UNIVERSIDADE D COIMBRA

CLIMATE@COA project: Climate and human adaptation during the Last Glacial Period in the Côa Valley region (Portugal)

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CEGOT Centro de Estudos de Geografia e Ordenamento do Território

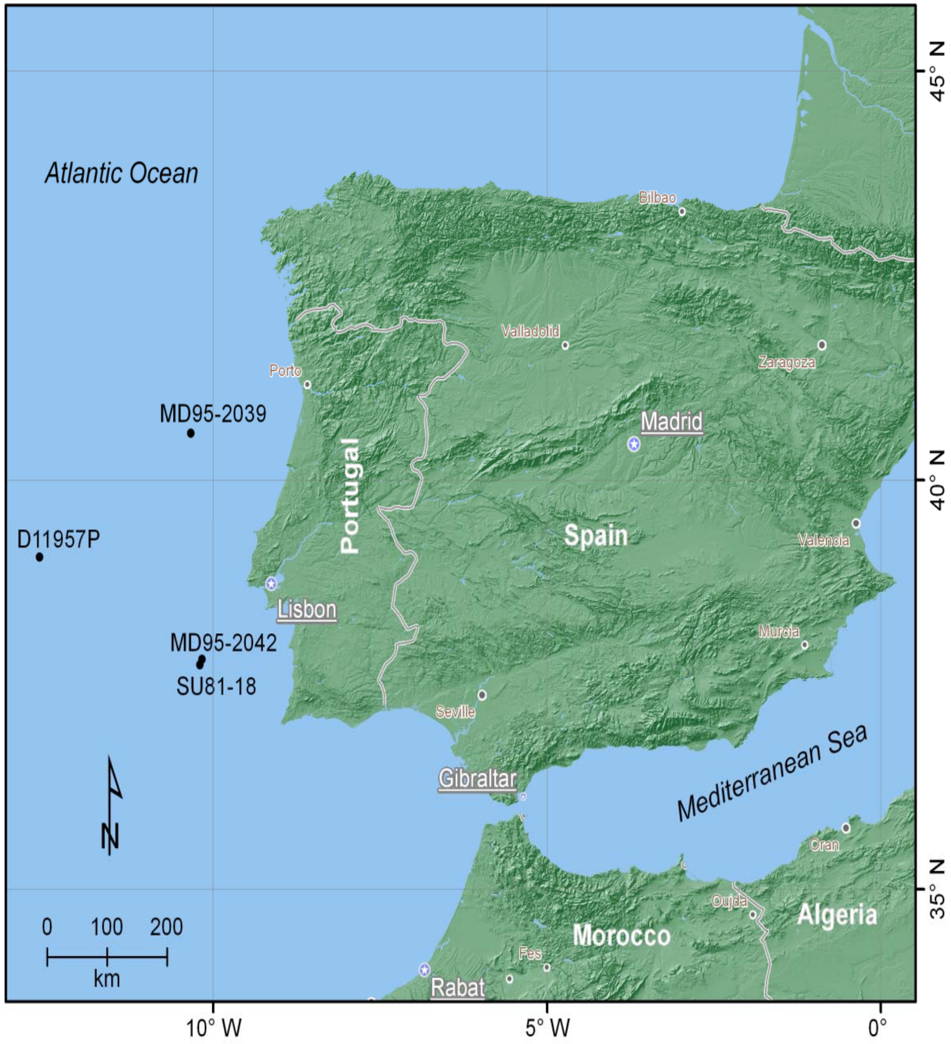
Fundação CoaParque

FCT Fundação para a Ciência e a Tecnologia

Cofinanciado por: COMPETE 2020 PORTUGAL 2020 UNIÃO EUROPEIA Fundo Europeu de Desenvolvimento Regional

WHY THIS RESEARCH IS IMPORTANT…?

CLIMATE FLUCTUATIONS OF LATE PLEISTOCENE

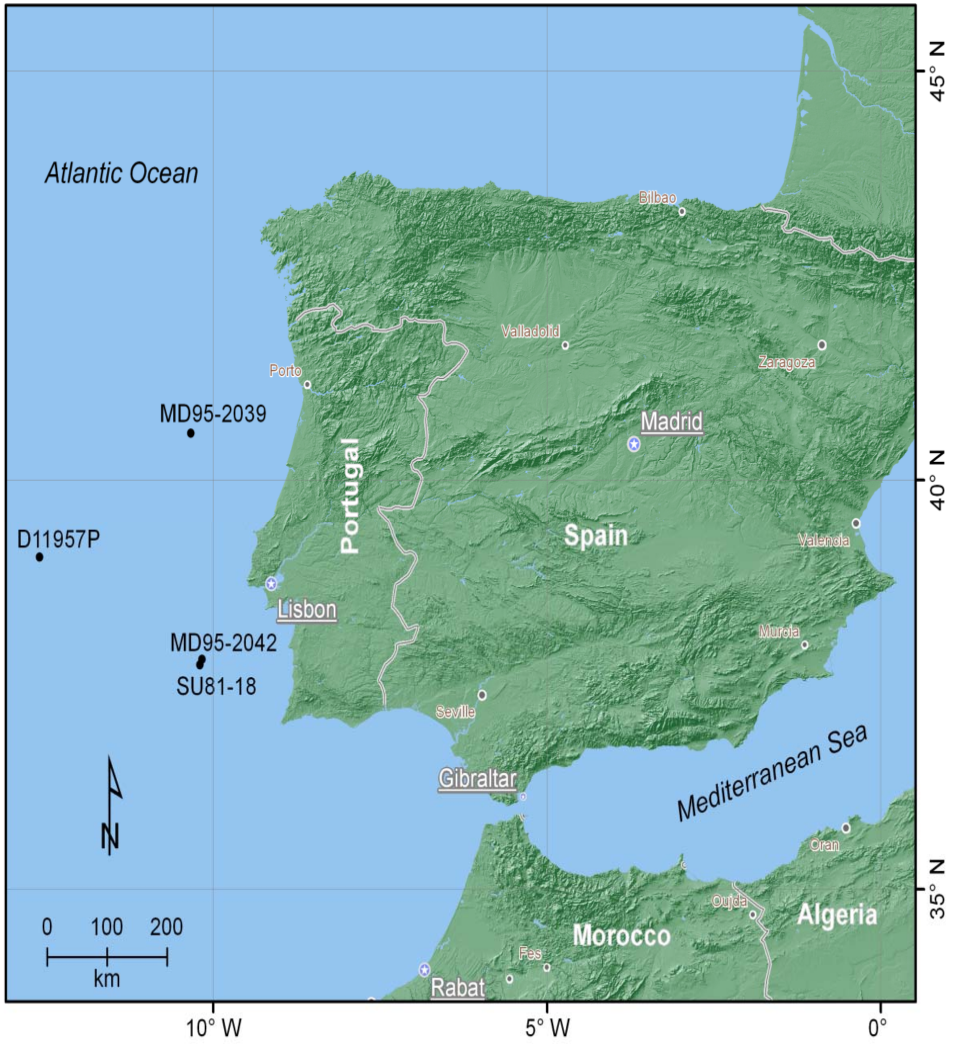


MARINE ISOTOPE STAGES 4, 3 AND 2

- Well-known from **marine record** on the western Iberian margin (*e.g.*, Lebreiro et al., 2009; Sanchez Goñi et al., 2010).
- **Four deep-sea cores** record last glacial sea surface temperature and vegetation for Portugal, at regional scale (Lebreiro et al., 2009; Sánchez Goñi et al., 2008; Turon et al., 2003 among others):
- The record of **core MD95-2042** is correlated very precisely to the Greenland Ice Core Record (GRIP) (Shackleton et al., 2004).

WHY THIS RESEARCH IS IMPORTANT…?

CLIMATE FLUCTUATIONS OF LATE PLEISTOCENE



MARINE ISOTOPE STAGES 4, 3 AND 2

- In **terrestrial archives** past environmental conditions have a **discontinuous record**.
- Large and rapid climate changes have **a recognized impact** on the **bioclimatic zones** (e.g., Sanchez Goñi et al., 2010);
- and possibly on the **dynamic, demography and settlement** patterns of Middle-Upper Palaeolithic (MP-UP) **hunter-gatherers of Iberia** (e.g., D'Errico and Sánchez Goñi, 2003).

