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This work was partly carried out during a Master training practice in the PACEA laboratory in Bordeaux by one of us (CM). We would like to thank the PACEA laboratory and its staff for allowing to achieve this unusual study but with strong results for petrous bone study.
We will not forget here to thank Professor F. Prat for the encouragement he has given to the other author of this paper (JLG) when the latter decided to study the petrous bones at the beginning of his Phd as well as when he entrusted him, despite some "talks", with the skulls of the comparative collection of the laboratory to saw them to access the petrous bones.
Finally, thank you to Daniela Rosso and Ana Rosso for their help with the translation of portions of this work.

Introduction

1 The two petrous parts are extremely important as they protect the elements necessary for hearing and for stability and they allow the outward passage of the 7th and 8th pair of cranial nerves and support the 5th pair of these nerves. Being solid, the temporal

bones are often found in relative abundance in archaeological sites but they are generally neglected because they have a morphological diversity that can be confusing at first. Their coarse form can repel most of us, but in reality they bear morphological characteristics that allow determining them "easily" (Guadelli 1987, 1990, 1999; Guadelli and Prat 1995; Steininger 1975). Thus, in the case where many bones of the postcranial skeleton would only allow making vague taxonomic assignments – i.e. determining Bos/Bison, Goat/Sheep (or worse, Ovicaprinae!) -the petrous parts of temporal bone leave absolutely no doubt in almost all cases.

2 Before anything else, let us recall quickly in a few lines the "topography" of the petrous bones with reference to the work of R. Barone (1966), P. Popesko (1980), A.J. Gulya & H.F. Schuknecht (1995) and Guadelli (in press).

1 - Reminders about the anatomy of the petrous part of the temporal bone

3 The temporal bone (*Os temporale*) consists of the petrous portion (*Pars petrosa*), the tympanic part (*Pars tympanica*), the squama temporalis part (*Pars squamosa*) and the mastoid portion (*Pars mastoida*). The union of the first two makes the auricular or tuberous portion of the temporal bone, to which, in some mammals (such as the Cat for example), a more or less developed extra part is added, the endotympanic part (*Pars endotympanica*).

4 The auricular portion articulates upwards with the postero-inferior portion of the temporal squama and towards the back with the occipital. The fusion of the squama and the auricular region occurs earlier or later depending on the groups, except for the Equine and Small Ruminants where these two elements remain independent.

1.1 - General shape of the petrous bone (Guadelli in press)

5 Given the observations done in this paper, we will only present here the medial and rostral faces.

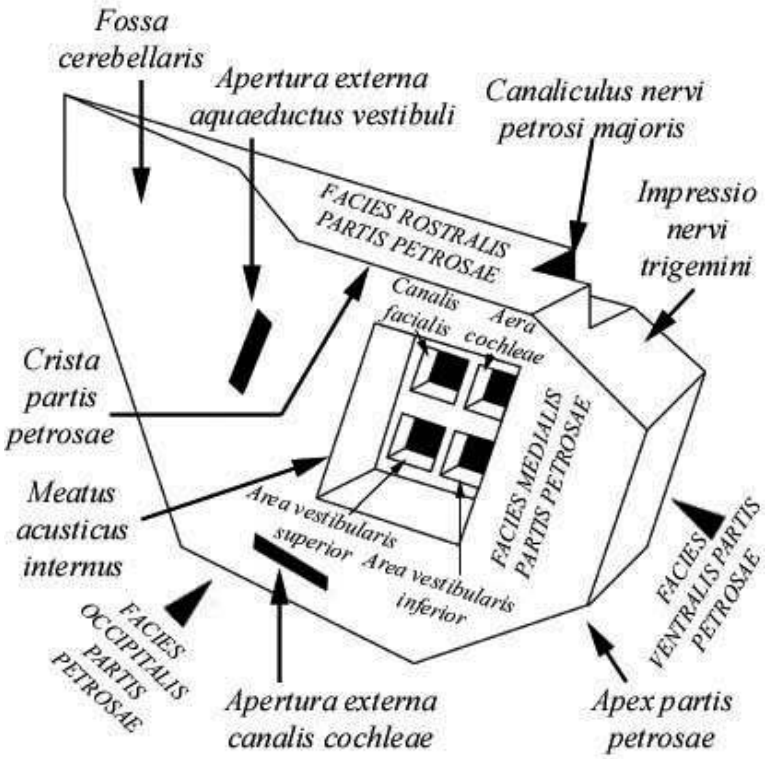
1.1.1 - Medial or cerebellar Face

6 The medial face of the petrous portion (*facies medialis partis petrosae*) (fig. 1) shows successively in the dorso-ventral direction the cerebellar fossa (*Fossa cerebellaris*), which corresponds to the more or less deep imprint of the cerebellum, the internal auditory meatus or internal auditory hiatus (*Meatus acusticus internus*) and quite ventrally, the antero-inferior apex (*Apex partis petrosae*) in which the imprint of the trigeminal nerve is cut out (*Impressio nervi trigemini*) (5^{th} pair). In some forms, this nerve passes through a canal (*Canalis nervi trigemini*) formed in this ventral projection. The bottom of the internal auditory meatus (*Fundus meatus acusticus internus*) is divided into four orifices by two crests, variable in development and orientation depending on the species, one roughly rostro-caudal and the other nearly dorso-ventral. The rostro-dorsal orifice, the largest, is the endocranial opening of the facial nerve canal (*Canalis facialis*) (7^{th} pair). The caudo-dorsal orifices or upper vestibular opening (utriculo-ampullar) (*Area vestibularis superior*), the caudo-ventral orifice or lower vestibular opening (saccular) (*Area vestibularis inferior*) and the rostro-ventral orifice, called cochlear (*Area cochleae*)

allow the passage of the corresponding branches of the stato-acoustic or vestibulo-cochlear nerve (*Nervi vestibulocochlearis*) (8th pair).

7 The orifice of the cochlear canal opens up caudally with respect to the internal auditory meatus (*Apertura externa canalis cochleae* or cochlea canal) and the endocranial orifice of the vestibular canal opens in dorso-caudal position (*Apertura externa Aquaeductus vestibuli*). Finally, the medial (cerebellar) and rostral (cerebral) faces are separated more or less clearly by the petrous crest (*Crista partis petrosae*) that begins at the cerebellar fossa and continues up to the antero-inferior apex.

Figure 1 - Topographic representation of the petrosal part of the left temporal bone (after Guadelli in press, fig. 1a).



1.1.2 - Rostral or cerebral face

8 The extent of the rostral face (*Facies rostralis partis petrosae*) (fig. 1), extremely variable depending on the species, is conditioned by the internal development, more or less important, of the parietal bone and the caudal edge of the temporal squama. Thus, for example, this face is highly developed in Rangifer and Bovinae, but much less in Rupicapra or Ovis and reduced to its simplest expression in Capra. This point alone would deserve a long chapter because in reality the rostral face exists, but depending on the species, it is "active," that is to say, it actually supports the brain, or "passive" when it is covered by the spheno-occipital crest (Guadelli in press).

9 Finally, on this rostral face and in a more or less lateral position, the opening of a small duct dug out in the thickness of the petrosal bone opens towards the bottom, it is called the Fallopian hiatus (*Canaliculus nervi petrosi majoris*). It allows the passage of a collateral branch of the facial nerve, the great superficial petrosal nerve.

10 In all the descriptions that follow, the petrosal bone will always be considered in anatomical position, and although its orientation relative to the Frankfort plane varies slightly depending on the species, the cerebral face corresponds to the rostral face and the caudal face to the occipital face.

2 - The choice of taxa: Sheep and Goat

11 The domestic Sheep (*Ovis aries* Linnaeus, 1758) and Goat (*Capra hircus* Linnaeus, 1758) belong to the subfamily of the Caprinae and are very close taxa, by their morphology and their evolutionary history.

12 Present day Sheep and Goats are descended from wild animals living in the Near and Middle East. As the oldest remains of Sheep, strictly speaking, date from 8,500 BC, the eastern Mouflon (*Ovis orientalis*), widely accepted as the wild ancestor of Sheep, would have been domesticated before this date by Neolithic populations (Helmer 1992). About the Goat, its wild ancestor, the aegagre Goat (*Capra aegagrus*) was domesticated between 9,500 and 8,500 BC (Helmer 1992), or even earlier, between 13,000 and 9,000 BC according to data from mitochondrial DNA (Naderi 2007).

13 Sheep and goat have been inseparable from pastoral peoples for 10,000 years. However, their skeletal remains are still very complex to discern, especially in the case of heavy fragmentation. Very numerous in archaeological sites, the remains are yet often grouped without distinction into a category "*Ovis/Capra*" or worse, "Ovicaprids.

14 Several authors have logically addressed these problems of distinction to highlight the characteristics proper to these two species. The most easily identifiable element remains the horn bone core on which many classifications stand. Other elements of the skull also provide specific distinctive features, such as the shape of the parieto-frontal and occipito- parietal sutures (Barone 1966), but the skulls often being particularly fragmentary, these criteria can rarely be considered. This is why many studies consider teeth as the main distinguishing feature, especially because of their hardness, which makes them one of the best-preserved elements in archaeological sites (Payne 1985; Helmer 2000; Halstead, Collins, Isaakidou 2002). These studies emphasize particularly the lower teeth, as well as methods for assigning an age to animals based on the eruption and stages of tooth wear (Grant 1982). The upper teeth have been the subjects of very few studies of this type.

15 Regarding the post-cranial skeleton, the distinction is often very complex, because of the great similarity between the bones of the two animals. Some publications provide keys to distinguish the bones of Goat and Sheep (Payne 1969; Prummel and Frisch 1986; Helmer and Rocheteau 1994; Fernandez 2002). Work has also shown the ability to distinguish the two taxa by analysing mitochondrial DNA (Loreille et al. 1997).

16 But among all these works, the petrous portion of the temporal bone is never directly mentioned and has never been the subject of a further study. There are very few publications that, in the counts of faunal lists, mention the presence of a petrous bone. Yet it is difficult to believe that the collections contain none because its high density (1.29 g/cm³ in *Rangifer tarandus* - Lam, Chen, Pearson 1999) makes it one of the best preserved anatomical parts (Bar Oz and Dayan 2007). The petrous portions are mentioned, counted or studied specifically in very rare cases, as in the work of O'Leary (2010) describing the anatomical part in several species of artiodactyls.

17 For all these reasons, the study of the petrous portion can thus provide much information on these taxa and form a new criterion of distinction, even for highly fragmented bones. To counter this, we chose to present the description of the petrous bone of *Capra ibex* and *Rupicapra rupicapra* in order to show the differences between the wild forms and these two domestic forms. We recognize that to have a global vision of the petrous portion of the temporal European Caprinae, the descriptions of the ones of *Ovis ammon*, *Capra aegagrus* and Tahrs are lacking, but the comparative material was not available. However, we are intending to fill this gap in the future.

3 - Method of study

18 The study of the petrous portion is based on the osteological description of the bone and its different faces, complemented by an osteometric study. It is based on measurements of lengths and angles on the bone, which were then analysed in the light of various statistical tests.

3.1 - Diameter measurements

19 Several easily measurable diameters are defined in the medial face (fig. 2):

- **Rostro-caudal diameter (Rcd):** length between the edge of the petrous crest and the edge of the caudal crest (measured along the cerebellar fossa);
- **Dorso-ventral diameter (Dvd)**: length between the antero-inferior apex and the ventral edge of the cerebellar fossa (measured in the rostral part of the fossa);
- **Rostro-caudal diameter of the internal auditory meatus (RcdIAM):** length of the meatus from one extremity to the other in the rostro-caudal direction;
- **Dorso-ventral diameter of the internal auditory meatus (DvdIAM)**: length of the meatus from one extremity to the other in the dorso-ventral direction.

20 These measurements, taken with a calliper, rely on clear marks and can be taken on an isolated petrous bone or even a petrous bone still in the skull. They are taken on both petrous bones of an individual if possible: as the differences between the two measurements are always low, an average left-right is calculated this way, on which we will work most of the time.

21 Measurement of the total dorso-ventral diameter (from the antero-inferior apex to the postero-superior apex) proved to be too variable to be reliable and reproducible: it was not used in this study.

22 For each measurement, the average and its confidence interval at 95% will be given, as well as the standard deviation, and the minimum and maximum values of the sample.

