Geodinamica Acta 20/4 (2007) 209-217

Geodinamica Acta

The wild river and the last Neanderthals: a palaeoflood in the geoarchaeological record of the Jarama Canyon (Central Range, Guadalajara province, Spain)

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Received: 03/01/06, accepted: 11/09/06

Abstract

The Upper Jarama Valley is located on the southern slope of the eastern part of the Spanish Central Range. In this area the valley cuts and runs through a narrow strip of carbonated rocks creating a karstic canyon with many caves and rock shelters in the cliffs at both banks. One of this rock shelters, Jarama VI, is located on the left bank of the Jarama River, in the middle of a hillside, 23 m above the river, and is partially filled up. The lithostratigraphic sequence begins with the, stratum alteration (unit 4), and a cold autochthonous clastic deposit follows it with a human occupation of the Middle Paleolithic (unit 3). The upper part of the unit 3 was affected by a strong erosion due to a huge palaeoflood, which caused the sedimentation of a sandy series (sub-unit 2.3) that ends in flood silts (sub-unit 2.2). Charcoals have yielded the ^{14}C date 32.600 ± 1.860 BP (Beta-56639). These deposits have their origin in a fluvial palaeosuperflood. At the top part of this level and inside the rock shelter there are clastic intercalations (sub-unitl 2.1) with plenty of Mousterian artefacts radiocarbon dated to 29500 ± 2700 BP (Beta-56638). A stratigraphic hiatus separates units 2 and 1. Unit 1 is a cold autochthonous clastic deposit containing many human occupation remains of the Early Upper Paleolithic age. The sequence is sealed by a stalagmitic crust (unit 0). The ^{14}C dates from Jarama VI seriate the palaeoflood in the chronostratigraphic scale. Therefore, both dates 32600 ± 1860 BP (Beta-56639) and 29500 ± 2700 BP (Beta-56638) date the upper part of level 2 somewhere in the Late Upper Pleistocene, between the isotopic stages 3 and 2.

Keywords: karstic canyon, rockshelter, palaeoflood, Late Upper Pleistocene, last Neanderthals.

1. Studied area: a karstic canyon situated south of the Spanish Central Range

The studied segment of the Upper Jarama Valley is located on the north-western edge of the Guadalajara province (Castilla–La Mancha, Spain) (Fig. 1), and more specifically in the municipality of Valdesotos. From a geographic point of view, this area is situated on the southern slope of the eastern end of the Spanish Central Range, and corresponds to a sector of the Jarama valley that is limited to the N by the Somosierra and Ayllón mountains, whereas by the S it is opened towards the basin of the Tajo river.

Geologically the Upper Jarama Valley is on the southern edge of the Iberian Massif, a mountainous chain generated by the Variscan orogenesis, devastated during the Mesozoic and rejuvenated by the action of the Alpine orogenesis, which formed the Spanish Central Range. The Central Range, constituted of igneous and metamorphic rocks, are

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doi:10.3166/ga.20.209-217

flanked to the N and S faces by detritic and calcareous deposits of the Upper Cretaceous discordants on the rocks of the massif. These rocks were folded and tilted during the Alpine orogenesis. On the southern edge of the Central Range the cretacic carbonated rocks are arranged in successive segments from the SW end up to the NE, forming a series of structural reliefs of monocline type, that in addition are karstifed. Towards the SE and discordant on both groups of materials, are the detritic and chemical sediments that refill the Tajo Basin, a closed depression of continental character refilled during the Tertiary. Therefore, the Jarama Valley region is limited to the north by the mountainous chains of Somosierra and Sierra de Ayllón, whereas to the south, the limits are represented by the Tertiary tabular forms of the Tajo Basin.

Fig. 1: Geographical location of Upper Jarama Valley.

In this area the Upper Jarama Valley cuts and runs through a narrow strip of dolomite, dolomitic limestone and limestone (Santonian, Upper Cretaceous) which is tilted towards the SW [1] and affected by a strong karstification. This karstic system is spanned by the Jarama River, creating a karstic canyon with many caves and rock shelters in the cliffs of both banks (Fig. 2), which are the proof of the different stages of the karstic development and the narrowness of the river (Plate 1, photo 1). Some of these caves have Quaternary stratigraphic deposits [2, 3, 4] such as Jarama VI (Plate 1, photo 2). Discordant above the cretacic limestone appear the Tertiary detritic deposits made by alluvial fans in an early stage previous to the location and confining of the Jarama River.

