

Geoarchaeology of the Holocene slope processes in the cave of Torca l'Arroyu (Llanera, Asturias, Spain)

Geoarqueología de los procesos de vertiente holocenos en la cueva de Torca l'Arroyu (Llanera, Asturias, España)

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RESUMEN

Torca l'Arroyu fue descubierta durante la construcción de la nueva red de saneamiento de Llanera (Asturias, España). Es una pequeña cueva desarrollada en las calizas y margas del Cretácico superior rellena por sedimentos cuyo techo presenta una abertura tipo torca. El depósito tiene forma de cono cuyo vértice se encuentra bajo la torca y está formado por capas inclinadas depositadas a partir de los arrastres producidos en la ladera exterior. En estos niveles se recogieron materiales arqueológicos, restos óseos y fragmentos carbonosos. Para situar los depósitos en el tiempo se dataron mediante ¹⁴C dos muestras óseas y varios carbones. Las fechas ofrecidas por las muestras óseas del nivel inferior son: UBAR-803 4.930±70 BP y UBAR-804 4.240±60 BP; las obtenidas de los carbones son: nivel inferior, UBAR-745 3.190±150 BP, y nivel superior UBAR-746 2.050±120 BP. Las dataciones de los huesos asociados a materiales arqueológicos nos indican la existencia en la ladera exterior de un asentamiento humano holoceno, cuyos materiales fueron arrastrados por la ladera y depositados en la cueva en una fecha posterior, como consecuencia del desarrollo de un incendio, proceso este que se repitió años después como atestigua la fecha más reciente. Las fechas ¹⁴C fueron sometidas a calibración dendrocronológica y comparadas con las de otros yacimientos cantábricos de similar cronología.

Palabras clave: Geoarqueología, Procesos de vertiente, Karst, Radiocarbono, Tafonomía, Holoceno

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Introduction

Torca l'Arroyu is located in the centre of the province of Asturias (UTM: X=270.400, Y=4.810.797, Z=170), near Oviedo (village of La Ponte, parish of Cayés, Council of Llanera) (Fig. 1). Its discovery was fortuitous, since it appeared during the works of construction of the new net of sewer of Llanera municipality (December 2001). After its find, the construction company stopped the works and asked for the professional services of R.E.G to carry out the archaeological documents of the find. There were previous proceedings to obtain the excavation permit from the *Principado de Asturias*.

Geological setting

The cavity of Torca l'Arroyu is located in the W side of the mesozoical deformed materials of the Oviedo Trough in the mesotertiary basin of Asturias. They form the cover of the western extreme of the Central Area of Cantabric Range

(Barnolas and Pujalte, 2004). It is opened in the limestones and marls of the Cenomanian which is placed in agreement over the conglomerates, sands and clays of the Albian (Gervilla *et al.*, 1973). They appear a few metres below following the slope. At this point, the Cretaceous is tilted towards NE (N135°E 19°/22° NE). They form the western flank of syncline of Llanera in the NW extreme of the synclinorium of Oviedo-Infiesto. Geomorphologically, the area of Torca l'Arroyu belongs to the morphological division called Longitudinal Depression (Martínez, 1981), it is also called Prelitoral Trough or Intermediate Depression (Martín-Serrano, 1994), which agrees partially with the unit of relief of the Mesozoical-Tertiary cover (Farias and Marquinez, 1995), units of relief that belongs to the coastal-mesozoical cantabric border, which is located in the NE extreme of the Septentrional Hesperian Massif. In this area, the river Nora runs confined within the Cretaceous materials mentioned. It runs from E to W after running through the detritic materials

of the Tertiary of the Basin of Oviedo; then, the river gets into the Carboniferous limestones of the Naranco hill, more towards the W. The cave is located in the slope of the right side of the Nora river,



Fig. 1.- Geographical location of Torca l'Arroyu.

Fig. 1.- Situación geográfica de Torca l'Arroyu.