Figure 2 - Diameter measurements on medial side (left petrosal part of sheep). 1: dorsoventral diameter (Ddv); 2: rostrocaudal diameter (Drc); 3: dorsoventral diameter of the internal acoustic meatus (DdvMAI); 4: rostrocaudal diameter of the internal acoustic meatus (DrcMAT) (after C. Mallet 2011, fig. 4).

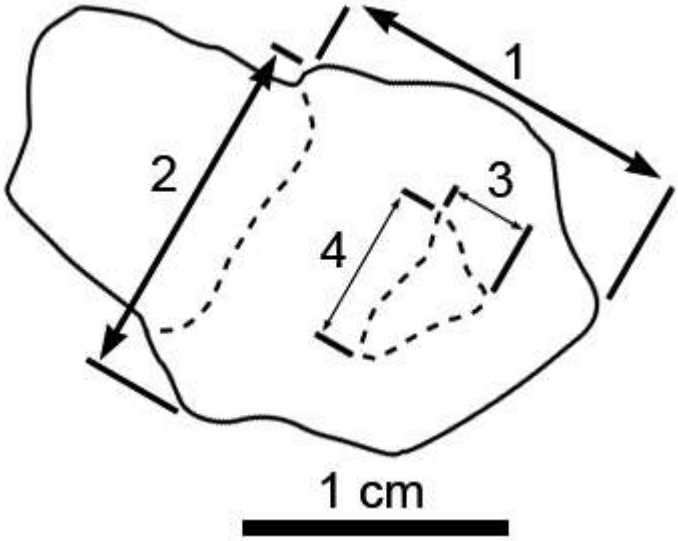
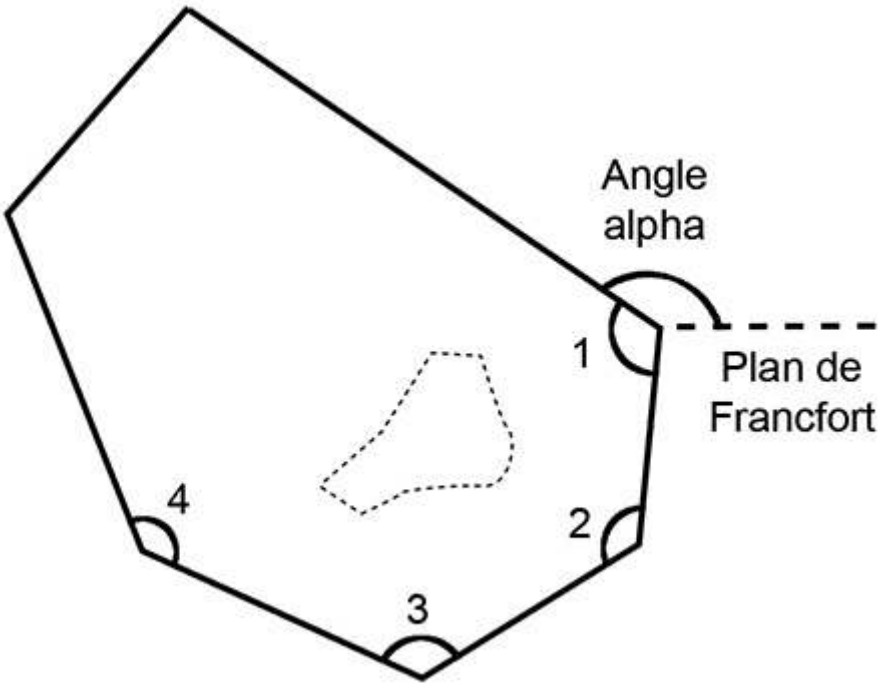


Figure 3 - Angle measurements on medial side. 1: rostral angle. 2: ventral angle. 3: ventrocaudal angle. 4: dorsocaudal angle (after C. Mallet 2011, fig. 5).



3.2 - Measurement of angles

23 We will consider in the medial face four opposite angles formed by the sides of the petrous bone (fig. 3), and the **alpha angle** formed by the rostral edge with the

Frankfort plane, which corresponds to the supplementary angle of the omega angle defined by one of us in his work (Guadelli in press).

24 As the measurement is not taken in direct contact with the bone but by sighting for the petrous bones still in place in the skull, the given precision is thus relative: the error margin is between 1 and 2 degrees.

- **Rostral angle:** formed by the rostral and rostro-ventral edges;
- **Ventral angle**: formed by the rostro-ventral and ventro-caudal edges;
- **Ventro-caudal angle**: formed by the ventro-caudal and caudal edges;
- **Dorso-caudal angle**: formed by the caudal and dorsal edges.

25 Like for the diameters, the left-right averages were calculated in order to facilitate analyses. Here again, the minimum and maximum values of each sample, the average, the confidence interval at 95% and the standard deviation will be indicated. The various measurements are given in decimal or minute degrees according to the cases.

3.3 - Statistical Analysis

26 We conducted statistical tests using the PAST software (version 2.07 © Hammer and Harper 1999-2011).

27 Verifying the normality of the sample was done through the test of **Shapiro-Wilk** as the distributions include less than 50 individuals: if $p < 0.05$, the distribution differs from of a normal distribution.

28 The search for correlations is based on the **Spearman correlation test**: if $p > 0.05$, there is no significant correlation between the two tested variables. In the case of a correlation, the R correlation coefficient will be indicated.

29 Finally the comparison of two normal distributions is based on **Fisher's F test** and on **Student's t test** to verify respectively the absence of differences between variances and the average of the two samples: if $p > 0.05$, we will consider that the variances or averages are not significantly different (Chenorkian 1996).

4 – The material

30 The studied sample consisted of current individuals and of one fossil individual. We counted in total 28 sheep and 12 goats.

31 The skulls of sheep come mostly from a collection carried out in the Pyrenees by one of us (JLG) in 1995. Their exact breed is unknown, but given the geographical area of collection and the very hooked morphology of the nasal bone, it is likely that they are Manech or Basco-Bearn breed sheep. Sex is also unknown, although it is very probable that they are only ewes. Their age could not be determined accurately because of the absence of the mandibles. Dental studies in goats and sheep to establish the age of the animals are almost all on the lower teeth (Payne 1973; Grant 1982), it was therefore impossible to apply them to these individuals.

32 Two individuals were recovered whole and prepared in 1995 and 2002 by one of us (JLG): a two-days old individual and a lamb slaughtered at the age of three weeks.

33 Thus we have 28 individuals, representing a total of 51 petrous bones (26 left and 25 right petrous bones), some skulls being incomplete and the petrous bones being absent.

Among these individuals, let's note that 12 have horn bone cores and 14 do not. The presence of horns remains undetermined for two individuals.

34 The skulls of the goats are from more diverse origins. Three skulls were collected by one of us (JLG). Two other skulls were found in the PACEA laboratory storage. One individual comes from the palaeontology collections of the PACEA laboratory. The other skulls were recovered from breeders in the Lot-et-Garonne and Gironde. For these individuals, we have information about the breed and the approximate age.

35 These 12 individuals represent a total of 21 petrous bones (10 left and 11 rights petrous bones), some skulls being again incomplete. About the breed, we have with certainty six Alpine goats and two Angora goats. Two skulls relate to very small individuals despite a relatively advanced age. Given these criteria and the shape of the horn cases, we believe that these are pygmy goats. Finally, we do not know the breed of two very young individuals for which we only have isolated petrous bones. The apparent disproportion between the number of sheep and the number of goats has a priori no impact on the study because of, as we shall see later, the great homogeneous shape encountered in *Capra hircus*.

36 In the absence of appropriate references and given our objectives, we arbitrarily defined three age classes according to the following criteria:

- **young**: presence of deciduous teeth erupted or during eruption, very few worn teeth;
- **average**: all permanent teeth out, little pronounced wear;
- **old**: all permanent teeth out, much pronounced wear.

37 Table 1 shows the number of different age classes for both species. The indeterminacy is due to the total absence of the upper teeth.

38 Whole skulls were sawn in the laboratory, according to the sagittal plane, following nasal and parietal sutures. Some petrous bones were disconnected from the skull to allow observation on all sides.

39 We also have in this sample a fossil skull of sheep from the Holocene levels of the site of Le Peuilh in Vetheuil in the Gironde, a site of the Médoc Region excavated by J. Roussot-Larroque that yielded notably lithic industries of the Middle Neolithic as well as ceramic from the Bronze Age (Roussot-Larroque 1982, 1984).

Table 1 – Age groups number of the two studied samples.

Chèvre		Mouton	
Âge	**Effectif**	**Âge**	**Effectif**
Jeune	3	Jeune	9
Moyen	6	Moyen	11
Vieux	2	Vieux	3
Indéterminé	1	Indéterminé	5
Total	**12**	**Total**	**28**

5 - Study of the petrous portion of *Ovis aries*

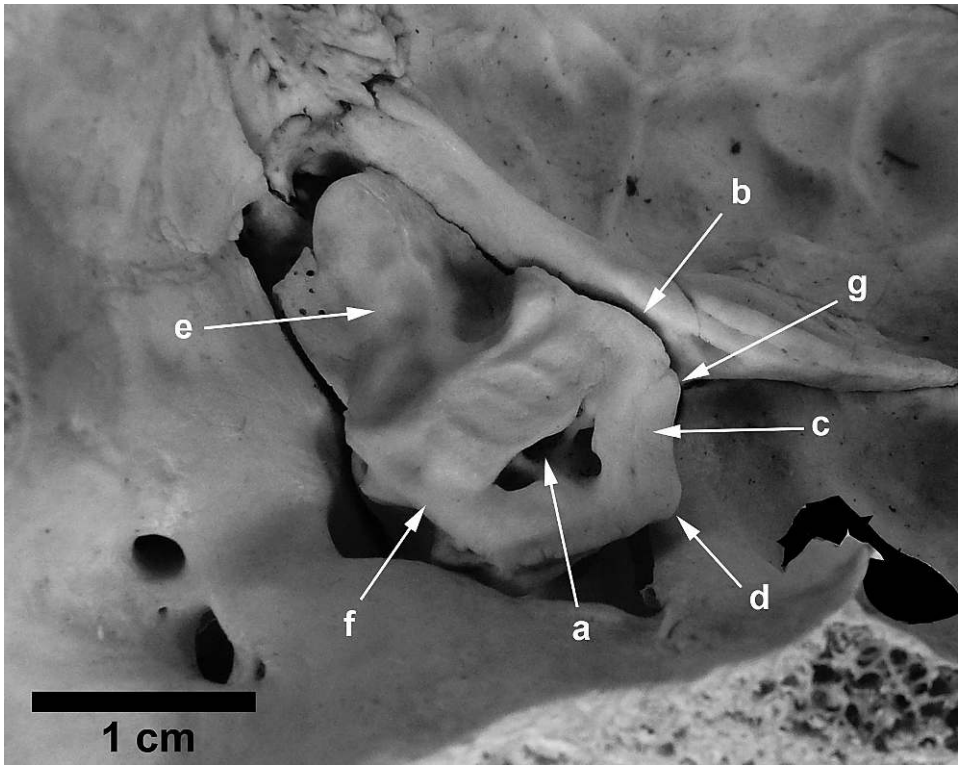
5.1 - Osteological description

5.1.1 - The medial face

40 Irregular, it is divided into two roughly equal parts in size. Ventrally, the antero-inferior apex (*Apex anteroinferior partis petrosae*) is little marked, rounded and thick, forming a rather open angle (fig. 4, d). Rostrally, the petrous crest (*Crista partis petrosae*) with a greatly varying shape, grows more or less depending on the case but always defines a passive rostral face, with the spheno-occipital crest above (*Crista sphenooccipitalis*) (fig. 4, b). Between the apex and the petrous crest, the imprint of the trigeminal nerve (*Impressio nervi trigemini*) is very little marked and concave, even completely flat (fig. 4, c). It is above the petrosal nerve hiatus (*Canaliculus nervi petrosi majoris*) which can either be set back under the imprint, either be raised and open at the end of a bony "chimney" (fig. 4 g). The internal auditory meatus (*Meatus acusticus internus*) that opens medially is triangular, with a sharp dorsal edge and remains overhanging (fig. 4 a). Only three instead of the four expected orifices are directly visible at the bottom of the meatus, separated by partitions forming a Y. The caudal crest, which runs on the caudal edge of the face, is thick and blunt (fig. 4, f). Small blades can grow laterally. These separate the orifice of the cochlear canal (Ap*ertura externa canalis cochleae*) of the orifice of the vestibular canal (*Apertura externa Aquaeductus vestibuli*). The first one, rounded, opens overlooking the jugular hole and, laterally, a groove runs along the caudal face of the petrous bone. The second one, also rounded, opens at the base of the cerebellar fossa (*Fossa cerebellaris*) (fig. 4, e). This

fossa, ogival or triangular in shape, has an average depth, non-parallel edges, little raised medially, and a central relief runs along half its length.