2. Jarama VI: a human-occupied rock shelter

Jarama VI rock shelter is located on the E bank of the Jarama River (Plate 1, photo 2), in the middle of a hillside, 23 m above the river, 822 m above the sea level (Fig. 2). Its opening is west oriented, being partially filled up (Plate 1, photo 3). The archaeological excavation yielded a lithostratigraphic sequence (Fig. 2; Plate 1, photo 4), which spans from the substratum limestone, fractured and altered (Plate 2, photo 1). The sequence presents the following stratigraphic units (from bottom to top) [4]:

• Unit 4 (10-15 cm). Carbonated sands from white to beige colour, fine to medium grain, with red clay forming centimetrical nodules. Its geometry is cuneiform and is a by-product of the rock substratum modification. They did not yield any archaeological nor palaeontological remains.

• Unit 3 (5-60 cm) (Plate 2, photo 2). Grey, brown and red-brown sands and conglomerates formed by shale gravels and quartzite and shale pebbles and also angular blocks and pebbles of autochthonous limestone. They are not cemented but have a matrix of clay, which gives them some cohesion. Inside, the materials have a parallel disposition between them and the depositional surface is erosive. Their geometry is tabular and shows an outstanding depositional leaning to the external area of the shelter. Its origin is related to cryoclastic processes from a cave ceiling which had been reworked later by the river water on the rock shelter's outmost area, also incorporating fluvial clasts. There is a Mousterian lithic industry (Middle Paleolithic), as well as bone remains from macromammals (*Bos*/*Bison* sp., *Rupicapra rupicapra, Cervus elaphus, Equus caballus* and Rhinocerotidae indet.) and micromammals (*Microtus* sp., Rodentia indet.).

• Unit 2 (10-160 cm) (Plate 2, photo 3). Sands and silts alternation. Sands are grey-coloured, fine to medium grain, well calibrated and washed, quartz, mica, shale and feldspar. The quartzitic silts have brownish tones. Both sediments appear without any cementation, although silts are more compact, while sands disintegrate more easily. Many sinsedimentary and postdepositional structures of a great quality are observed, as parallel laminations, planar and furrowed crossed laminations, stream ripples, fluid escape structures, convolute lamination, roots traces, animal galleries, etc. This unit presents a cuneiform geometry. These sandy facies correspond to overflowing deposits containing many sedimentary structures (sub-unit 2.3), detecting also archaeological materials coming from Unit 1, and originated

