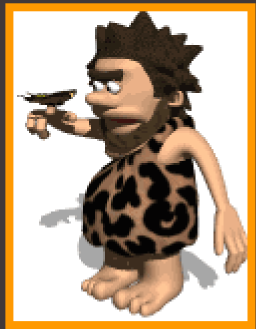
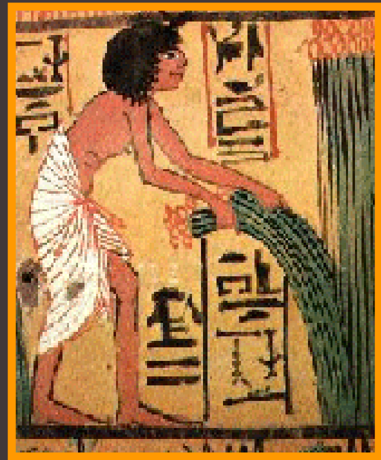
HISTORIA DEL CLIMA, EL AGUA Y EL HOMBRE

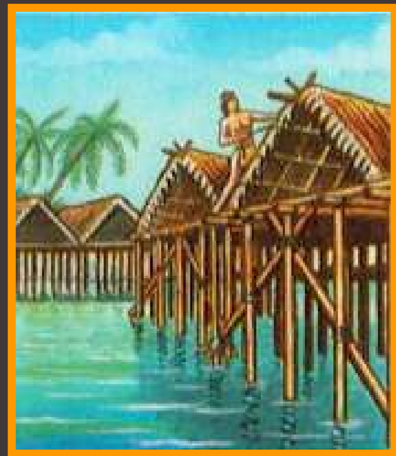




8 de Febrero 2012

Master en Cambio Global

Universidad Internacional
Menéndez Pelayo - CSIC

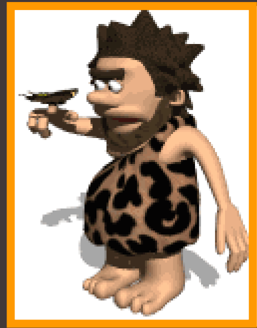


Penélope González-Sampériz

Instituto Pirenaico de Ecología-CSIC

http://bit.ly/pgonzal

HISTORIA DEL CLIMA, EL AGUA Y EL HOMBRE



¿Periodos climáticos = Periodos culturales? ¿Interacción o Determinismo?

Desarrollo / Colapso. Elementos clave y ejemplos de la Historia Reciente

Ejemplos del Pasado

- Extinción Neanderthales
- Evento 8.2 y el Bajo Aragón
- Revolución Neolítica
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- 4.000 BP : COLAPSOS
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  - *Valle del Indo*
  - *Meseta China*
  - *Cultura Argárica*
- Edad Bronce – Edad Hierro
- Civilización Maya

Conclusiones

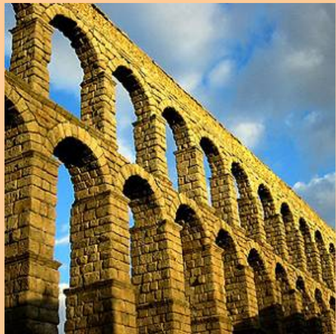
Si a pesar del **gran avance tecnológico** que caracteriza a la sociedad occidental del **siglo XXI**, basta un *verano extremadamente caluroso* para causar **grandes sequías**, cosechas perdidas, **restricciones** en el suministro de agua e incluso un aumento de la **mortalidad** en poblaciones de la tercera edad, no resulta difícil imaginar cómo algunas CIVILIZACIONES PREHISTÓRICAS pudieron llegar incluso al **COLAPSO** por razones asociadas a cambios climáticos!!

Sin pretender dar una visión de *"determinismo climático"* a la Historia de la Humanidad…

Muchos *cambios* “*climáticos*” coinciden cronológicamente con *cambios* “*culturales*”

¿CASUALIDAD?

¿INTERACCIÓN?



Muchos **eventos abruptos** coinciden con AUGES y/o COLAPSOS de civilizaciones…

hagamos un breve y rápido repaso a la Historia…

… comenzando por la PREHISTORIA,

y contextualizando ciertas “casuísticas”

GRANDES PERÍODOS CLIMÁTICOS "GENERALES" ASIMILABLES A GRANDES CAMBIOS CULTURALES

PLENIGLACIAL WURMIENSE (MIS 4 y 3: **80-20 ka BP**)

Periodos culturales:

MUSTERIENSE (PALEOLÍTICO MEDIO) hasta ±40 ka BP

PALEOLÍTICO SUPERIOR hasta comienzo Holoceno (11.5 ka BP). Transición Medio-Superior MIS 4 – MIS 3???

Homo sapiens neanderthalensis y *Homo sapiens sapiens* (Cro-Magnon) dominante en Paleolítico Superior (extinción definitiva Neanderthal 20 ka BP Gibraltar, ppo MIS 2 ????)

Cazadores – Recolectores

Hábitat principal: CUEVAS

Impacto/Huella humana en el medio inapreciable. Impacto clima en humanos notable

Paisaje estépico dominante pero no generalizado y existencia de refugios mesotermófilos en costas e interior

GRANDES PERÍODOS CLIMÁTICOS “GENERALES” ASIMILABLES A GRANDES CAMBIOS CULTURALES

TARDIGLACIAL (MIS 2: LGM - Holoceno 11.5 ka BP)

Periodos culturales: gran diversidad

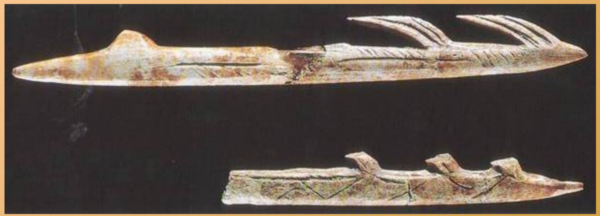
PALEOLÍTICO SUPERIOR Auriñaciense, Solutrense, Magdaleniense, Aziliense

Periodos climáticos: gran variabilidad (“cambios abruptos”)

TARDIGLACIAL: HE, Oldest & Older Dryas, Bolling, IACP, Allerod, YD

Homo sapiens sapiens (extinción Neanderthal por variabilidad climática???)

Cazadores – Recolectores



Hábitat principal: CUEVAS, ABRIGOS

Impacto en el medio inapreciable

Paisaje estépico aún dominante: comienzan desarrollos forestales pioneros colonizadores

GRANDES PERÍODOS CLIMÁTICOS “GENERALES” ASIMILABLES A GRANDES CAMBIOS CULTURALES

HOLOCENO TEMPRANO (**11.5 – 7.5 ka BP**)

Periodo cultural: EPIPALEOLÍTICO o MESOLÍTICO

Periodo climático: PREBOREAL y BOREAL

Cazadores – Recolectores

Hábitat principal: ABRIGOS

Impacto en el medio inapreciable

Desarrollo forestal creciente. Rápido aumento temperatura y humedad

----

Periodo cultural: NEOLÍTICO

Periodo climático: ATLÁNTICO

Agricultores y pastores.

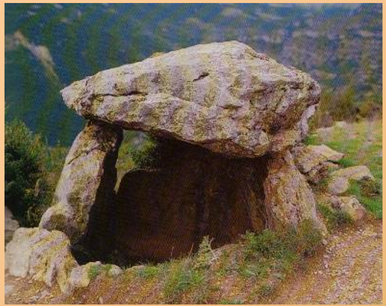
Hábitat princiapal: Sedentarismo. Primeros poblados

Comienzo impacto importante en el medio y perdurable en el tiempo

Tras *“óptimo climático”*, señal compleja por deforestaciones humanas pero nueva tendencia aridez q da paso a Holoceno Medio.

GRANDES PERÍODOS CLIMÁTICOS "GENERALES" ASIMILABLES A GRANDES CAMBIOS CULTURALES

HOLOCENO MEDIO (**7.5 - 4 ka BP**)



Periodo cultural: NEOLÍTICO, CALCOLÍTICO, MEGALITISMO

Periodo climático: ATLÁNTICO

Agricultores y Pastores.

Hábitat principal: POBLADOS al aire libre, CUEVAS, ABRIGOS

Impacto en el medio cada vez mayor: deforestaciones, cultivos, pastos…

Aparición de la **cerámica**

Principio de la Edad de los Metales: **cobre**

Cambio bosques dominantes: re-expansión coníferas, incremento ruderales...

Tendencia clima más seco

GRANDES PERÍODOS CLIMÁTICOS "GENERALES" ASIMILABLES A GRANDES CAMBIOS CULTURALES

HOLOCENO RECIENTE (**4 – 2.7 ka BP / cambio de era**)

Periodo cultural: EDAD DEL BRONCE y EDAD DEL HIERRO

Periodo climático: SUB-BOREAL y SUBATLÁNTICO

Agricultores, Pastores, **Ganaderos, Alfareros, Comerciantes...**

Jerarquización. Organización social y territorial

Hábitat principal: POBLADOS al aire libre, CIUDADES, CASTROS…

Alta **densidad de población** según zonas

Impacto en el medio aún mayor: primeras obras de ingeniería…

Bosque abierto coníferas. Expansión ***Fagus*** y ***Abies*** en Sub-Boreal.

Tendencia más frío y humedad en Sub-Boreal y más seco SubAtlántico.

A partir 2.700 BP y cambio era: Iberos e Imperio Romano (PHIR)

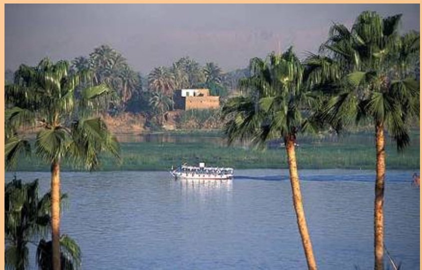
Incendios

Inundaciones & pp extremas

Terremotos

Erupciones

Crecidas fluviales



El hombre, desde su aparición en la Tierra, actúa sobre la Naturaleza… Pero es obvio que interactúa con ella…
beneficiándose en unos casos, y resultando "negativamente afectado" en otros…

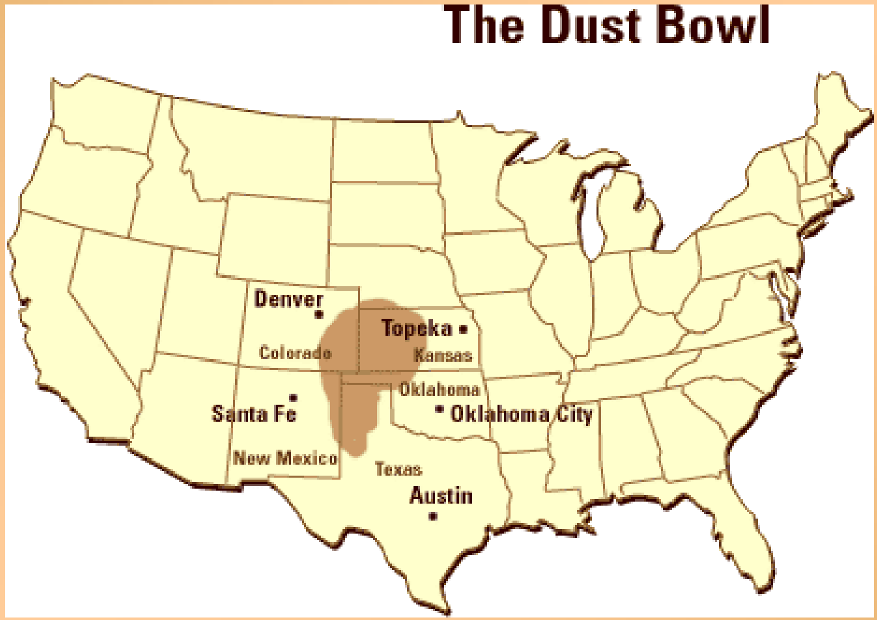
El impacto que fenómenos climáticos y cambios medioambientales tienen en la estructura económico-cultural de la sociedad, incluso en la actualidad, es muy grande…

EJEMPLO DE LA HISTORIA RECIENTE… S.XX!!!

DUST BOWL (**USA, 1930**)

CRISIS CLIMÁTICA + CRISIS ECONÓMICA Y SOCIAL

Tras 1ª Guerra Mundial, caen precios cereales.
Granjeros USA aumentan producción (mecanización y + tierras).
Stock en 1929 alterando la débil situación económica.



Años 30: gran depresión económica!!!
Origen: inadecuado uso del suelo (sobre-explotación Grandes Llanuras).

↓

Catástrofe ambiental, **económica** y humanitaria (**EROSIÓN**, hambrunas, **emigración**, *crack*).

EJEMPLO DE LA HISTORIA RECIENTE… S.XX!!!

DUST BOWL (**USA, 1930**)

CRISIS CLIMÁTICA + CRISIS ECONÓMICA Y SOCIAL

Abandono tierras debido al stock inicial (± 30% desempleo).
La sobre-explotación = pérdida de nutrientes y capacidad de infiltración.
Aumento erosión por abandono de cultivos.
1931-1939, severa sequía que incrementa la acción erosiva
En 1934, mayor sequía hª de USA. 75% país afectado (27 estados).



LA EROSIÓN EÓLICA QUE SE GENERÓ ES CONOCIDA COMO **"DUST BOWL"**

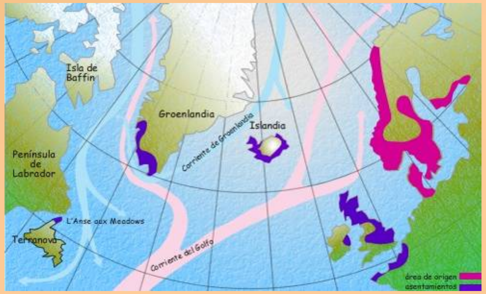
… y el CRACK de la bolsa de New York aún hoy produce escalofríos…

La sobre-producción existía en USA, pero los **efectos** de la *crisis económica de los años 30* se vieron acentuados por la pronunciada sequía...

No parece haber sido la causa, pero el **clima** sí que actuó como **catalizador**!!!

… en otros casos, esencialmente durante la Prehistoria, el **papel del clima** (y esencialmente de la presencia / ausencia de **agua** y/o incrementos de sequías y/o crisis de aridez) parece que ha sido más "*relevante*"… Incluso determinante en el DESARROLLO y COLAPSO de Civilizaciones!!!

CAMBIOS CLIMÁTICOS “ABRUPTOS” / PRESENCIA-AUSENCIA DE AGUA = AUGES, COLAPSOS Y MIGRACIONES?

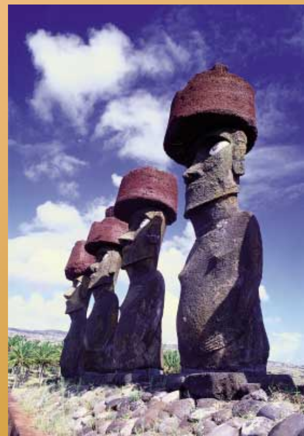


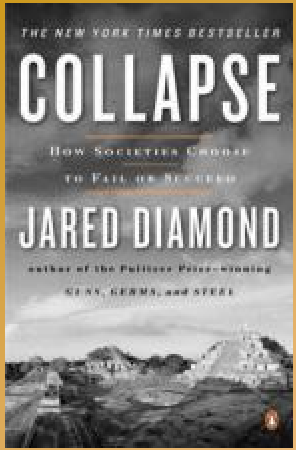
Imperio Egipcio (5000 – 2000 BP)
Beneficios río Nilo. Riqueza llanura inundación

Expansión Roma (2000 BP)
Auge durante RHP (Roman Humid Period)

Expansión Vikinga (1000 AD)
Llegada Groenlandia-Terranova en MCA

Isla de Pascua (700-1680 AD)
Cambio climático o sobre-explotación antrópica?





“COLAPSO. Por qué unas sociedades perduran y otras no”

Jared Diamond

Elementos clave DESARROLLO o COLAPSO de Civilizaciones

Aprovechamiento-Agotamiento recursos (varias causas potenciales)

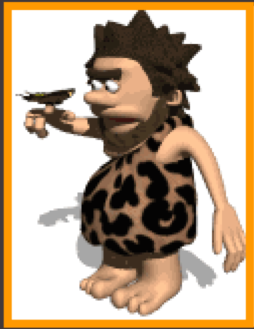
i) *buena o mala gestión* recursos-suelo-agricultura. Relación directa con desarrollo económico y cultural de la humanidad. Ayer, hoy & mañana.

ii) CAMBIOS CLIMÁTICOS. Investigación actual = cómo cambios composición paisaje (fauna + flora) o cambios climáticos a escala global, han estado o han podido estar relacionados con la extinción de especies, migraciones, nuevos tipos de economía, “Imperialismo-Expansionismo”, etc.

iii) *catástrofes ambientales* (terremotos, volcanes, huracanes). Pérdidas humanas y económicas. Desaparición de pueblos y/o civilizaciones.

iv) *epidemias*. Malaria & Imperio Romano?