Figure 4 - *Ovis aries*. Petrosal part of left temporal bone. Medial side.

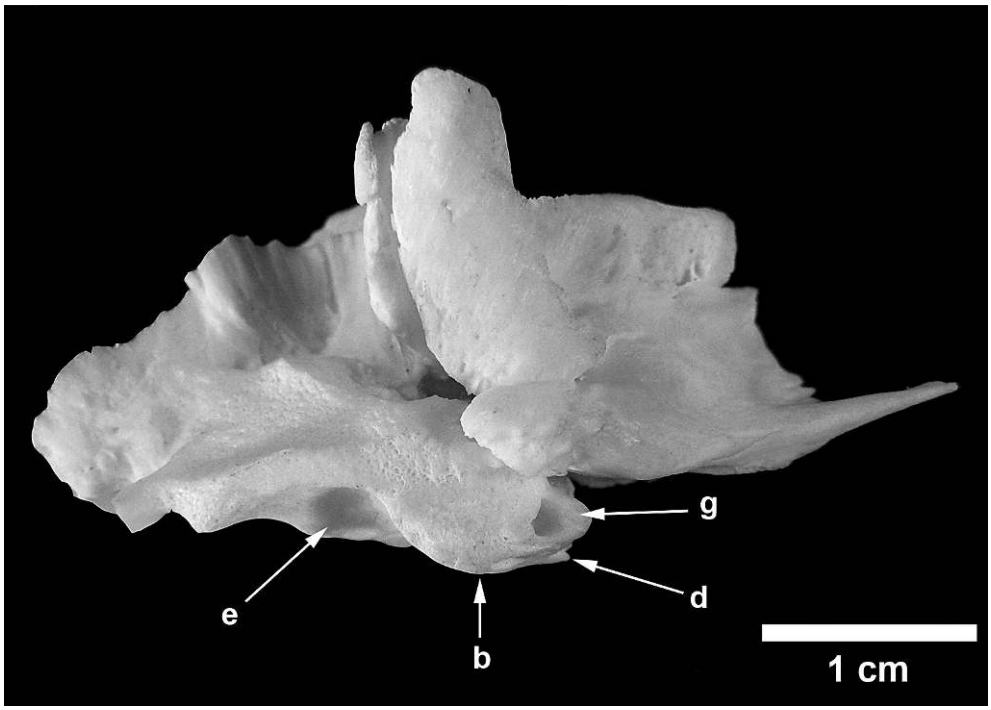


a: internal acoustic meatus (Meatus acusticus internus), b: petrosal crest (Crista partis petrosae), c: trigeminal nerve print (Impressio nervi trigemini), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), f: caudal crest (Crista caudalis), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris) (picture Guadelli J.-L. & C. Mallet 2011).

5.1.2 - The rostral face

41 It is very seldom active, which makes its description complex and unhelpful. The angle between the medial and rostral face is always acute, although it may sometimes be close to 90°. The face is elongated rearward, generally flat; it can sometimes stretch backwards to form a slight tip (fig. 5).

Figure 5 - *Ovis aries.* Petrosal part of left temporal bone. Rostral side.

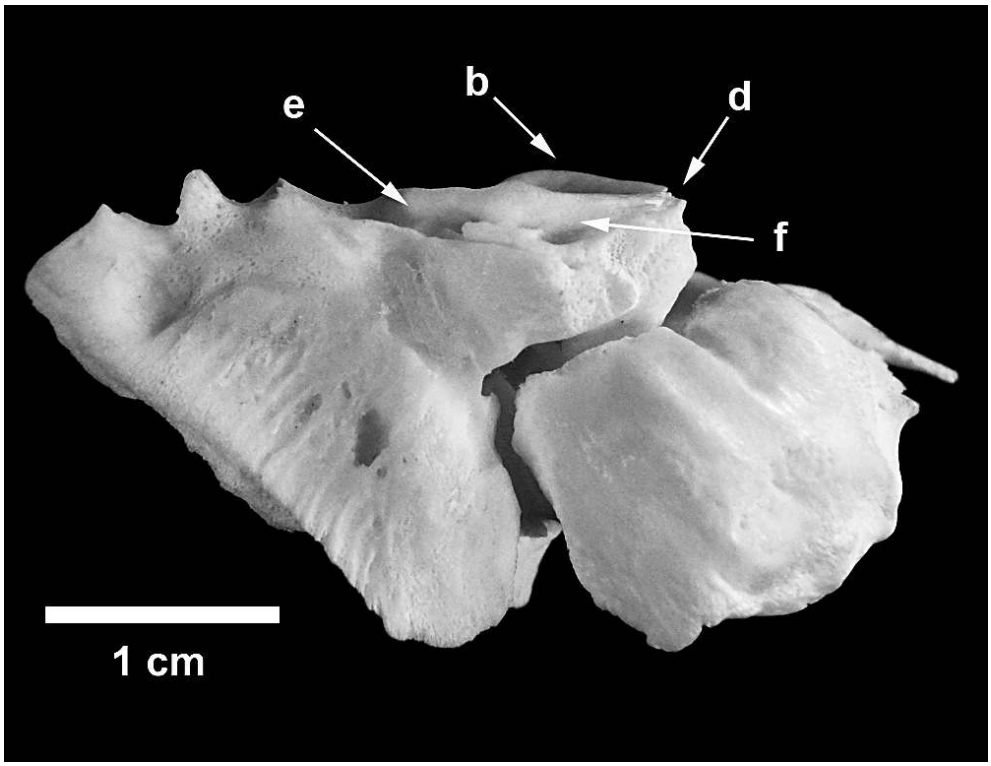


b: petrosal crest (Crista partis petrosae), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris) (picture Guadelli J.-L. & C. Mallet 2011).

5.1.3 - The caudal face

42 Generally triangular, this face has an inverted heart-shaped, surrounding the tympanic bulla (fig. 6). These edges are rectilinear. The lateral groove at the opening of the cochlear canal is clearly distinguishable. Half of the face, very irregular, forms the basis of the mastoid process (*Processus mastoideus*).

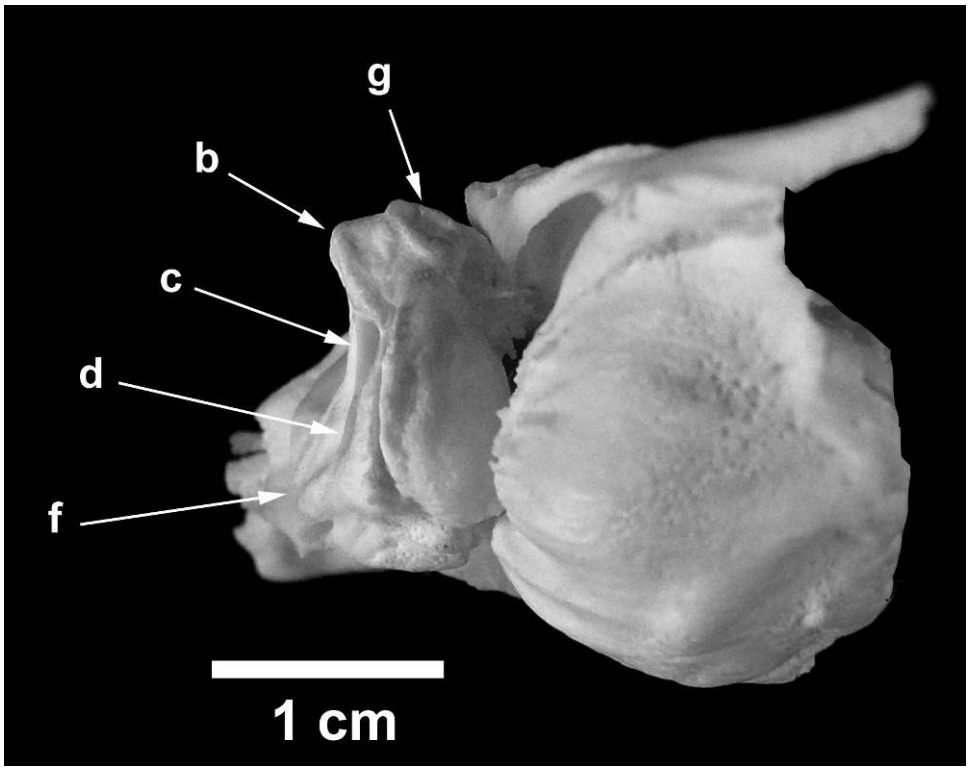
Figure 6 - *Ovis aries.* Petrosal part of left temporal bone. Caudal side. b: petrosal crest (Crista partis petrosae), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), f: caudal crest (Crista caudalis) (picture Guadelli J.-L. & C. Mallet, 2011).



5.1.4 - The ventral face

43 The antero-inferior apex is not marked in the centre (fig. 7, d). The dome sheltering the cochlea (*Cochleae*), whose axis is lopsided caudally, is then visible. In contrast, we distinguish the musculo-tubal canal. The hiatus of the petrosal nerve is visible on this face (fig. 7, g).

Figure 7 - *Ovis aries*. Petrosal part of left temporal bone. Ventral side.

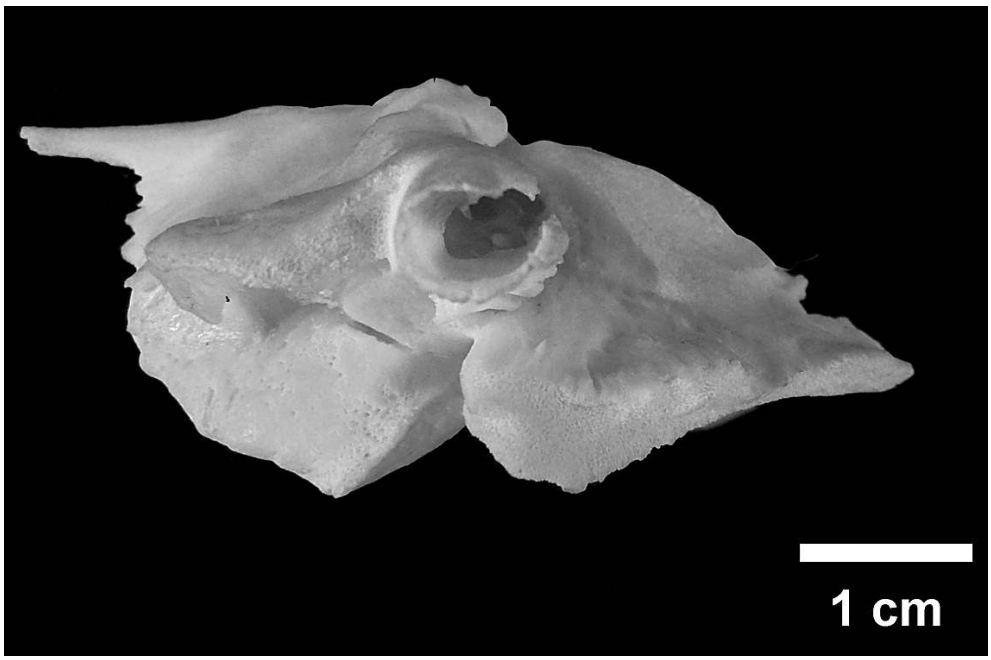


b: petrosal crest (Crista partis petrosae), c: trigeminal nerve print (Impressio nervi trigemini), d: anteroinferior apex (Apex partis petrosae), f: caudal crest (Crista caudalis), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris) (picture Guadelli J.-L. & C. Mallet, 2011).

5.1.5 - The lateral face

44 The mastoid process is stretched dorsally, flattened, with a mastoid foramen (*Foramen mastoideus*) also flattened (fig. 8).

Figure 8 - *Ovis aries*. Petrosal part of left temporal bone. Lateral side (picture Guadelli J.-L. & C. Mallet, 2011).



5.2 – Osteometry

45 For the measured diameters and after checking the normality of the distributions, we obtain the characteristics shown in Table 2.

