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TRACING THE INTRODUCTION OF DOMESTIC SMALL BOVIDS IN AUSTRAL AFRICA USING PALAEOPROTEOMICS

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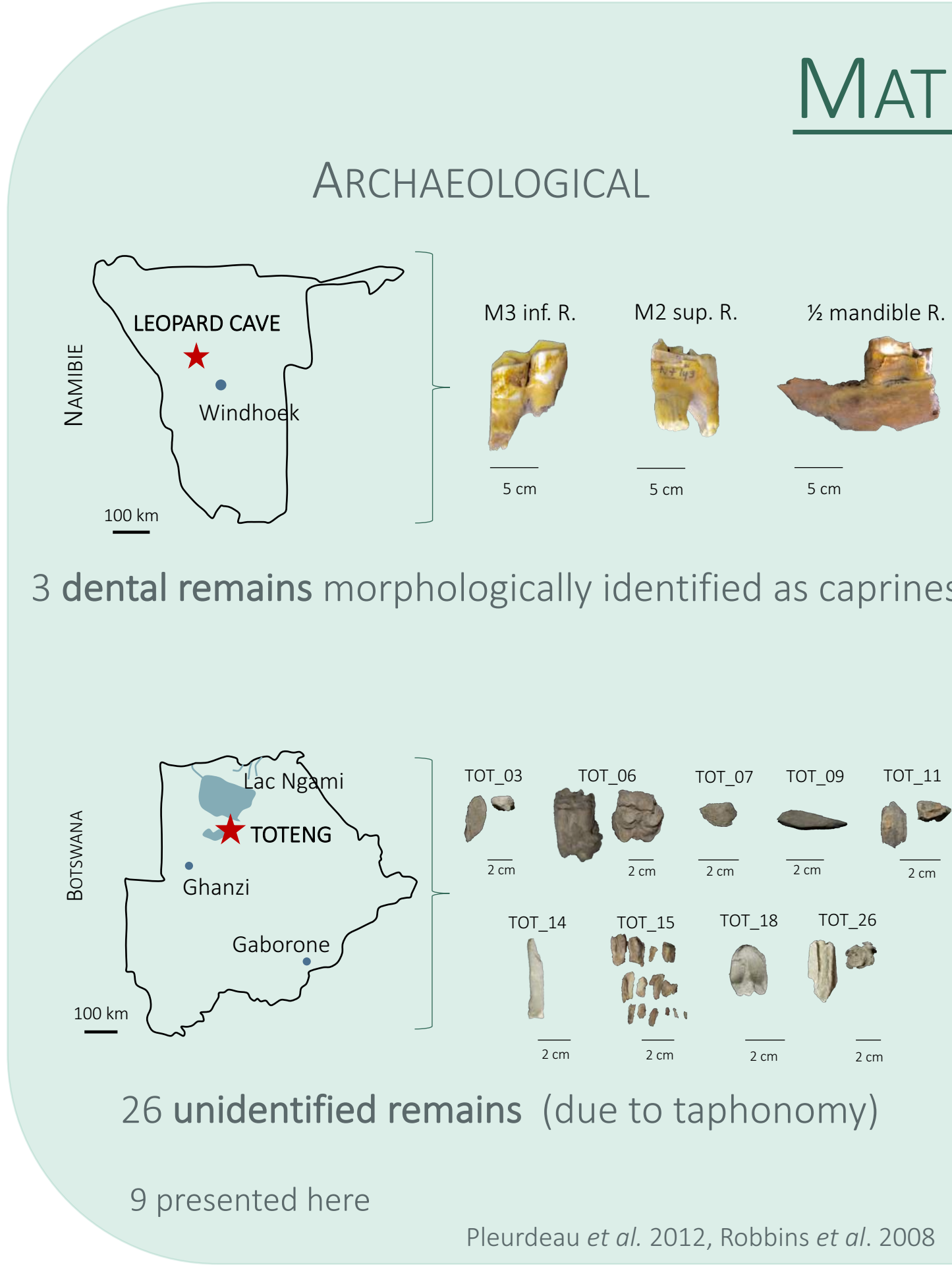


