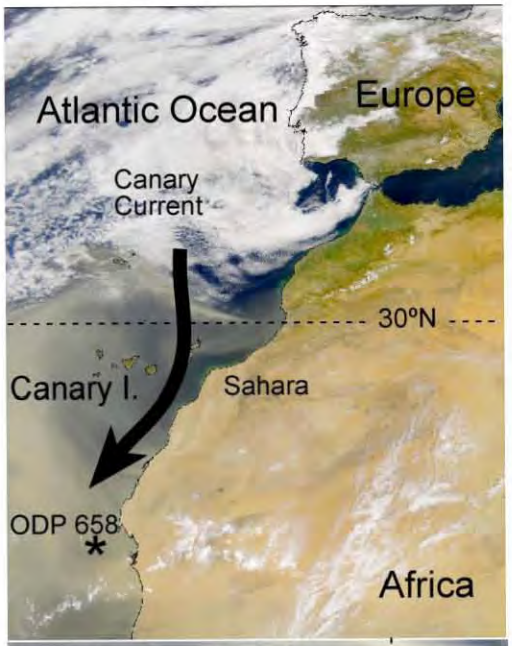
Paleoclimatología canaria

La cadena de oscilaciones del clima

I

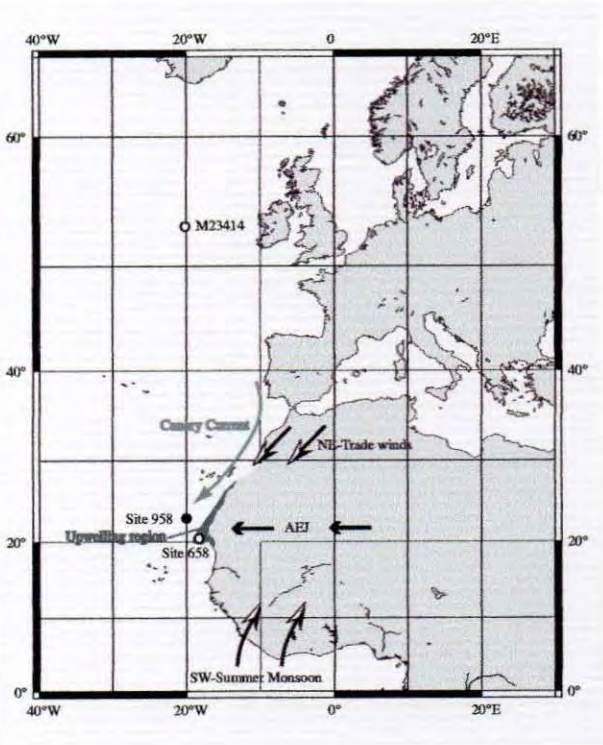
Testimonios eólicos

A


Atlantic Ocean
Europe
Canary
Current
30ºN
Canary I.
Sahara
ODP 658
Africa

B

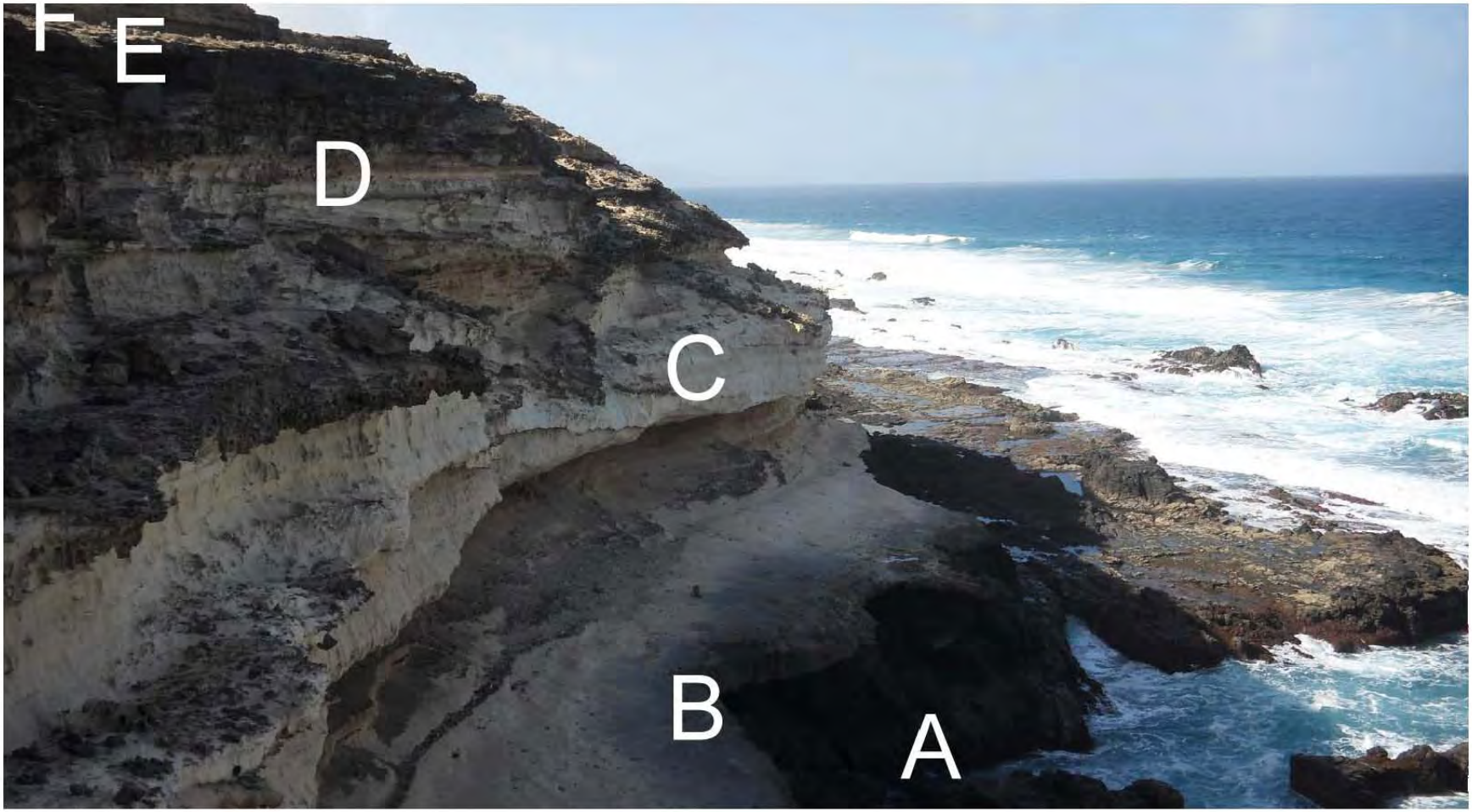
Eastern Canary I.
13ºW
Lanzarote
Penedo
Mala
Piedra Alta
Fuerteventura
Corralejo
Los Lajares
La Monja
La Cruz
El Matorral
Arucas
La Jaqueta
Istmo Jandía
Gran Canaria
Sahara

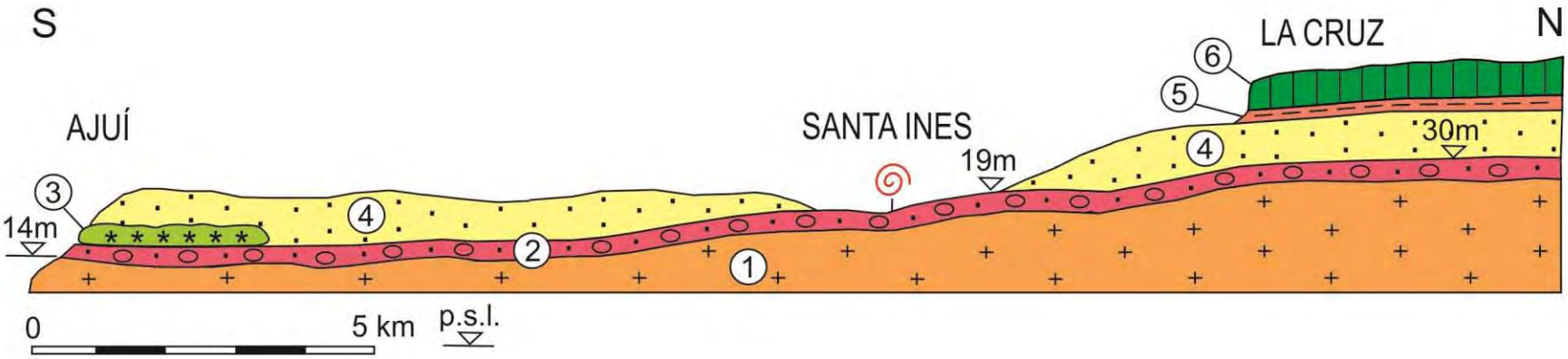

40°W
20°W
0
20°E
60°
40°
20°
0°
M23414
Canary Current
NE-Trade winds
Site 958
AEJ
Upwelling region
Site 658
SW-Summer Monsoon

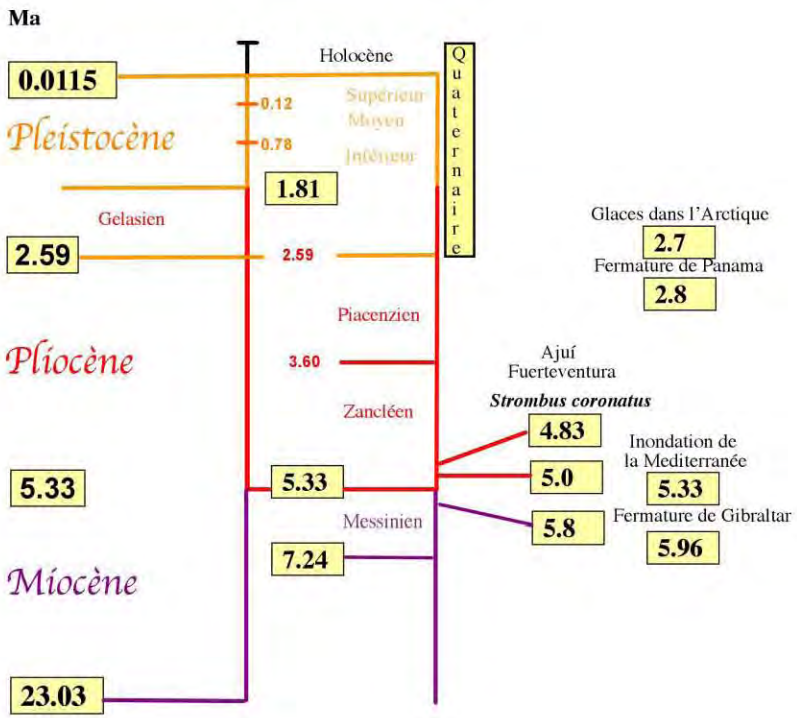
EL PLIOCENO

- Desde hace 5.333 Ma hasta hace 2.588 Ma

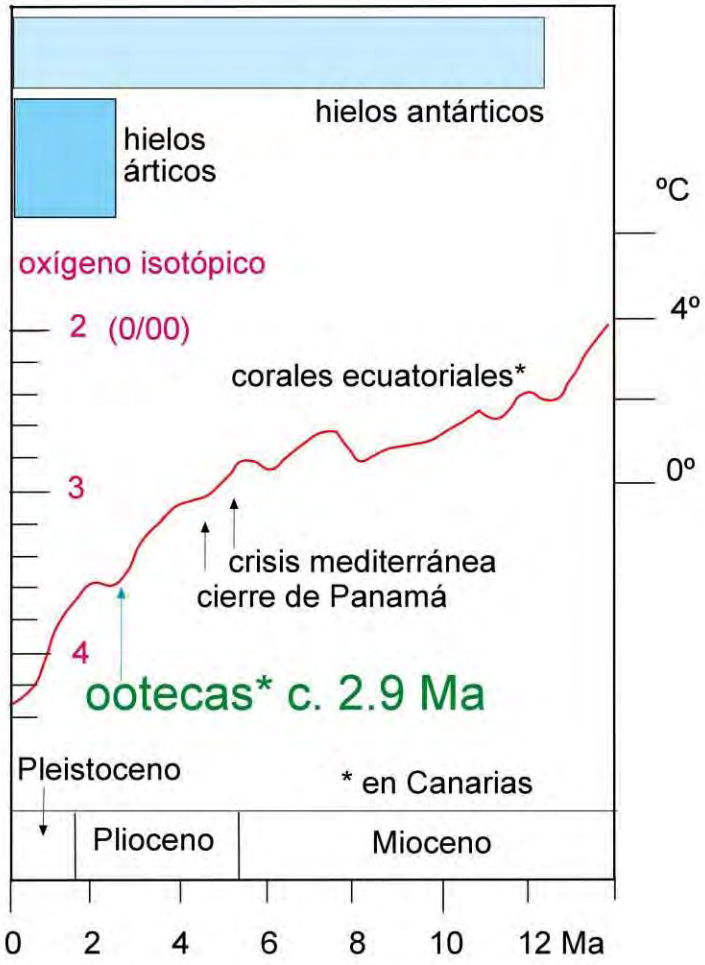
Adagio (lento y majestuoso)

