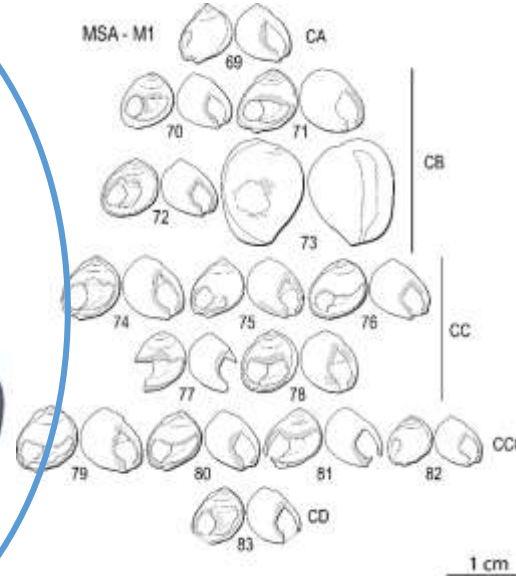
d'Errico et al. 2023 *JHE*

73 ka- 70 ka



80 ka- 73 ka

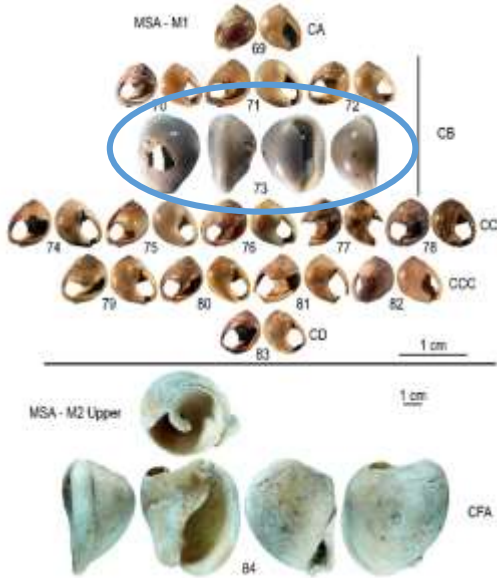
100 ka- 80 ka



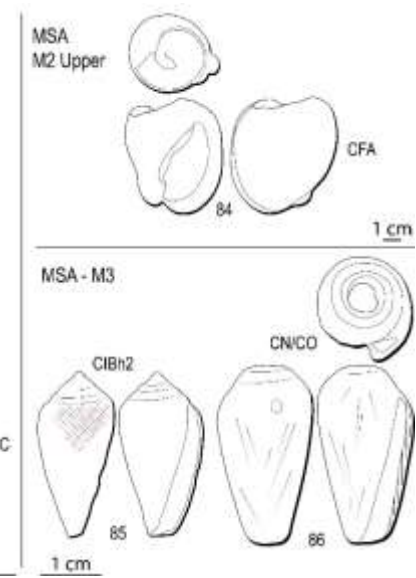
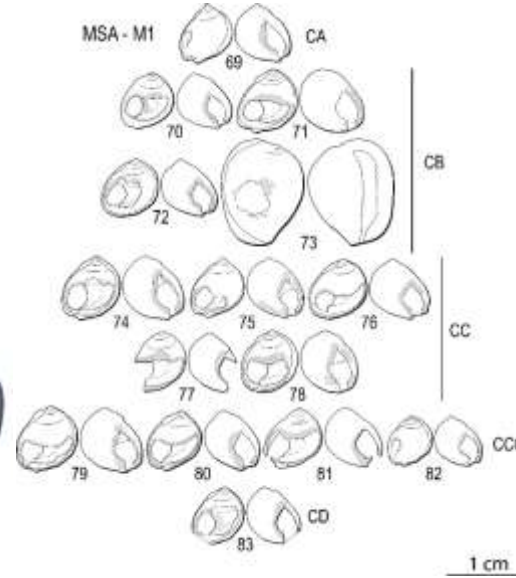
Blombos Cave, South Africa

d'Errico et al. 2023 *JHE*

73 ka- 70 ka



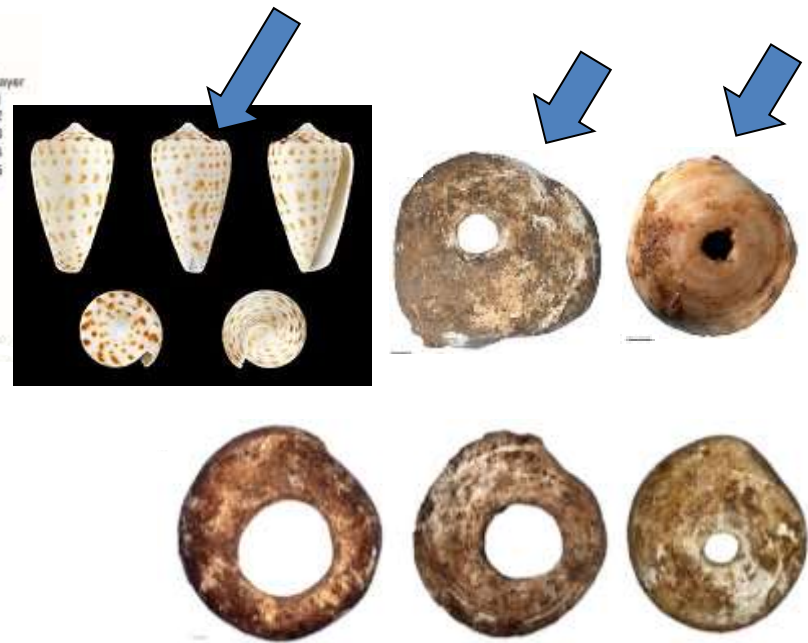
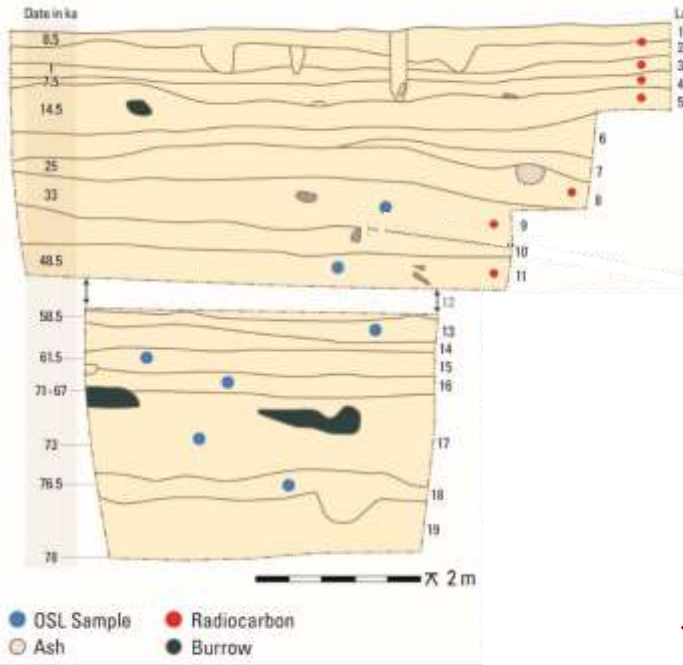
100 ka- 80 ka



80 ka- 73 ka



Panga ya Saïdi, Kenya

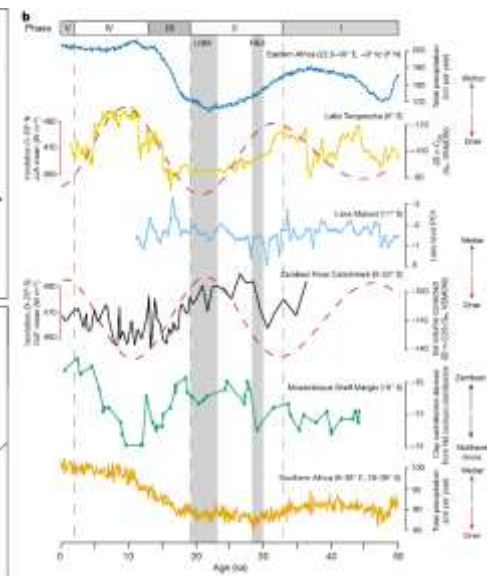
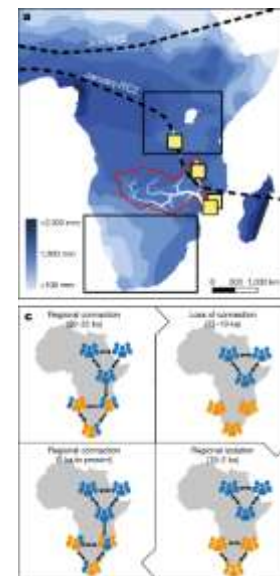
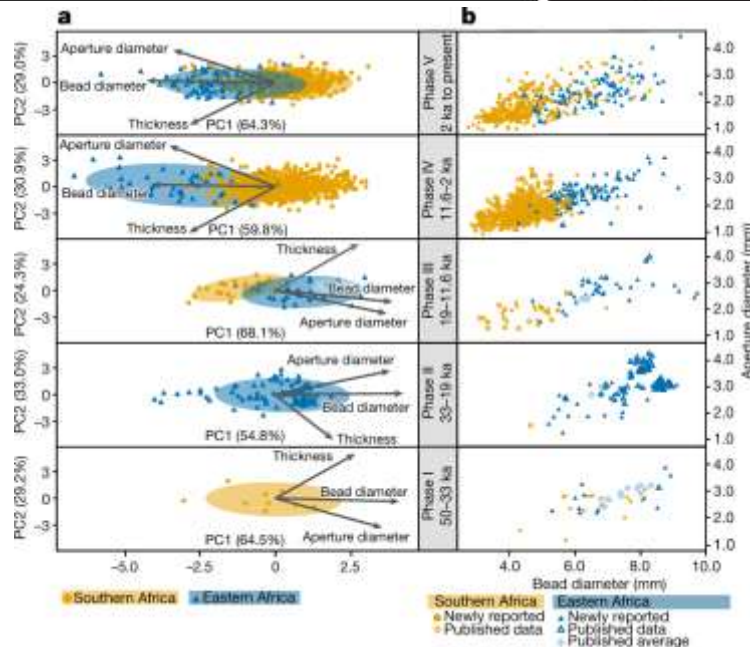
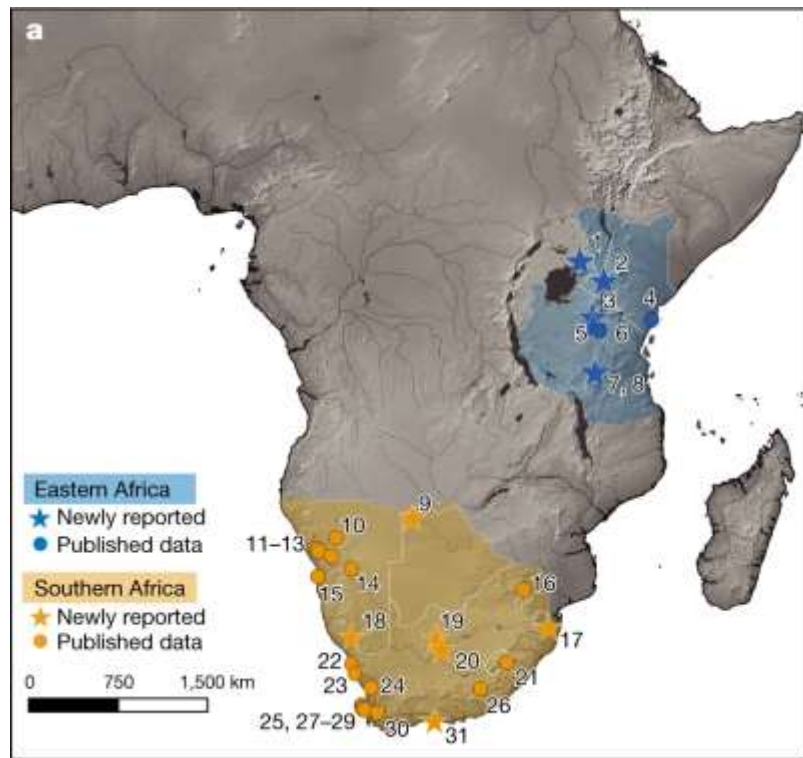


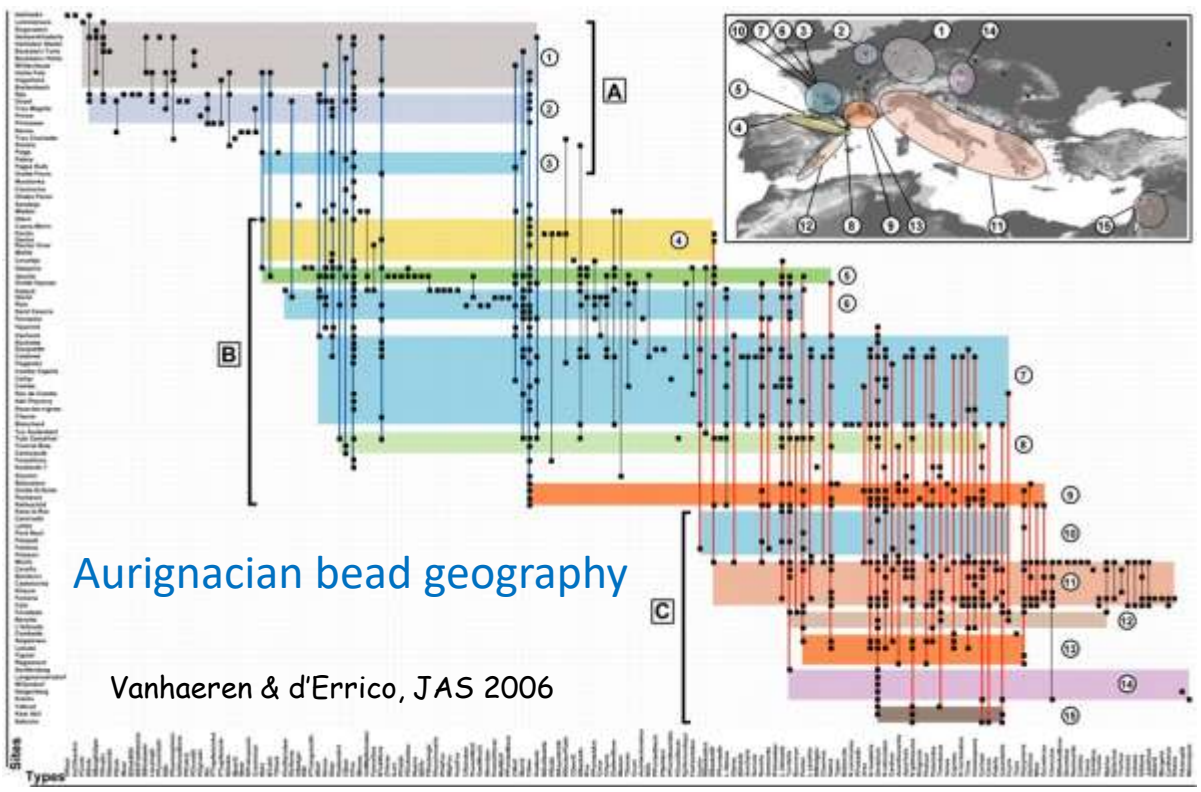
❖ >200 beads, bone tools, engraved bones, and pigment lumps

Shipton *et al.* 2018 *Nature Communications*



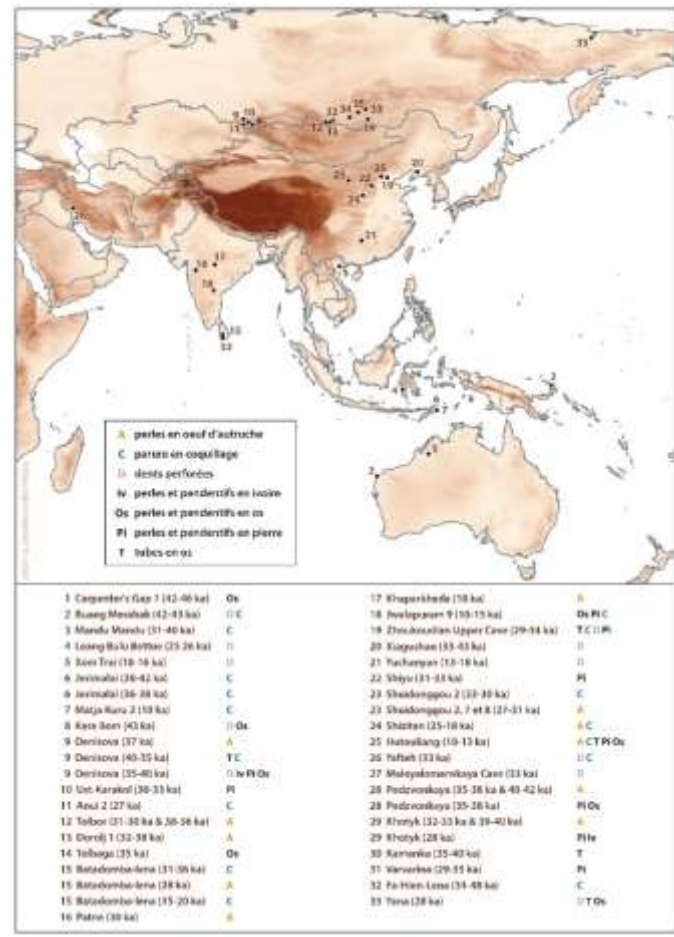
d'Errico *et al.* 2020 *JHE*



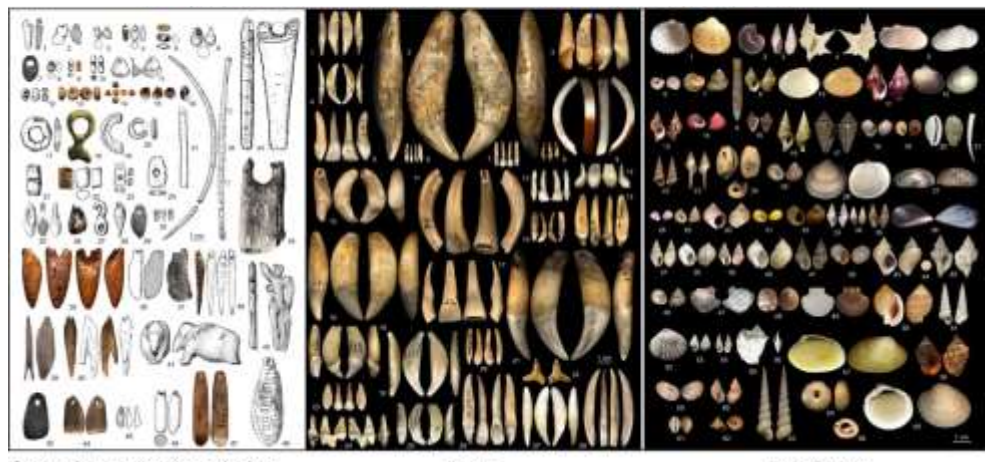


Aurignacian bead geography

Vanhaeren & d'Errico, JAS 2006

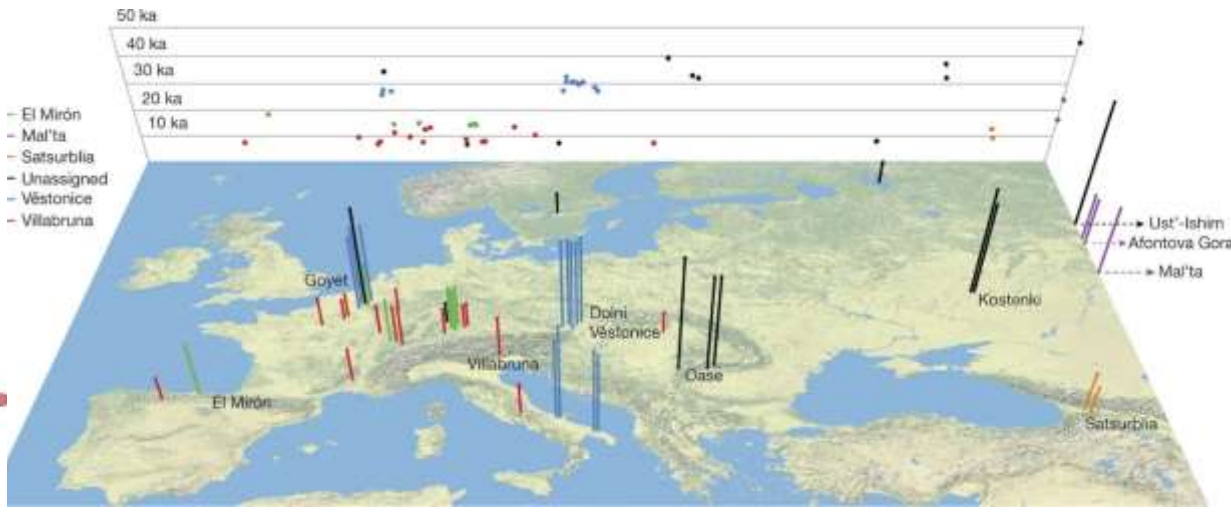
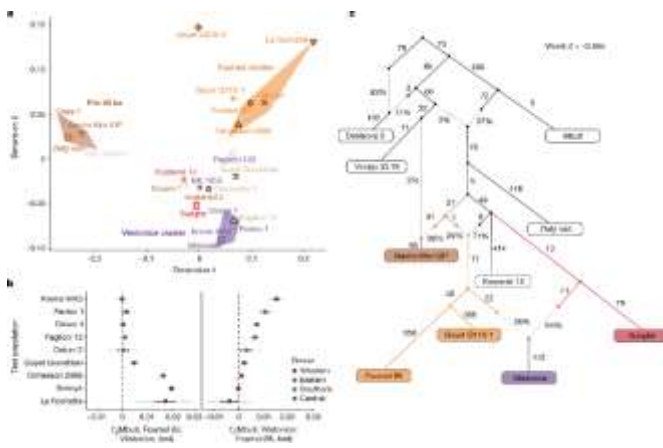


