Back to the Past: The Taphonomic Time Machine

The Laboratory of Environmental Analyses and Experimental Taphonomy

LeaT (mncn-csic)

Fossils in the making

2009-2022
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.
IT SEEMS TO BE A GOOD IDEA, AS OTHER COLLEAGUES HAVE ALSO CREATED A SIMILAR EXPERIMENTAL LABORATORY
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.
Climatic Chamber

CO₂

Liquid Nitrogen (cryogenic)
EXTREME SOLAR RADIATION:

13 ultraviolet & infrared lamps
(2400 W/m²)

Pyranometer Reading of extreme solar radiation
### Parámetros climáticos promedio de Tel Aviv (1916–2007)

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

**Fuente nº1:** Israel Meteorological Service

**Fuente nº2:** Hong Kong Observatory for data of sunshine hours

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**WORK IN PROGRESS**

**GLOBAL WEATHERING PROJECT**
humidity

0 days

27 days

POLLEN

15 days

+ Sun (1200W)

12 days
MECHANICAL TESTING EQUIPMENT (from 500 grams to ~500 Kg force)
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.
Publications compression
ABRASION (WEEKS/MINUTES) FROM DESERT
Publications abrasion

**Experimental Effects of Water Abrasion on Bone Fragments**

Yolanda Fernández-Jalvo

Museo Nacional de Ciencias Naturales (CSIC), Departamento de Paleobiología, Jose Gutiérrez Abascal 2, 28006-Madrid, Spain

Peter Andrews

The Natural History Museum, Department of Paleontology, Cromwell Road, London SW7 5BD, UK


https://doi.org/10.1017/0281-2592-1

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

Romina Frontini a, b, Yolanda Fernández-Jalvo a, c, Maria Dolores Pesquero Fernández a, c, Rodrigo J. Vecchi a and Cristina Bayón a

Received 10 December 2018/Accepted 25 March 2019/Published online: 8 April 2019

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

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

Quaternary International 481 (2018) 5–11

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Quaternary International

Original article

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

Yolanda Fernández-Jalvo a, c, Maria Dolores Marín Monfort a, c

ScienceDirect


http://france.elevier.com/locate/GEOBIO

LETHAIA

Digestion versus abrasion features in rodent bones

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


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 abrasion, which may render it difficult to determine whether the agent causing the rounding was a predator or not.
MUFFLE FURNACE OF HIGH TEMPERATURES (1200ºC) CREMATION

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

Experimental pot-polish

Pot polishing marks from White (1992: 125)

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

Yolanda Fernandez-Jalvo and D. Margaret Avery

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 Quipar, Murcia, Spain


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ABSTRACT
The development of projectile technology is a hallmark of human history, providing our ancestors with warmth, security and cooked food. Evidence for fire use before 400 thousand years ago (ka) remains controversial, largely to the technologically fragile nature of charred ash. Here we present a new method for identifying high intensity fire events from the distant past in replicated soils. When applied to this method to examine burned sediments from a Palaeolithic site in northeastern China, we find evidence for repeated fire use, dated to 1.8 million years ago. This suggests that the evolution of fire use in this region was influenced by factors such as environmental changes and human behavior.
SMALL EQUIPMENTS

HIGH RESOLUTION AND AUTOMATIZED MAGNIFICATION

ULTRASONIC BATH

FLUORESCENCE CHAMBER

ESPECTROPHOTOMETRE, SCALES, PIRANOMETRE, THERMOMETER WITH THERMOCUPLES...
CORROSION INORGANIC: SUBSTRATE
(14 months)
CORROSION INORGANIC: SUBSTRATE (14 months)

Mn deposited by bacteriae
All experiments are validated by monitoring the nature.
TRUE CASES FROM TODAY AND PAST TIMES
BOOKS BASED ON EXPERIMENTAL WORK

- Understanding Time in Taphonomy: A 30-Year Field Study in Wales (Peter Andrews, Yolanda Fernandez-Jalvo, Nova)
¡¡¡THANKS!!!!

TIME MACHINE!!!
Fossils in the making

Make your site a reality!!