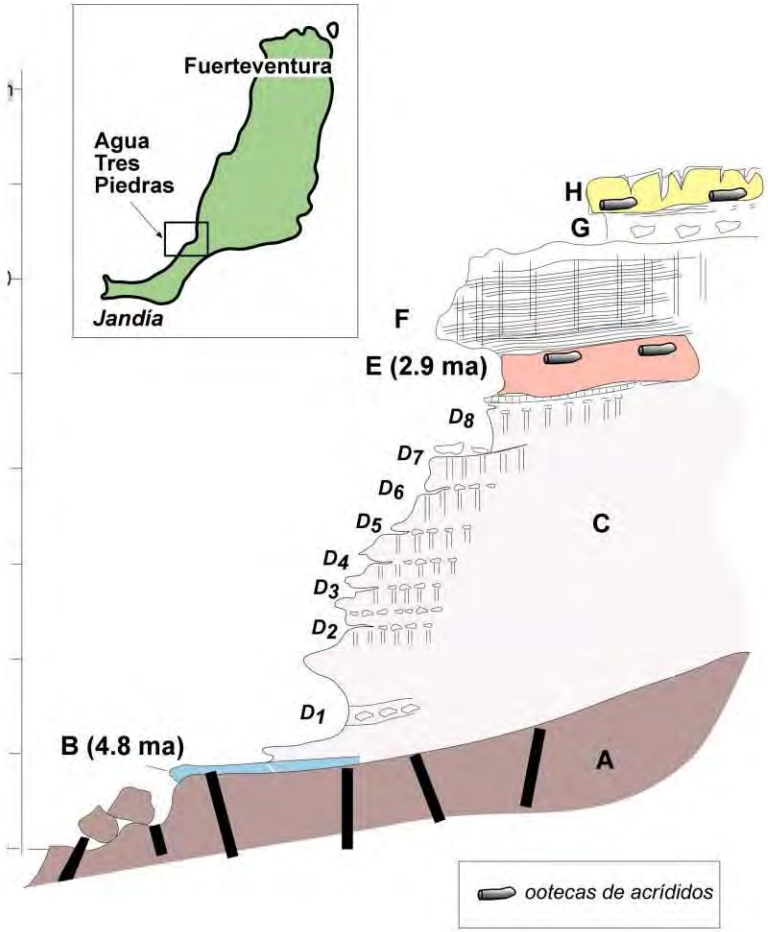

F
E
D
C
B
A


S
N
LA CRUZ
AJUÍ
SANTA INES
19m
30m
14m
0
5 km
p.s.l.
1
2
3
4
5
6



Gradstein et al. 2004

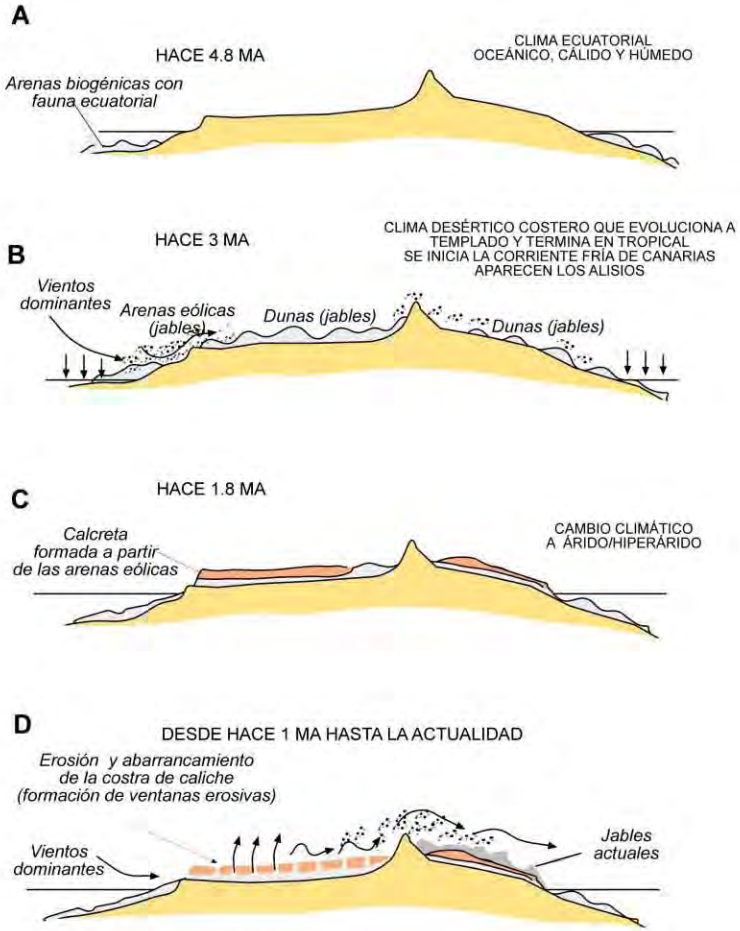

hielos antárticos
hielos árticos
ºC
oxígeno isotópico
2 (0/00)
4º
corales ecuatoriales*
0º
3
crisis mediterránea
cierre de Panamá
4
ootecas* c. 2.9 Ma
Pleistoceno
* en Canarias
Plioceno
Mioceno
0
2
4
6
8
10
12 Ma

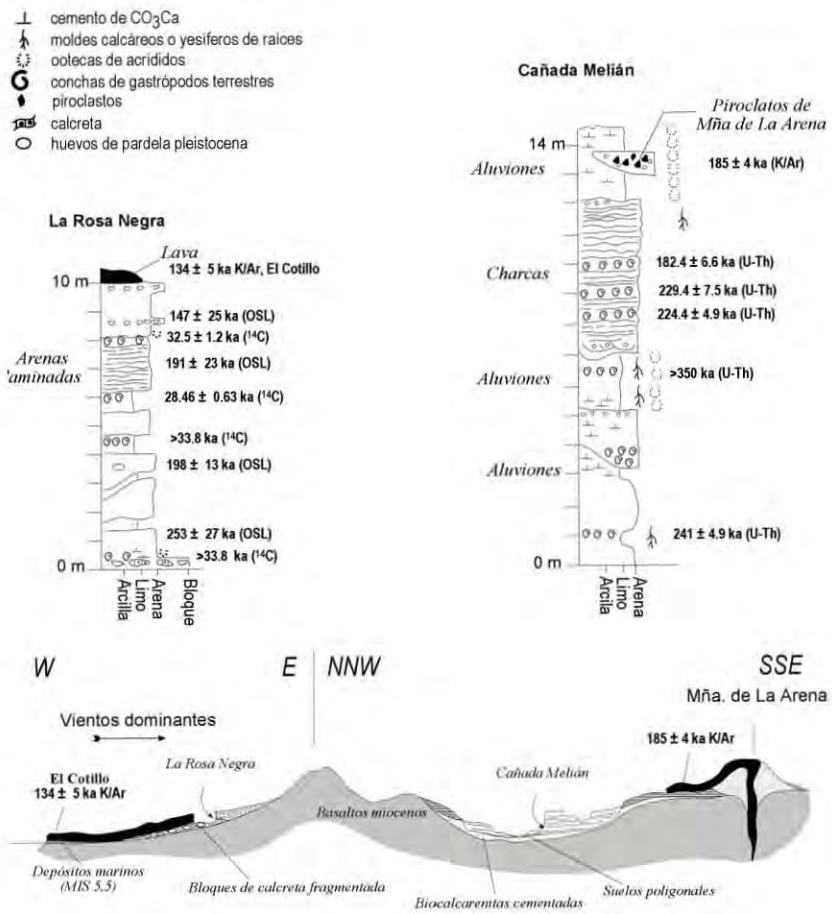

Fuerteventura
Agua
Tres
Piedras
Jandía
H
G
F
E (2.9 ma)
D8
D7
D6
D5
D4
D3
D2
D1
C
B (4.8 ma)
A
ootecas de acrídidos

EL PLEISTOCENO

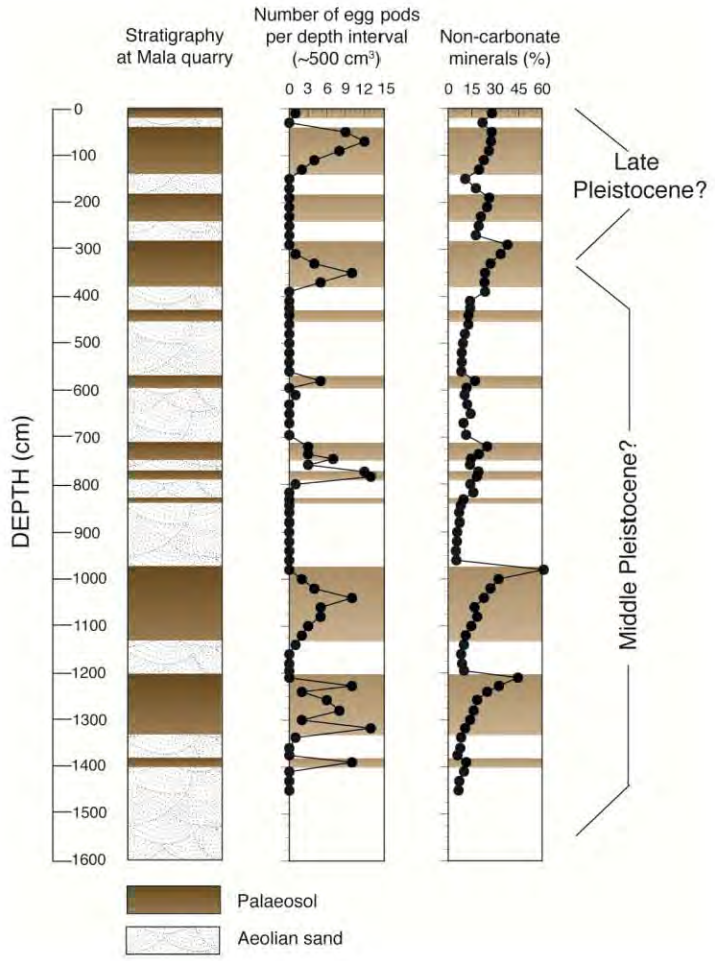
- Desde hace 2.588 Ma hasta hace 11.700 años