HISTORIA DEL CLIMA, EL AGUA Y EL HOMBRE



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- Civilización Maya

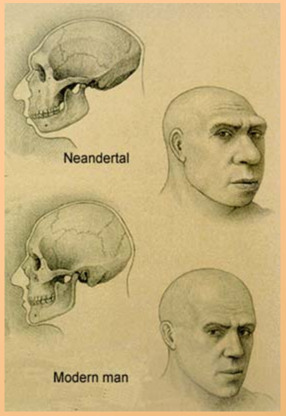
Conclusiones

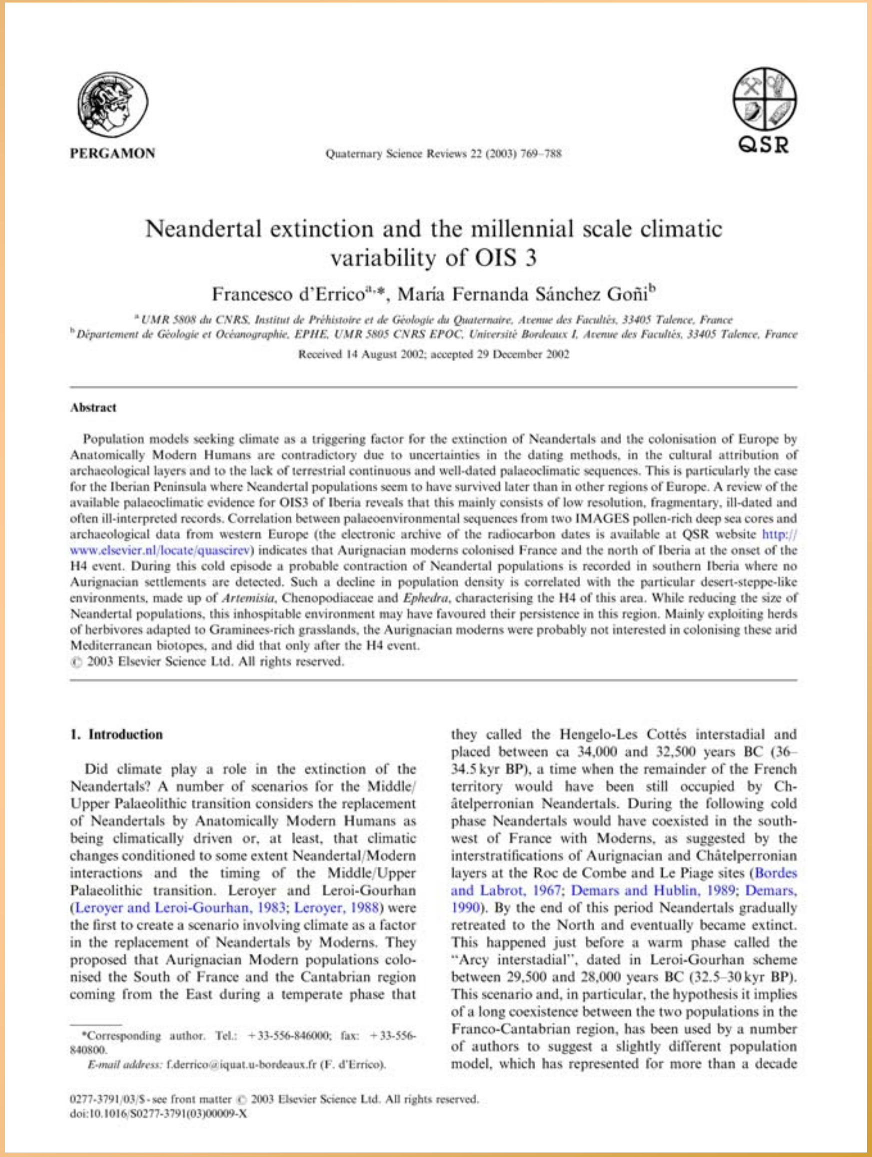
LA EXTINCIÓN DEL HOMBRE DE NEANDERTHAL

¿Inadaptación medioambiental?
¿Competencia? Diversas teorías…

Características físicas:

estructura ósea y morfología diferente, *mejor adaptados climas fríos*, cuerpos **pequeños y robustos** que ayudaban a mantener el calor…





PERGAMON

Quaternary Science Reviews 22 (2003) 769–788

QSR

Neandertal extinction and the millennial scale climatic variability of OIS 3

Francesco d'Errico[a,*], María Fernanda Sánchez Goñi[b]

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Received 14 August 2002; accepted 29 December 2002

Abstract

Population models seeking climate as a triggering factor for the extinction of Neandertals and the colonisation of Europe by Anatomically Modern Humans are contradictory due to uncertainties in the dating methods, in the cultural attribution of archaeological layers and to the lack of terrestrial continuous and well-dated palaeoclimatic sequences. This is particularly the case for the Iberian Peninsula where Neandertal populations seem to have survived later than in other regions of Europe. A review of the available palaeoclimatic evidence for OIS3 of Iberia reveals that this mainly consists of low resolution, fragmentary, ill-dated and often ill-interpreted records. Correlation between palaeoenvironmental sequences from two IMAGES pollen-rich deep sea cores and archaeological data from western Europe (the electronic archive of the radiocarbon dates is available at QSR website http://www.elsevier.nl/locate/quascirev) indicates that Aurignacian moderns colonised France and the north of Iberia at the onset of the H4 event. During this cold episode a probable contraction of Neandertal populations is recorded in southern Iberia where no Aurignacian settlements are detected. Such a decline in population density is correlated with the particular desert-steppe-like environments, made up of *Artemisia*, Chenopodiaceae and *Ephedra*, characterising the H4 of this area. While reducing the size of Neandertal populations, this inhospitable environment may have favoured their persistence in this region. Mainly exploiting herds of herbivores adapted to Graminees-rich grasslands, the Aurignacian moderns were probably not interested in colonising these arid Mediterranean biotopes, and did that only after the H4 event.

1. Introduction

Did climate play a role in the extinction of the Neandertals? A number of scenarios for the Middle/Upper Palaeolithic transition considers the replacement of Neandertals by Anatomically Modern Humans as being climatically driven or, at least, that climatic changes conditioned to some extent Neandertal/Modern interactions and the timing of the Middle/Upper Palaeolithic transition. Leroyer and Leroi-Gourhan (Leroyer and Leroi-Gourhan, 1983; Leroyer, 1988) were the first to create a scenario involving climate as a factor in the replacement of Neandertals by Moderns. They proposed that Aurignacian Modern populations colonised the South of France and the Cantabrian region coming from the East during a temperate phase that they called the Hengelo-Les Cottés interstadial and placed between ca 34,000 and 32,500 years BC (36–34.5 kyr BP), a time when the remainder of the French territory would have been still occupied by Châtelperronian Neandertals. During the following cold phase Neandertals would have coexisted in the south-west of France with Moderns, as suggested by the interstratifications of Aurignacian and Châtelperronian layers at the Roc de Combe and Le Piage sites (Bordes and Labrot, 1967; Demars and Hublin, 1989; Demars, 1990). By the end of this period Neandertals gradually retreated to the North and eventually became extinct. This happened just before a warm phase called the "Arcy interstadial", dated in Leroi-Gourhan scheme between 29,500 and 28,000 years BC (32.5–30 kyr BP). This scenario and, in particular, the hypothesis it implies of a long coexistence between the two populations in the Franco-Cantabrian region, has been used by a number of authors to suggest a slightly different population model, which has represented for more than a decade

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d'Errico & Sánchez-Goñi (2003). Quaternary Science Reviews;

Carrión (2003). Quaternary Science Reviews;

Finlaysson (2003). Quaternary Science Reviews;

Utrilla et al. (2004). BAR International Series

CRONOLOGÍA Y HÁBITAT: perduración en S de Europa (Gibraltar, Gorham's cave) hasta 20-25 ka. Resto Europa: ± 45.000 BP (transición Paleolítico Medio-Superior)

EXTINCIÓN - DESAPARICIÓN: "Frontera del Ebro" irreal … Pérdida biomasa gramíneas para grandes herbívoros. Mosaico vegetal al sur, no sólo estepa. Biodiversidad extrema. Fauna variada

ZILHAO & D'ERRICO / UTRILLA ET AL.

"Frontera ecológica"? inexistente en Valle Ebro: Musteriense S – Auriñaciense N?

Coprolitos Gabasa /Arbreda / Cova Beneito

SÁNCHEZ-GOÑI & D'ERRICO

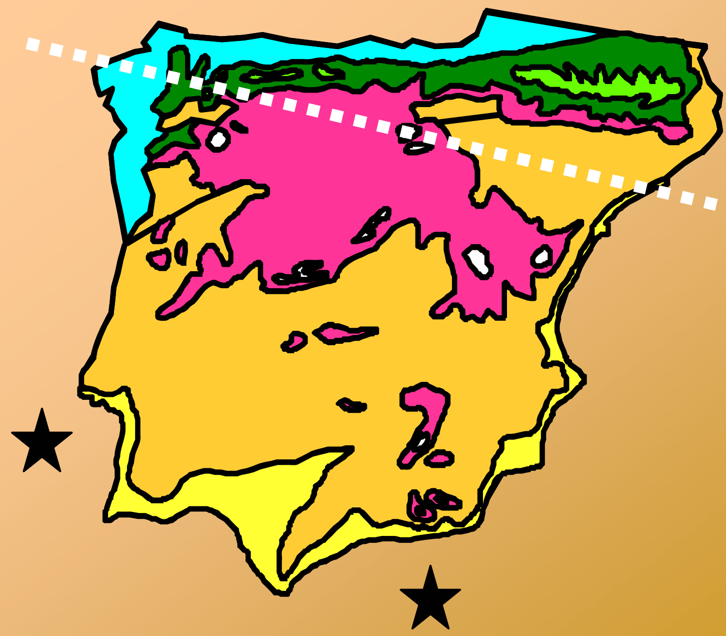
"Frontera ecológica" por pérdida biomasa al S, sin grandes bóvidos ni Poaceae

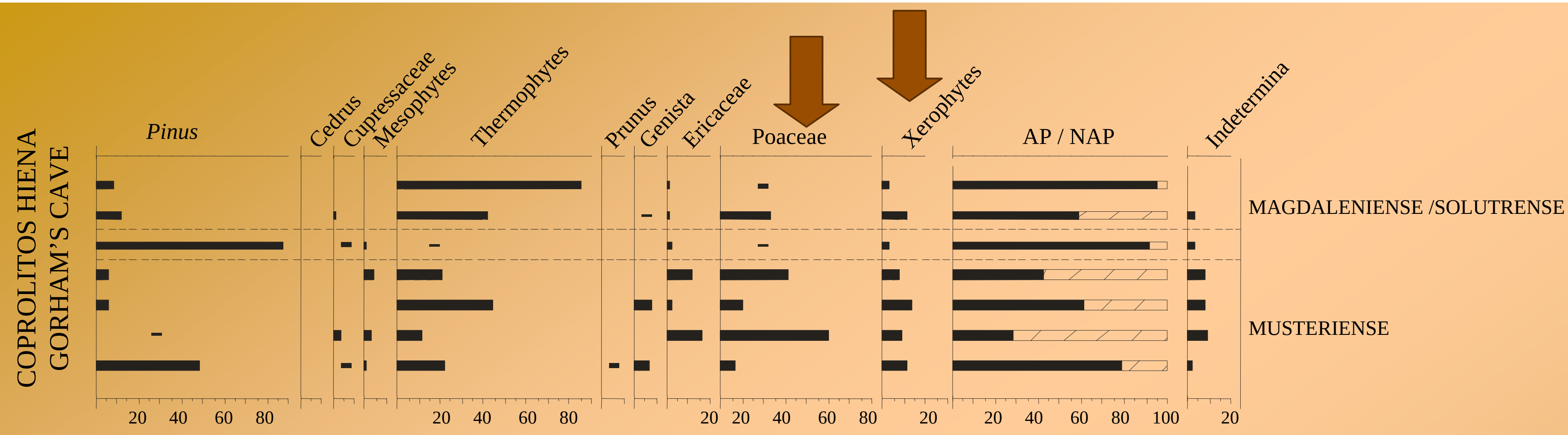
Sondeos marinos: *Alborán / Lisboa*

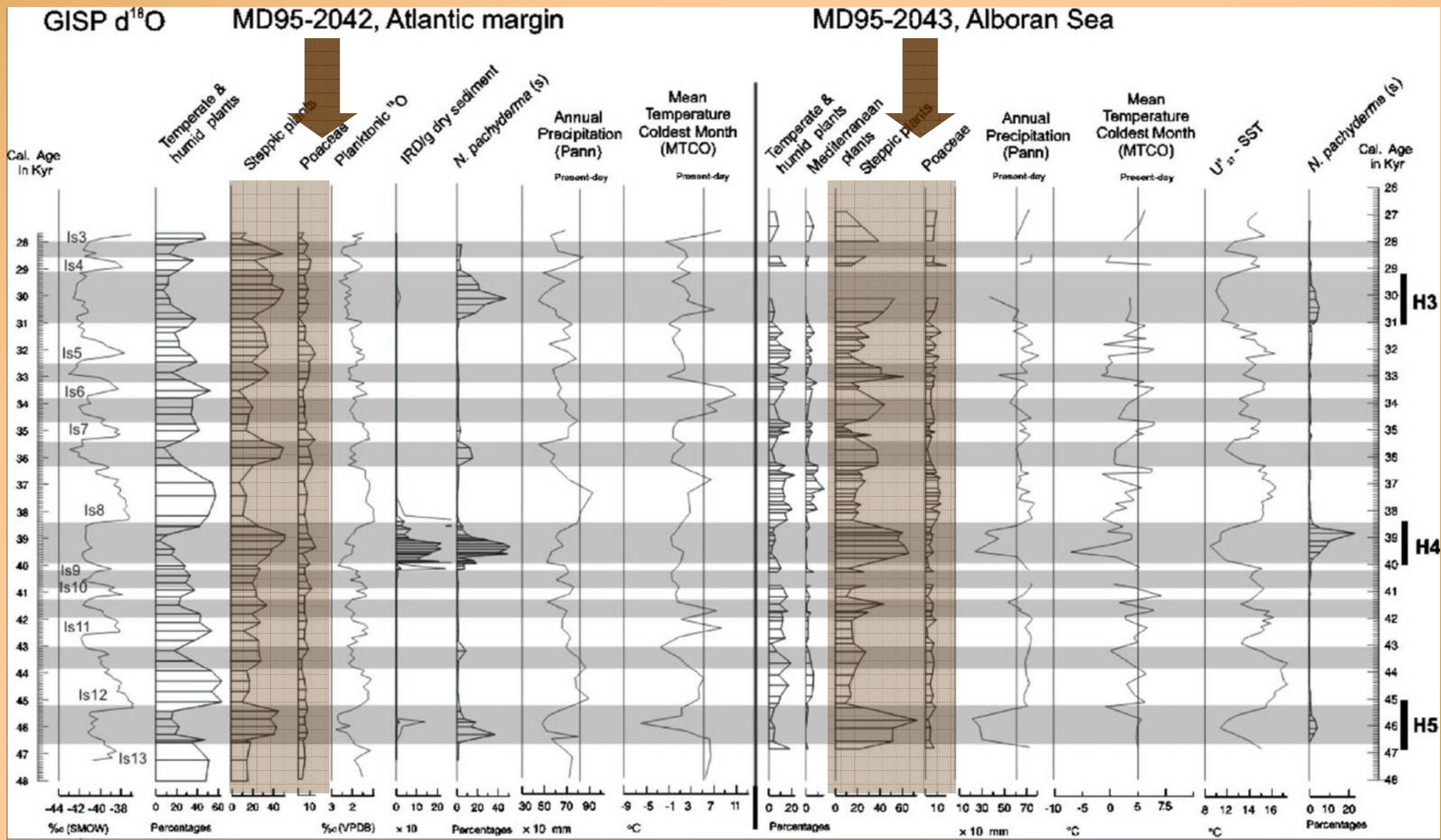
CARRIÓN & FINLAYSSON

Mosaicos al S: estepas, refugios, veget. Medit…

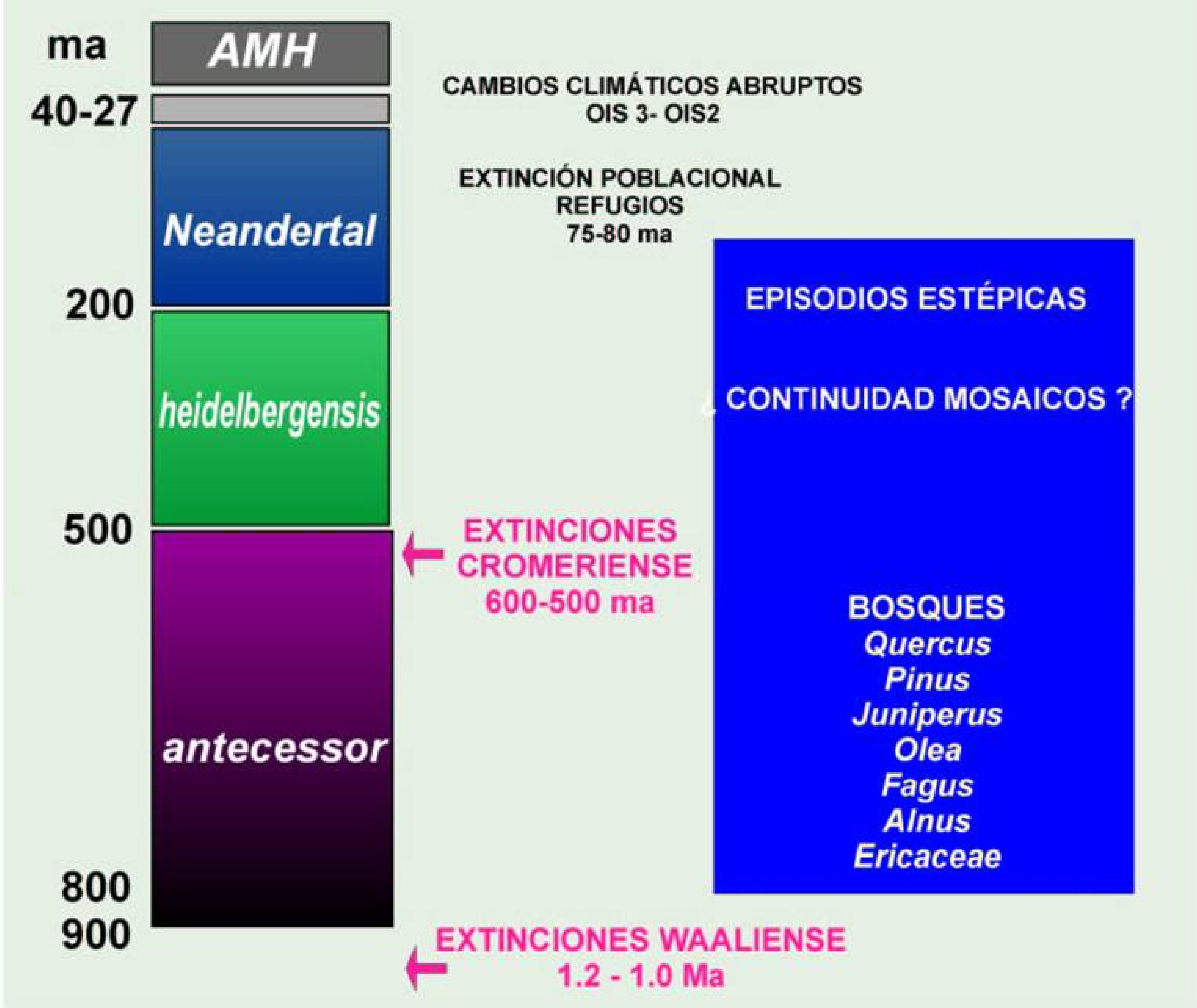
Reg. continentales (lagos, tuberas, cuevas, coprolitos). Fauna variada. *Gorham's cave*




COPROLITOS HIENA
GORHAM'S CAVE
Pinus
Cedrus
Cupressaceae
Mesophytes
Thermophytes
Prunus
Genista
Ericaceae
Poaceae
Xerophytes
AP / NAP
Indetermina
MAGDALENIENSE /SOLUTRENSE
MUSTERIENSE


GISP d18O
MD95-2042, Atlantic margin
MD95-2043, Alboran Sea
Cal. Age in Kyr
Temperate & humid plants
Steppic plants
Poaceae
Planktonic 18O
IRD/g dry sediment
N. pachyderma (s)
Annual Precipitation (Pann)
Mean Temperature Coldest Month (MTCO)
Mediterranean plants
U'37 - SST
H3
H4
H5
‰ (SMOW)
Percentages
‰ (VPDB)
× 10 mm
°C

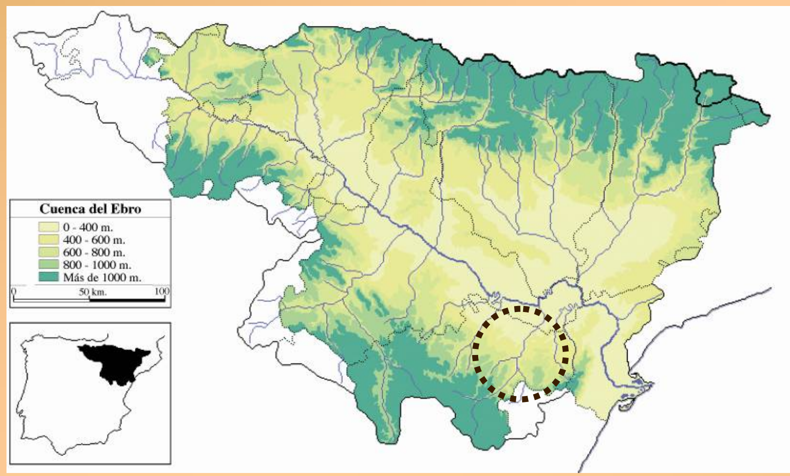




Es crucial revisar toda la información paleoecológica para las principales transiciones paleoantropológicas en la Península Ibérica. De este modo, podremos estimar con mayor solvencia la veracidad de las hipótesis ambientalistas que tanto alcance tienen en los medios de comunicación, pero a menudo representan aproximaciones hiperreductivas de una realidad evolutiva intrínsecamente compleja (Carrión, no publicado)

EL EVENTO 8.2 Y LA OCUPACIÓN HUMANA EN EL BAJO ARAGÓN

Causa climática determinante de migraciones y cambios en patrones de ocupación humana???



