

# Back to the Past:

# The Taphonomic Time Machine

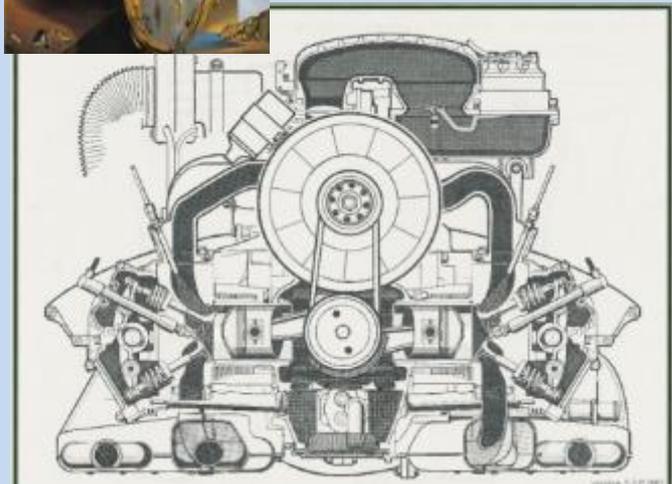


The Laboratory of Environmental Analyses and  
Experimental Taphonomy

## LeaT (mncn-csic)



Fossils in the making



# Why?



One of the most intriguing processes in the long history of life forms is fossilization. **Fossils are direct witnesses of past life**, not only bringing to us remains of past organisms, but **also evidence of activity of other animals and plants, as well as abiotic processes recorded on fossil surfaces**, their histology and composition. In order to interpret these processes and modifications, taphonomic investigations have been able to experimentally produce "**fossils in the making**", and reduce the time restriction we may have at present.



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# IT SEEMS TO BE A GOOD IDEA, AS OTHER COLLEAGUES HAVE ALSO CREATED A SIMILAR EXPERIMENTAL LABORATORY

The screenshot shows the website for the Experimental Archaeology and Taphonomy Laboratory at CENIEH. The page features a navigation menu with 'Infraestructura' highlighted, and a sub-menu with 'Laboratorios' selected. The main content area includes a photo of a woman at a microscope, a detailed description of the laboratory's services, and a photo of the laboratory interior. A right-hand sidebar contains contact information for two staff members: Felipe Cuartero Monteagudo and Javier Llamazares González.

Arqueología Experimental y Tafonomía

El Laboratorio de **Arqueología Experimental y Tafonomía** ofrece la planificación y desarrollo integral de programas experimentales centrados en la resolución de problemáticas arqueológicas sobre cuestiones tecnológicas, tafonómicas y de procesos de formación de yacimientos. Entre otros servicios ofrecemos la elaboración de réplicas arqueológicas fidedignas para desarrollar experimentaciones funcionales o simulación de alteraciones orientadas a aplicar protocolos de restauración.

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Interpreting taphonomic modifications depends on identifying the agents producing the modifications and the processes by which they are made, and this depends on actualistic studies providing comparable data from modern observations under controlled conditions. This is the main objective of the Laboratory of Environmental Analysis and Experimental Taphonomy





Liquid Nitrogen (cryogenic)

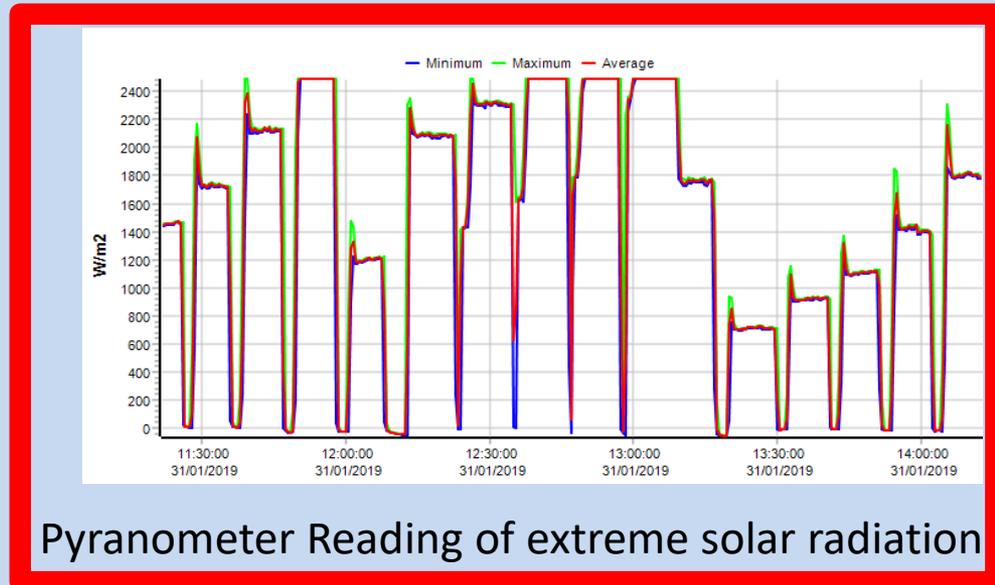
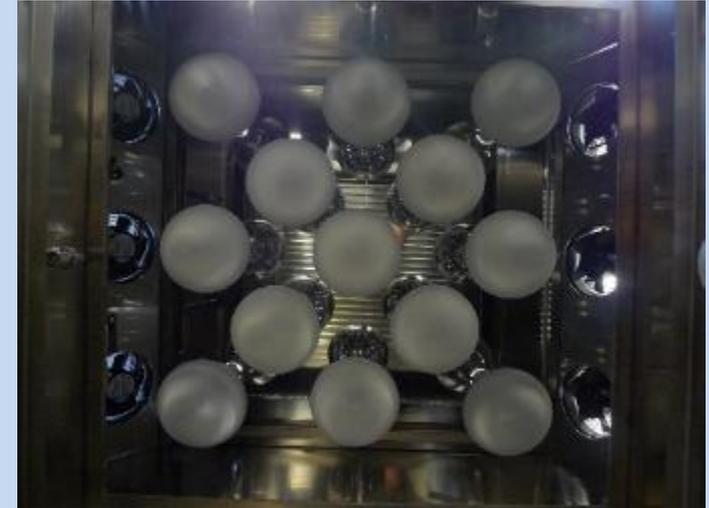
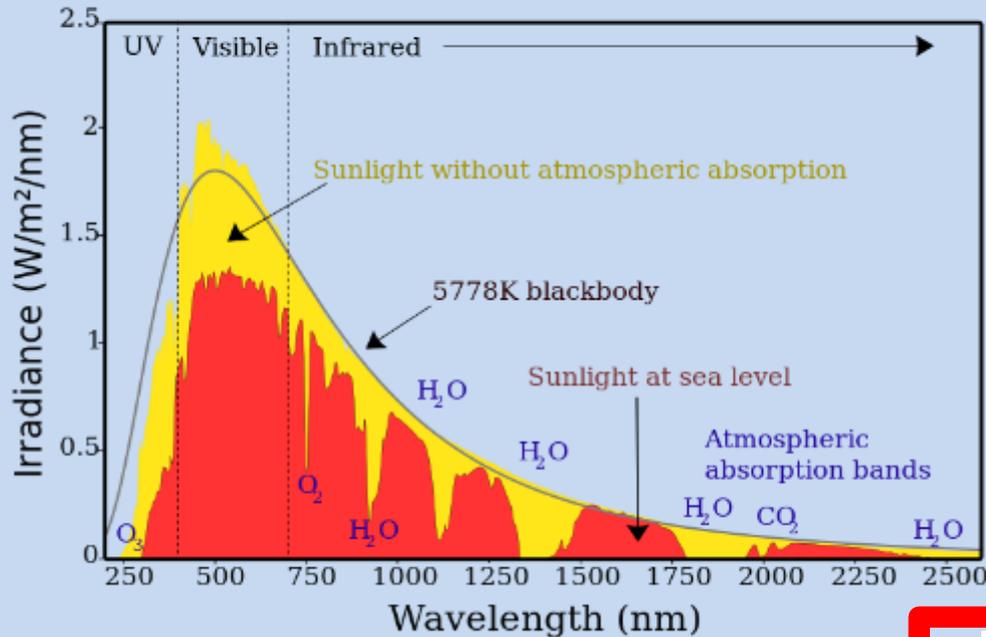




