

# Paleogenetic analysis for the valorization of Cultural Heritage

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David Caramelli**

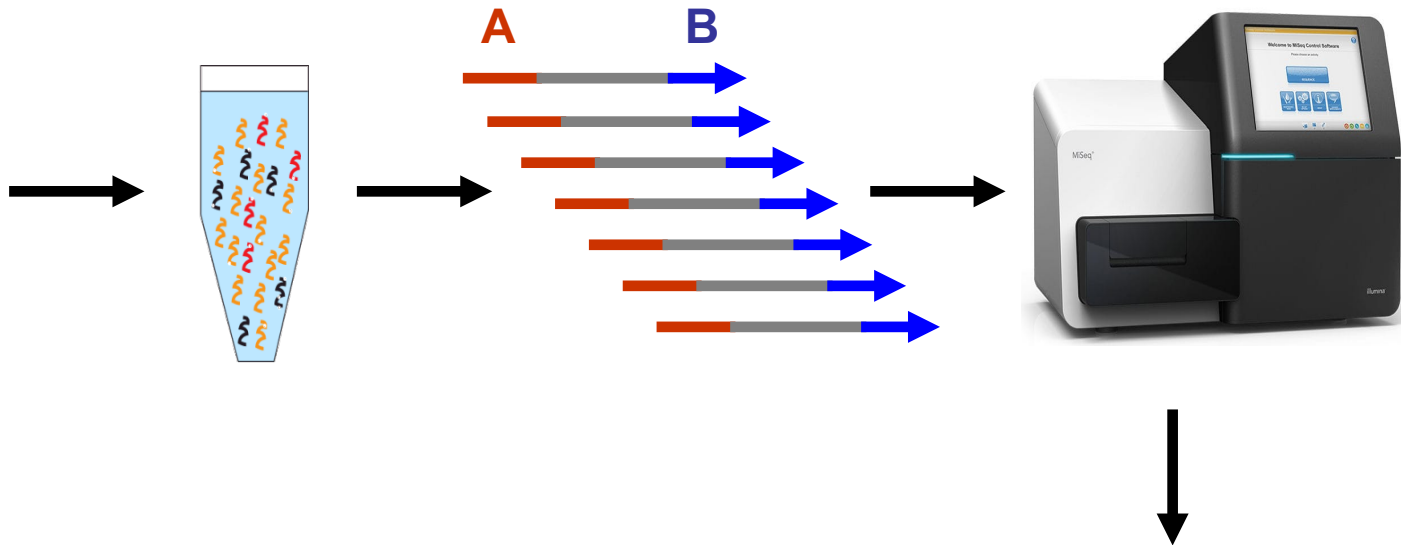
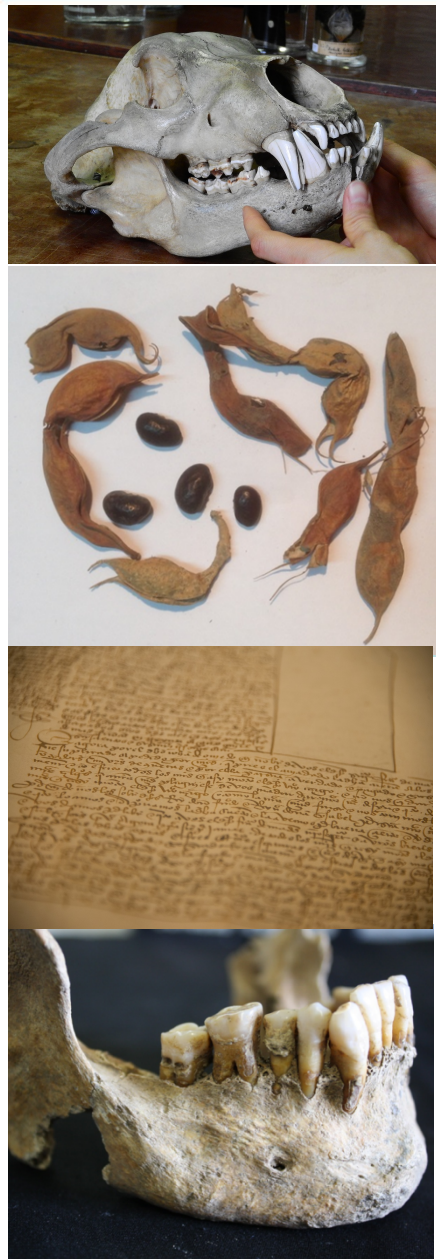
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*Laboratorio di Antropologia Molecolare e Paleogenetica*