46 The rostro-caudal and dorso-ventral diameters vary roughly in the same proportions, as evidenced by the Dvd/Rcd ratio (unitless) whose average is close to 1. For the internal auditory meatus, only the rostro-caudal diameter has a normal distribution. Rcd and Dvd are fairly well correlated (R = 0.4742), while Dvd/Rcd is only negatively correlated with Rcd (R = - 0.6058), Rcd IAM is not correlated with any other variable. Thus the diameters show a high variability although relationships emerge between them.

47 About the angles, we obtain the characteristics shown in table 3 after checking the normality of the distribution.

48 We find a rather large variability, but also the complete absence of correlations: every angle appears to vary independently. This confirms the variability of the morphology of the medial face in sheep.

Table 2 - Distinctive features of the main diameters on the medial side of *Ovis aries.*

	Drc	Ddv	Ddv / Drc	DrcMAI
Valeur minimale	9,20	9,55	0,79	4,10
Valeur maximale	14,15	14,15	1,12	7,10
Moyenne ± 95%	12,27 ± 0,50	11,61 ± 0,41	0,95 ± 0,03	5,25 ± 0,26
Écart-type	1,26	1,02	0,09	0,67

Table 3 - Distinctive features of the main angles on the medial side of *Ovis aries*.

	Angle rostral	Angle ventral	Angle ventro-caudal	Angle dorso-caudal	Angle alpha
Valeur minimale	111° 30'	104°	100°	136° 30'	140° 30'
Valeur maximale	141° 30'	133° 30'	135° 30'	156°	155° 30'
Moyenne ± 95%	126° 52' 4" ± 2° 33' 36"	117° 31' 12" ± 2° 33'	119° 13' 48" ± 2° 52' 48"	147° 3' ± 2° 13' 12"	147° 2' 24" ± 1° 24'
Écart-type	6° 34' 12"	6° 29' 24"	7° 20' 24"	5° 42' 36"	3° 15'

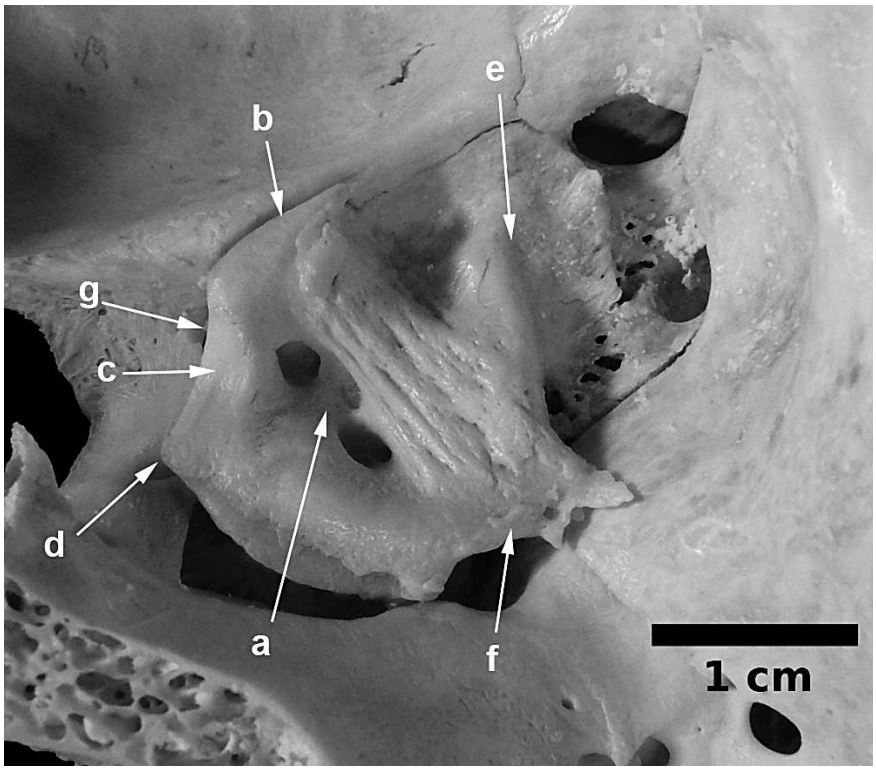
6 - Study of the petrous portion of *Capra hircus*

6.1 - Osteological description

6.1.1 - The medial face

49 Irregular, it splits into two clear parts as in *Ovis aries*. The antero-inferior apex (*Apex anteroinferior partis petrosae*) is flat, very marked and extends ventrally to form a more acute angle (fig. 9, d). The ventro-caudal edge is convex while the rostro-ventral edge is concave. The petrous crest (*Crista partis petrosae*), very characteristic, develops massively, taking the shape of a teardrop, thick at the base and extending dorsally to a point (fig. 9, b). The imprint of the trigeminal nerve (*Impressio nervi trigemini*) is clearly marked and concave (fig. 9, c). The hiatus of the petrosal nerve (*Canaliculus nervi petrosi majoris*) always opens directly over this imprint and has a flattened section (fig. 9, g). The internal auditory meatus (*Meatus acusticus internus*) is oval or lozenge-shaped, with a non-protruding dorsal edge (fig. 9, a). At the bottom three orifices, separated by Y-shaped partitions, also open. The caudal crest strongly stretches caudally, covering the occipital bone to form a sharp bone blade (fig. 9, f). Thus, it hides in medial view the opening of the cochlear canal (*Apertura externa canalis cochleae*), which has a flattened section. The orifice of the vestibular canal (*Apertura externa aquaeductus vestibuli*), which opens at the base of the cerebellar fossa, is also flattened in section according to the development of the caudal crest. Finally, the cerebellar fossa (*Fossa cerebellaris*), rectangular or trapezoid in shape, has parallel edges raised medially and a significant depth (fig. 9, e).

Figure 9 - *Capra hircus*. Petrosal part of left temporal bone. Medial side.

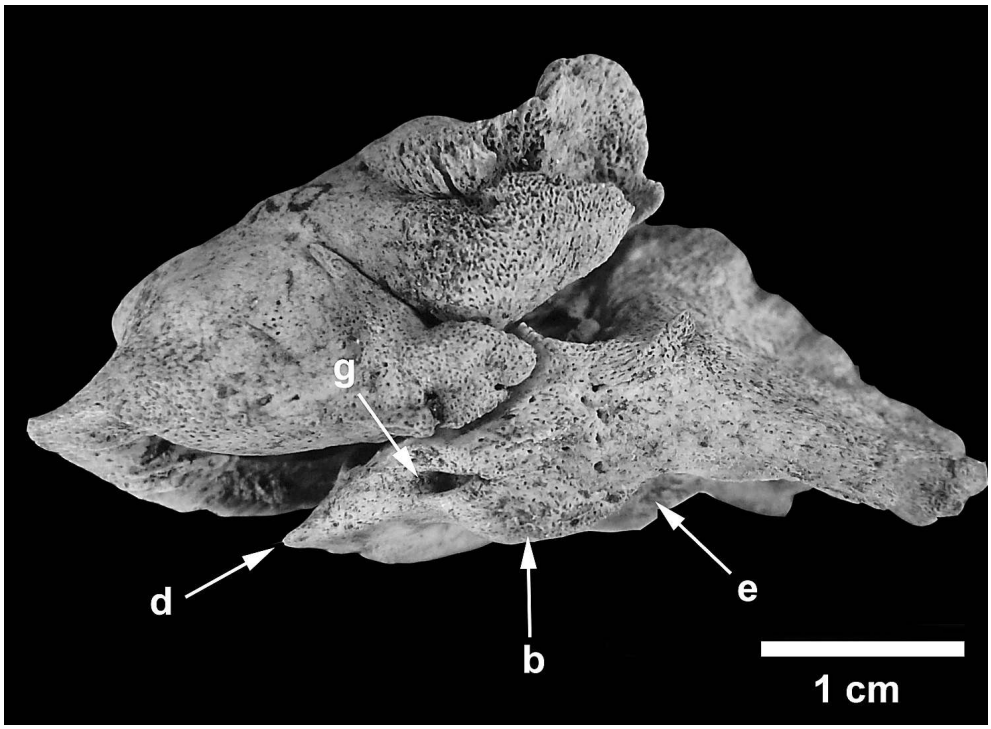


a: internal acoustic meatus (Meatus acusticus internus), b: petrosal crest (Crista partis petrosae), c: trigeminal nerve print (Impressio nervi trigemini), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), f: caudal crest (Crista caudalis), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris) (picture Guadelli J.-L. & C. Mallet 2011).

6.1.2 - The rostral face

50 Always active, it is rectangular or triangular, according to the development of the petrous crest, and can stretch as a point towards the back. Its surface is reduced to a few square millimetres (fig. 10).

Figure 10 - *Capra hircus*. Petrosal part of left temporal bone. Rostral side.

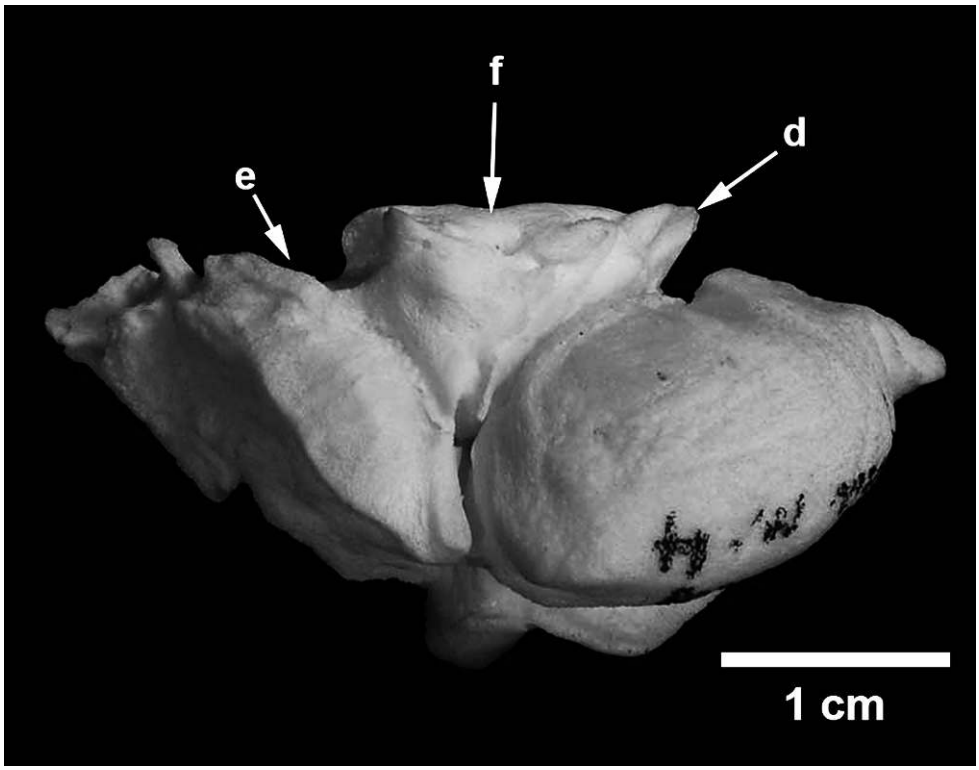


b: petrosal crest (Crista partis petrosae), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris) (picture Guadelli J.-L. & C. Mallet 2011).

6.1.3 - The caudal face

51 It is triangular with concave medial and ventral sides and a lateral convex side. The openings of the canals are clearly distinguishable and the base of the mastoid process (*Processus mastoideus*) is well marked (fig. 11).

Figure 11 - *Capra hircus*. Petrosal part of left temporal bone. Caudal side.