INTRODUCTION

- In Austral Africa, no remains of domestic caprines (sheep *Ovis aries* and goat *Capra hircus*) has never been found in archaeological assemblages. This suggests that those domestic animals have been introduced from the Near East to East Africa and then to the southern part of the continent (MacHugh, Larson & Orlando 2017, Vigne 2011).
- Classical morphological determination of caprines from bone remains is often tricky due to the similarities between close related species as well as between domestic and wild species, fragmentation of the remains and bone diagenesis.
- Paleoproteomics has revealed as a powerful approach for the distinction of domestic caprines (Buckley *et al.* 2010). We used this technique on remains from two Austral African sites considered as the oldest pastoral sites of the region: Leopard Cave in Namibia (Pleurdeau *et al.* 2012) and Toteng in Botswana (Robbins *et al.* 2008). Our objective was to ascertain the presence or absence of domestic animals at these sites.
- Three different sample preparation protocols were tested in order to identify the best conditons for remains from arid environment. Bottom-up proteomics analysis was performed on an ESI-Q-TOF device with a data dependent autoMS/MS method. Modern samples from referential collections (MNHN) were also analyzed to constitute a database of unreported diagnostic peptides for species identification.

MATERIALS

ARCHAEOLOGICAL



3 dental remains morphologically identified as caprines

26 unidentified remains (due to taphonomy)

9 presented here

Pleurdeau *et al.* 2012, Robbins *et al.* 2008

MODERN

Bones and teeth from domestic and wild African species



Goat *Capra hircus*
Brandberg breed



Sheep *Ovis aries*
Damara breed



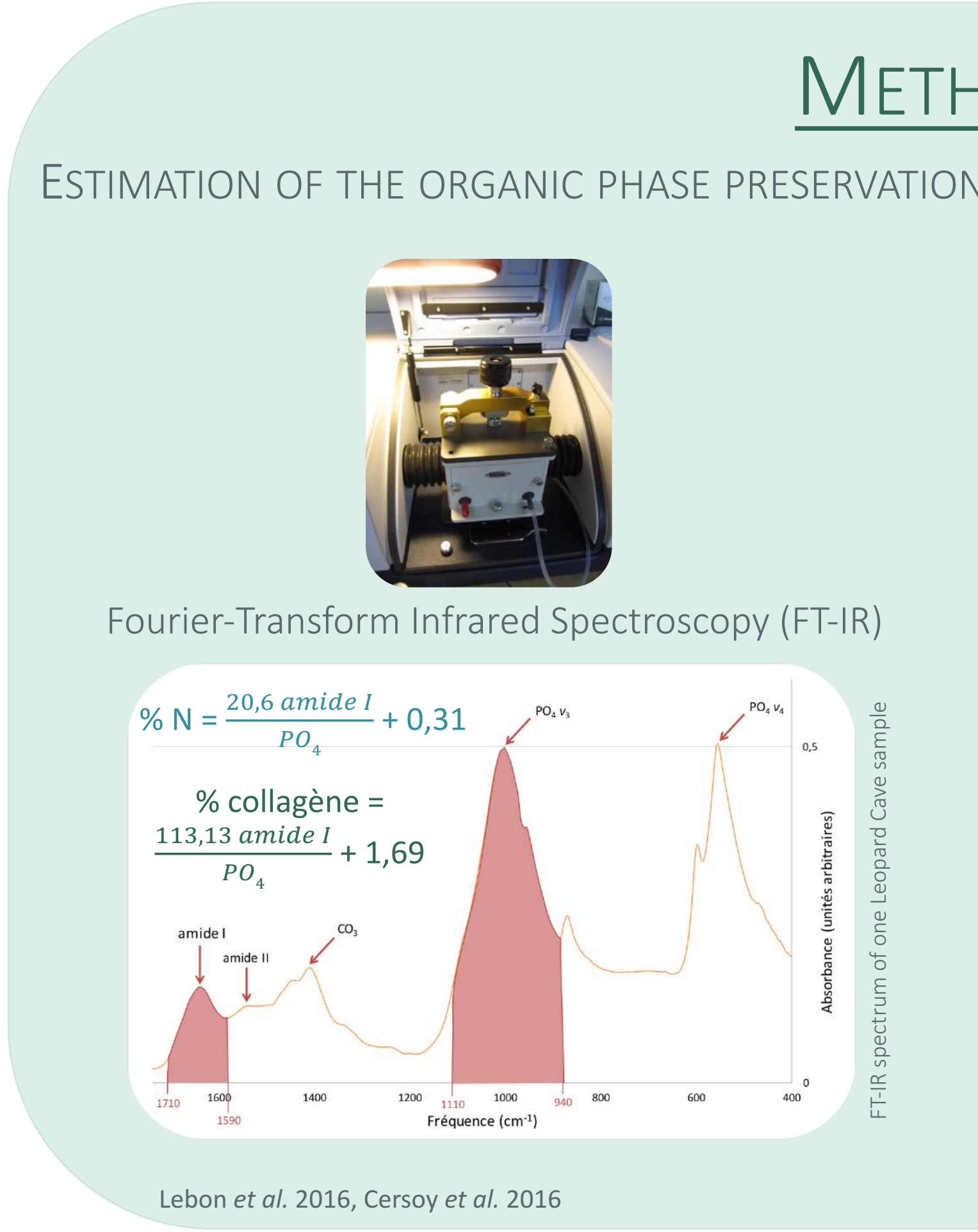
Impala *Aepyceros melampus*
Collections Anatomie Comparée MNHN