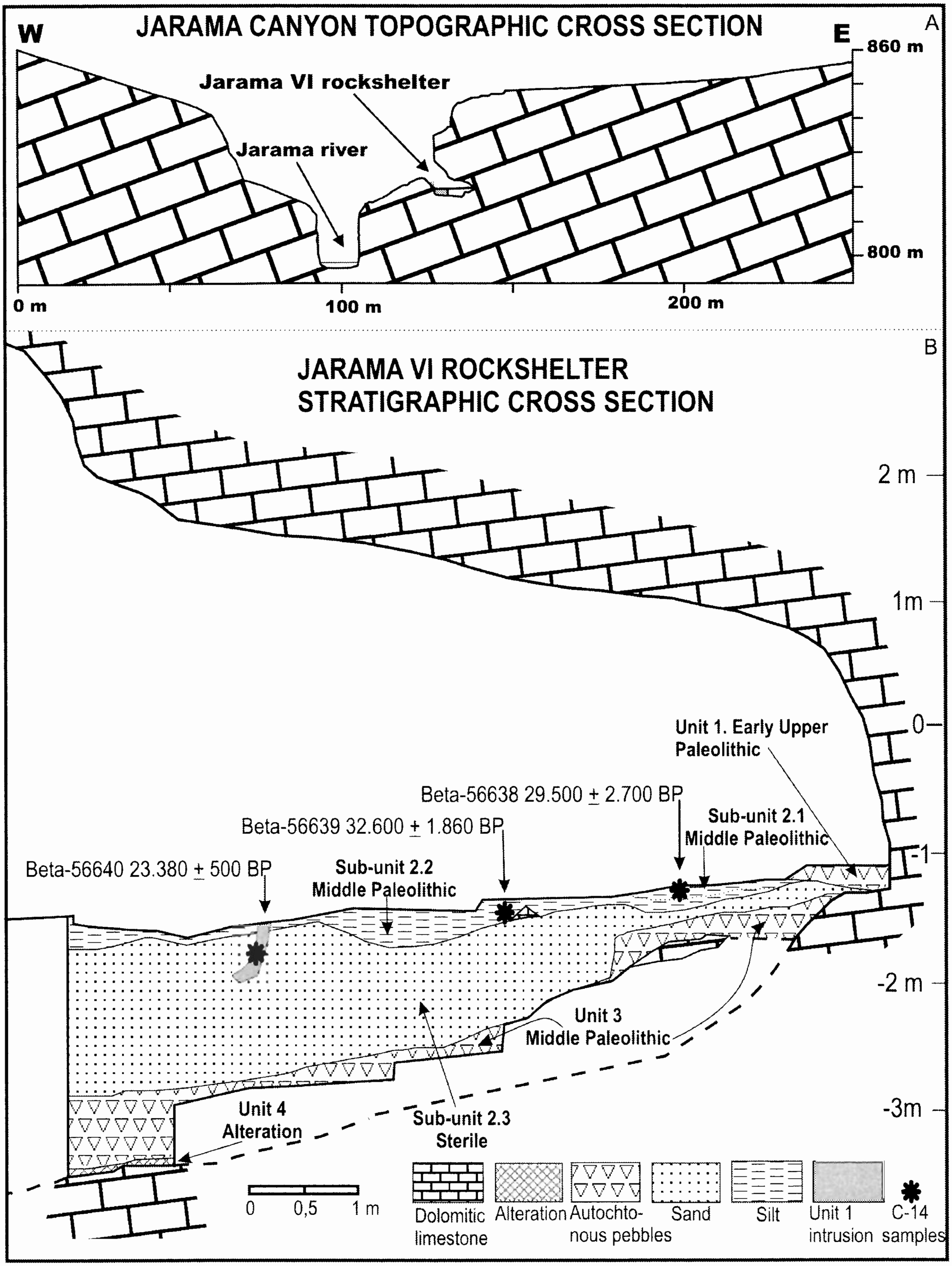

Fig. 2. A: Topographic profile of the Jarama canyon. B: Schematic cross-section of the Jarama VI stratigraphic record.