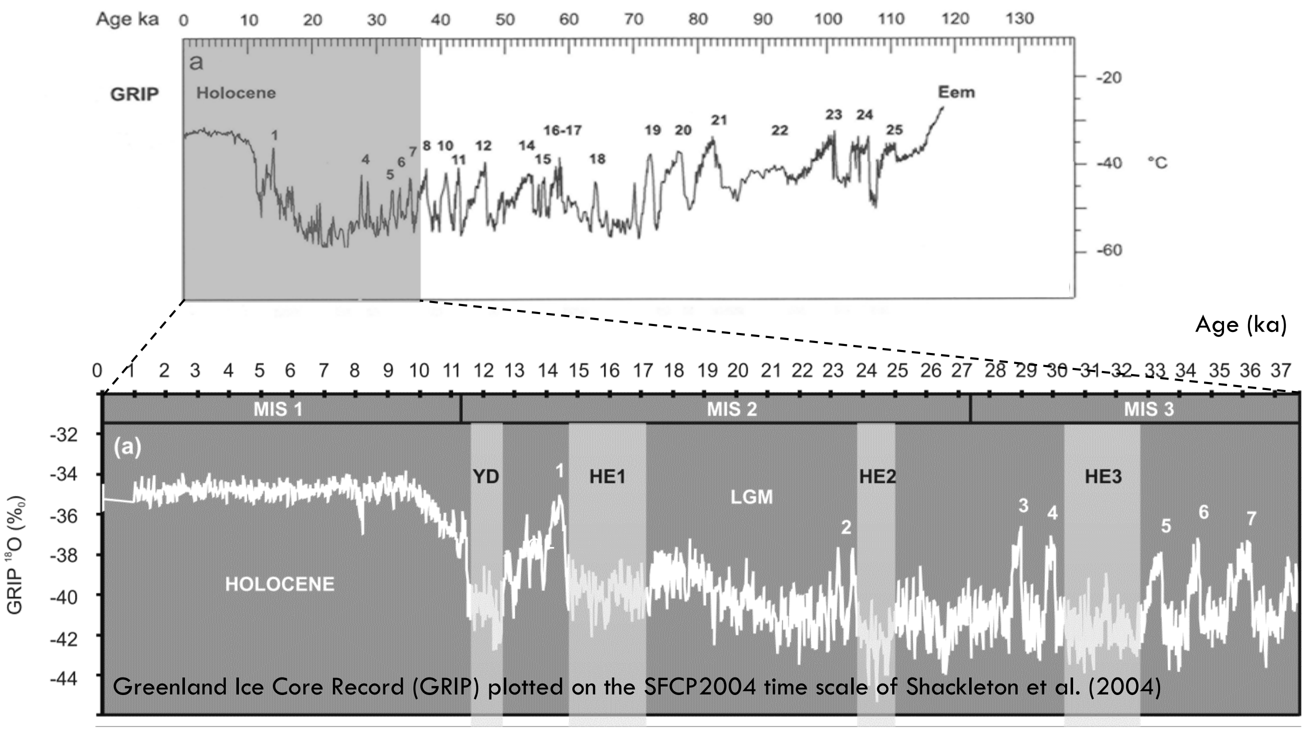
WHY THIS RESEARCH IS IMPORTANT…?

CLIMATE FLUCTUATIONS OF LATE PLEISTOCENE

Vertical stripes place Heinrich events (HE) 1, 2, 3, and the Younger Dryas (YD)

Numbers 1-7 refer to the Greenland Interstadials (GI)

Last Glacial Maximum (LGM)



During the last glacial period, Greenland stadial-interstadial cycles, with a periodicity of ~1500 yr, are associated with severe changes in surface sea temperature (SST). These **cycles** are often characterized by a **period of rapid warming followed by a slow cooling phase, then rapid cooling followed by rapid and intense warming phase.**

WHY THIS RESEARCH IS IMPORTANT…?

IN IBERIAN KARST A CORRELATION FRAMEWORK WITH CLIMATE SHIFTS HAS BEEN PROPOSED TO EXPLAIN MP-UP DISCONTINUITIES

Quaternary Research 75 (2011) 66–79

Contents lists available at ScienceDirect

Quaternary Research

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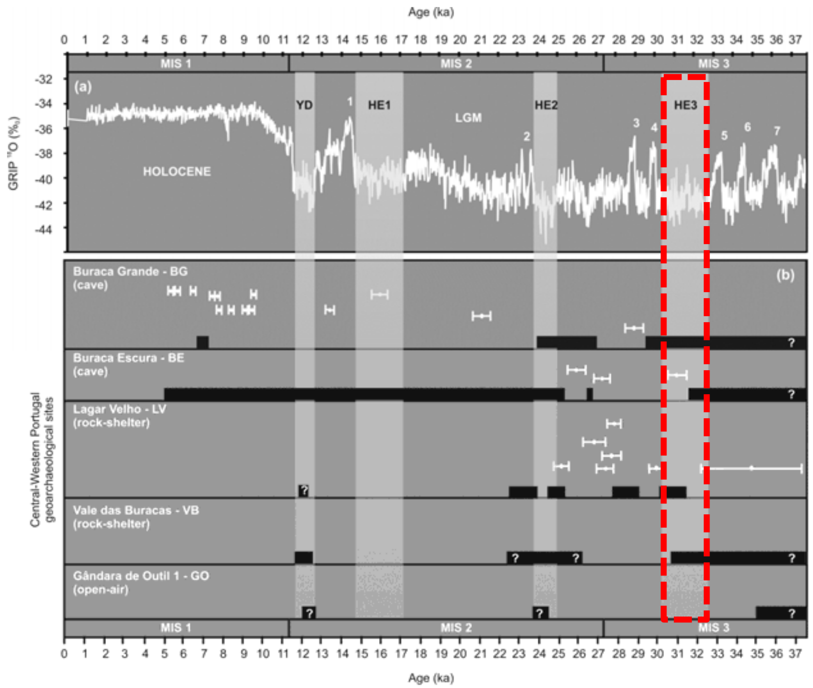
Palaeoenvironmental forcing during the Middle–Upper Palaeolithic transition in central-western Portugal

Thierry Aubry [a], Luca A. Dimuccio [b,c,*], Miguel Almeida [d], Maria J. Neves [d,f], Diego E. Angelucci [e], Lúcio Cunha [b]



Quaternary International xxx (2011) 1–10

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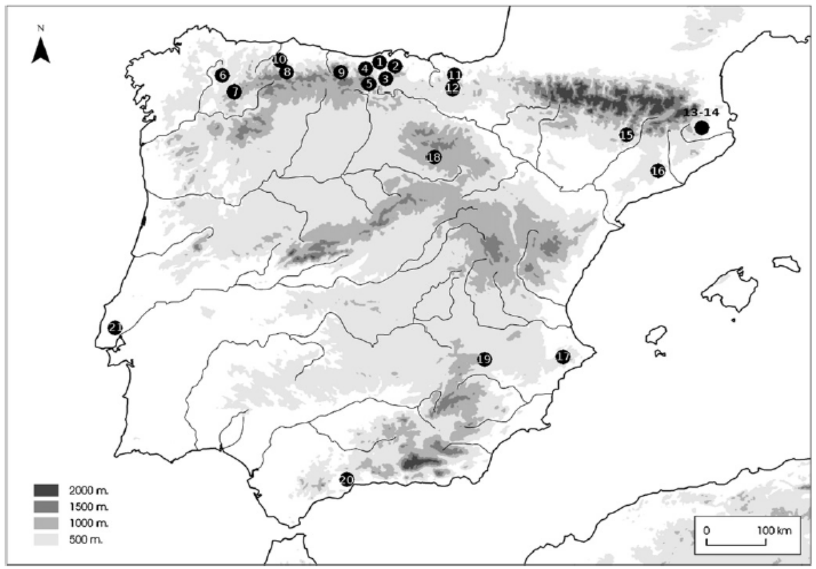
The significance of stratigraphic discontinuities in Iberian Middle-to-Upper Palaeolithic transitional sites

Carolina Mallol*, Cristo M. Hernández, Jorge Machado

Among others….



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Among others....

However, despite all these data, the whole question relating to the Middle-to-Upper Palaeolithic transition has been excessively dependent on the karst archives and should now be investigated in detail in other geomorphological contexts - among which the fluvial and plateau, both present in the Côa Valley region, stands out.