Springbok *Antidorcas marsupialis*
Collections Anatomie Comparée MNHN

METHODS

ESTIMATION OF THE ORGANIC PHASE PRESERVATION



Lebon *et al.* 2016, Cer soy *et al.* 2016

SAMPLE PREPARATION

Demineralization: Tris-EDTA 0.5 M, pH 7.4, HCl 1M, 20 min, HCl 0.6M, 4h

Solubilization: NH₄CO₃ 50 mM, 3 h, 65°C, 350 rpm

Digestion: Trypsin « Proteomics Grade » (Promega) 1 µg/ µL, 18h, 37°C, 350 rpm

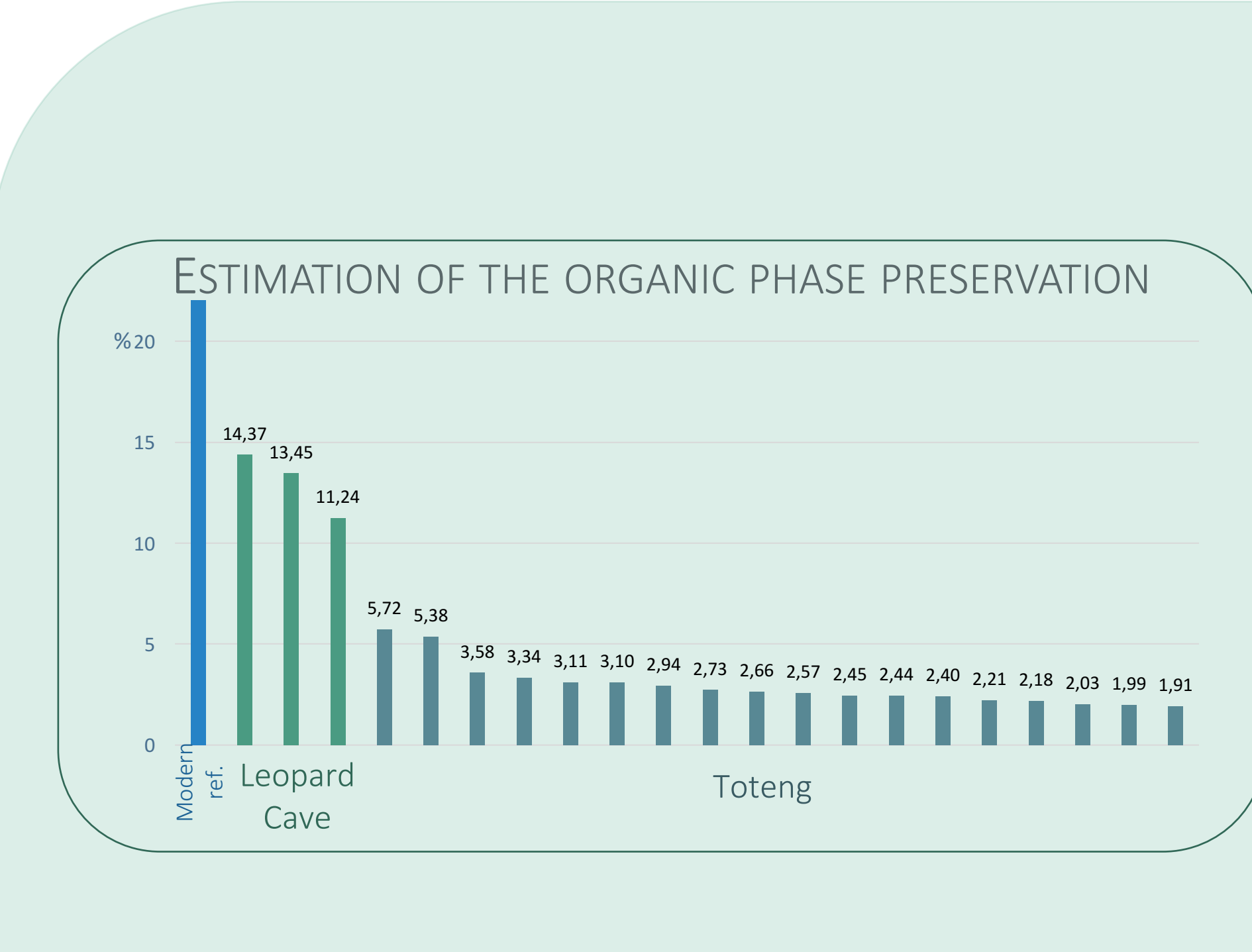
MASS SPECTROMETRY ANALYSIS



- UHPLC : Ultimate 3000-RSLC (ThermoSci), Acclaim RSLC Advantage II column (2,2 µm, 2,1x100 mm, ThermoSci);
- MS : ESI-Q-TOF positive mode, *m/z* 200-3000
- Analysis : AutoMS/MS data

