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Grotte de Sylvie 1: a new Late Pleistocene site into the Réseau Lachambre (Têt Valley, Eastern Pyrenees). Initial study on a *Hyaena natal den*

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Abstract

A new Pleistocene hyena den, located into the Réseau Lachambre karstic complex (Têt Valley; Eastern Pyrenees), is here presented. Sylvie 1 is an accessory cavity of the former network with a documented large mammal assemblage putatively corresponding to the Late Pleistocene and mainly dominated by *Crocota spelaea*. The majority of the studied bones shows cracks, punctures and gnaw marks as a consequence of hyena activity. A brief overview of the taphonomy of the documented remains and the morphometric comparisons with the dentognathic apparatus of the European *Crocota* fossil record enables us to identify Sylvie 1 as a *Crocota spelaea* natal den from Late Pleistocene.

Keywords: Quaternary, Carnivores, Hyaneidae, *Crocota*, Occitanie.

1. Introduction

The Réseau Lachambre is one of the three large karstic networks located in the surroundings of the Villefranche-de-Conflent village (Têt Valley; Eastern Pyrenees). The field surveys performed since 2011 have evidenced a rich paleontological record date to Middle-Late Pleistocene (Madurell-Malapeira *et al.*, 2019). During 2015 and 2019 surveys, our research team inspected in detail the Grotte de Sylvie 1, a small, horizontal cavity located ca. 40 meters above the Grotte de Lachambre, preserving dozens of large mammal bones in the gallery surface.

According to our preliminary analysis the large mammal assemblage from Sylvie 1 is composed by the following taxa: *Crocota spelaea*, *Ursus spelaeus*, *Ursus arctos*, Felidae indet. (medium size), *Lynx pardinus*, *Vulpes vulpes*, *Canis cf. c. lupus*, *Capreolus capreolus*, *Capra pyrenaica* and Artiodactyla indet. Additionally, putative hyena activity was recorded evidenced by gnaw marks, bone shaft fragments and two coprolites.

The focus of the present/initial study centered on clarifying the chronology of the mammal assemblage

with particular attention to the most abundant remains, the hyenas, which represents ca. 90% of the identified elements - with a NISP (number of identified elements) of 140-, being a huge number of juveniles/neonates which represents 60% of the analyzed specimens.

2. Material and methodology

The studied specimens are host by the Conflent Spéléo Club de Prades and the Direction Régionale des Affaires Culturelles (DRAC) Occitane (Montpellier, France). The comparative fossil sample includes data of extinct *Crocota crocuta* and *C. spelaea* from Mediterranean and Western Europe published by Argant (1991), Cardoso (1993) and García (2003) (see in Fig. 2); and extant *C. crocuta* stored at the Royal Museum for Central Africa (Tervuren, Belgium, RMCA; J.M.-M. personal measurements).

Descriptive statistics for dentognathic remains were computed using bivariate graphs made with PAST software. To identify the cave hyena den type, we follow Diedrich (2011, 2012).

Most of the authors agrees that the dentognathic diagnostic elements in order to distinguish *C. spelaea* from other *Crocota* species are m1 and P4. In this