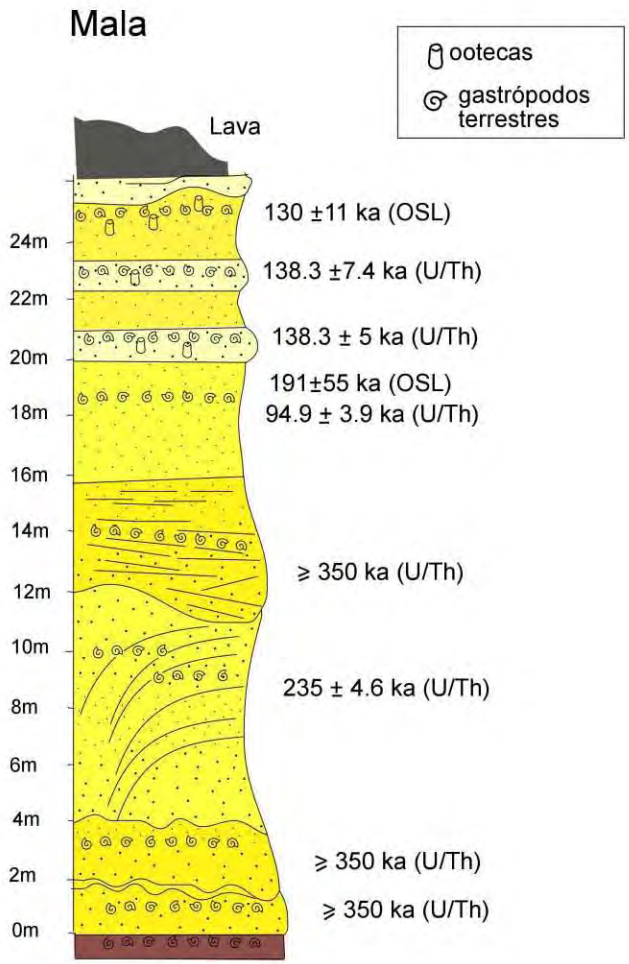
andante, allegro y vicace

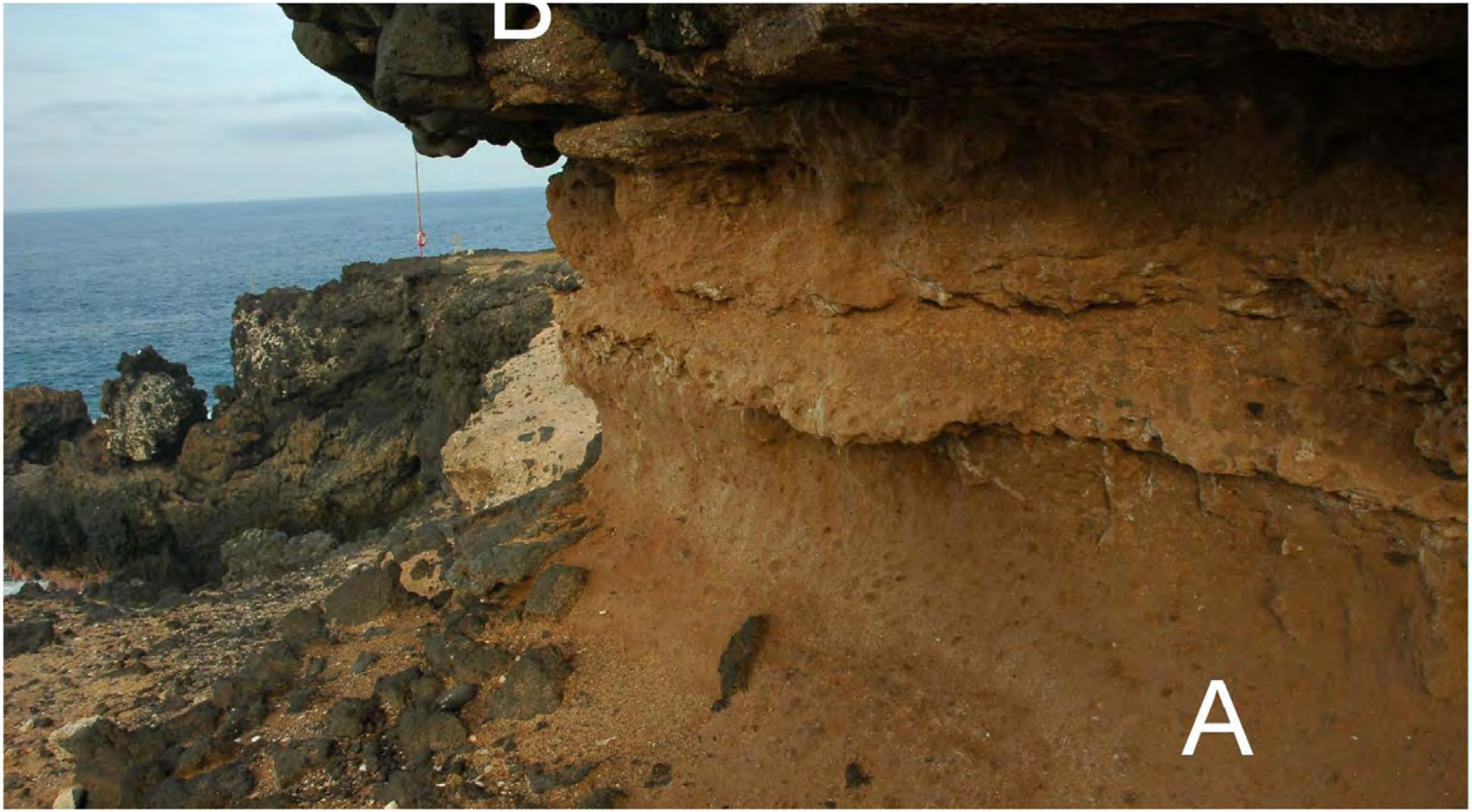

A
HACE 4.8 MA
CLIMA ECUATORIAL
OCEÁNICO, CÁLIDO Y HÚMEDO
Arenas biogénicas con
fauna ecuatorial
B
HACE 3 MA
CLIMA DESÉRTICO COSTERO QUE EVOLUCIONA A
TEMPLADO Y TERMINA EN TROPICAL
SE INICIA LA CORRIENTE FRÍA DE CANARIAS
APARECEN LOS ALISIOS
Vientos
dominantes
Arenas eólicas
(jables)
Dunas (jables)
Dunas (jables)
C
HACE 1.8 MA
Calcreta
formada a partir
de las arenas eólicas
CAMBIO CLIMÁTICO
A ÁRIDO/HIPERÁRIDO
D
DESDE HACE 1 MA HASTA LA ACTUALIDAD
Erosión y abarrancamiento
de la costra de caliche
(formación de ventanas erosivas)
Vientos
dominantes
Jables
actuales

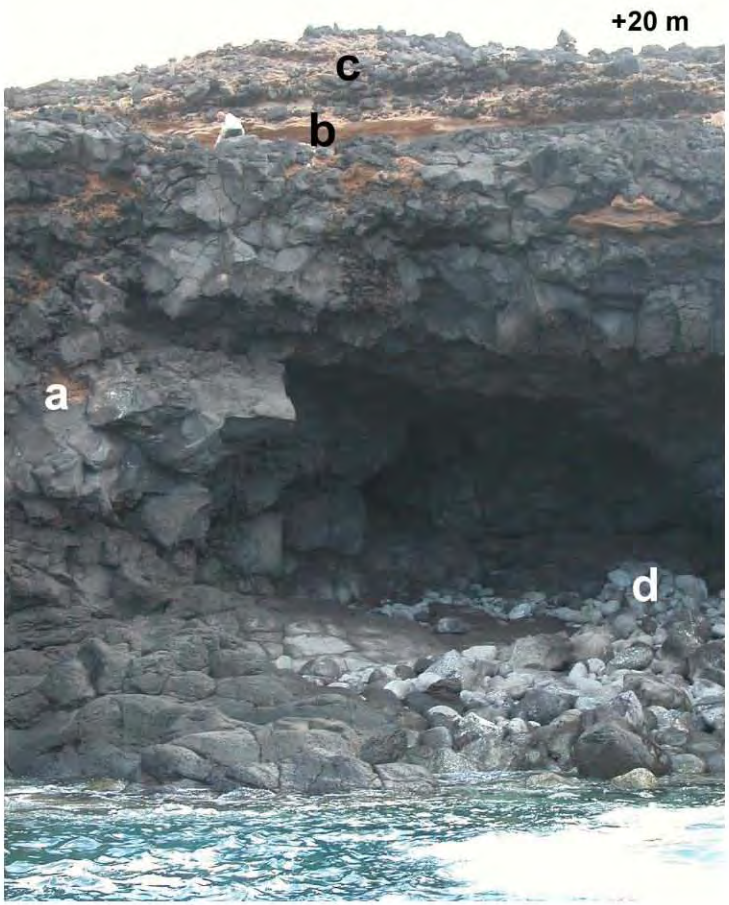

cemento de CO_3Ca
moldes calcáreos o yesíferos de raíces
ootecas de acrídidos
conchas de gastrópodos terrestres
piroclastos
calcreta
huevos de pardela pleistocena
La Rosa Negra
Lava
134 ± 5 ka K/Ar, El Cotillo
10 m
147 ± 25 ka (OSL)
32.5 ± 1.2 ka (^{14}C)
Arenas laminadas
191 ± 23 ka (OSL)
28.46 ± 0.63 ka (^{14}C)
>33.8 ka (^{14}C)
198 ± 13 ka (OSL)
253 ± 27 ka (OSL)
>33.8 ka (^{14}C)
0 m
Arcilla
Limo
Arena
Bloque
Cañada Melián
Piroclatos de Mña de La Arena
14 m
Aluviones
185 ± 4 ka (K/Ar)
Charcas
182.4 ± 6.6 ka (U-Th)
229.4 ± 7.5 ka (U-Th)
224.4 ± 4.9 ka (U-Th)
Aluviones
>350 ka (U-Th)
Aluviones
241 ± 4.9 ka (U-Th)
0 m
Arcila
Limo
Arena
W
E
NNW
SSE
Mña. de La Arena
Vientos dominantes
185 ± 4 ka K/Ar
La Rosa Negra
Cañada Melián
El Cotillo
134 ± 5 ka K/Ar
Basaltos miocenos
Depósitos marinos (MIS 5,5)
Bloques de calcreta fragmentada
Biocalcarenitas cementadas
Suelos poligonales

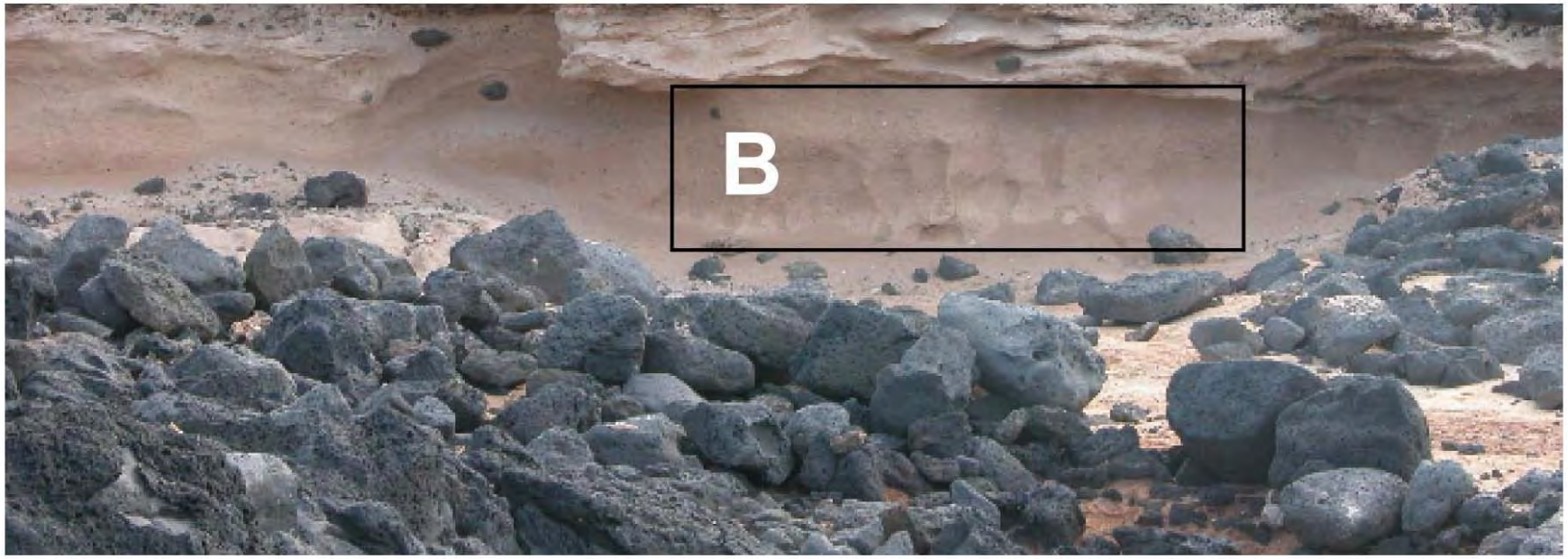
CAT


Stratigraphy at Mala quarry
Number of egg pods per depth interval (~500 cm³)
0 3 6 9 12 15
Non-carbonate minerals (%)
0 15 30 45 60
DEPTH (cm)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
Late Pleistocene?
Middle Pleistocene?
Palaeosol
Aeolian sand


Mala
ootecas
gastrópodos terrestres
Lava
130 ±11 ka (OSL)
138.3 ±7.4 ka (U/Th)
138.3 ± 5 ka (U/Th)
191±55 ka (OSL)
94.9 ± 3.9 ka (U/Th)
≥ 350 ka (U/Th)
235 ± 4.6 ka (U/Th)
≥ 350 ka (U/Th)
≥ 350 ka (U/Th)
24m
22m
20m
18m
16m
14m
12m
10m
8m
6m
4m
2m
0m