# EXTREME SOLAR RADIATION:

13 ultraviolet & infrared lamps  
(2400W/m<sup>2</sup>)

Spectrum of Solar Radiation (Earth)



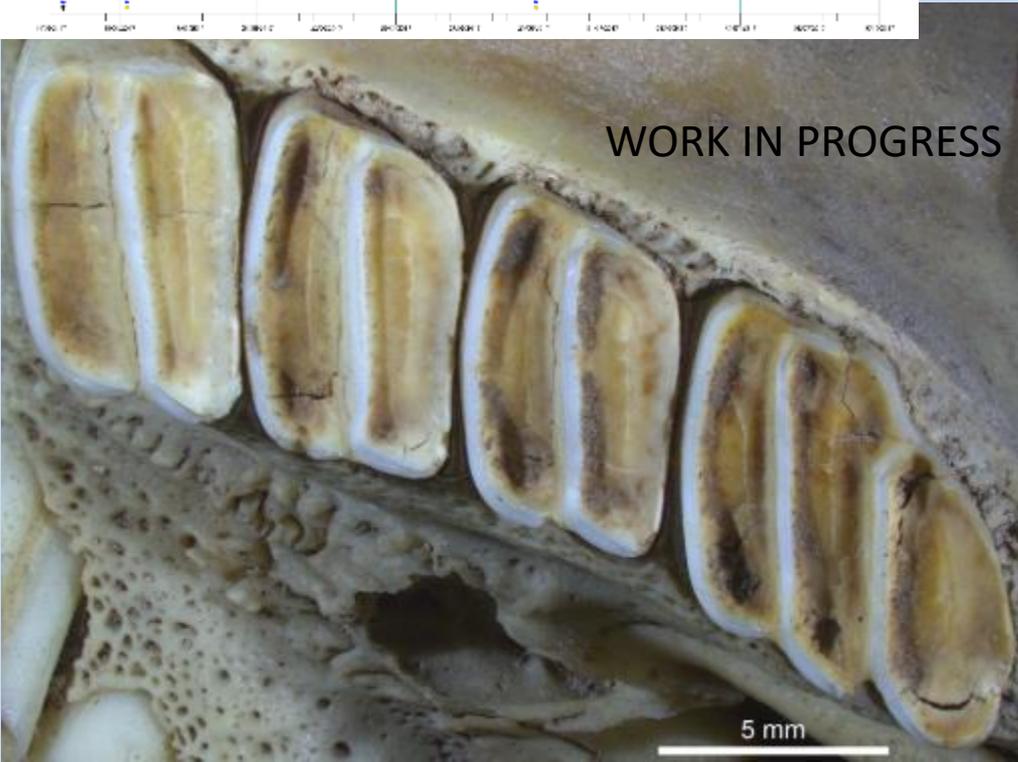
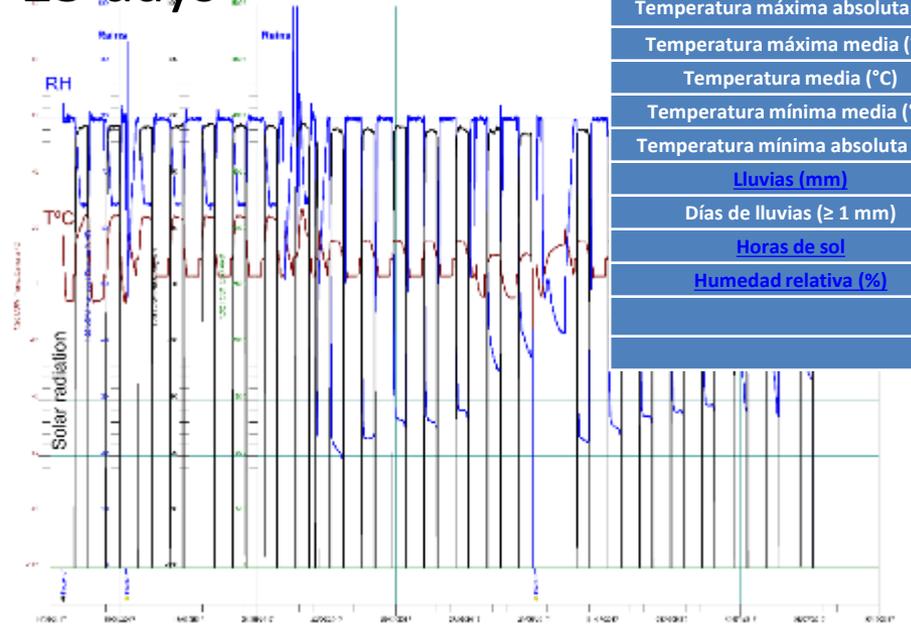
Pyranometer Reading of extreme solar radiation

Mes	Ene	Feb	Mar	Abr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic	Anual
Temperatura máxima absoluta (°C)	26.8	29.6	35.2	40.4	46.5	37.6	37.4	34.4	35.4	38.4	35.3	27.9	46.5
Temperatura máxima media (°C)	18.3	19.1	21.8	24.5	26.7	28.6	31.3	32.0	30.9	28.8	24.7	19.8	24.04
Temperatura media (°C)	13.5	13.8	15.9	18.6	21.1	23.4	26.2	27	25.5	22.9	19	14.8	20.3
Temperatura mínima media (°C)	8.7	9.0	10.1	12.7	15.6	18.3	21.2	22.1	20.2	17.0	13.4	9.9	16.44
Temperatura mínima absoluta (°C)	0.5	-1.9	3.5	7	11.2	15	19	20	15.7	11.6	6	4	-1.9
Lluvias (mm)	145.9	115.1	75.6	18	2.3	0.3	0	0.7	1.4	70.3	110.3	133.4	673.3
Días de lluvias (≥ 1 mm)	15.8	12	9.5	4.1	1.8	0.3	0	0.3	0.5	6.2	10.5	12.9	73.9
Horas de sol	192.2	205.9	235.6	270	328.6	357	368.9	356.5	300	279	234	189.1	3316.8
Humedad relativa (%)	73	71	69	65	68	70	70	70	67	66	66	72	68.9