*J.M Cecchi., R. Stanyon, Il Museo di Storia Naturale dell'Università degli Studi di Firenze. Le collezioni antropologiche ed etnologiche, Firenze University Press, 2014.*

## DNA analysis on ancient biological remains



- determination of species of origin
- individual identification of famous personalities
- phylogenetic relationships
- reconstructing life style and cultural contexts

## Paleogenetic analysis





## Human skeletal remains







**The human skeleton from  
Lamalunga, Altamura**





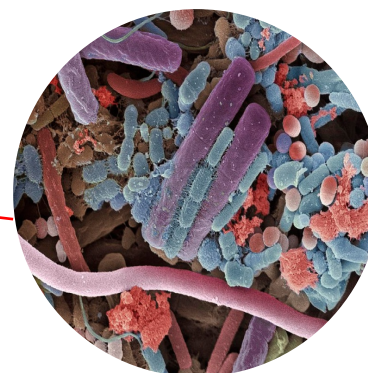
## Removing a skeletal fragment from the cave



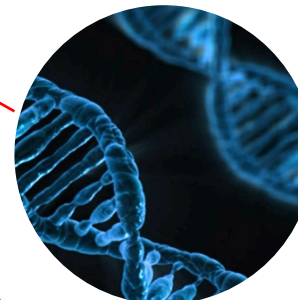




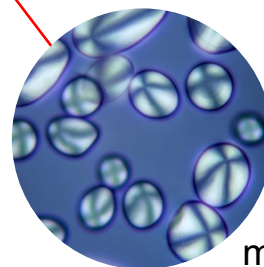
## Ancient *dental calculus*



Bacterial flora



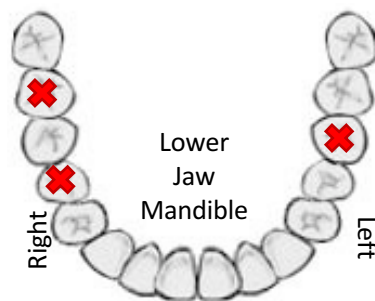
Human DNA from  
mucosa cells



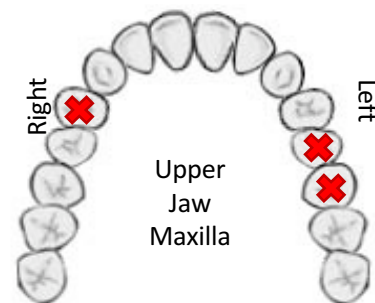