A


+20 m
c
b
a
d

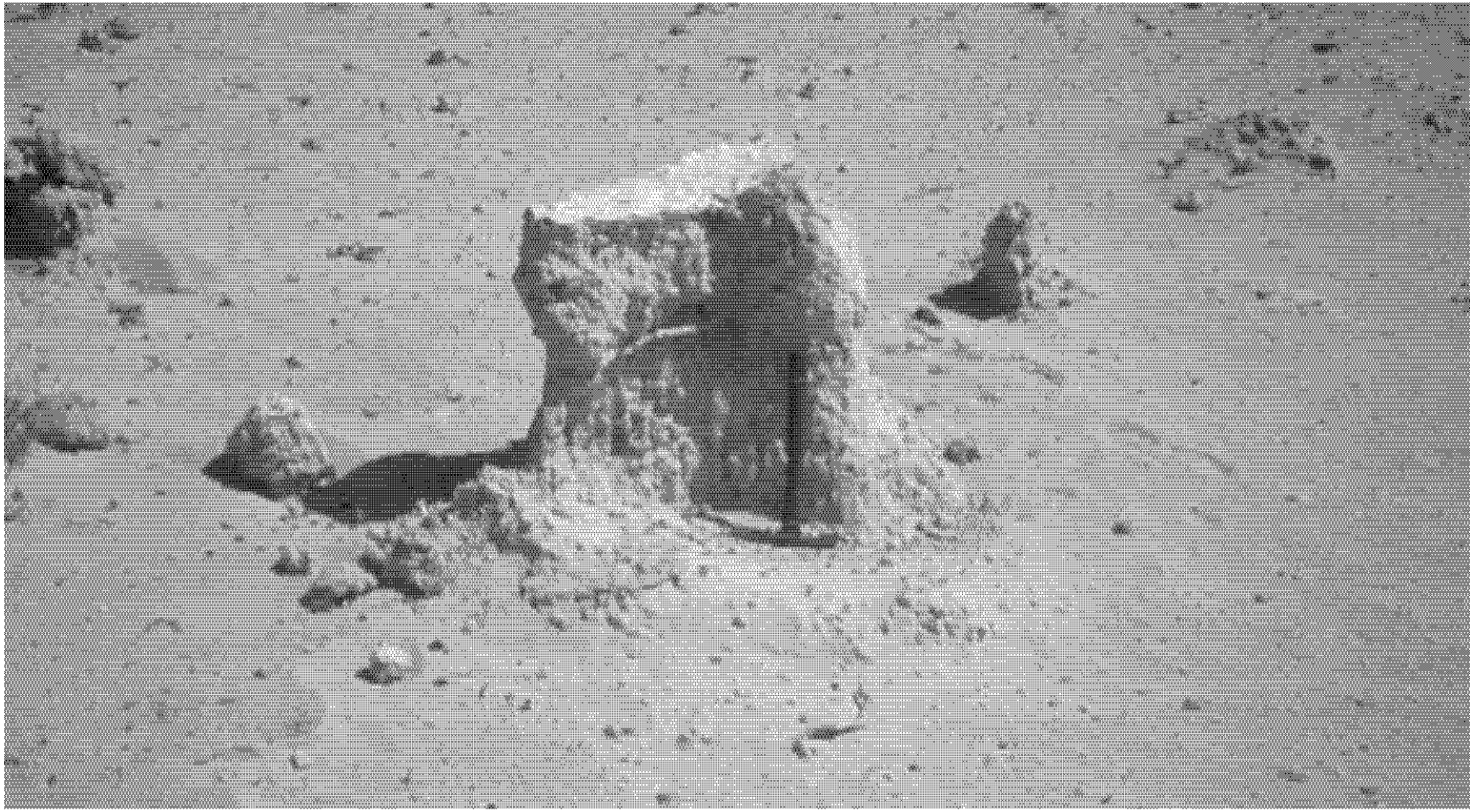

B

A: Modern, Uzbekistan

C: Fossil detail, Fuerteventura (Istmo Jandía locality)

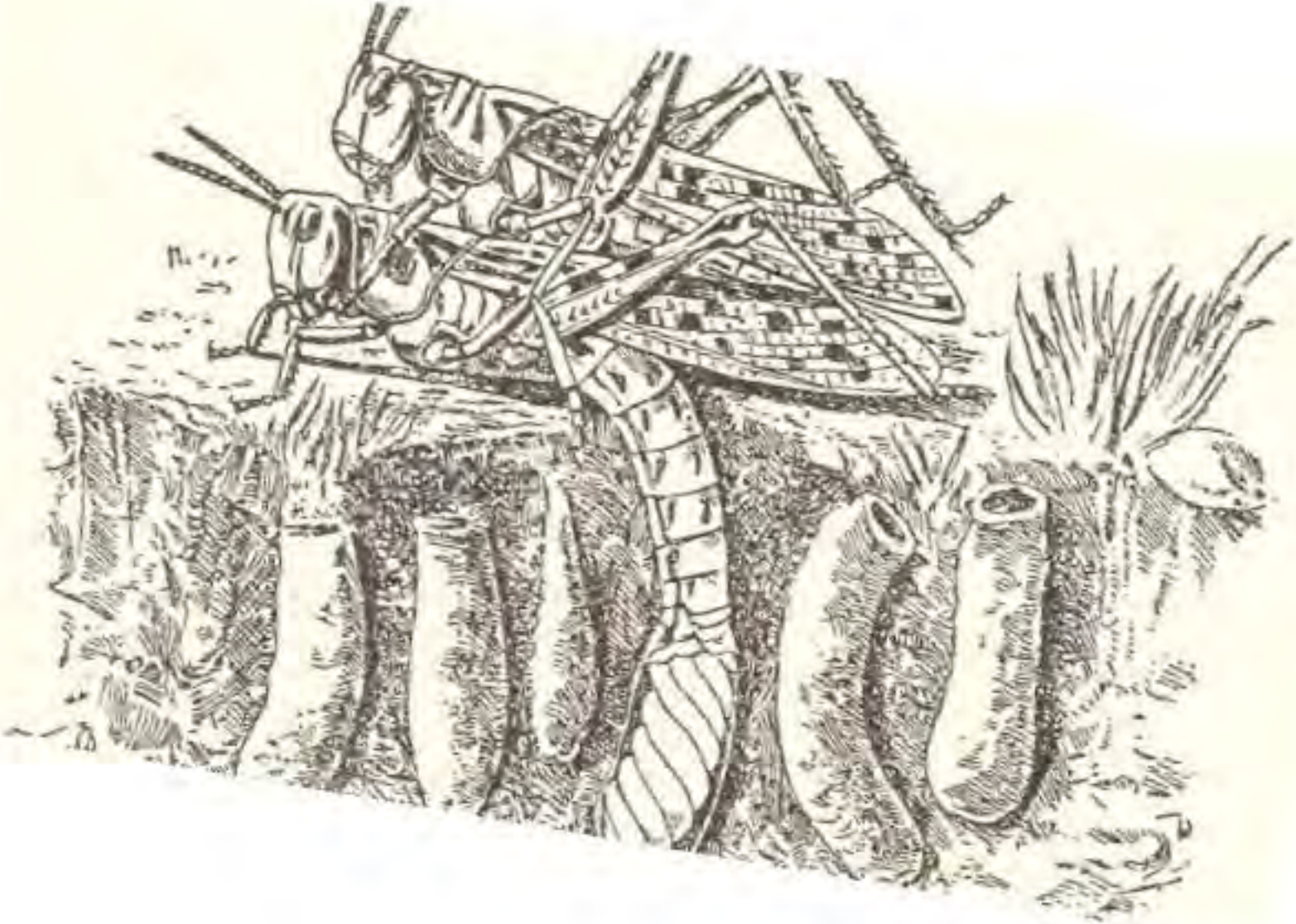
B: Fossil, Lanzarote (Mala)

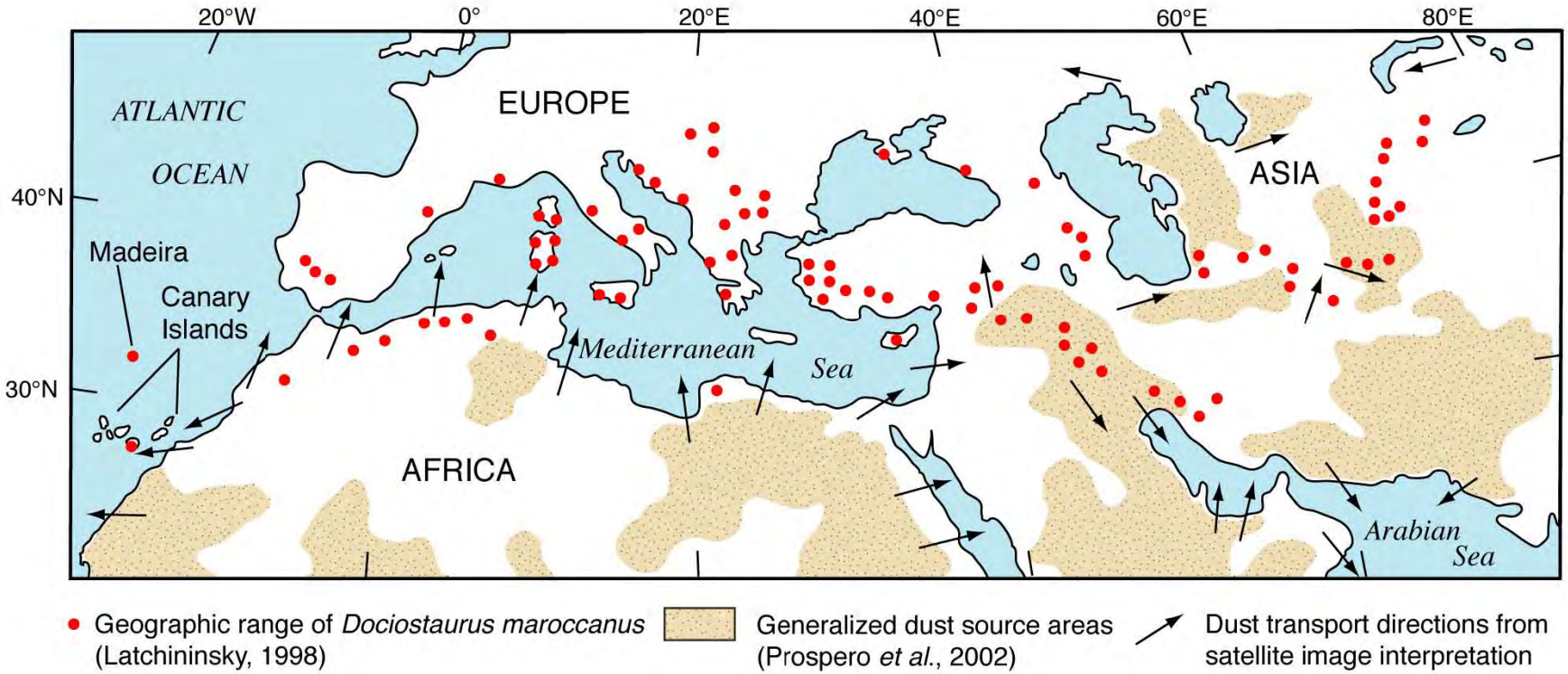
D: Fossil, Fuerteventura (Istmo Jandía locality)