Fuente n°1: Israel Meteorological Service<sup>22 23</sup>

Fuente n°2: Hong Kong Observatory for data of sunshine hours<sup>24</sup>

# 25 days Humid Pampa winter simulation

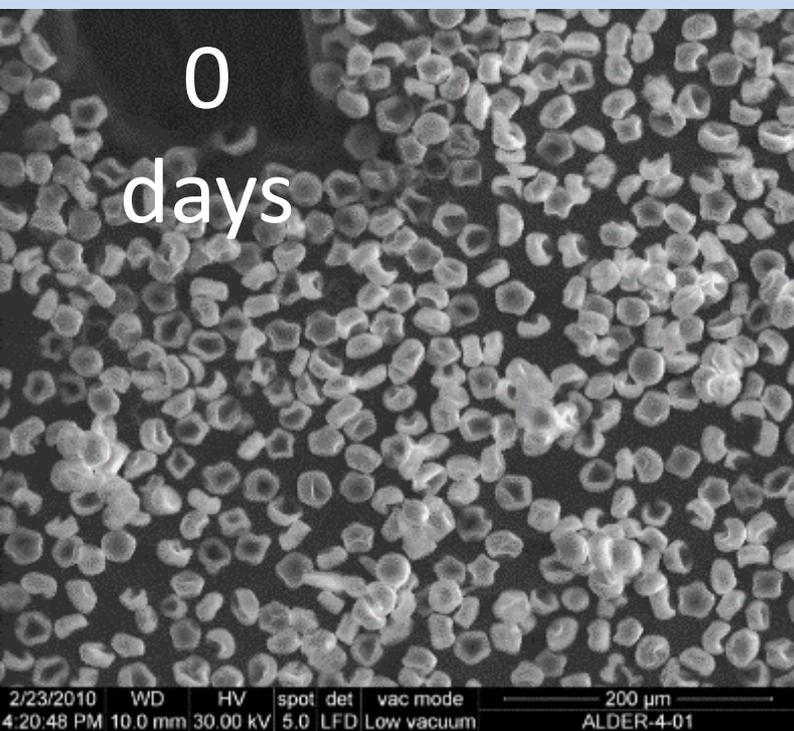


WORK IN PROGRESS

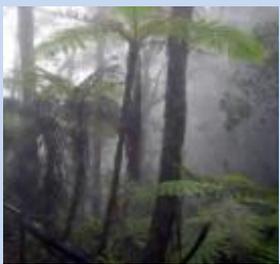


GLOBAL WEATHERING PROJECT





**POLLEN**



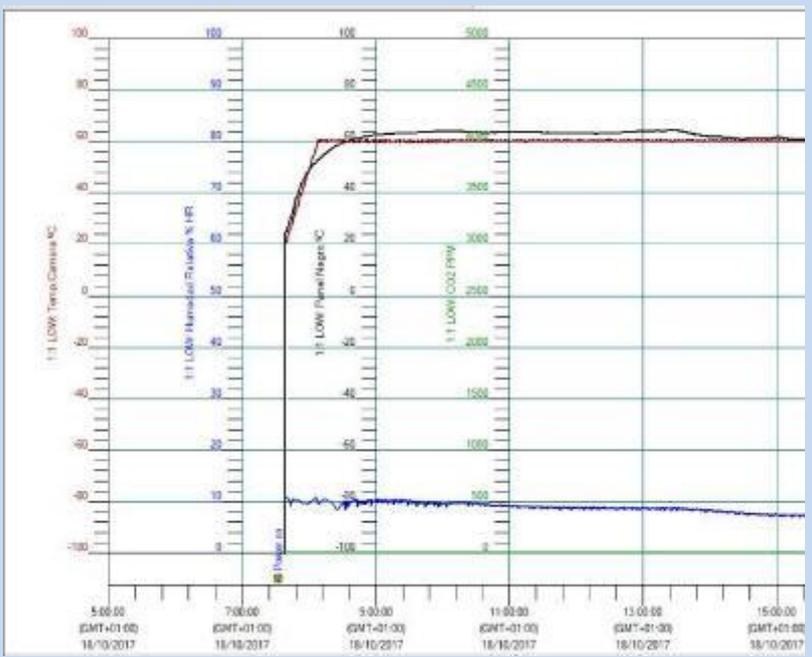
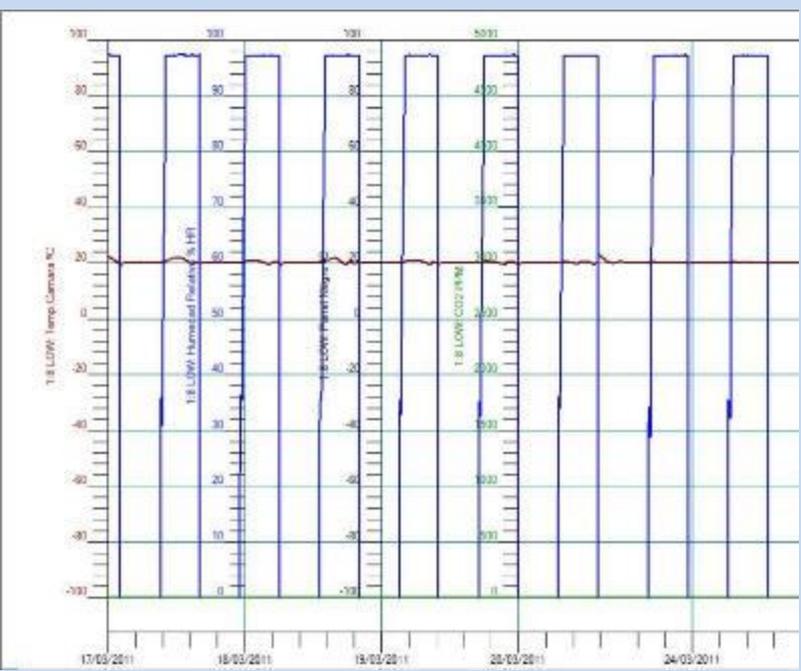
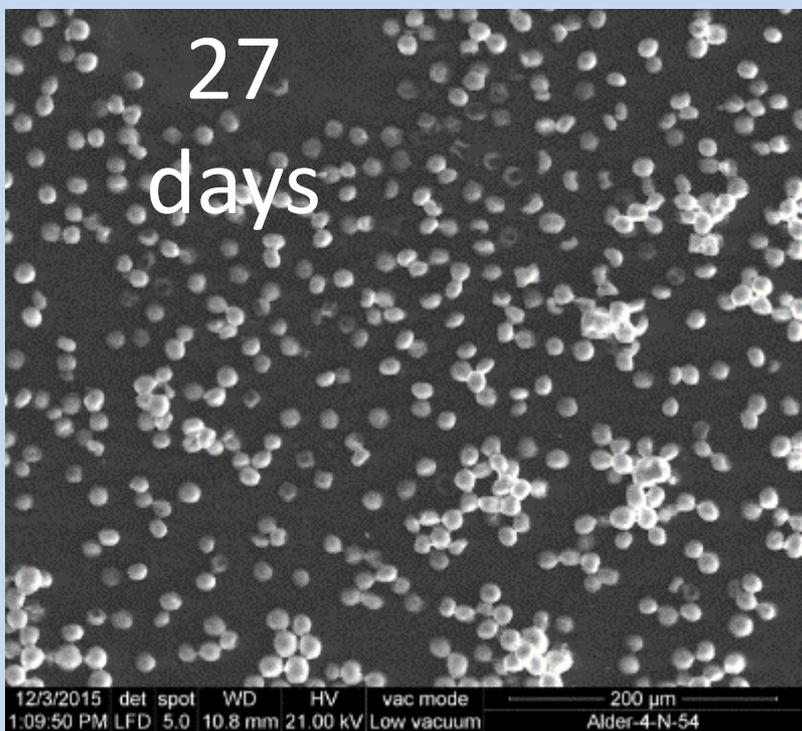
humidity

15 days



Sun  
(1200W)