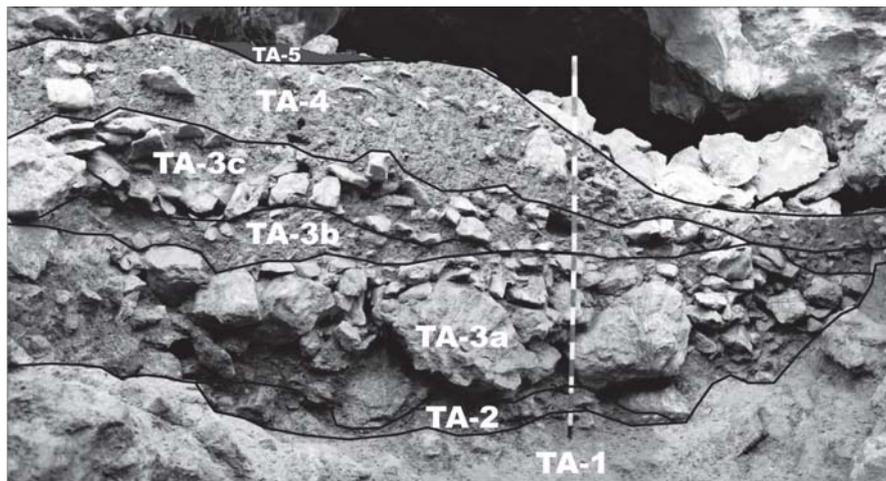


Fig. 2.- Stratigraphical scheme of Torca l'Arroyo.

Fig. 2.- Esquema estratigráfico de Torca l'Arroyo.

which runs among 140 and 150 m level. The slope ends up in a small plain belonging to the rests of a applanation surface subsequent to the Paleogene, because this surface links with the higher levels of the deposit of that chronology belonging to the Tertiary Basin of Oviedo, and, it is previous to the confinement of the Quaternary fluvial net.

The made gap cut a karstic cavity partially filled. It is expanded in an alternation of sandy limestones and marls where the first ones prevail. They appear into banks of tabular geometry of metric and high power. We do not have the cenital extreme of the cave. It was wiped out by the construction works on the slope where it was discovered. The access to the outside would be probably in the missing area. The opening would be blinded and would be a collapse sinkhole (*torca*) where the partial filling took place through a deposit formed by a cone of thick and thin detritic materials crowned by a speleotheme.

Lithostatigraphy

The different sections that can be seen in the gap have allowed to obtain a complete lithostatigraphic sequence from the deposit affected by the works. The base of the sequence lays on the limestones and marls mentioned, which are karstified with an irregular pre-depositional surface where a threshold area stands out. It is situated, approximately, in the vertical of the disappeared cenital entrance. This ledge determines the geometry of the deposit; so that two sediment areas can be distinguished. In one of them, the material transport shows a NE direction, and in the

other, a S direction. This one is worse controlled due to record disappearance. From bottom to top the sequence is composed of the following lithostratigraphic units (Fig. 2):

- ▶ TA-1: 40 visible cm of clays and yellow sandy marls with small stones of autochthonous limestone rounded by alteration, with a high content in carbonates, with irregular geometry, they fill the karstic palaeotopography of the cavity soil. Sterile.
- ▶ TA-2: 8-10 cm of dark brown clays with stones of autochthonous limestone rounded by alteration, they are very scanty and with a low content in carbonates. It contains scanty rests of mammals and gastropods together with fragments of carbonized organic matter. Its contact is net with the previous materials and its geometry is lenticular, it is getting lost toward the proximal extreme of the deposit. It presents a strong depositional inclination towards NE, it is shaped by the paleotopography of the cavity.
- ▶ TA-3. It is composed of three subunits or levels from wall to ceiling:
 - TA-3a: 60-100 cm (in the W profile) of clast-supported conglomerate formed by blocks and pebbles of autochthonous limestone. Its lower contact is net and its geometry is lenticular. It is getting thin towards the proximal extreme of the deposit, it shows a marked depositional dip towards NE. Two lithic polished tools, ceramic fragments and bone rests (sampled for ^{14}C) come from those deposits.
 - TA-3b: 30 cm (in N profile) of brown clays, very plastic, scanty carbonated, with lenticular geometry

and inclined arrangement similar to the previous level. They contain many fragments of carbonized organic matter (sampled for ^{14}C), some bone and gastropods rests.