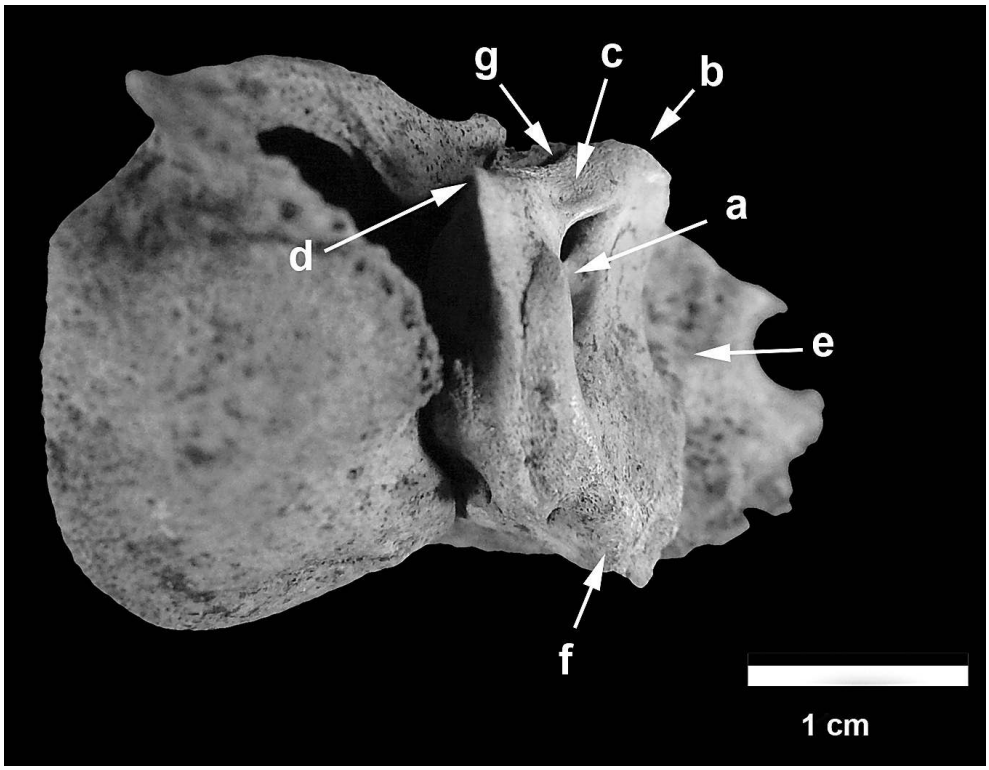


d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), f: caudal crest (Crista caudalis) (picture Guadelli J.-L. & C. Mallet 2011).

6.1.4 - The ventral face

52 In its centre, the antero-inferior apex stands out clearly (fig. 12, d). The cochlea (*Cochleae*) presents here a linear axis, not lopsided caudally. The hiatus of the petrosal nerve (fig. 12, g) appears under the imprint of the trigeminal nerve (fig. 12, c).

Figure 12 - *Capra hircus*. Petrosal part of left temporal bone. Ventral side.

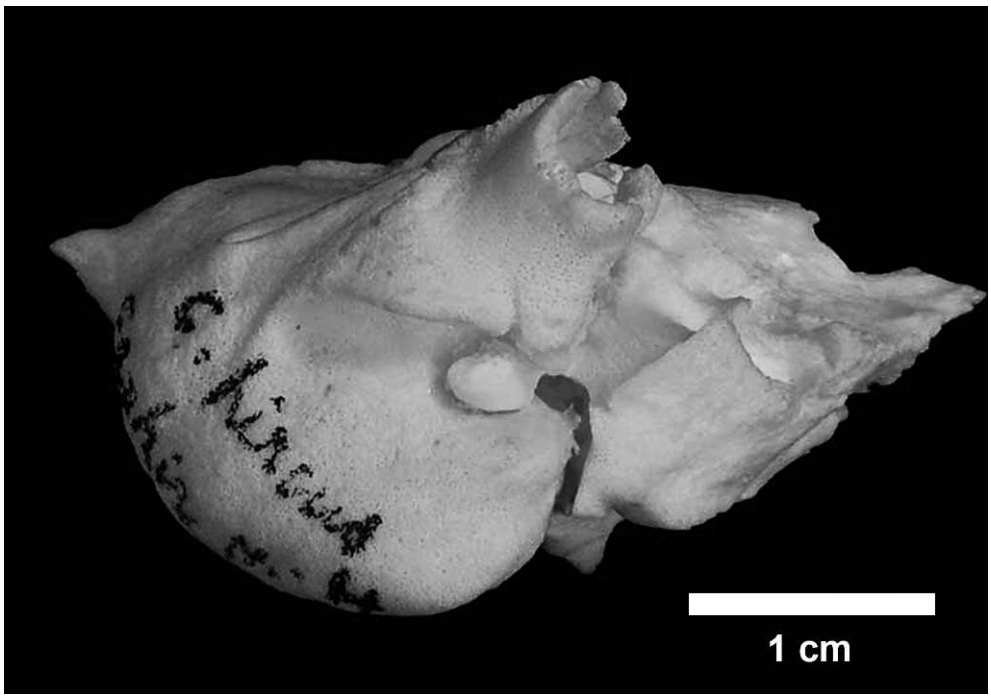


a: internal acoustic meatus (Meatus acusticus internus), b: petrosal crest (Crista partis petrosae), c: trigeminal nerve print (Impressio nervi trigemini), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), f: caudal crest (Crista caudalis), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris) (picture Guadelli J.-L. & C. Mallet 2011).

6.1.5 - The lateral face

53 The mastoid process here is very thick at the base and extends rearward with a slight twist. The mastoid foramen (*Foramen mastoideum*) is rounded in section (fig. 13).

Figure 13 - *Capra hircus*. Petrosal part of left temporal bone. Lateral side (picture Guadelli J.-L. & C. Mallet 2011).



7 – Osteometry

54 The normality of the distributions being verified, we obtain the characteristics of the considered diameters, shown in table 4.

Table 4 - Distinctive features of the main diameters on the medial side of *Capra hircus*.

	Drc	Ddv	Ddv / Drc	DrcMAI	DdvMAI
Valeur minimale	13,90	12,50	0,60	4,90	2,00
Valeur maximale	24,05	15,90	0,94	8,35	3,40
Moyenne ± 95%	19,05 ± 2,48	14,30 ± 0,72	0,77 ± 0,07	7,34 ± 0,60	2,83 ± 0,27
Écart-type	3,75	1,09	0,11	0,90	0,40

55 For Goats, the rostro-caudal diameter grows much more than the dorso-ventral diameter, these two measurements showing an excellent positive correlation (R = 0.7552). The Dvd/Rcd ratio is always less than 1 and is strongly correlated with Rcd only (R = - 0.9231). The diameters of the internal auditory meatus, RcdIAM and DvdIAM, are, as for them, correlated with Rcd and Dvd respectively. All this therefore indicates that the major part of the development of the medial face of goats is done in the rostro-caudal direction, and that the different diameters evolve uniformly.

56 As for the angles, we obtain the results shown in table 5, after checking the normality of the distribution.

57 There again we see some variability. Note especially that in the Goat, the ventral angle hardly exceeds 110°. The alpha angle, meanwhile, does not seem significant to distinguish the two taxa. Two negative correlations were observed: between the ventral

and rostral angles (R = - 0.9088) and between the ventral and dorso-caudal angles (R = - 0.6105). Thus, within the sample, when an angle opens, the other will tend to close up. Again we see a very precise dynamics of the evolution of the medial face in the Goat, very different from that of the Sheep.

Table 5 - Distinctive features of the main angles on the medial side of *Capra hircus*.

	Angle rostral	Angle ventral	Angle ventro-caudal	Angle dorso-caudal	Angle alpha
Valeur minimale	113° 30'	81°	125°	112°	145°
Valeur maximale	141°	110° 30'	142°	151° 30'	154° 30'
Moyenne ± 95%	127° 57' 36" ± 5° 33' 36"	97° 30' ±6° 29' 24"	134° 45' ± 3° 39' 36"	134° 2' 24" ± 8° 28' 48"	149° 45' ± 2° 6'
Écart-type	8° 22' 48"	9° 46' 48"	5° 31' 12"	12° 47' 24"	2° 47' 24"

8 - Distinction between *Ovis aries* and *Capra hircus*

58 Table 6 summarizes the main distinguishing features in the medial face and table 7 includes the observable characteristics on the other faces of the petrous bone.

59 At an osteometric level, we retain only those measurements showing a significant difference between Fisher and Student's tests. Rcd appears as the most reliable and the most significant measurement, to the extent that the values of the two samples do not overlap (fig. 14). Dvd and Dvd/Rcd are less significant but are good indicators to differentiate the taxa (fig. 15 and 16). RcdIAM appears reliable only after the withdrawal of an aberrant individual of the sample: its use therefore requires caution. As for the angles in the medial face, the ventral, ventro-caudal and dorso-caudal angles are clearly distinguishable from each other (fig. 17). All these results are reported in Table 8.

60 Thus, based on discriminating characteristics highlighted in particular in the medial face and the various measurements tested, the determination of the taxon between Sheep and Goat on the basis of the petrous portions is entirely possible and the confusion unlikely. These criteria should allow identifying a species even from isolated petrous bones, thus helping to count the number of individuals represented in the faunal lists. The study of the petrous bones may also eventually be a way to assign an age to an individual, or perhaps to go back to the breed for domestic species, and thus refine knowledge about the domestication processes (Mallet 2011; Mallet in preparation).

61 After presenting the petrous bone of two domestic taxa, for comparison, we will discuss more quickly (for lack of material) of this type of bone in two wild Caprinae, the Alpine Ibex and the Chamois.

Table 6 - Distinctive criteria on the medial side between *Ovis aries* and *Capra hircus*.

	Face médiale	
	Ovis aries	***Capra hircus***
Aspect général	Face plus longue que large S'étire caudalement en se rétrécissant	Face massive aussi longue que large
Apex antéro-inférieur	Court, épais, mousse, peu marqué voire inexistant, vient très peu en recouvrement du basioccipital	Long, fin, saillant, vient en recouvrement du basioccipital de façon prononcée
Crête pétreuse	Forme très variable, étirée rostralement, peu saillante, face rostrale rarement active	Forme de goutte d'eau, épaisse rostro-ventralement et pointue dorsalement, face rostrale toujours active, sillon médial souvent présent
Empreinte du nerf trijumeau	Faiblement concave et marquée, bord rostro-ventral rectiligne ou légèrement concave, crête dorsale la séparant du MAI	Fortement concave, bord rostro-ventral fortement incurvé, pas de crête dorsale la séparant du MAI
Hiatus du nerf pétreux	Section arrondie, cerclé d'os épais en relief ou en retrait sous le bord rostro-ventral	Section aplatie, s'ouvre au fond d'un sillon, toujours à l'aplomb du bord rostro-ventral
Méat auditif interne	Triangulaire, bord dorsal saillant et en surplomb, bords ventraux mousses, profondeur moyenne	Ovale, symétrique rostro-caudalement, bords mousses, faible profondeur
Crête caudale	Épaisse, mousse, globuleuse, surmontant un sillon latéral pourvue de petites lames osseuses	Fine, saillante, fort développement des lames osseuses en direction caudale autour du trou jugulaire
Orifice de l'aqueduc cochléaire	Souvent visible en vue médiale, arrondi, surplombe un sillon s'étendant dans le trou jugulaire	Jamais visible en vue médiale, absence de sillon dans le trou jugulaire
Orifice de l'aqueduc du vestibule	Arrondi, situé non loin de l'orifice de l'aqueduc cochléaire	Allongé, formant une fente bien séparée de l'aqueduc cochléaire par la crête caudale
Fosse cérébelleuse	Longue et étroite, bords non parallèles, forme générale d'ogive rétrécie dorsalement, contacts avec les os adjacents non soudés	Courte et large, profonde, bords parallèles, forme générale de trapèze, contacts avec les os adjacents soudés

Table 7 - Distinctive criteria of the rostral, caudal, ventral and lateral sides between *Ovis aries* and *Capra hircus*.

	Ovis aries	***Capra hircus***
Face rostrale	Face rostrale souvent passive ou réduite à quelques mm², hiatus du nerf pétreux en relief ou en retrait s'ouvrant rostro-ventralement	Face rostrale active, triangulaire ou rectangulaire chez les individus adultes, hiatus du nerf pétreux s'ouvrant ventralement au fond d'un sillon
Face caudale	Face triangulaire à bords rectilignes enserrant la bulle tympanique, angle resserré autour de la bulle, présence d'un sillon latéralement à l'orifice de l'aqueduc cochléaire	Face triangulaire à bords incurvés enserrant peu la bulle, angle ouvert autour de la bulle, absence de sillon latéralement à l'orifice de l'aqueduc cochléaire
Face ventrale	Apex antéro-inférieur peu marqué, cochlée déjetée caudalement, face médiale peu concave voire plate	Apex antéro-inférieur bien marqué, axe de la cochlée rectiligne, face médiale nettement concave
Face latérale	Apophyse mastoïde aplatie dorsalement, trou mastoïdien aplati	Apophyse mastoïde large et massive, trou mastoïdien arrondi

Figure 14 - Average and statistical distribution (Boxplot) of the Drc values between *Ovis aries* and *Capra hircus*.