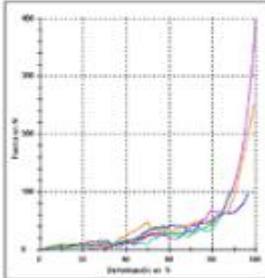
12 days



# MECHANICAL TESTING EQUIPMENT (from 500 grams to ~500 Kg force)

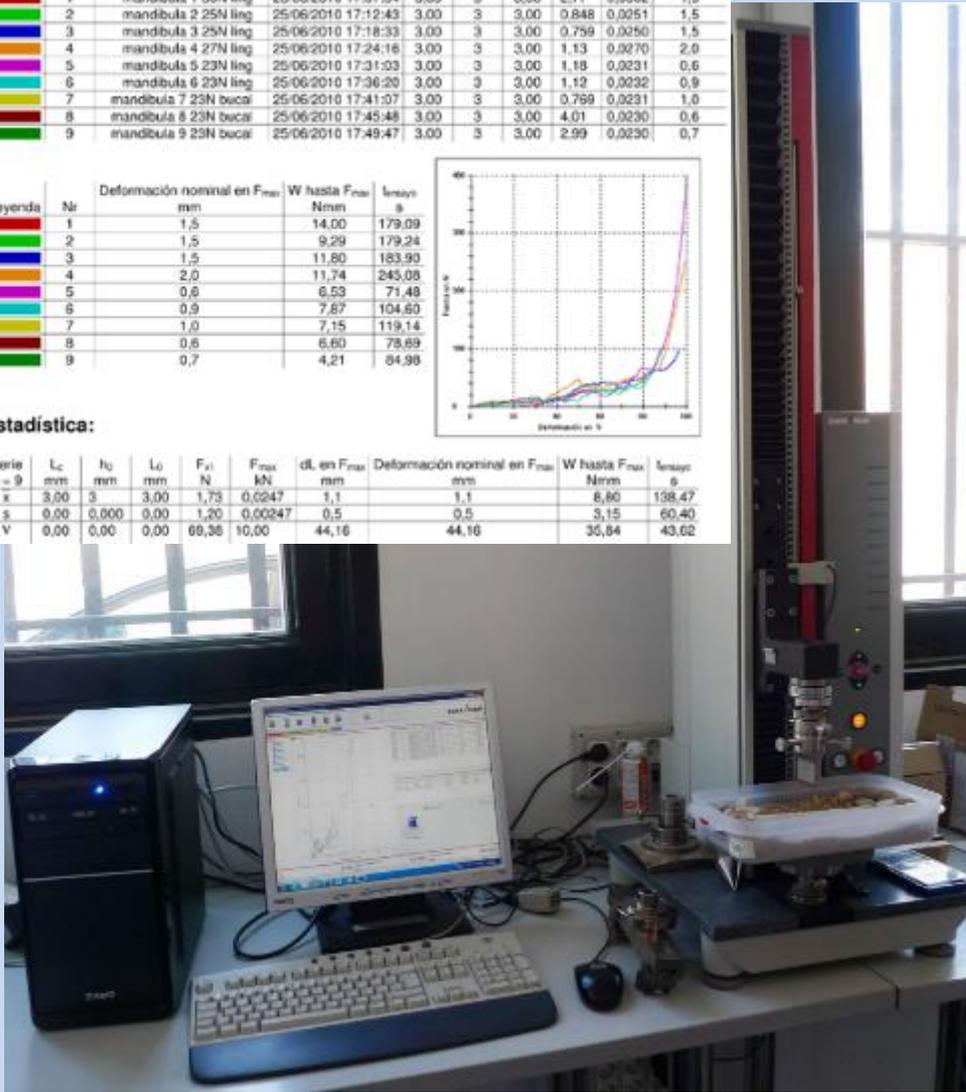
Leyenda	Nr	Identificación de la probeta	Fecha/Hora	L <sub>c</sub> mm	h <sub>0</sub> mm	L <sub>0</sub> mm	F <sub>0.2</sub> N	F <sub>max</sub> kN	dL en F <sub>max</sub> mm
1	1	mandibula 1 30N ling	25-06-2010 17:07:34	3,00	3	3,00	2,77	0,0302	1,5
2	2	mandibula 2 25N ling	25-06-2010 17:12:43	3,00	3	3,00	0,848	0,0251	1,5
3	3	mandibula 3 25N ling	25-06-2010 17:18:33	3,00	3	3,00	0,799	0,0250	1,5
4	4	mandibula 4 27N ling	25-06-2010 17:24:16	3,00	3	3,00	1,13	0,0270	2,0
5	5	mandibula 5 23N ling	25-06-2010 17:31:03	3,00	3	3,00	1,18	0,0231	0,6
6	6	mandibula 6 23N ling	25-06-2010 17:36:20	3,00	3	3,00	1,12	0,0232	0,9
7	7	mandibula 7 23N bucal	25-06-2010 17:41:07	3,00	3	3,00	0,799	0,0231	1,0
8	8	mandibula 8 23N bucal	25-06-2010 17:45:48	3,00	3	3,00	4,01	0,0230	0,6
9	9	mandibula 9 23N bucal	25-06-2010 17:49:47	3,00	3	3,00	2,99	0,0230	0,7

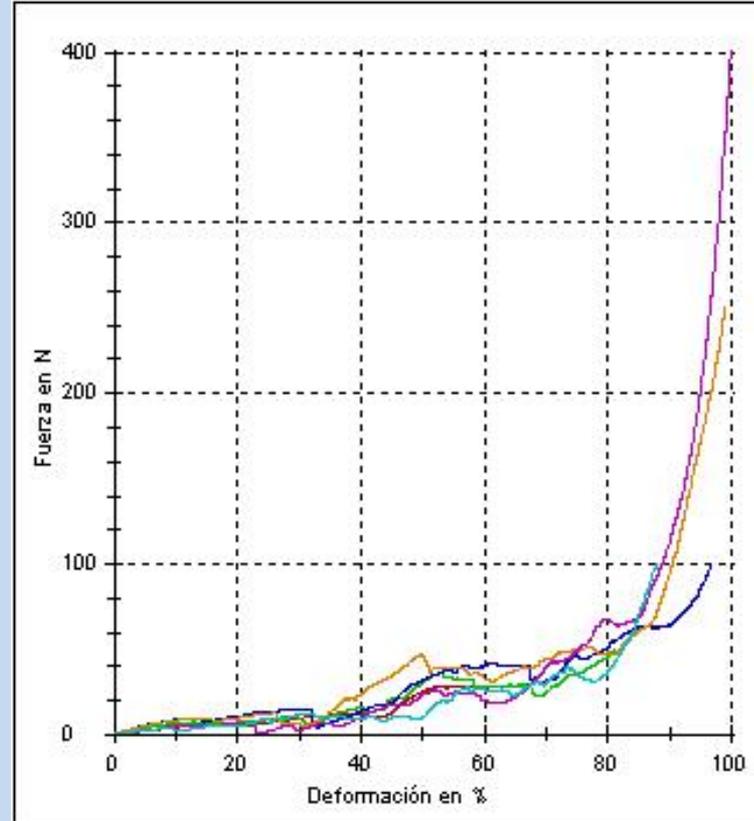
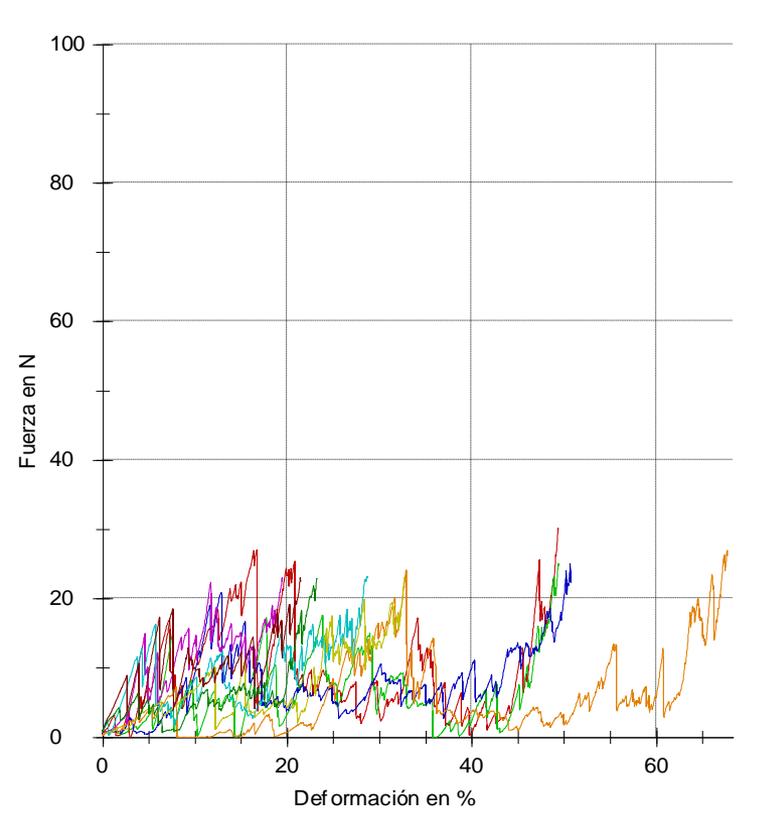
Leyenda	Nr	Deformación nominal en F <sub>max</sub> mm	W hasta F <sub>max</sub> Nmm	tiempo s
1	1	1,5	14,00	179,09
2	2	1,5	9,29	179,24
3	3	1,5	11,80	183,90
4	4	2,0	11,74	245,08
5	5	0,6	6,53	71,48
6	6	0,9	7,87	104,60
7	7	1,0	7,15	119,14
8	8	0,6	6,60	78,89
9	9	0,7	4,21	84,98



### Estadística:

Serie	n	L <sub>c</sub> mm	h <sub>0</sub> mm	L <sub>0</sub> mm	F <sub>0.2</sub> N	F <sub>max</sub> kN	dL en F <sub>max</sub> mm	Deformación nominal en F <sub>max</sub> mm	W hasta F <sub>max</sub> Nmm	tiempo s
x	9	3,00	3	3,00	1,73	0,0247	1,1	1,1	6,60	138,47
s		0,00	0,000	0,00	1,20	0,00247	0,5	0,5	3,15	60,40
V		0,00	0,00	0,00	69,36	10,00	44,16	44,16	35,84	43,62





Bone response under identical forces, either dry or wet conditions with different types of water (basic to acid pH) and different substrates (clay-gravel).