BACKGROUND

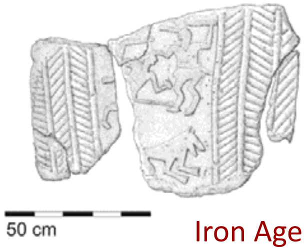
CÔA VALLEY OPEN-AIR PALAEOLITHIC ROCK-ART (PORTUGAL)

(World Heritage by the UNESCO since 1998)

Pre-Magdalenian graphic phase

(d)

Late glacial



(e)

Iron Age

Journal of Archaeological Science xxx (2010) 1–14

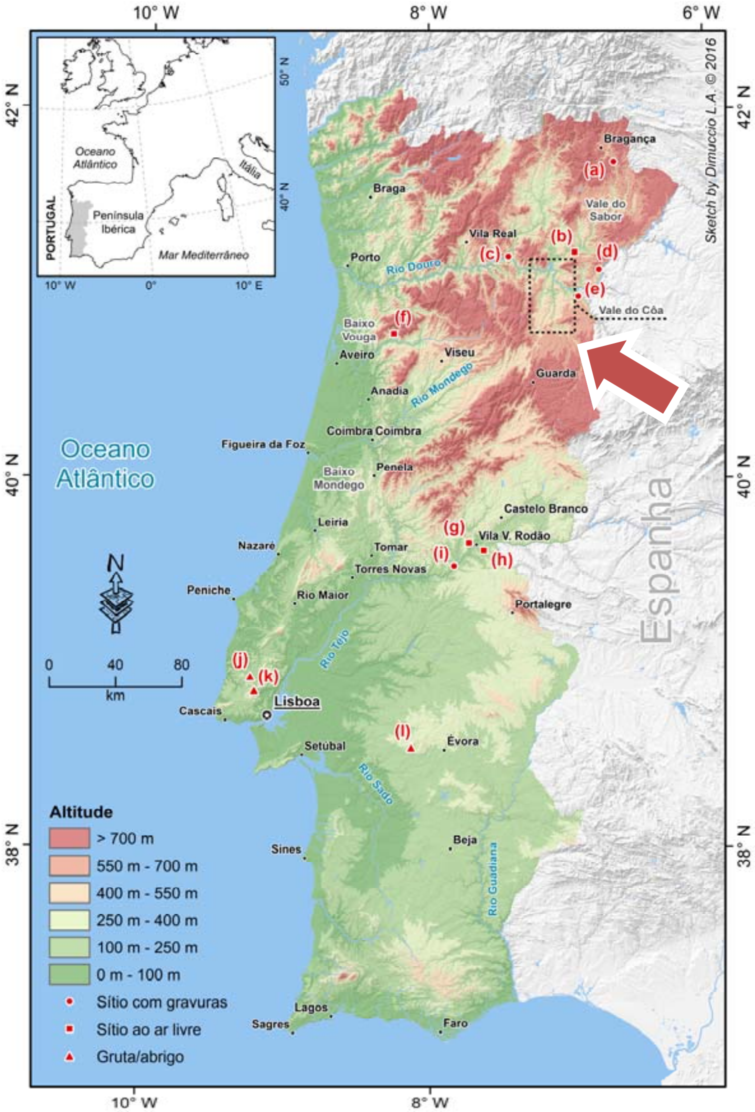
Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Palaeolithic engravings and sedimentary environments in the Côa River Valley (Portugal): implications for the detection, interpretation and dating of open-air rock art

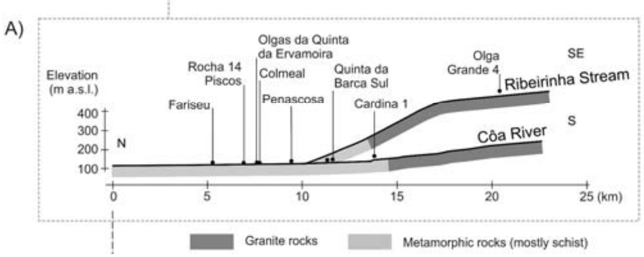
Thierry Aubry[a,*], Luca Antonio Dimuccio[b,c], M. Mercè Bergadà[d], Jorge Davide Sampaio[a], Farid Sellami[e]

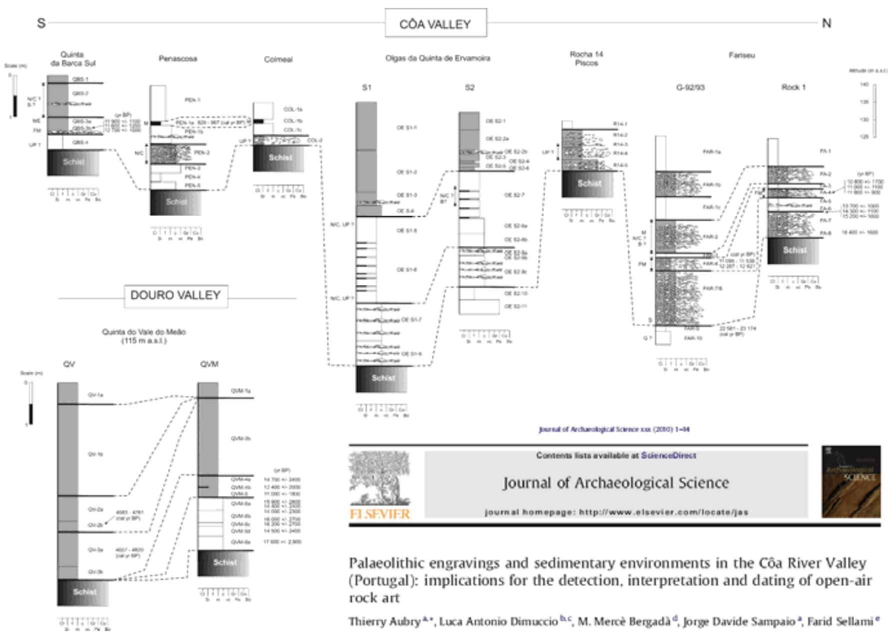


(Aubry, T., Moura, H & Dimuccio, L.A., 2017)

BACKGROUND
SEDIMENTARY ENVIRONMENT

Alluvial and **slope deposits** preserved in Côa Valley have demonstrated to be a **valuable record** of information about **Late-Pleistocene** terrestrial sedimentary processes, depositional environments and hunter-gatherer's behavior.





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ELSEVIER

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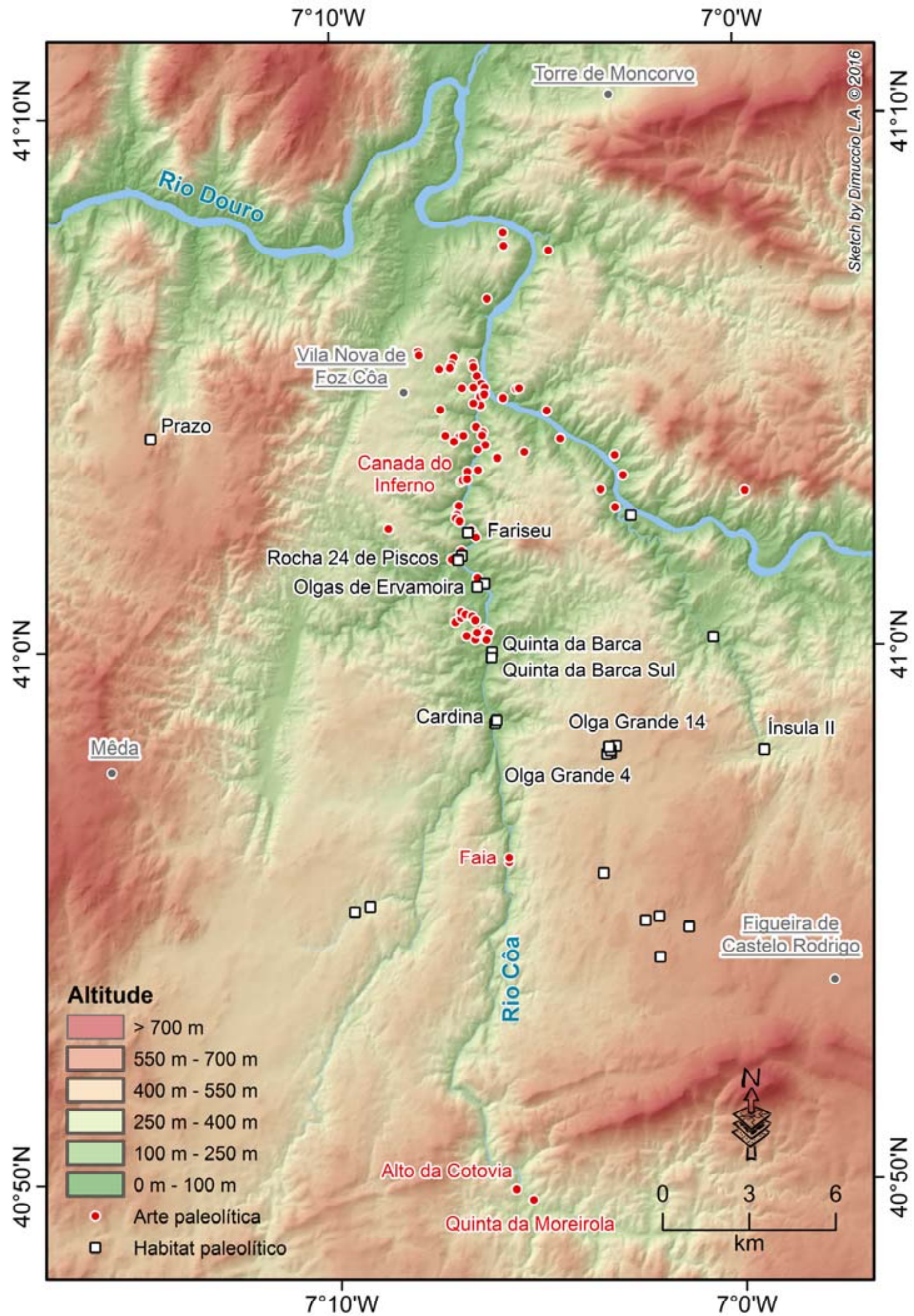