- TA-3c: 30-40 cm of clast-supported conglomerate with scanty matrix, more plentiful at the base. It is formed by boulders and pebbles of autochthonous limestone, angular, which include fragments of speleothemes that have come off the ceiling of the cavity, and limestone plaquets. Both, towards the proximate extreme and towards the distant one, this subunit joints the TA-3a, so that the big clayish lentil remains in the centre. It contains rests of carbonized organic matter and bone rests.
- ▶ TA-4: 50-75 cm of very dark brown clays that are arranged parallelly to the previous subunit. It has a well marked limit due to the lithological difference; however, a discontinuity in the sediment process cannot be seen. This unit shows some internal arrangement outlined by two levels of black organic matter (sampled for ^{14}C) and by the arrangement of autochthonous limy plaquets. They are slightly overlapped parallelly to the depositional surface, which is configurated by some levels with a certain order. Both levels present a remarkable lateral continuity, so that they can be seen in the different cuts. Its depositional inclination is towards NE, the same that is outlined by the alignment of plaquets. They contain bone rests, gastropods and fragments of pottery.
- ▶ TA-5: 2-10 cm of stalagmit that embraces rounded pebbles and seals the whole detritic deposit that lays below; as a result, there is an inclined crust towards the inside of the cavity with direction N-NE on the surface. It contains gastropods and bones.

Radiocarbonic dates

In order to obtain numeric ages for the site of Torca l'Arroyo, we sent 5 samples of charcoal and bone material coming from two different archaeological levels, TA-3 and TA-4 to the Laboratory of ^{14}C Date of the University of Barcelona, finally, they got reduced to 4 samples (Fig. 2). Table I shows the source unit of the samples, the material, the code of laboratory, the date assignation results expressed in BP with its uncertainty belonging to once the usual

deviation of the radiometric measures. It also shows the results of the dates calibration according to CalPal 2005 SFCP curve (Weninger *et al.*, 2006). The probability intervals are indicated, whose sum is equal to 95,4% (calibration 2 S), expressed in calendaric years cal. BP.

Archaeological material

Inside the cavity, the only recuperated lithic materials (unit TA-3a) are two polished pieces of a small size (69,53x19,79x16,30 mm and 62,07x18,94x16,02 mm) made out of amphibolite. Both pieces present the usual characteristics of the chisels (Eiroa *et al.*, 1999). The pottery of Torca l'Arroyo form a small collection that is composed of an amount of 68 fragments. All of them are handmade, 61 of them were recuperated in the unit TA-3 (2 decorated and 2 carenated), 5 fragments, in the unit TA-4, and 2 fragments, in the mixture of the gap. Besides, in the surface of the hillside knapped lithics tools of varied typology were gathered.

The malacological rests are scanty and come from subunit TA-3a and subunit TA-4. This group is only composed of gastropods. A specimen of *Patella vulgata* (Linné, 1758), recuperated in TA-3a, stands out. The rest of the group belongs to three different kinds of continental gastropods.

The zooarchaeological analysis of the macromammals shows the following spectrum of species: *Bos taurus*, *Ovis aries/Capra hircus* among the domesticated ones, and *Sus scropha*, *Orientalagus cuniculus*, *Cervus elaphus*, *Ursus arctos* and *Vulpes vulpes* among the wild ones. The lot of bones is composed of 203 rests; the ones of unit TA-3 stand out among them because they are the more numerous group (Table II). Compared to unit TA-3, unit TA-4 is no representative; it can be stood out the lack of animals of big size and the presence of rests of some kind of ovicaprid. The bones of Torca l'Arroyo presents a very well preserved fauna. The taphonomic information indicates that the different animals of units TA-3 and TA-4 were processed by the human being (except the fox). Despite we can explain the represented fauna and its consequences to the human being, the existence of other alterations indicates that we face a group slanted by different processes. The presence of rolled and polished bones in unit TA-3 evidences that we are before a bone group moved by hydric transport. In the same way, the

Units	TA-3		TA-4		Surface		MNI TA-3	MNI TA-4	MNI Surface
	NR	%	NR	%	NR	%	Ad/Juv/Inf	Ad/Juv/Inf	Ad/Juv/Inf
<i>B. taurus</i>	22	12.3			2	22.2	1/1/0		1/0/0
Big	51	32.9			1	11.1			
<i>C. elaphus</i>			1	4.5				1/0/0	
Average	2	1.3	1	4.5					
<i>S. scropha</i>	50	32.3					1/0/2	1/0/0	
Ovicaprid indet.	1		5	22.7				1/0/0	
Small	22	14.2	11	50	4	44.4			
<i>U. arctos</i>	1	0.6					1/0/0		
<i>V. vulpes</i>		0.0	4	18.2				1/0/0	
<i>O. cuniculus</i>					2	22.2			1/0/0
Indet.	24	6.5							
Total	173		22		9		3/1/2	4/0/0	2/0/0

Table I.- Torca l'Arroyo. Calibrated radiocarbonic dates.

