



# Analysis of hair remains from a hunter-gatherer grave from Patagonia: Taxonomic identification and archaeological implications



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## ABSTRACT

The results of the analysis of hair remains from a hunter-gatherer grave from northern Patagonia are presented in this paper. One of the samples analyzed consisted in hair that remained attached to the hide used to manufacture a small pouch left in the burial pit as a funerary offering. The second sample was taken from the inside of the same pouch. The hair taxonomic determination was performed by considering cross-sections of the hairs, the patterns of the medulla, and the shape and disposition of the cuticle scales by microscopic observation of molds of the hair surfaces. Samples were identified as *Lagidium viscacia* and *Homo sapiens*, respectively. These results provide the first evidence of both the exploitation of small mammal (*Lagidium*) hide and the offering of human hair in a grave, among Patagonian hunter-gatherers.

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## 1. Introduction

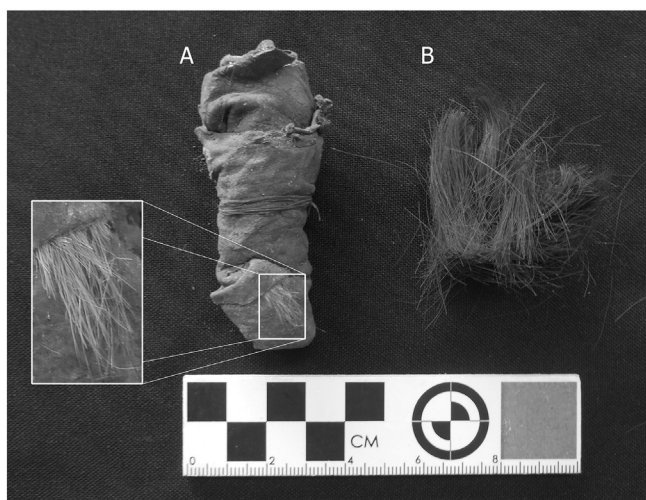
From the early 20th century, the microscopic study of hair has been widely applied to identify mammal species within the scope of dietary studies of living faunal species, mainly in the analysis of pellets (Ballejo and De Santis, 2013), faeces (Perrin and Campbell, 1980), and stomach contents (Day, 1966) of predators. Though hair samples have also been used for the identification of mammals from archaeological deposits (e.g. Mansilla et al., 2011; Dove and Peurach, 2002; Capriles, 2002), the constraints for the preservation of fibers have limited the potential of this method. In this paper, the results of a study of hair from the Cueva Galpón site (northern Patagonia, Argentina) are presented. The samples of hair analyzed were collected from a leather pouch left as an offering in one of the mortuary contexts of the site: one is a small cluster of hairs that remained attached to the hide with which the pouch was made, and the other is a lock of hair that constituted the only content of the pouch (Fig. 1). The main subjects of this paper are to make accurate taxonomic identifications of hair samples obtained, to assess the taphonomic conditions for the survival of hair in the site, and to discuss the archaeological implications of these identifications at both local and regional scales.

## 2. The archaeological context

The hair samples come from Cueva Galpón, an archaeological site located on the eastern edge of the Pailemán Hills, in northeast Patagonia (Argentina) (41° 09' 30" S, 65° 47' 30" W, 430 m.a.s.l.), at the bottom of a rock shelter (Fig. 2A). The rock shelter is filled with a sandy-silty deposit (60–65 cm), sealed by an overlying layer of sheep dung (~0.40 cm thick). This layer is strongly compacted and dehydrated, and the presence of dark reddish brown organic sediment at the bottom (5YR 3/2) may suggest the occurrence of a basal layer of bat guano. Considering the origin of the rock shelter sediments, four main sources of detrital components can be defined: aeolian, from rocks detached from the bedrock roof, biological (dung and guano), and anthropogenic (bones, wood, grasses, and seeds) (Fig. 2 B,C,D). The archaeological record mainly consists of human remains and rock art (Carden and Prates, 2015). Over half (55%) of the bioarchaeological record found in Cueva Galpón was thermally altered (Serna, 2014). However, the intensity and manner in which the heat had affected the remains were extremely variable, which made it possible to differentiate two bone assemblages. One of them consisted in a concentration of fragmented bone specimens with traces of intense combustion: (a) white colouration (i.e., charring); (b) heat-induced cracks and morphological alterations (e.g. transverse cracks, patina fractures, longitudinal splitting, rolled-up edges, warping; Buikstra and Swegle, 1989; Owens, 2010; Gonçalves, 2011) and (c) the presence of a clinker or thermally altered portion of soft tissue. The second assemblage, located a few metres away from the paintings, was less concentrated and with evidence of a much more irregular combustion. These specimens showed signs of very heterogeneous burning, with