En áreas "críticas" y ante eventos extremos, **SI**

Quaternary Research 71 (2009) 121–132

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/yqres

Short Paper

Patterns of human occupation during the early Holocene in the Central Ebro Basin (NE Spain) in response to the 8.2 ka climatic event

P. González-Sampériz [a,*], P. Utrilla [b], C. Mazo [b], B. Valero-Garcés [a], MC. Sopena [b], M. Morellón [a], M. Sebastián [b], A. Moreno [a], M. Martínez-Bea [b]

[a] Instituto Pirenaico de Ecología CSIC, Avda. Montañana 1005, Apdo 202, 50080 Zaragoza, Spain
[b] Dpto. de Ciencias de la Antigüedad (Prehistoria), Universidad de Zaragoza, C/Pedro Cerbuna 12, 50009 Zaragoza, Spain

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Holocene
Migration
Hunter-gatherers
Aridity
Archaeology

ABSTRACT

The Central Ebro River Basin (NE Spain) is the most northern area of truly semi-arid Mediterranean climate in Europe and prehistoric human occupation there has been strongly influenced by this extreme environmental condition. Modern climate conditions single out this region due to the harsh environment, characterised by the highest absolute summer temperatures of the Ebro River Basin. The Bajo Aragón region (SE Ebro River Basin) was intensively populated during the Early Holocene (9400–8200 cal yr BP) but the settlements were abandoned abruptly at around 8200 cal yr BP. We propose that this "archaeological silence" was caused by the regional impact of the global abrupt 8.2 ka cold event. Available regional paleoclimate archives demonstrate the existence of an aridity crisis then that interrupted the humid Early Holocene. That environmental crisis would have forced hunter-gatherer groups from the Bajo Aragón to migrate to regions with more favourable conditions (i.e. more humid mountainous areas) and only return in the Neolithic. Coherently, archaeological sites persist during this crisis in the nearby Iberian Range (Maestrazgo) and the North Ebro River area (Pre-Pyrenean mountains and along the northwestern Ebro Basin).

Introduction

Prehistoric and historic societies around the world, particularly those located in semi-arid areas, have been highly vulnerable to abrupt climatic changes, with numerous examples of widespread abandonment, migrations and even cultural collapses. Examples include the Eastern Sahara occupation during the Holocene humid period (Hoelzmann et al., 2001), the Neolithic migrations that occurred in Europe (Turney and Brown, 2007), and the population decreases in the North American Great Plains during the Altithermal period of the Middle Holocene (Meltzer, 1999). In several cases, environmental crises caused by increased aridity have been considered a main trigger in civilization collapse, as the Akkadian Empire, the Argaric Culture and the Maya Civilization, although other possible socio-economic factors have also been considered (respectively, Cullen et al., 2000; Carrión et al., 2007; Haug et al., 2003). The Ebro River Valley (NE Spain) has a long history of human occupation (Utrilla, 2002; Montes et al., 2006) and because of the harsh environmental conditions that characterise this Mediterranean area it provides several examples of the complex interplay of climate and human societies. In addition, this region includes the Bajo Aragón area, an ecologically "fragile" area characterised by a strong water deficit (López-Martín et al., 2007).

The Holocene (last 11.5 ka) has been classically considered a climatically stable episode, especially when compared with the last glacial period. However, there is increasing evidence of significant climate variability at suborbital scales during the present interglacial at a global scale (Mayewski et al., 2004). In the Iberian Peninsula several sites document large climate variability during the Holocene and particularly the strong impact in vegetation communities and hydrology during the Early Holocene (Ramil-Rego et al., 1998; Sánchez-Goñi and Hannon, 1999; Carrión, 2002; Plá and Catalan, 2005; González-Sampériz et al., 2006; Davis and Stevenson, 2007; Morellón et al., 2008).

The 8.2 ka event is one of the most significant climate crisis of the last 11.5 ka and was globally identified as a short cold and arid period (Alley and Agustsdottir, 2005; Rohling and Pälike, 2005). This event appears to have been generally cooler over much of the Northern Hemisphere, and it is also characterised by: i) a widespread aridity in low latitudes (de Menocal et al., 2000; Gasse and Van Campo, 1994); ii) enhanced seasonality (Baldini et al., 2002); and iii) dry northerly winds influence in the western Mediterranean (Frigola et al., 2007). Although many new paleoclimate records have contributed to reconstruct the climate variability associated to this event (see compilation in Mayewski et al., 2004), the forcing mechanisms remain under discussion (Bauer et al., 2004; Rohling and Pälike, 2005). Global climate models (GCM) show that colder conditions in the north Atlantic would translate into more arid conditions in the continental areas of the Mediterranean region, including the Iberian Peninsula

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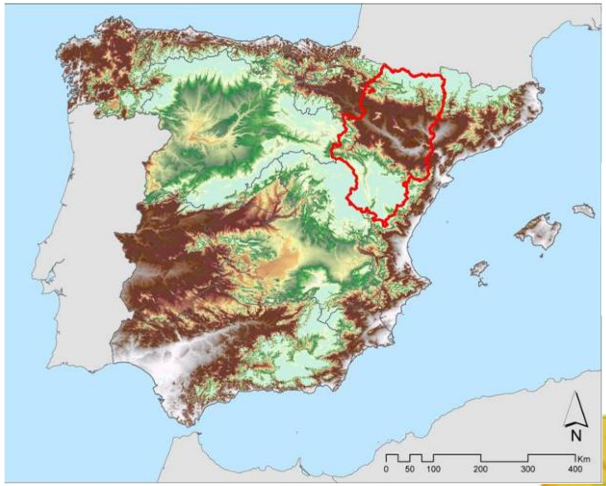
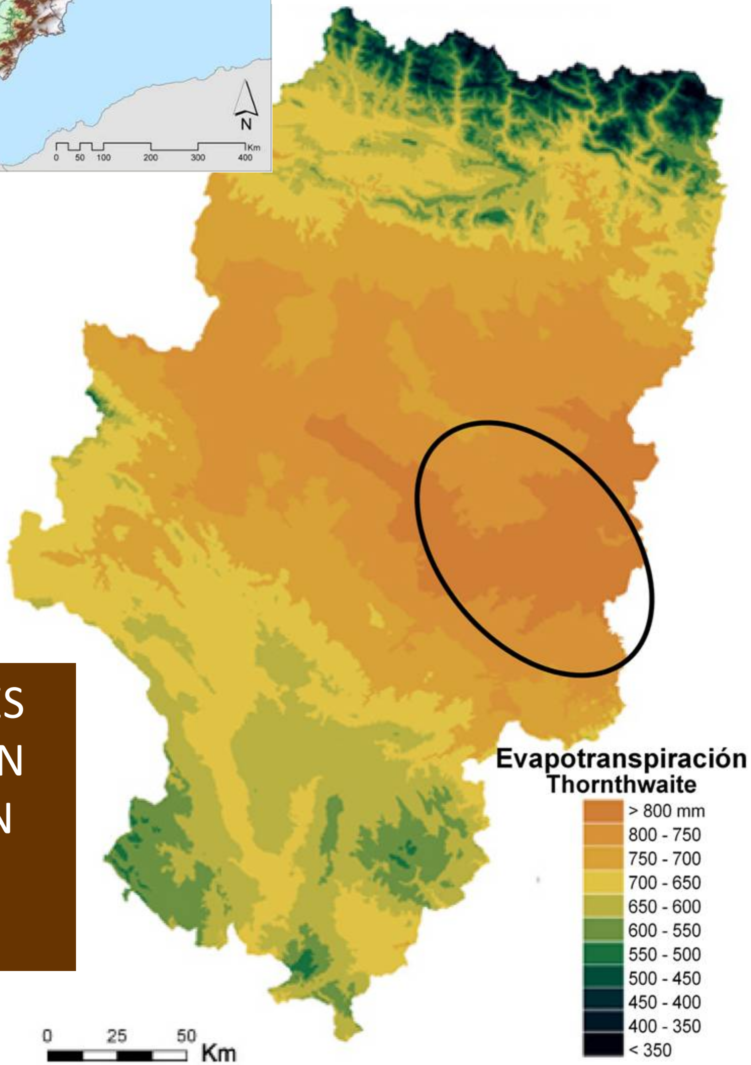
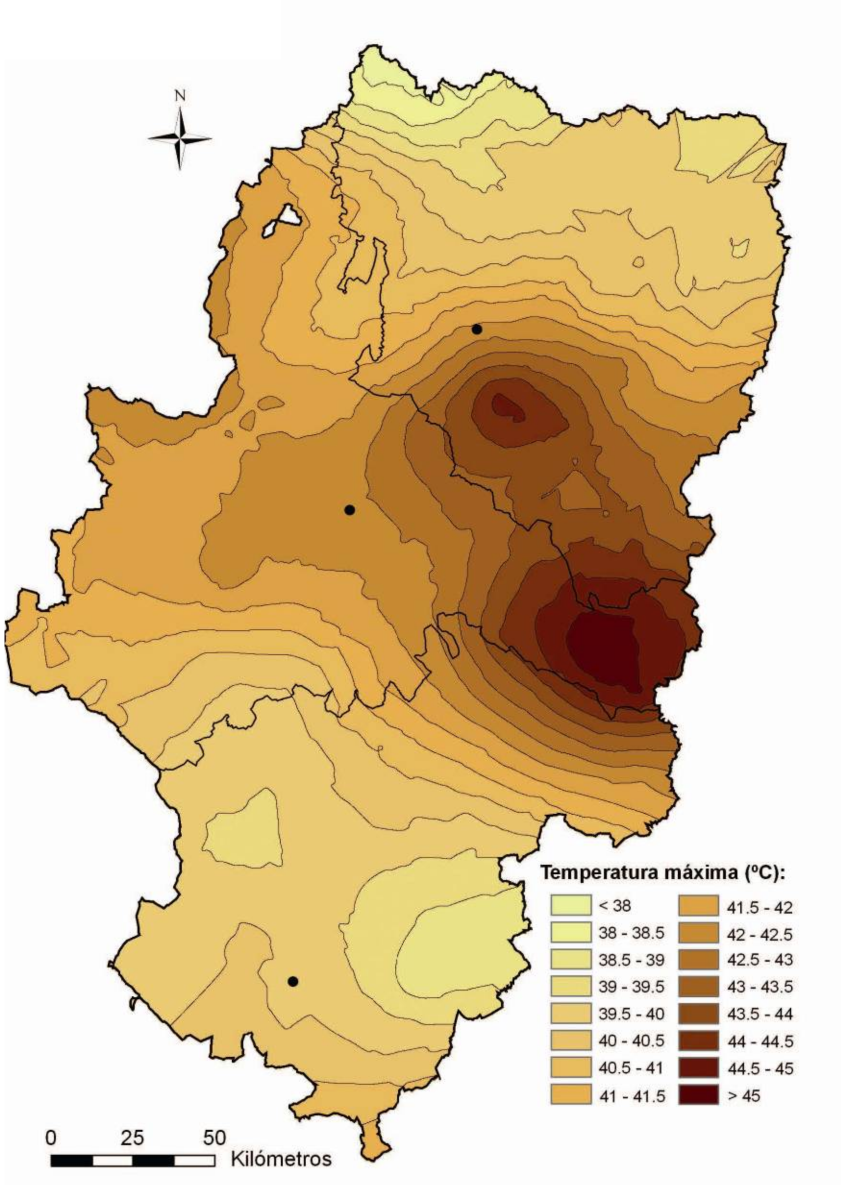
doi:10.1016/j.yqres.2008.10.006

González-Sampériz et al. (2009). Quaternary Research



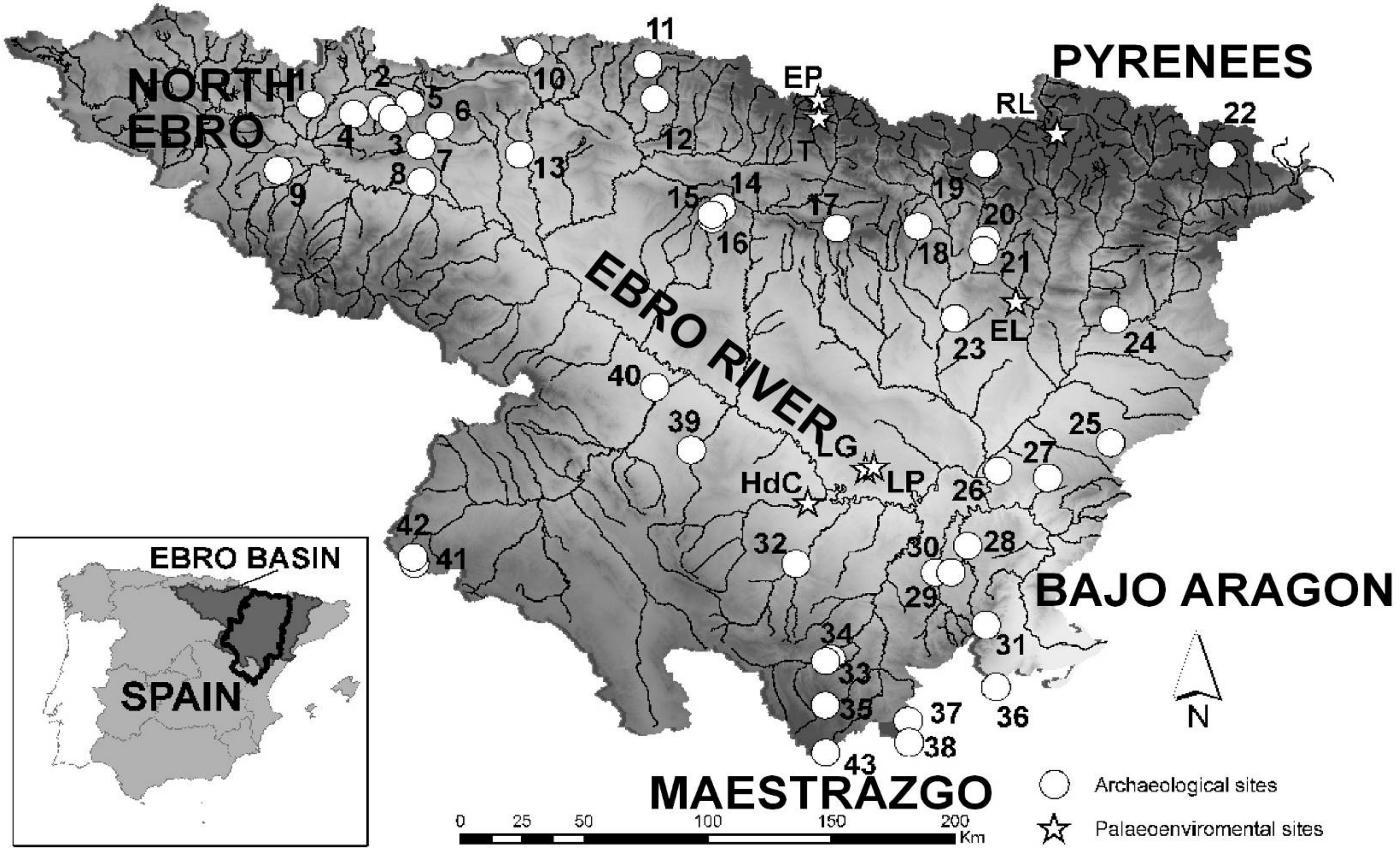
Continentalidad extrema: temperaturas máximas & mayor índice evapotranspiración (diferencia entre precipitación y evaporación…)



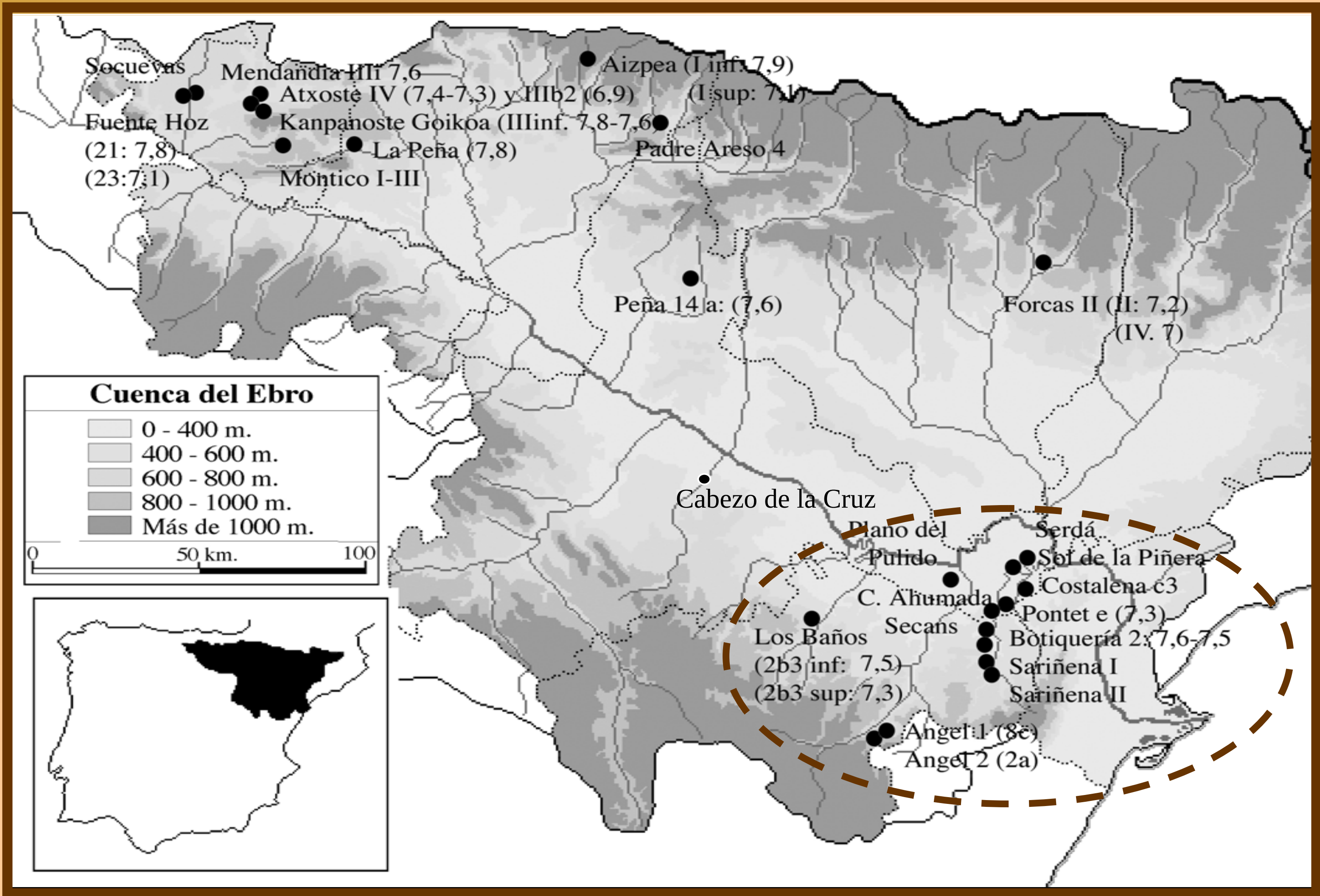


CONDICIONES EXTREMAS EN UNA REGIÓN "FRÁGIL"!!

Con una larga historia de ocupación humana…, particularmente **intensa** durante el Holoceno Temprano (máxima hdad en la región según registros “paleo”!!!)