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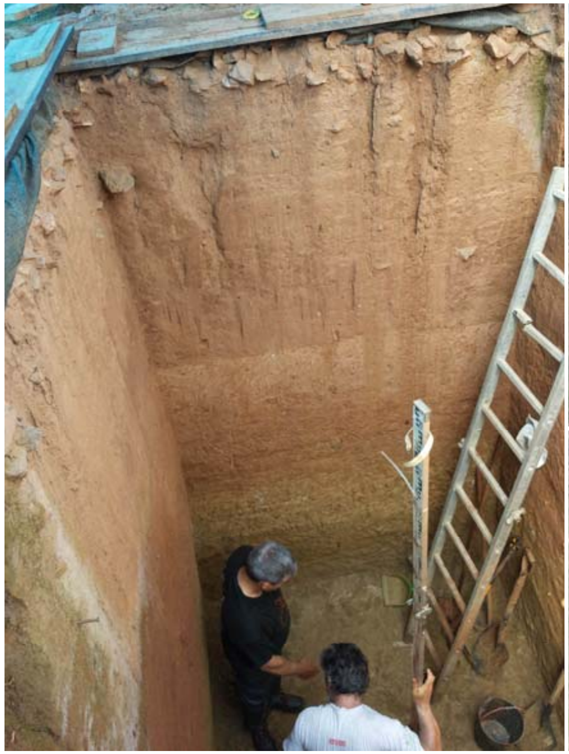
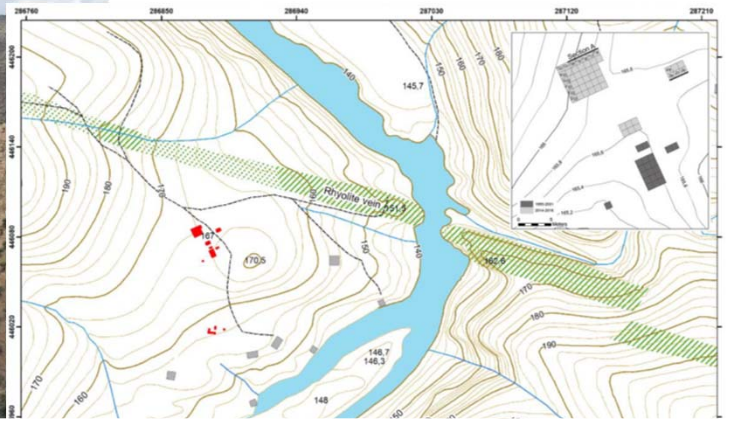


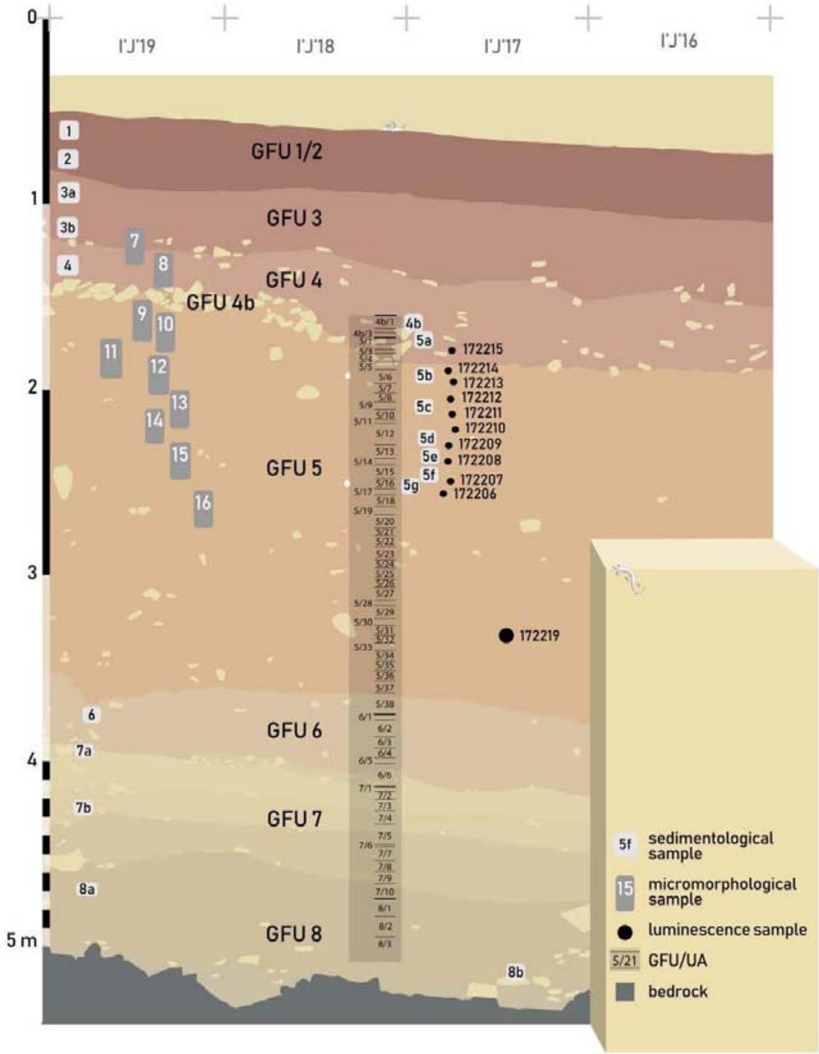



THE EXAMPLE OF CARDINA-SALTO DO BOI SITE

ca. 5-m-thick siliciclastic succession preserved on the top of left bank meander, 166 m above sea level and 20 m above the Côa riverbed, just before a rhyolite dyke.

MATERIALS AND METHODS

LOCAL STRATIGRAPHY WITH RECURRENT SEDIMENTARY FEATURES



FACIES ANALYSIS

- Detail **field strata description (GFUs; GCs)**;
- **Grain-size characterization** and **decomposition** (PACEA lab.);
- **Clay mineralogy** (including illite crystallinity and illite chemical index);
- **Micromorphology** on MP-UP transition (Univ. Barcelona);

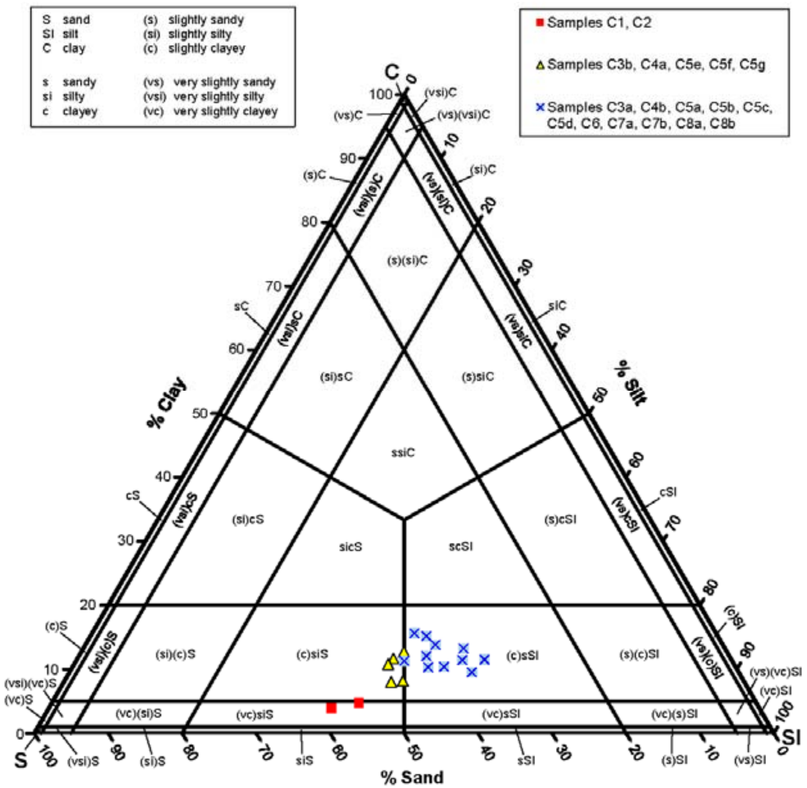
…supported by **^{14}C, TL and OSL dating** (using pIRIR protocol) and archaeological attributions (*vide* Aubry et al., 2019; *submitted*).