Tabla I.- Torca l'Arroyo. Dataciones radiocarbónicas calibradas.

scavenger action of carnivores suggests that they acted on the bone sample slanting it. Therefore, we can think that these two agents could slant the bone sample and, at the same time, they can be also the main responsible ones of the high trampling that the bone rests show.

Geoarchaeological interpretation

Considering the information exposed before, the first to be distinguished, on studying the sediment filling of Torca l'Arroyo, is that although it is a site located in a secondary position, it contains a very interesting geoarchaeological information that we will try to decode along this work. The hypothetical geodynamic model that we lay out considers the previous existence of an open air site located in the slope where the sinkhole opens. It is in a topographic position superior to the sinkhole. In this way, the slope and the small hill where the slope ends up offer excellent conditions for the human habitat, with a S orientation and with a good sight control over the near fluvial bed of the Nora river. The chronology of this occupation of surface is marked by the date UBAR-803 4.930±70 BP (5.850-

5.530 cal. BP) (Fig. 3), obtained from bone rests of an only specimen of *B. taurus*. The length of this occupation would be defined by the date obtained from a sample that contains several bones, UBAR-804 4.240±60 BP (4.940-4.580 cal. BP) (Fig. 3), so that its result would be the mean of its different ages. If we sum the probabilities of both dates, the period of validity for the settlement would be in the interval 5.860-4.610 cal. BP, whose considered duration is 1.250 years, in the low part of the Subboreal (Middle Holocene) (Ravazzi, 2003). This long duration of the inhabitation of the slope settlement together with the presence of ceramic materials that seem to belong to two different moments would be showing us the existence of two moments of inhabitation: one of them would belong to the Neolithic, associated to the date UBAR-803, which the decorated ceramics would come from, and the other one, to the Copper Age, associated to the date UBAR-804, the carenated ceramics belong to it. The first moment would be related to the Neolithic levels of some other near sites such as the A2 level of the Mazaculos Cave (La Franca, Asturias) (González-Morales, 1995) whose date is

Unit	Material	Lab. Code	¹⁴ C dates BP	2 σ calibrated dates cal. BP (0 = AD1950)
TA-4	Charcoals	UBAR-746	2050 ± 120	2340 – 1740 cal. BP
TA-3b	Charcoals	UBAR-745	3190 ± 150	3790 – 3030 cal. BP
TA-3a	Bones indet.	UBAR-804	4240 ± 60	4940 – 4580 cal. BP
TA-3a	Bones of <i>Bos taurus</i>	UBAR-803	4930 ± 70	5850 – 5530 cal. BP

Table II.- Torca l'Arroyo. Taxonomic profiles according to NR and MNI (NR: number of remains; MNI: minimal number of individuals; Ad: adult; Juv: juvenile; Inf: infantile).

Tabla II.- Torca l'Arroyo. Perfiles taxonómicos a partir de NR y MNI (NR: número de restos; MNI: mínimo número de individuos; Ad: adulto; Juv: juvenil; Inf: infantil).