# Hydraulic shop press (up to 30 tons)

Compaction / compression / deformation experiments by hydraulic press. This equipment is not automatic or computer controlled, but it is very precise in keeping the weight (from 500 kilos to 6 or 30 tons) constant and for days, weeks or as long as necessary.



Falling blocks



# Publications compression

Quaternary International 330 (2014) 118–123

Contents lists available at ScienceDirect

**Quaternary International**

journal homepage: [www.elsevier.com/locate/quaint](http://www.elsevier.com/locate/quaint)

ELSEVIER

Compressive marks from gravel substrate on vertebrate remains: a preliminary experimental study

M.D. Marín-Monfort<sup>a,\*</sup>, M.D. Pesquero<sup>a,b</sup>, Y. Fernández-Jalvo<sup>a</sup>

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<sup>b</sup> Fundación Conquistas Paleontológicas de Teruel-Daróprelo, Avda. Sagunto s/n, 44002 Teruel, Spain

CrossMark

**quaternary** MDPI

Article

**Understanding the Impact of Trampling on Rodent Bones**

Yolanda Fernández-Jalvo<sup>1,2\*</sup>, Lucía Rueda<sup>1,2</sup>, Fernando Julian Fernández<sup>3</sup>, Sara García-Morato<sup>1,4</sup>, María Dolores María-Monfort<sup>1,5,6</sup>, Claudia Ines Montalvo<sup>7</sup>, Rodrigo Tomassini<sup>8</sup>, Michael Chazan<sup>5,9</sup>, Liora K. Horwitz<sup>10</sup> and Peter Andrews<sup>11</sup>

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<sup>3</sup> CONICET-Grupo de Estudios en Arqueometría, Facultad de Ingeniería, Universidad de Buenos Aires (UBA), Av. Ponce de León 850 (CP C1063ACV), Ciudad Autónoma de Buenos Aires 1063, Argentina; fernandezfj@tycho.com.ar  
<sup>4</sup> Facultad de Ciencias Geológicas, Departamento de Geodinámica, Estratigrafía y Paleontología, Universidad Complutense de Madrid, José Antonio Novais 12, 28040 Madrid, Spain  
<sup>5</sup> Departamento de Botánica y Geología, Universidad de Valencia, Burjassot, Valencia, 46100 Madrid, Spain

Springer Link

Published: 21 May 2021

**Compression and digestion as agents of vertebral deformation in Sciaenidae, Merlucidae and Gadidae remains: an experimental study to interpret archaeological assemblages**

Romina Frontini<sup>✉</sup>, Eufrasia Roselló-Izquierdo, Arturo Morales-Muñoz, Christiane Denys, Émilie Guillaud, Yolanda Fernández-Jalvo & María Dolores Pesquero-Fernández

*Journal of Archaeological Method and Theory* (2021) | Cite this article

Archaeological and Anthropological Sciences (2021) 13: 215  
<https://doi.org/10.1007/s12520-021-01466-2>

ORIGINAL PAPER

**Evaluation of size-related salmonid fish vertebrae deformation due to compression: an experimental approach**

Arturo Morales Muñoz<sup>1</sup> · Romina Frontini<sup>2</sup> · Yolanda Fernández-Jalvo<sup>3</sup> · Eufrasia Roselló-Izquierdo<sup>1</sup> · María Dolores Pesquero-Fernández<sup>4</sup> · Alicia B. Hernández<sup>4</sup> · Liliana A. García<sup>5</sup>

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Abstract

Contents lists available at ScienceDirect

**Quaternary International**

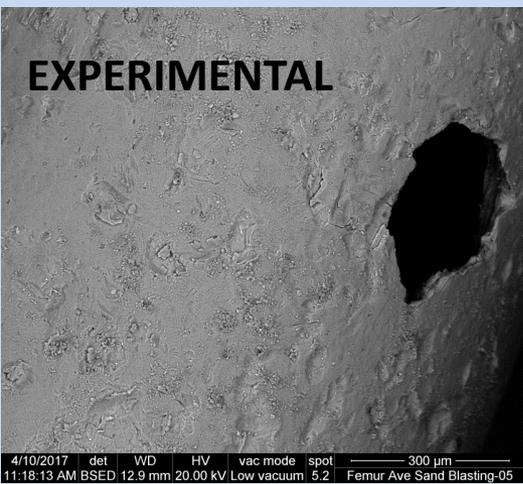
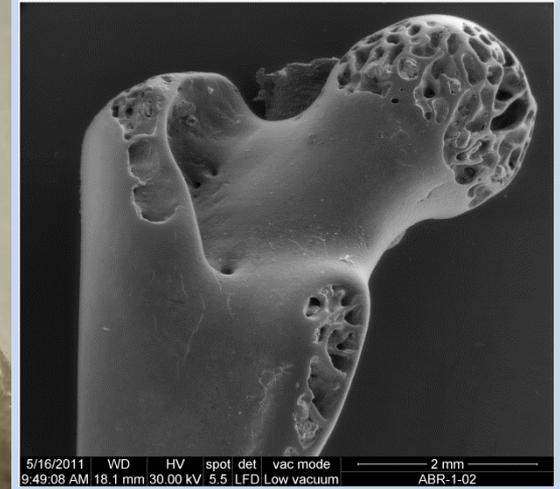
journal homepage: [www.elsevier.com/locate/quaint](http://www.elsevier.com/locate/quaint)

ELSEVIER

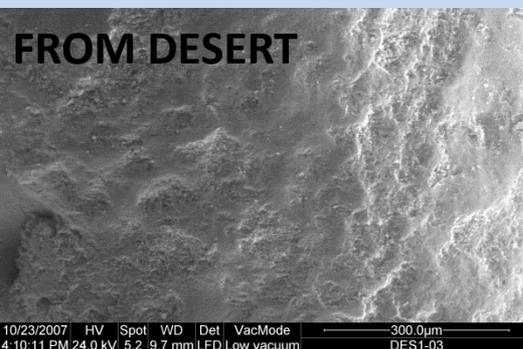
Very human bears: Wild brown bear neo-taphonomic signature and its equifinality problems in archaeological contexts

Jordi Rosell<sup>a,b,\*</sup>, Ruth Blasco<sup>c</sup>, Maite Arilla<sup>a,b</sup>, Yolanda Fernández-Jalvo<sup>d</sup>





# ABRASION (WEEKS/MINUTES)



# Publications abrasion

PROMETHEUS PRESS/PALAEONTOLOGICAL NETWORK FOUNDATION QUERQUELL  
**Journal of Taphonomy** 2003 available online at www.journals.taphonomy.com  
VOLUME 1 (ISSUE 3)

## Experimental Effects of Water Abrasion on Bone Fragments

Yolanda Fernández-Jalvo<sup>\*</sup>  
*Museo Nacional de Ciencias Naturales (CSIC), Departamento de Paleobiología,  
José Gutiérrez Abascal 2, 28006-Madrid Spain*

Peter Andrews  
*The Natural History Museum, Department of Paleontology, Cromwell Road,  
London SW7-5BD, U.K.*

Archaeological and Anthropological Sciences (2019) 11:4891–4907  
<https://doi.org/10.1007/s12520-019-00834-3>

ORIGINAL PAPER

**Abrasion in archaeological fish bones from sand dunes. An experimental approach**

Romina Frontini<sup>1</sup> • Yolanda Fernández-Jalvo<sup>2</sup> • María Dolores Pesquero Fernández<sup>2</sup> • Rodrigo J. Vecchi<sup>1</sup> • Cristina Bayón<sup>3</sup>

Received: 10 December 2018 / Accepted: 25 March 2019 / Published online: 8 April 2019  
© Springer-Verlag GmbH Germany, part of Springer Nature 2019

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Disponible en ligne sur [www.sciencedirect.com](http://www.sciencedirect.com)

 ScienceDirect

Geobios 41 (2008) 157–181  
<http://france.elsevier.com/direct/GEOBIO>

Original article

## Experimental taphonomy in museums: Preparation protocols for skeletons and fossil vertebrates under the scanning electron microscopy

Yolanda Fernández-Jalvo<sup>a,\*</sup>, María Dolores Marín Monfort<sup>b,c</sup>

 ELSEVIER

 GEOBIOS

 **Lethaia**  
AN INTERNATIONAL JOURNAL OF PALAEOBIOLOGY AND STRATIGRAPHY

## Digestion versus abrasion features in rodent bones

YOLANDA FERNÁNDEZ-JALVO, PETER ANDREWS, PALOMA SEVILLA AND VIRGINIA REQUEJO

**LETHAIA**

Fernández-Jalvo, Y., Andrews, P., Sevilla, P. & Requejo, V. 2014: Digestion vs. abrasion features in rodent bones. *Lethaia*, Vol. 47, pp. 323–336.