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**Fig. 1.** Samples of analyzed hair: (A) leather pouch showing attached hair, and (B) lock of hair from within the pouch.

totally burnt and partially burnt elements, while others showed no evidence of burning. Along with human bones, other kinds of material were found (e.g. body ornaments, mollusk shells, ochre, pieces of cordage, leather ropes, textiles, wood, etc.); some of these items also showed traces of burning. One of the most outstanding features of the site was this erratic combustion of sediments, bones and artifacts. The samples of hair analyzed in this paper were associated with the second mortuary context, dated ca. 3300  $^{14}\text{C}$  years BP:  $3314 \pm 51$  (AA-91,544) and  $3264 \pm 38$  (AA-91,543) years BP (Carden and Prates, 2015).

### 3. Materials and methods

The pelage of most mammals consists of two main kinds of hair: guard hairs and underfur. In cross-section, hair shows three layers from the outside in: 1) the cuticle, which is made of overlapped scales covering the hair surface; 2) the cortex, which is made of spindle-shaped cells; and 3) the medulla, which is made of cells separated by air vesicles, forming a shaft through the middle of the hair. Guard hairs have taxonomical value since they usually have diagnostic morphological features that allow the delimitation of species or groups of

species. Such features can be recognized by observing the pattern of the medulla, the shape and disposition of the cuticle scales, the distance between scales, and the cross-section and width of the hairs (Brunner and Coman, 1974). The pelage covering the dorsal part of the body is the one best suited for morphology-based identifications (Chehébar and Martín, 1989), due to its greater resistance to both physical and chemical post-mortem processes. The proximal part of the hair is also suitable to make identifications because it displays a wider range of morphological variations among species and shows more marked features (Vázquez et al., 2000).

Preparation of the samples before analysis included washing the hairs to remove any impurities, using only water and detergent. With the aim of facilitating the observation and analysis of the pattern and organization of the scales, imprints of the hair surfaces were copied by creating molds. These molds were made by placing the hairs on a glass slide and coating them with a thin layer of colourless liquid enamel, which was removed after allowing it to dry for a few minutes; the observation of these molds was carried out by transparency under a magnification of 400x. Medullas were also observed by transparency under a microscope, and contrasted with comparative samples from local species.

### 4. Results

The sample collected from the pouch hide is approximately 12 mm long. The colour of the hair is light in the proximal portion and it darkens towards the distal end. In cross-section, most of the hair corresponds to the medulla and only a thin portion is occupied by the cortex. The medulla has air vesicles partially separated from each other, forming a shaft through the middle of the hair. This medulla's setting is described as ladder-like and reticular by Chehebar and Martín (1989) (Fig. 3A). Scales have smooth edges and are arranged transversely to the longitudinal axis of the hair, so they are wider than long and take the form of a "mosaic" setting, sensu Chehebar and Martín (1989) (Fig. 3C). This general appearance matches the one of the hairs of *Lagidium viscacia* (mountain viscacha or *pillquín*) (Fig. 3B, D) and it differs from those of other mammals inhabiting the region, such as *Dolichotis patagonum* (Patagonian mara), with differences at a medullar level. The medulla of maras shows a sponge-like, reticular setting, with smaller and more randomly arranged air vesicles than in *L. viscacia*.

The second analyzed sample, which was inside the leather pouch, was taken from a lock of hair about 15 mm thick, and composed of highly preserved hairs 55 mm long. Hairs are dark brown, and their hue is



**Fig. 2.** Cueva Galpón site: (A) Excavation area; (B) Rock hand sample (rhyolite) (C) Diverse components of the very coarse sand, medium sand, fine sand and silt fractions; bones with different thermally altered stages; and vegetable matter.