RESULTS

GRAIN-SIZE CHARACTERIZATION AND DECOMPOSITION

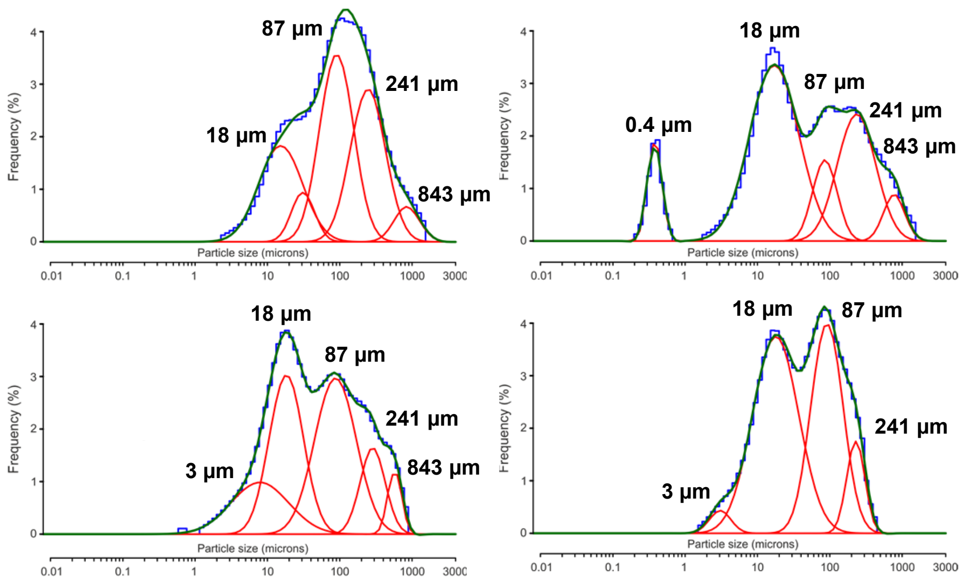
GRAIN-SIZE CHARACTERIZATION

GFU 1÷2 are massive and bioturbated coarsest units (slightly gravelly), with muddy sand fraction (**very slightly clayey silty sand**); **GFU 3÷4** with relatively more silt and clay (**slightly clayey silty sand**); **GFU 5÷8** consist in tabular fine-grained bodies with aggradational character and recurrent grain-size characteristics (**slightly clayey sandy silt**).



GRAIN-SIZE DECOMPOSITION (Just few examples…)

Several modes in hydraulic continental environments can reflect either multiple sedimentary **sources** or different **transport** mechanisms (e.g., Sun et al., 2002; Liu et al., 2018).

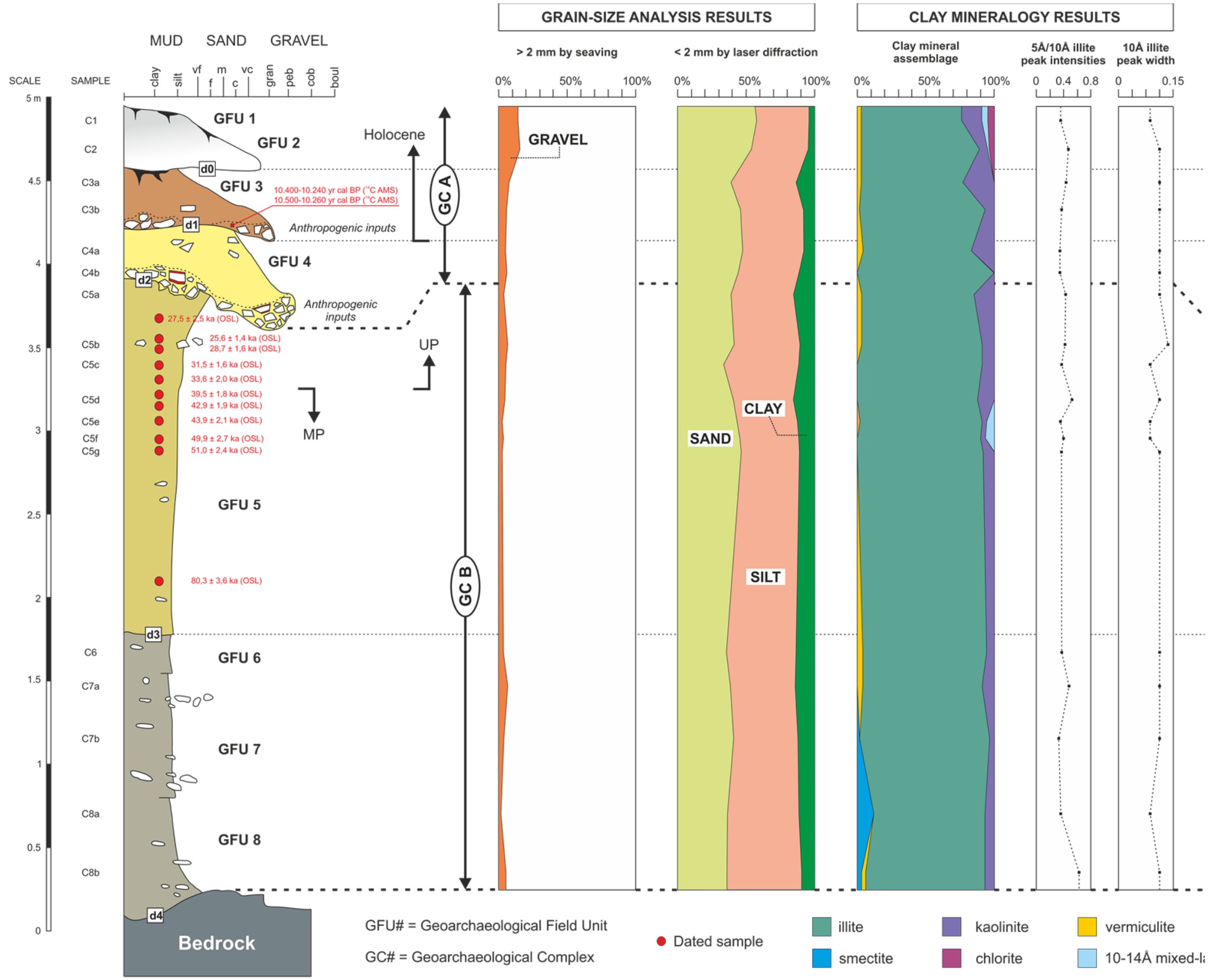


GRAIN-SIZE COMPONENTS (in order of contribution)

i. medium to fine silt (mean **18 µm)**
ii. medium to fine sand (mean **241 µm**)
iii. very fine sand (mean **87 µm**)
iv. coarse sand (mean **843 µm**)
v. ultrafine particles (mean **0.4 µm)**
vi. clay (mean **3 µm**)