The origin of most fossil small mammal assemblages is predation by avian or mammalian predators. Bone corrosion by gastric juices observed in these fossils is direct evidence of digestion, and traits of digestion indicate the type of predator involved. However, certain features observed in digested bones, such as rounding and polishing, are similar to the rounding and polishing produced by other processes, particularly



 **Palaeontologia Electronica**  
[palaeo-electronica.org](http://palaeo-electronica.org)

## Rolling bones: A preliminary study of micromammal abrasion on different initial taphonomic stages

Sara Garcia-Morato, Maria Dolores Marin-Monfort, and Yolanda Fernández-Jalvo

**ABSTRACT**

The identification of transport process is key to interpret the palaeoecology, the dating and the site formation. Apart from dispersal and size/shape selection, bone

Quaternary International 481 (2018) 3–13

Contents lists available at ScienceDirect

**Quaternary International**

journal homepage: [www.elsevier.com/locate/quaint](http://www.elsevier.com/locate/quaint)

## Characterization of recent marks produced on fossil bone surface during sullegic and trephic processes and their influence on taphonomic studies

M.D. Marín-Monfort<sup>a,b,\*</sup>, M. Suñer<sup>b,c</sup>, Y. Fernández-Jalvo<sup>d</sup>

 ELSEVIER

 CrossMark

# MUFFLE FURNACE OF HIGH TEMPERATURES (1200°C) CREMATION



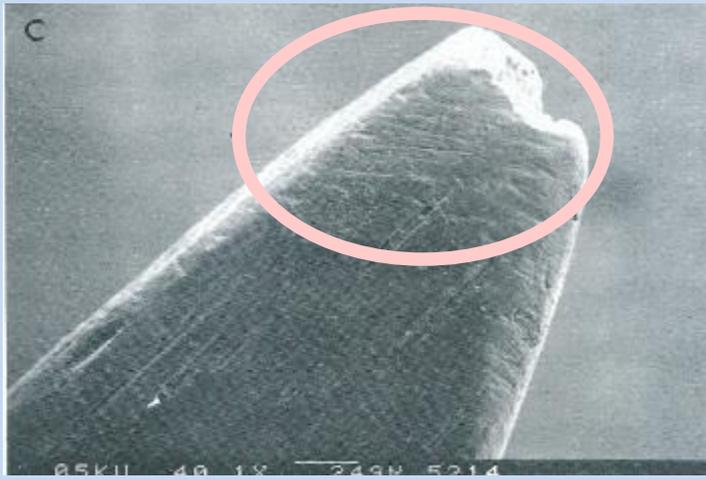
crucibles



Grades and colours of bones exposed to fire (from Fernández-Jańvp and Andrews, 2016)

## Experimental pot-polish

## BOILING



Pot polishing marks from White (1992: 125)



6/20/2022 det HV WD spot vac mode 100 µm  
11:37:52 AM BSED 20.00 kV 17.9 mm 5.0 Low vacuum 455LH-FR-03

# Publications CREMATION

Afr Archaeol Rev (2015) 32:751–791  
DOI 10.1007/s10437-015-9206-7



## ORIGINAL ARTICLE

### Pleistocene Micromammals and Their Predators at Wonderwerk Cave, South Africa

Yolanda Fernandez-Jalvo<sup>1</sup> · D. Margaret Avery<sup>2</sup>

Published online: 4 December 2015

© Springer Science+Business Media New York 2015



### Fire in the Early Palaeolithic: Evidence from burnt small mammal bones at Cueva Negra del Estrecho del Río Quípar, Murcia, Spain

S.E. Rhodes<sup>3,4,5\*</sup>, M.J. Walker<sup>6</sup>, A. López-Jiménez<sup>4</sup>, M. López-Martínez<sup>6</sup>, M. Haber-Uriarte<sup>6</sup>, Y. Fernández-Jalvo<sup>1</sup>, M. Chazan<sup>7</sup>

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#### ABSTRACT

The development of pyrotechnology is a hallmark of human history, providing our ancestors with warmth, security and cooked food. Evidence for fire use before 400 thousand years ago (kyr) remains contentious due largely to the taphonomically fragile nature of charcoal and ash. As such, it is imperative to the study of prehistoric fire that we develop techniques and methodologies for identifying anthropogenic fire use via more robust materials. A new methodology described by Fernández-Jalvo and Avery (2015) based on small mammal taphonomy to identify high intensity fire events from the distant past is replicated herein. When we applied this method to assemblages from Cueva Negra del Estrecho del Río Quípar, an early rock shelter in southern Spain, it revealed

Journal of Human Evolution 63 (2012) 859–866



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Journal of Human Evolution

Journal homepage: www.elsevier.com/locate/jhevol



#### News and views

### The Oldowan horizon in Wonderwerk Cave (South Africa): Archaeological, geological, paleontological and paleoclimatic evidence

Michael Chazan<sup>8,\*</sup>, D. Margaret Avery<sup>9</sup>, Marion K. Bamford<sup>5</sup>, Francesco Berna<sup>4,c</sup>, James Brink<sup>1,e</sup>, Yolanda Fernandez-Jalvo<sup>1</sup>, Paul Goldberg<sup>4,d</sup>, Sharon Holt<sup>1</sup>, Ari Matmon<sup>1</sup>, Naomi Porat<sup>8</sup>, Hagai Ron<sup>1,f</sup>, Lloyd Rossouw<sup>1,m</sup>, Louis Scott<sup>7,n</sup>, Liora Kolska Horwitz<sup>7</sup>

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Wonderwerk Cave  
South Africa

a small number of localities in southern Africa, none of which is interpreted as representing primary contexts (Kuman, 1998; Schick and Toth, 2006). Here we provide the first comprehensive description of an *in situ* Oldowan deposit from basal Stratum 12 inside Wonderwerk Cave, Northern Cape Province, South Africa.

#### The Wonderwerk Cave Earlier Stone Age sequence

Wonderwerk Cave is a ~140 m phreatic tube formed in the dolomites of the Ruruman Hills (Northern Cape Province, South Africa) (Fig. 1a). Beginning in the 1940s, archaeological excavations were carried out at the site by Malan and colleagues (Malan and Cooke, 1941; Malan and Wells, 1943) followed by further investigations by other researchers (Butzer, 1984). The most extensive excavations were undertaken by Peter Beaumont from the 1970s to the early 1990s (Beaumont and Vogel, 2006). Since 2007, our team has been engaged in fieldwork at the site, primarily in Excavation 1 located ~30 m from the cave mouth (Fig. 1b–d). This work has focused on sampling for micromorphological analyses of sediments, pollen, phytoliths and for cosmogenic burial and paleomagnetic dating. All samples were taken from the freshly cleaned Earlier Stone Age (ESA) sections left by Beaumont (maximum ESA section height 2 m). In addition, limited test excavations aimed at *in situ* sampling of the lowest ESA horizon, Stratum 12, were carried out. Analyses of archaeological finds (lithics, fauna and macro-botanical remains) deriving from Beaumont's excavations of the ESA levels has also been undertaken.

During fieldwork, we subdivided the ESA sedimentary sequence into nine lithostratigraphic units (Fig. 2). Overall, the sediments consist of reddish, powdery, bedded quartz silt and sand with

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† Author in residence.