Plant  
microresidues

## Porticus Octaviae (Rome), IX-XII sec. CE

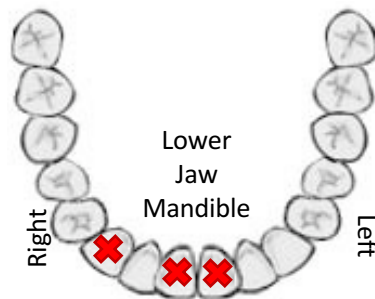
PO. 108-7



PO. Z. US44

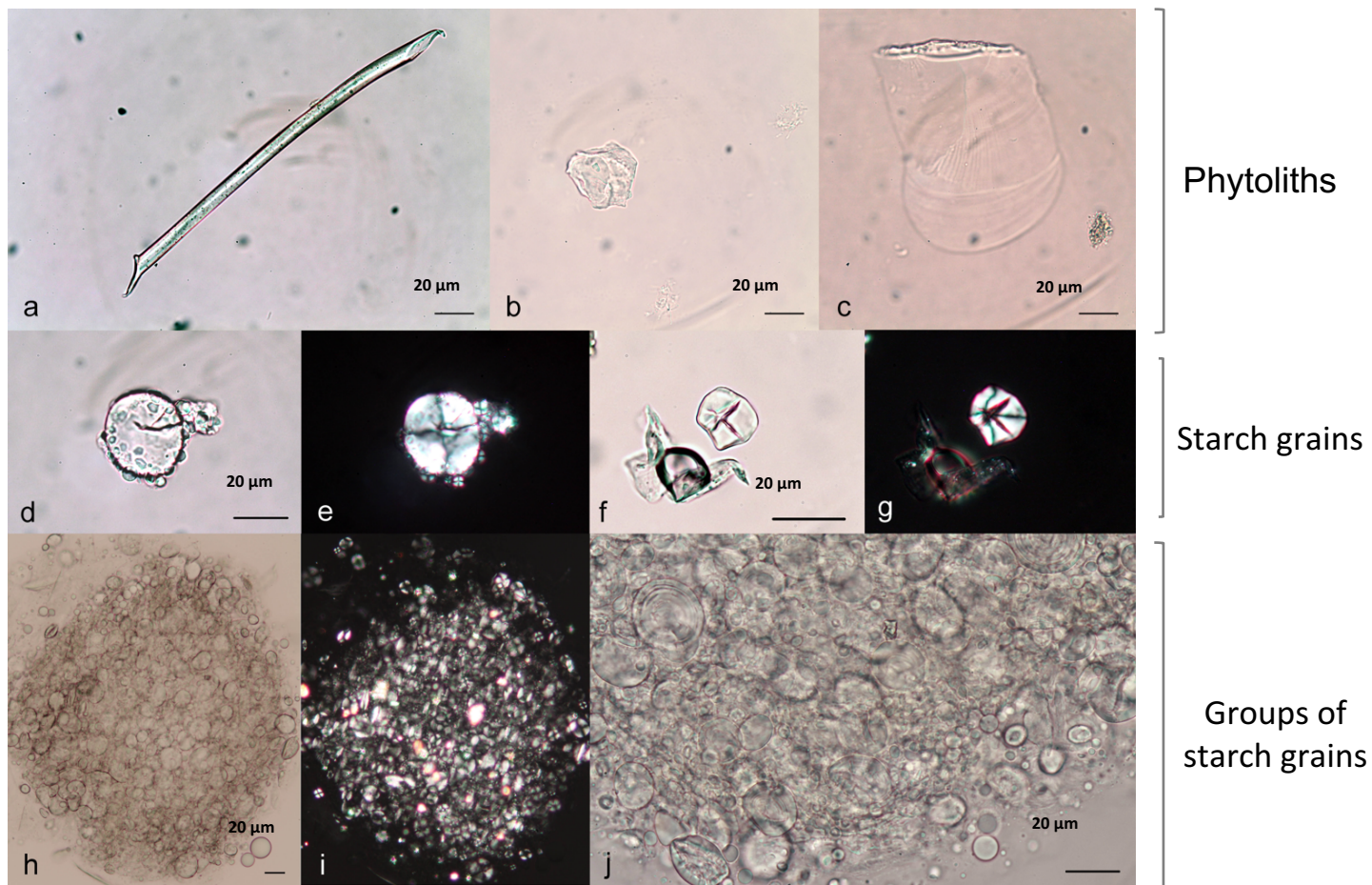


PO. 898-11



## Dietary plant microresidues

- Poaceae, Panicoideae, Hordeum, Triticum

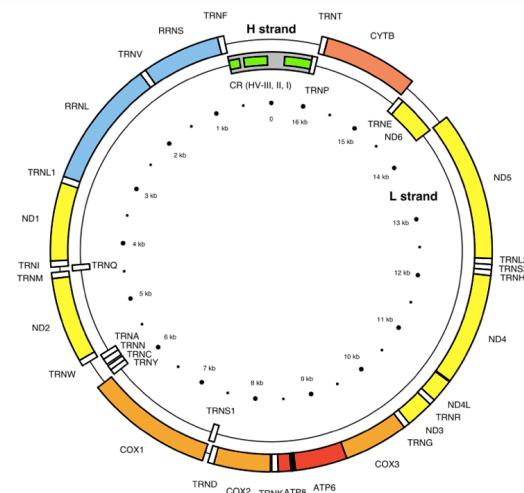




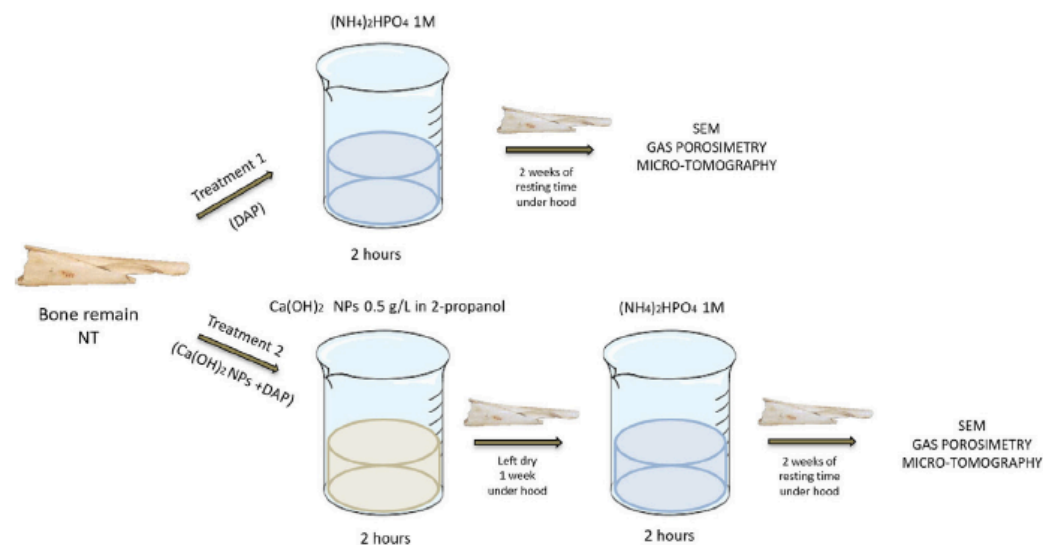


## Complete human mitochondrial genomes

Sample ID	Hg	Total Variants	Variants	Missing positions
● P.O 108-7	U5a1c2a1	26	A73G, A183G, A263G, A750G, A1438G, A2706G, A4769G, C7028T, A8860G, G9477A, C10544T, A11467G, G11719A, A12280G, A12308G, G12372A, T13617C, C14766T, A14793G, A15326G, C16192T, C16256T, C16270T, C16286T, C16320T, A16399G	15
● P.O Z. US44	X2 + 225 + @16223	21	A73G, A153G, T195C, G225A, A263G, A750G, A1438G, G1719A, A2706G, A4769G, T6221C, C7028T, A8860G, G11719A, C12705T, A13966G, T14470C, T15090C, A15326G, C16278T, T16519C	10