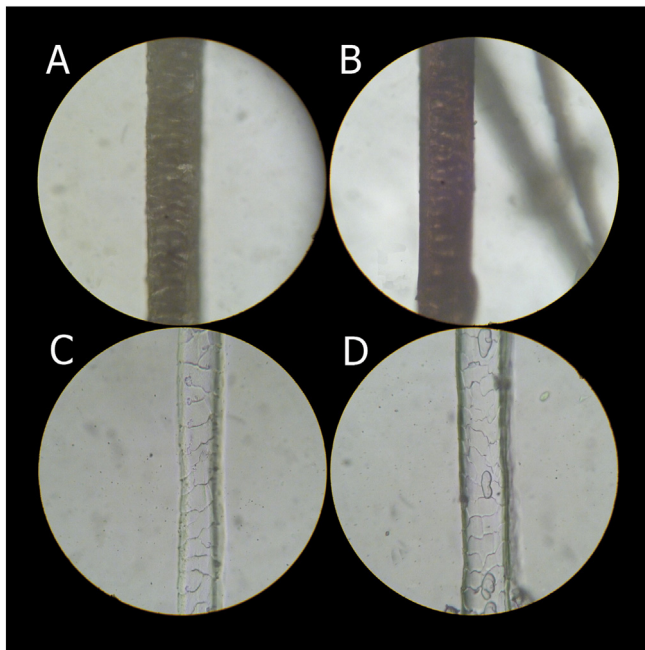


Fig. 3. Comparison of archaeological sample 1 and modern samples: (A) hair attached to the leather, (B) hair medulla of modern *Lagidium viscacia*, (C) scales of the hair attached to the leather, and (D) hair scales of modern *Lagidium viscacia*.

homogeneous throughout their length. The medulla occupies between half and one third of the hair width, and it shows several fragmentations. Air vesicles are small, randomly arranged, and with an amorphous appearance. This medullar pattern is referred to as sponge-like and reticular by Chehebar and Martín (1989) (Fig. 4A). Scales are similar to those of *L. viscacia*, but these are arranged more closely together and display a slightly dentate edge. According to the types proposed by Chehebar and Martín (1989), this pattern matches the one defined as “dentate mosaic” (Fig. 4C). On this basis, the analyzed sample displays strong affinities with *Homo sapiens* hair (Fig. 4B, D) and, to a lesser

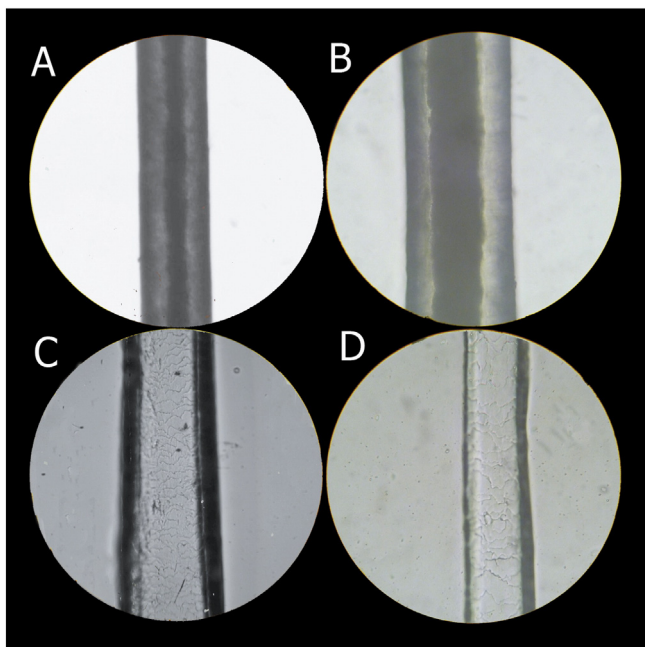


Fig. 4. Comparison of archaeological sample 2 and modern samples: (A) medulla of the hair found inside the leather pouch, (B) hair medulla of *Homo sapiens*, (C) scales of the hair found inside the leather pouch, and (D) hair scales of *Homo sapiens*.