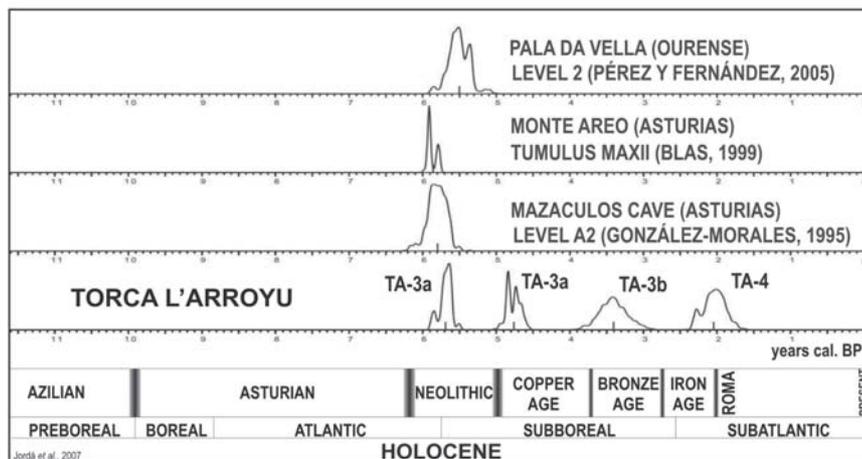


Fig. 3.- Calibrated ^{14}C dates (CalPal 2005 SFCP curve, Weninger *et al.*, 2006), regional parallels and chronology.

Fig. 3.- Calibración de las fechas ^{14}C (CalPal 2005 SFCP curve, Weninger *et al.*, 2006), paralelos regionales y cronología.

GAK-15221 5.050 ± 120 BP (6.040-5.560 cal. BP), the level 2 of Pala da Vella (Rubiá, Ourense) (Pérez y Fernández, 2005) whose date is GrN-19395 4.790 ± 120 BP (5780 - 5220 cal. BP) or the tumulus MAXII of Monte Areo (Carreño, Asturias) (Blas, 1999) whose date is CSIC-1380 5.133 ± 30 BP (6.000-5.720 cal. BP) (Fig. 3).

Inside the cavity, the sequence begins with some materials which are produced by the rock alteration of the substratum (unit TA-1). They fill in the existing palaeotopography in the cavity ground and probably, were placed in a time when the cavity was without outside communication. The sequence continues when the connection of the cave with the outside is made through a small collapse sinkhole which contains external materials. After leaving the settlement of the slope, some of its rests and the thin geologic materials from the surface went through processes linked to a dynamic of gravity-slope with hydric influence due to rainfalls of some intensity. This produced clay layers, which are the source of TA-2.

Later, there was a fire in the slope and the vegetation was wiped out. As a consequence, the archaeological rests that were still there and the surface geological materials went through a new sediment cycle by processes of gravity-slope with hydric influence, which are the source of the clay layers with pebbles and blocks that ended up in subunit TA-3a, whose inside contains a lot of archaeological materials (bone and ceramic rests, polished tools) and clear signs of hydric transport. The presence of big angular

blocks of autochthonous limestone in the low part of TA-3a evidences that in those moments, there were collapses in the opening of the *torca*, which enlarged its original size. The sediment process of gravity-slope continues with the clay layer of subunit TA-3b dated in the interval 3.790-3.030 cal. BP, in the top of the Subboreal (Middle Holocene) (Ravazzi, 2003), which has scanty lateral extension in the sediment cone, and with the clay layer with stones and blocks of subunit TA-3c, which superimposes on subunit TA-3a towards the distal areas of the cone. Both, TA-3b and TA-3c contain scattered and scanty archaeological rests, which evidences that the rests of the settlement of the slope surface were practically dismantled.

Later, the slope where the settlement was located went through another fire which wiped out its vegetal cover; besides, new episodes of dragging by gravity-slope processes took place and led to the sediment process of unit TA-4 dated in the interval 2.340-1.740 cal. BP, in the low part of Subatlantic (Late Holocene) (Ravazzi, 2003), where two levels of well stratified ashes and charcoals can be seen in the clay sediments. Later, during a wet epoch with mild temperatures of some duration, the precipitation of the carbonate took place. It formed the espeleotheme which sealed the deposits of the sinkhole. The precipitation continued over it, and stalagmites and stalactites were produced; in some cases they have formed small columns.

Finally and with posteriority to the formation of the culminating espeleotheme, slope processes of certain intensity

produced draggings in the hillside that they led to the closing of the *torca*, and therefore of the cavity, by means of an accumulation of big limy blocks that closed the opening. This one, with the passage of time and the agricultural practices developed in the hillside, remained masked, demonstrating only for a light depression in the hillside, you upset perceptibly, until, the works of the new net of sewer of Llanera, in December 2001, did that the cavity and its landfill were going out to the light.

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