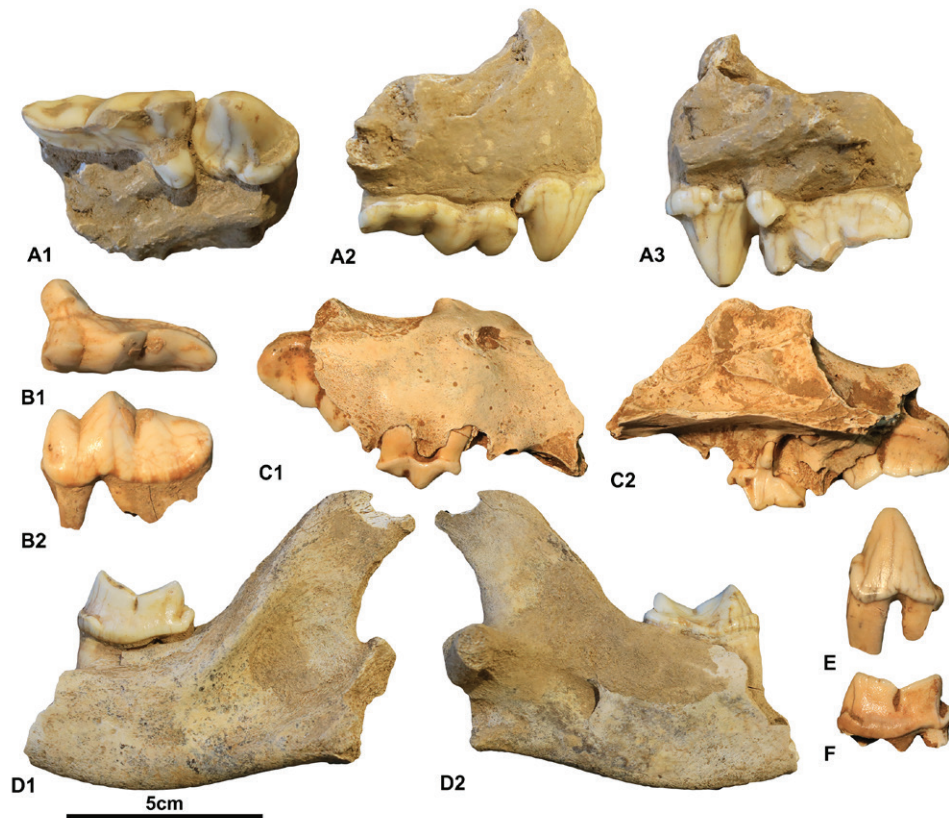


Fig. 1. -Dentognathic remains of *Crocuta spelaea* from Grotte de Sylvie 1. A- GDS2019-58 in 1- occlusal view; 2- buccal view; 3- lingual view; B- GDS2015-77 Upper P4 in 1- occlusal view; 2- buccal view; C- GDS2015-65 in 1- buccal view; 2- lingual view. D- GDS2019-54 left mandible in 1-buccal view; 2-lingual view. E) GDS2015-221 upper P3 in buccal view; F) GDS2015-67 lower m1 in buccal view.

work we compared these elements, recovered from Grotte de Sylvie 1, with extant and extinct specimens of *Crocuta* spp. (Fig. 2).

3. Systematic paleontology

Description and anatomical comparisons of selected specimens:

GDS2019-58 is a right partial maxilla preserving P3 and P4. The tooth row shows a moderate curvature, typical of *C. spelaea* (García, 2003; Fig. 1). The other two partial maxillary remains are attributed to juvenile individuals, both preserving dP4 and P4 in eruption. All the studied P3 are characterized by well-developed cingulum and show mesiodistally developed protocone without accessory cusps. The P4 protocone and parastyle are located at the same level and display a mesiodistally well-developed metastyle blade.

GDS2019-54 left partial adult hemimandible shows an almost complete ramus and condyle process. The corpus is slender and presents a basal edge strongly convex at the m1 level, typically featured in *C. spelaea* specimens (García, 2003; Fig.

1D1). The m1 presents a well-developed cingulum on the lingual side, a paraconid more developed than the protoconid and a talonid and a metaconid weakly developed. The two latter are typical characters of *C. spelaea* (García, 2003).

Biometrical comparisons:

It is commonly accepted that spotted hyenas experienced an increase in size from Middle to Late Pleistocene (Werdelin & Solounias, 1991; García, 2003). The bivariate resulting graphs show clearly how the studied specimens fits within the known variability of *C. spelaea* being larger than the fossil and extant *C. crocuta* (Fig. 2).

Tooth marks:

A total of 40% - with a NISP of 96- of large mammal long bones are affected by hyaena activity. Most of the remains presents transversal cracks (58%) and tooth marks (60%) of which 40% are related to furrowing. Finally, the percentage of partially digested structures reaches 20%.