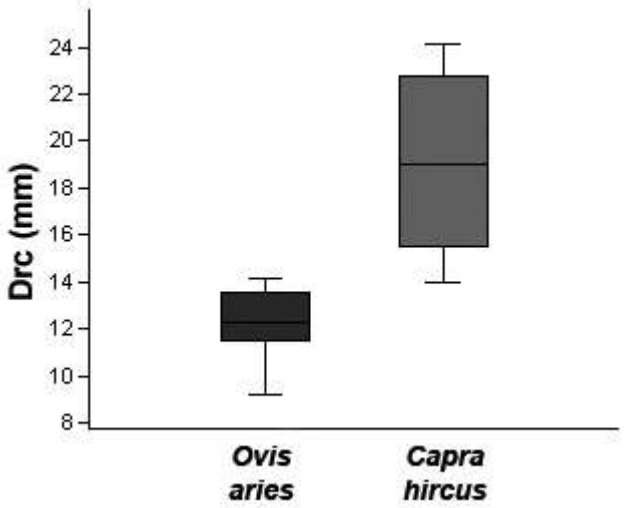


Figure 15 - Average and statistical distribution (Boxplot) of the Ddv values between *Ovis aries* and *Capra hircus*.

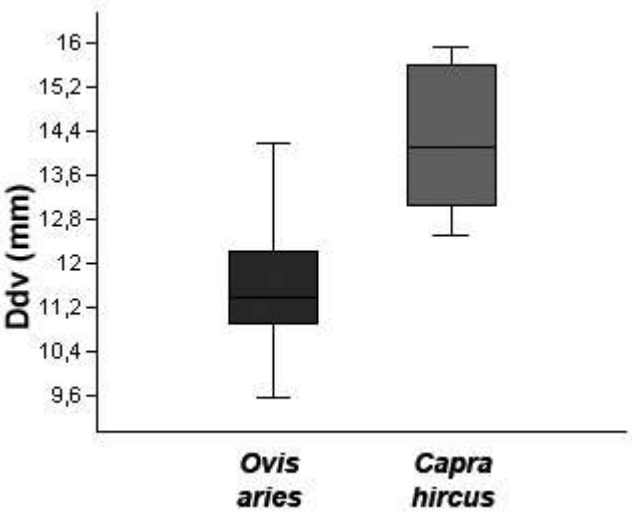


Figure 16 - Average and statistical distribution (Boxplot) of the Ddv / Drc ratio between *Ovis aries* and *Capra hircus*.

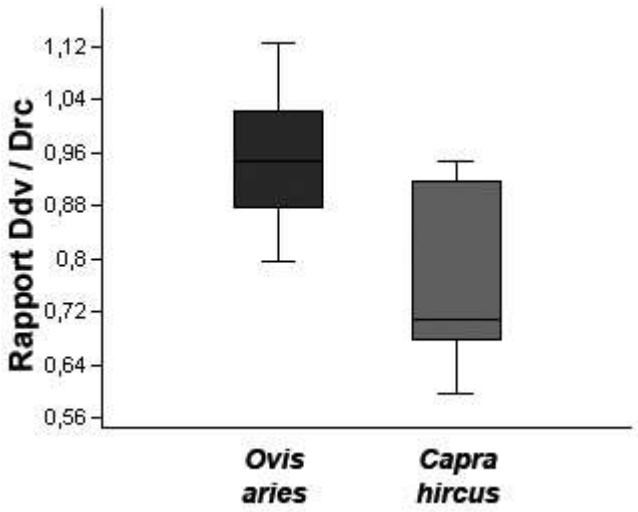


Figure 17 - Average and statistical distribution (Boxplot) of the ventral angle values, the ventrocaudal angle values and the dorsocaudal angle values, between *Ovis aries* and *Capra hircus*.

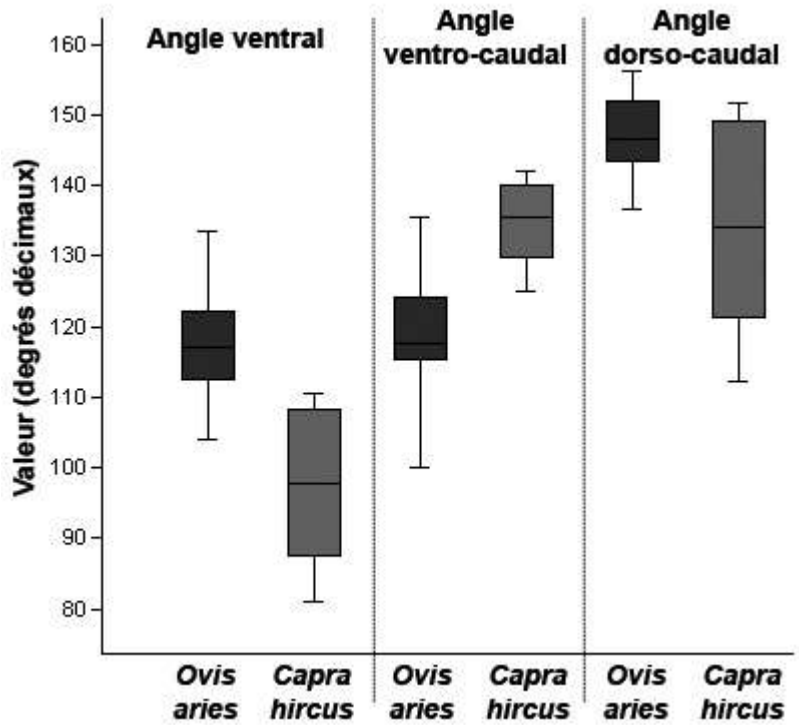


Table 8 - Average ± 95% of the three significant different diameters and the three significant different angles between *Ovis aries* and *Capra hircus*.

	Drc	Ddv	Ddv / Drc	Angle ventral	Angle ventro-caudal	Angle dorso-caudal
Ovis aries	12,27 ± 0,50	11,61 ± 0,41	0,95 ± 0,03	117° 31' 12" ± 2° 33'	119° 13' 48" ± 2° 52' 48"	147° 3' ± 2° 13' 12"
Capra hircus	19,05 ± 2,48	14,30 ± 0,72	0,77 ± 0,07	97° 30' ± 6° 29' 24"	134° 44' 24" ± 3° 39' 36"	134° 2' 24" ± 8° 28' 48"

9 - Summary presentation of characteristics found in two wild taxa: *Capra ibex* and *Rupicapra rupicapra*

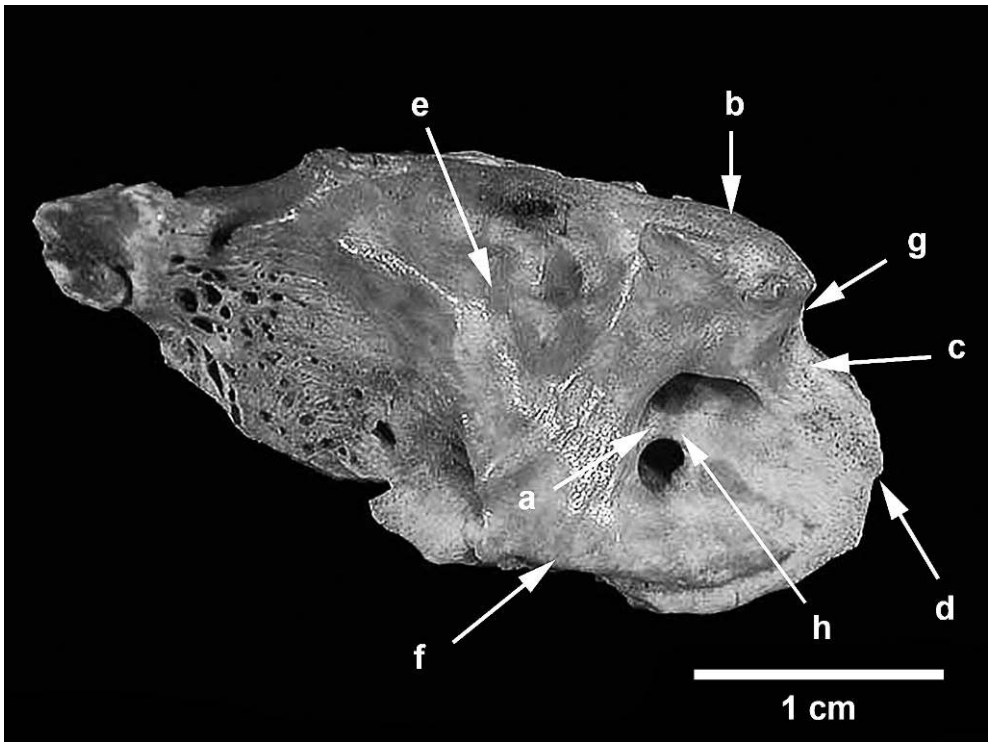
9.1 - *Capra ibex* Linnaeus, 1758

9.1.1 - Osteological description

9.1.1.1 - The medial face

62 The medial face of the Alpine Ibex petrous bone has a wide and convex antero-inferior apex (*Apex partis petrosae*) (fig. 18, d) and, above, a strong concavity (fig. 18, c) corresponding to the imprint of the trigeminal nerve (*Impressio nervi trigemini*) (5th pair) (Guadelli 1987). The cerebellar fossa (*Fossa cerebellaris*) is kidney-shaped and deep (fig. 18, e). The vestibular canal (*Apertura externa Aquaeductus vestibuli*) opens rearward at the bottom of a short sub-vertical groove. Due to the strong development of the dorso-ventral crest (DVC) that extends on the medial side (fig. 18, h), the internal auditory meatus has two main orifices (fig. 18, a), a caudal one and a rostral one, the latter being split by a small rostro-caudal crest (RCC) that appears to constitute the beginning of a partition.

Figure 18 - *Capra ibex*. Petrosal part of left temporal bone. Medial side.

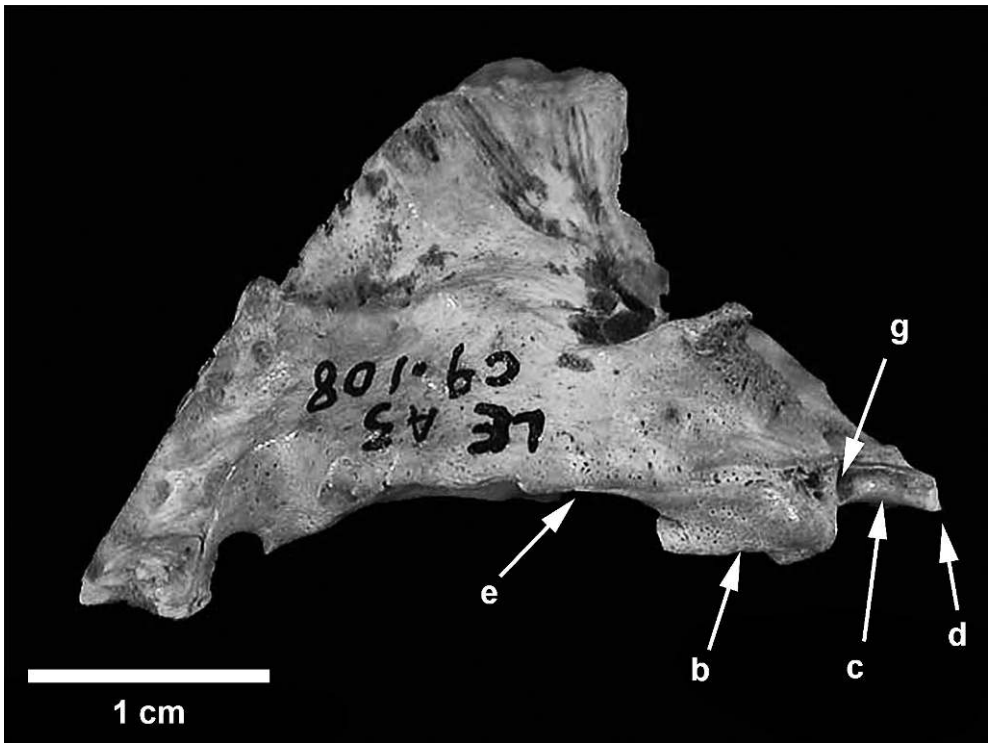


a: internal acoustic meatus (Meatus acusticus internus), b: petrosal crest (Crista partis petrosae), c: trigeminal nerve print (Impressio nervi trigemini), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), f: caudal crest (Crista caudalis), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris), h: dorsoventral crest (CDV) (picture Guadelli J.-L. 2000).