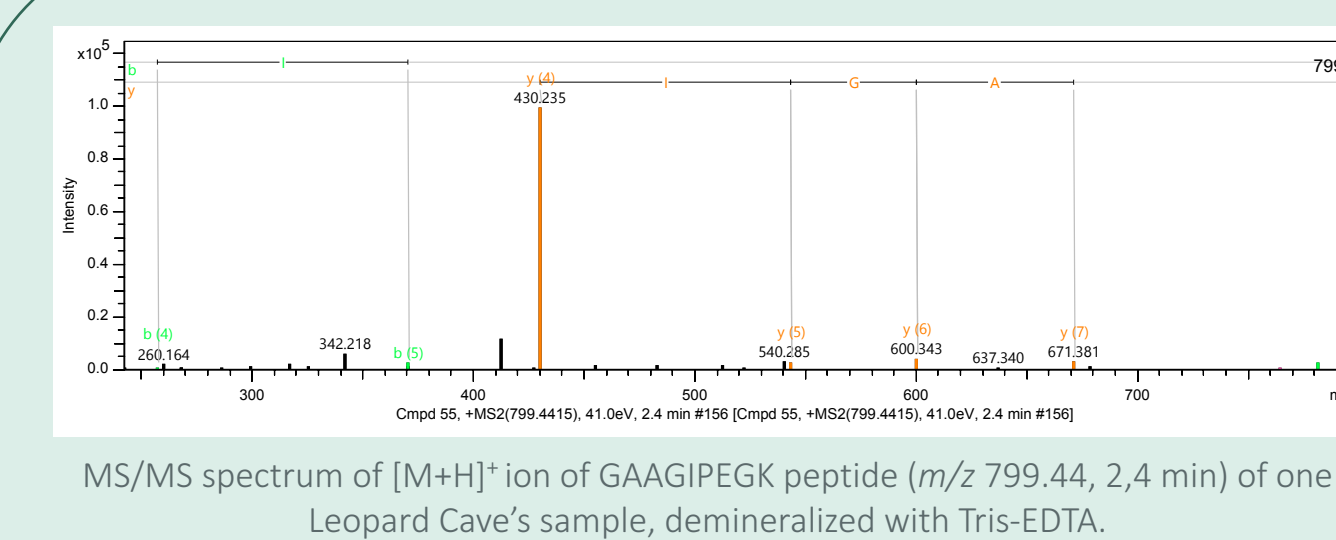
RESULTS

ESTIMATION OF THE ORGANIC PHASE PRESERVATION



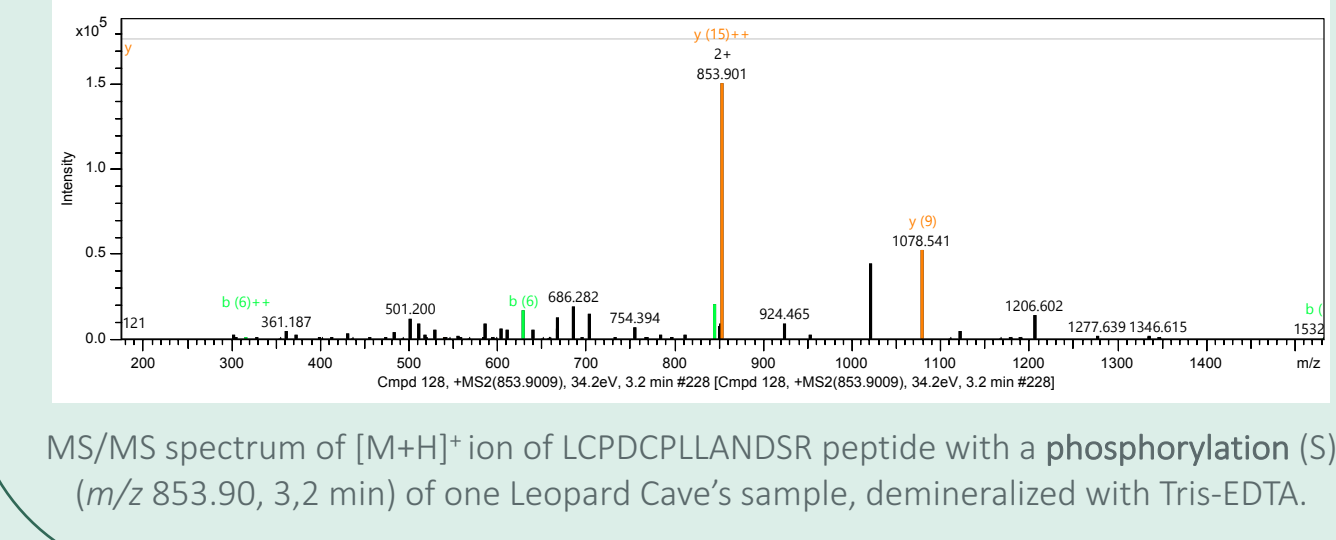
Lebon *et al.* 2016, Cer soy *et al.* 2016