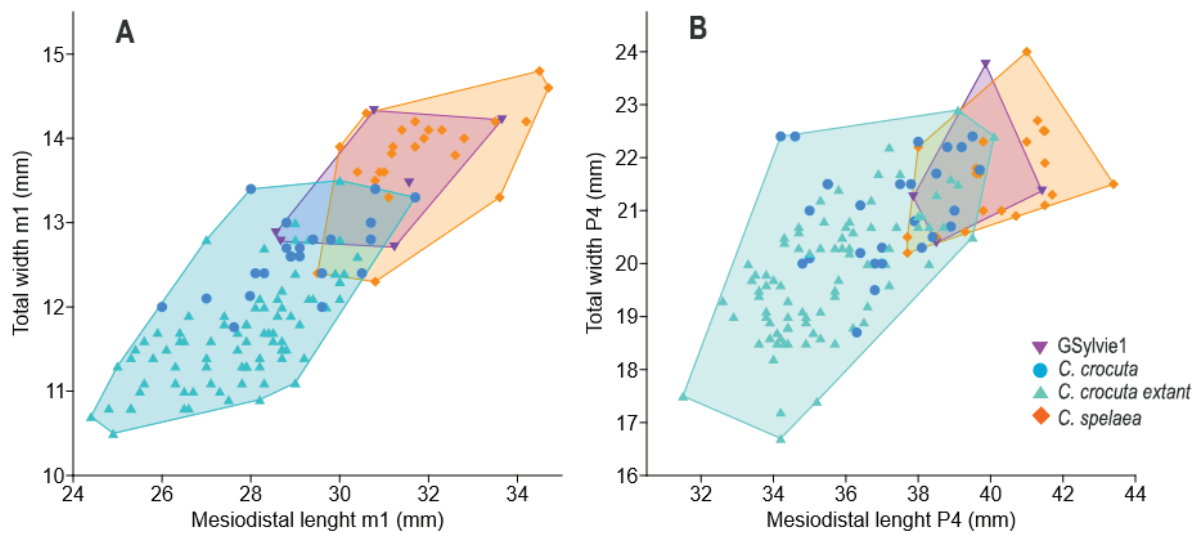


Fig. 2. -Bivariate graph of mesiodistal length against buccolingual width. A- lower m1; B- upper P4. Data from : Trinchera Dolina TD8 (Burgos, Spain; García, 2003), Lunel-Viel (Hérault, France; Cardoso, 1993), Casal Selce (Rome, Italy; Sardella & Petrucci, 2012), Valdegoba (Burgos, Spain; García 2003), Châtillon-Saint-Jean (Drôme, France; Cardoso, 1993), Gargas (Hautes-Pyrénées, France; Cardoso, 1993), Jaurens (Corrèze, France; Cardoso 1993), Giséy-sur-Ouche and Savigny-les-Beaune (Bourgogne, France; Argant, 1991).

4. Discussion and conclusions

According to recent DNA studies, genus *Crocota* has an African origin around 3.85-3.65 Ma and a later dispersion into Europe in the latest Early Pleistocene (Vinuesa *et al.*, 2015 and references therein) replacing the short-faced hyena *Pachycrocota brevirostris*. The oldest occurrence of *C. crocuta* is documented in the Gran Dolina TD4W of Atapuerca complex around 0.8 Ma (García & Arsuaga, 2001). The earliest record of large cave hyena *C. spelaea* is dated around 0.3 Ma in Western Europe (Sauqué *et al.*, 2017).

The genus *Crocota* includes species belonging to the bone-cracking ecomorphotype due to teeth adaptations for breaking bones (Vinuesa, 2018). The specimens from Sylvie 1 show adaptations to this feeding behavior, namely: 1) mandibular ramus adapted to resist the torsional forces generated by prey movement during the biting action (Werdelin & Solounias, 1991; Sardella & Petrucci, 2012); 2) powerful bone-crushing complex (P3/p3 and P4) (García, 2003; Vinuesa, 2018); 3) reduction of m1 talonid (Werdelin & Solounias, 1991; García, 2003; Vinuesa, 2018); 4) reduction or absence of m1 metaconid (García, 2003; Sauqué *et al.*, 2017); 5) enlargement of P4 metastyle blade and equal orientation of protocone and parastyle (García, 2003); 6) more curved teeth in *C. spelaea* (García, 2003; Sauqué *et al.*, 2017). According to these assertions the studied specimens from Sylvie 1 share

with *C. spelaea* both anatomical and biometrical characteristics allowing us to interpret the studied assemblage to ca. latest Middle Pleistocene to Late Pleistocene.

The bone-cracking hyenas usually generate bone accumulation in their dens (Diedrich & Žák, 2006; Diedrich, 2011; Vinuesa *et al.*, 2015). Depending on the den type the bone remains could present different degree of tooth marks and cracking structures. Diedrich (2012) observes three distinct type of hyena den in the Bohemian Karst: birth/natal den, communal den and prey depot. As the hyenas do not have any special abilities to climb, they usually occupy and live in sub-horizontal caves that require no climbing (Diedrich & Žák, 2006; Diedrich, 2011). Consequently, the prey remains in such birth/natal dens correspond mainly to hyena cubs tooth-marked bones, used to obtain nutritional resources (Diedrich & Žák, 2006). The Grotte of Sylvie 1 is a sub-horizontal cavity with easy access, the prey bones recovered presents 60% of tooth marks, mainly furrowing interpreted as the action of cubs eating. The historical speleological explorations re-worked the sediments not allowing the correct preservations of coprolites, which explains why only two of them were found.

In the light of these evidences, we identify Grotte de Sylvie 1 as a natal den of latest-Middle to Late Pleistocene *Crocota spelaea*. Further studies on the micro mammal assemblage will help to clarify the

chronology meanwhile future systematic excavations will add more data about the composition of the large mammal assemblage.

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