9.1.1.2 - The rostral face

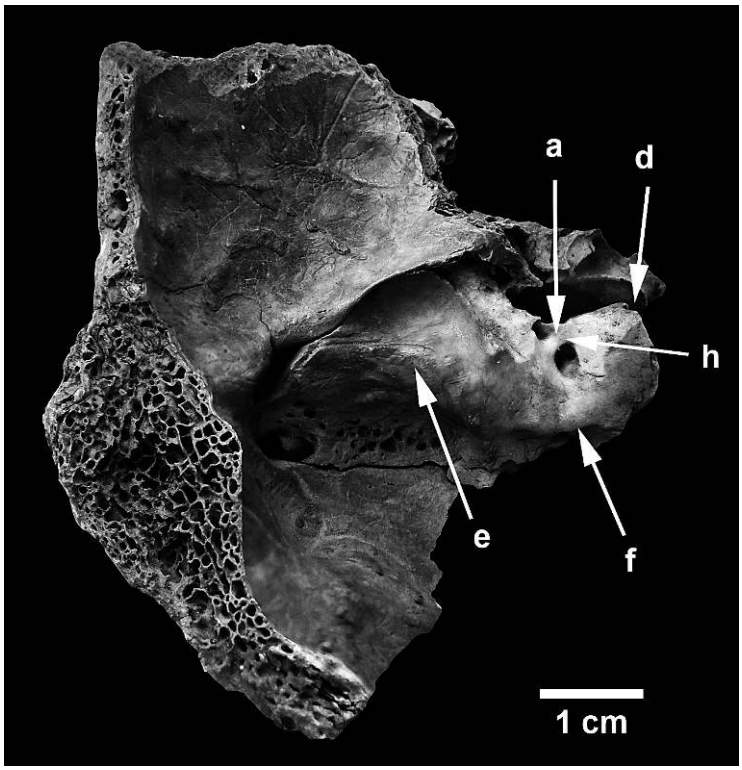
63 Ibex petrous bones have an extremely reduced rostral face, hardly larger than a grain of rice (fig. 19) and the temporal bone largely covers the petrous bone. Moreover, it would be more accurate to speak of rostro-medial face due to the inward tilt of the brain region: this morphological feature causes an area of weakness and thus a very common and very characteristic breakage of these petrous bones (fig. 20 and 21). In this regard, a very promising research path exists for archaeozoologists because according to the type of fracture presented by the petrous portion of the temporal bone, we can infer the action that led to the breakage (Guadelli in press). Indeed, according to the taxa, the petrous bone will come off whether after one or more (very) violent shocks on the skull –in the case of Bovinae – whether with virtually no impact on the skull – in the case of Caprinae; between these two extremes, we have an assemblage of intermediate cases that depend on the degree of attachment of the petrous bone to the adjacent parts depending on the taxon and/or the age of the subject.

Figure 19 - *Capra ibex*. Petrosal part of left temporal bone. Rostral side.



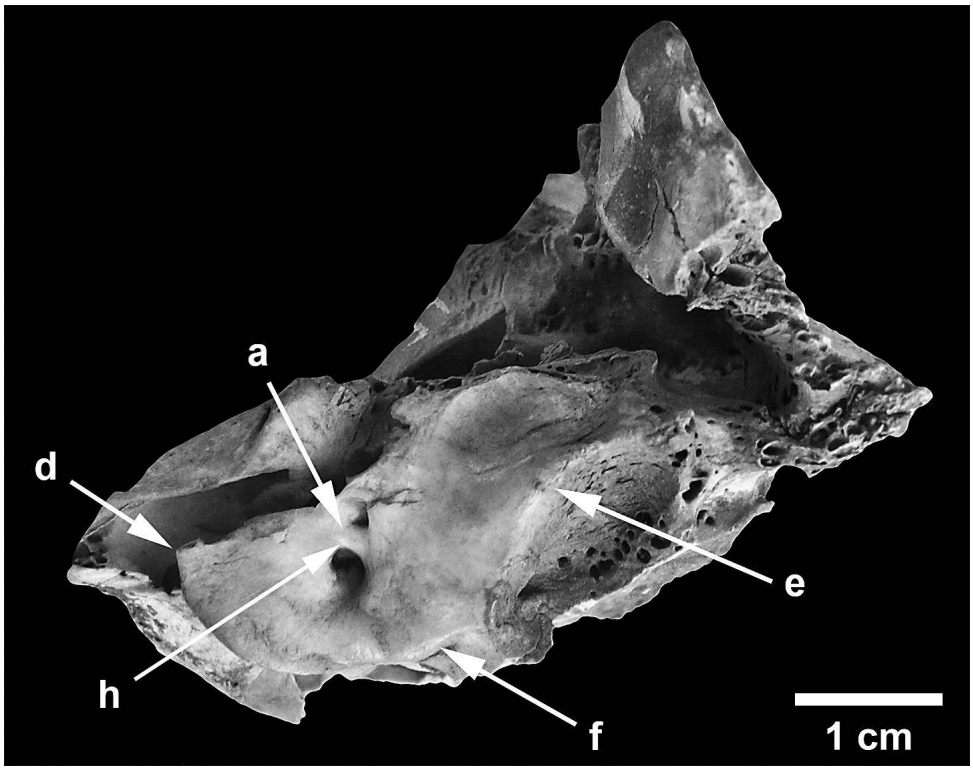
b: petrosal crest (Crista partis petrosae), c: trigeminal nerve print (Impressio nervi trigemini), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris) (picture Guadelli J.-L. 2000).

Figure 20 - *Capra ibex.* Petrosal part of left temporal bone. Broken medial side.



A: INTERNAL ACOUSTIC MEATUS (MEATUS ACUSTICUS INTERNUS), D: ANTEROINFERIOR APEX (APEX PARTIS PETROSAE), E: CEREBELLAR FOSSA (FOSSA CEREBELLARIS), F: CAUDAL CREST (CRISTA CAUDALIS), H: DORSOVENTRAL CREST (CDV) (PICTURE GUADELLI J.-L. 2011).

Figure 21 - *Capra ibex*. Petrosal part of right temporal bone. Broken medial side.



A: INTERNAL ACOUSTIC MEATUS (MEATUS ACUSTICUS INTERNUS), D: ANTEROINFERIOR APEX (APEX PARTIS PETROSAE), E: CEREBELLAR FOSSA (FOSSA CEREBELLARIS), F: CAUDAL CREST (CRISTA CAUDALIS), H: DORSOVENTRAL CREST (CDV) (PICTURE GUADELLI J.-L. 2011).

9.1.1.3 - The ventral face

64 In the Ibex, the opening of the fallopian hiatus canal (*Canaliculus nervi petrosi majoris*) (fig. 19 g) is found in the middle of the imprint of the trigeminal (*Impressio nervi trigemini*) and laterally to it. The fact that the cerebral face appears as offset inwardly causes a sharp concavity of the medial face.

9.2 - *Rupicapra rupicapra* Linnaeus, 1758

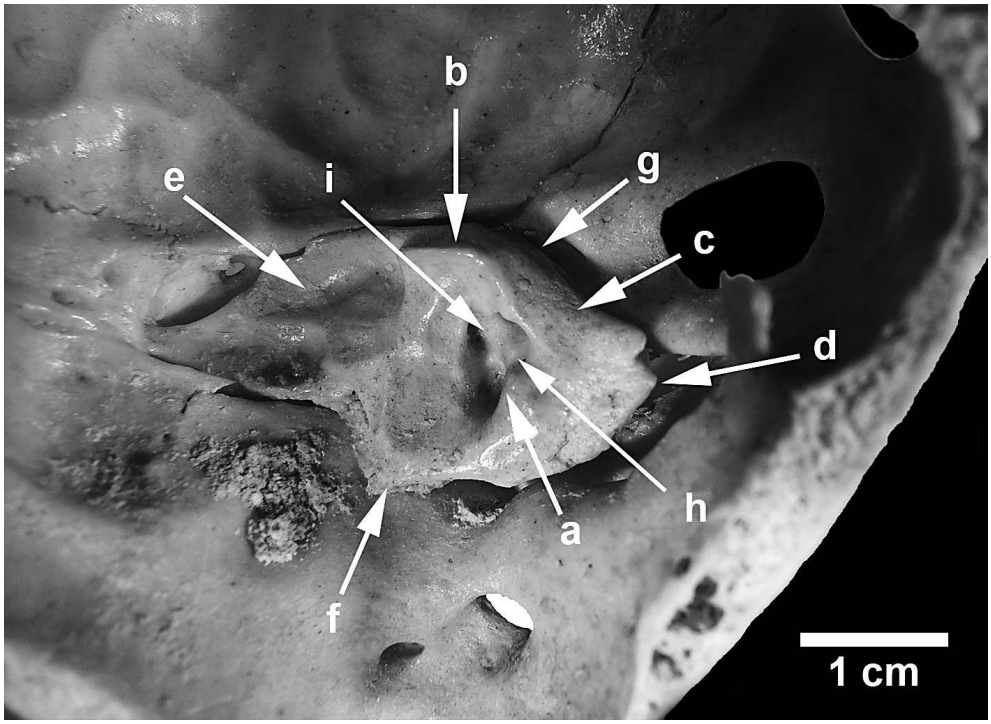
9.2.1 - Osteological description

9.2.1.1 - The medial face

65 The medial face of the Chamois petrous bone has a long antero-inferior apex (*Apex partis petrosae*) with a flattened tip, often notched (fig. 22, d); above, a very large concavity corresponds to the imprint of the trigeminal nerve (*Impressio nervi trigemini*) (5^{th} pair) (fig. 22, c). This imprint is tilted medially. The cerebellar fossa (*Fossa cerebellaris*) deep and kidney-shaped has a rostro-ventral/dorso-caudal main axis (fig. 22, e). Ventrally to this fossa, there is a depressed surface that ends at the internal auditory meatus (fig. 22, a). The medial face thus appears concave on the inner side, which is reinforced by the petrous crest (*Crista partis petrosae*) that develops on the medial side (see below) (fig. 22, b). In the internal auditory meatus, due to the strong development of the dorso-ventral crest (DVC) that extends on the medial side (fig. 22,

h), we observe three main orifices, one is caudal and the two other rostral (*Canalis facialis and Area cochleae*) separated by a powerful rostro-caudal crest (RCC) (fig. 22, i).

Figure 22 - *Rupicapra rupicapra*. Petrosal part of left temporal bone. Medial side.



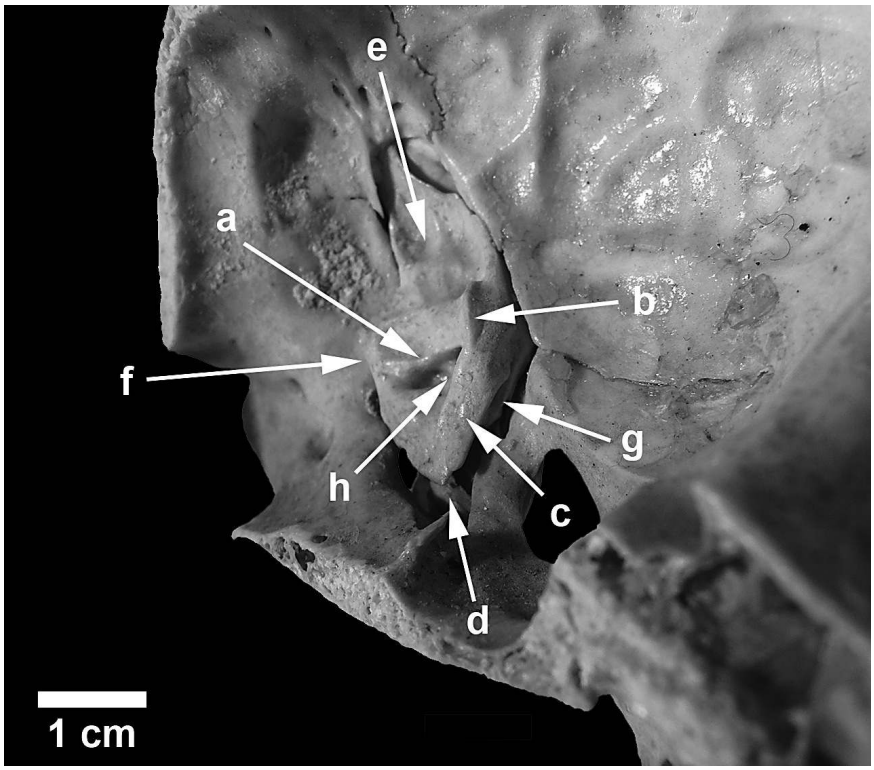
A: INTERNAL ACOUSTIC MEATUS (MEATUS ACUSTICUS INTERNUS), B: PETROSAL CREST (CRISTA PARTIS PETROSAE), C: TRIGEMINAL NERVE PRINT (IMPRESSIO NERVI TRIGEMINI), D: ANTEROINFERIOR APEX (APEX PARTIS PETROSAE), E: CEREBELLAR FOSSA (FOSSA CEREBELLARIS), : CAUDAL CREST (CRISTA CAUDALIS), G: PETROSAL NERVE HIATUS (CANALICULUS NERVI PETROSI MAJORIS), H: DORSOVENTRAL CREST (CDV), I: ROSTROCAUDAL CREST (CRC) (PICTURE GUADELLI J.-L. 2011).