MS/MS SPECTRA

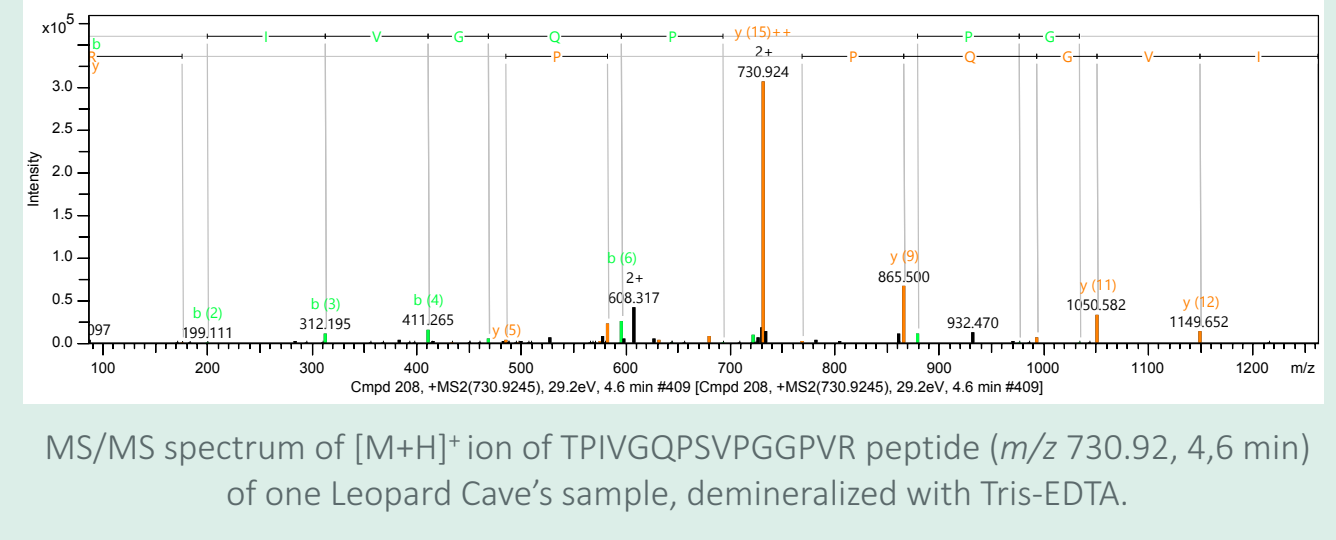


Alpha 2 chain collagen type I

Alpha 2 HS glycoprotein

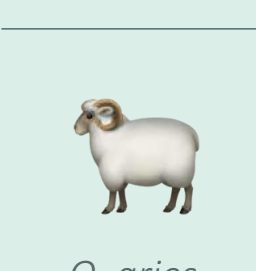
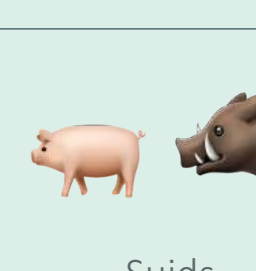
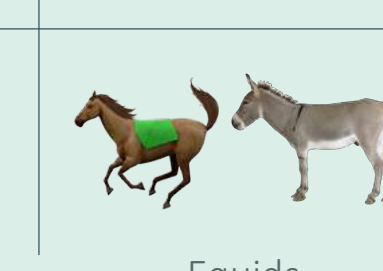
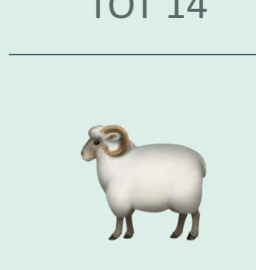
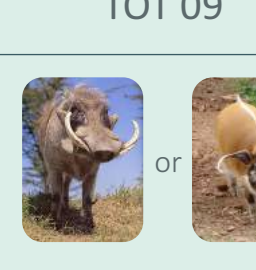
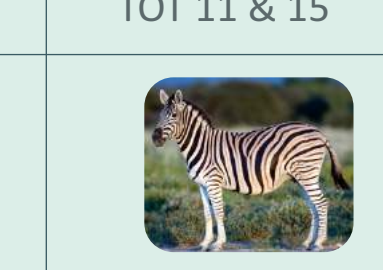


MS/MS spectrum of [M+H]⁺ ion of LCPCDCLLAPLNSR peptide with a phosphorylation (S) (m/z 853.90, 3,2 min) of one Leopard Cave's sample, demineralized with Tris-EDTA.



MS/MS spectrum of [M+H]⁺ ion of TPVIGQPSVPGGPVR peptide (m/z 730.92, 4,6 min) of one Leopard Cave's sample, demineralized with Tris-EDTA.