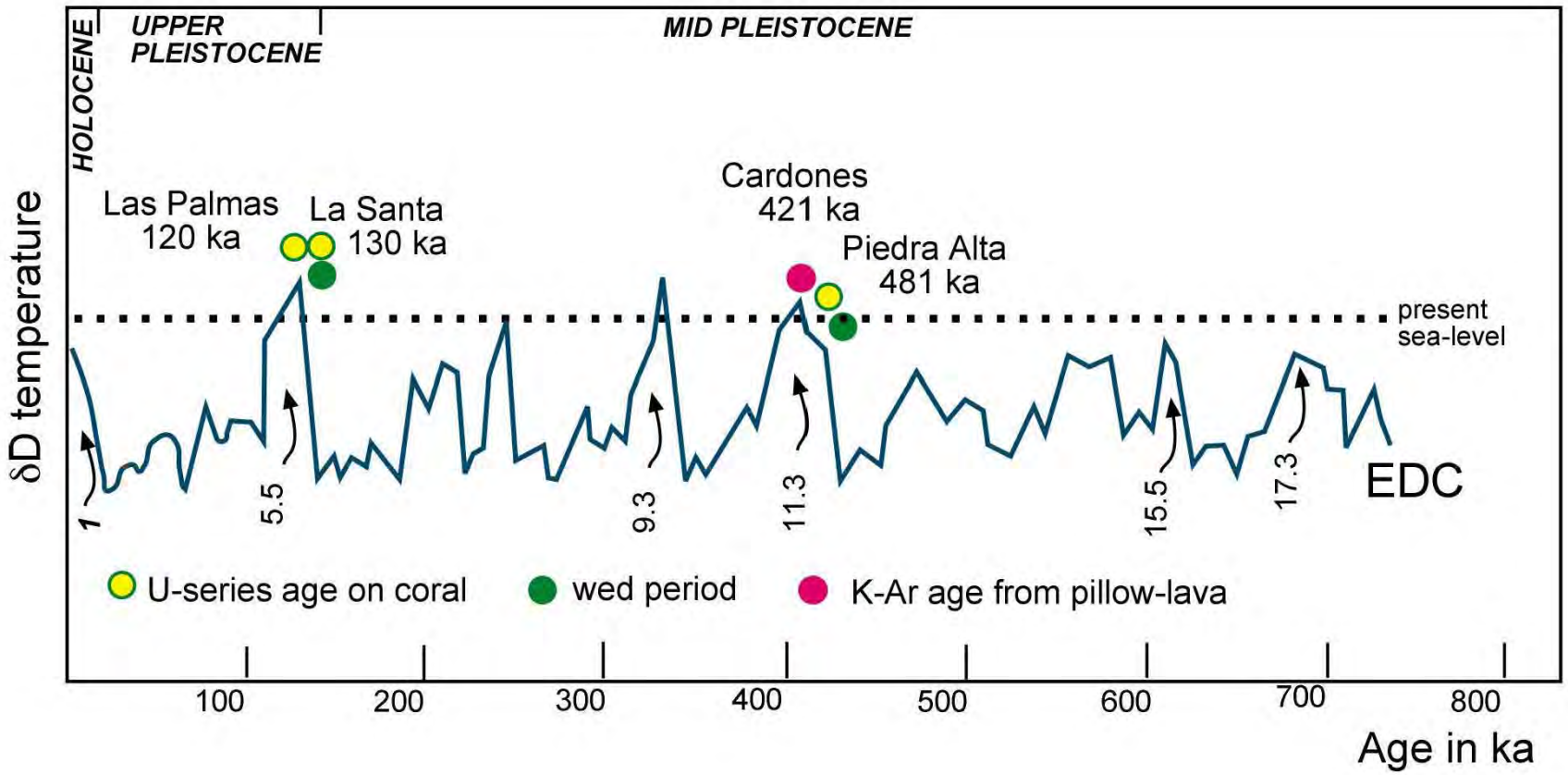


lichtbeständig • dokumentenecht
rproof • lightfast • document proof
nt à l'eau et à lumière • infalsifiable
resistente al agua y a la luz

2
3
3m
4
5
6
7
8
9




20°W
0°
20°E
40°E
60°E
80°E
40°N
30°N
ATLANTIC
OCEAN
EUROPE
ASIA
Madeira
Canary
Islands
Mediterranean
Sea
AFRICA
Arabian
Sea
Geographic range of *Dociostaurus maroccanus* (Latchininsky, 1998)
Generalized dust source areas (Prospero *et al.*, 2002)
Dust transport directions from satellite image interpretation


HOLOCENE
UPPER PLEISTOCENE
MID PLEISTOCENE
Las Palmas 120 ka
La Santa 130 ka
Cardones 421 ka
Piedra Alta 481 ka
present sea-level
δD temperature
1
5.5
9.3
11.3
15.5
17.3
EDC
U-series age on coral
wed period
K-Ar age from pillow-lava
100
200
300
400
500
600
700
800
Age in ka

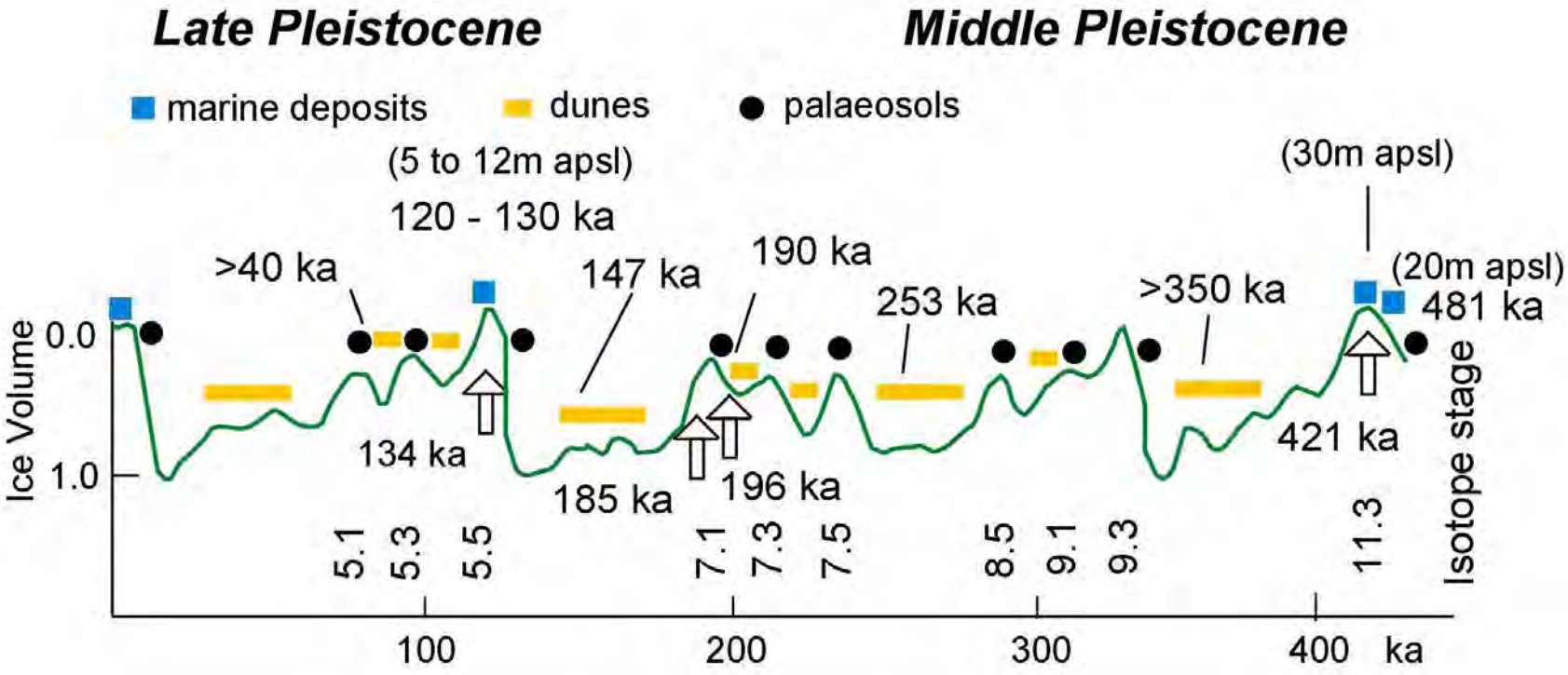
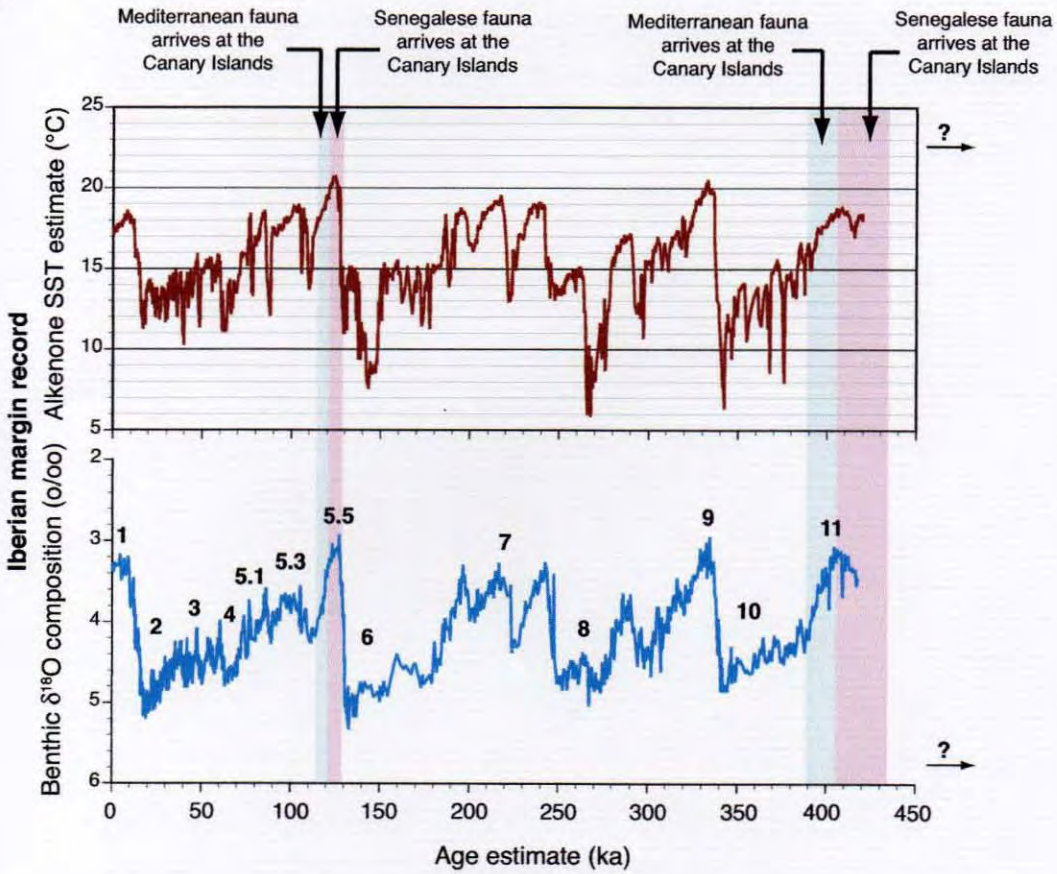
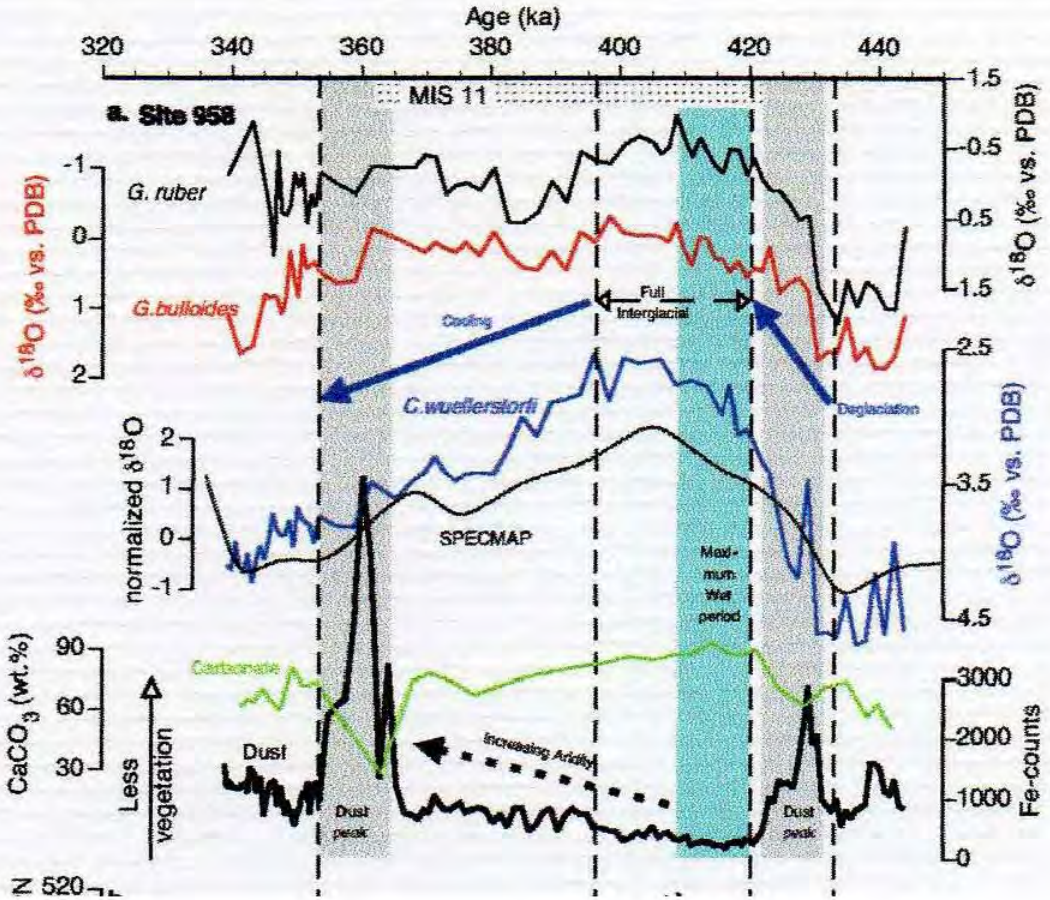
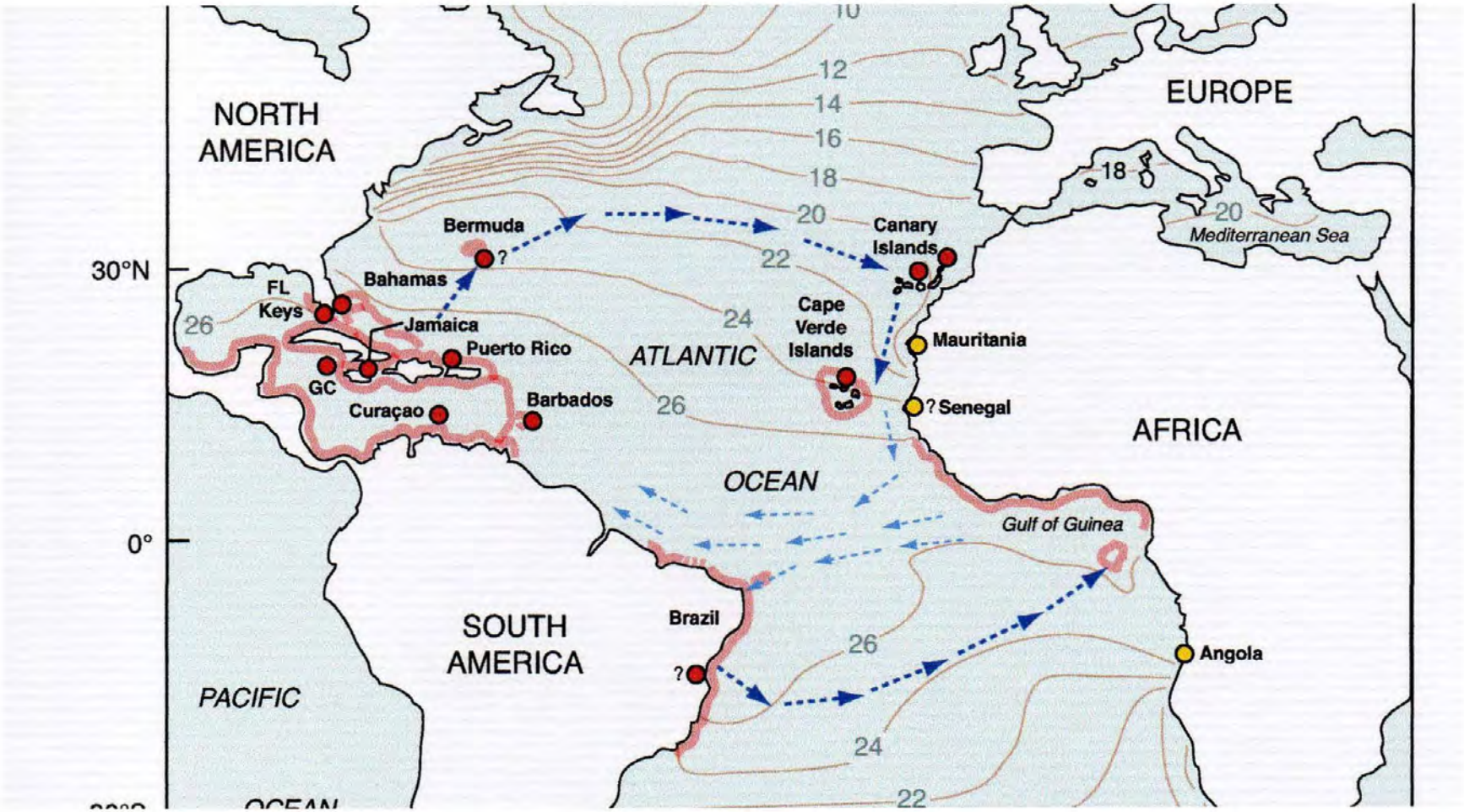
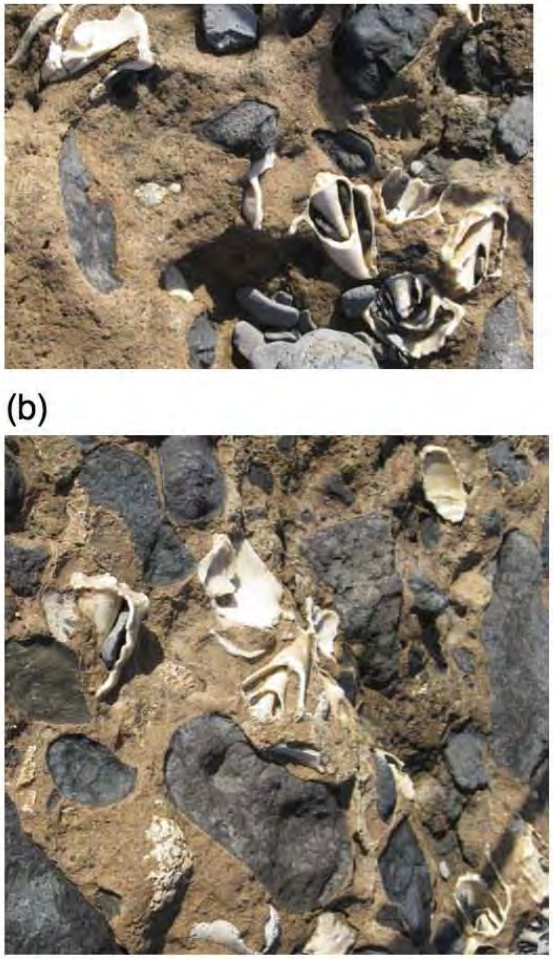