66 The vestibular canal (*Apertura externa aquaeductus vestibuli*) opens toward the back at the bottom of a long groove oriented in the rostro-dorsal/caudo-ventral direction. The petrous crest is short and convex as it bends to border the imprint of the trigeminal nerve on the medial side. The opening of the cochlear canal does not belong to the medial face but to the caudal face.

9.2.1.2 - The rostral face

67 The rostral face of the petrous bone of the Chamois, lanceolate with a dorsal point, is more developed than in the Ibex, the Goat or the Sheep because the parietal bone covers less completely the petrous bone in the former than in the latters (fig. 22 and 23). Its surface is convex and has a fine dorso-ventral groove on the medial side. The medial edge that constitutes the petrous crest is very sharp and turned on the internal side. The opening of the canal of the facial nerve (*Canaliculus nervi petrosi majoris*) that opens directly onto the ventral side is only composed of a long and very narrow rostro-caudal groove (fig. 23, g). This hiatus is very lopsided on the lateral side of the ventral face.

Figure 23 - *Rupicapra rupicapra*. Petrosal part of left temporal bone. Rostral side.



A: INTERNAL ACOUSTIC MEATUS (MEATUS ACUSTICUS INTERNUS), B: PETROSAL CREST (CRISTA PARTIS PETROSAE), C: TRIGEMINAL NERVE PRINT (IMPRESSIO NERVI TRIGEMINI), D: ANTEROINFERIOR APEX (APEX PARTIS PETROSAE), E: CEREBELLAR FOSSA (FOSSA CEREBELLARIS), F: CAUDAL CREST (CRISTA CAUDALIS), g: PETROSAL NERVE HIATUS (CANALICULUS NERVI PETROSI MAJORIS), H: DORSOVENTRAL CREST (CDV) (PICTURE GUADELLI J.-L. 2011).

9.2.1.3 - The ventral face

68 The ventral face is very narrow and long. The ventral view shows that the medial face is concave and the petrous crest, projected on the medial side, is very acute.

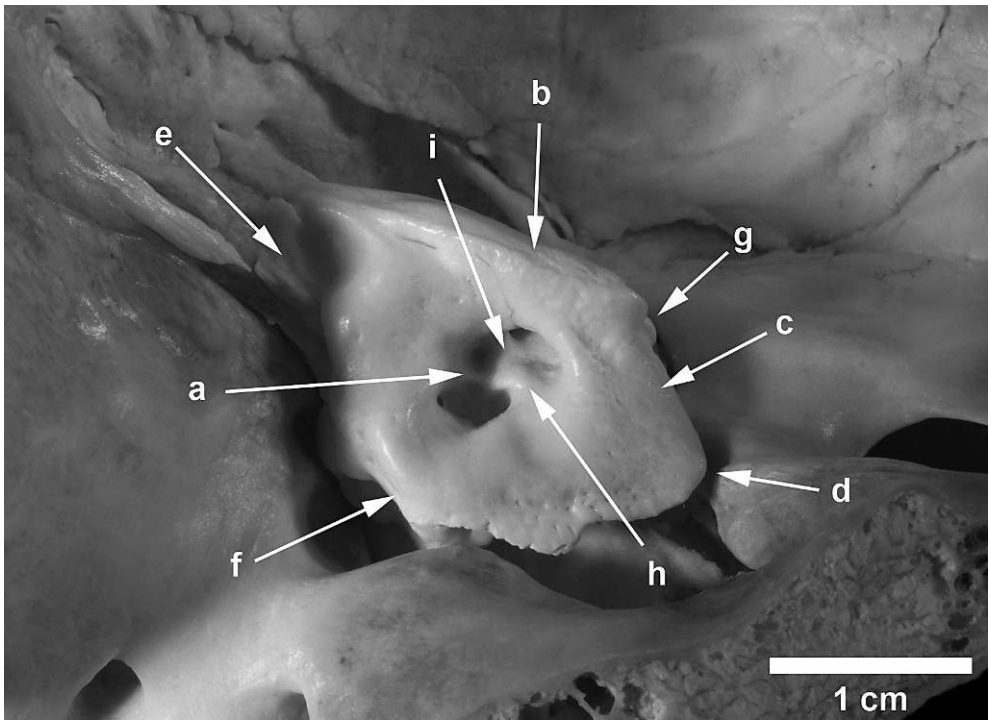
9.2.2 - Biometric elements

69 In the absence of a collection satisfactory in quantity, it is obviously unrealistic to confer any general characteristic to the metric data taken on the petrous bones; therefore, this is only for information that we give here the values of the angles of the medial face edges (table 9). Comparing these values with those in tables 3 and 5 shows the elongated shape of the medial face and the development of the antero-inferior apex. However, we must not neglect the morphology proper to the petrous bone of each taxon as the values of the same angles obtained from *Dama dama* (table 9) show that in the Fallow Deer, the medial face is also elongated with a very long antero-inferior apex giving it the "appearance" of a Chamois. However, figures 24 and 25 compared to figures 22 and 23 allow finding that in *Dama dama*, as in all Deer (Guadelli in press), the parietal bone hardly covers the rostral face of the petrous part of the temporal bone: this face is thus extremely more developed than in *Rupicapra rupicapra*, in which the parietal covers much more this region of the petrous bone.

Table 9 - Values of the three angles for *Rupicapra rupicapra* and *Dama dama*.

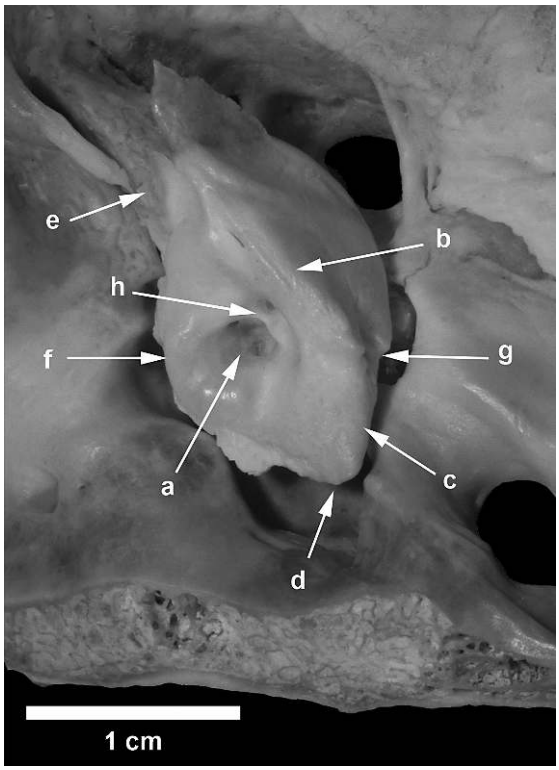
	Angle rostral	Angle ventral	Angle ventro-caudal	Angle dorso-caudal	Angle alpha
Rupicapra rupicapra	156°	73°	155°	127°	132°
Dama dama	136°	70°	144°	141°	150°

Figure 24 - *Dama dama*. Petrosal part of left temporal bone. Medial side.



A: INTERNAL ACOUSTIC MEATUS (MEATUS ACUSTICUS INTERNUS), B: PETROSAL CREST (CRISTA PARTIS PETROSAE), C: TRIGEMINAL NERVE PRINT (IMPRESSIO NERVI TRIGEMINI), D: ANTEROINFERIOR APEX (APEX PARTIS PETROSAE), E: CEREBELLAR FOSSA (FOSSA CEREBELLARIS), F: CAUDAL CREST (CRISTA CAUDALIS), G: PETROSAL NERVE HIATUS (CANALICULUS NERVI PETROSI MAJORIS), H: DORSOVENTRAL CREST (CDV) (PICTURE GUADELLI J.-L.

Figure 25 - *Dama dama*. Petrosal part of left temporal bone. Mediorostral side.



a: internal acoustic meatus (Meatus acusticus internus), b: petrosal crest (Crista partis petrosae), c: trigeminal nerve print (Impressio nervi trigemini), d: anteroinferior apex (Apex partis petrosae), e: cerebellar fossa (Fossa cerebellaris), f: caudal crest (Crista caudalis), g: petrosal nerve hiatus (Canaliculus nervi petrosi majoris), h: dorsoventral crest (CDV) (picture Guadelli J.-L. 2011).

Conclusion

70 Although ignored by most archaeozoologists, the petrous portions of temporal bone keep very well, and despite a slightly confusing morphology, allow precise identification of the animal. We have seen that it is possible to define a group of topographic and morphometric characteristics to distinguish *Capra hircus* from *Ovis aries*, and others that characterise a higher taxinomic level (*e.g.* the extent of the rostral face in relation with the degree of development of the parietal bone on this face respectively in Cervidae and Bovidae). In this sense, the foundations laid by this work can greatly assist in the identification and counting of skeletal remains of Sheep and Goat in archaeological sites.

71 However, the study of the petrous bones has implications that go well beyond the simple determination of the taxon and it is important for the archeozoologist-Quaternary palaeontologist to be focused in this area.

72 As the morphometric characteristics of the petrous portions of temporal bone allow to obtain accurate measurement, with enough pieces it would certainly be possible to bring arguments to the delicate issue of domestication:

- Recognition of the wild forms that have been domesticated (strangely here Mouflon(s) and Aegagrus);
- Dating the first appearance of domestic forms;

- Identification of the area(s) of domestication;
- Recognition of the route(s) of diffusion of domestication;
- Arrival date of the first domestic forms in a given place and what was (were) the first race(s) post domestication...

73 Finally, the petrous bones also allow determining the animal's age at death to form mortality profiles (Guadelli in press; Mallet in preparation) but with the difficulty that, according to the taxa, it is not the same characteristics that change morphology.

74 The study of the petrous portion remains an avenue of research that may harbour many elements of reflection for palaeontology and zooarchaeology.

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RÉSUMÉS

Dans cet article, les auteurs mettent en évidence les caractères morphométriques permettant de distinguer les portions pétreuses de temporal de différents Caprinae, en insistant sur le Mouton (Ovis aries) et la Chèvre (Capra hircus), et en complétant avec quelques caractères propres au Bouquetin (Capra ibex) et au Chamois (Rupicapra rupicapra). Sont abordées également les implications de l'étude des portions pétreuses de ces taxons dans les analyses archéozoologiques et paléontologiques des ensembles fauniques post-pléistocènes : problèmes liés aux formes domestiquées et reconnaissance des races domestiques, bassins de domestication, chronologie de l'expansion de ce processus ; estimation de l'âge au décès pour la constitution des courbes de mortalité...

In this paper, the authors highlight the morphometric features allowing the distinction between the petrous part of the temporal bone of some Caprinae, with a particular consideration of sheep (Ovis aries) and goat (Capra hircus), in association with some specific features of ibex (Capra ibex) and chamois (Rupicapra rupicapra). The authors also consider the implication of the study of petrous bones for these particular taxa in zooarchaeological and palaeontological analysis, especially for post-pleistocene faunal assemblages : identification of domesticated and wild forms, domestication geographic areas, chronological extension of the domestication process ; death age estimation for curves of mortality...

INDEX

Keywords : Petrosal part of the temporal bone, Otic region, Petrous bone, Ovis aries, sheep, Capra hircus, goat, Capra ibex, Alpine ibex, Rupicapra rupicapra, Chamois, domestication
Mots-clés : portion pétreuse de temporal, région otique, rocher, Ovis aries, Mouton, Capra hircus, Chèvre, Capra ibex, Bouquetin des Alpes, Rupicapra rupicapra, Chamois, domestication

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