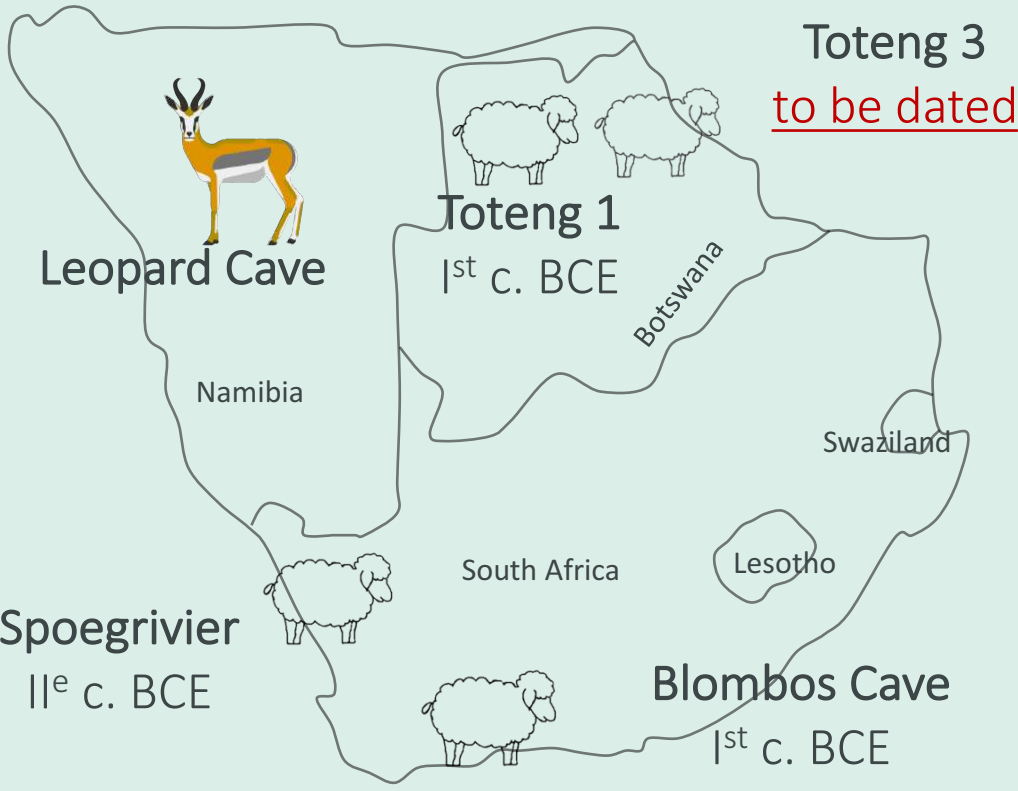
BIOCHRONOLOGY & GEOGRAPHIC REPARTITION

TOT 14	TOT 09	TOT 11 & 15
 <i>O. aries</i>	 Suids	 Equids
Biochronology & geographic repartition Kingdon 1997		
 <i>O. aries</i>	 <i>Phacochoerus sp.</i> or <i>Potamochoerus sp.</i>	 <i>Equus burchellii</i>

CONCLUSION

- Identification of the best protocol for arid environments remains : Tris-EDTA
- Identification of specific markers of unpublished species (*Antidorcas marsupialis*) on 2 different proteins
- Attribution of 4 morphologically undetermined remains
- Identification of sheep at Toteng → confirmation of domestication at this site
- Re-attribution of Leopard Cave remains → wild species: no domestication at this site

ARCHAEOLOGICAL IMPLICATIONS



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- MacHugh, Larson & Orlando 2017, *Annual Review of Animal Bioscience*, 5, 329-51.
- Vigne 2011, *Comptes rendus biologiques*, 334(3), 171-181.
- Buckley *et al.* 2010, *Journal of Archaeological Science*, 37(1), 13-20.
- Pleurdeau *et al.* 2012, *Plos One*, 7(7), e40340.

- Robbins *et al.* 2008, *Journal of African Archaeology*, 6(1), 131-149.
- Lebon *et al.* 2016, *Radiocarbon*, 1-15.
- Cer soy *et al.* 2017, *Radiocarbon*, 1-16.
- Kingdon 1997, Princeton Univ. Press, London, 544 p.