Early Upper Palaeolithic beadtypes



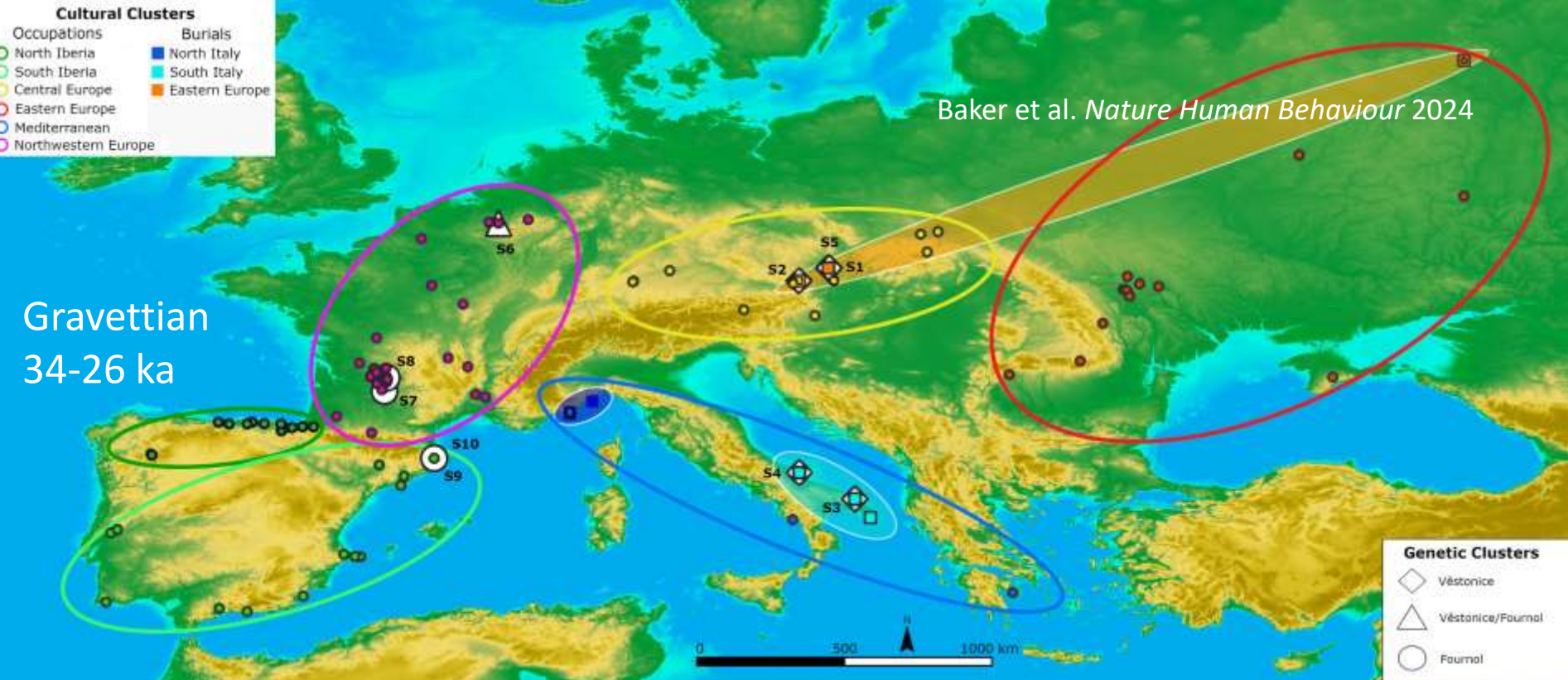
façonnés sur pierre, os, ivoire, ... dents coquillages

d'Errico 2021 Proc. Coa Symposium



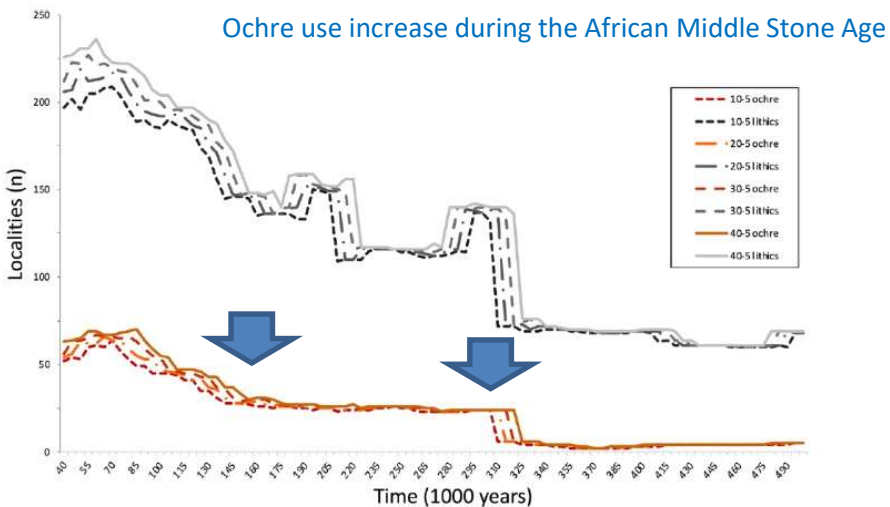
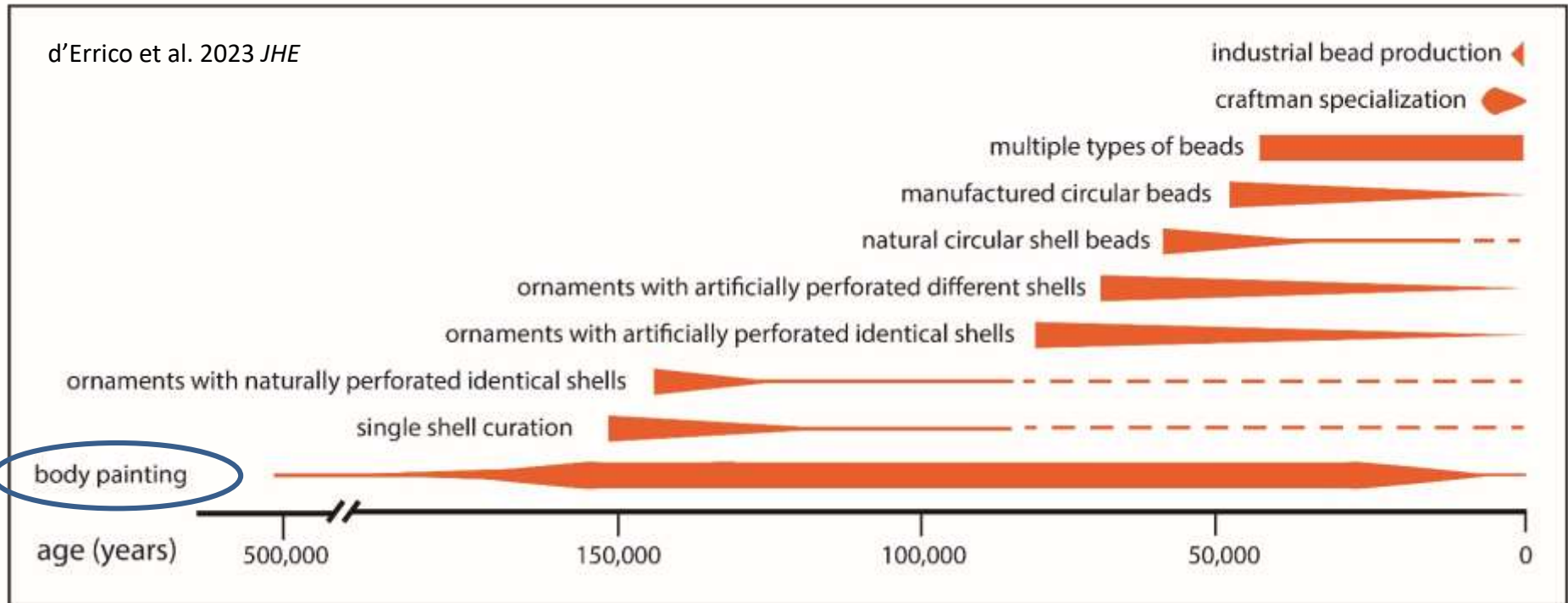
- Cultural Clusters**
- Occupations
 - North Iberia
 - South Iberia
 - Central Europe
 - Eastern Europe
 - Mediterranean
 - Northwestern Europe
 - Burials
 - North Italy
 - South Italy
 - Eastern Europe

Gravettian
34-26 ka



- Genetic Clusters**
- ◇ Věstonice
 - △ Věstonice/Faouml
 - Faouml

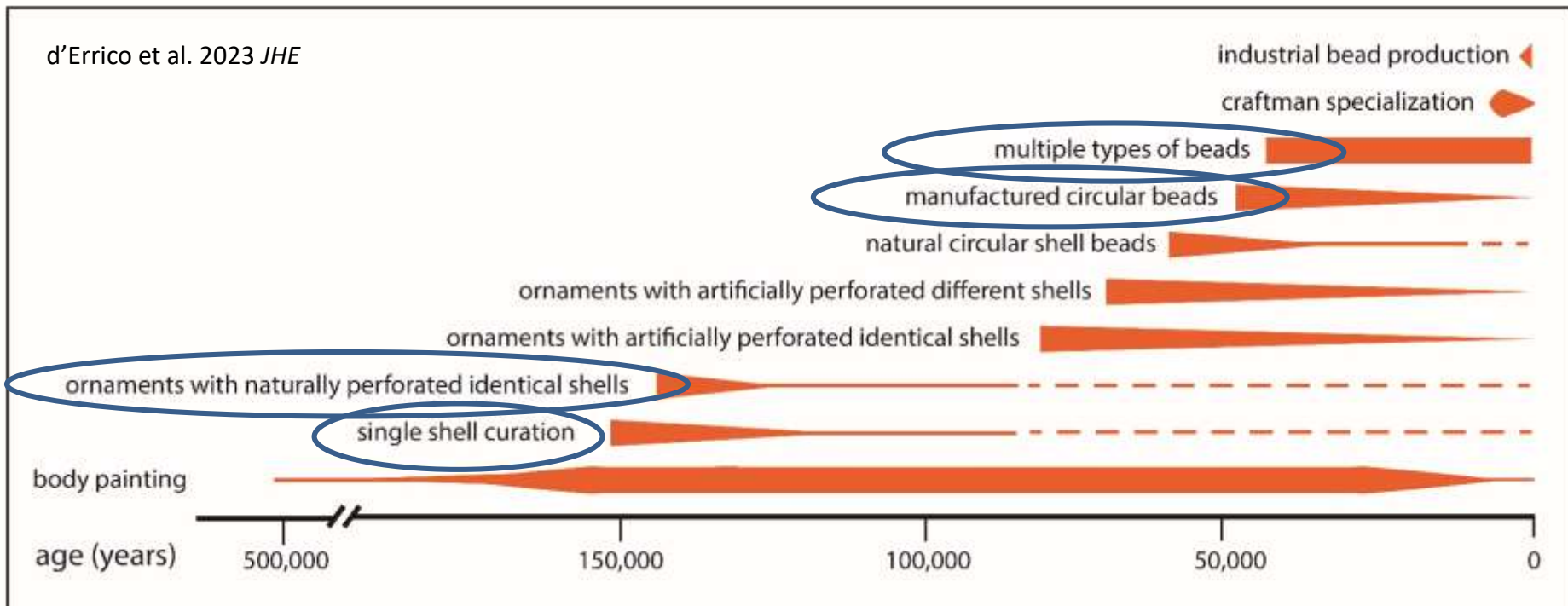
A multistep evolutionary scenario for the culturalisation of the human body



Dapschauskas et al. *J. World Prehist.* 2022

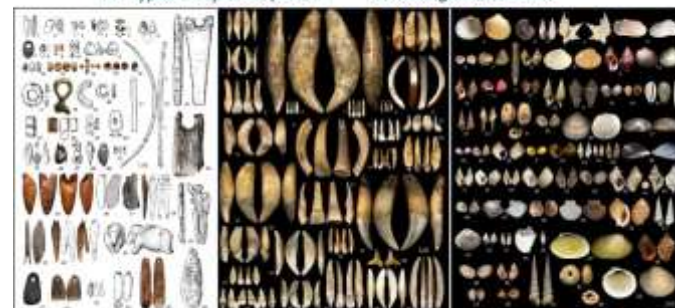
A multistep evolutionary scenario for the culturalisation of the human body

d'Errico et al. 2023 *JHE*



Création et analyse d'une base de données des parures aurignaciennes

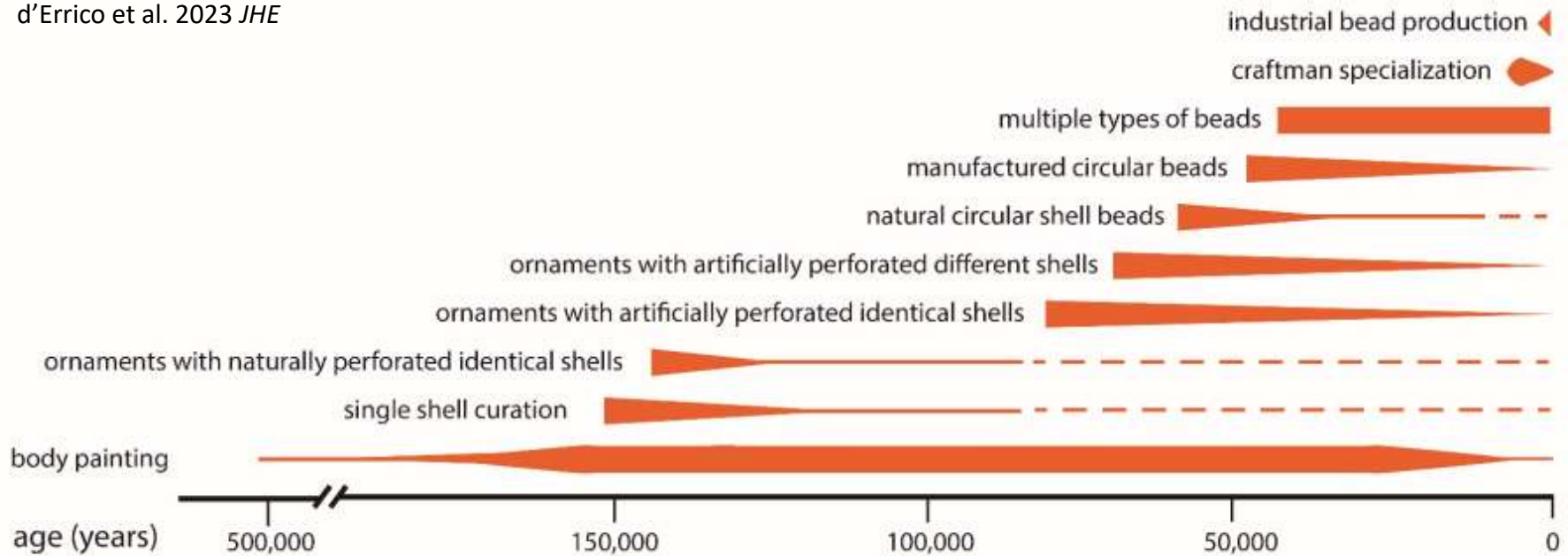
161 types d'objets de parure 98 sites géoréférencés



façonnés sur pierre, os,ivoine... dents coquillages

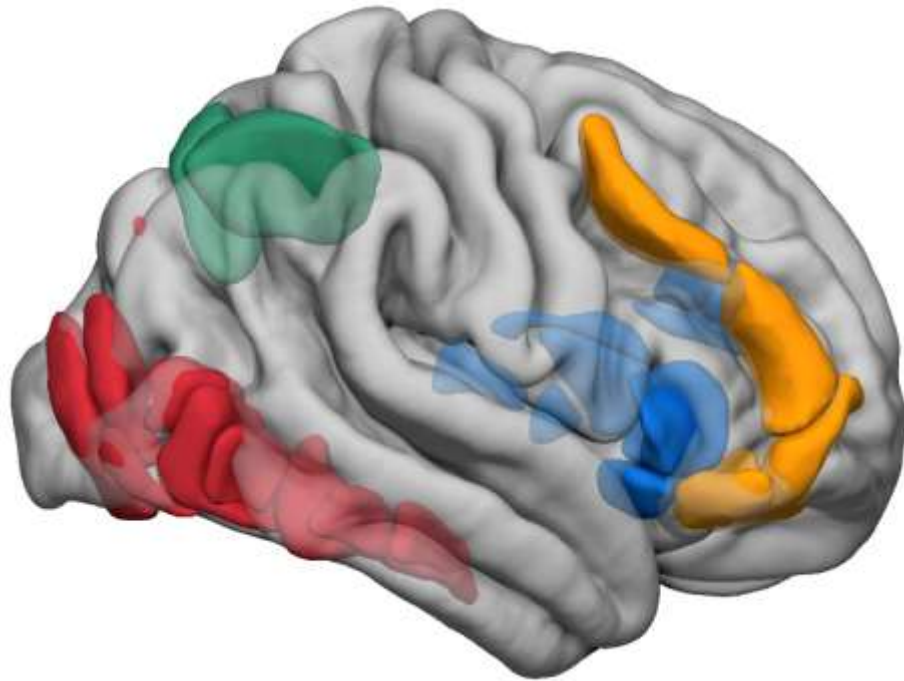
A multistep evolutionary scenario for the culturalisation of the human body

d'Errico et al. 2023 *JHE*



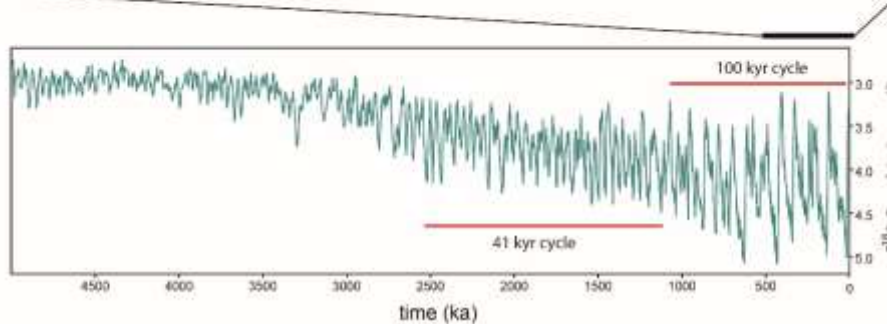
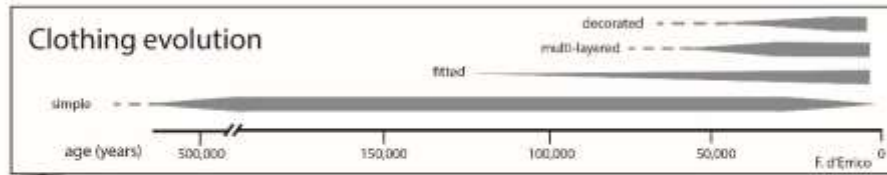
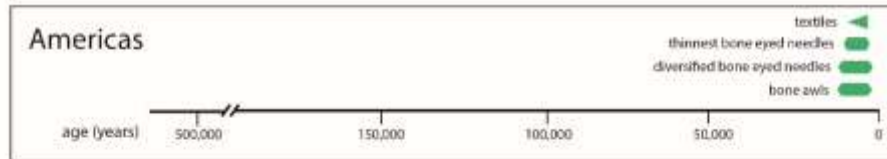
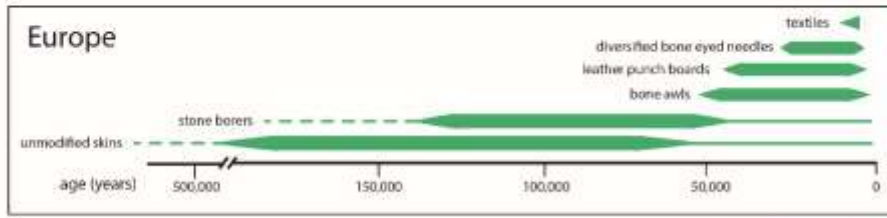
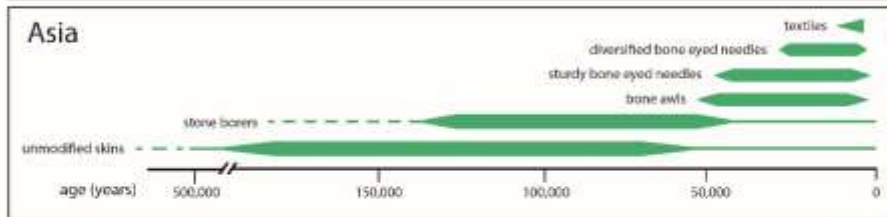
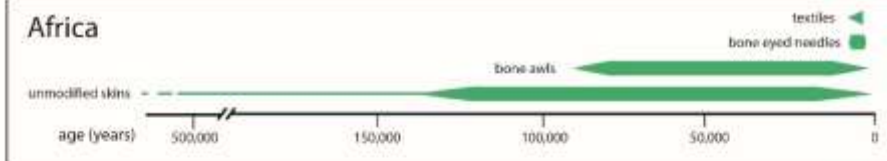
Brain regions involved in the attribution of a social status from face ornamentation

Salagnon, d'Errico et al., *Brain structure and function*. In press



- Parahippocampal gyrus: Contextual associations (type of ornaments \leftrightarrow social status) (Aminoff et al., 2007)
- FFA et OFA: Automatic visual processing of faces
- Temporal pole: orientation of the visual system towards social elements and perhaps modulation of the activity of the ventral visual pathway (Pehrs et al., 2015).
- ❖ **Saliency network**
Perceptual decision-making (Chand & Dhamala, 2016; Lamichhane et al., 2016; Uddin, 2015).
- ❖ **Prefrontal cortex**
Social cognition (Forbes & Grafman, 2010) and social status evaluation (Mah et al., 2004).
- ❖ **Intraparietal sulcus**: Greater attentional mobilization (longer reaction times)

Results show the activation of a network including visual, insular, limbic, and frontal regions involved in executive control and social cognition



Blombos and Sibudu bone awls, South Africa 90-70 ka



Early bone needles from China and Europe, 40-14 ka

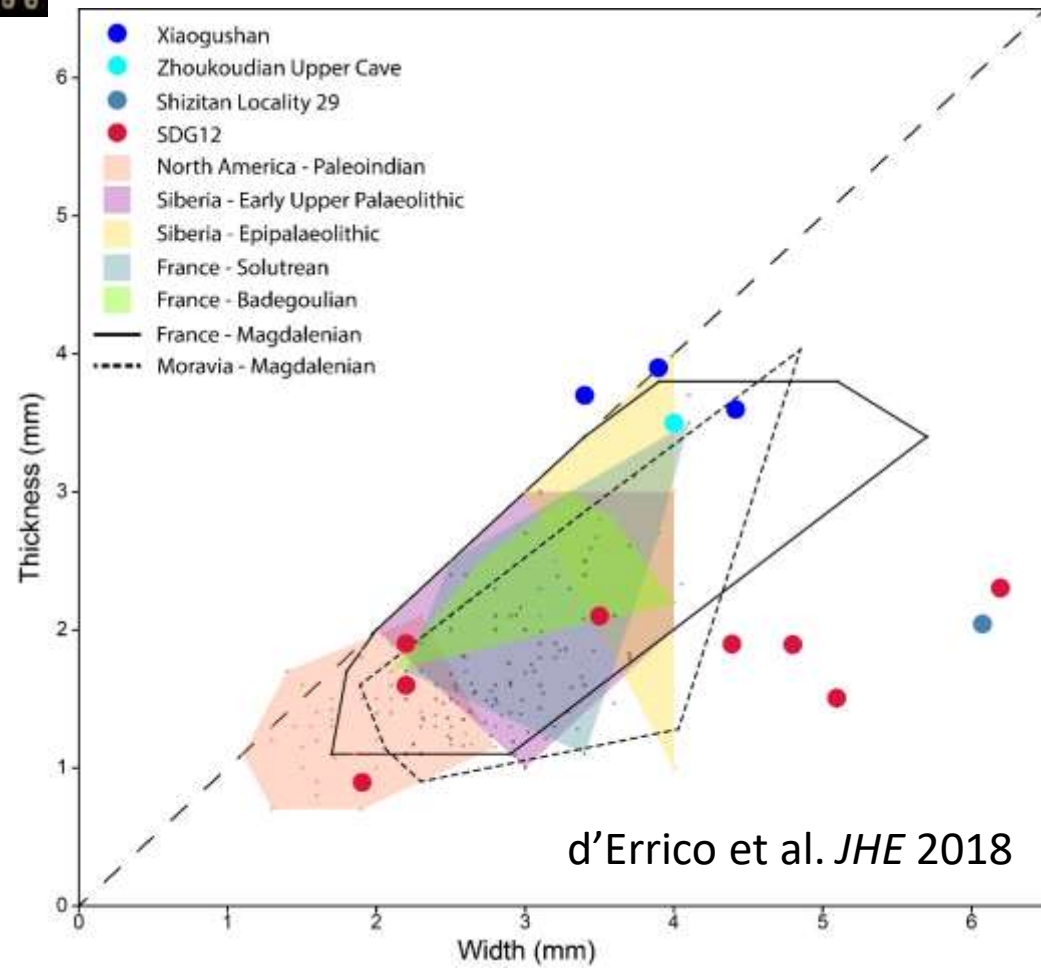
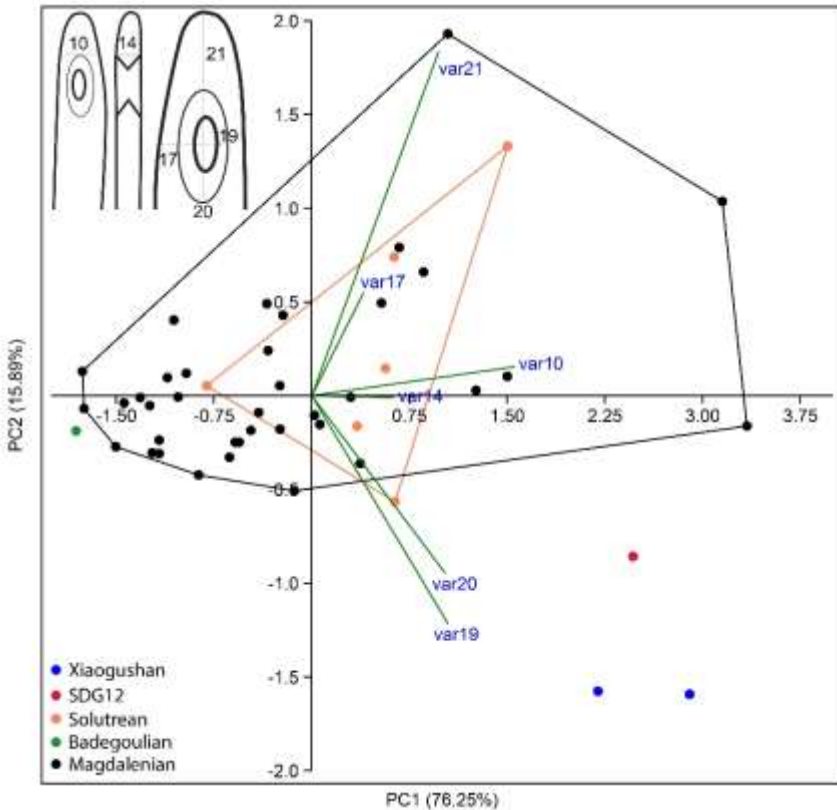
Gilligan, d'Errico et al. *Science Advances* 2024

d'Errico in *Oxford Handbook of the Archeology and Anthropology of body modification* 2024

Niche construction does not stop with the beginning of the Upper Palaeolithic!

Evolution of clothing

Reflection of niche construction



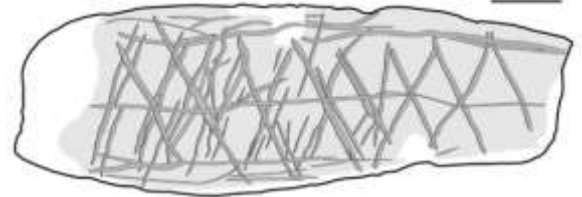
d'Errico et al. *JHE* 2018



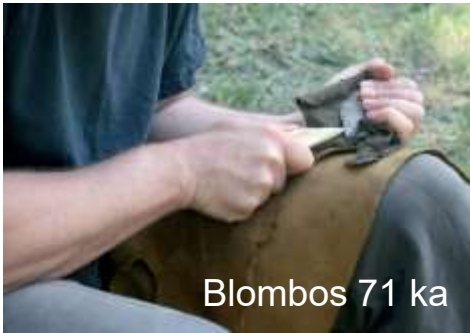
Taforalt, 80 ka



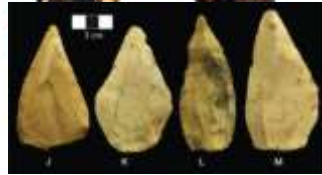
1 cm



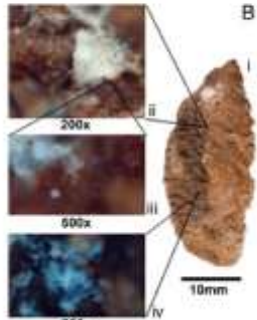
Klasies River, Blombos 100-71 ka



Blombos 71 ka



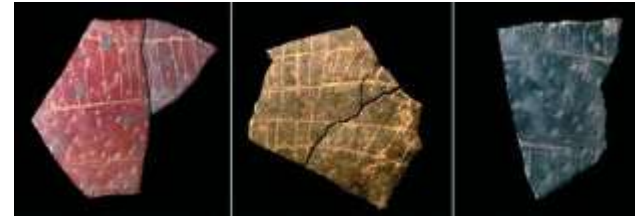
Border Cave 74 ka



Sibudu 65 ka



Blombos, 71 ka



Diepkloof, Klipdrift, Apollo 11



Katanda 95 ka



Blombos 71 ka



Blombos 100 ka



Sibudu Cave 80-40 ka

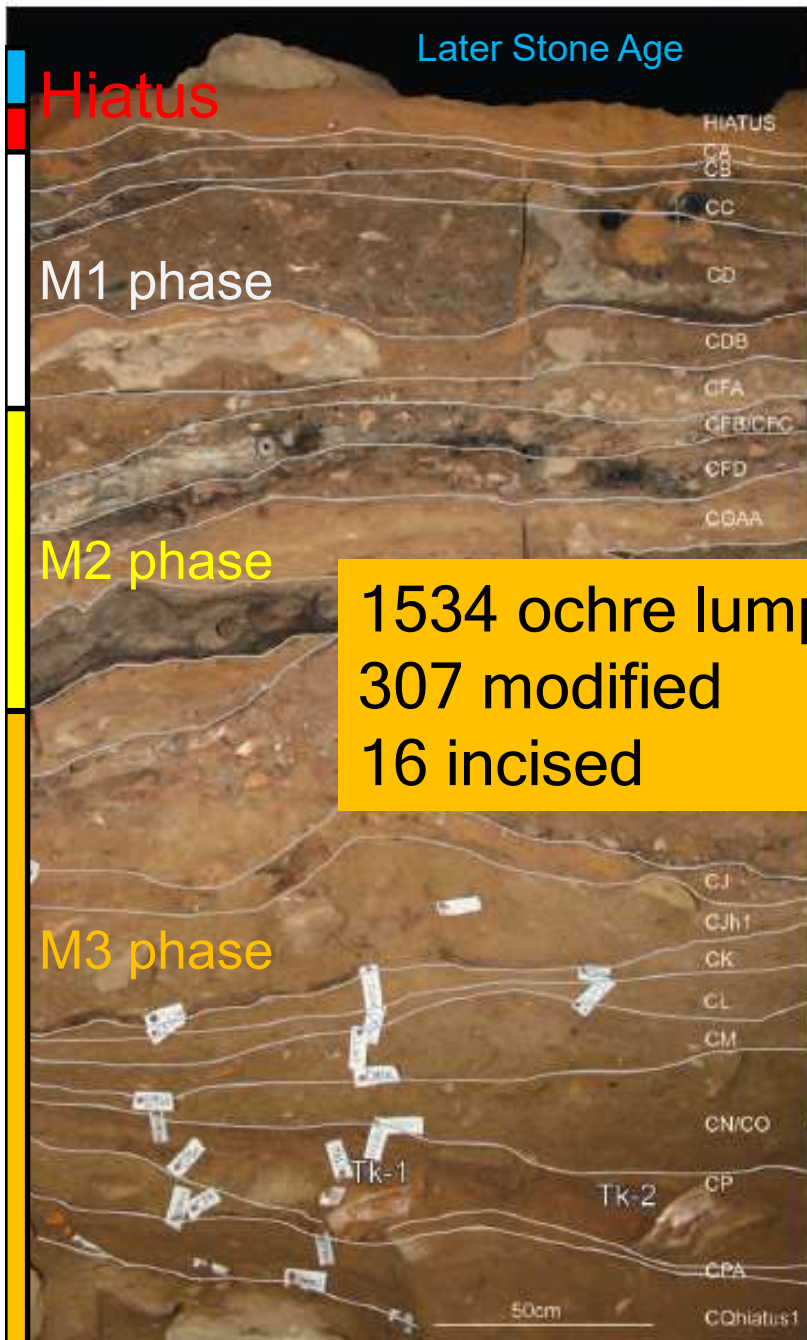


Twin Rivers 260-400 ka



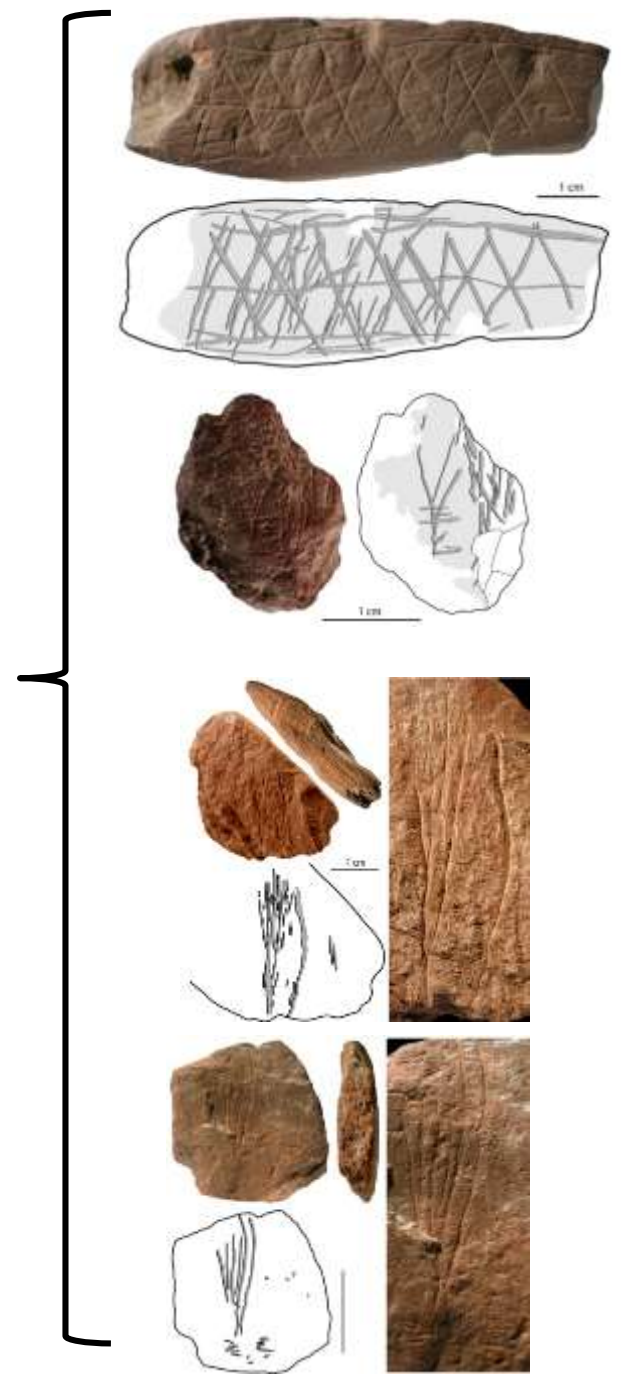
1-3 Qafzeh 100 ka
4 Klasies River 90 ka
5 Blombos 140-65 ka
6 Soldmeins cave 125 ka

Blombos Cave stratigraphy



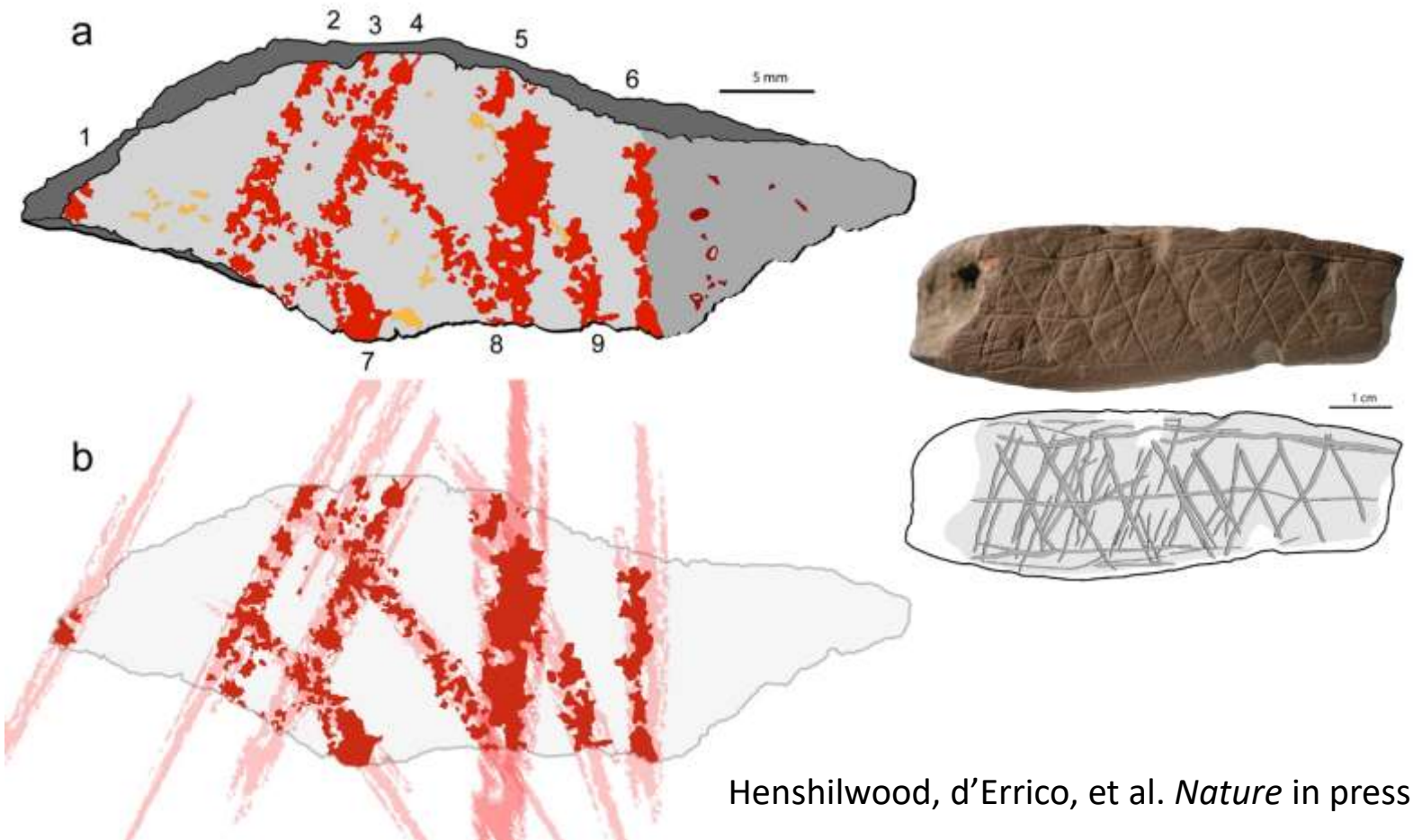
OSL ages (ka)	TL ages (ka)
68 ± 4	67 ± 7; 81 ± 10
73 ± 3	77 ± 8; 82 ± 8
77 ± 3	105 ± 9
82 ± 4	
97 ± 4	
101 ± 4	U/Th age > 92 ka

1534 ochre lumps > 10 mm
 307 modified
 16 incised





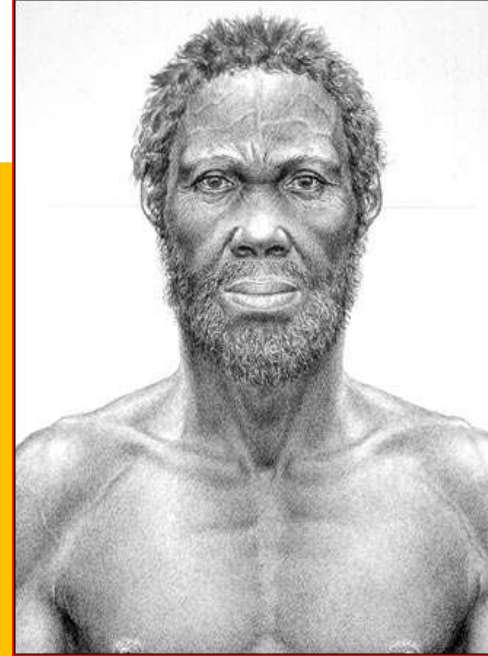
Blombos Cave
73 ka



Henshilwood, d'Errico, et al. *Nature* in press

Sibudu, 60 ka

Taforalt, 80 ka



1 cm



71 ka



64 ka



10mm



20



50



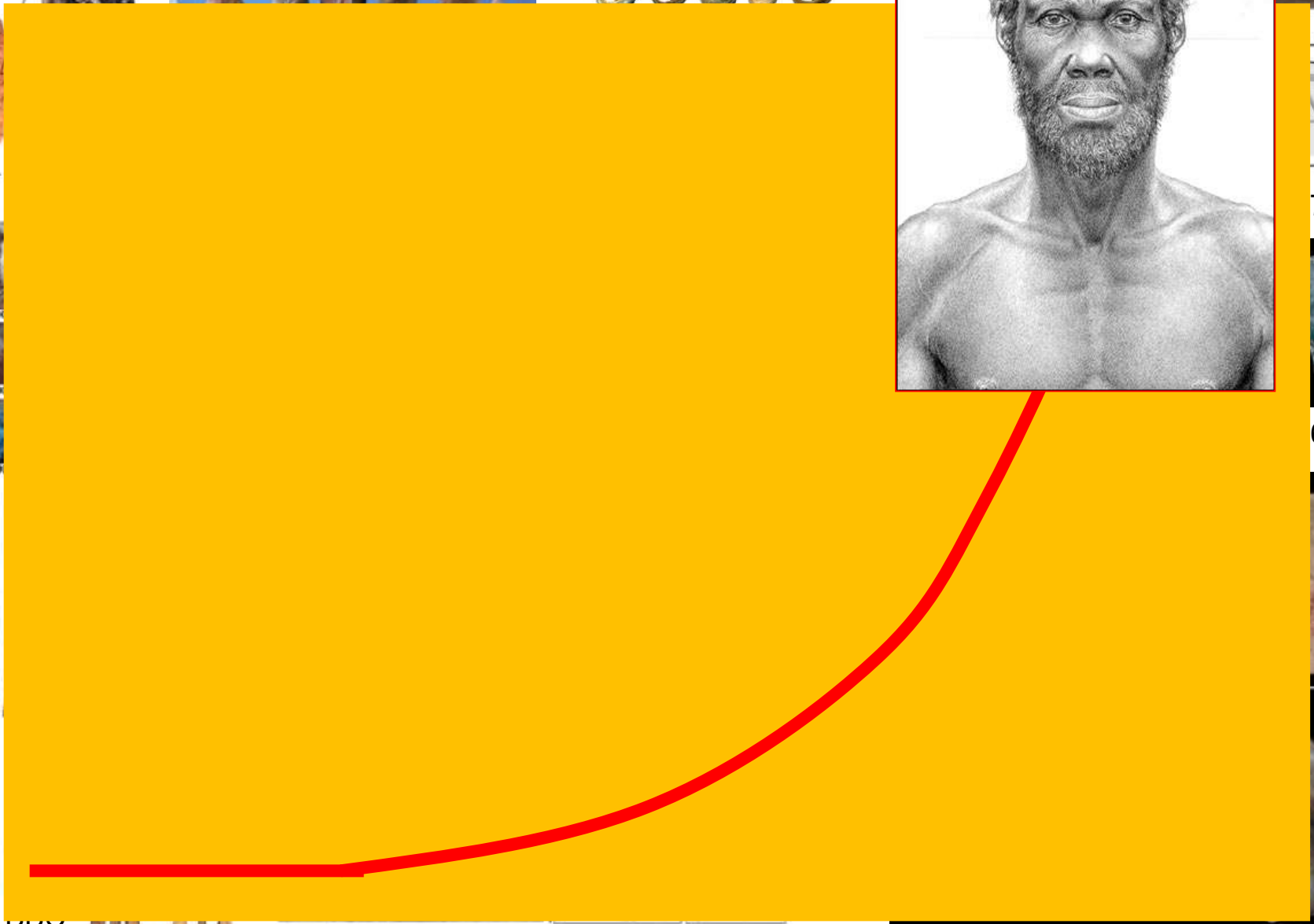
20



Blombos, 71 ka

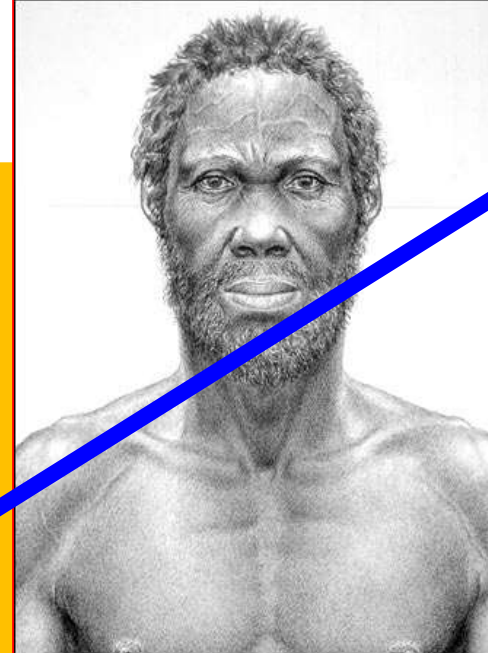


Blombos, 100 ka



Sibudu, 60 ka

Taforalt, 80 ka



1 cm



71 ka



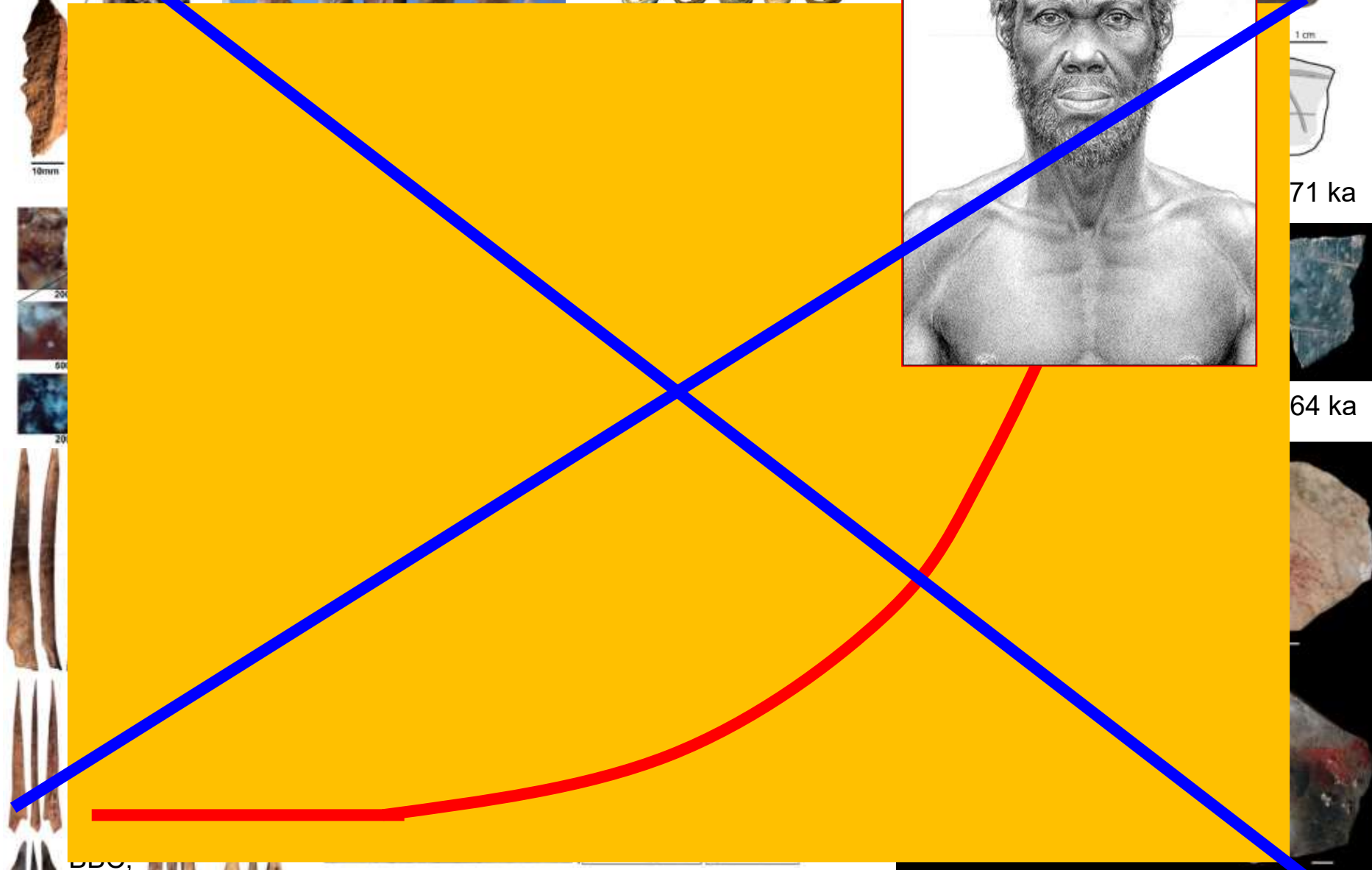
64 ka



Blombos, 71 ka



Blombos, 100 ka

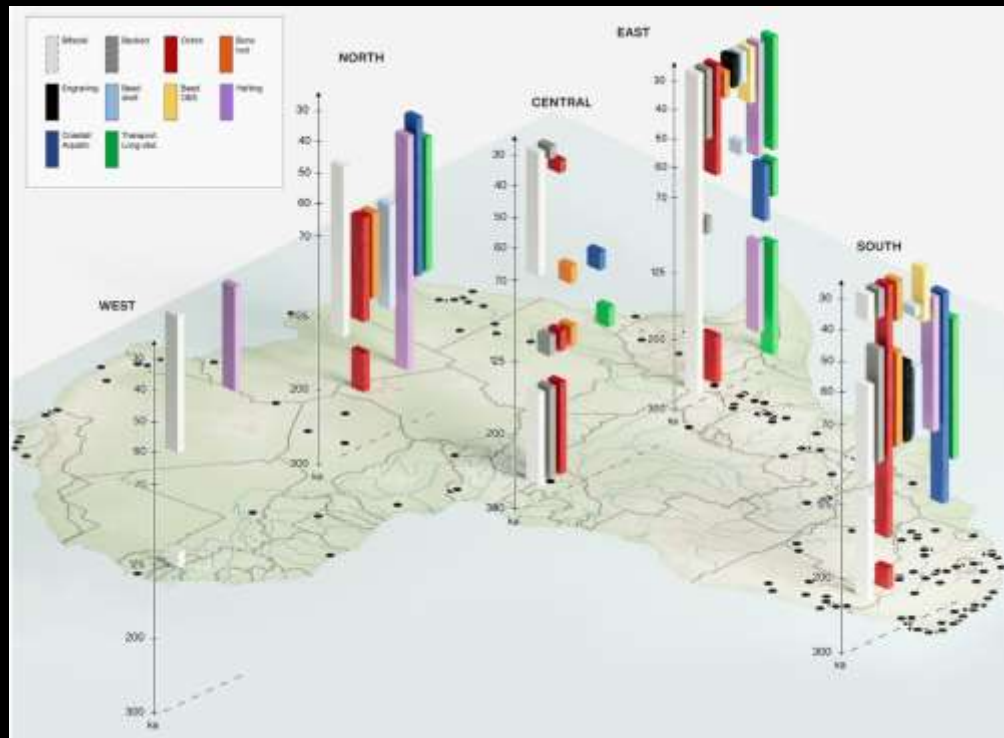


Synthesis..... and way forward

- Empirical evidence **contradicts** the hypothesis of an origin of modern human cognition produced by the sudden or the gradual emergence of a cultural 'package' due to a biological event

Synthesis..... and way forward

- Empirical evidence **contradicts** the hypothesis of an origin of modern human cognition produced by the sudden or the gradual emergence of a cultural 'package' due to a biological event
- We observe instead a heterogenic, multiorigin, asynchronous pattern with no single epicenter in Africa and encompassing fossil 'species' other than *H. sapiens* in Africa



Synthesis..... and way forward

- Empirical evidence **contradicts** the hypothesis of an origin of modern human cognition produced by the sudden or the gradual emergence of a cultural 'package' due to a biological event
- We observe instead a heterogenic, multiorigin, asynchronous pattern with no single epicenter in Africa and encompassing fossil 'species' other than *H. sapiens* in Africa
- Temporal pattern of cultural change is more complex than what we would expect with a gradual, incremental accumulation. Rather than an accumulation we find multiple, asynchronous, and unstable regional trajectories

Synthesis..... and way forward

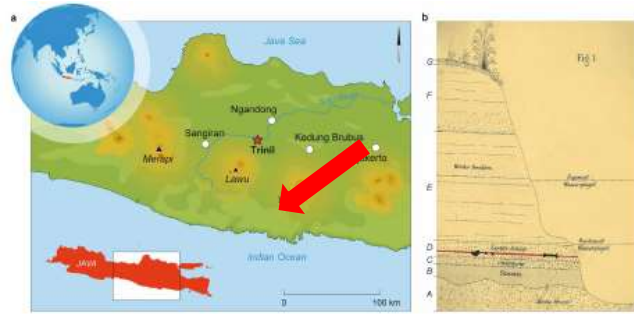
- Empirical evidence **contradicts** the hypothesis of an origin of modern human cognition produced by the sudden or the gradual emergence of a cultural 'package' due to a biological event
- We observe instead a heterogenic, multiorigin, asynchronous pattern with no single epicenter in Africa and encompassing fossil 'species' other than *H. sapiens* in Africa
- Temporal pattern of cultural change is more complex than what we would expect with a gradual, incremental accumulation. Rather than an accumulation we find multiple, asynchronous, and unstable regional trajectories
- Gradual **decoupling after 300 ka in the relationship between morphology and cognition** indicating that the **main driver becomes cultural niche construction rather than natural selection**

Synthesis..... and way forward

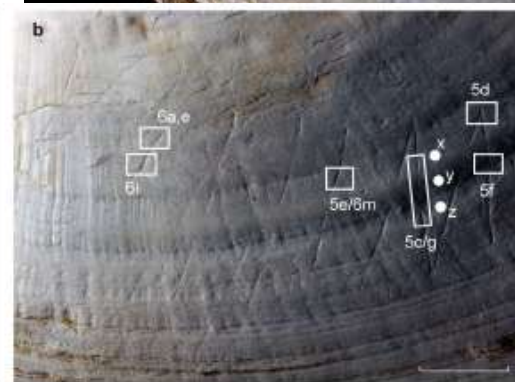
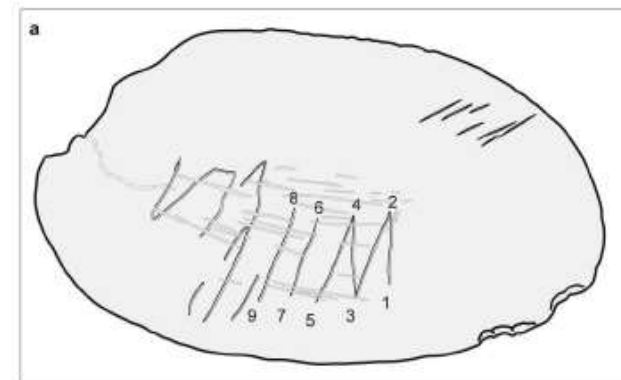
- Empirical evidence **contradicts** the hypothesis of an origin of modern human cognition produced by the sudden or the gradual emergence of a cultural 'package' due to a biological event
- We observe instead a heterogenic, multiorigin, asynchronous pattern with no single epicenter in Africa and encompassing fossil 'species' other than *H. sapiens* in Africa
- Temporal pattern of cultural change is more complex than what we would expect with a gradual, incremental accumulation. Rather than an accumulation we find multiple, asynchronous, and unstable regional trajectories
- Gradual **decoupling after 300 ka in the relationship between morphology and cognition** indicating that the **main driver becomes cultural niche construction rather than natural selection**
- In this context we must accept the idea that it is material culture and brain plasticity that shapes cognition and not the opposite

Homo erectus at Trinil on Java used shells for tool production and engraving

Josephine C. A. Joordens^{1,2}, Francesco d'Errico^{3,4}, Frank P. Wesselingh⁵, Stephen Munro^{6,7}, John de Vos⁵, Jakob Wallinga^{8,9}, Christina Ankjaergaard^{8,9}, Tony Reimann^{8,9}, Jan R. Wijbrans², Klaudia F. Kuiper², Herman J. Mûcher^{1,10}, H el ene Coqueugniot³, Vincent Pri e^{11,12}, Ineke Joosten¹³, Bertil van Os¹³, Anne S. Schulp^{2,5,14}, Michel Panuel^{15,16}, Victoria van der Haas¹, Wim Lustenhouwer², John J. G. Reijmer² & Wil Roebroeks¹



Joordens, d'Errico,
Wesselingh et al.
Nature 2014



birch bark pitch



Terra Amata, ochre

380 ka



Belvedere Maastricht



300 ka

Sclayn 40 ka



La Chapelle-aux-Saints



Tabun 120 ka

Campitello quarry 180 ka



Könisgau 80 ka



Maltravieso

64 ka



Pech-de-L'Azé



Fumane 47 ka



Cueva Anton 50 ka



Ardales



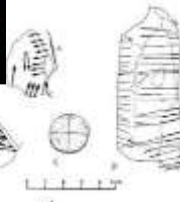
Les Pradelles 60 ka



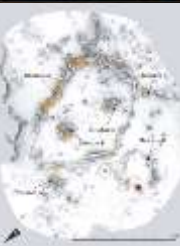
Quneitra 60 ka



Neandertal innovations



Grotte du Renne 45 ka



Bruniquel 176 ka



Krapina 130 ka



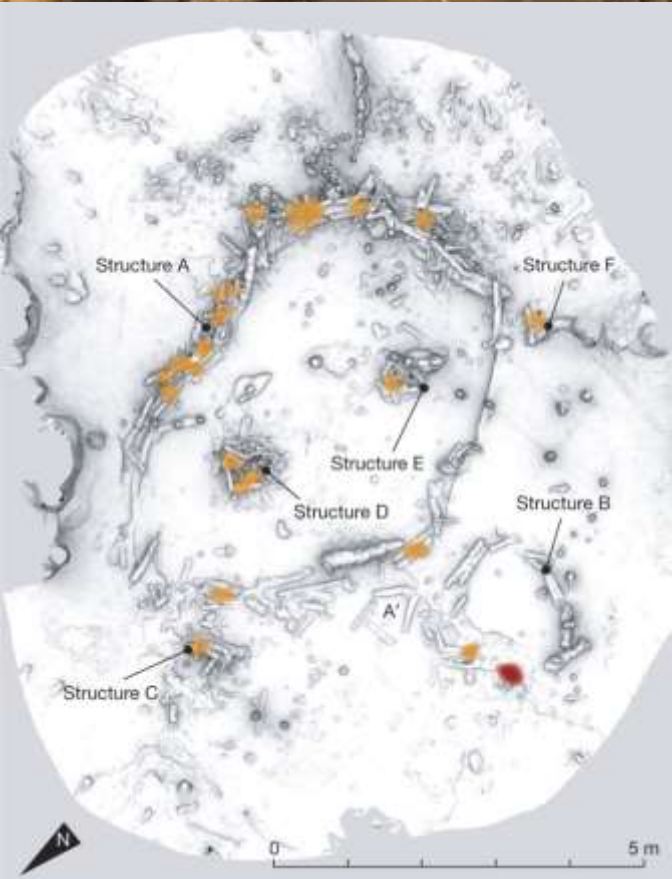
Fumane 47 ka



Gorham's Cave 40 ka

Grotte du Renne 45 ka

Bruniquel Cave 176 ka



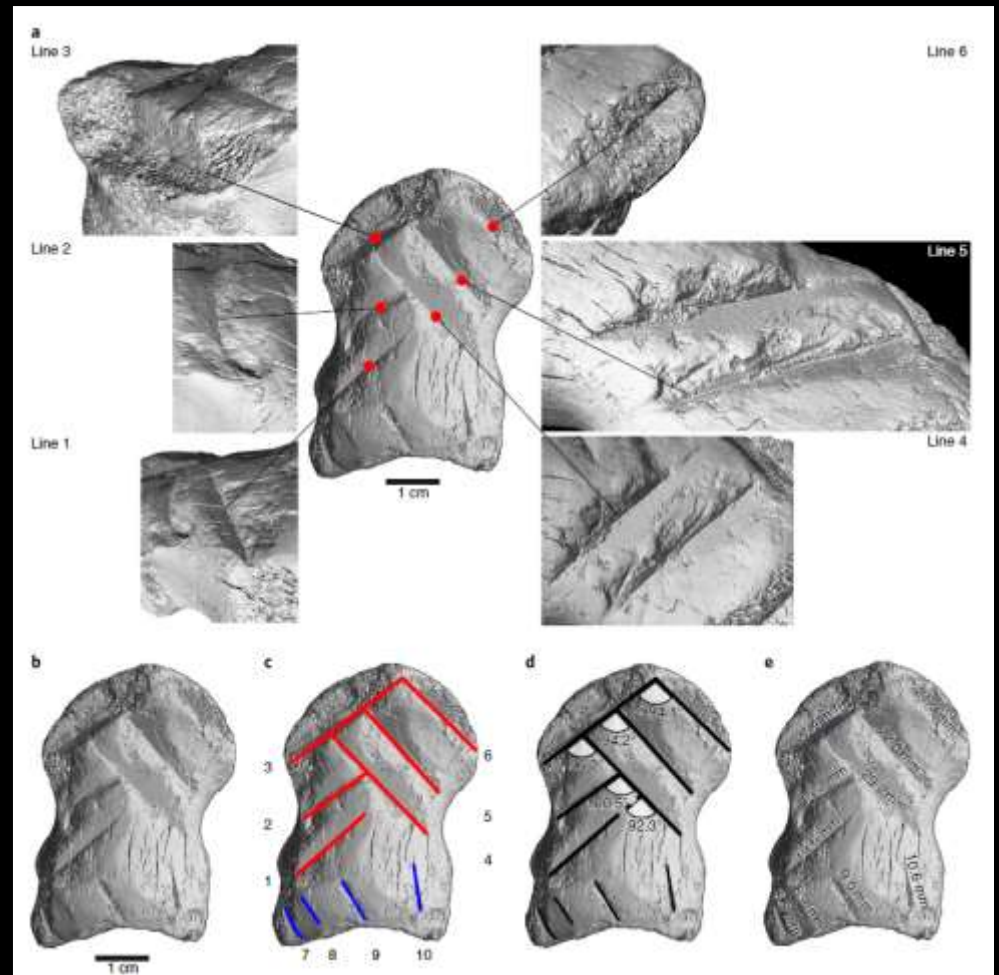
Jaubert et al. 2016 *Nature*



Einhornhöhle
Germany
Megaloceros
phalange

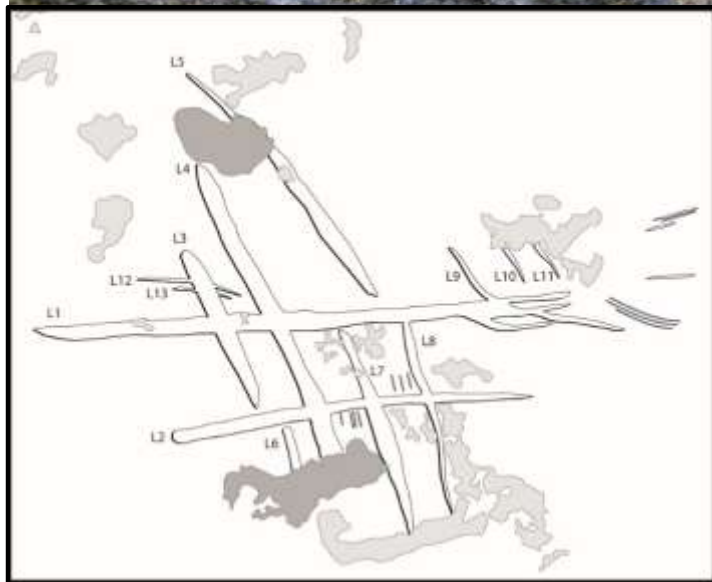
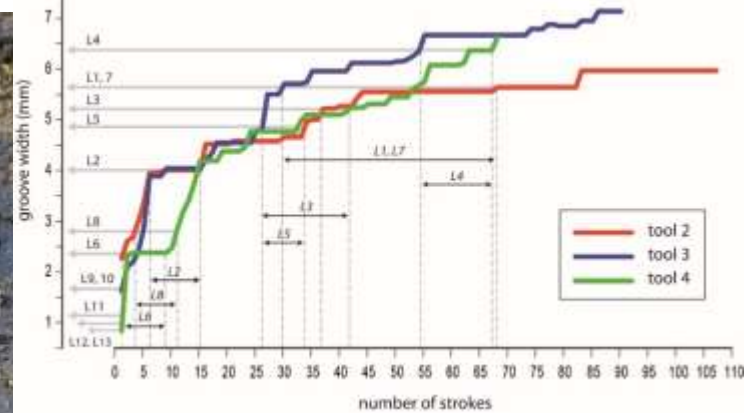
10 notches creating a
structured pattern

51 ka



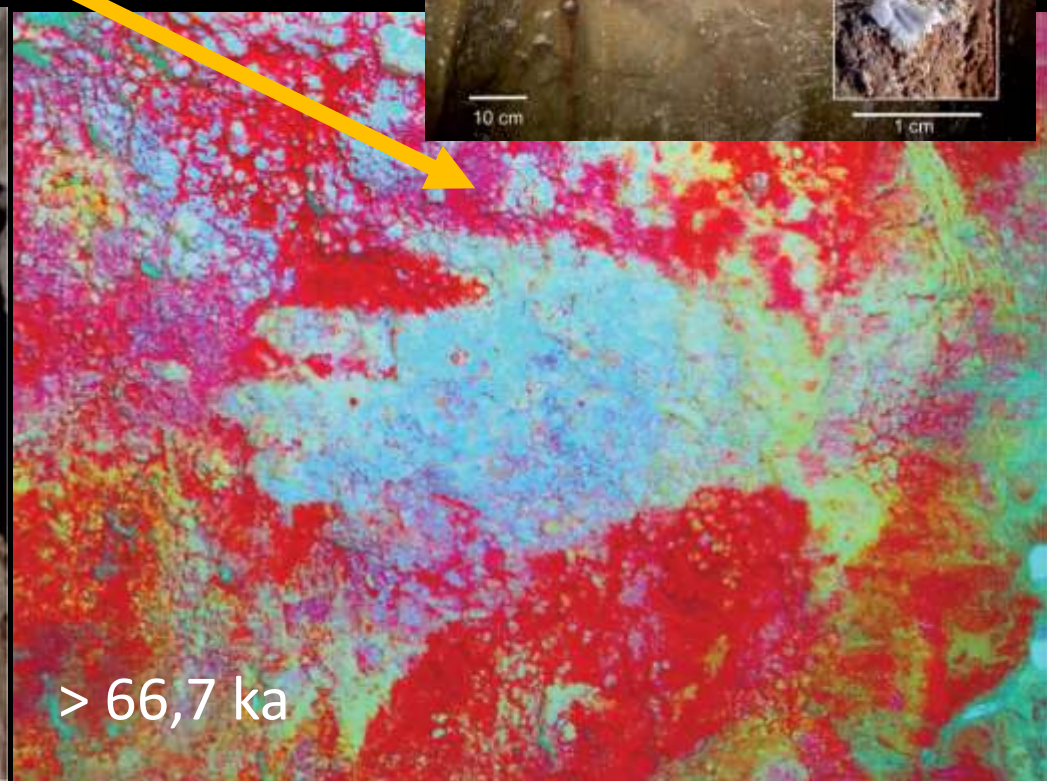
Leder et al. *Nature
Ecology & Evolution* 2021

Gorham's Cave Gibraltar c.40 ka





Hoffmann et al.
Science 2018

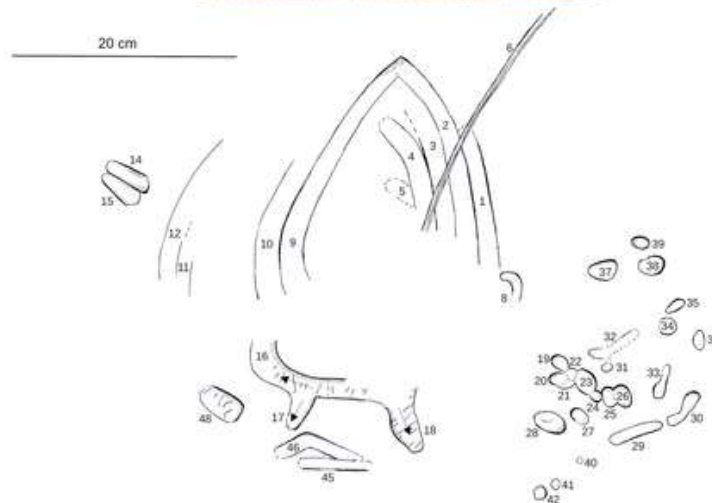
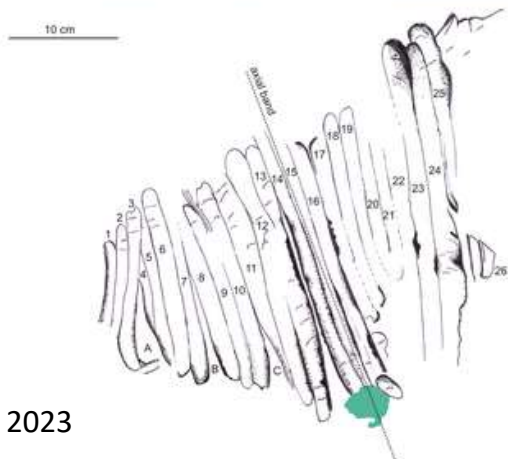
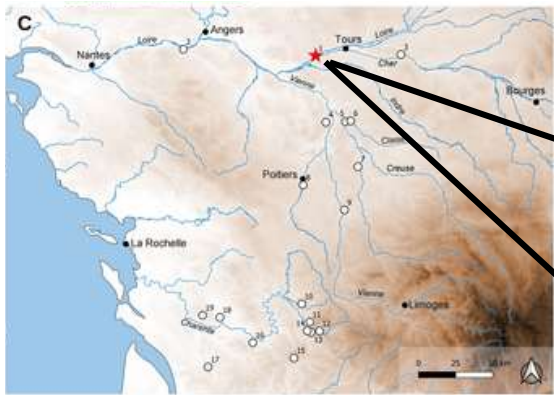




Pitarch, Zilhao, d'Errico et al. 2021. *PNAS*



La Roche-Cotard, Loire Valley France 57 ka finger flutings

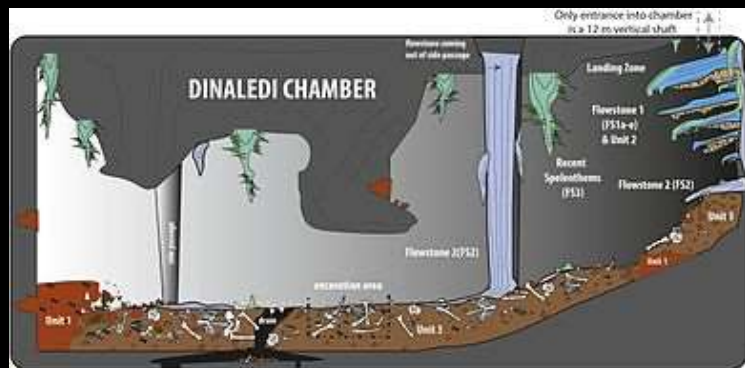


Sima de los Huesos, Atapuerca, Spain

400 ky, *Pre-Neanderthal*, 13 meter deep chimney
 28 individuals (> young males), Carnivore remains
 Acheulean handaxe

Rising Stars, South Africa

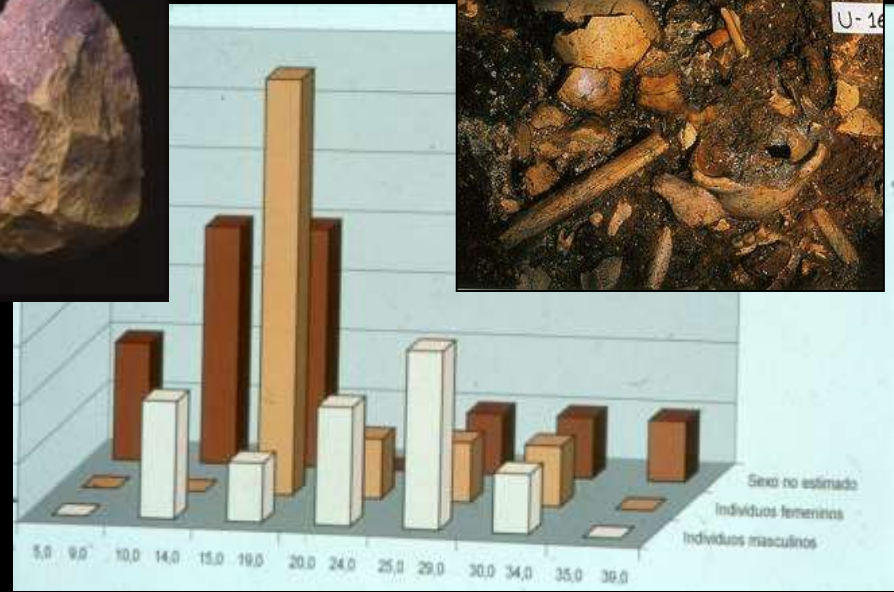
300 ky, *Homo naledi*



Stratigraphic position of flowstones and sedimentary units (not to scale- sketch only)

Unit 1: laminated maroon mudstone.	FS 1: Series of older flowstones restricted to the landing zone.
Unit 2: older mud clast breccias.	FS 2: Series of younger flowstones on chamber floor and walls. Directly covers hominin bones in places.
Unit 3: cave floor sediments; youngest mud clast breccias.	FS 3: Recent speleothems.

Hominin fossils. Micro-mammal fossils.



Earliest known primary burials (120-90 ky)



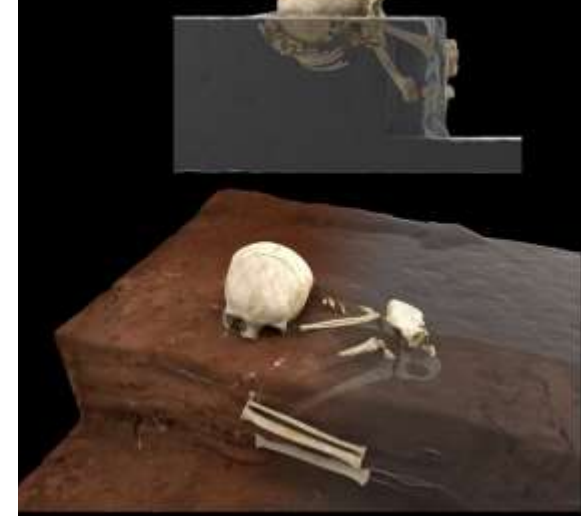
Qafzeh 11



Qafzeh 9 and 10



Neanderthal burial, Tabun level C, 100-150 ky

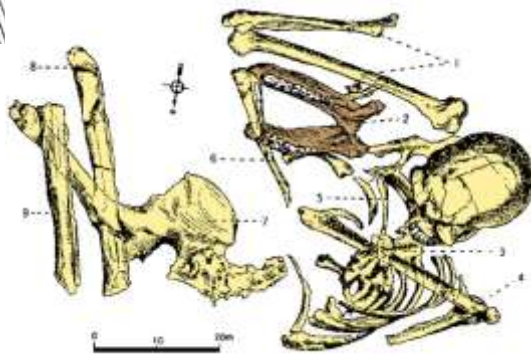


Panga Ya Saidi Kenya, 78 000 ans



Martinon-Torres, d'Errico et al *Nature* 2021

Skhul 5, Israel, 110 ka



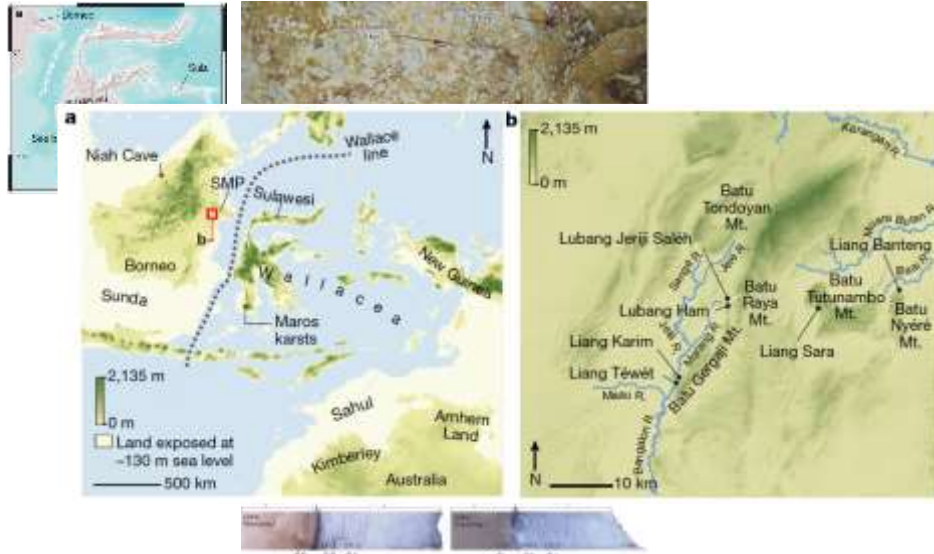
Border Cave 74 ka

d'Errico & Backwell *JHE* 2016



Pleistocene cave art from Sulawesi, Indonesia

M. Aubert^{1,2*}, A. Brumm^{1†*}, M. Ramli³, T. Sutikna^{1,4}, E. W. Saptomo⁴, B. Hakim⁵, M. J. Morwood[†], G. D. van den Bergh¹, L. Kinsley⁶ & A. Dosseto^{7,8}

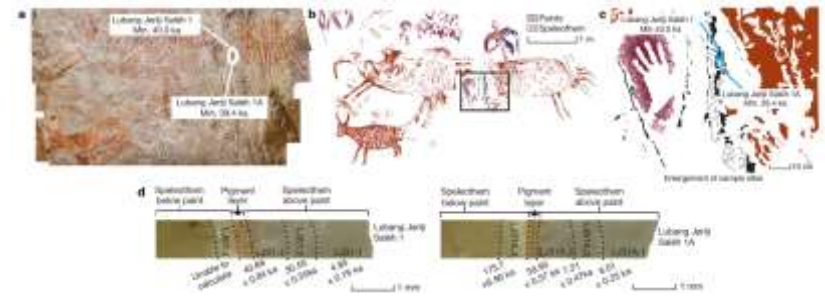


LETTER

<https://doi.org/10.1038/s41586-018-0679-9>

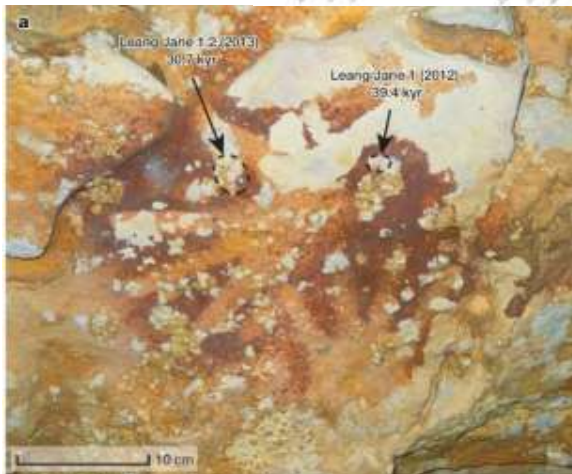
Palaeolithic cave art in Borneo

M. Aubert^{1,2,8*}, P. Setiawan^{3,4}, A. A. Oktaviana^{4,8}, A. Brumm⁵, P. H. Salsiyarto⁴, E. W. Saptomo⁴, B. Istiawan⁵, T. A. Ma'rifat⁵, V. N. Wahyuono⁵, F. T. Atmoko⁵, J.-X. Zhao⁶, J. Huntley⁴, P. S. C. Taçon¹, D. L. Howard⁷ & H. E. A. Brand⁷



Apollo 11, Namibia
c. 28–30 ka

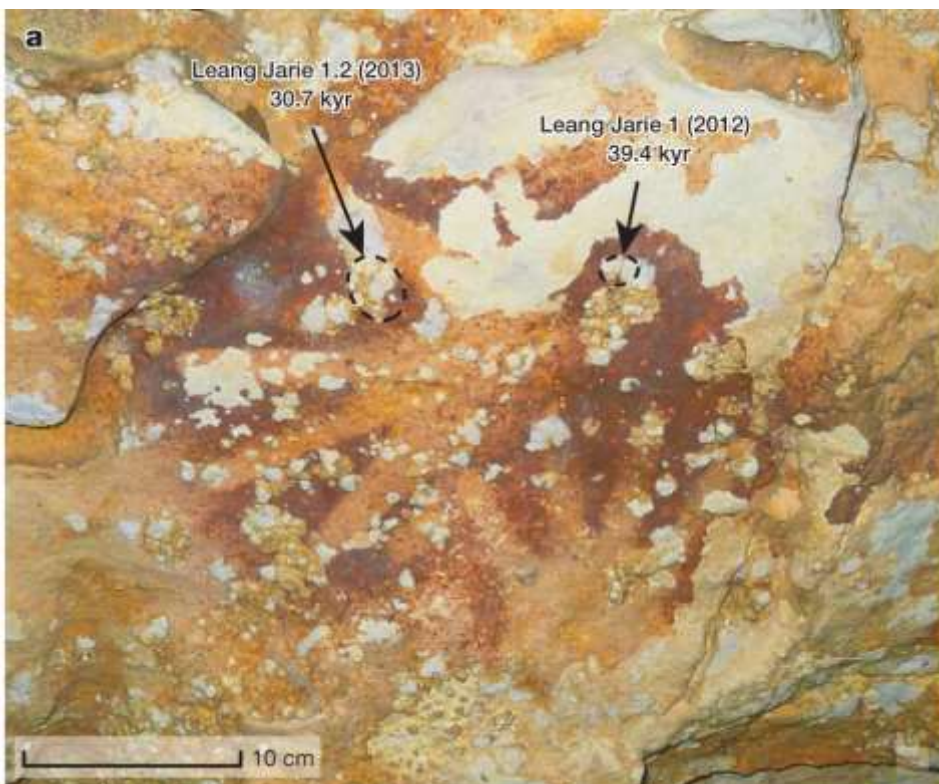
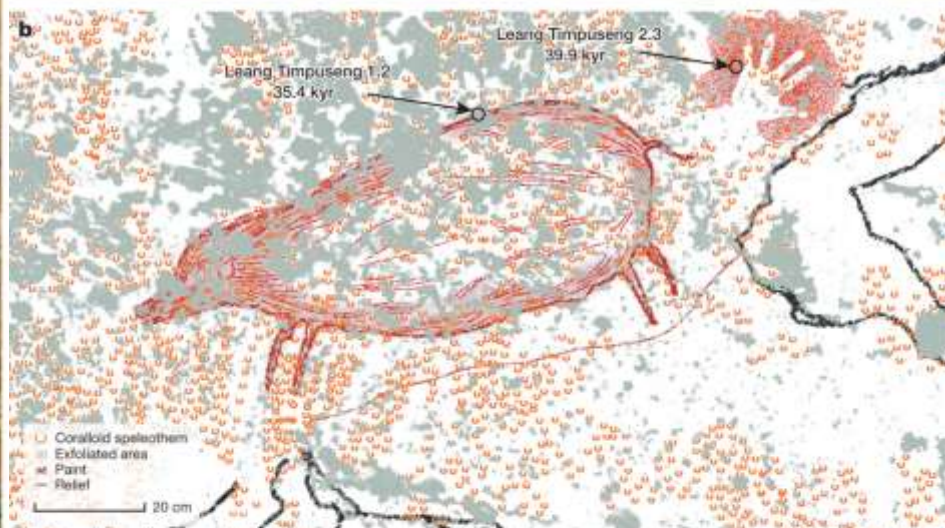
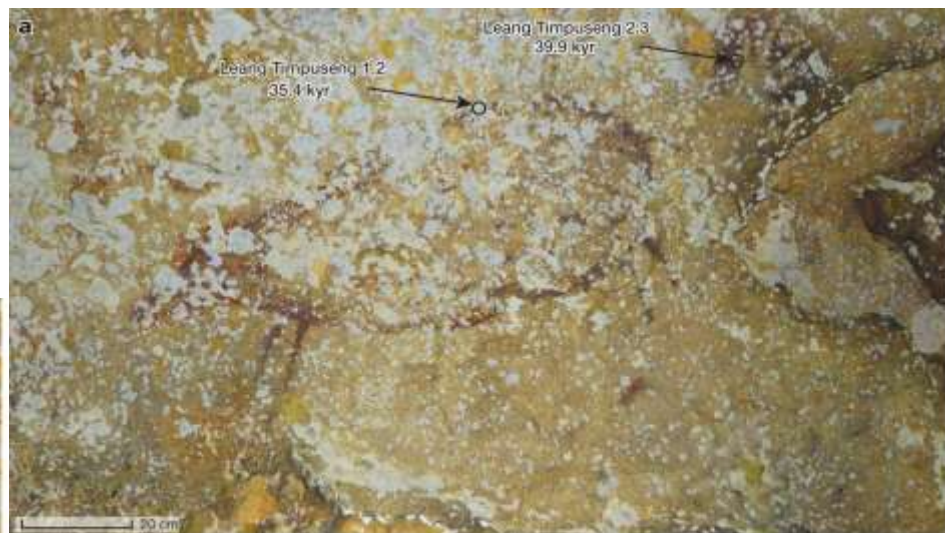
Chauvet Cave France, 36 ka



Pleistocene cave art from Sulawesi, Indonesia

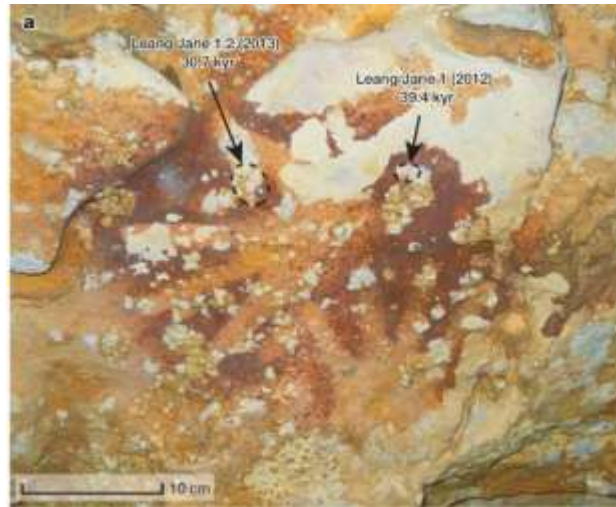
M. Aubert^{1,2*}, A. Brumm^{1,4*}, M. Ramli³, T. Sutikna^{1,4}, E. W. Saptomo⁴, B. Hakim⁵, M. J. Morwood[†], G. D. van den Bergh¹, L. Kinsley⁶ & A. Dosseto^{7,8}

39.9 ka

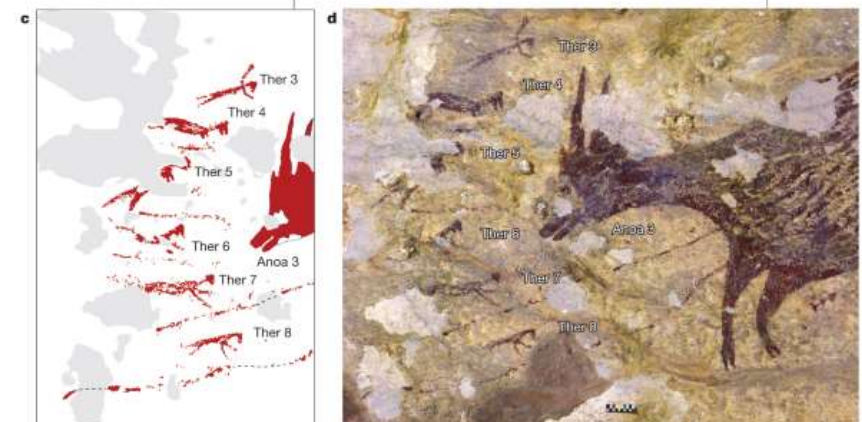
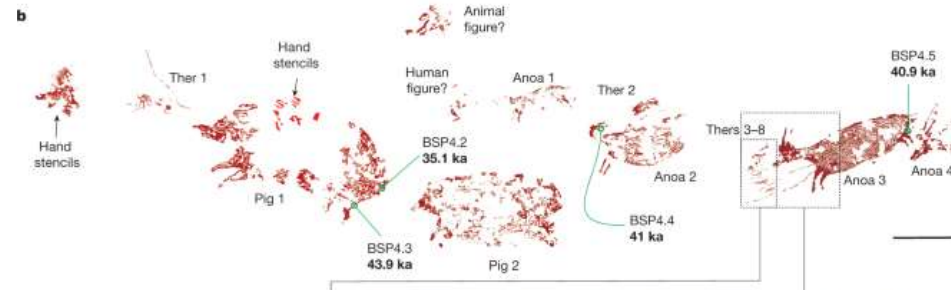
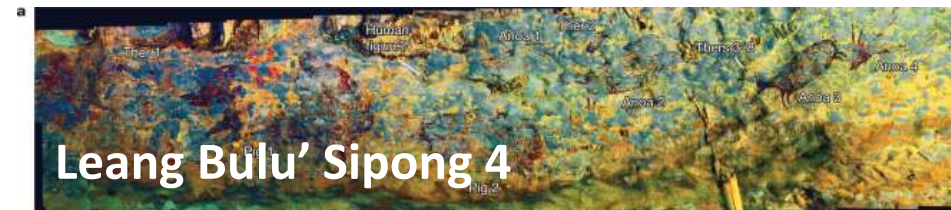


Pleistocene cave art from Sulawesi, Indonesia

M. Aubert^{1,2*}, A. Brumm^{1†*}, M. Rami³, T. Sutikna^{1,4}, E. W. Saptomo⁴, B. Hakim⁵, M. J. Morwood[‡], G. D. van den Bergh¹, L. Kinsley⁶ & A. Dosseto^{7,8}



Aubert et al.
2019 *Nature*

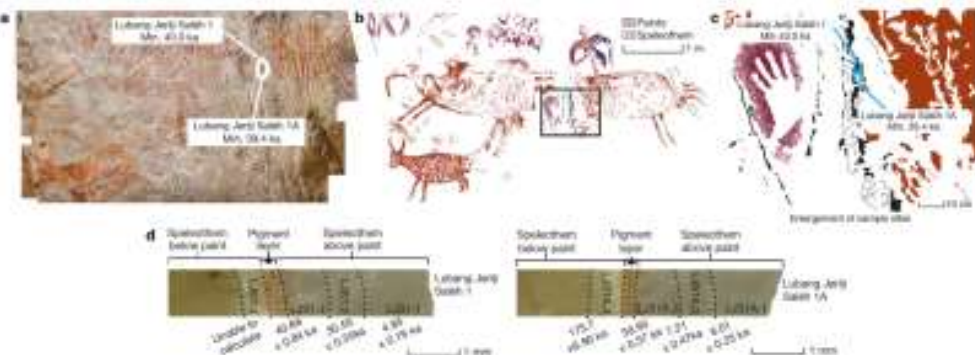


LETTER

<https://doi.org/10.1038/s41586-018-0679-9>

Palaeolithic cave art in Borneo

M. Aubert^{1,2,8*}, P. Setiawan^{3,8}, A. A. Oktaviana^{4,8}, A. Brumm², P. H. Salsiyarto⁴, E. W. Saptomo⁴, B. Istiawan⁵, T. A. Ma'rifat⁵, V. N. Wahyuono⁶, F. T. Atmoko⁶, L.-X. Zhao⁶, I. Huntley⁶, P. S. C. Taçon¹, D. L. Howard⁷ & H. E. A. Brand⁷





Apollo 11, Namibia c. 28-30 ka



Original



Enhanced



AP 4

Original



Enhanced



AP 3

Original



Enhanced



Huyge et al. *Antiquity* 2011

20-16 ka

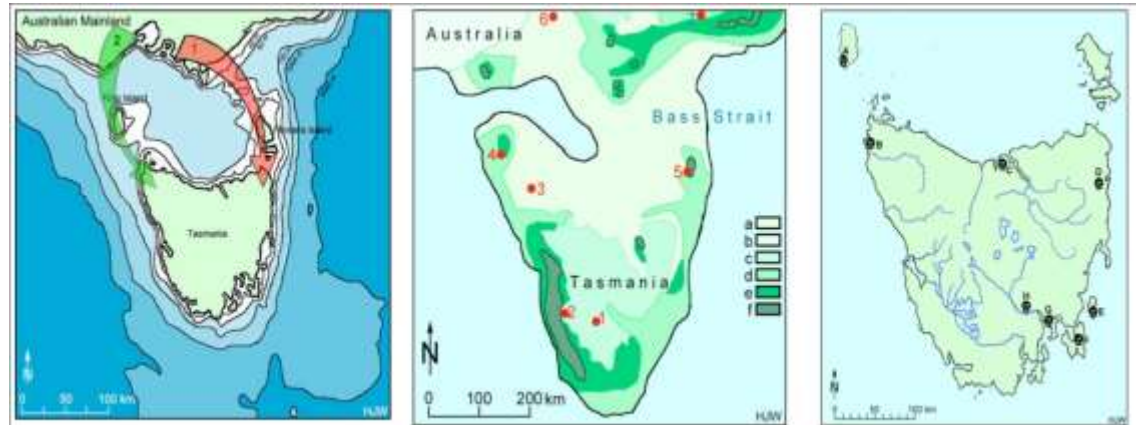
Late Pleistocene Demography and the Appearance of Modern Human Behavior



Adam Powell,^{1,3} Stephen Shennan,^{2,3} Mark G. Thomas^{1,3*}

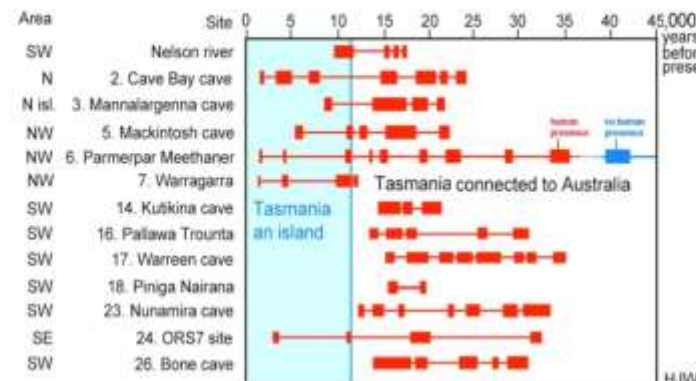
Henrich 2004 *American Antiquity*

Loss of cultural innovations in Tasmania



35,000 BP

35,000-10,000 BP 10,000 BP



Lost cultural innovations

- bone tools
- cold-weather clothing
- hafted tools
- nets
- fishing spears
- barbed spears
- spear-throwers
- boomerang

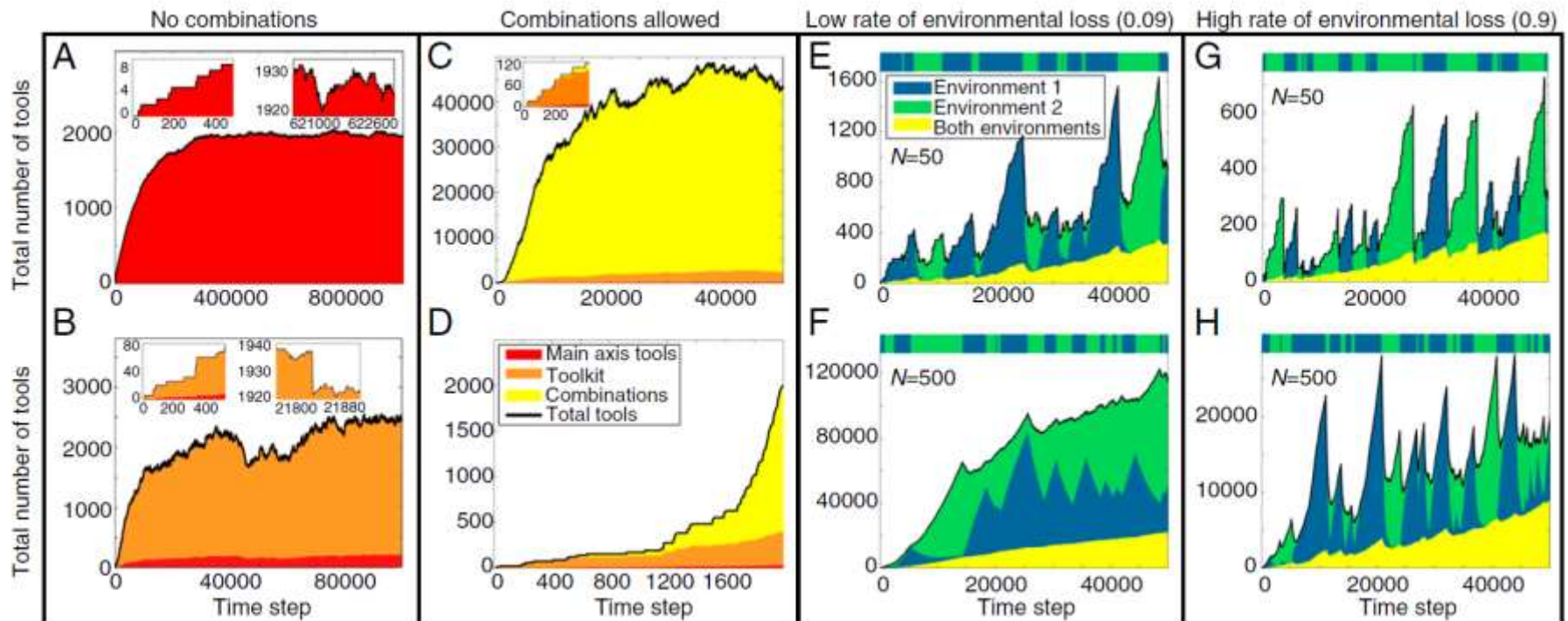
19th century:
toolkit of only 24 items

Evolution in leaps: The punctuated accumulation and loss of cultural innovations

Oren Kolodny^{1,2}, Nicole Creanza^{1,2}, and Marcus W. Feldman²

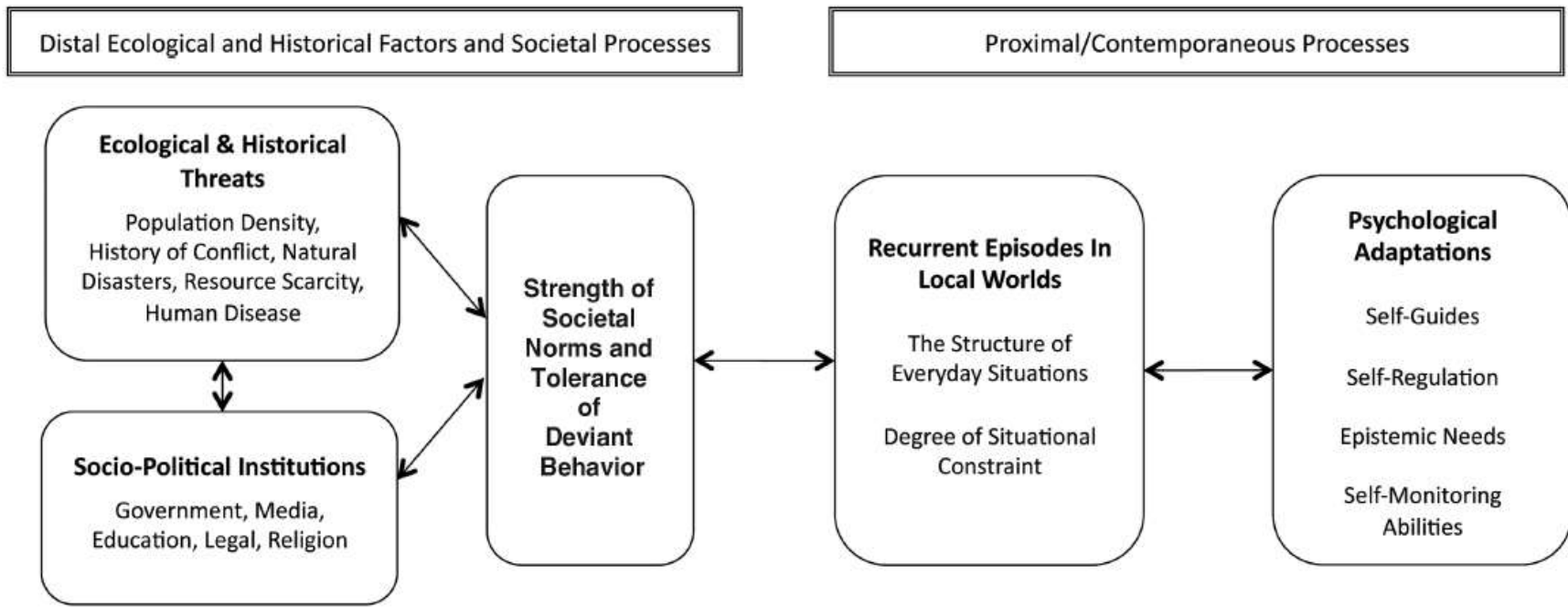
Department of Biology, Stanford University, Stanford, CA 94305

Contributed by Marcus W. Feldman, October 20, 2015 (sent for review September 3, 2015; reviewed by Jeremy R. Kendal, Michael J. O'Brien, and Peter J. Richerson)



Differences Between Tight and Loose Cultures: A 33-Nation Study

Michele J. Gelfand,^{1*} Jana L. Raver,² Lisa Nishii,³ Lisa M. Leslie,⁴ Janetta Lun,¹ Beng Chong Lim,⁵ Lili Duan,⁶ Assaf Almaliach,⁷ Soon Ang,⁸ Jakobina Arnadottir,⁹ Zeynep Aycan,¹⁰ Klaus Boehnke,¹¹ Pawel Boski,¹² Rosa Cabecinhas,¹³ Darius Chan,¹⁴ Jagdeep Chhokar,¹⁵ Alessia D'Amato,¹⁶ Montse Ferrer,¹⁷ Iris C. Fischlmayr,¹⁸ Ronald Fischer,¹⁹ Marta Fülöp,²⁰ James Georgas,²¹ Emiko S. Kashima,²² Yoshishima Kashima,²³ Kibum Kim,²⁴ Alain Lempereur,²⁵ Patricia Marquez,²⁶ Rozhan Othman,²⁷ Bert Overlaet,²⁸ Penny Panagiotopoulou,²⁹ Karl Peltzer,³⁰ Lorena R. Perez-Florizno,³¹ Larisa Ponomarenko,³² Anu Realo,³³ Vidar Schei,³⁴ Manfred Schmitt,³⁵ Peter B. Smith,³⁶ Nazar Soomro,³⁷ Erna Szabo,¹⁸ Nalinee Taveesin,³⁸ Midori Toyama,³⁹ Evert Van de Vliert,⁴⁰ Naharika Vohra,⁴¹ Colleen Ward,⁴² Susumu Yamaguchi⁴³



tight

loose



Hutterites



Cubeo



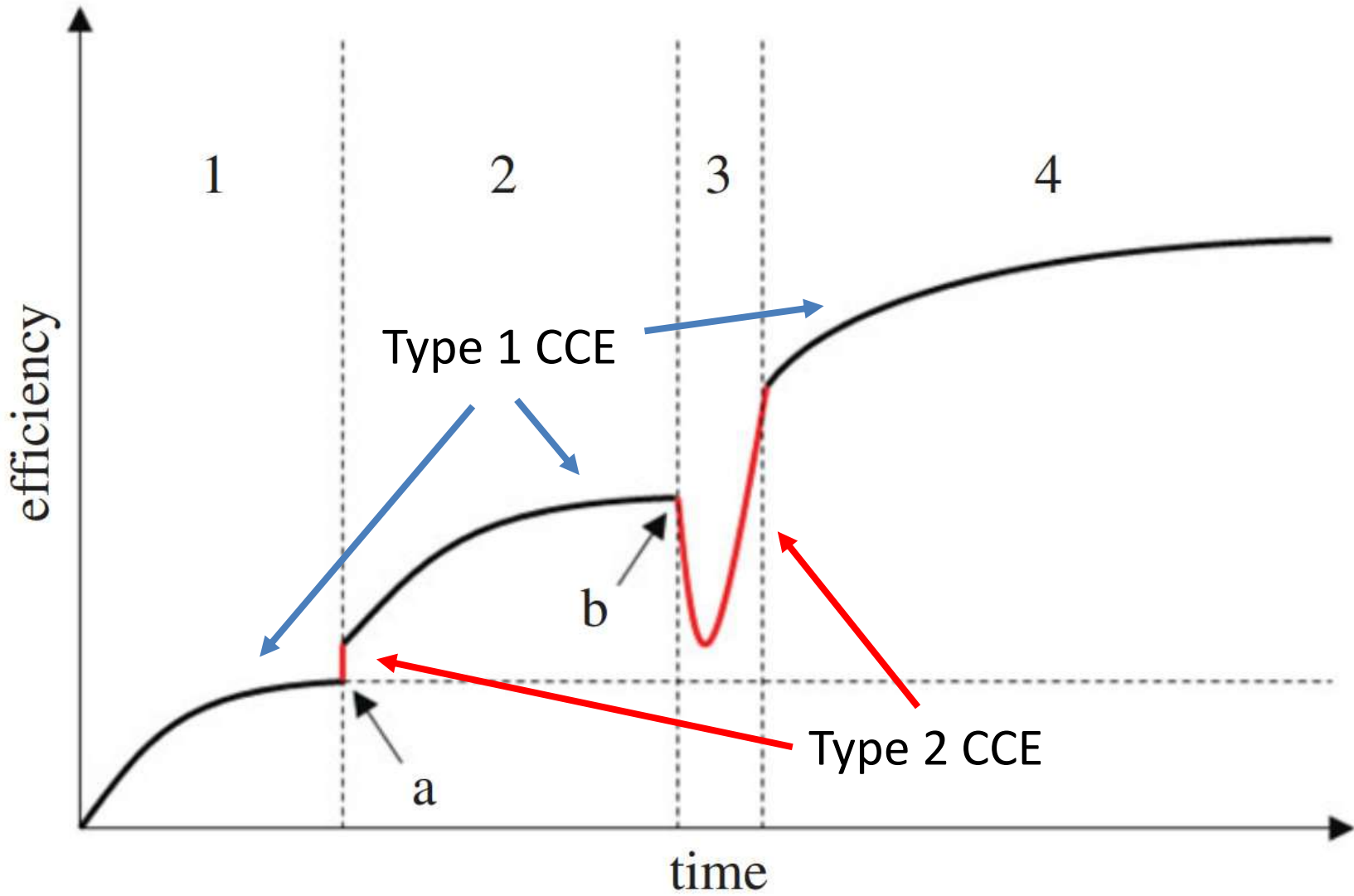
Skolt Lapps

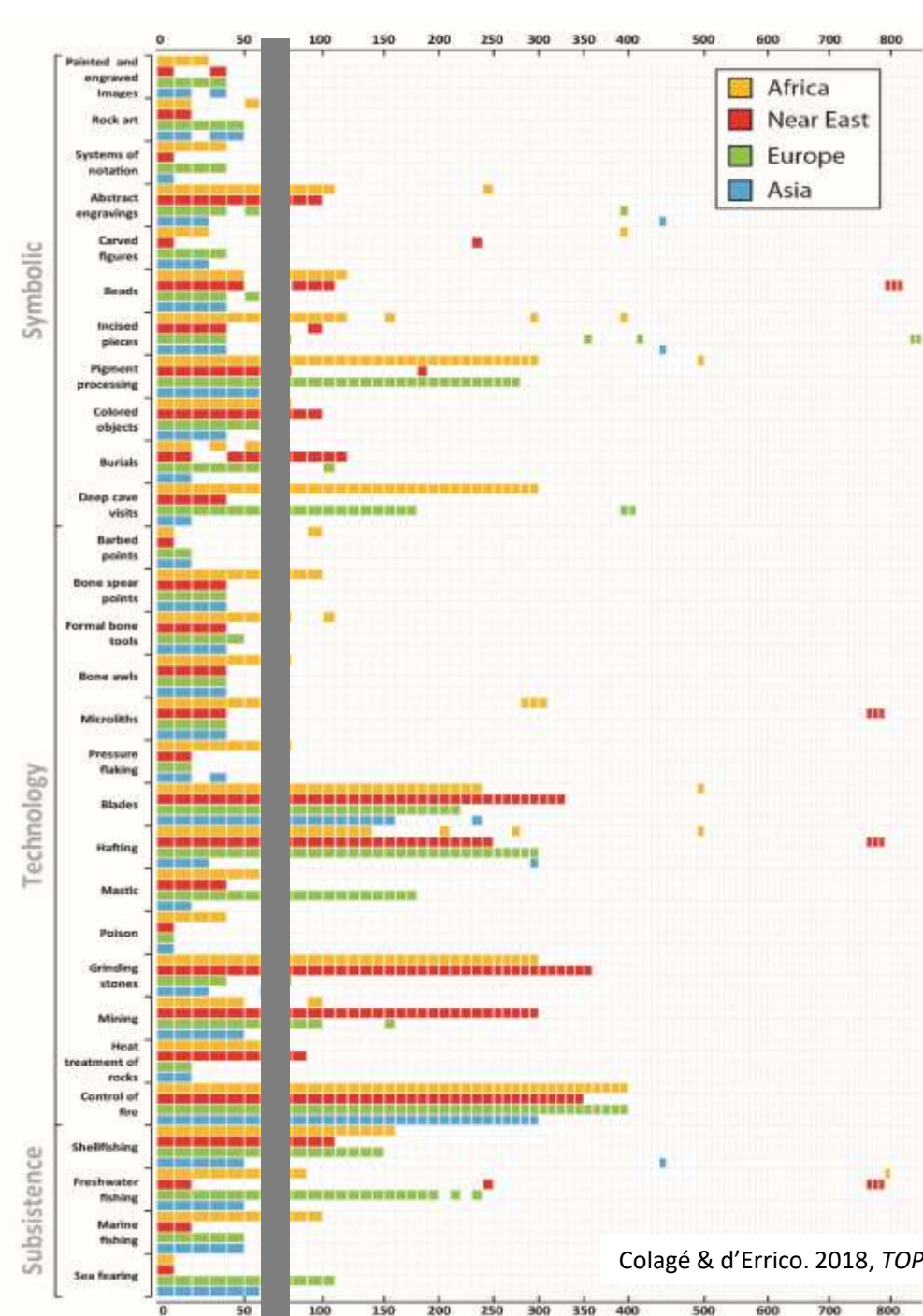
Cumulative Cultural Evolution (CCE) comprises two distinct processes:

Type I CCE **optimizes** cultural traits that exploit a given set of natural phenomena

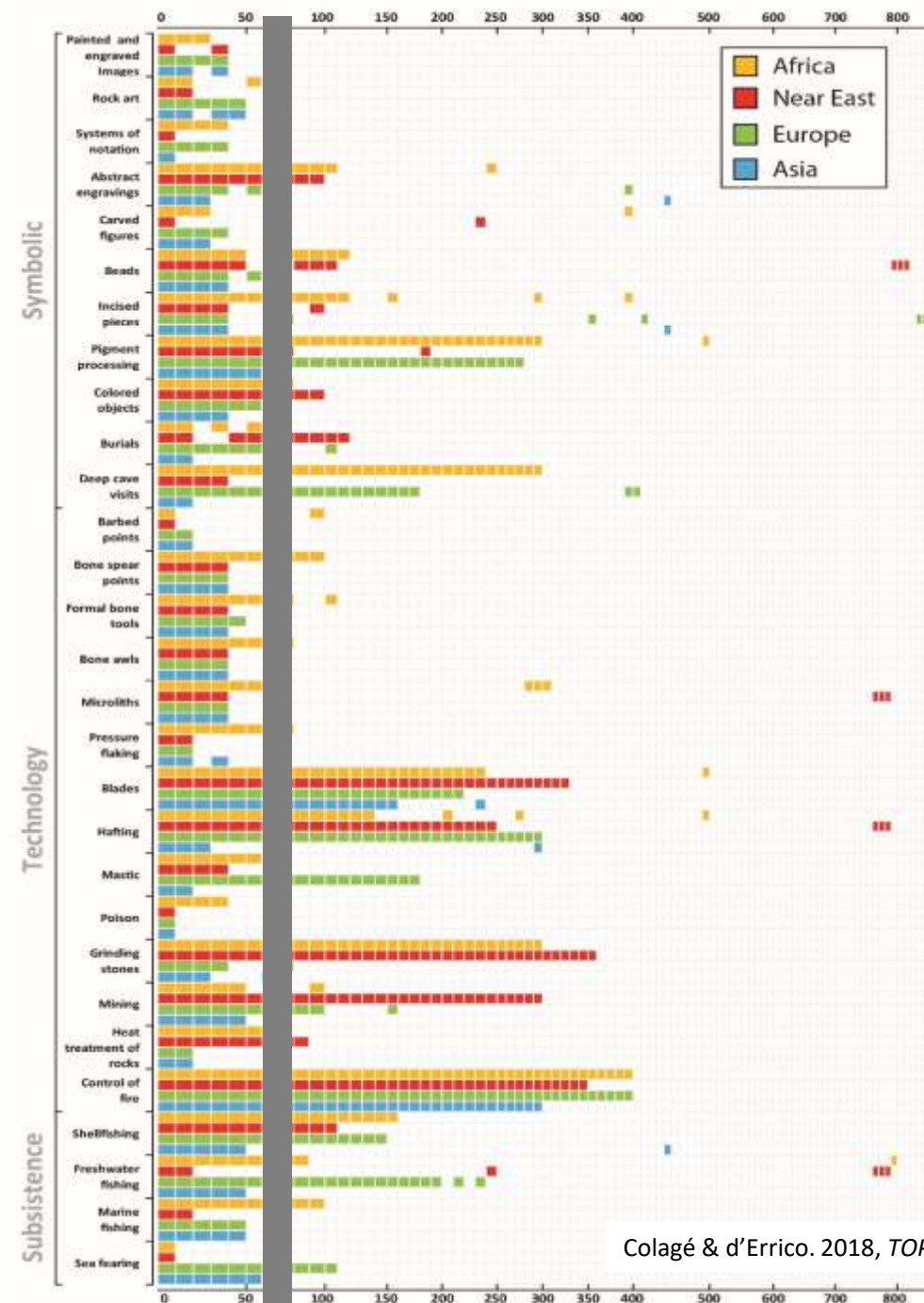
Type II CCE **expands** the set of natural phenomena we exploit





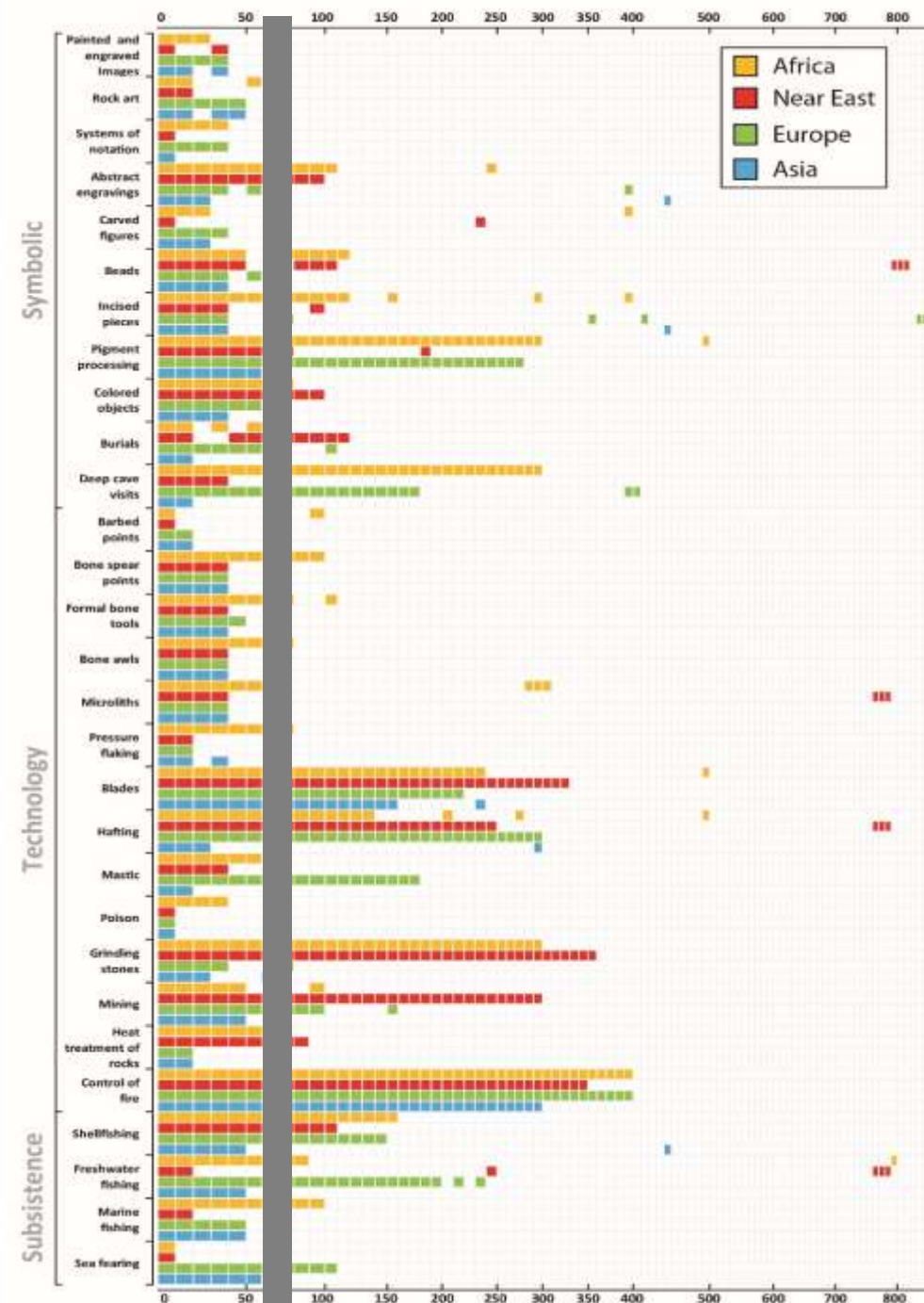


Colagé & d'Errico. 2018, *TOPICS in Cognitive Science*



Colagè & d'Errico. 2018, *TOPICS in Cognitive Science*

- cultural innovations emerged at different times in different parts of the world, among different populations, and some of them were lost and reacquired later on in different forms
 - a number were present outside Africa before modern humans dispersal
 - the timing, location, and pace of innovation appearance is inconsistent with scenarios attributing the spread of modern cultural traits to concomitant classic biological Darwinian evolutionary processes (such as heritable genetic mutations or speciation events)
- ↓
- **cultural innovations were triggered by several interconnected and dynamic factors, both environmental and social**
 - **they are the outcome of complex and non-linear population dynamics and cultural trajectories that need to be understood and traced at a regional scale**



Cultural Exaptation



Social learning



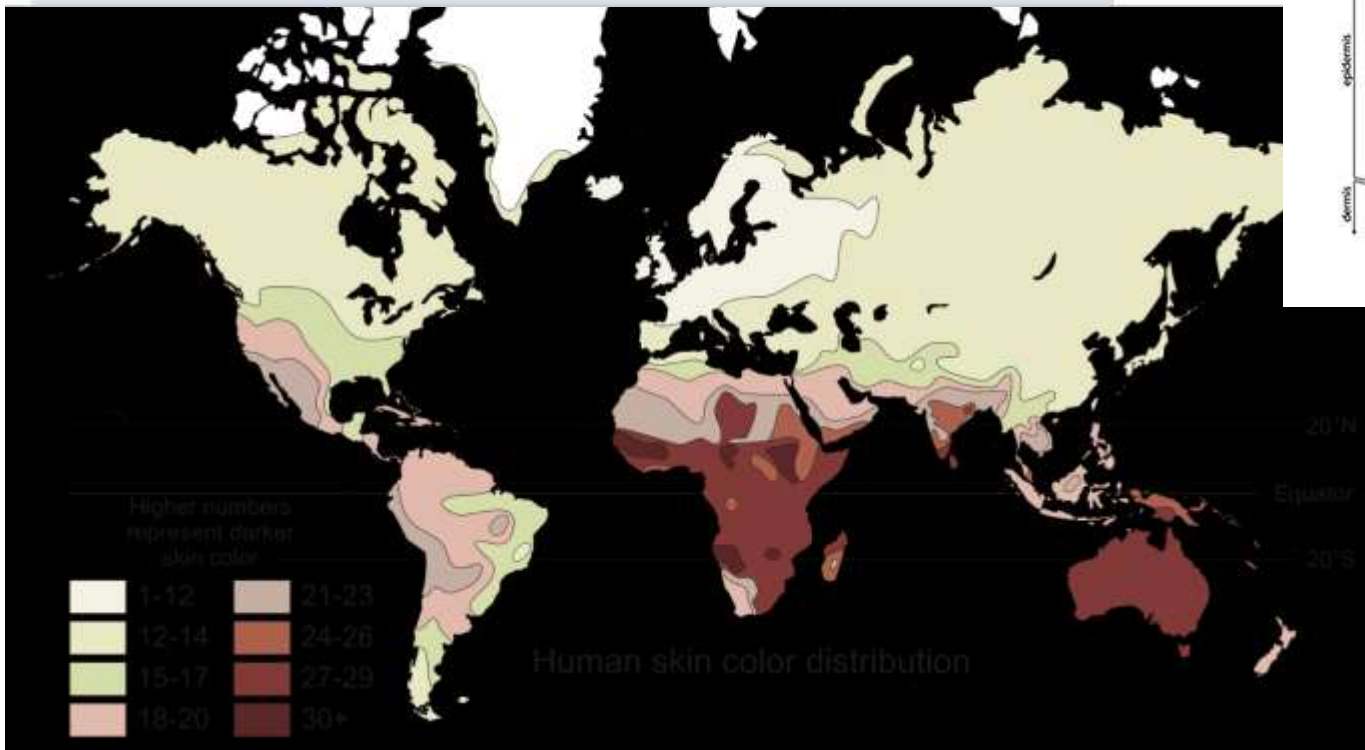
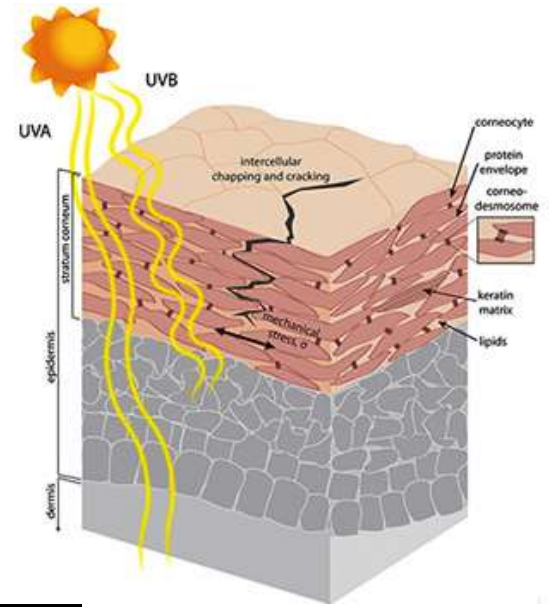
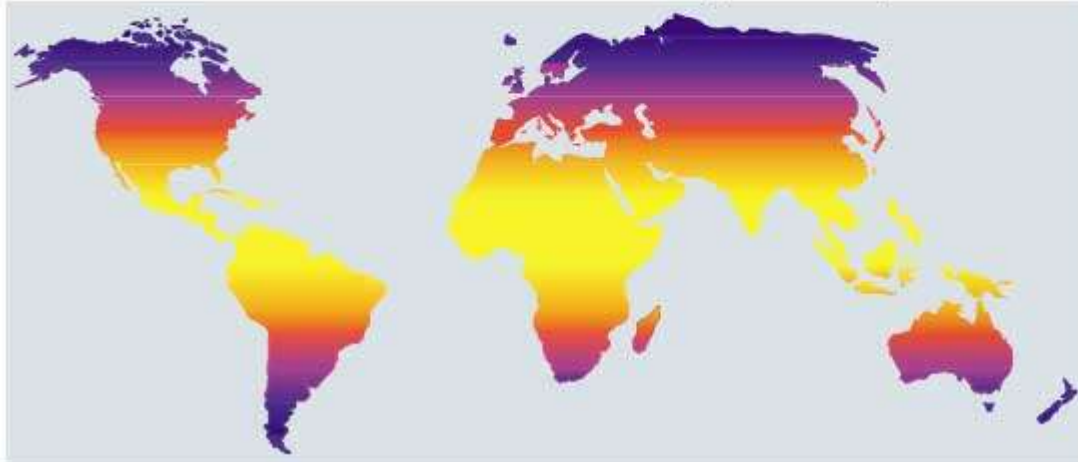
Cultural Neural Reuse



Cultural innovation

- Colagè I., d'Errico, F. 2018. Culture: the driving force of human cognition. *Topics in Cognitive Science*.
- d'Errico F., Colagè I. 2018. Cultural Exaptation, Teaching, and Cultural Neural Reuse: A mechanism for the emergence of modern culture and behaviour. *Biological Theory*
- Colagè I., d'Errico, F. 2023. The Roots of Creativity: Investing in cultural transmission. *Acta Philosophica*

Hours of illumination from Solar Bud after one day of full sun exposure

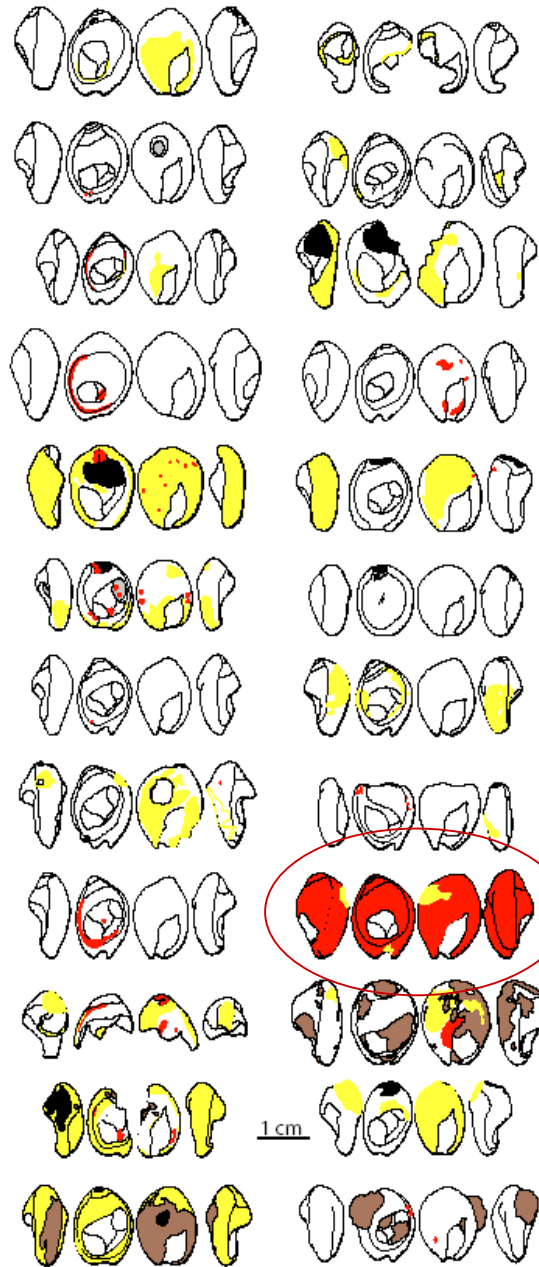




Taforalt, Grotte des Pigeons, 80 ka

d'Errico et al.
2009 PNAS

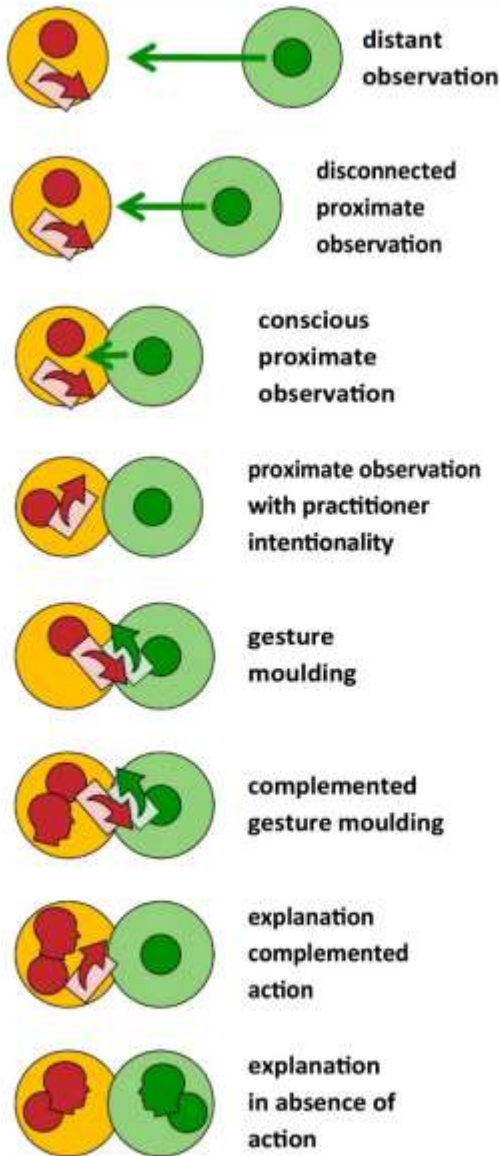
RED PIGMENT



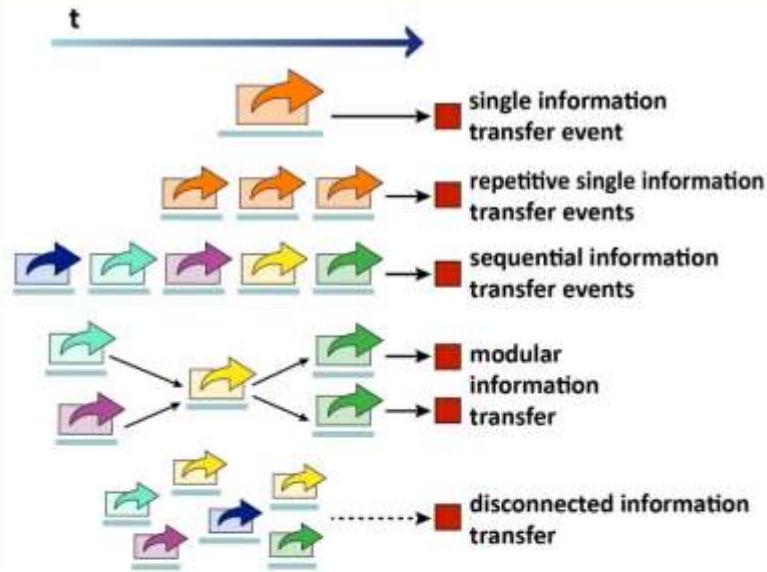
beads covered with pigments



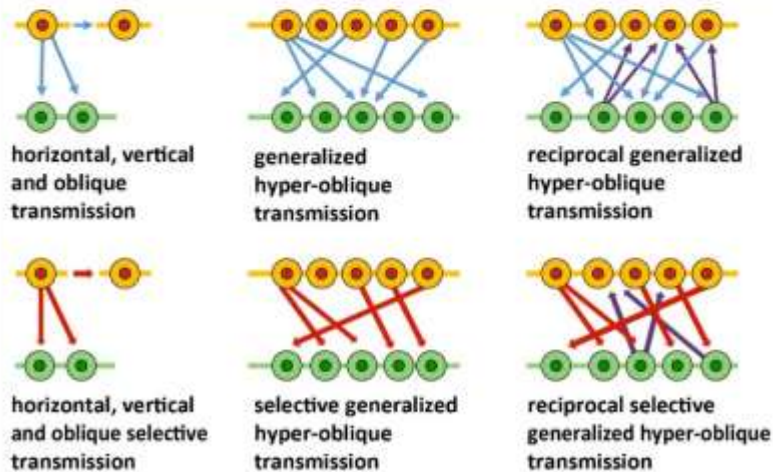
Spatial dimension



Temporal dimension



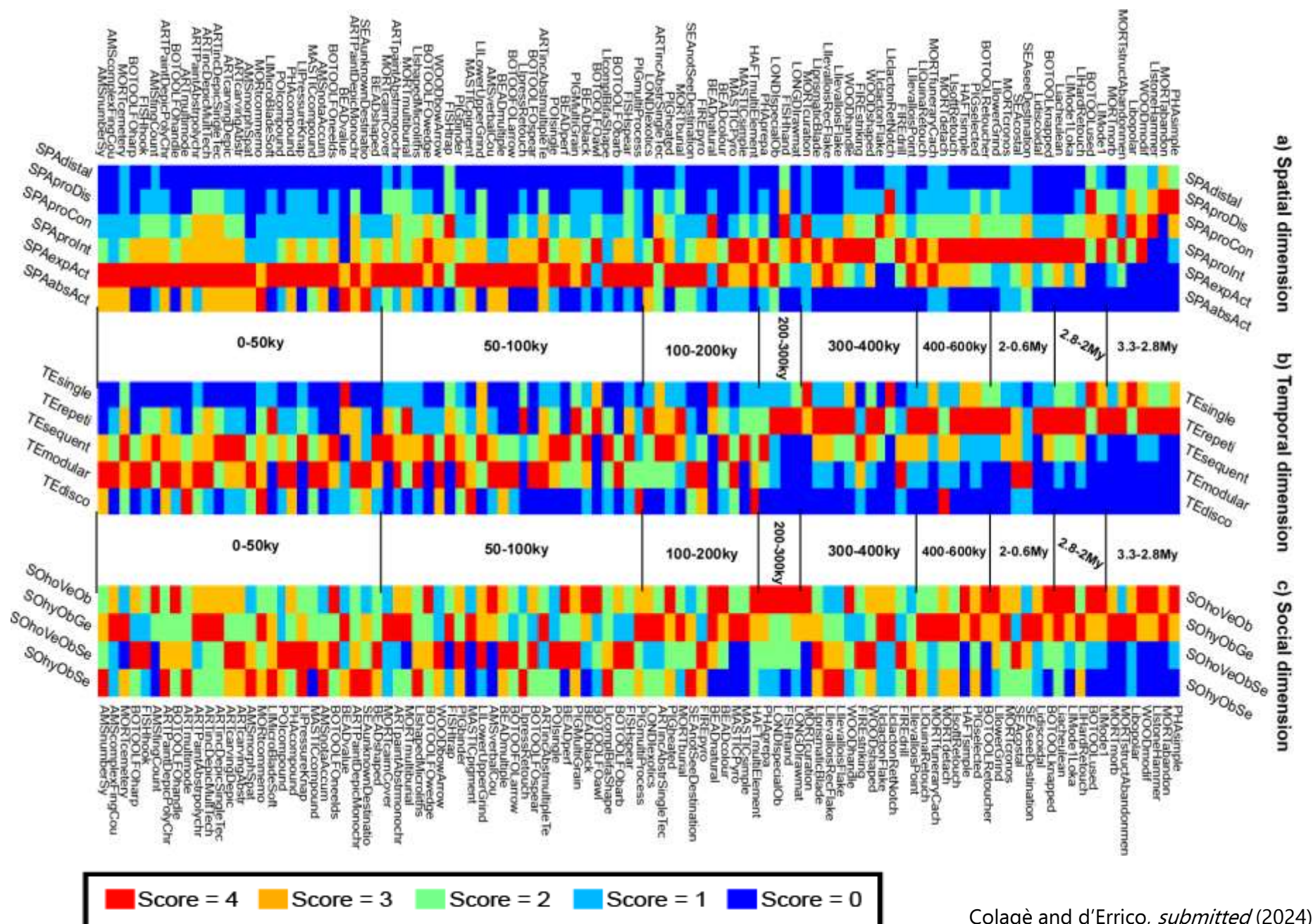
Social dimension



A conceptual framework to classify different transmission strategies of cultural practices used by human and non-human primates

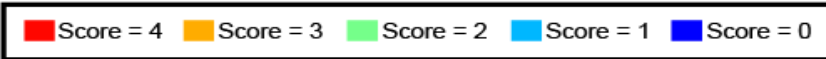
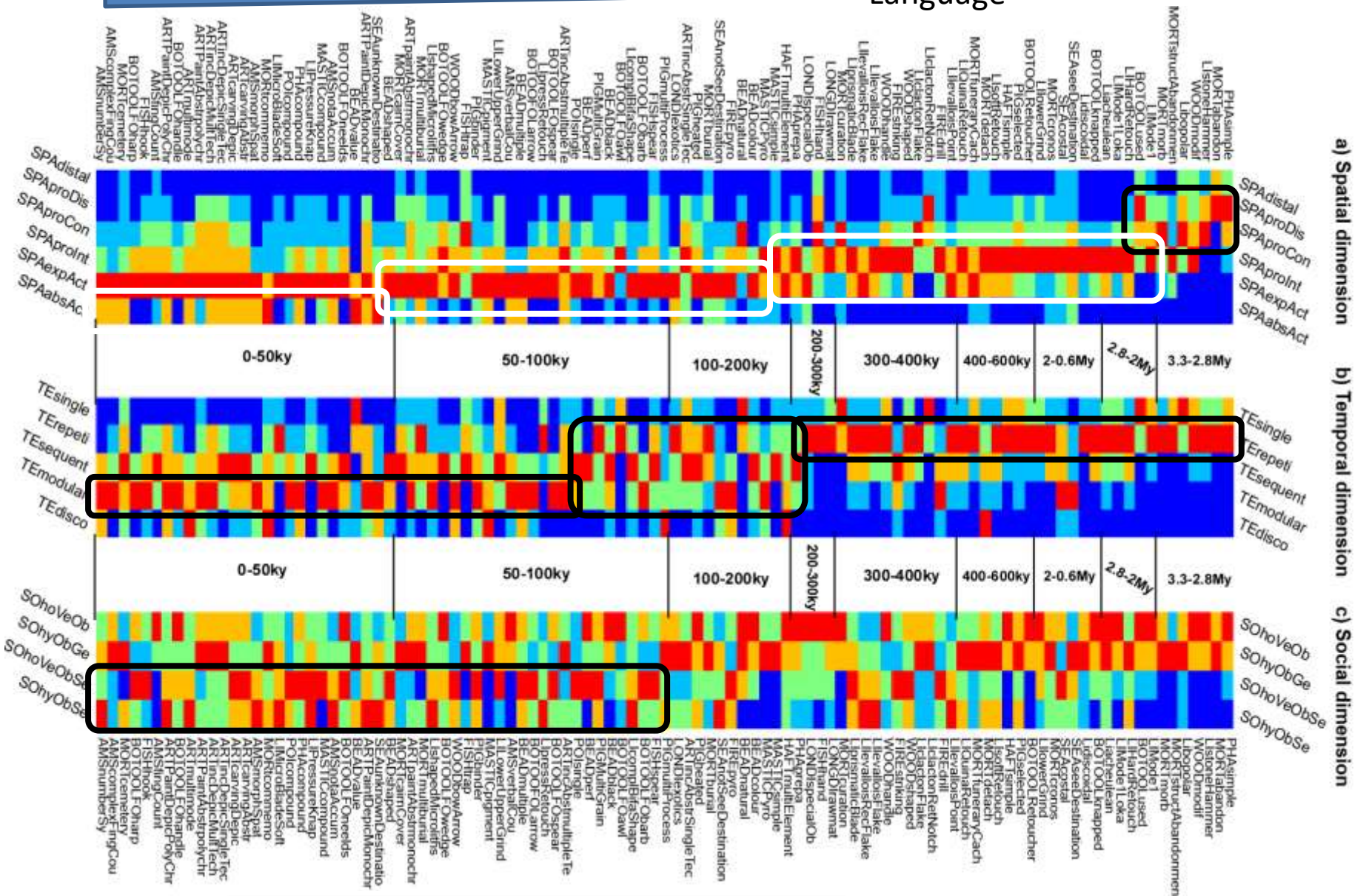
Modes of cultural transmission

d'Errico & Banks
Cambridge Arch. J. 2015

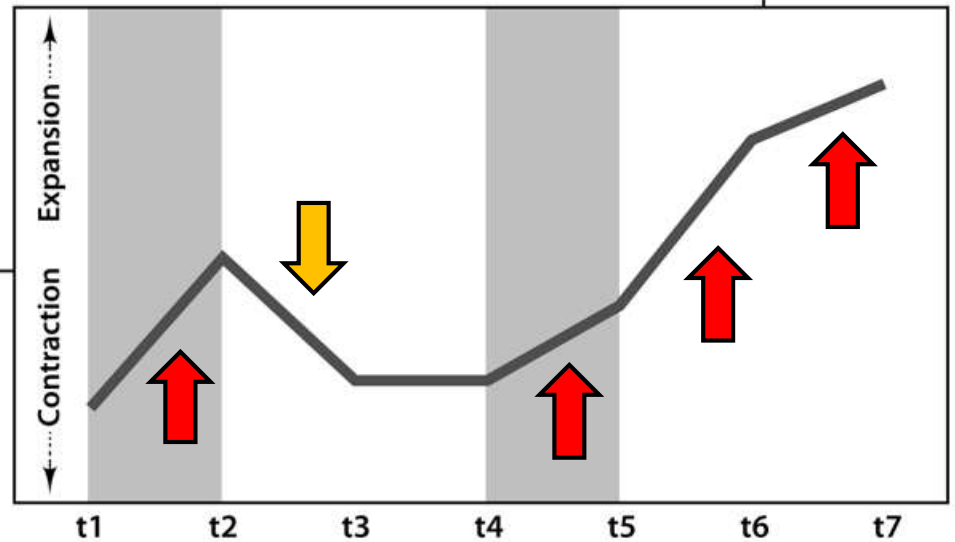
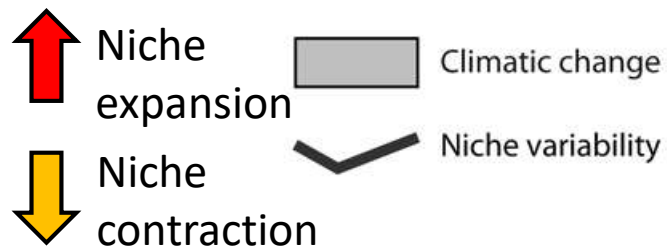
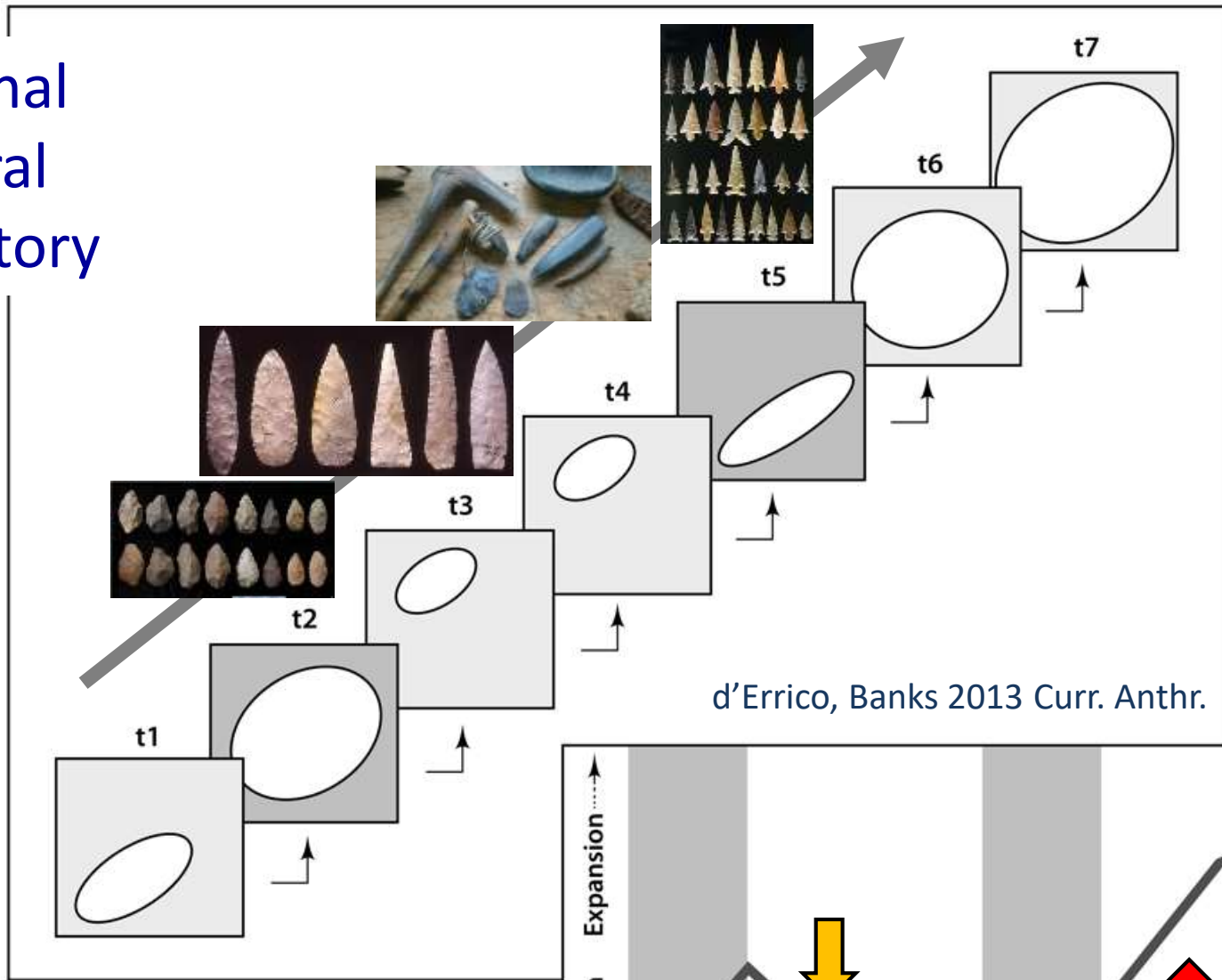


Symbolism activated

Language



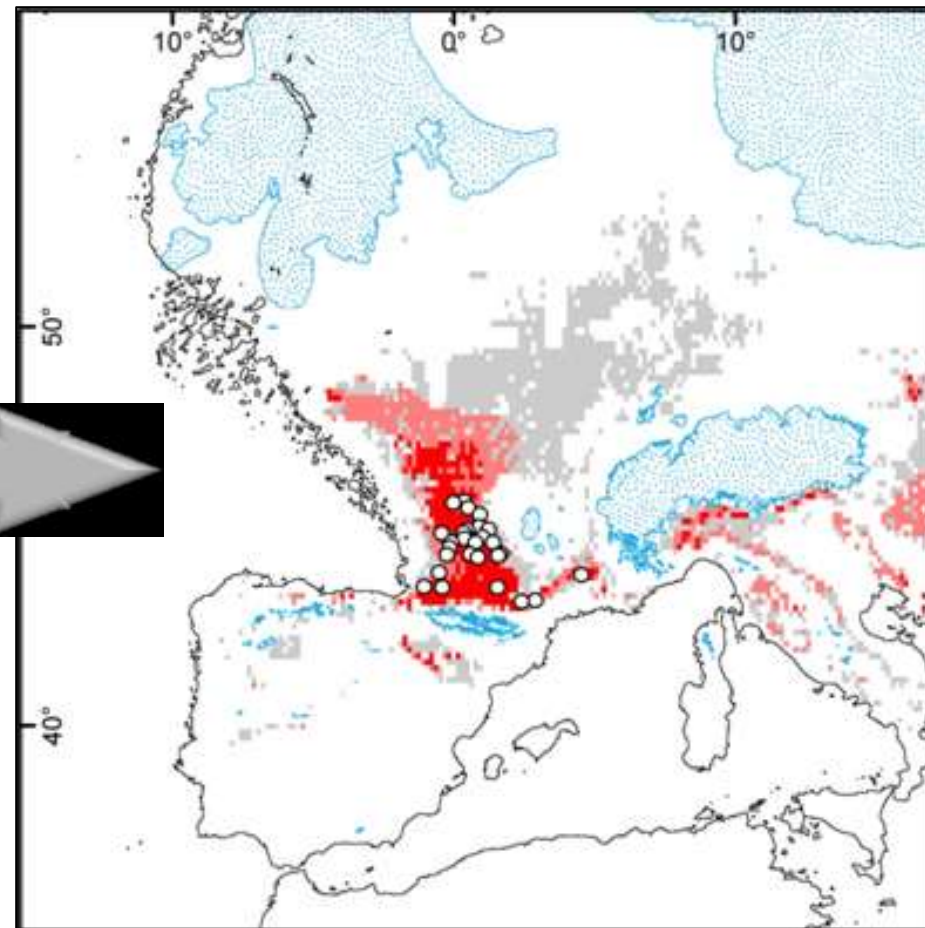
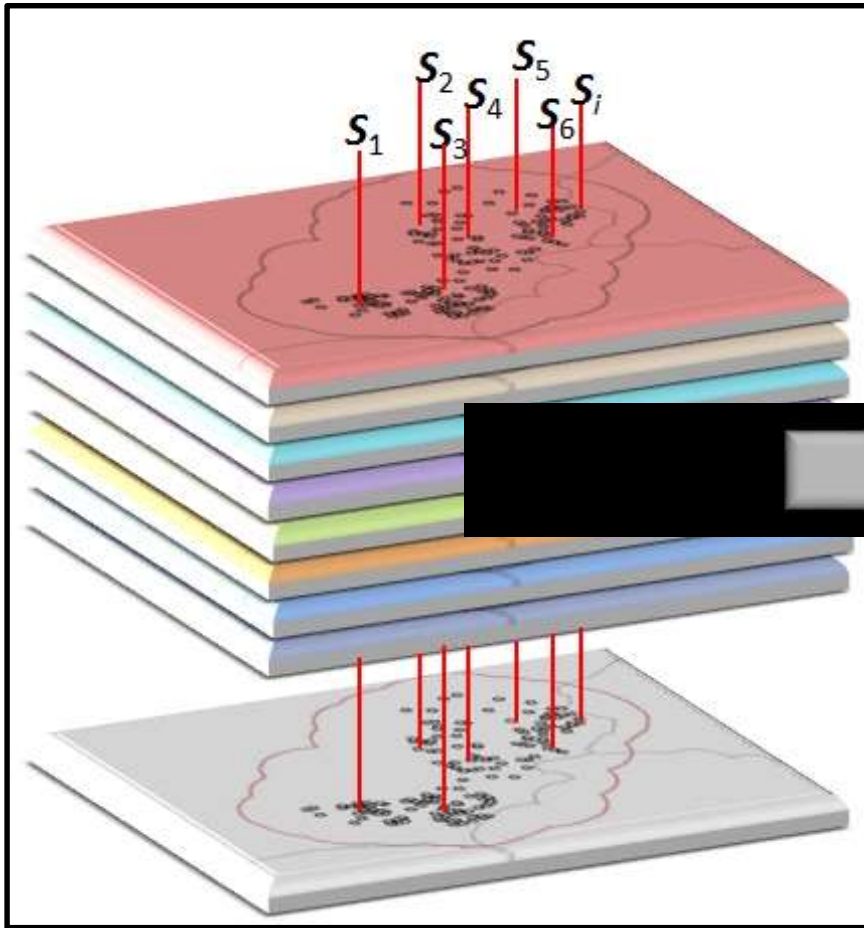
Regional Cultural trajectory



Eco-cultural niche modeling

Predictive algorithms and environmental layers

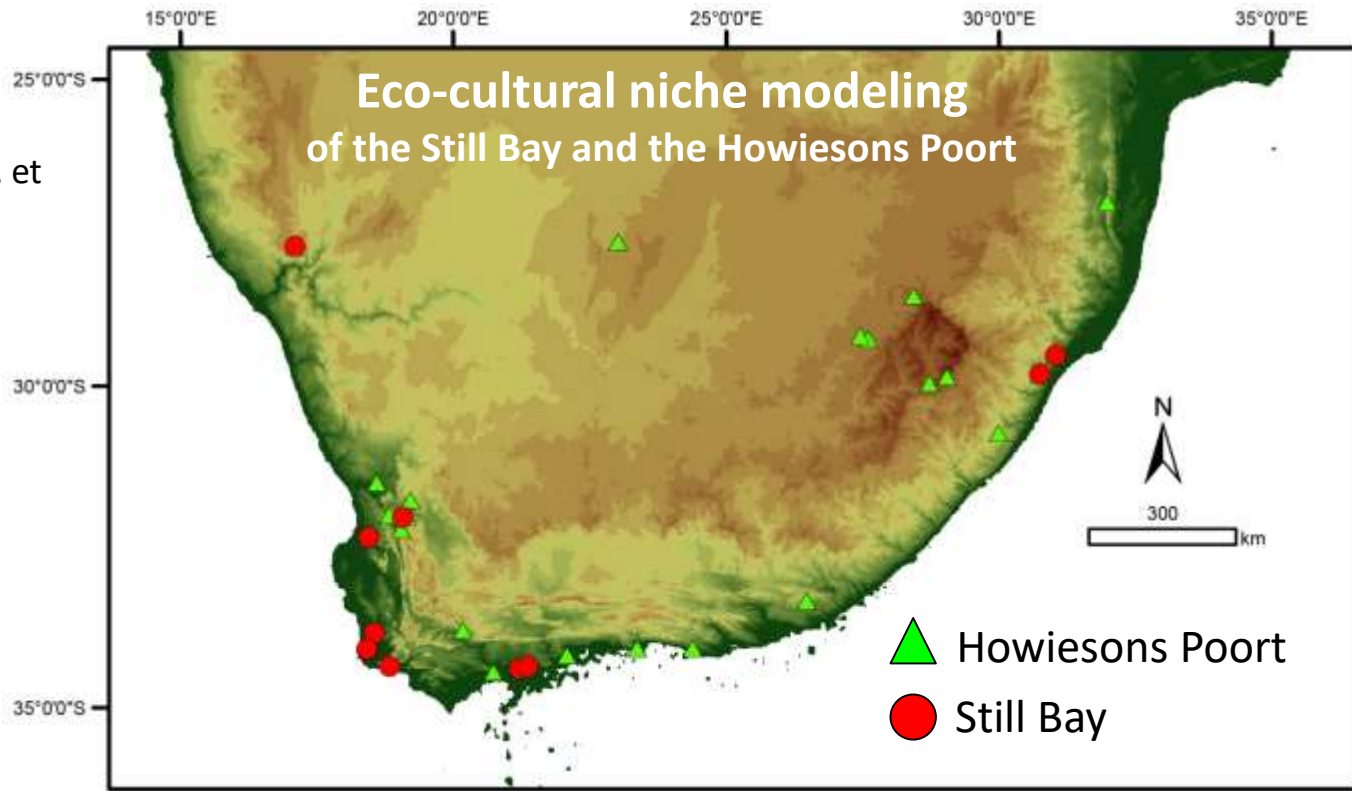
Eco-cultural niche



S_i = parameter

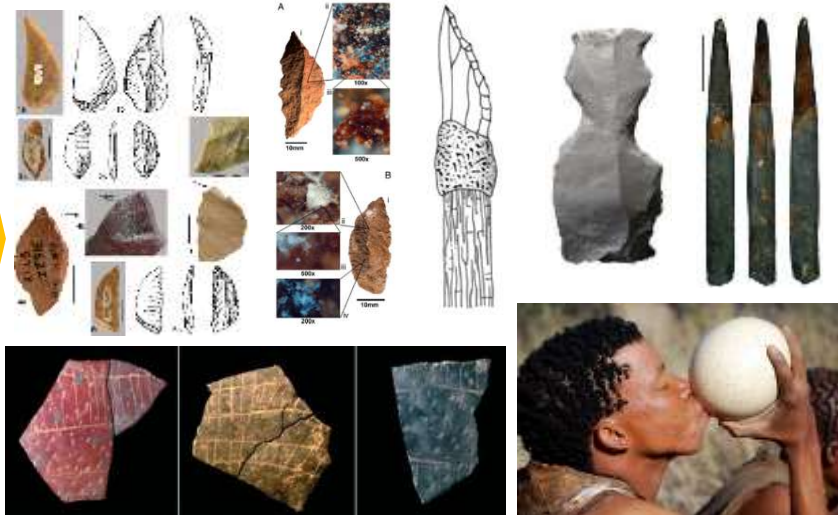
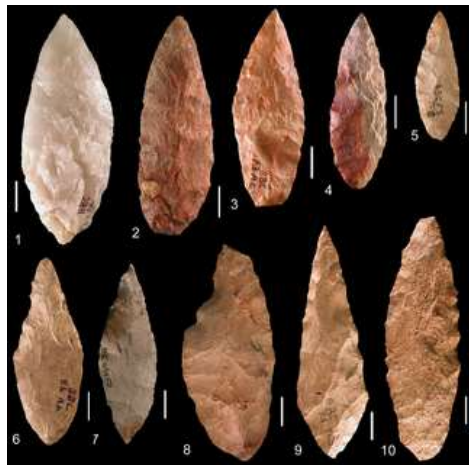
colors = different probabilities of niche presence

d'Errico, Banks, et al. *PNAS* 2017



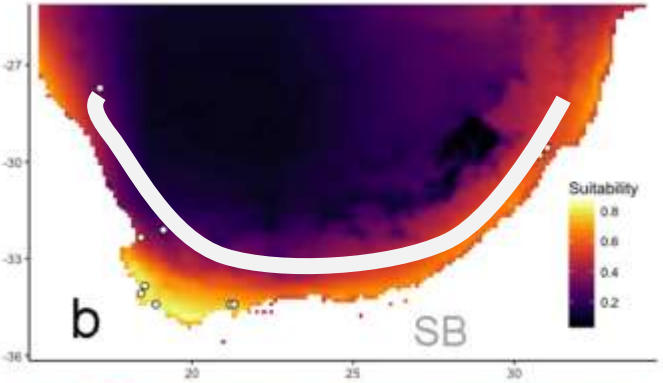
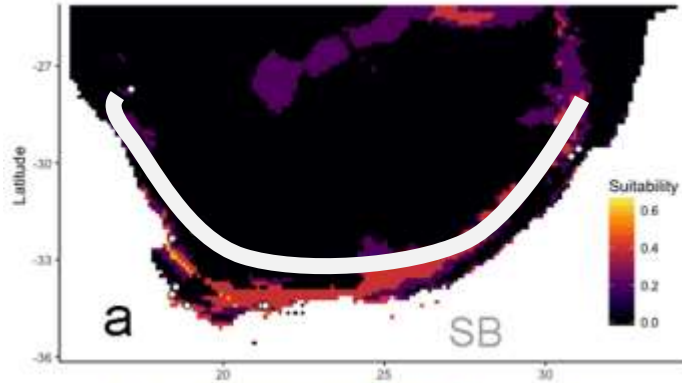
Still Bay (c. 73-70 ka)

Howiesons Poort (c. 66-58 ka)

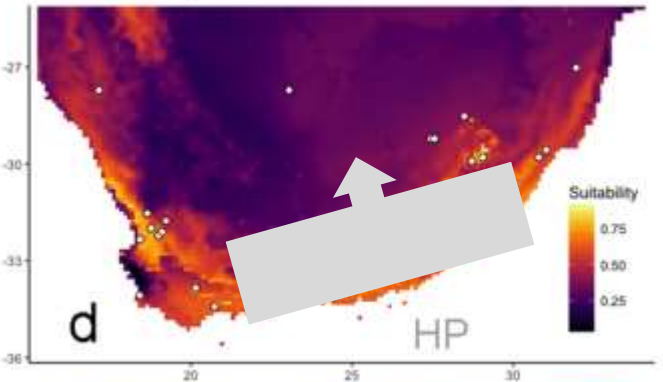
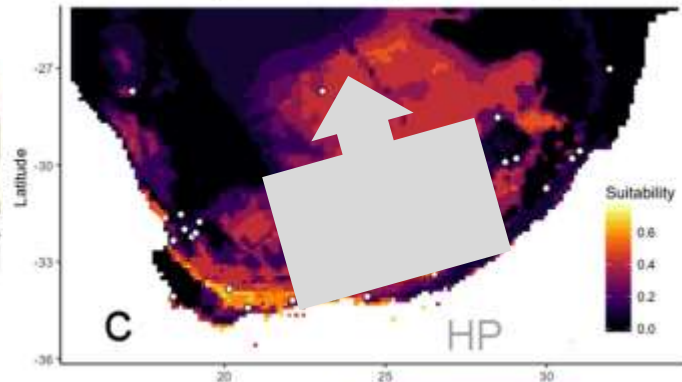


Bioclim

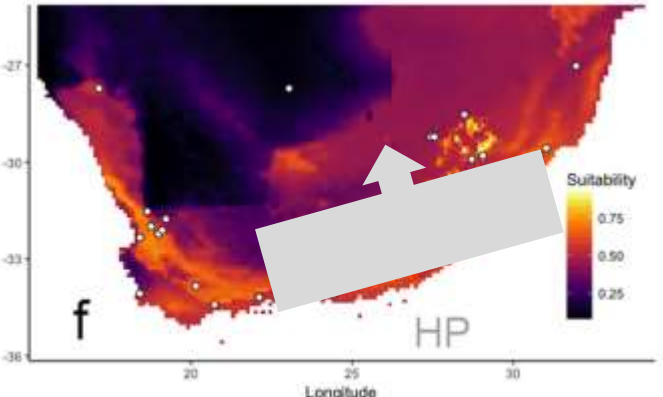
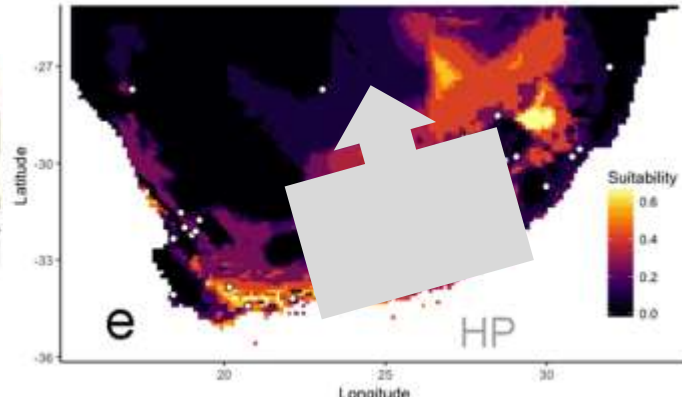
Maxent



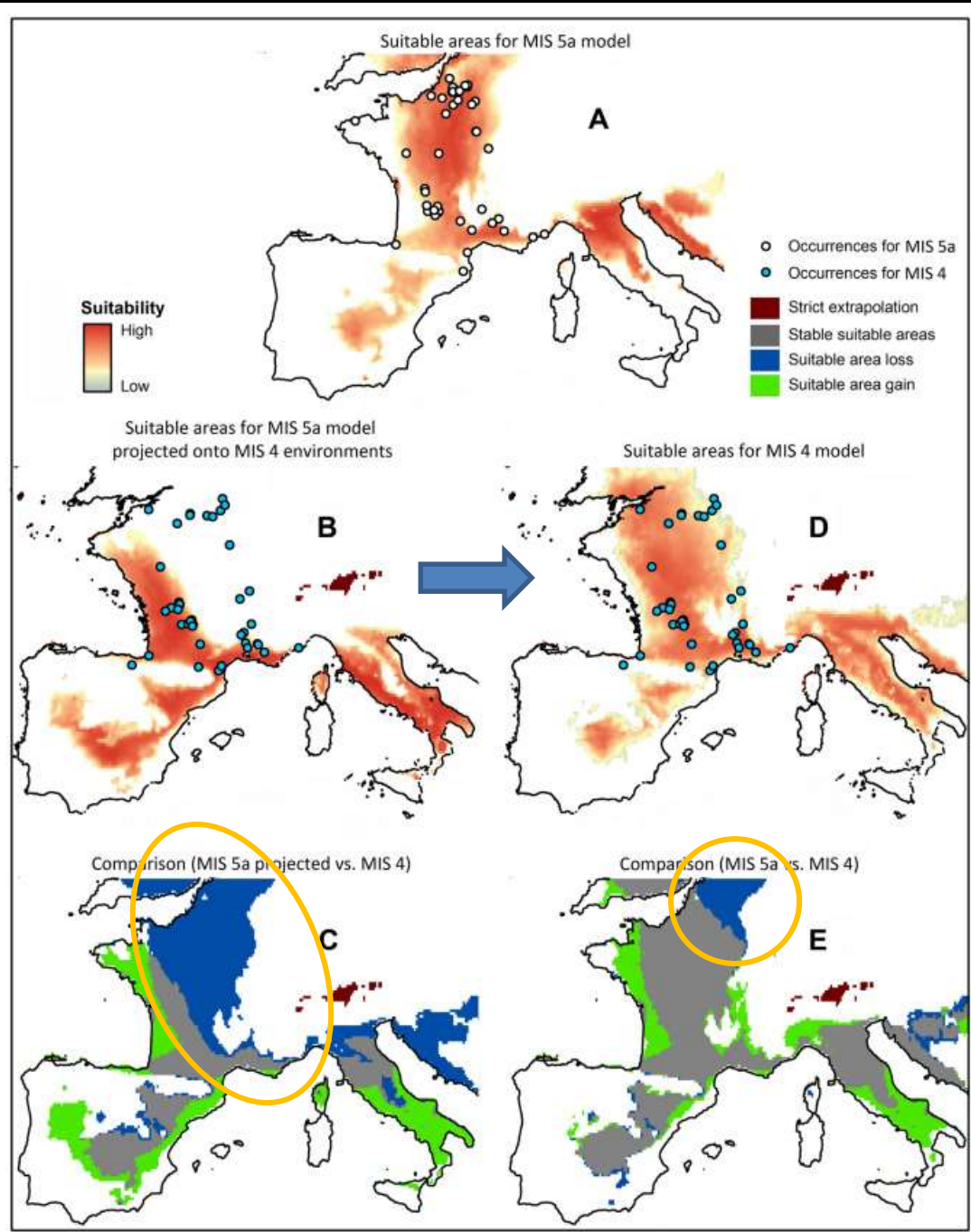
72 ka



66 ka



60 ka



Conclusione

- I comportamenti simbolici non sono il risultato di classici processi evolutivi darwiniani, cioè di una nuova cognizione associata a una nuova specie.
- Sono meglio spiegati come il risultato di un processo di costruzione di nicchia a lungo termine, influenzato da adattamenti culturali e conseguenti nuove modalità di trasmissione culturale che sfruttano la plasticità cerebrale tipica dei membri del nostro genere.

Conclusione

- I comportamenti simbolici non sono il risultato di classici processi evolutivi darwiniani, cioè di una nuova cognizione associata a una nuova specie.
- Sono meglio spiegati come il risultato di un processo di costruzione di nicchia a lungo termine, influenzato da adattamenti culturali e conseguenti nuove modalità di trasmissione culturale che sfruttano la plasticità cerebrale tipica dei membri del nostro genere.
- Pratiche simboliche più complesse sono state innescate da diversi fattori interconnessi e dinamici, sia ambientali che sociali
- Sono il risultato di dinamiche di popolazione e di traiettorie culturali complesse e non lineari, che devono essere comprese e tracciate su scala regionale.

Thank you!



Mr. fish