# SMALL EQUIPEMENTS



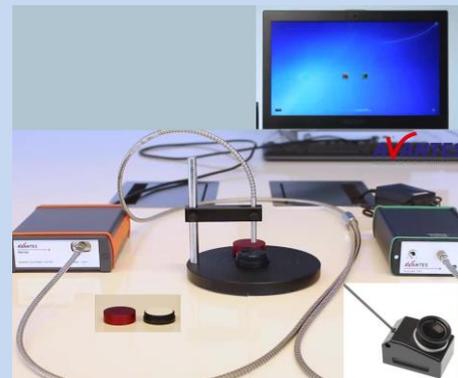
HIGH RESOLUTION AND  
AUTOMATIZED MAGNIFICATION



FLUORESCENCE CHAMBER

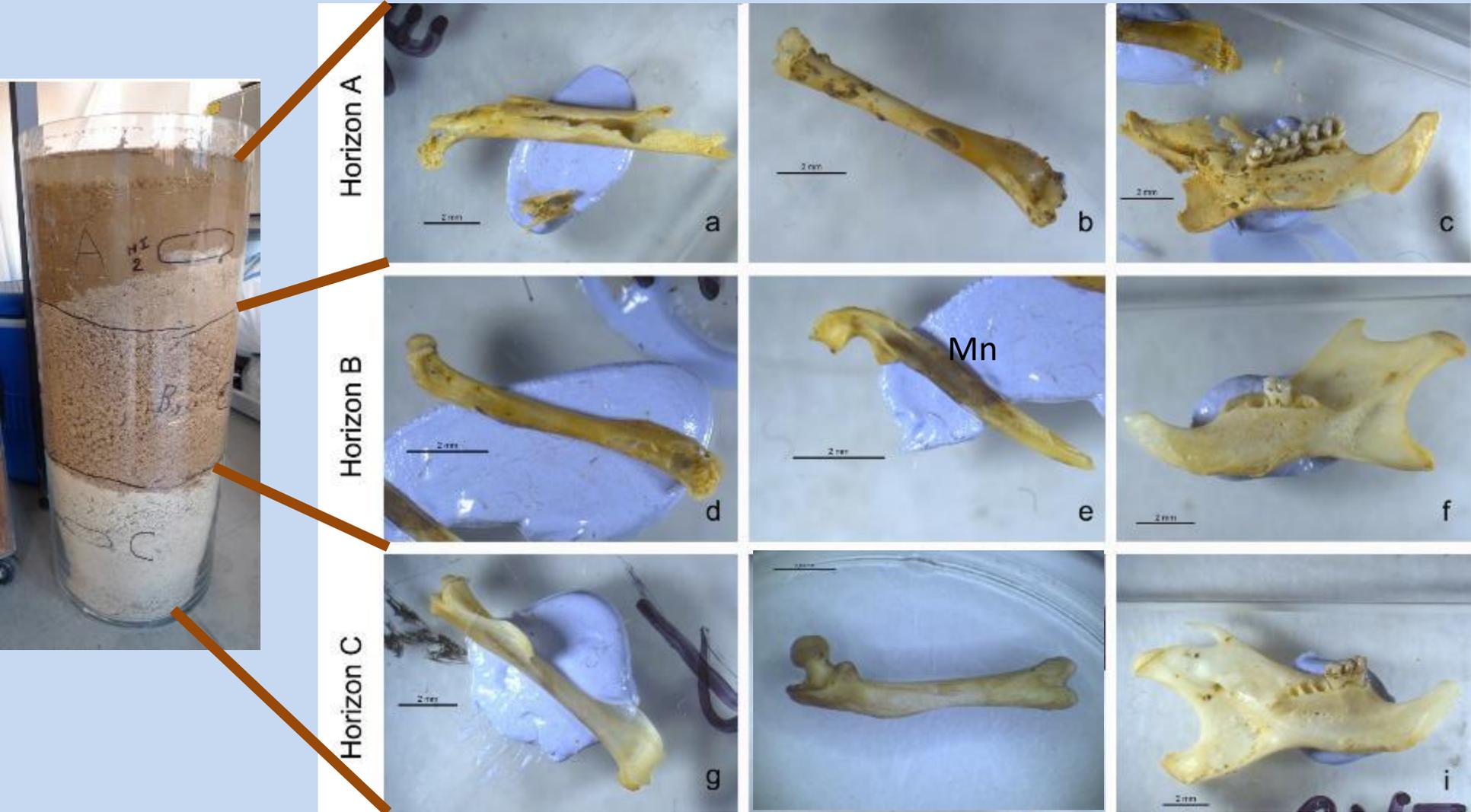


ULTRASONIC BATH

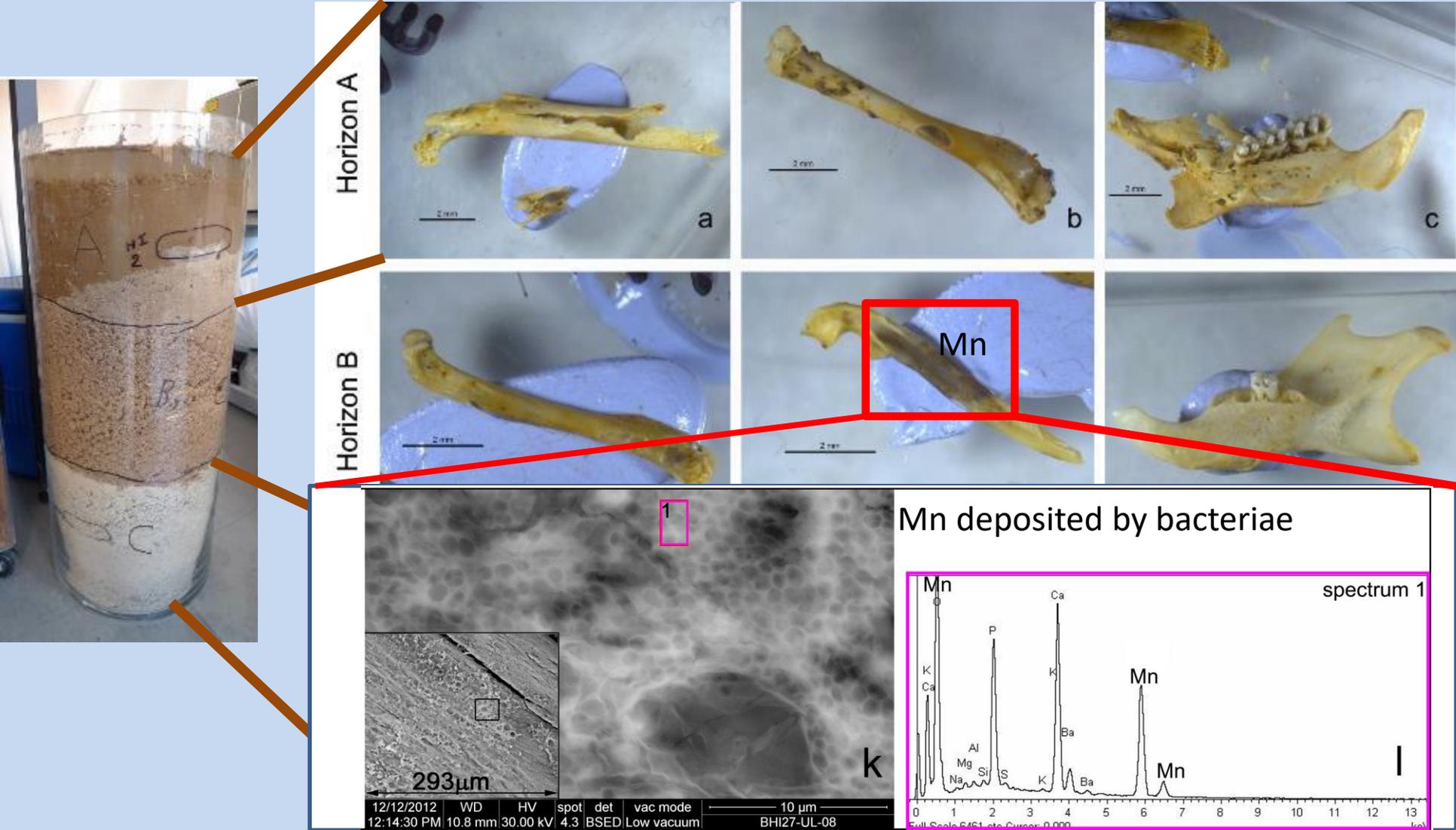


ESPECTROPHOTOMETRE, SCALES,  
PIRANOMETRE, THERMOMETER  
WITH THERMOCUPLES...