RESULTS

CLAY MINERALOGY

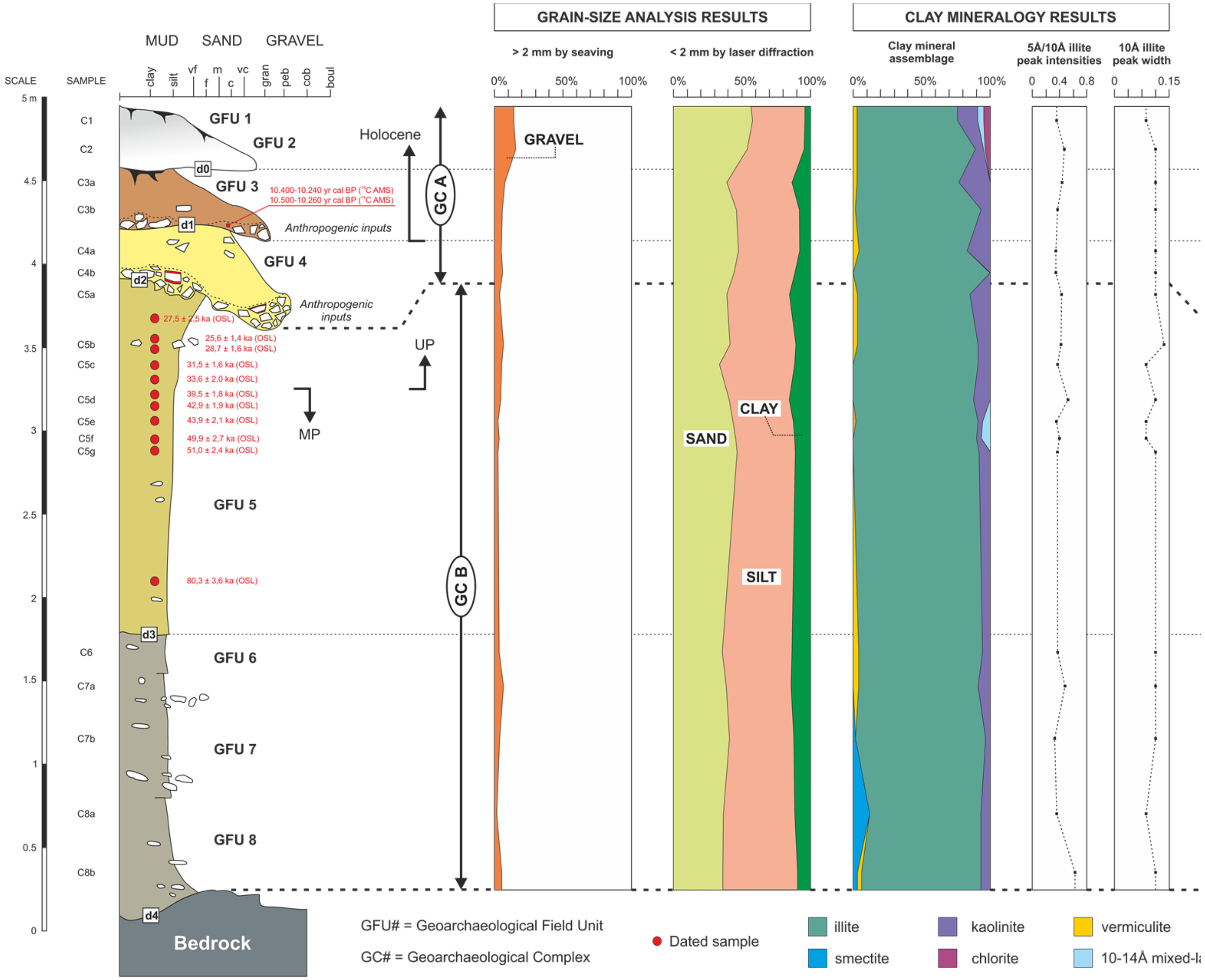


CLAY MINERALS

- **Illite** is clearly **dominant** (73-94%) in all sampled sediments, largely surpassing kaolinite (3-23%).
- An obvious **differentiation** between the **more superficial** field units and the **deeper** ones.
- **Kaolinite** amount **increases stratigraphically upwards** and thus tends to be higher in the relatively coarser units.
- **Kaolinite** content is relatively **higher** (23-15%) in the samples collected immediately **below unconformities**.

RESULTS

CLAY MINERALOGY

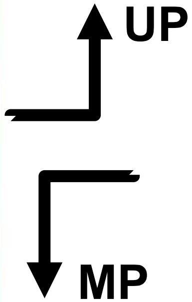


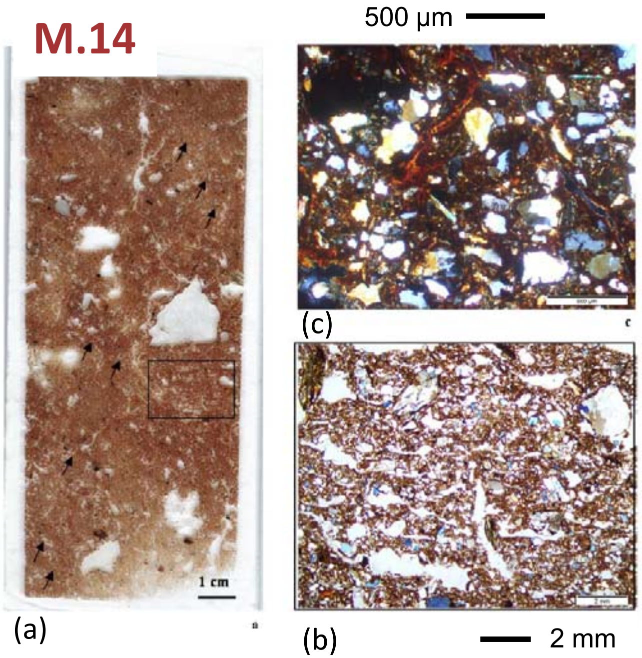
ILLITE CRYSTALLINITY AND CHEMICAL INDEX

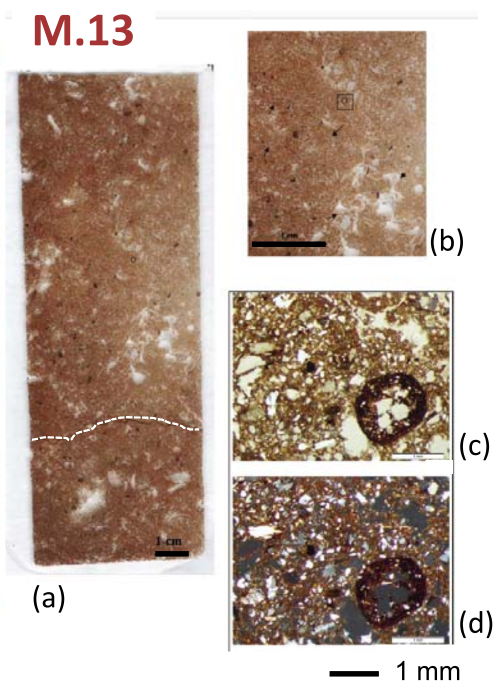
- **Illite crystallinity** is extremely **high** as consequence of a **minimal** structural **deterioration** during **transportation** from the source area to the place of sedimentation.
- 89% of the sampled sediments show a **Fe/Mg-rich illite**, implying **little** or **non-chemical weathering**.
- When the **10-14Å mixed-layer** clays are present, it is found that **illite** tends to show a relatively **lower** degree of **crystallinity**.

RESULTS

MICROMORPHOLOGY (by M. Mercè Bergadà – Univ. Barcelona)







PRELIMINARY MICROMORPHOLOGICAL RESULTS

The **Middle-to-Upper Palaeolithic transition** is characterized by a phase of **episodes of low energy alluvium**, followed by a stage of **stability** in the environment that would lead to the development of an **intense biological** activity.

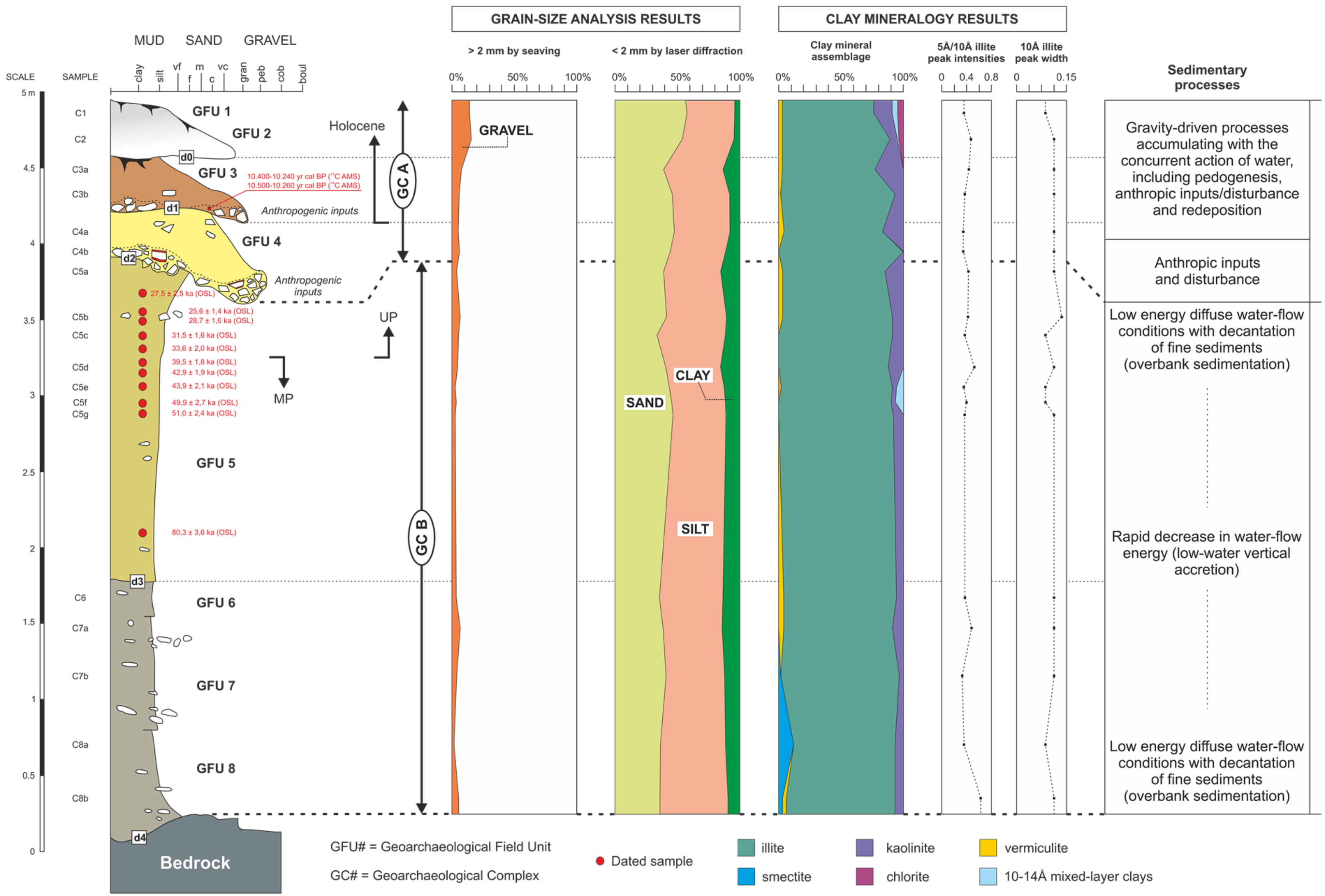
Groundmass of silty clays with medium to fine sands of subangular to tabular morphology.