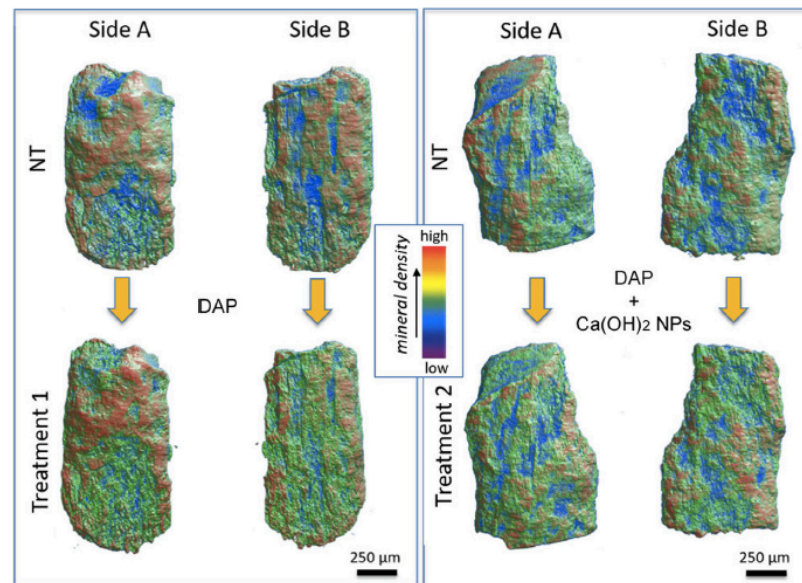
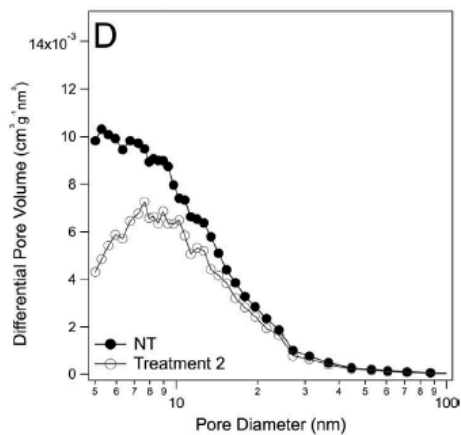
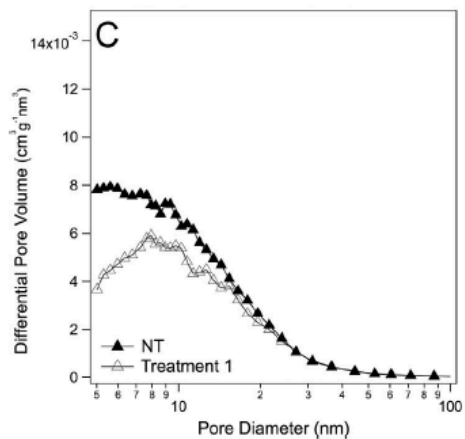
## Restoration of ancient skeletal remains



**Scheme 1.** Representative sketch describing the consolidation treatments on the bone remains. Consolidation 1: involved only one soaking step in an aqueous solution of DAP 1 M. Consolidation 2: it was based on a first soaking in 0.5 g/L  $\text{Ca}(\text{OH})_2$  NPs dispersion in 2-propanol for 2 hours, followed by a completely drying under hood for one week, then a second soaking was done in an aqueous solution of DAP 1 M for 2 hours, the following two weeks the sample was maintained in a confined environment at RH = 75%. Acronym NT indicates the untreated bone.

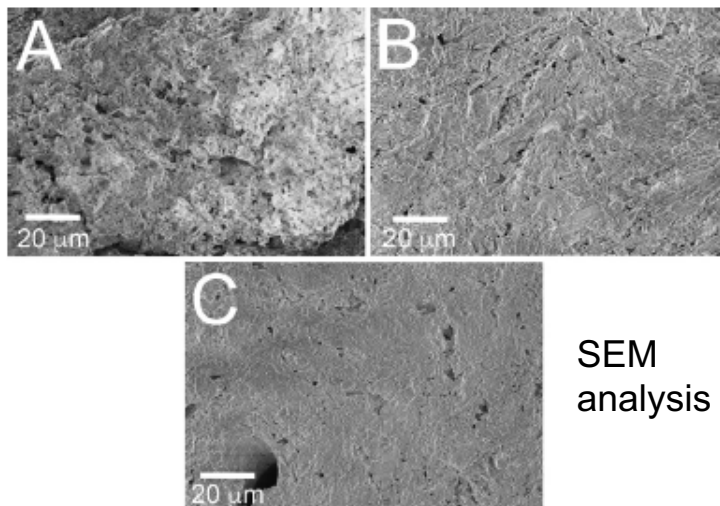


## Efficacy of the consolidation treatments



Microtomography analysis

Gas porosimetry measurements



SEM  
analysis

## Paleogenetic analysis on treated and untreated fragments

Results of the mitochondrial genome sequencing performed on the bones from the Neolithic site of Kierzkowo.

Sample Name	Endogenous DNA (%)	Mean Coverage (X)	Fold Coverage ( $\geq 5X$ ) (%)	DMG 1st Base 3'	DMG 1st Base 5'	Average fragment length (bp)	ContamMix	Haplogroup
K3.4 consolidation 1	18.56	126.52	99.95	0.32	0.33	58.09	0.98	U5b2b1a1
K3.4 consolidation 2	12.52	39.05	99.69	0.30	0.31	61.54	0.98	U5b2b1a1
K3.4 untreat	6.18	14.79	94.27	0.31	0.31	54.69	0.92	U5b2b1a1
K5.3 consolidation 1	0.08	14.94	97.51	0.32	0.38	51.48	0.98	U5b1d1a
K5.3 consolidation 12	5.54	14.84	97.95	0.27	0.29	63.11	0.91	U5b1d1a
K5.3 untreat	5.35	31.76	99.78	0.33	0.30	56.74	0.99	U5b1d1a
K6.2 consolidation 1	3.44	11.72	95.89	0.18	0.17	56.73	0.82	J1c
K6.2 consolidation 2	27.53	60.74	99.38	0.22	0.22	60.1	0.93	J1c
K6.2 untreat	32.58	362.91	99.91	0.22	0.22	60.17	0.97	J1c

## Cited papers

Journal of Human Evolution 82 (2015) 88–94

Contents lists available at [ScienceDirect](#)

Journal of Human Evolution

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The Neanderthal in the karst: First dating, morphometric, and paleogenetic data on the fossil skeleton from Altamura (Italy)



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Original Paper | Published: 06 January 2020

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[Alessandra Modi](#) , [Lisa Pisaneschi](#), [Valentina Zaro](#), [Stefania Vai](#), [Chiara Vergata](#), [Enrico Casalone](#), [David Caramelli](#), [Jacopo Moggi-Cecchi](#), [Marta Mariotti Lippi](#) & [Martina Lari](#) 

*Archaeological and Anthropological Sciences* **12**, Article number: 10 (2020) | [Cite this article](#)

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Original article

Evaluation of Diammonium hydrogen phosphate and Ca(OH)<sub>2</sub> nanoparticles for consolidation of ancient bones



Annalisa Salvatore <sup>a</sup>, Stefania Vai <sup>b</sup>, Stefano Caporali <sup>c</sup>, David Caramelli <sup>b</sup>, Martina Lari <sup>b,\*</sup>,<sup>1</sup>, Emiliano Carretti <sup>a,\*</sup>