extent, with that of introduced domestic cattle (*Bos taurus* and *Equus caballus*). The pattern is also similar to that of *Lama guanicoe*, but they differ in that the latter has a sponge-like, reticular medulla that covers almost the entire width of the hair, does not show fragmentation, and is divided into two longitudinal lines. Beyond the similarities described above, no affinities between the analyzed samples and hair from other native large- and medium-sized mammals, such as *Ozotoceros bezoarticus* (Pampas deer), *Puma concolor* (puma), *Lycalopex gymnocercus* (Pampas fox), have been recognized. Given the morphological features of the analyzed hair, and considering that the funerary ensemble where the sample comes from has an age of ca. 3100 years BP—when no species of cattle had yet been introduced—, we assume that the hair sample corresponds to *Homo sapiens*.

## 5. Discussion

Several factors can be identified as contributing to the preservation of hide, hair, and other nonperishable materials at the site, an uncommon occurrence in the regional archaeological record. Dry conditions are extreme in the rock shelter, which enhances the preservation of organic matter (Cameron et al., 2006). These conditions are generated by the arid local climate (with an average annual rainfall of 150–200 mm), as well as by the fact that there are no humidity sources inside the rock shelter, such as infiltration through the bedrock, or rainwater runoff/accumulation. Moreover, the temperature is cold in winter and cool in summer, which also promotes conditions for good preservation. Though temperatures can be as high as 40 °C outside in the summertime, the heat at the site is tempered because the sun's rays never reach the interior of the rock shelter, and also because it is surrounded by a large volume of rock.

The slightly acidic chemical conditions of the soil must have prevented the biodegradation of the archaeological materials. These conditions were inferred by the presence of a white powder-like material in the cavities of the rock fragments fallen from the roof, in the sediments, and also in the layer of guano. Through X-ray diffractometry, the mineral was identified as brushite ( $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$ ), a hydrated acid calcium phosphate. Brushite may be formed by the leaching of phosphate-rich solutions derived from guano (Rowe, 2010); these solutions may have chemically reacted with the calcium of the hydroxyapatite of bones and crystallized into brushite under conditions of slightly acidic pH (Dumitras et al., 2004). That is to say, that initially the presence of bat guano, which is rich in phosphates, and later of sheep guano may have led to the high preservation of soft tissue items in the site due to the acidification of the soil and the sealing of the sediments containing them.

Beyond the chemical conditions for the preservation of hair, we must now reverse the direction of reasoning and ask why the ignition affected some archaeological items and not others, such as the hair remains. The finding of berlinite—which is formed at the expense of brushite—in a sample of guano allows us to propose the occurrence of a spontaneous ignition process of the bat guano (see discussion in Martini, 1994). Owing to microbial processes, the temperature inside the guano deposit increased until spontaneous ignition led to its combustion, with the formation, among others, of a rare high-temperature aluminium phosphate, berlinite ( $\text{AlPO}_4$ ) (Martini, 1994; Onac and White, 2003; Onac et al., 2007). Consequently, we hypothesize that the erratic, irregular pattern of burning observed at the site is the result of multiple localized ignition points.

Based on the study of hair samples from Cueva Galpón, two main interpretations with several archaeological implications at both local and regional scales can be derived. First, in order to manufacture the leather pouch offered in the human burial at the site, makers used tanned leather of *Lagidium viscacia*, and second, the main or only content of the pouch was a lock of human hair.

Regarding the first point, archaeofaunal studies in continental Patagonia have traditionally focused on the exploitation of large-sized

mammals, mainly guanacos, which were the key resource for the economic organization of hunter-gatherers, and one of the main components of the archaeological record in the area. Smaller mammals (less than 3 kg) have been less relevant and visible in the archaeological debate, although in the last decade they have gained increasing significance (Fernández et al., 2011; Alcaráz, 2015). In the case of *L. viscacia*, most of the records from Patagonia suggest that it was not usually exploited by humans (Andrade et al., 2010), although it inhabited several outcrops in the area (Rowlands, 1974). The mountain viscacha is a Caviidae rodent inhabiting rugged, rocky mountainous country with sparse vegetation (Álvarez and Martínez, 2006). In northeastern Patagonia, it inhabits the Pailemán Hills and the Somuncurá Plateau (Redford and Eisenberg, 1992). The limited local evidence of human use of this species comes from Andean North Patagonia (El Trébol, Cueva Trafal 1, Valle Encantado 1, Cuyín Manzano, Cueva de Haichol and Alero Santo Rosario sites), most of them dated between the middle and early Holocene, when small-sized fauna may have been more relevant in hunter-gatherer economy than it was later (Andrade et al., 2010; Crivelli, 2010; Hajduk et al., 2008). Over the same period, but in central Chile, *Lagidium* was one of the most important components of human palaeo-diets (Labarca, 2005).