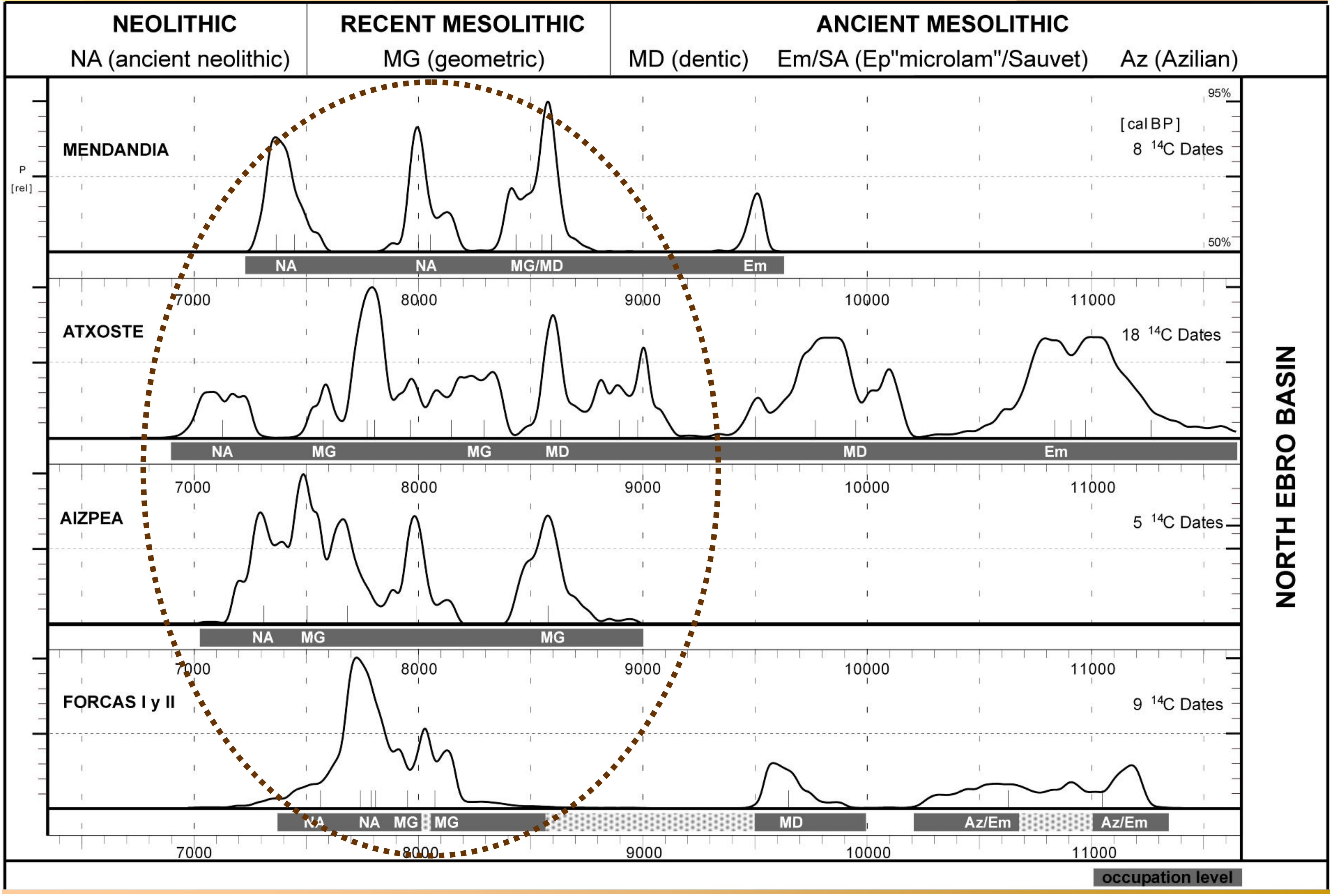


… incluso en las zonas más áridas, donde las temperaturas máximas de verano alcanzan a menudo los 45 º C o incluso más!!!!

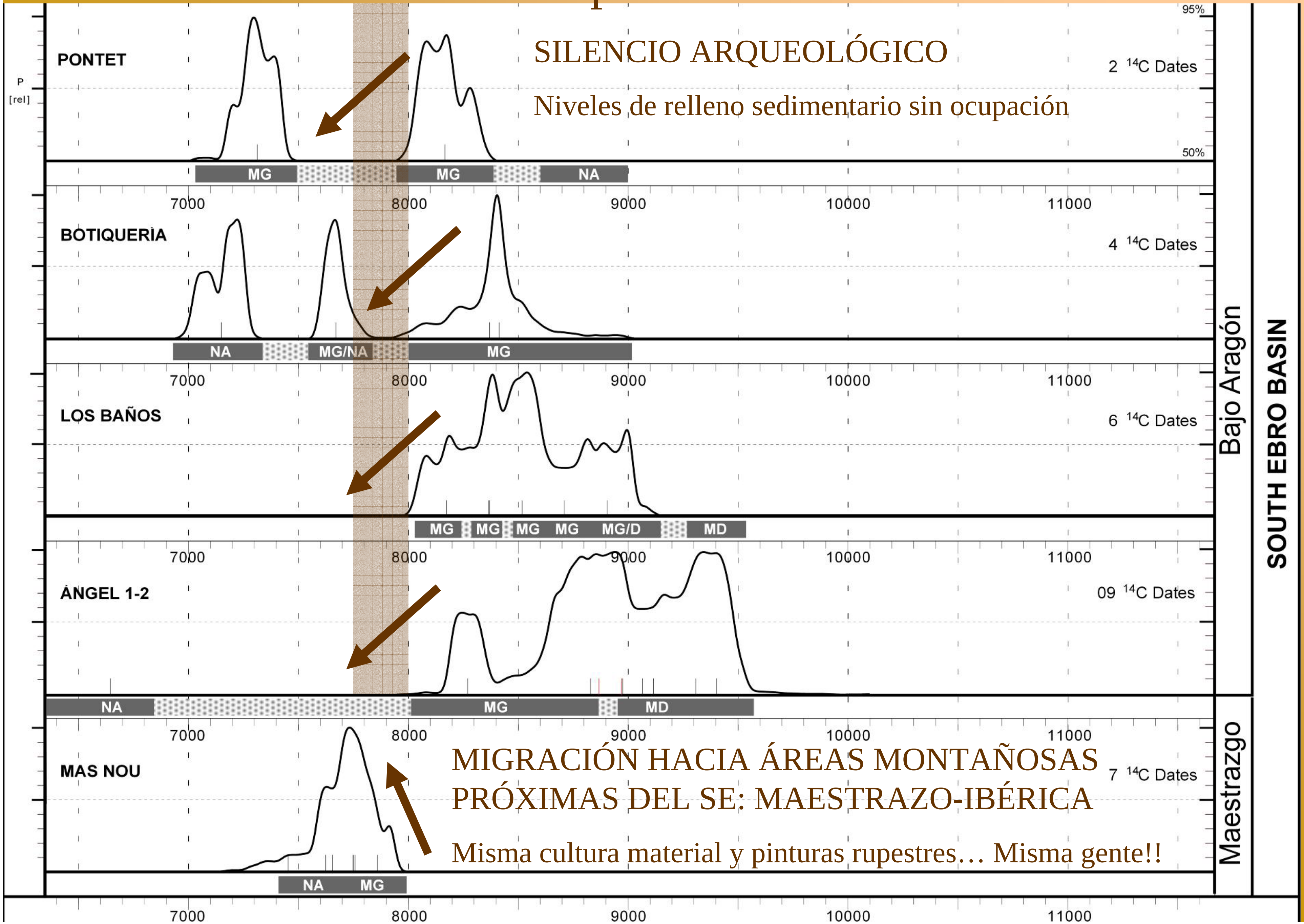


Este trabajo se basa en 228 dataciones de 40 yacimientos distintos, pero son muchísimos más (con cultura material) pero q no han sido excavados ni datados todavía…

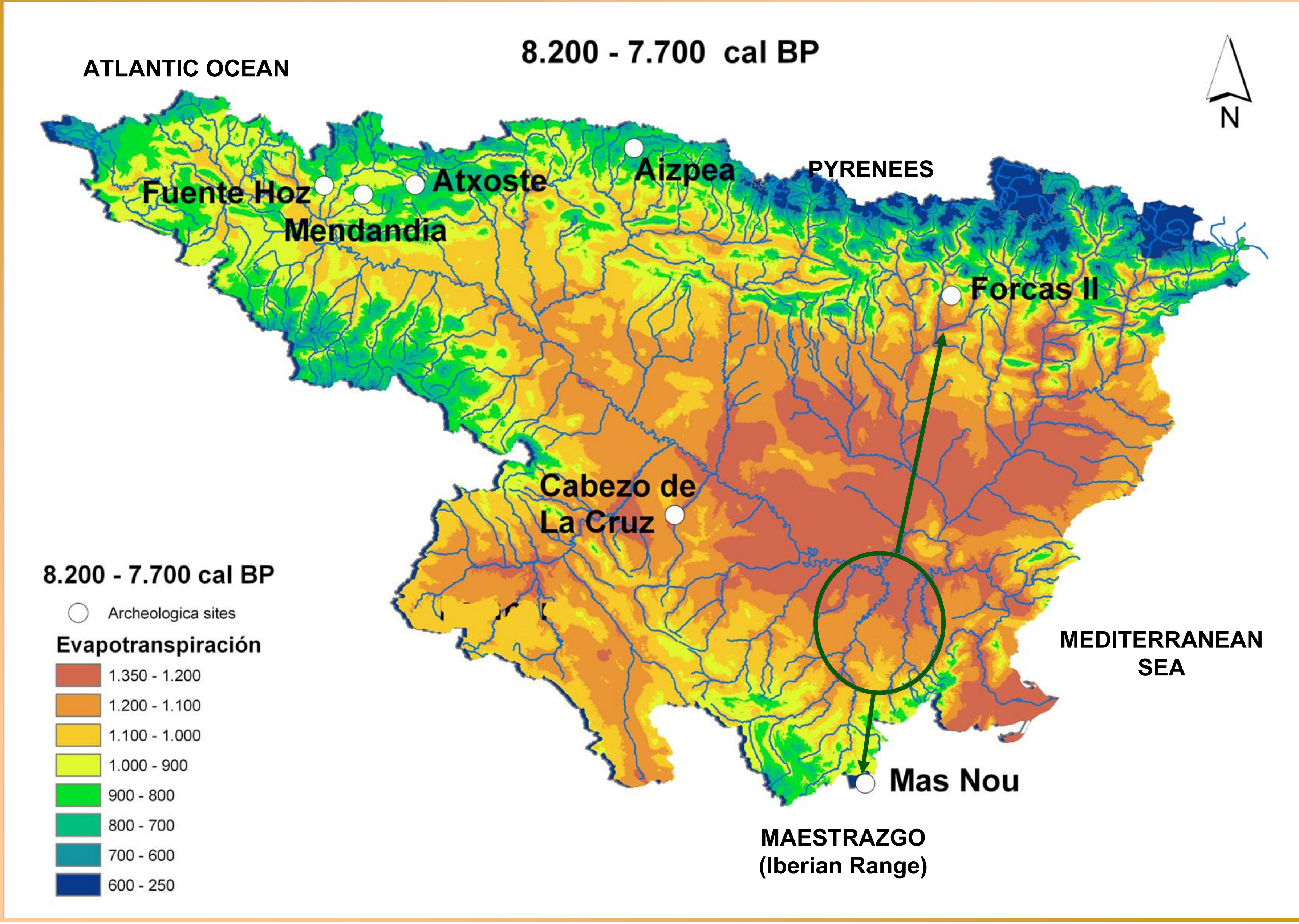
Norte Valle Ebro: ocupación bastante continua



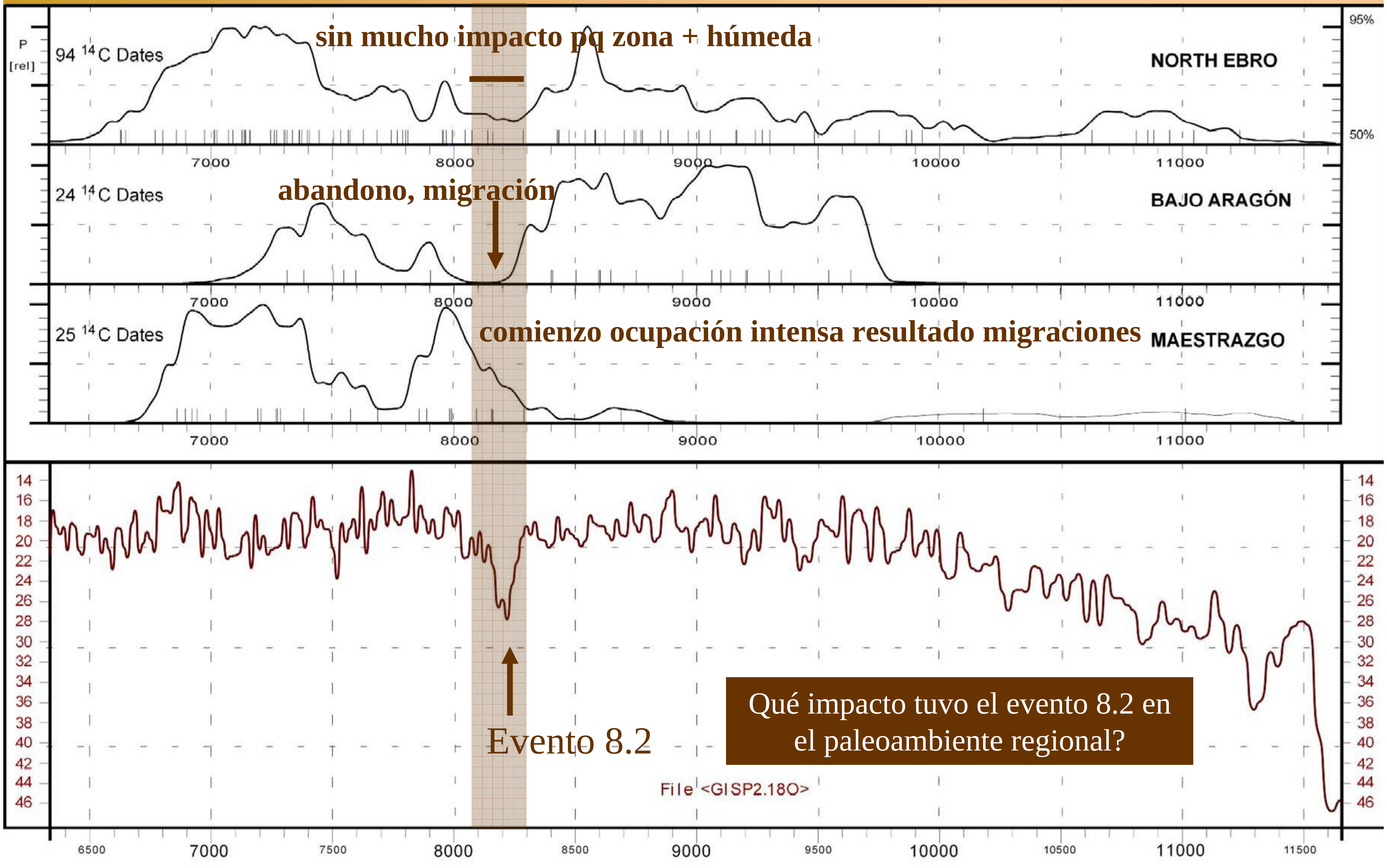
Sur Ebro: NO ocupación durante 500 años



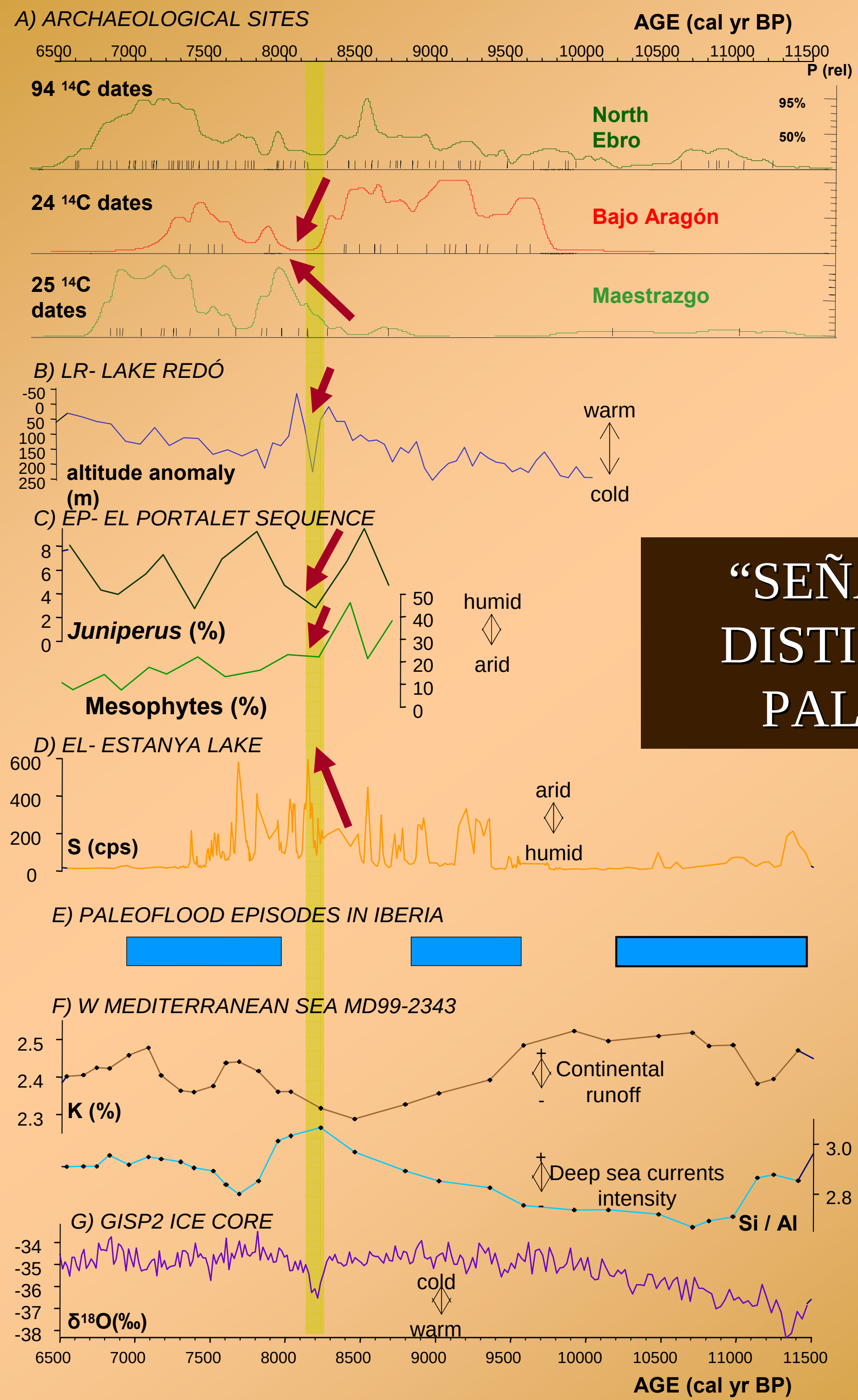
Las áreas más húmedas del norte mantienen la misma ocupación durante este intervalo



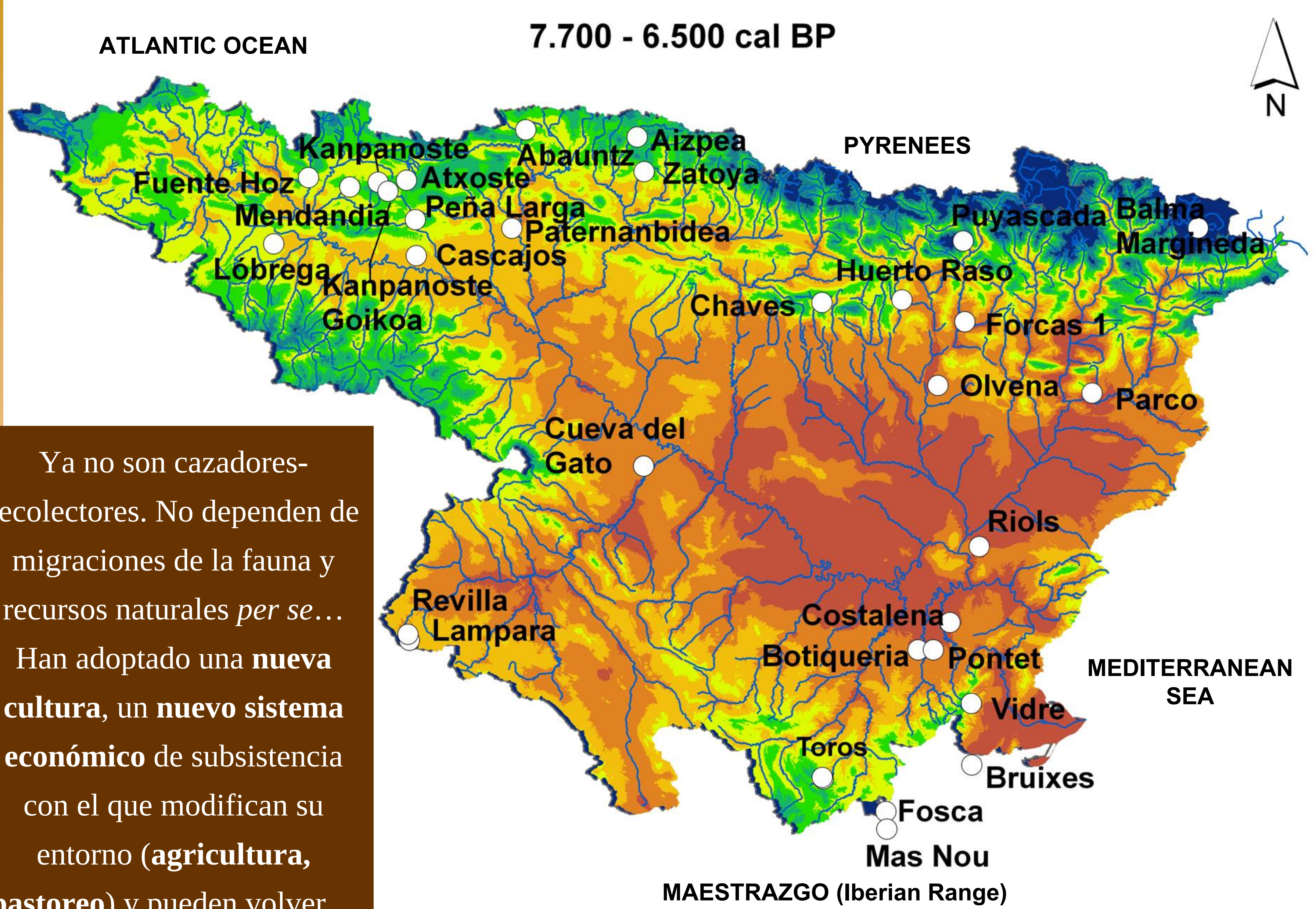
¿POR QUÉ? Impacto (aumento aridez) del evento 8.2



“SEÑALES” DEL 8.2 EN DISTINTOS REGISTROS PALEOCLIMÁTICOS



Sólo con la llegada del Neolítico, los humanos volvieron a ocupar el Bajo Aragón…



Ya no son cazadores-recolectores. No dependen de migraciones de la fauna y recursos naturales *per se*… Han adoptado una **nueva cultura**, un **nuevo sistema económico** de subsistencia con el que modifican su entorno (**agricultura, pastoreo**) y pueden volver…

CRECIENTE FÉRTIL:

“REVOLUCIÓN NEOLÍTICA”

EL NACIMIENTO DE LA AGRICULTURA

Hoy, aún hay en colinas zona “antepasados silvestres”: dos tipos de trigo, cebada, legumbres, vacas, ovejas, cabras y cerdos salvajes…

+ 11.000 BP, mutación o hibridación trigo silvestre = semillas más grandes, más alimento, no disemina x viento, crece siempre en el mismo sitio, año tras año…

11.500 BP: fin glaciación. **Clima** + seco. Necesidad estar cerca de ríos

Oriente Medio (POA): Creciente Fértil, x forma y ríos Tigris y Eúfrates, rodeado desiertos

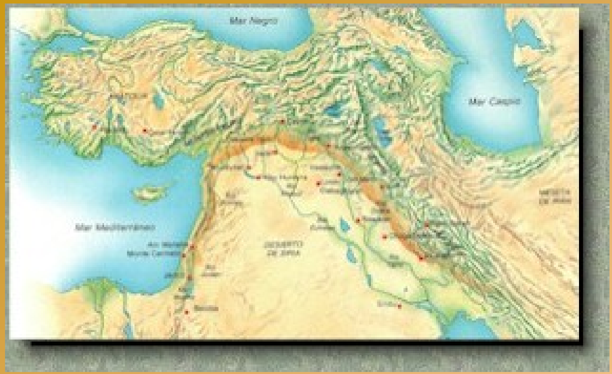
Aumento **densidad demográfica** (sedentarismo por necesidad demográfica, aumento demográfico por sedentarismo?)

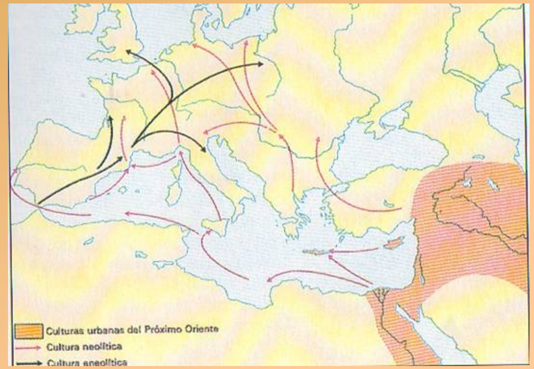
C**ambios económicos muy rápidos**: agricultura, ganadería, alfarería, piedra pulimentada…

Asentamiento población + excedentes = **sociedades complejas** donde surgió la **escritura** (cuneiforme, Sumerios). FIN DE LA PREHISTORIA

Benignidad climática + Ndad demográfica + Sedentarismo + Agricultura

¿dónde ponemos la ecuación? ¿QUÉ PROVOCA QUÉ?





cultivos y animales diferentes… x ***adaptación*** en la expansión o x ***surgimiento independiente***?

DETERMINISMO ECOLÓGICO? Influencia Medioambiente en desarrollo económico…

Zonas nucleares de la invención ¿"Independiente“? de la Agricultura

CRECIENTE FÉRTIL	OASIS SÁHARA	SAHEL AFRICANO	NORTE CHINA	NW SUDAMÉRICA	MESOAMÉRICA	SE ASIÁTICO
10.000 BP trigo cebada	8.000 BP 5.000 BP bóvido ovicáprido	3.000 BP mijo sorgo ñame	9.000 BP mijo arroz perro cerdo	7.000 BP mandioca patata cacahuete alpaca llama	8.000 BP calabaza judías maíz	6.000 BP arroz gallina toro
8.000 BP bóvido cerdo						

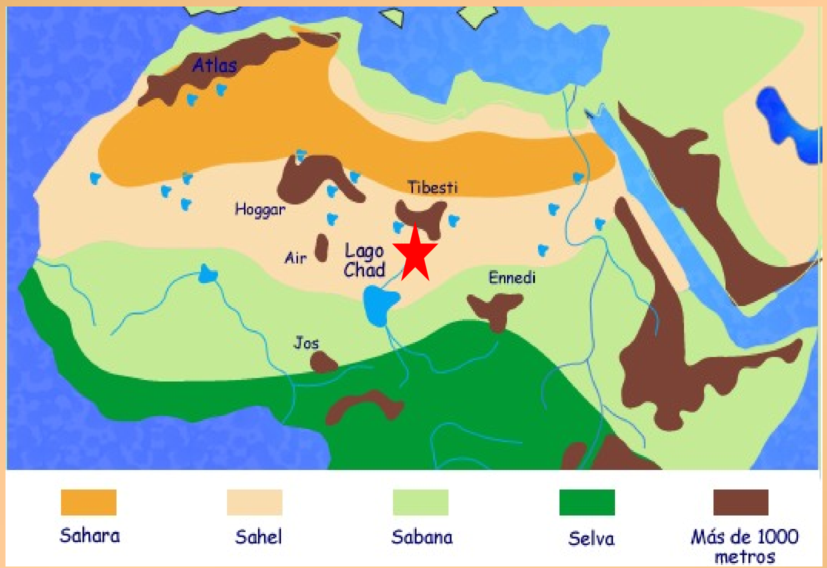
DESPLAZAMIENTO LÍMITE SAHARA-SAHEL EN HOLOCENO TEMPRANO Y MEDIO

Evolución *"West Nubian Palaeolake"*- MEGACHAD

i) aumento precipitación local (9400 BP)

ii) 1ª ocupación humana (6300 BP)

iii) final sincrónico (3500 BP)



Desplazamiento al N del cinturón monzónico = migraciones animales y humanas

ELSEVIER

Palaeogeography, Palaeoclimatology, Palaeoecology 169 (2001) 193–217

PALAEO

www.elsevier.nl/locate/palaeo

Environmental change and archaeology: lake evolution and human occupation in the Eastern Sahara during the Holocene

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Abstract

The West Nubian Palaeolake is the most large-scale hydrographic evidence in the Eastern Sahara of the early to mid-Holocene wet phase that affected northern Africa. It is the result of a significant increase in local rainfall due to the northward shift of the tropical rainfall belt. A series of fieldwork-based differential GPS (DGPS) measurements along several profiles across the West Nubian Palaeolake basin provides the first precise topographic data from this up to a 5330 km^2 large palaeolake feature. In combination with sedimentological, geochemical, and archaeological results, an almost complete picture of significant palaeoclimatic changes and human occupation during the early to mid-Holocene for this region is presented. Different stages of palaeolake evolution ranging from non-existence of the lake through stable freshwater conditions to its extinction were identified in the period from 9400 to 3800 ^{14}C yr BP. These lake stages coincide with phases of intensive human inhabitation between ca. 6300 and 3500 ^{14}C yr BP, and include at least four settlement phases distinguishable by style of pottery. These are known from adjacent areas of the palaeolake region, emphasizing strong prehistoric cultural connections in the Eastern Sahara. During the highstands of the palaeolake in the early to mid-Holocene, the Dotted Wavy-Line pottery relates to the Early Khartoum type culture with its supra-regional distribution from the Nile Valley to the Chad, and possibly with slightly different forms even to the Atlantic coast. Later in the Holocene, Western Nubia with its large palaeolakes and migration paths along palaeowadis, such as Wadi Howar, acted as an important natural and cultural link between the Nile Valley and the Chad Basin until the region was deserted during the fourth millennium BP. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Environmental change; Palaeolimnology; Archaeology; Holocene; Sudan; Eastern Sahara

1. Introduction

At about 9 ^{14}C kyr BP the tilt of the earth's axis was stronger than today and the time of the perihelion was at the end of July (Berger, 1978). This led to stronger insolation during the Northern Hemisphere summer and an increase in the amplitude of the seasonal cycle which enhanced the land–ocean temperature contrast, which in turn amplified the African and Indian monsoon (Kutzbach and Otto-Bliesner, 1982; Kröpelin, 1994; Kröpelin and Petit-Maire, 2000). During the early and mid-Holocene period the Sahelian and Saharan regions were considerably wetter than today as indicated by faunal and botanical remains, lacustrine sediments and archaeological

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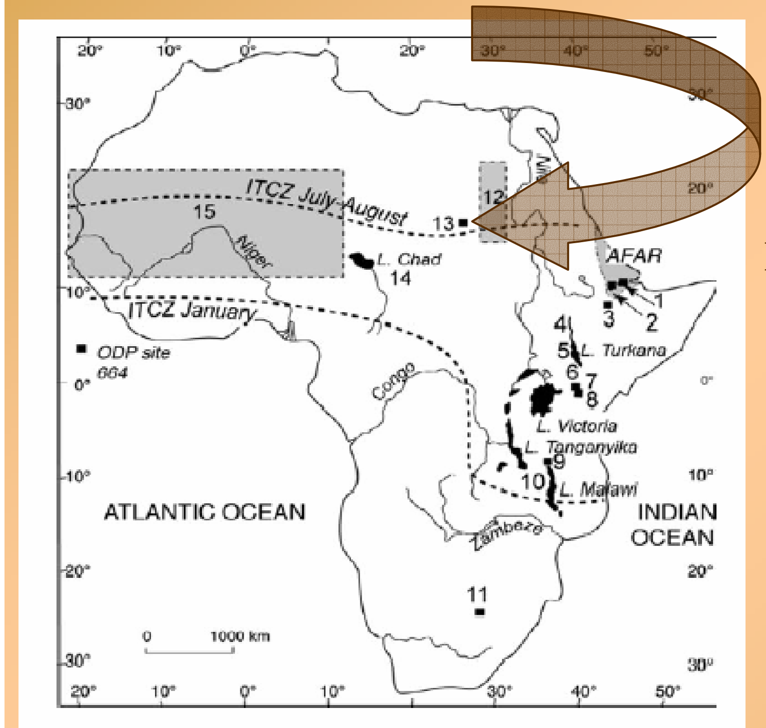
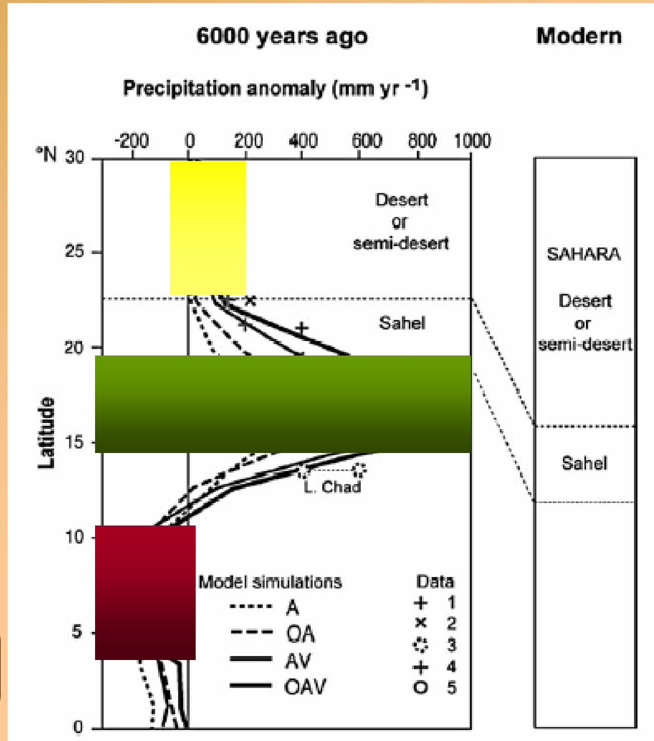
PII: S0031-0182(01)00211-5

Hoelzmann et al. (2001). Palaeogeography, Palaeoclimatology, Palaeoecology; Gasse (2000). Quaternary Science Reviews

West Nubian Palaeolake





Fases ocupación humana ± **intensas** (proliferación y/o abandono yacimientos: **301 hallazgos aire libre**!!!).

Semi-sedentarios. No estruct habitación. Restos útiles de cazador-recolector-pescador.

Fauna: hipopótamo, búfalo gigante, elefante, jirafa, gacela… "Perca del Nilo" (+ de 1m largo). Importantes recursos lacustres.

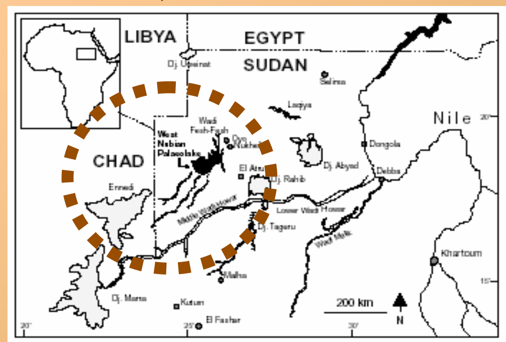
No domesticación

Evolución (9400-3800 BP)

i) inexistencia

ii) lago estable

iii) extinción



CRISIS DE ARIDEZ **GLOBAL**
+ 4.200 – 4.000 BP

IMPERIO AKADIO (Próximo Oriente)

CIVILIZACIÓN HARAPPEA (Valle del Indo)

CULTURA QUIJIA (Meseta China)

CULTURA ARGÁRICA (Sur Península Ibérica)

COLAPSO IMPERIO ACADIO

Mesopotamia (Sumer / Akkad)

Inicio: 2.334 BC (4.284 BP)

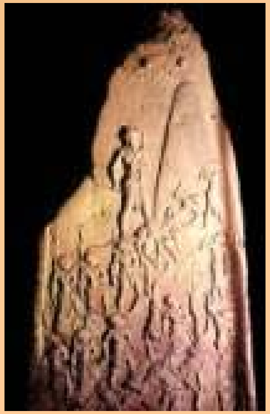
Fin: 2.193 BC (4.143 BP)

Colapso abrupto alrededor 4.170 + 150 BP

Condiciones + áridas. Descenso global pp 30%

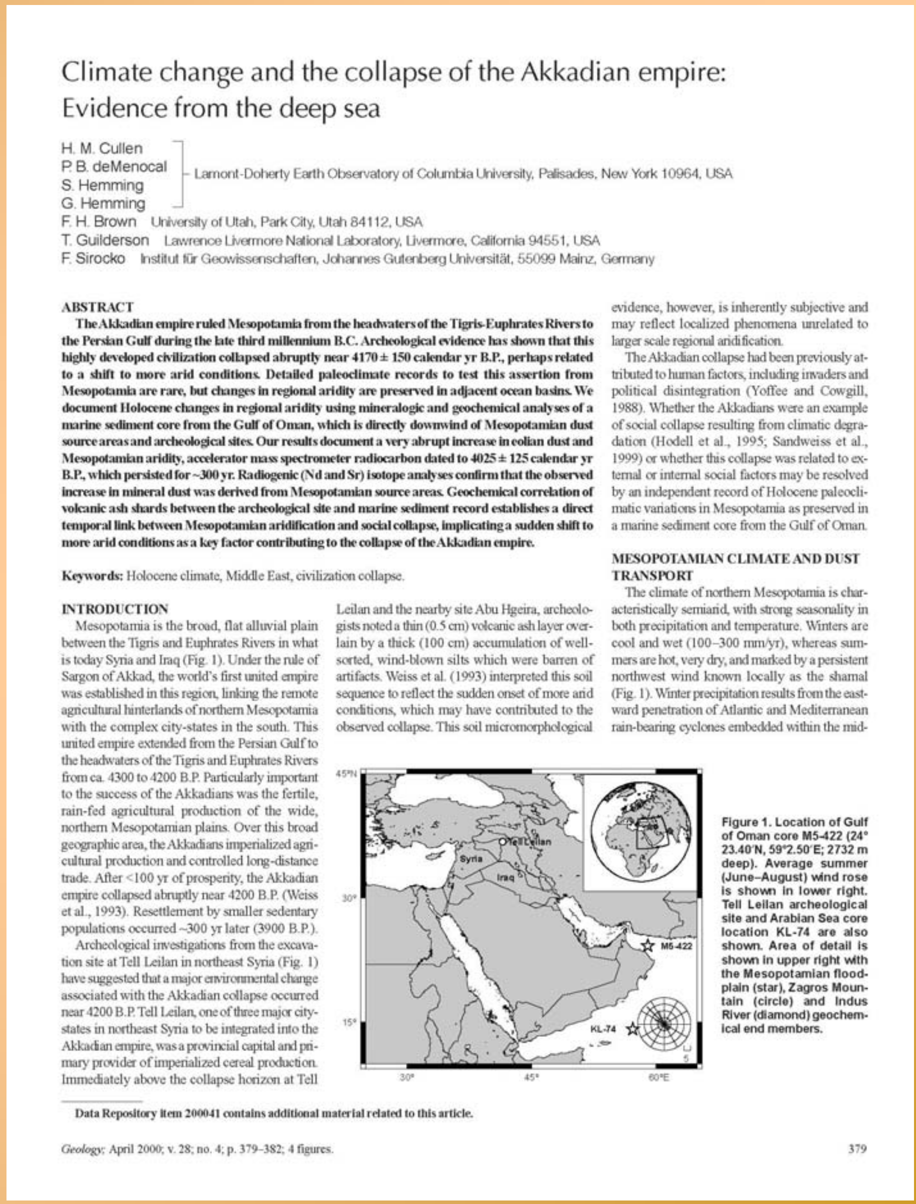
¿Un factor detonante más?

Técnicas almacenamiento grano + regulación hídrica sofisticadas pero insuficientes



ESTELA DE NARAM-SIN

MÁSCARA DE SARGÓN



Climate change and the collapse of the Akkadian empire: Evidence from the deep sea

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F. H. Brown University of Utah, Park City, Utah 84112, USA
T. Guilderson Lawrence Livermore National Laboratory, Livermore, California 94551, USA
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ABSTRACT

The Akkadian empire ruled Mesopotamia from the headwaters of the Tigris-Euphrates Rivers to the Persian Gulf during the late third millennium B.C. Archeological evidence has shown that this highly developed civilization collapsed abruptly near 4170 ± 150 calendar yr B.P., perhaps related to a shift to more arid conditions. Detailed paleoclimate records to test this assertion from Mesopotamia are rare, but changes in regional aridity are preserved in adjacent ocean basins. We document Holocene changes in regional aridity using mineralogic and geochemical analyses of a marine sediment core from the Gulf of Oman, which is directly downwind of Mesopotamian dust source areas and archeological sites. Our results document a very abrupt increase in eolian dust and Mesopotamian aridity, accelerator mass spectrometer radiocarbon dated to 4025 ± 125 calendar yr B.P., which persisted for ~300 yr. Radiogenic (Nd and Sr) isotope analyses confirm that the observed increase in mineral dust was derived from Mesopotamian source areas. Geochemical correlation of volcanic ash shards between the archeological site and marine sediment record establishes a direct temporal link between Mesopotamian aridification and social collapse, implicating a sudden shift to more arid conditions as a key factor contributing to the collapse of the Akkadian empire.

Keywords: Holocene climate, Middle East, civilization collapse.

INTRODUCTION

Mesopotamia is the broad, flat alluvial plain between the Tigris and Euphrates Rivers in what is today Syria and Iraq (Fig. 1). Under the rule of Sargon of Akkad, the world's first united empire was established in this region, linking the remote agricultural hinterlands of northern Mesopotamia with the complex city-states in the south. This united empire extended from the Persian Gulf to the headwaters of the Tigris and Euphrates Rivers from ca. 4300 to 4200 B.P. Particularly important to the success of the Akkadians was the fertile, rain-fed agricultural production of the wide, northern Mesopotamian plains. Over this broad geographic area, the Akkadians imperialized agricultural production and controlled long-distance trade. After <100 yr of prosperity, the Akkadian empire collapsed abruptly near 4200 B.P. (Weiss et al., 1993). Resettlement by smaller sedentary populations occurred ~300 yr later (3900 B.P.).

Archeological investigations from the excavation site at Tell Leilan in northeast Syria (Fig. 1) have suggested that a major environmental change associated with the Akkadian collapse occurred near 4200 B.P. Tell Leilan, one of three major city-states in northeast Syria to be integrated into the Akkadian empire, was a provincial capital and primary provider of imperialized cereal production. Immediately above the collapse horizon at Tell Leilan and the nearby site Abu Hgeira, archeologists noted a thin (0.5 cm) volcanic ash layer overlain by a thick (100 cm) accumulation of well-sorted, wind-blown silts which were barren of artifacts. Weiss et al. (1993) interpreted this soil sequence to reflect the sudden onset of more arid conditions, which may have contributed to the observed collapse. This soil micromorphological evidence, however, is inherently subjective and may reflect localized phenomena unrelated to larger scale regional aridification.

The Akkadian collapse had been previously attributed to human factors, including invaders and political disintegration (Yoffee and Cowgill, 1988). Whether the Akkadians were an example of social collapse resulting from climatic degradation (Hodell et al., 1995; Sandweiss et al., 1999) or whether this collapse was related to external or internal social factors may be resolved by an independent record of Holocene paleoclimatic variations in Mesopotamia as preserved in a marine sediment core from the Gulf of Oman.

MESOPOTAMIAN CLIMATE AND DUST TRANSPORT

The climate of northern Mesopotamia is characteristically semiarid, with strong seasonality in both precipitation and temperature. Winters are cool and wet (100–300 mm/yr), whereas summers are hot, very dry, and marked by a persistent northwest wind known locally as the shamal (Fig. 1). Winter precipitation results from the eastward penetration of Atlantic and Mediterranean rain-bearing cyclones embedded within the mid-

Figure 1. Location of Gulf of Oman core M5-422 (24° 23.40′N, 59°2.50′E; 2732 m deep). Average summer (June–August) wind rose is shown in lower right. Tell Leilan archeological site and Arabian Sea core location KL-74 are also shown. Area of detail is shown in upper right with the Mesopotamian floodplain (star), Zagros Mountain (circle) and Indus River (diamond) geochemical end members.

Data Repository item 200041 contains additional material related to this article.

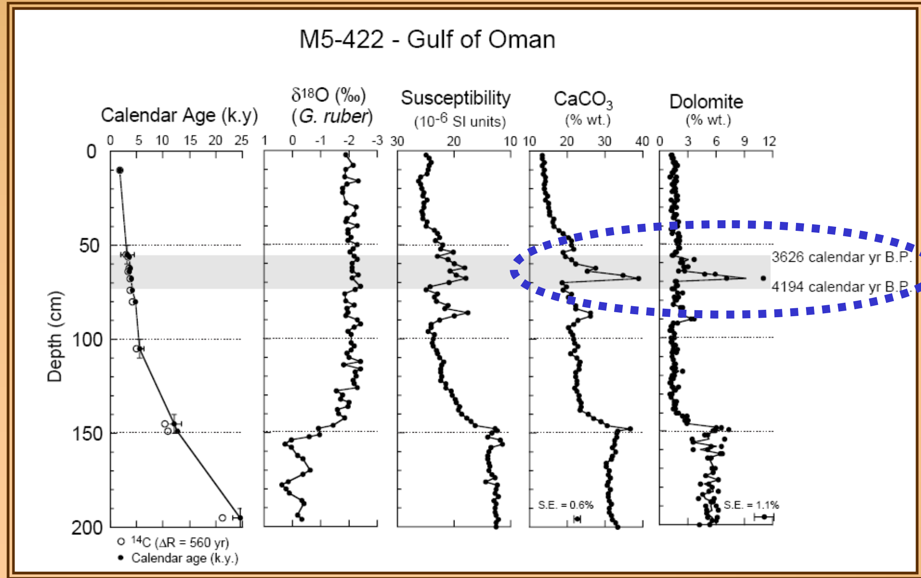
Geology; April 2000; v. 28; no. 4; p. 379–382; 4 figures. 379

Cullen et al. (2000). Geology;

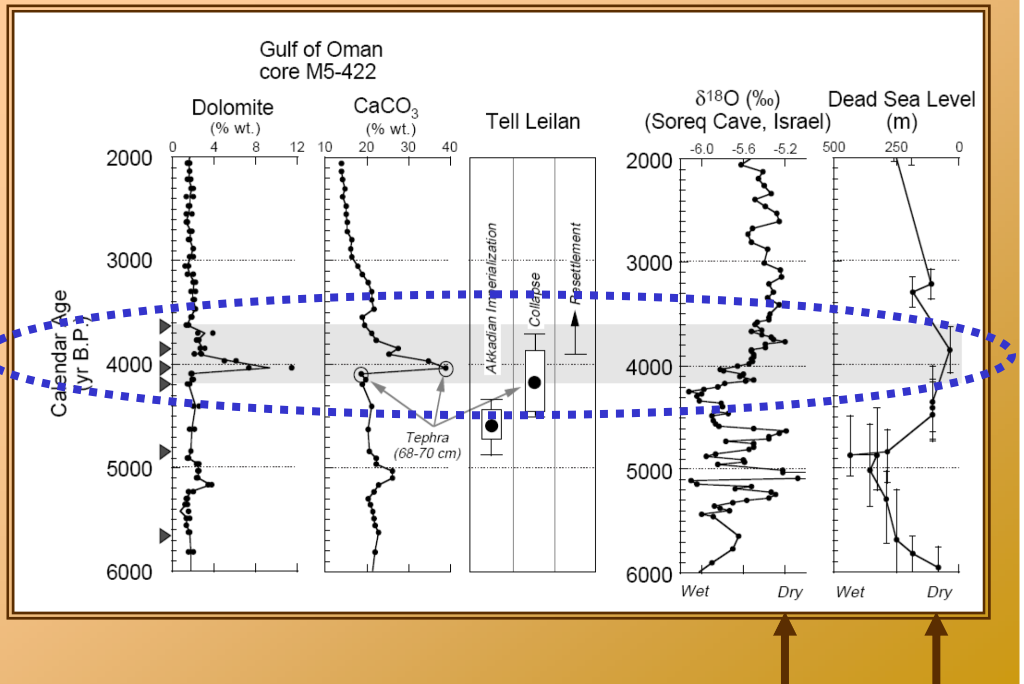
Weiss et al. (1993). Science

NO registros paleoclimáticos de detalle en **Mesopotamia**

Datos del **Golfo de Omán**: <u>sondeo marino</u> *M5-422* (brusco aumento aportes eólicos –dolomita- y sedimento origen terrígeno). Comparación con <u>estalagmita</u> de *Soreq cave*.



Reducción yacimientos llanuras del Norte (por crisis aguda de aridez), emigración masiva al Sur y desestabilización del sistema.



COLAPSO VALLE DEL INDO

Civilización **Harappea**

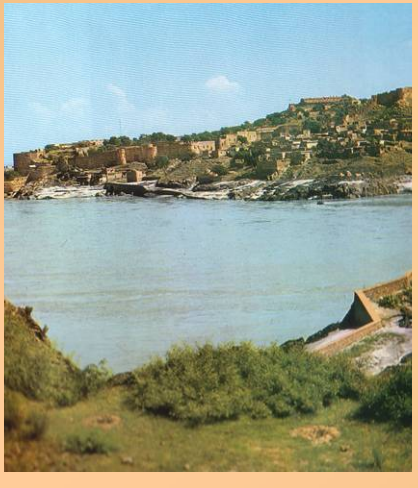
Inicio: 4450 BP. Fin: 4090 BP

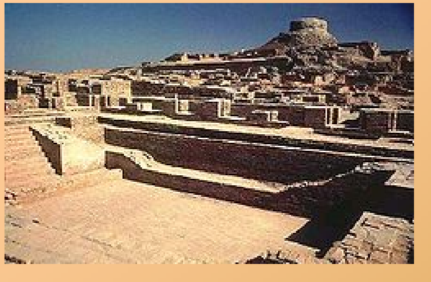
Centenar pueblos + 2 ciudades = 1 millón km^2

Río Indo: desbordamiento anual, inundaciones & sedimentos fértiles

Base economía: *agricultura regadío*. AGUA

Colapso x cambio medioambiental? Descenso pp repercute en dinámica fluvial y crisis?





GEOPHYSICAL RESEARCH LETTERS, VOL. 30, NO. 8, 1425, doi:10.1029/2002GL016822, 2003

Climate change at the 4.2 ka BP termination of the Indus valley civilization and Holocene south Asian monsoon variability

M. Staubwasser,[1] F. Sirocko,[2] P. M. Grootes,[3] and M. Segl[4]

Received 20 December 2002; revised 20 December 2002; accepted 31 January 2003; published 18 April 2003.

[1] Planktonic oxygen isotope ratios off the Indus delta reveal climate changes with a multi-centennial pacing during the last 6 ka, with the most prominent change recorded at 4.2 ka BP. Opposing isotopic trends across the northern Arabian Sea surface at that time indicate a reduction in Indus river discharge and suggest that later cycles also reflect variations in total annual rainfall over south Asia. The 4.2 ka event is coherent with the termination of urban Harappan civilization in the Indus valley. Thus, drought may have initiated southeastward habitat tracking within the Harappan cultural domain. The late Holocene drought cycles following the 4.2 ka BP event vary between 200 and 800 years and are coherent with the evolution of cosmogenic ^{14}C production rates. This suggests that solar variability is one fundamental cause behind Holocene rainfall changes over south Asia.

INDEX TERMS: 3344 Meteorology and Atmospheric Dynamics: Paleoclimatology; 4267 Oceanography: General: Paleoceanography; 1620 Global Change: Climate dynamics (3309). **Citation:** Staubwasser, M., F. Sirocko, P. M. Grootes, and M. Segl, Climate change at the 4.2 ka BP termination of the Indus valley civilization and Holocene south Asian monsoon variability, *Geophys. Res. Lett.*, *30*(8), 1425, doi:10.1029/2002GL016822, 2003.

1. Introduction

[2] Northern hemisphere records reveal millennial-scale climate changes during the Holocene, which may have been tuned to solar radiation variability [*Sirocko et al.*, 1996; *deMenocal et al.*, 2000; *Bond et al.*, 2001]. The most pronounced changes in northern Africa and western Asia occurred at the mid-late Holocene transition between 5.5 and 4.0 ka cal. BP, where one or several successive shifts towards dryer conditions are well documented [*Bar-Matthews et al.*, 1997; *deMenocal et al.*, 2000; *Gasse*, 2000]. Around 4.2 ka BP the ancient civilizations of Egypt and Mesopotamia suffered from sustained drought or even collapsed entirely [*Weiss et al.*, 1993; *Hassan*, 1997; *Cullen et al.*, 2000]. At the same time the Harappan civilization of the Indus valley (Pakistan) transformed from a highly organized urban phase to a post-urban phase of smaller settlements accompanied by a southeastward migration of the population [*Possehl*, 1997]. However, previous climate records are inconclusive on the timing of south Asian Holocene climate change, the underlying mechanisms of such change, and whether the Harappan civilization decline was the result of climate change [*Singh et al.*, 1990; *Possehl*, 1997; *Enzel et al.*, 1999; *Weiss*, 2000].

2. Regional Setting and Chronology

[3] Due to the effects of the south Asian monsoon a strong zonal precipitation gradient exists across the Arabian Sea (AS) (Figure 1a). The only significant freshwater source to the northern AS was the river Indus, until irrigation and flood control measures dramatically reduced its outflow over the last century [*Milliman et al.*, 1984]. Summer monsoon ocean upwelling, which in the western AS lowers sea surface salinity, does not affect the northern AS or the Gulf of Oman (GO), and low salinity water from the Bay of Bengal does not flow into the northern AS during winter [*Levitus et al.*, 1994]. However, a strong seasonality is imposed on northern AS and GO sea surface temperatures (SST) and mixed layer depth by the reversing monsoon winds and associated air temperatures (Figures 1b and 1c) [*Rao et al.*, 1989].

[4] Laminated sediment core 63KA was retrieved from a site on the continental margin off Pakistan at 316 m water depth off the formerly active Indus delta (Figure 1a). The chronology of the mid-late Holocene section presented here is based on 36 ^{14}C dated single species samples of planktonic foraminifera, typically *Globigerinoides sacculifer*, but *Orbulina universa* in three occasions (Figure 2). ^{14}C ages were calibrated by least-squares fitting of a ^{14}C plateau resolved between 5 and 6 ka BP to the ^{14}C calibration record (supplementary note 1)[1] [*Staubwasser et al.*, 2002]. The obtained reservoir age of 565 ^{14}C years was then used throughout the rest of the core.

3. The 4.2 ka BP drought Event

[5] The $\delta^{18}O$ record of surface dwelling planktonic foraminifer *Globigerinoides ruber* shows little change in the mid-Holocene, but enhanced variability in the late Holocene with $\delta^{18}O$ values between −1.7‰ to −2.1‰ (Figure 2). Between ~1.0 ka BP and ~0.4 ka BP detailed observations are somewhat compromised by intermittent absence of *G. ruber* in the core. The relatively variable late Holocene appears to begin with a (positive) shift to heavier $\delta^{18}O$ at 4.2 ka BP. This shift in *G. ruber* $\delta^{18}O$ may reflect any combination of cooler sea surface temperatures (SST) and heavier $\delta^{18}O$ of the

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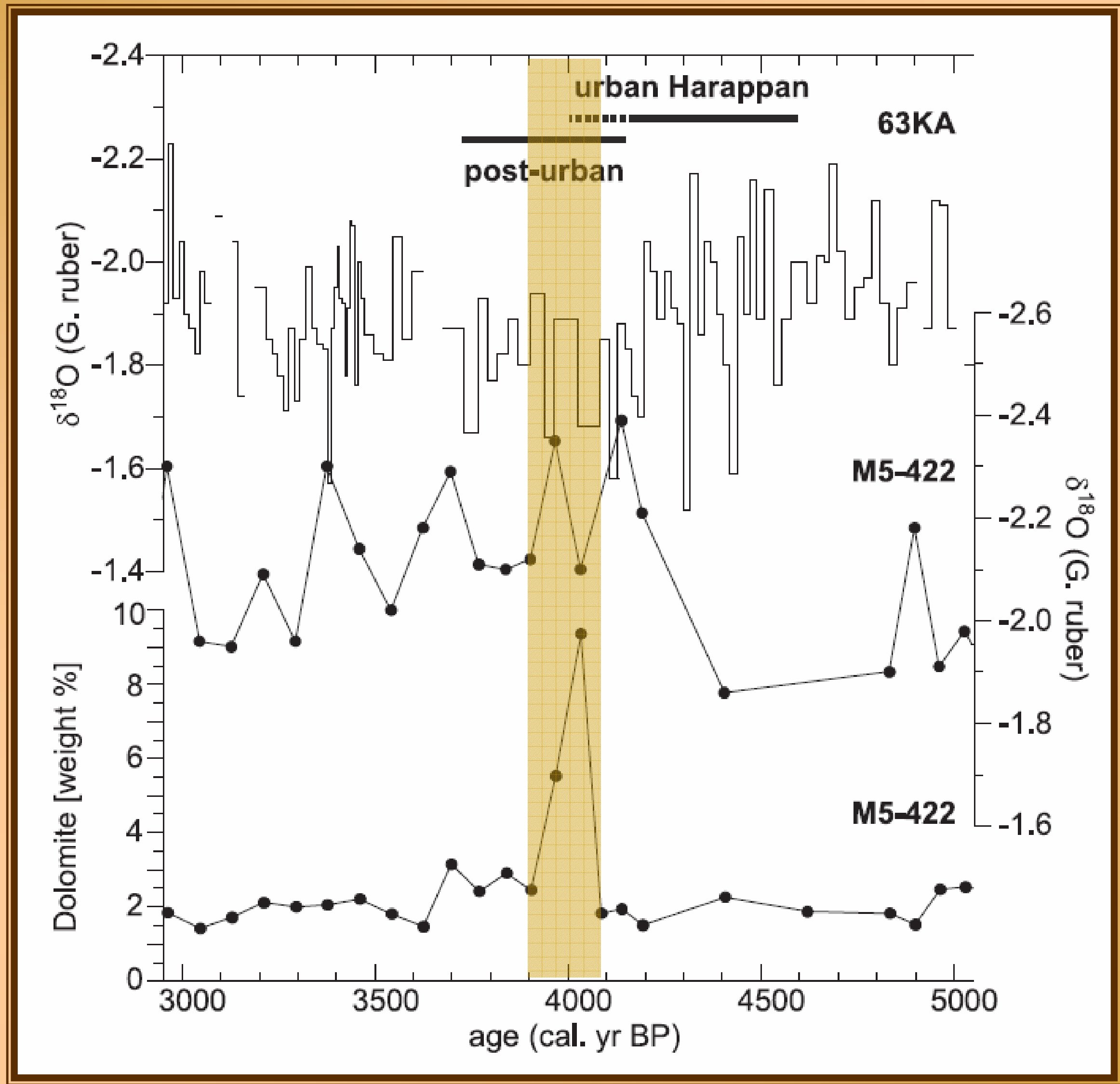
[4]Geowissenschaften, Universität Bremen, Bremen, Germany.

0094-8276/03/2002GL016822$05.00

[1] Auxiliary notes and tables are available via Web browser or via Anonymous FTP from ftp://ftp.agu.org, directory "apend" (Username = "anonymous", Password = "guest"); subdirectories in the ftp site are arranged by paper number. Information on searching and submitting electronic supplements is found at http://www.agu.org/pubs/esupp_about.html.

Staubwasser et al. (2003). Geophysical Research Letters



Cultivo sin “esfuerzo” cuando retroceso aguas inundación. **Excedentes**. Ganadería aprovechada **transporte** x no ndad campo. **Intercambio comercial**. Auge y expansión. Desequilibrio cuando Indo irregular (descenso pp)

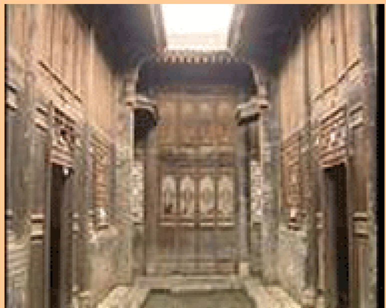
REDUCCIÓN DEMOGRÁFICA MESETA CHINA

Expansión **cultura QIJIA**
(4300 - 4000 BP)

Área semi-árida + sensible cambios climáticos

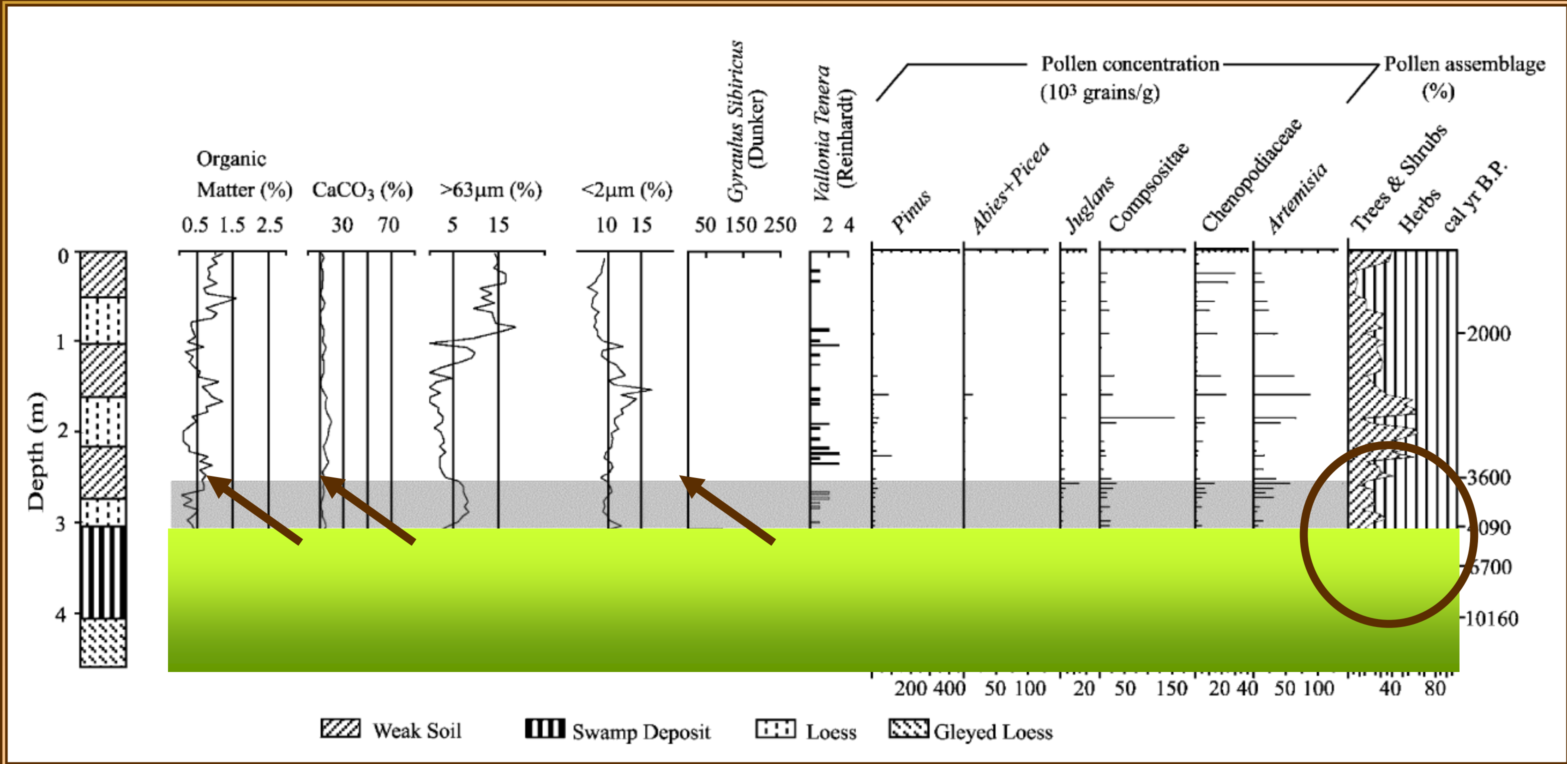
Colapso “catastrófico”
Abandono, migraciones, reducción demográfica drástica

Mijo, cerdos, ovejas…
Metalurgia (E. Bronce)

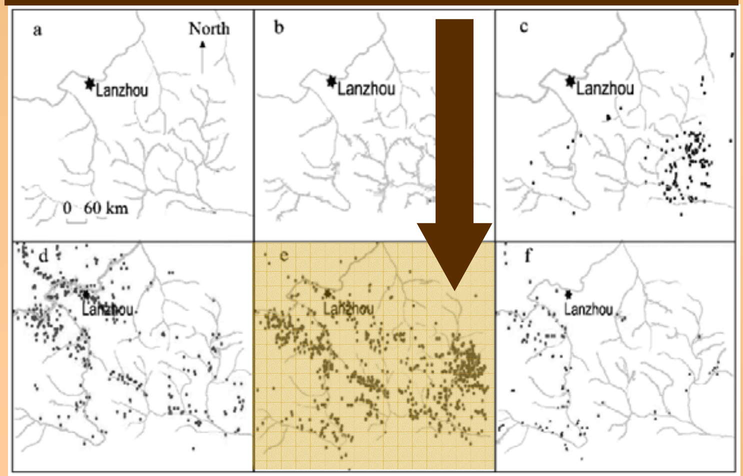


An et al. (2005). Quaternary Research

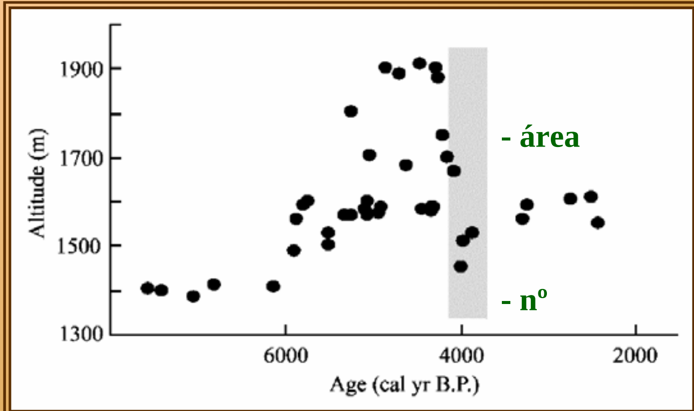
aumento aridez = descenso molusco zonas hdas (*Gyraulus sibiricus*), MO, CO_3Ca, y AP (Sujiawan record)



CULTURA QIJIA 4300 - 4000 BP



Distribución yacimientos arqueológicos en **cotas y tiempo**: *antes crisis* aridez, *expansión* hasta en *altitud*



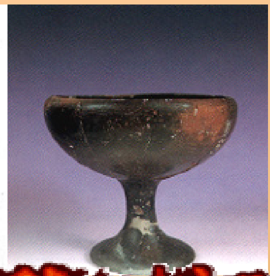
COLAPSO ARGÁRICO

Desaparición-colapso de gran civilización (ARGAR: 4.400 – 3.500 cal yr BP) desde Almería hasta Alicante y Albacete)

Aprovechamiento intensivo (deforestación masiva + incremento incendios) y posterior **agotamiento** de sus **recursos???**

Cronológicamente **coincide** con **crisis aridez** global **4000 BP**

Detonante?
SOBREEXPLOTACIÓN?
CLIMA?



ELSEVIER

Quaternary Science Reviews 26 (2007) 1455–1475

QSR

Holocene environmental change in a montane region of southern Europe with a long history of human settlement

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Received 7 April 2006; accepted 28 March 2007

Abstract

This paper uses a palynological sequence to examine the Holocene (8390–160 cal yr BP) environmental history of the Sierra de Baza (Granada, southeastern Spain) with the goal of establishing the mechanisms exerting control over vegetation change. During the period ca 8390–6320 cal yr BP, *Pinus* dominated the pollen spectra, indicating a forested landscape over the high-elevation areas of the Sierra. From ca 6320–3800 cal yr BP, an expansion of deciduous oaks and other broad-leaf trees took place. After an optimum around 5800–5600 cal yr BP, mesophytes decreased in the 3800–2560 cal yr BP interval while a fire-prone scrub became established. The main loss of forest accompanied the spread of thorny matorral after ca 2560 cal yr BP. Overall, this mountain region has shown itself to be sensitive to a range of influences, among which a continental climate that has become increasingly arid over the last 5000 years, the scarcity of soils suitable for cultivation, a geology that includes sources of copper and other metals and, especially, the incidence of grazing as well as the repeated appearance of fires during the last 4000 years, are highlighted. The history of the vegetation of the Sierra de Baza seems clearly influenced by changes in local economy. Here we discuss how ecological transitions have interacted with cultural changes, with emphasis on the locally highly populated Chalcolithic (5700–4400 cal yr BP) and Argaric (4400–3550 cal yr BP) periods, as well as the Iberian period (3200–2220 cal yr BP). The sierra was abandoned during the Iberian Period which was, paradoxically, when the highest human impact on mountain vegetation is noticeable.

1. Introduction

Although compatible with the influence of millennial-scale climate change, the timing and intensity of disturbances have demonstrated the importance of contingent events on vegetation development in the Iberian Peninsula during the Holocene (Carrión et al., 2001a). The apparently chaotic picture of vegetation dynamics in Mediterranean Spain includes scenarios of inertia and resilience at a palaeoecological scale (Carrión and van Geel, 1999; Carrión, 2002; Franco et al., 2005). Plausibly, in a context of orographic complexity and long history of species interactions due to the persistence of multiple glacial refugia (García-Antón et al., 1990; Peñalba, 1994; Carrión et al., 2003a, Arroyo et al., 2004), subtle differences in initial conditions during glacial times would have tended to cascade and affect the outcome of post-glacial events so that the duplication of the exact sequence of vegetation types at a particular site is highly improbable.

It appears that the patterns of vegetation change reach maximum complexity between the mid- and late-Holocene. Thus, for instance, although an aridification trend over the last five millennia is well-established (Araus et al., 1997; Pantaleón-Cano et al., 2003), the timing of forest decline is spatially uneven and cannot be solely explained by current differences in physical setting (Carrión, 2001). Among the

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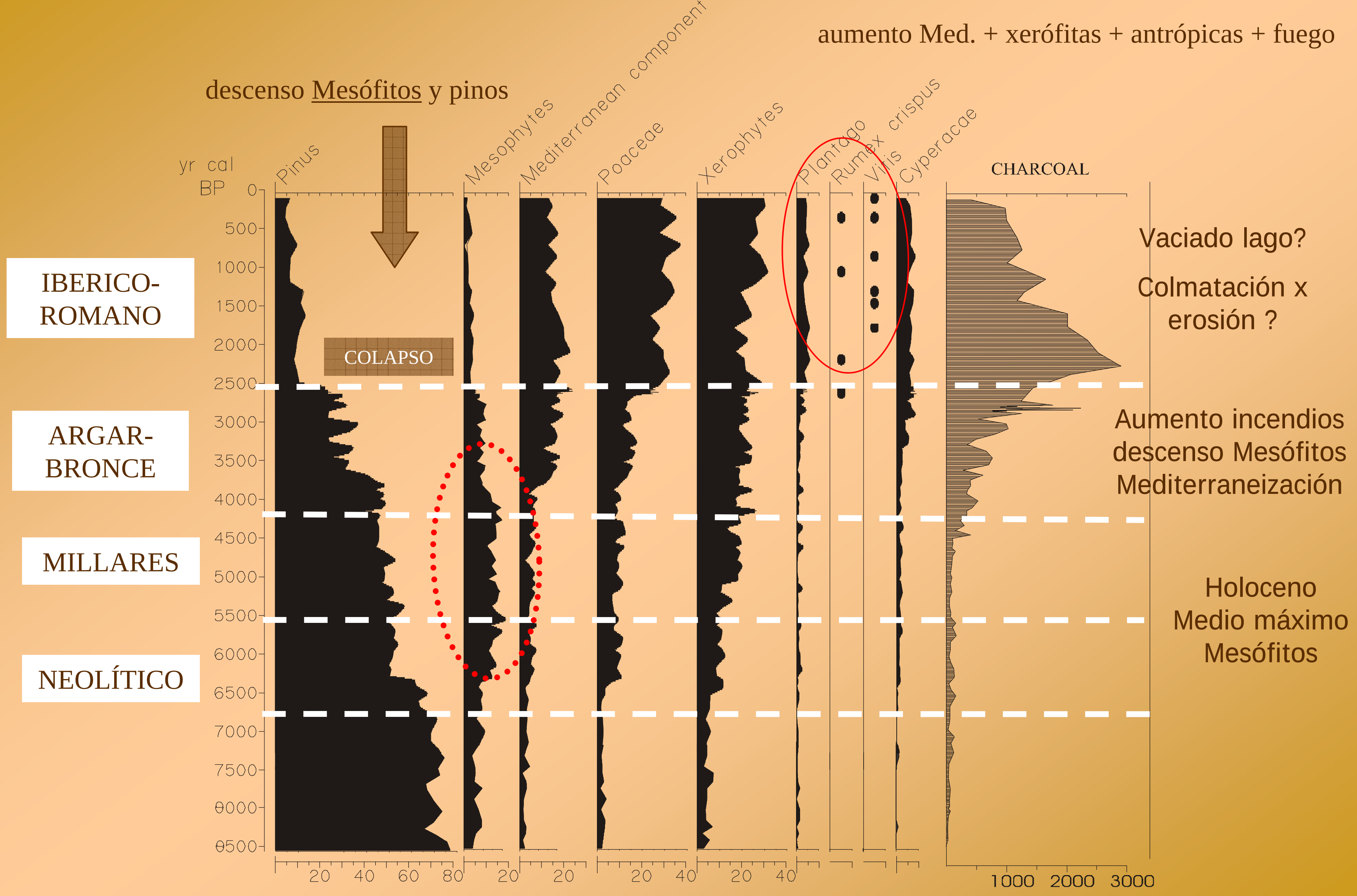
doi:10.1016/j.quascirev.2007.03.013

Carrión et al. (2003). The Holocene

Carrión et al. (2006). Quaternary Science Reviews.

BAZA : a partir cultura Argar aumenta virulencia fuego



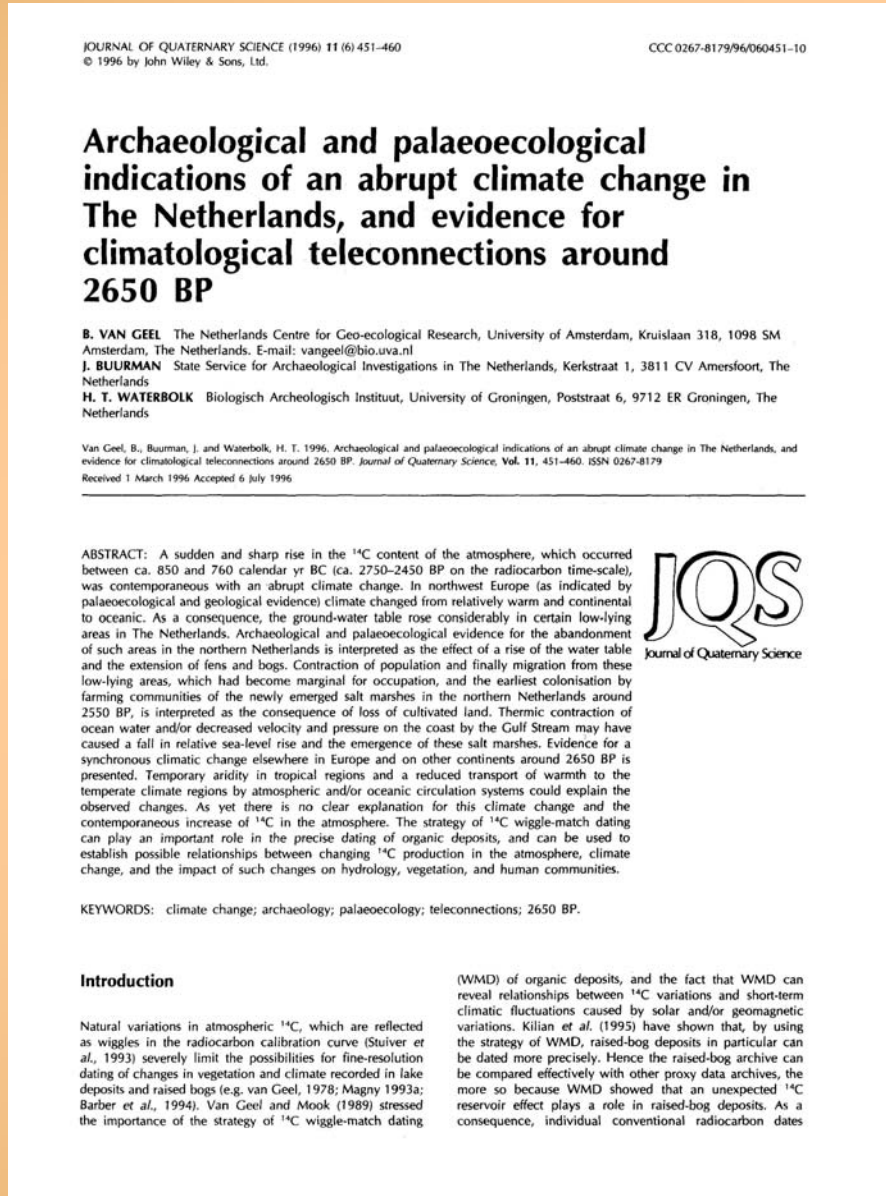
EDAD BRONCE - HIERRO

HOLANDA 2650 BP: + frío & + hdad: **expansión terrenos turbosos**

Transición Sub-boreal / Sub-atlántico

Migraciones de llanuras y asentamientos junto ríos a zonas elevadas: **encharcamientos**, PALAFITOS, **pérdidas cosechas**…

Crisis "ambiental", económica & social



JOURNAL OF QUATERNARY SCIENCE (1996) 11 (6) 451–460

CCC 0267-8179/96/060451-10

Archaeological and palaeoecological indications of an abrupt climate change in The Netherlands, and evidence for climatological teleconnections around 2650 BP

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Van Geel, B., Buurman, J. and Waterbolk, H. T. 1996. Archaeological and palaeoecological indications of an abrupt climate change in The Netherlands, and evidence for climatological teleconnections around 2650 BP. *Journal of Quaternary Science*, **Vol. 11**, 451–460. ISSN 0267-8179

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ABSTRACT: A sudden and sharp rise in the ^{14}C content of the atmosphere, which occurred between ca. 850 and 760 calendar yr BC (ca. 2750–2450 BP on the radiocarbon time-scale), was contemporaneous with an abrupt climate change. In northwest Europe (as indicated by palaeoecological and geological evidence) climate changed from relatively warm and continental to oceanic. As a consequence, the ground-water table rose considerably in certain low-lying areas in The Netherlands. Archaeological and palaeoecological evidence for the abandonment of such areas in the northern Netherlands is interpreted as the effect of a rise of the water table and the extension of fens and bogs. Contraction of population and finally migration from these low-lying areas, which had become marginal for occupation, and the earliest colonisation by farming communities of the newly emerged salt marshes in the northern Netherlands around 2550 BP, is interpreted as the consequence of loss of cultivated land. Thermic contraction of ocean water and/or decreased velocity and pressure on the coast by the Gulf Stream may have caused a fall in relative sea-level rise and the emergence of these salt marshes. Evidence for a synchronous climatic change elsewhere in Europe and on other continents around 2650 BP is presented. Temporary aridity in tropical regions and a reduced transport of warmth to the temperate climate regions by atmospheric and/or oceanic circulation systems could explain the observed changes. As yet there is no clear explanation for this climate change and the contemporaneous increase of ^{14}C in the atmosphere. The strategy of ^{14}C wiggle-match dating can play an important role in the precise dating of organic deposits, and can be used to establish possible relationships between changing ^{14}C production in the atmosphere, climate change, and the impact of such changes on hydrology, vegetation, and human communities.

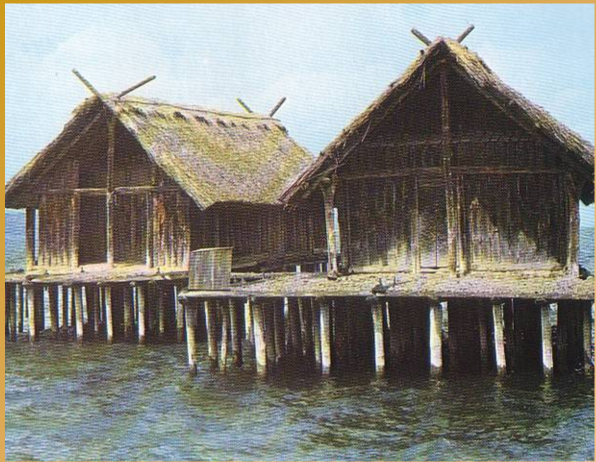
JQS
Journal of Quaternary Science

KEYWORDS: climate change; archaeology; palaeoecology; teleconnections; 2650 BP.

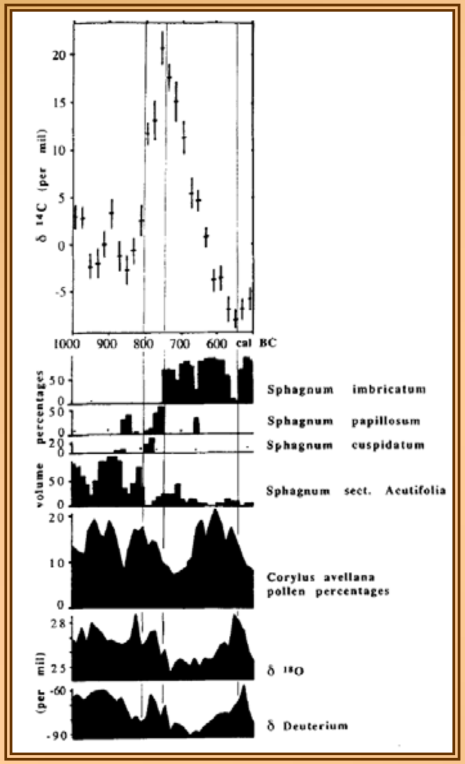
Introduction

Natural variations in atmospheric ^{14}C, which are reflected as wiggles in the radiocarbon calibration curve (Stuiver *et al.*, 1993) severely limit the possibilities for fine-resolution dating of changes in vegetation and climate recorded in lake deposits and raised bogs (e.g. van Geel, 1978; Magny 1993a; Barber *et al.*, 1994). Van Geel and Mook (1989) stressed the importance of the strategy of ^{14}C wiggle-match dating (WMD) of organic deposits, and the fact that WMD can reveal relationships between ^{14}C variations and short-term climatic fluctuations caused by solar and/or geomagnetic variations. Kilian *et al.* (1995) have shown that, by using the strategy of WMD, raised-bog deposits in particular can be dated more precisely. Hence the raised-bog archive can be compared effectively with other proxy data archives, the more so because WMD showed that an unexpected ^{14}C reservoir effect plays a role in raised-bog deposits. As a consequence, individual conventional radiocarbon dates

Van Geel et al. (1996). Journal of Quaternary Science



áreas equilibrio frágil “marginales”



debilitamiento circulación monzónica = aridez áreas tropicales = reducción circulación calor al N y S (ni por corrientes oceánicas ni por circulación Atmosférica) = ENFRIAMIENTO

Proliferación turberas **influencia adopción Metalurgia del Fe**. Abundantes nódulos de hierro en turberas Centroeuropa… + abundantes a partir del 2650 BP? materia prima más fácil de conseguir q Bronce? + accesible? … puede ser, pero en este momento téncicas de fundición ya muy avanzadas!!!!

NO DETERMINISMO AMBIENTAL, PERO SÍ INFLUENCIA ADOPCIÓN / AVANCE TECNOLÓGICO

+ caro (importación); cambio positivo economía

CIVILIZACIÓN MAYA

Península Yucatán: 4.550 BP / 800 BP

Florecimiento cultural: **600-800 AD**

"COLAPSO" 800-900 AD (1200-1100 BP)

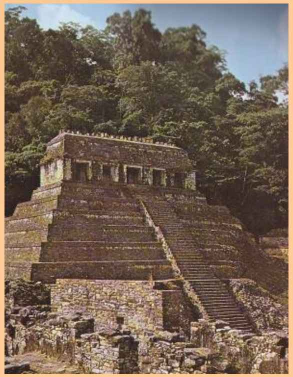
Mayas en "desierto" estacional vulnerable, con **3-13 millones habitantes**

I*ngeniería hidrológica* (aljibes, canales…) pero dependen de existencia lluvias!!!

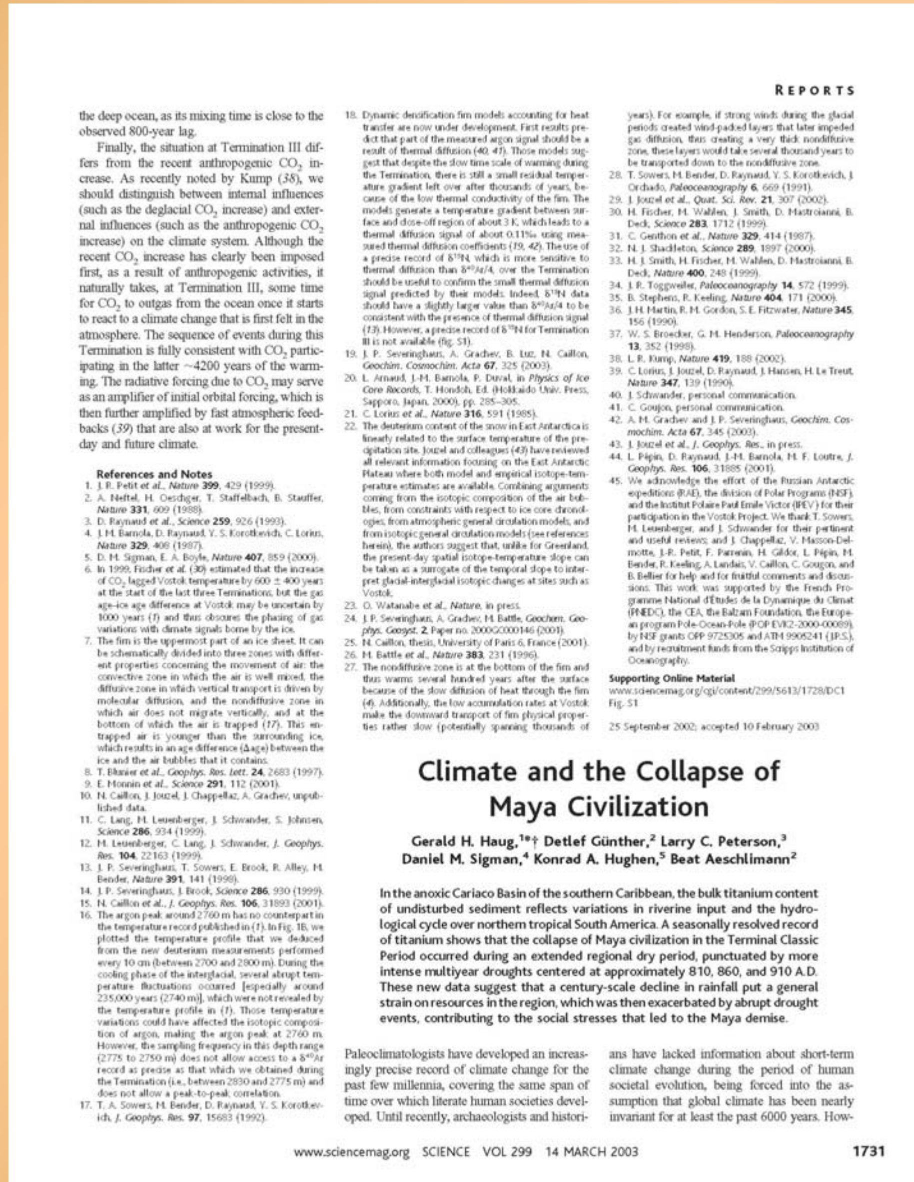
Final Período Clásico = estrés social x **sequía** intensa prolongada + torrencialidad + erosión… CAOS.

Abandono grandes ciudades

*Estudios en **lagos Yucatán** + cuenca marina de **Cariaco** (costa de Venezuela), de **clima semejante**, registran **"fallos" en lluvias veraniegas** durante período colapso Maya.*



Precipitaciones anuales (mm) Península Yucatán



REPORTS

Climate and the Collapse of Maya Civilization

Gerald H. Haug,[1*†] Detlef Günther,[2] Larry C. Peterson,[3] Daniel M. Sigman,[4] Konrad A. Hughen,[5] Beat Aeschlimann[2]

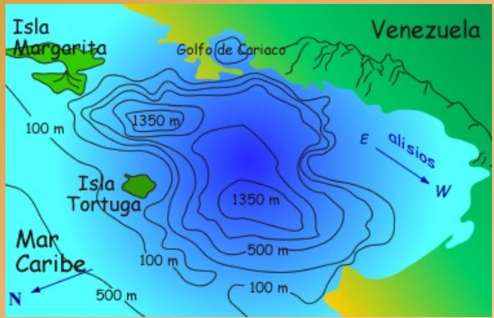
In the anoxic Cariaco Basin of the southern Caribbean, the bulk titanium content of undisturbed sediment reflects variations in riverine input and the hydrological cycle over northern tropical South America. A seasonally resolved record of titanium shows that the collapse of Maya civilization in the Terminal Classic Period occurred during an extended regional dry period, punctuated by more intense multiyear droughts centered at approximately 810, 860, and 910 A.D. These new data suggest that a century-scale decline in rainfall put a general strain on resources in the region, which was then exacerbated by abrupt drought events, contributing to the social stresses that led to the Maya demise.

Paleoclimatologists have developed an increasingly precise record of climate change for the past few millennia, covering the same span of time over which literate human societies developed. Until recently, archaeologists and historians have lacked information about short-term climate change during the period of human societal evolution, being forced into the assumption that global climate has been nearly invariant for at least the past 6000 years. How-

www.sciencemag.org SCIENCE VOL 299 14 MARCH 2003 1731

Haugh et al. (2003). Science

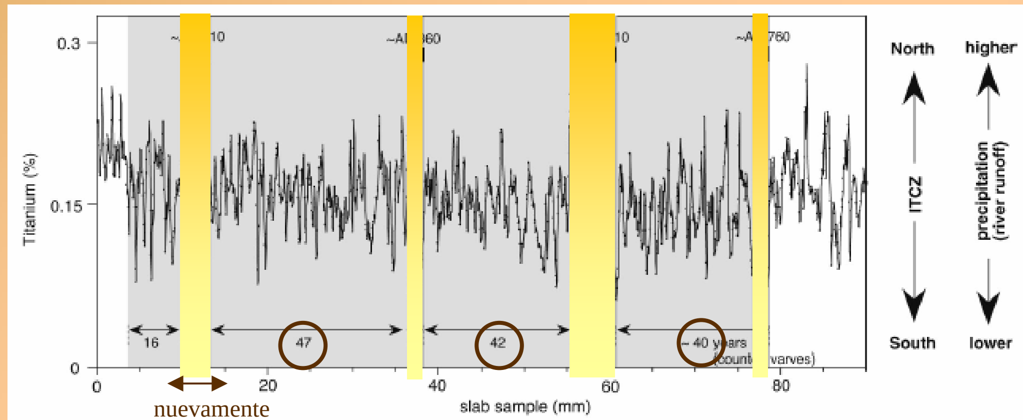
*Estudios en **lagos Yucatán** & cuenca marina de **Cariaco** (costa de Venezuela), de **clima semejante**, registran **"fallos" en lluvias veraniegas** durante período colapso Maya.*



Periodicidad: $\pm$ 40 años "moderados", entre 5-10 "crisis"

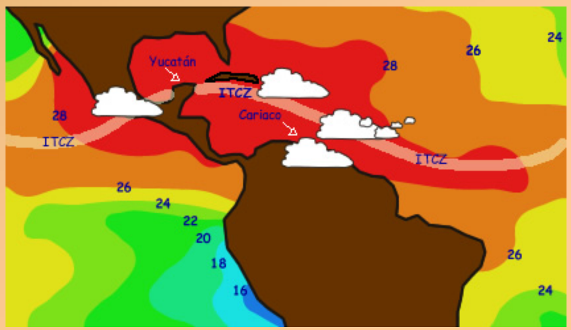
corto pero muy intenso

aridez moderada



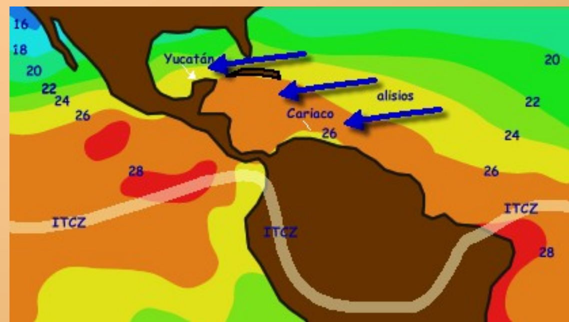
nuevamente muy intenso

Sedimentos anuales laminados recogen aportes fluviales ("inputs") relacionando contenido terrígeno (Ti) con estación lluvias



VERANO: abundancia lluvias. La ITCZ se posiciona sobre la región

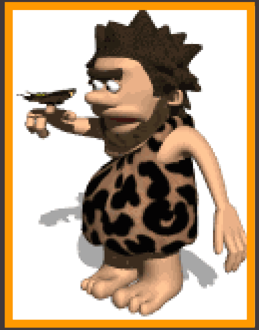
Si la ITCZ no asciende latitudinalmente lo suficiente = no lluvias estación húmeda



INVIERNO: lluvias sustituidas x vientos alisios (secos). ITCZ + al S

Sequías x variaciones posición estacional **Zona Convergencia Intertropical** (ITCZ) detonante COLAPSO civilización MAYA!!!

HISTORIA DEL CLIMA, EL AGUA Y EL HOMBRE



¿Periodos climáticos = Periodos culturales? ¿Interacción o Determinismo?

Desarrollo / Colapso. Elementos clave y ejemplos de la Historia Reciente

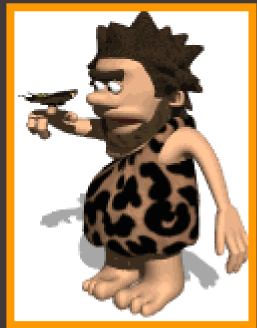
Ejemplos del Pasado

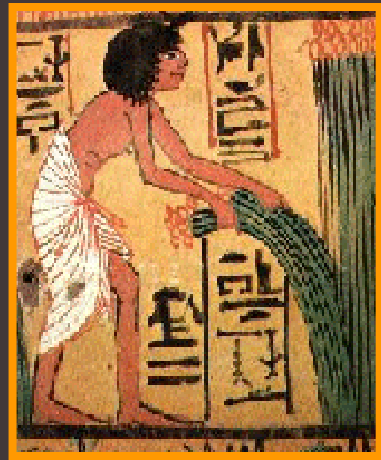
- Extinción Neanderthales
- Evento 8.2 y el Bajo Aragón
- Revolución Neolítica
- Sáhara – Sahel
- 4.000 BP : COLAPSOS
  - *Imperio Acadio*
  - *Valle del Indo*
  - *Meseta China*
  - *Cultura Argárica*
- Edad Bronce – Edad Hierro
- Civilización Maya

Conclusiones

CONCLUSIONES ???

HISTORIA DEL CLIMA, EL AGUA Y EL HOMBRE

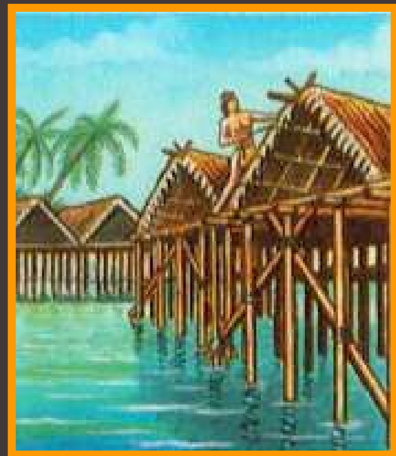




8 de Febrero 2012

Master en Cambio Global

Universidad Internacional Menéndez Pelayo - CSIC



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