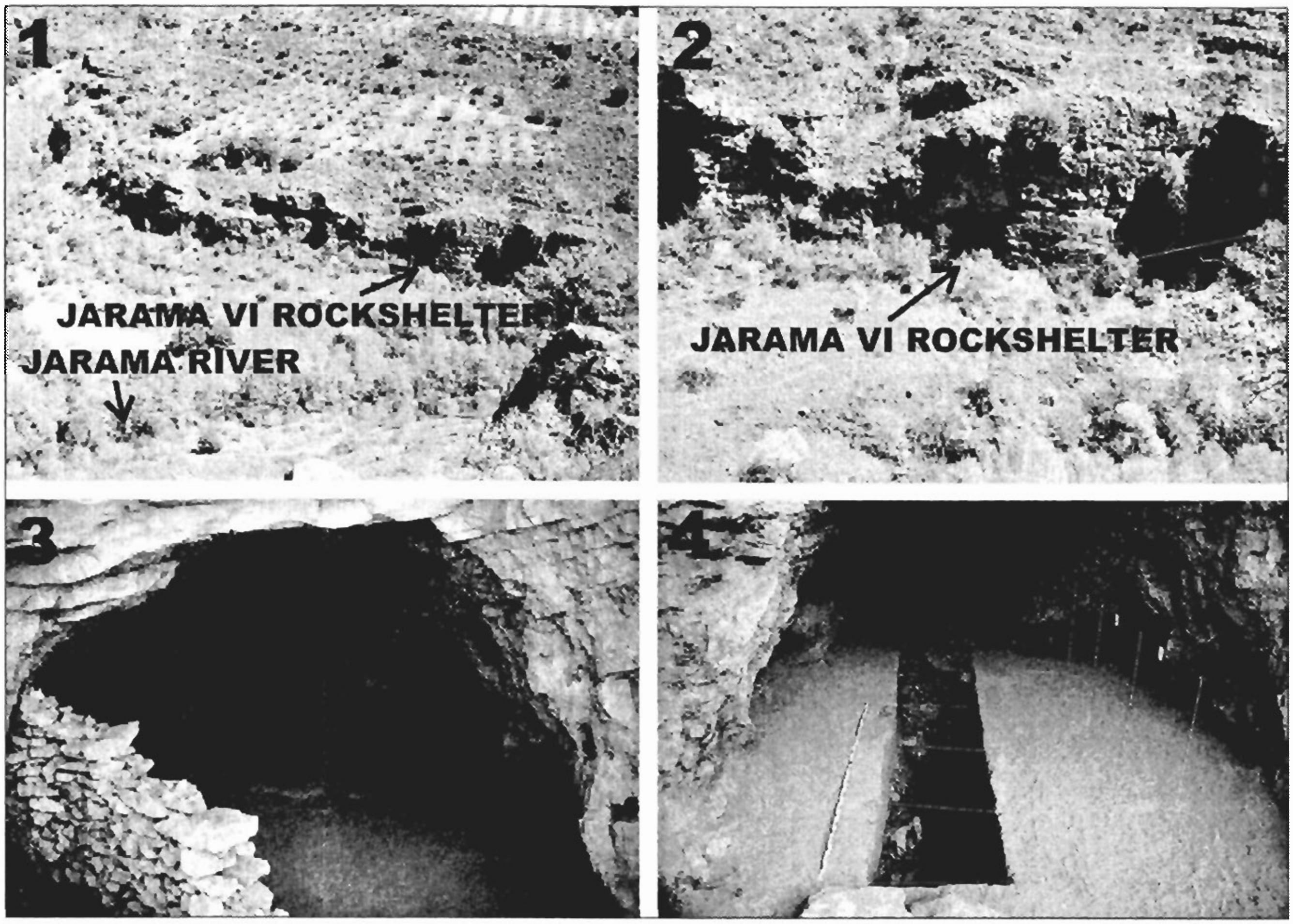

Plate 1. Photo 1: The canyon of the Jarama with the rock shelter of Jarama VI; **Photo 2:** The rock shelter of Jarama VI in the E shore of the canyon of the Jarama; **Photo 3:** The rock shelter of Jarama VI before excavations (1989); **Photo 4:** The rock shelter of Jarama VI after the last year of excavation (1993).

on the postsedimentary biological activity. On the upper part of the stratum silt materials (sub-unit 2.2.) derived from the flood plain, there are bone remains and Mousterian (Middle Paleolithic) lithic industry scattered, and occasionally are disposed in a concentrated way around a small combustion structure, showed through the charcoal concentration and the silt sediment rubefaction that supports them (Plate 2, photo 4). Charcoals have yielded the date Beta-56639. Intrusions of archaeological materials are also detected in the sand levels produced by the postsedimentary biological activity. These typically fluvial deposits, where overflowing and flood plain facies are detected, have their origin in a fluvial super-flood. At the top part of this level and inside the rock shelter there are clastic intercalations (sub-unit 2.1) and plenty of Mousterian lithic artefacts (Middle Paleolithic) with a radiocarbon date (Beta-56638). The faunal remains from level 2 are represented by macromammals (*R. rupicapra, C. elaphus*), micromammals (*Pliomys* cf. *lenki*, *Microtus arvalis-agrestis* group, *Apodemus* sp., cf. *Oryctolagus cuniculus* y Rodentia indet), birds (*Alectoris rufa, Pica pica* and *Pyrrhocorax graculus*), amphibious (*Pelobates cultripes*) and Pisces indet.

• Unit 1 (20-50 cm) (Plate 2, photo 5). Reddish sands with fine to medium grain and quartz, mica and feldspar silts, which contain angular autochthonous limestone pebbles with their edges corroded by dissolution. They also contain shale gravels with planar morphology. On the base there are quartzite, shale and quartz fluvial pebbles brought by human action. The clay matrix is scarce and locally a carbonated cementation is apparent. Its shape is massive, although slight laminations marked by planar clasts can sometimes be noted. Its geometry is irregular and its lower limit is erosive. The origin of the clasts of this unit is related to cryoclastic processes in the frame of a cold and dry climate. This level contains a huge accumulation of archaeological lithic artefacts from the Early Upper Paleolithic, as well as bone remains of macrommals (*Bos/Bison* sp., *R. rupicapra, C. elaphus, E. caballus*, Rhinocerontidae indet. and Canidae indet.), micromammals (Soricidae indet., *Microtus arvalis-agrestis* group, *Allocricetus bursae, Sciurus vulgaris*, cf. *O. Cuniculus* and Rodentia indet.), birds (*A. rufa, Coturnix coturnix, Columba livia/oenas, Bubo bubo, Falco* sp., *P. pica, P. pyrrocorax, P. graculus, Corvus corone* and Corvidae indet.), reptiles (*Lacerta lepida*), and anphibious (*Bufo bufo*). A material intrusion from this level in level 2 has provided the radiocarbon date Beta-56640 obtained through charcoal.

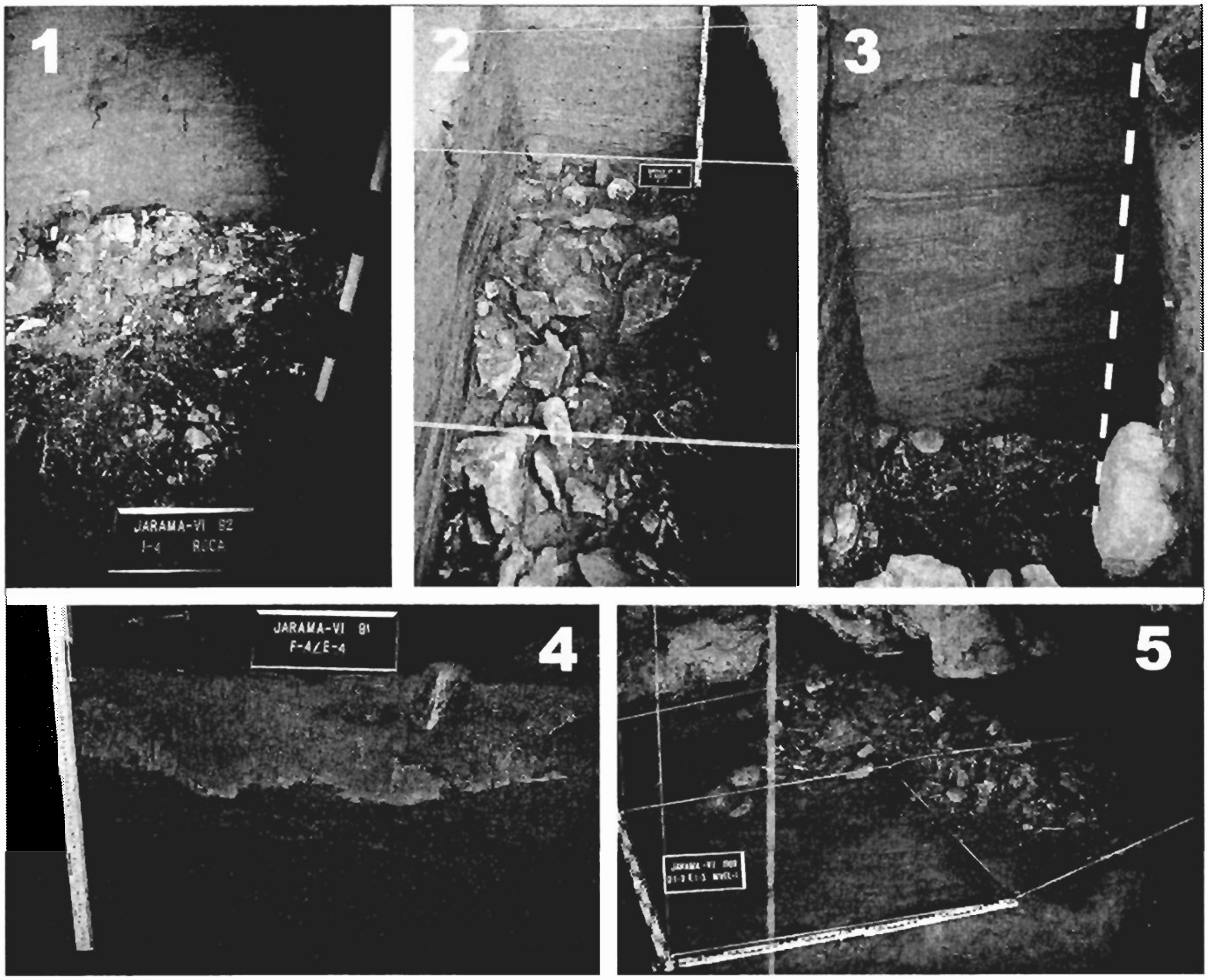

Plate 2. Photo 1: Section of the unit 3, showing the contacts with the substratum limestones and with the level 2; **Photo 2:** Superficial view of the autochthonous clasts generated for cryoclastic processes and the archaeological remains of the unit 3. The autochtonous clasts are generated for cryoclastic processes; **Photo 3:** Stratipgraphic section of unit 2 (fluvial sands and silts); **Photo 4:** Detail of the unit 2, showing the contact between the sub-units 2.1 and 2.2; **Photo 5:** Superficial view of the remains of the unit 1 inside the shelter. The autochthonous clasts are generated for cryoclastic processes.

• Unit 0. Breccia and stalagmitic crust grey or white coloured. Its origin is linked to the chemical precipitation of calcium carbonate in a temperate-warm and slightly moist environment.

3. The time recorded in Jarama VI and the last Neanderthals of Iberian peninsula

In order to get an isotopic chronology for the different levels of the site, a radiocarbon (^{14}C) dates series was accomplished. For this reason two series of samples of different origin were sent to the Beta Analytic Inc. Laboratory in Miami (Florida, USA) in 1992 and 1993. The first consists of three samples of charcoal remains from unit 2 and the second series consists of bone remains from units 1 and 3, both to be dated through conventional radiocarbon system. The results (Table 1) have been positive for the charcoal samples from unit 2, while, unfortunately, the bone remains from units 1 and 3 have not produced any chronological data. According to the laboratory report, it was due to the lack of collagen in the chosen bones, so it was not possible to extract it for the subsequent ^{14}C date.

In a first approach, the radiocarbon dates from Jarama VI locate the site in the chronostratigraphic scale (Fig. 3). Therefore, both dates 32600 ± 1860 BP (Beta-56639) and 29500 ± 2700 BP (Beta-56638) let placed the upper part of unit 2 somewhere on the Later Upper Pleistocene, between the isotopic stages 3 and 2. While the 23380 ± 500 BP (Beta-56640) would place unit 1 in the middle of the isotopic stage 2 [5]. According to sample Beta-56638, its location inside unit 2 indicates accurately the limits of its upper part. The wide scope of the sample makes an overlap with the former, Beta-56639, whose typical deviation is also wide, and thus the samples from which they come can likely be considered as belonging to the same moment.

Both the earlier dates, 32600 ± 1860 BP (Beta-56639) and 29500 ± 2700 BP (Beta-56638), (Fig. 2) are associated with Middle Paleolithic stone industries made up by neanderthals and they open new perspectives for studying this period in the central part of the Iberian Peninsula. In fact, Jarama VI unit 2 is some 8000 years younger than the highest Mousterian level from Abric Romaní (Barcelona province) dated through Uranium series (Fig. 3) [6]. Likewise, this date is 6.000 years earlier than AMS ^{14}C dates obtained on the aurignacian levels from l'Arbreda (Gerona province) [7] and El Castillo (Cantabria province) [8] (Fig. 3). Likewise the former sample, this one comes from a Middle Paleolithic stone industries context, allowing a long term lasting of these industries around 30 ka in this part of the Spanish central plateau. The dates agree with those from Zafarraya (Málaga province), situated between 32-29 ka [9] (Fig. 3). In such a context, Jarama VI dates establish the long-term duration of the Middle Paleolithic of the Iberian Peninsula (Fig. 3), a fact already suggested over the last years by some scientists [10, 11, 12, 13]. Another evidence for the Middle Paleolithic settlement in the area is found on several sites from the Guadalajara province. Some of them even have neanderthalians palaeoanthropological remains, as in Los Casares cave [14, 15] and Los Torrejones cave, although in the latter the remains are ascribed to *Homo* cf. *neanderthalensis* [16].

The third date (Fig. 2) poses some interpretation problems. Until now, the unit 1 had been allocated to the Middle Paleolithic [4], but the nature of their technological remains, made mainly on quartz and rock crystal, makes difficult such an identification. There are in addition some elements quite similar to those from the Upper Paleolithic, like the little steep retouched pieces, for instance. Therefore, waiting to accomplish the techno-typological study, this date could be considered as the result of an intrusion of the sediments and charcoal from unit 1, which could be dated somewhere at the beginning of the Upper Paleolithic. This Upper Paleolithic identification should not be surprising in the area, since human activity from this period has been found in the near sites of Jarama I [17]. Those are: Jarama II (Valdesotos)[18], Los Torrejones cave, Enebralejos rockshelter (Tamajón) [16, 19], Los Casares cave (Riba de Saelices) [20, 21] and La Hoz cave (Santa María del Espino) [20, 21, 22]. All of these sites are in the Guadalajara province. In a wider context, this date can be correlated with that from N.V.12-B level from Nerja Cave (Málaga province), 23400 ± 2300 BP (UBAR-342) [23], corresponding to one of the base levels of the cave's access, where stone industries have been found, ascribed to the Early Upper Paleolithic (Fig. 3).

Table 1 : Jarama VI radiocarbonic dates

Stratigraphic units	Material	Reference	Radiocarbonic date
1	Bone	insufficient collagen	
1 (indirect)	Charcoal	Beta-56640	23.380 ± 500 B.P.
2.1	Charcoal	Beta-56638	29.500 ± 2.700 B.P.
2.2	Charcoal	Beta-56639	32.600 ± 1.860 B.P.
3	Bone	insufficient collagen	

4. A palaeoflood in the stratigraphic record of Jarama VI

The characteristics of the deposits of Jarama VI can be interpreted in sedimentological and palaeoclimatic terms. The Jarama VI sedimentary sequence begins with an unproductive level originated on the stratum alteration. A cold autochthonous clastic deposit (Plate 2, photo 2) follows it with a human occupation clearly dated in the Middle Paleolithic (unit 3) that has not been possible to establish through the ^{14}C method. The upper part of the level was affected by a great erosive period due to a huge palaeoflood, which caused the sedimentation of unit 2 (Plate 2, photo 3). It has been mentioned that a radiocarbon date from bone remains obtained on unit 3 was not successful, because of the lack of collagen in the samples. But this fact was significant from a taphonomic point of view related to the origin of the level. It shows an important sub-aerial materials alteration associated to long open air exposure before burying.

On this erosive surface of the top of the unit 3 there's an important sedimentary fluvial sequence which thickness diminishes towards the interior of the cavity. This deposition was due to a palaeoflood of great magnitude. These sediments begin with a sandy series (sub-unit 2.3) (Plate 2, photo 3) characterized by the abundance of sedimentary structures, which corresponds to a facies of overflow in a sedimentation out of channel. The sandy series (sub-unit 2.3) ends with a level of silts (sub-unit 2.2) (Plate 2, photo 4), a facies of flood plain, with predominance of the sedimentation by decantation. On these silts, once the water withdrew, occasional Middle Paleolithic human occupations took place. These occupations are dated between 32600 ± 1860 BP (Beta-56639), which shows the flood ending, and 29500 ± 2700 BP (Beta-56638), corresponding to a cryoclastic sedimentation inserted on the upper part of the silts (sub-unit 2.1).

There is a stratigraphic hiatus due to erosion processes that separates units 2 and 1. Unit 1 has a cold autochthonous clastic nature containing many human occupation remains from Early Upper Paleolithic age (Plate 2, photo 5). Although these remains could not be directly dated. They could be dated using radiocarbon method through an indirect way, admitting the date of 23380 ± 500 BP (Beta-56640) for this unit. A radiocarbon date from bone remains obtained on level 1 was unproductive, because of the lack of collagen on the samples. This fact shows an important sub-aerial materials alteration associated to long open air exposure before burying.

Like in other sites of the area, such as Jarama I and Jarama II [4, 17], the sequence is sealed by a stalagmitic crust which today has almost disappeared. Behind the development of the stalagmitic crust that seals the Pleistocene record mentioned,

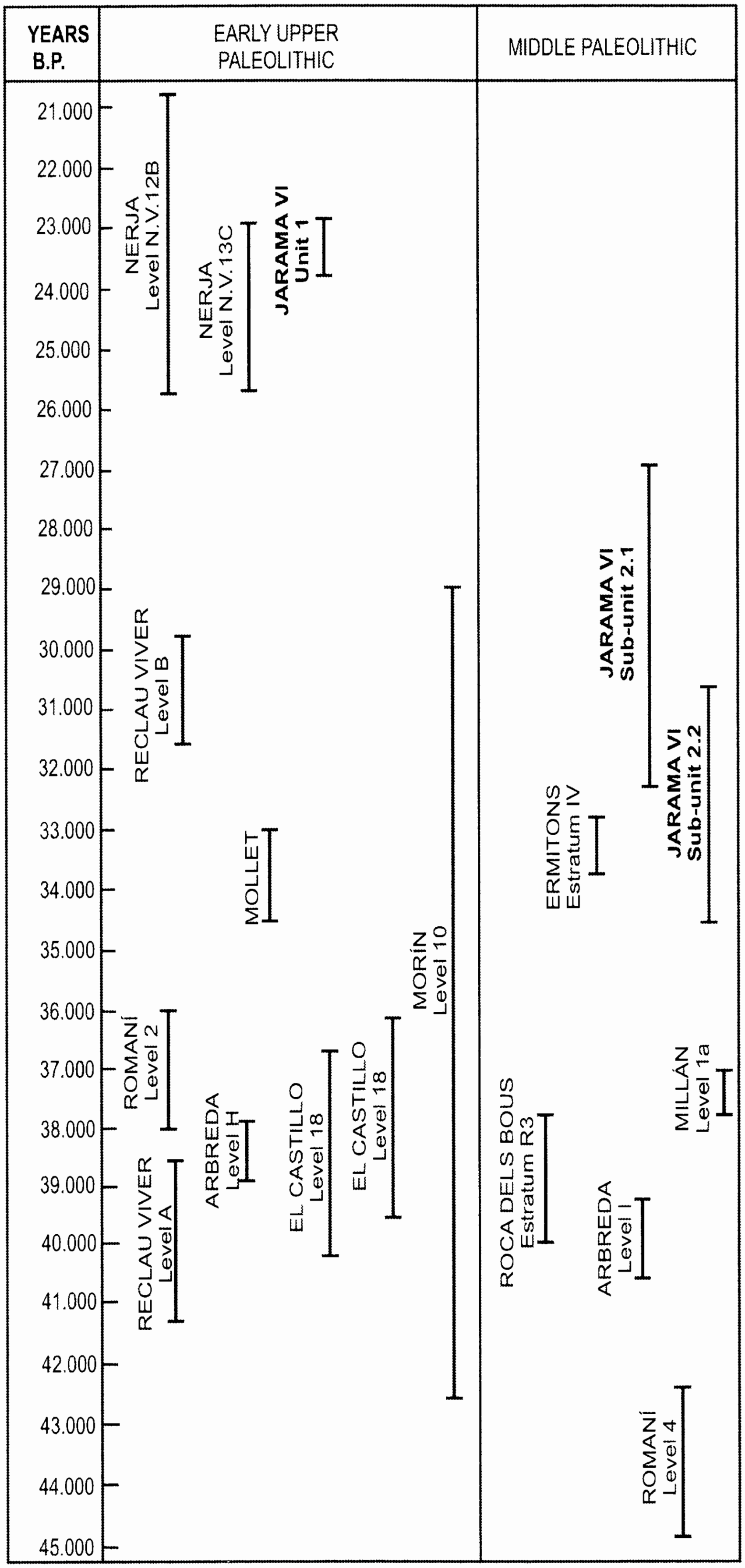

Fig. 3: Jarama VI radiocarbonic dates and other dates for Spanish Later Upper Pleistocene sites.

a strong erosion has destroyed the sequence disappearing almost all unit 1, whose remains are observed only on well preserved areas of rock shelter. This problem also affected the silts located at the upper part of level 2, which are not found on the outer part of the shelter. Although no other stratigraphic level with the original position has been detected, it has been possible to recover archaeological remains of a human occupation during pre-Beaker Copper Age. So, the Jarama VI record could be stretched to the Middle Holocene (4500 / 4000 BP) with a clear correlation with near sites on both sides of the Central Range, as the near cave of Jarama II.

In order to explain the reasons of the palaeoflood detected in the unit 2, we can give two hypotheses:

- The first hypothesis explains the fluvial fill of the rock shelter for the formation of a flood plain of great thickness produced by the obstruction of the fluvial canyon of the Jarama river downstream from the rockshelter, which is precisely where it is narrow. The obstruction of the canyon was probably due to a great slide of detritic deposits generated in the slopes by cryoclastic and solifluction processes contemporary of the cryoclastic processes that produced the unit 3. Palaeofloods of this type have been detected in other mountain rivers of the Iberian Peninsula, since it is also the case with the upper valley of the Segre river (Alòs de Balaguer, Lleida), where there exists a record of raises of the fluvial level of 20 m in the final Pleistocene [24] produced by obstructions of the karstic canyon of the Segre river. Even at present, the Segre river has risen 10 to 13 m (J. L. Peña, pers. com.). Minor values have been observed in other rivers of the Pyrenees [25].
- The second hypothesis would explain this flood as result of a great overflow similar to the cataclysmic super-flood known from geological literature [26], detected in the Holocene geological records [27] and in historical documents [28]. That overflow would have risen the waters of the river Jarama at least 23 m over its current riverbed, inside the canyon, leaving sediments of overflow in the rock shelter. This rapid flood could have been caused by intense rainfalls concentrated in the head-board of the river, or to a fast thaw

process of the snow accumulated in the Central Range or due to the overlapping of both processes.

Within a second approach to the data from the site record, the sedimentological characteristics of Jarama VI deposits can be interpreted in palaeoclimatic terms. So, units 1 and 3 are related to cold climatic episodes, the lower (unit 3) moister and the upper (unit 1) drier. Unit 2 shows both a moist and temperate climate with flood events that caused a fluvial sedimentation on the rock shelter. The end of silt sedimentation (sub-unit 2.2) on the inundation plain is dated by the sample Beta-56639 at circa 32600 ± 1860 BP. Using the polinic scale, from the palaeoclimatic interpretation and the radiocarbon dates available, the silts from unit 2, dated by the sample Beta-56639, would be situated in the interstadial just below the Arcy episode. The upper part of these silts with autochtonous pebbles (sub-unit 2.1) (Beta-56638) would be situated between the Arcy and Kesselt episodes, all of them on the lower part of Later Würm. The Beta-56640 date places level 1 in the cold Tursac stage, around the middle part of Late Würm.

The Jarama VI sedimentary sequence begins with a sterile level (stratum alteration). A cold cryoclastic deposit follows it with a human occupation clearly located on the Middle Paleolithic (unit 3). The upper part of this unit was affected by strong erosion due to a huge palaeoflood, which caused the sedimentation of a sandy series (sub-unit 2.3) and ends with flood silts (sub-unit 2.2). On these silts, once the water withdrew, occasional Middle Paleolithic human occupations could be seen. These occupations are dated between 32600 ± 1860 BP (Beta-56639), which shows the flood ending, and 29500 ± 2700 BP (Beta-56638), corresponding to an autochthonous clastic sedimentation inserted on the upper part of the silts (sub-unit 2.1). On the other hand, from the geological point of view, the record of Jarama VI allows to record the development of a great flood in the Upper Jarama during a concrete moment of the Late Upper Pleistocene dated circa 32000 years B.P.

Acknowledgements

This study has been made in the setting of the projects *Prehistoric Research on the Upper Jarama Valley (Valdesotos, Guadalajara, Spain)* financed by the Autonomous Government of Castilla-La Mancha (Spain) and *The human settlement in Upper Duero Basin during Upper Palaeolithic and Epipalaeolithic: Palaeoenvironment reconstructions of Quaternary from karst-environment research,* financed by a "*Ramón y Cajal* Contract" of the Spanish Ministry of Education and Science, both directed by J.F. Jordá Pardo.

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