# CORROSION INORGANIC: SUBSTRATE (14 months)



# CORROSION INORGANIC: SUBSTRATE (14 months)



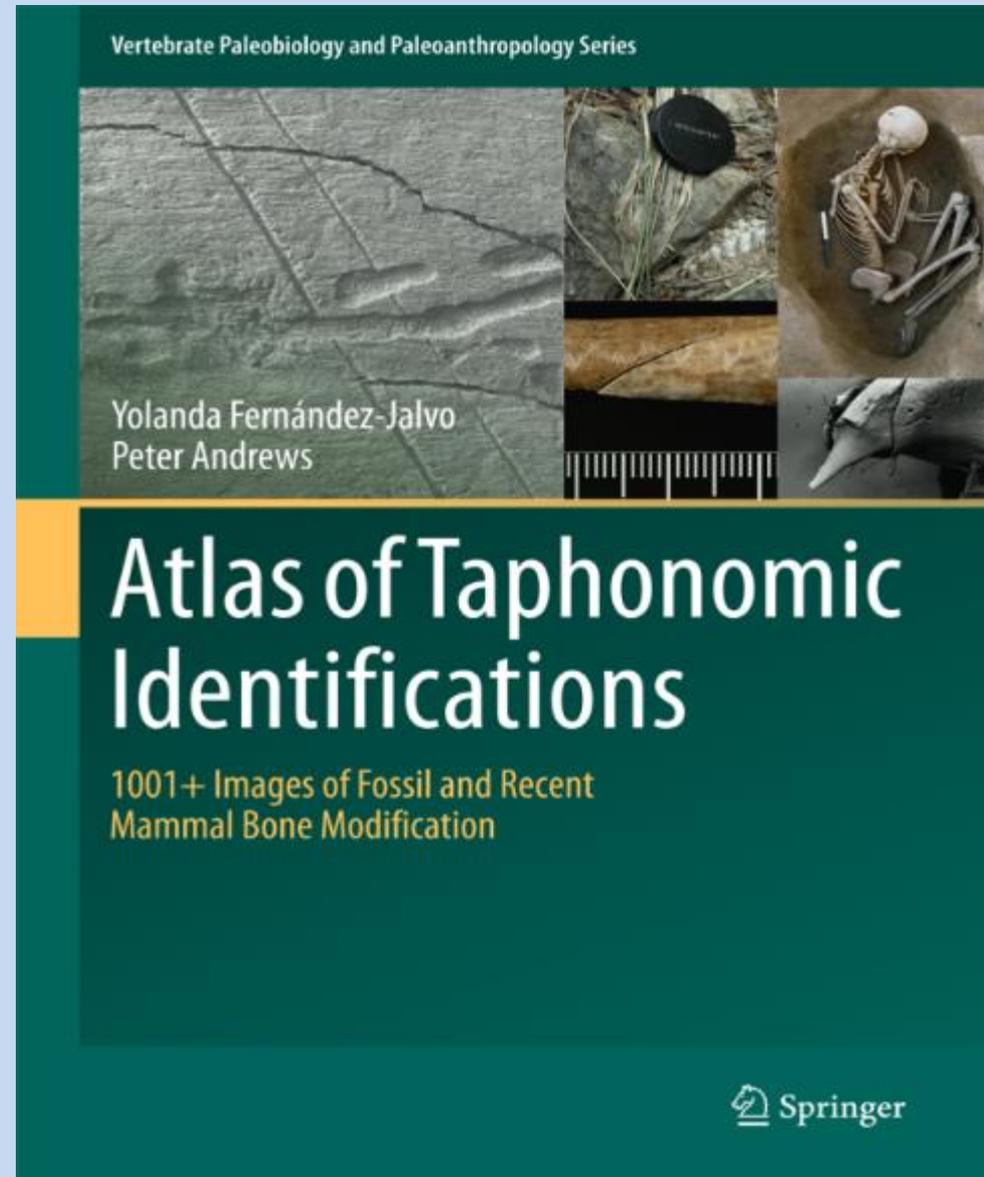
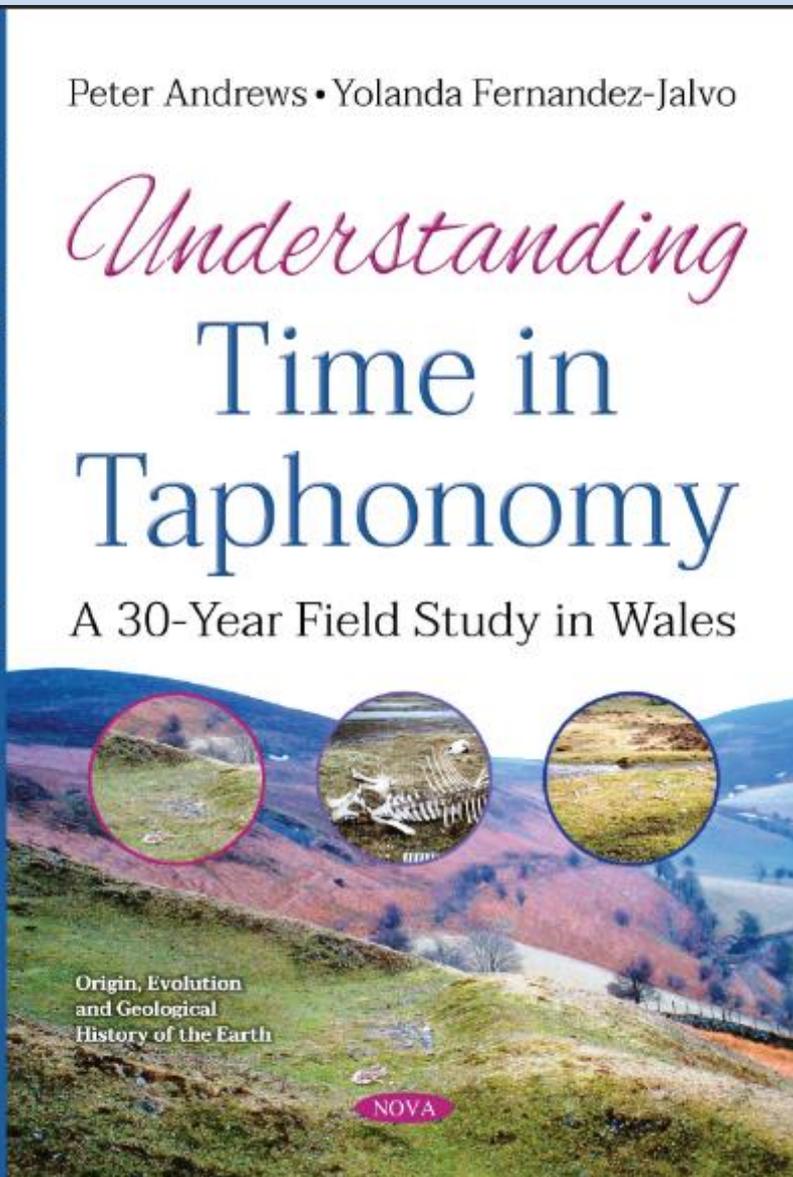
# All experiments are validated by monitoring the nature



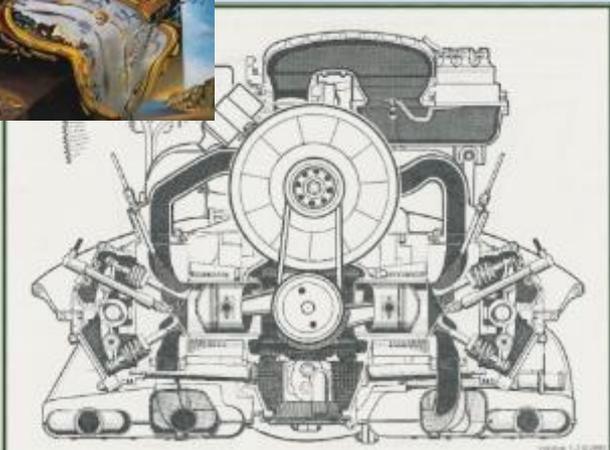
# TRUE CASES FROM TODAY AND PAST TIMES



# BOOKS BASED ON EXPERIMENTAL WORK



# !!!THANKS!!!!



TIME MACHINE!!!  
Fossils in the making



# LeaT

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