M.14 – (a) General view where some very diffuse laminae are located (arrows), that could correspond to very low energy sedimentary episodes; (b) sedimentary crust; (c) traces of clays illuviation in suspension (as coating).

M.13 – (a) General view; line indicates the start of bioturbation; (b) passage features and other bioturbation traces with arrows; (c) (d) orthic nodule (formed *in situ*).

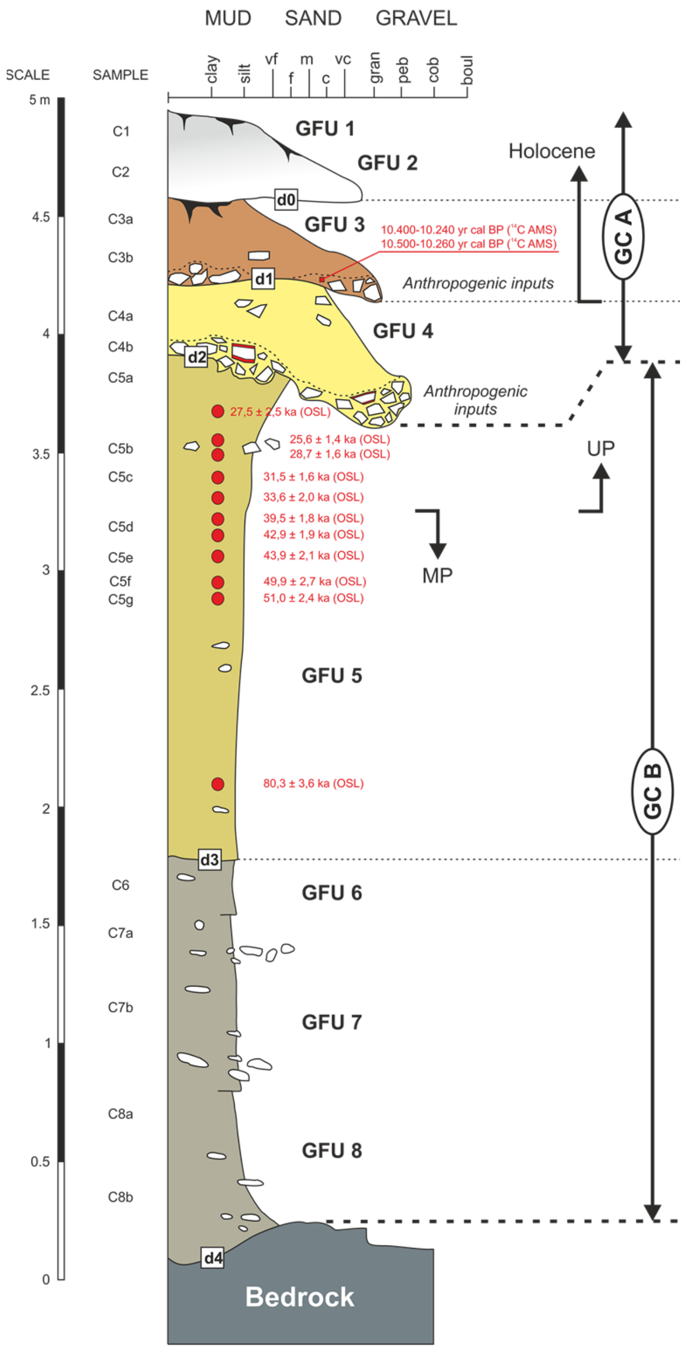
INTERPRETATIONS

SEDIMENTARY PROCESSES



FINAL REMARKS

DEPOSITIONAL ENVIRONMENTS



A stratigraphic succession spanning from **MIS 5 to MIS 1** of **two** sedimentary **sequences** (GC B and GC A):

GC B = **stable floodplain sequence**, linked to generally continuous and low intense meteoric precipitation initially under more temperate and humid climate (with some seasonality) that evolved to colder conditions;

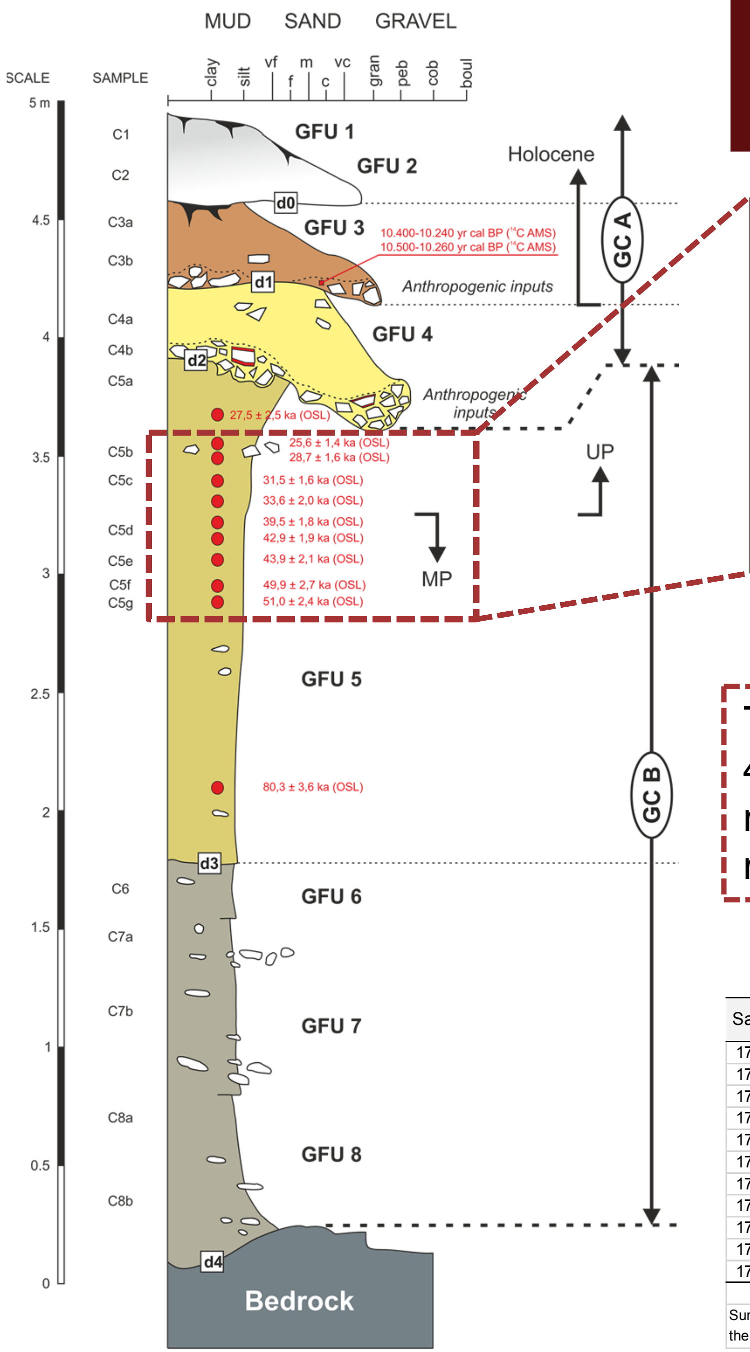
GC A = subsequent period, after GI 3 (ca. 27.5 ka) and during Holocene, of progressive increase in humid conditions and chemical-weathering attested by the more superficial disturbed **slope sequence**, driven by gravity processes and shallow surface waters flow.