Late Pleistocene
Middle Pleistocene
marine deposits
dunes
palaeosols
(5 to 12m apsl)
120 - 130 ka
>40 ka
147 ka
190 ka
253 ka
>350 ka
(30m apsl)
(20m apsl)
481 ka
134 ka
185 ka
196 ka
421 ka
Ice Volume
0.0
1.0
5.1
5.3
5.5
7.1
7.3
7.5
8.5
9.1
9.3
11.3
Isotope stage
100
200
300
400
ka

Figure 16


Mediterranean fauna arrives at the Canary Islands
Senegalese fauna arrives at the Canary Islands
Mediterranean fauna arrives at the Canary Islands
Senegalese fauna arrives at the Canary Islands
Iberian margin record
Alkenone SST estimate (°C)
Benthic δ18O composition (o/oo)
Age estimate (ka)
?
?
1
2
3
4
5.1
5.3
5.5
6
7
8
9
10
11


Age (ka)
320
340
360
380
400
420
440
MIS 11
a. Site 958
G. ruber
G.bulloides
C.wuellerstorfi
δ18O (‰ vs. PDB)
Cooling
Full Interglacial
Deglaciation
normalized δ18O
SPECMAP
Maximum Wet period
CaCO3 (wt.%)
Carbonate
Dust
Less vegetation
Increasing Aridity
Dust peak
Fe-counts


NORTH AMERICA
EUROPE
AFRICA
SOUTH AMERICA
ATLANTIC
OCEAN
PACIFIC
Mediterranean Sea
Gulf of Guinea
30°N
0°
Bermuda
Bahamas
FL Keys
Jamaica
Puerto Rico
GC
Curaçao
Barbados
Canary Islands
Cape Verde Islands
Mauritania
Senegal
Brazil
Angola
10
12
14
16
18
20
22
24
26

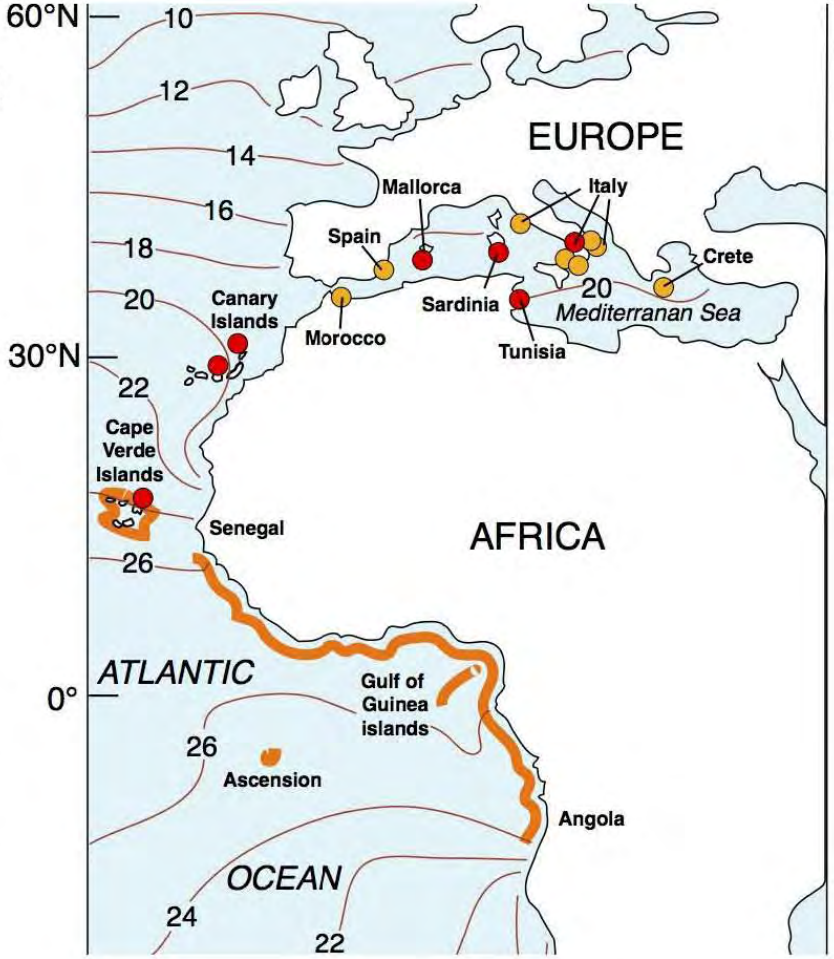


EXPLANATION

Modern *Strombus bubonius*

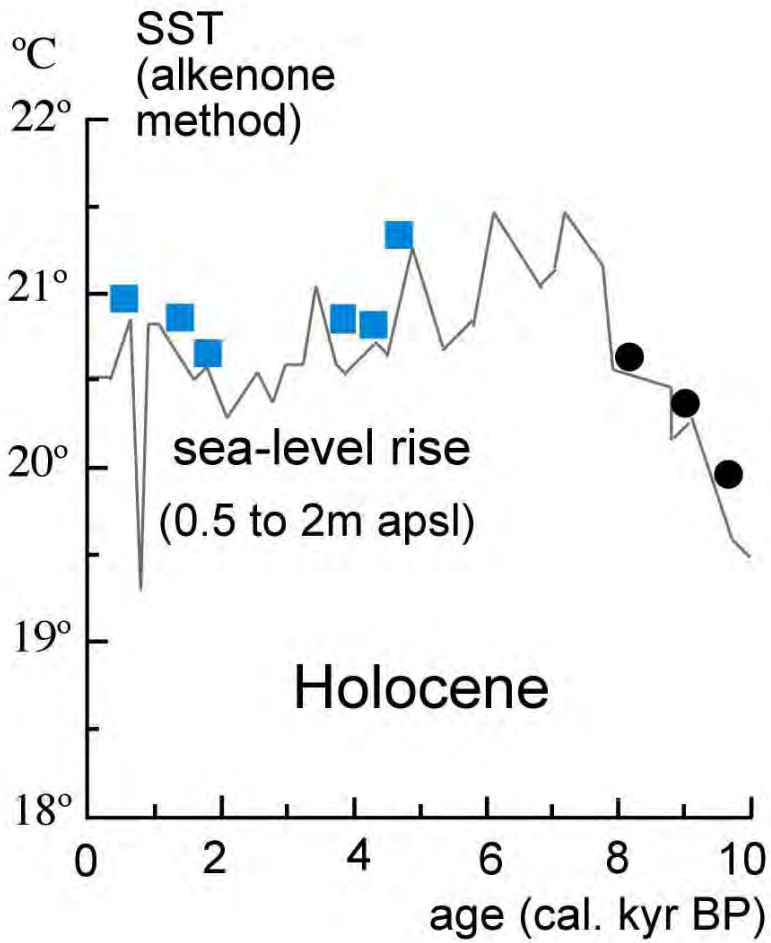
Fossil *Strombus bubonius* with ~120 ka U-series age on coral

Fossil *Strombus bubonius* correlated with ~120 ka U-series age on coral by amino acids

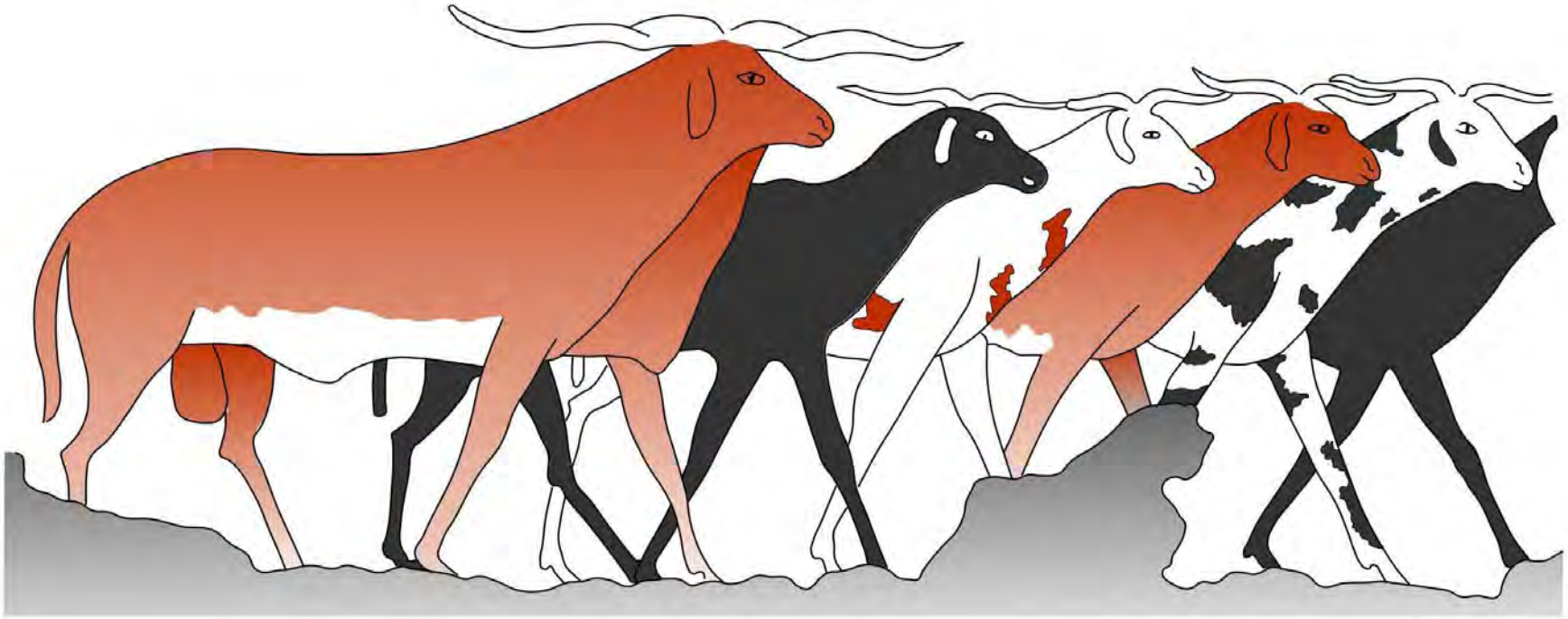


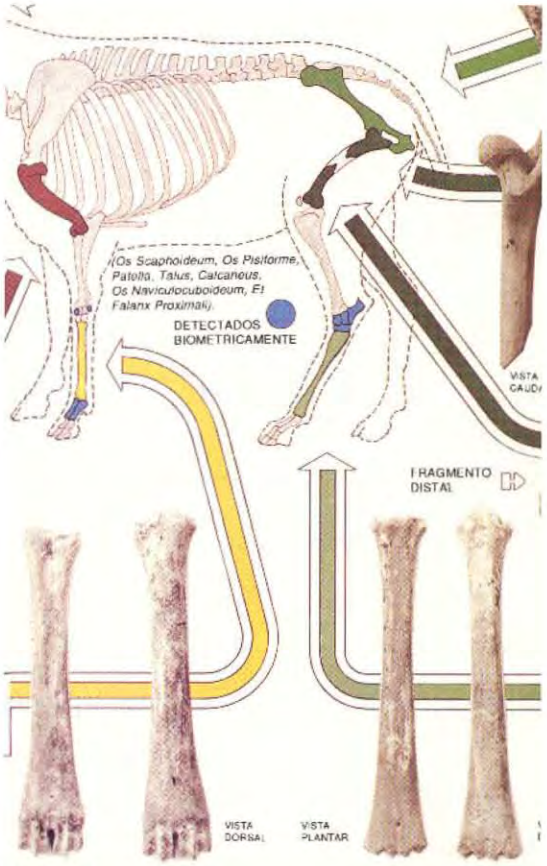
EL HOLOCENO

- Desde hace 11.700 años hasta la actualidad


°C
SST
(alkenone
method)
22°
21°
20°
19°
18°
sea-level rise
(0.5 to 2m apsl)
Holocene
0
2
4
6
8
10
age (cal. kyr BP)

t

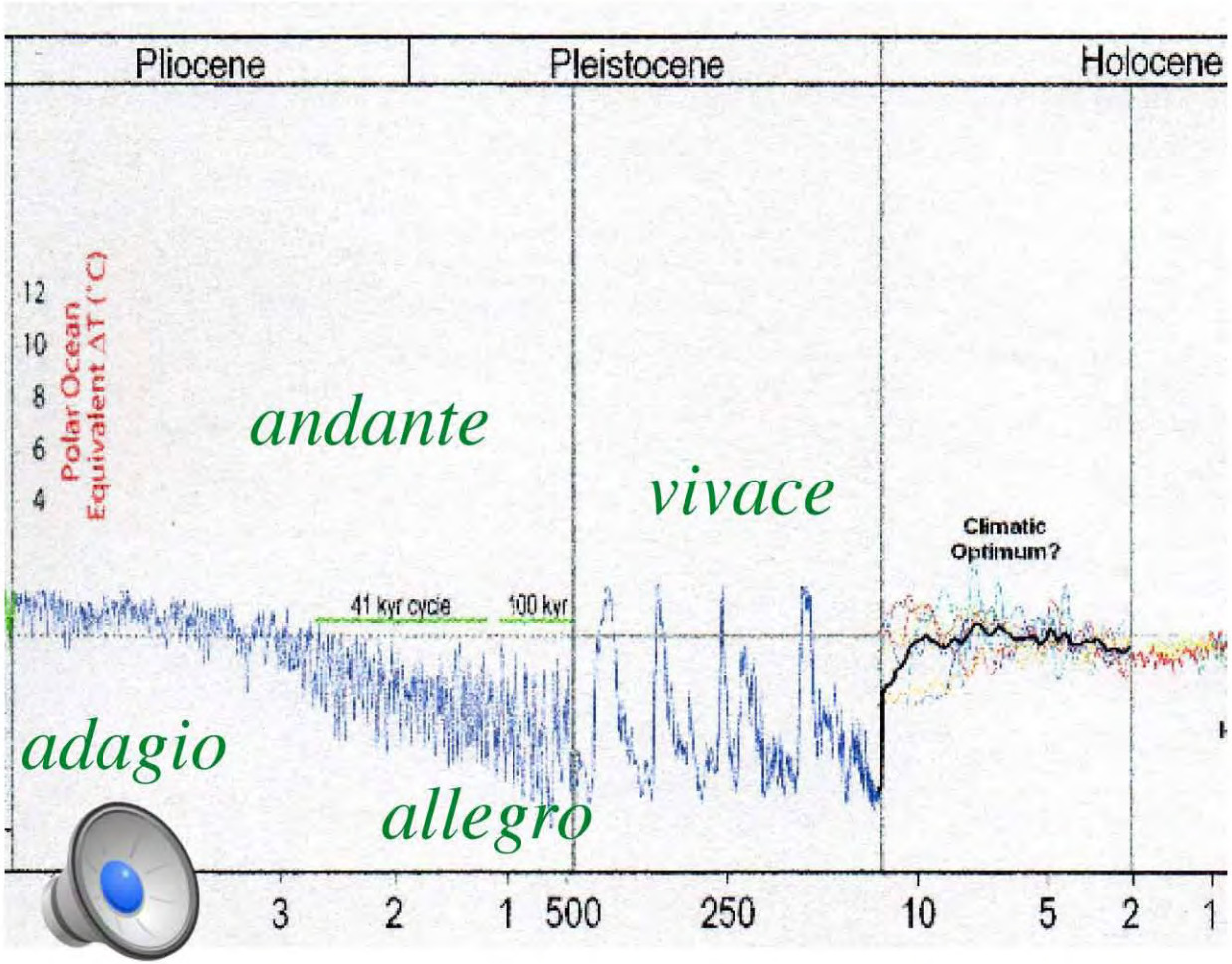


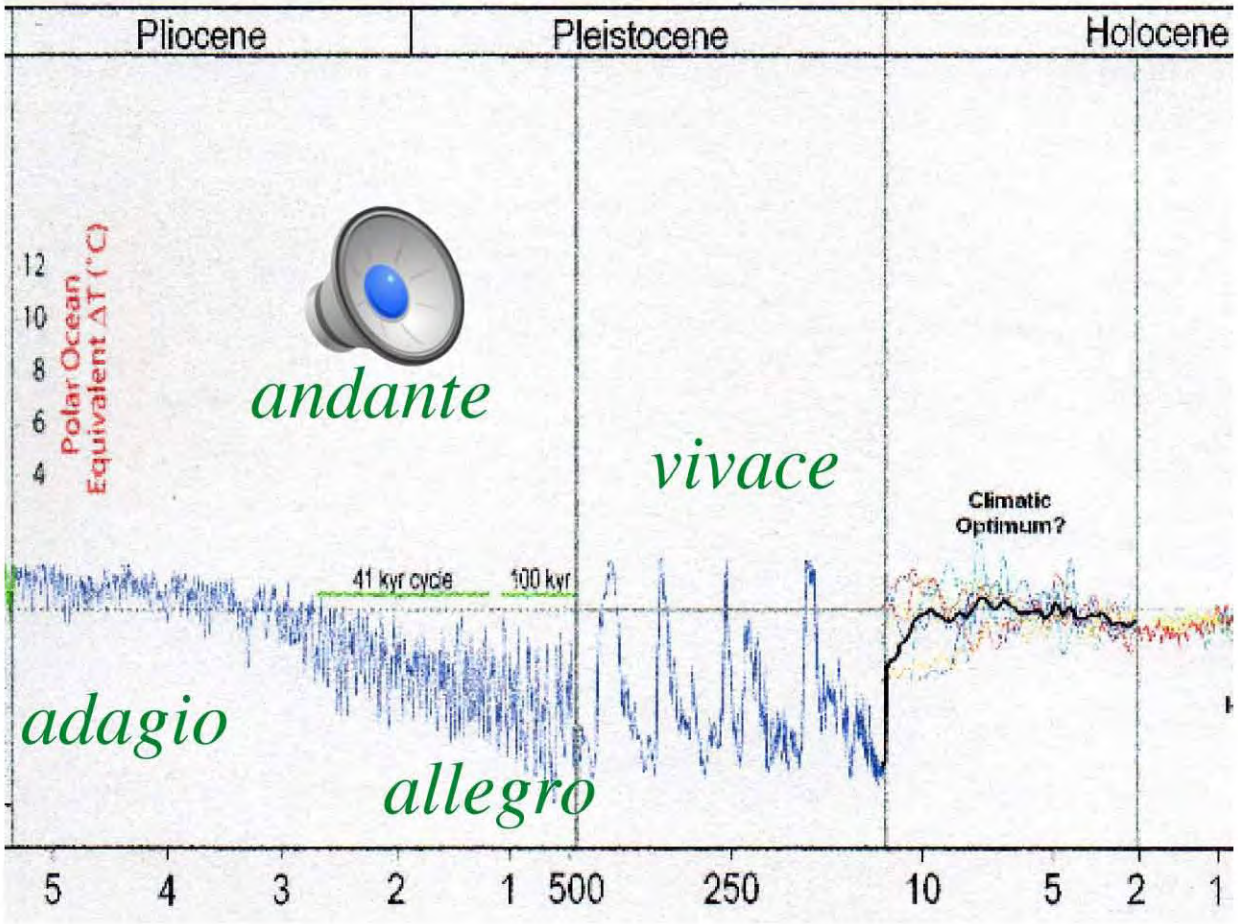


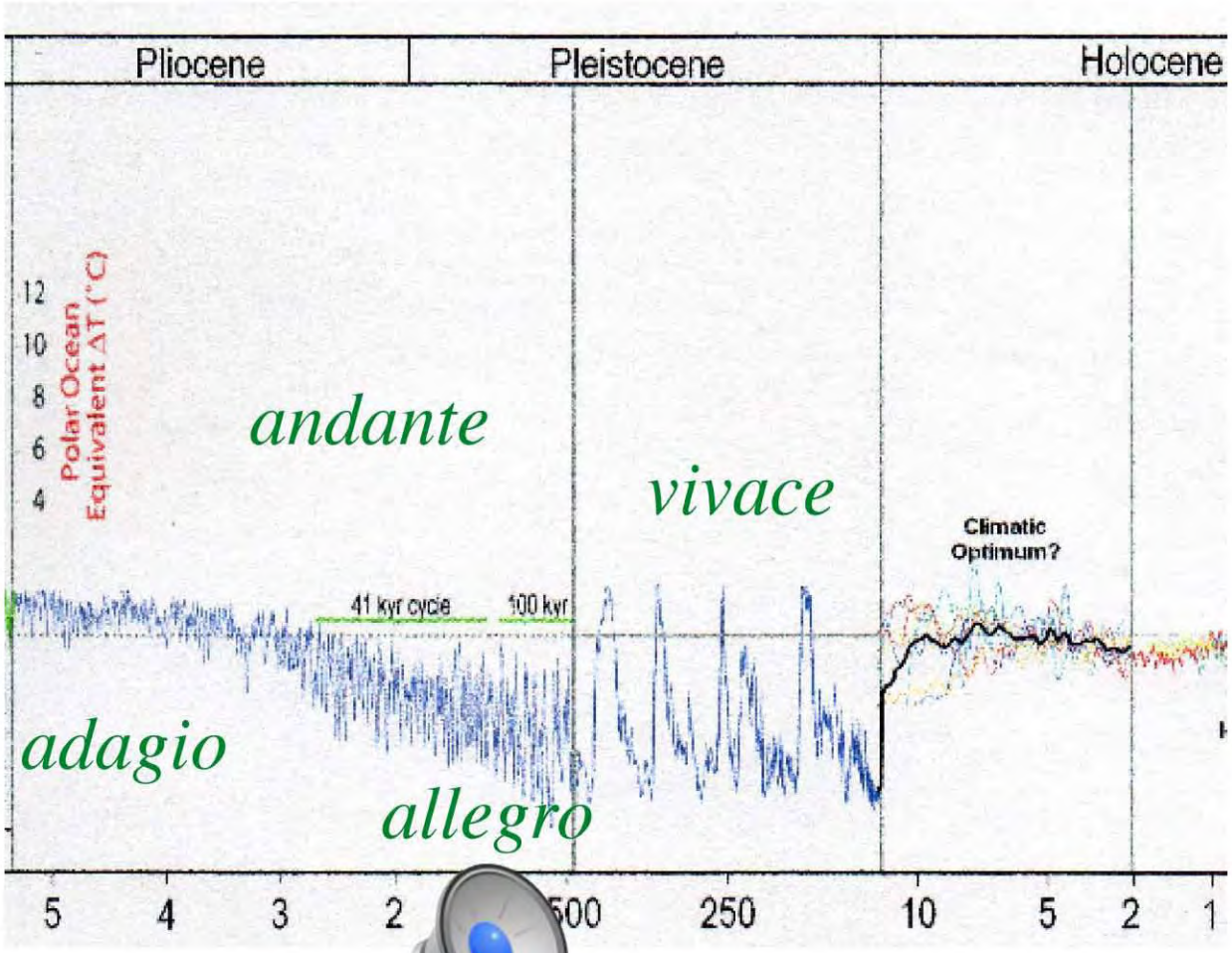
150 a 168 mm (adultos)
122 a 152 mm (sin episis distal)

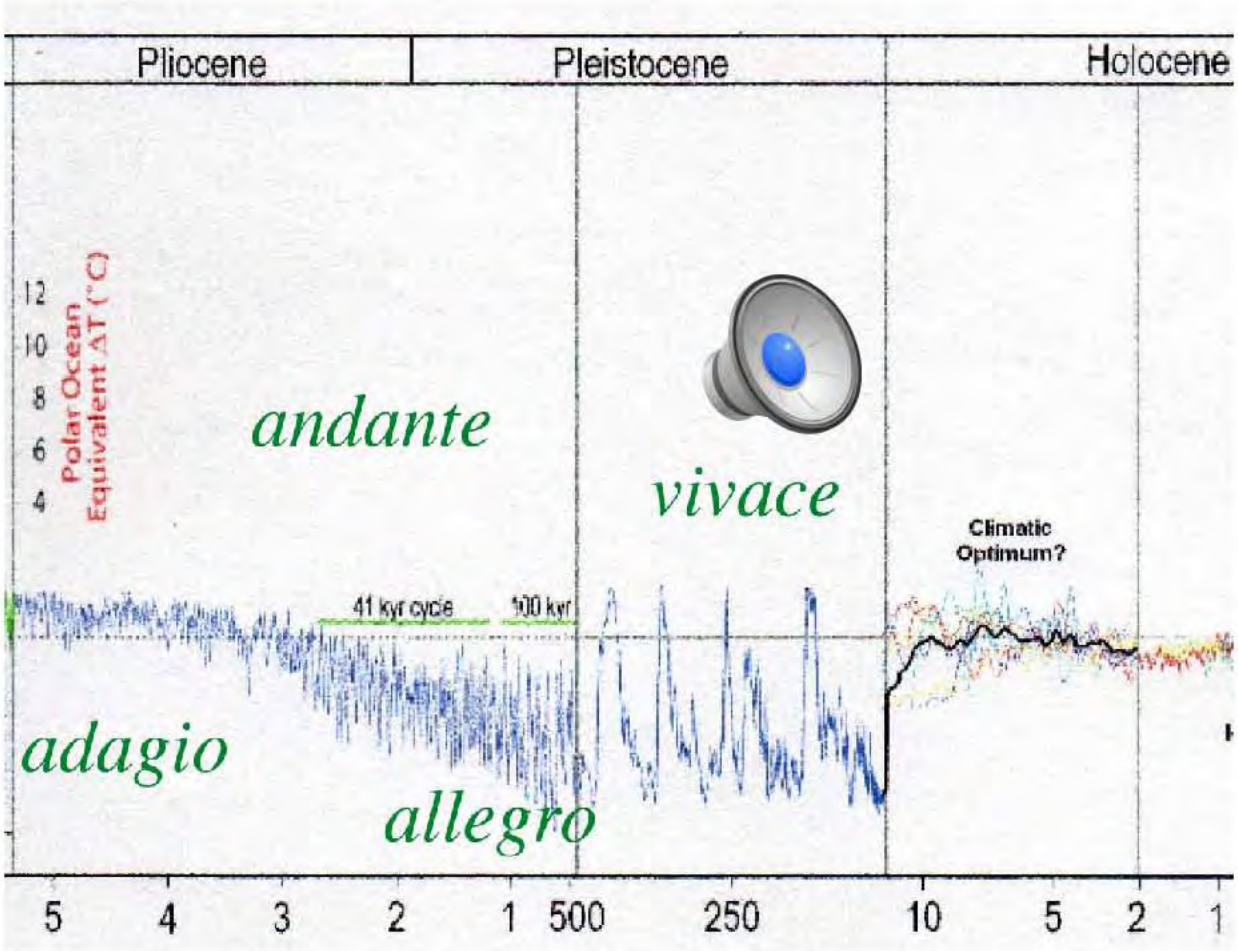
126 a 170mm (sin epífisis distal)

orientativo: *Ovis longipes* del Sudán
141 mm (metacarpo) y 145 (metatarso)


Pliocene
Pleistocene
Holocene
Polar Ocean Equivalent ΔT (°C)
12
10
8
6
4
andante
vivace
adagio
allegro
41 kyr cycle
100 kyr
Climatic Optimum?
3
2
1
500
250
10
5
2
1


Pliocene
Pleistocene
Holocene
Polar Ocean Equivalent ΔT (°C)
12
10
8
6
4
andante
vivace
Climatic Optimum?
41 kyr cycle
100 kyr
adagio
allegro
5
4
3
2
1
500
250
10
5
2
1


Pliocene
Pleistocene
Holocene
Polar Ocean Equivalent ΔT (°C)
12
10
8
6
4
andante
vivace
adagio
allegro
41 kyr cycle
100 kyr
Climatic Optimum?
5
4
3
2
500
250
10
5
2
1


Pliocene
Pleistocene
Holocene
Polar Ocean
Equivalent ΔT (°C)
12
10
8
6
4
andante
vivace
adagio
allegro
41 kyr cycle
100 kyr
Climatic
Optimum?
5
4
3
2
1
500
250
10
5
2
1

Últimas publicaciones en revistas de impacto

- 2013- *Palaeogeography, Palaeoclimatology, Palaeoecology* (En prensa)
- 2011 – *Lethaia* 44, 440-454.
- 2010 – *Global and Planetary Change* 72, 318-320.
- 2008 – *Landslides* 5, 227-234.
- 2007 – *Global and Planetary Change* 57, 222-234.
- 2004 – *Quaternary Science Reviews* 23, 2045-2055.
- 2003 – *Episodes* 26, 133-134.
- 2002 – *Palaeogeography, Palaeoclimatology, Palaeoecology* 185, 197-210.

Autores (orden alfabético) -Institución

- Betancort JF - ***ULPGC***
- Carracedo JC – ***CSIC***
- Cilleros A – ***ULPGC***
- Coca J - ***ULPGC***
- Fontugne M – ***CNRS***
- Guillou H - ***CNRS***
- Hervás J - ***JRC European Commission***
- Lomoschitz A – ***ULPGC***
- Meco J. - ***ULPGC***
- Montesinos M - ***MAGRAMA***
- Muhs D – ***US Geological Survey***
- Patterson D – ***US Geological Survey***
- Perera MA - ***Cabildo Lanzarote***
- Petit-Maire N - ***CNRS***
- Ramos AJG – ***ULPGC***
- Redondo A - ***ULPGC***
- Rodríguez Yanes JJ - ***ULPGC***
- Scaillet S -***CNRS***
- Simmons K - ***US Geological Survey***
- Yepes J – ***ULPGC***
- **Además, fotos de Guacimaro Soler (alumno ULPGC)**

Dataciones en publicaciones previas

- Meco J & Stearns Ch (1981) *Quaternary Research* 15, 199-208.
- Petit-Maire N, Delibrias G, Meco J, Pomel S & Rosso JC (1986) *C R Acad Sc Paris* 303, 1241-1246.
- Petit-Maire N, Delibrias G, Meco J, Pomel S & Rosso JC (1987) *Palaeoecology of Africa* 18, 351-356.
- Meco J, Petit-Maire N & Reyss JL (1992). *C R Acad Sc Paris* 341, 197-210.
- Cornu S, Pätzold J, Bard E, Meco J & Cuerda-Barceló (1993) *Palaeogeography, Palaeoclimatology, Palaeoecology* 103, 1-20.

La cadena de oscilaciones del clima en el pasado de Canarias

Resumen:

En Canarias están las pruebas de la existencia de una cadena climática en esta parte del Globo: eslabones de clima de pleno glacial árido-frío (dunas), de clima interglacial temprano árido-sub-húmedo (polvo), de clima cálido y húmedo de máximo interglacial (depósitos marinos), de clima de transición árido-templado (calcretas) y otra vez clima glacial-árido-frio. Esta cadena se desarrolla desde hace cinco millones de años inicialmente en adagio *(lento y majestuoso) para pasar sucesivamente a un* andante*,* allegro *y* vivace*. Este largo proceso está medido desde 1981 hasta este año de 2013 por todas las dataciones existentes: K/Ar en lavas, U/Th en fósiles marinos y terrestres, C14 tradicional y en acelerador atómico en fósiles, OSL en dunas, Series de U en corales, además de ensayos sobre aminoácidos e isótopos de Sr en marcha. Todo ello con una espléndida y sorprendente información paleontológica.*