The evidence presented here suggests that *L. viscacia* was also exploited for its hide during the Late Holocene. As expected, the use of animal skins to manufacture clothing and tools by aboriginal people has often been reported by chroniclers and travelers in Patagonia (Prates, 2009; Vitores, 2015; Andrade and Boschín, 2015), and occasionally inferred from the archaeological record (see Ciampagna et al., 2006). Depending on both the type and functional characteristics of clothing, hide had specific requirements in terms of quality for tanning, strength, softness, plasticity and thickness. In general, large guanaco skins were used to manufacture large items, often subjected to intense use and exposed to adverse conditions and severe degradation, such as housing covers (*toldos*), large blankets, and even footwear. The skins of juvenile and unborn large mammals (i.e. guanacos), and also some anatomical parts of adult large mammal skins (e.g. hocks) were used to make finer clothing (Prates, 2009). Though references to the exploitation of small-sized mammal skins are unusual in the archaeological and historical literature of the area (see an exception in Quintana, 2005), observations made by chroniclers show that these were occasionally used for making “special” items (e.g. fine, soft and/or small clothing, and accessories); for example: skins of foxes, skunks (D’Orbigny, [1828–29] 1999:308), coypus (Pernetty, 1770; Aguerre, 2000:127), rhea chicks (*charos*) (Moyano, 1948: 130) and rodents (Andrade and Boschín, 2015; see a North American example in Lowie, 1909). Apart from the fact that *L. viscacia* could have had a special symbolic connotation among Patagonian indigenous people (Casamiquela, 1988:12), in this case the use of this type of hide seems to have also been associated with the requirements for making such a small piece; that is to say, appropriate qualities for tanning, plasticity, softness and thin thickness.

As regards the second point, the inclusion of a lock of human hair as an offering in a burial has some potentially relevant implications, although these are difficult to be tested and proven. In the study area, funerary offerings other than garments or accessories worn by the dead are not usually found, and much less hair, whose potential for preservation is certainly low. Though no archaeological information on this practice is known for Patagonia (see non-local examples in Valdesogo, 1999), transcultural data suggests that the act of offering hair to the dead has usually been considered as a means by which the symbolic presence of a mourner is incorporated into a grave. This is so because hair is a personal item that represents only and directly the individual to whom it belongs. Not only is the custom of including metonymic symbols for protection/company of the dead into graves very widespread among South American hunter-gatherers (Politis, 2007; Prates, 2014; Zilio, 2015), but also the offering of tufts of hair (cut at the moment of the funeral ritual by close mourners) as a sign of pain has

been observed among them during historic times. Therefore, hair may have been offered not only as a representation of a symbolic accompaniment of the dead to the afterlife, but also as a commemorative act and manifestation of sadness of a mourner during the funeral rite.

## 6. Final remarks

In this paper, the results of the analysis of two samples of hair from the Cueva Galpón site were presented. These samples were included in a grave as part of the funerary offerings of a human burial. Though hair and hide are unusual items in the archaeological record of the area, both macro- and micro-environmental conditions (extreme dryness, cool environment, sediment acidity, and soil sealing by guano) may have contributed to their preservation. By means of the analysis of hair samples, it was found that the hide used to manufacture the pouch corresponds to *Lagidium viscacia*, a small rodent, whose hide exploitation was unknown in Patagonia. Furthermore, the small pouch contained a lock of hair whose morphology is compatible with that of humans. It is possible that the practice of offering hair reflects the intention of both accompanying the dead to the afterlife and manifesting the pain of one of the closest mourners.

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