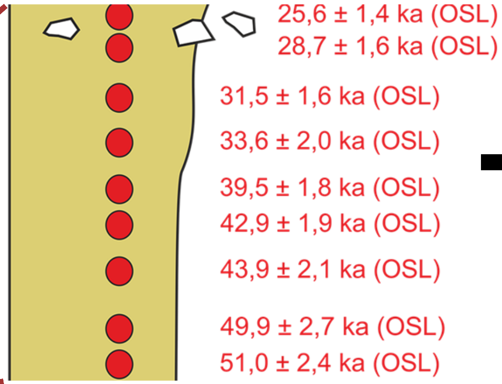
Sample	Depth (cm)	w.c. (%)	Dose rate Q (Gy/ka)	Dose Q (Gy)	n_Q	Dose rate KF (Gy/ka)	Dose KF (Gy)	n_{KF}	Age Q (ka)	Age KFuncorr (ka)	Age KFcorr (ka)
172219	270	0	4.90 ± 0.24	-		5.83 ± 0.25	417 ± 7	8	-	71.4 ± 3.2	**80.3 ± 3.6**
172206	193	4	4.96 ± 0.26	172 ± 21	4	5.89 ± 0.27	267 ± 4	8	35 ± 5	45.4 ± 2.1	**51.0 ± 2.4**
172207	190	4	4.37 ± 0.22	161 ± 27	3	5.30 ± 0.23	235 ± 7	6	37 ± 6	44.4 ± 2.4	**49.9 ± 2.7**
172208	179	4	4.91 ± 0.23	177 ± 15	5	5.85 ± 0.24	229 ± 6	8	36 ± 3	39.1 ± 1.9	**43.9 ± 2.1**
172209	170	4	4.65 ± 0.22	171 ± 23	6	5.59 ± 0.23	214 ± 3	18	37 ± 5	38.2 ± 1.6	**42.9 ± 1.9**
172210	161	2	4.82 ± 0.25	189 ± 40	5	5.76 ± 0.25	203 ± 2	7	39 ± 8	35.2 ± 1.6	**39.5 ± 1.8**
172211	153	3	4.80 ± 0.25	217 ± 33	6	5.74 ± 0.26	172 ± 7	6	45 ± 7	29.9 ± 1.8	**33.6 ± 2.0**
172212	145	3	4.85 ± 0.24	129 ± 10	5	5.79 ± 0.24	163 ± 5	7	27 ± 3	28.1 ± 1.5	**31.5 ± 1.6**
172213	136	2	4.64 ± 0.23	136 ± 27	6	5.58 ± 0.24	143 ± 5	6	29 ± 6	25.6 ± 1.5	**28.7 ± 1.6**
172214	130	1	4.75 ± 0.23	143 ± 11	6	5.69 ± 0.24	130 ± 5	11	30 ± 3	22.8 ± 1.3	**25.6 ± 1.4**
172215	118	2	4.91 ± 0.24	134 ± 24	6	5.84 ± 0.25	143 ± 11	6	27 ± 5	24.5 ± 2.2	**27.5 ± 2.5**

Summary of OSL data. Q is quartz and KF is K-rich feldspar extracts. n_x is the number of accepted aliquots. The fading corrected KF ages (Age KFcorr) is expected to the be most accurate estimate of the burial dose for these samples.

FINAL REMARKS

ARCHAEOLOGICAL IMPLICATIONS





UP

MP

A non-depositional unconformity (hiatus, with no evident erosion), dated to 40,5-32 ka interval, in an alluvial palaeoenvironment.

This data supports the evidence of the persistence (after 41 ka) of Neanderthal-associated Middle Palaeolithic material culture in some regions of Iberia after they were replaced by AMH on the rest of Europe.

Sample	Depth (cm)	w.c. (%)	Dose rate Q (Gy/ka)	Dose Q (Gy)	n_Q	Dose rate KF (Gy/ka)	Dose KF (Gy)	n_{KF}	Age Q (ka)	Age KFuncorr (ka)	Age KFcorr (ka)
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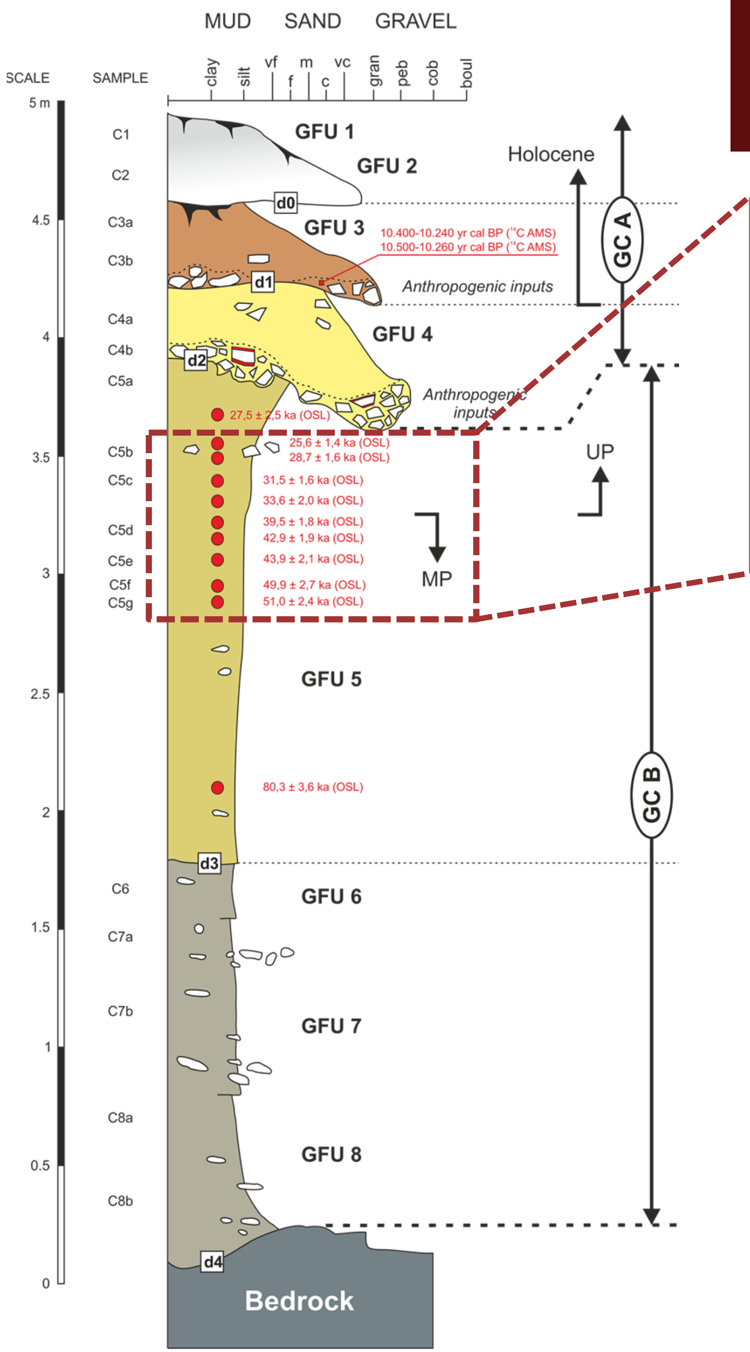
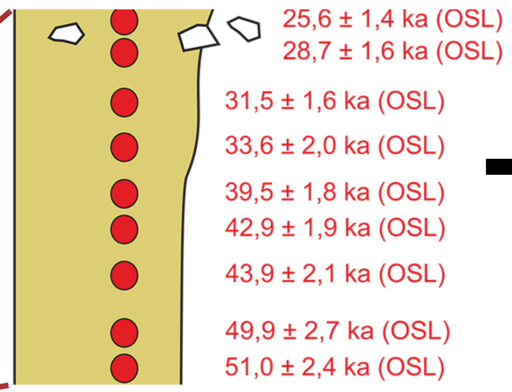
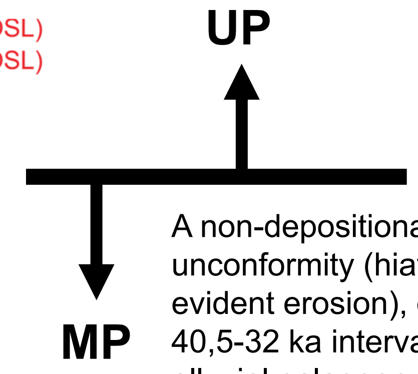
NEXT STEPS







A non-depositional unconformity (hiatus, with no evident erosion), dated to 40,5-32 ka interval, in an alluvial palaeoenvironment.

Further work is needed to establish if **this non-depositional unconformity** could be **related** to **drastic change in climatic conditions** attested in Atlantic **marine record** and to characterized and establish the **precise chronology** of human occupation during **sedimentary hiatus**.

THANK YOU FOR YOUR ATTENTION...!

Cofinanciado por: