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Lithic materials in high fluvial terraces of the central Pyrenean piedmont (Ebro Basin, Spain)

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ABSTRACT

Lithic materials from Lower Palaeolithic are scarce in the Ebro Basin. Archaeological surveys carried out in some alluvial terraces on central Pyrenean piedmont have unearthed three new sites with remains of lithic industries related to cobble and core technology and large cutting tools. In the upper terrace levels (T1 and T2) from the Alcanadre and Cinca rivers, some pieces have been recovered on the surfaces: cobble-tools at Las Fitas and bifacial tools at San Quílez. The approximate age of these levels ranges between 780 ka and 1000 ka, established by paleomagnetism and evolutionary stages of calcrete. A cleaver was interbedded into a terrace (T5 level) of a minor tributary of the Cinca River (Olriols), whose age has been established at a regional scale between 178/151 ka. This T5 level is related to one of the cold phases of greater advance of Pyrenean glaciers during MIS 6.

These new findings help us to widen our knowledge of a poorly known period of the human occupation of the middle Iberian basin. The chronological imprecision of most of the lithic materials has been partially overcome by means of geomorphological data, which offers a generic chrono-cultural framework for the people who used them.

1. Introduction

The Ebro Basin is located in the NE of the Iberian Peninsula. It is a depressed area flanked by the Pyrenees, the Iberian Ranges and the Catalan Coastal Range (Fig. 1). The current climate is continental Mediterranean, with semiarid features and extreme temperatures. The Ebro River drains the basin from NNW to SSE to the Mediterranean Sea, and its most important tributaries come from the Pyrenean ranges.

The discoveries of ancient Palaeolithic tools linked to Quaternary accumulations in the Ebro Basin are infrequent and usually lack stratigraphic context, both isolated finds and more important lithic assemblages. Far from being exhaustive, we shall note some of the most important references on the topic:

- In the western sector of the Depression stand out the Najerilla valley ensembles (La Rioja), where some important sets of bifacial tools (more than 220 bifaces, trihedral pieces and cleavers) were located (Utrilla, 1985; Utrilla et al., 1986a, 1986b, 1988). There are other minor collections in the surroundings of the Urrúnaga reservoir in the Zadorra basin (Sáenz de Buruaga et al., 1989), as well as in the Pamplona basin (García Gazólaz, 1994), the Coscobilo destroyed cave (Barandiarán and Vallespí, 1984), the Urbasa plateau (Barandiarán and Montes, 1992) and the Cidacos terraces (Barandiarán, 1973; Domingo et al., 2000).
- In the central and eastern area, we note some scattered findings in the Jalón valley (Gimeno and Mazo, 1983; Galindo, 1986), in Caspe, next to the Ebro river itself (Mazo and Utrilla, 1992) and several ensembles from Castelló de Plá endorheic depression (Mir and Rovira, 1985), Nerets in the Noguera Pallaresa basin (Rosell et al., 2014), and from the Farfanya and the Femosa

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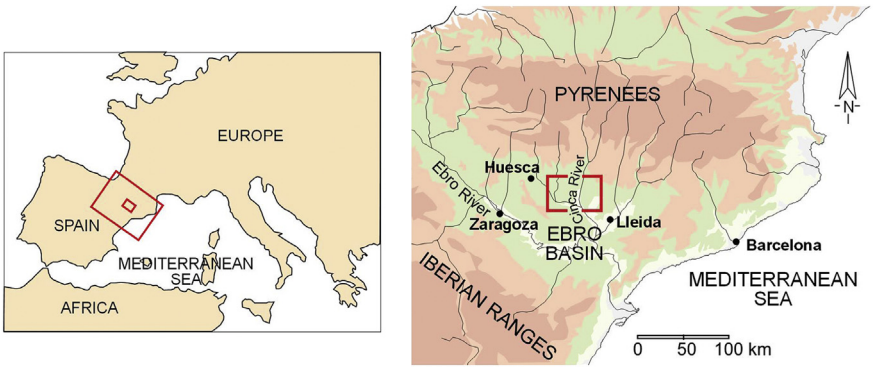

Fig. 1. Location of the study area.

valleys, both in the Segre basin (Mora et al., 1986; Peña-Monné et al., 2005).

In areas bordering the Ebro Basin, there are some noteworthy stratified open air sites, including Torralba and Ambrona in Soria, whose underground drainage goes to the Jalón river (Santonja et al., 2014), Cuesta de la Bajada in Teruel, related to the San Blas terrace cited in the Obermaier's *Hombre Fósil* (1916) (Santonja and Pérez-González, 2014) and several sites in the Catalonian littoral basins, including La Cansaladeta (Vergès and Ollé, 2014), Barranc de la Boella (Vallverdú et al., 2014), Vallparadís (Martínez et al., 2013) and Sant Juliá de Ramis and other lithic assemblages in the Ter valley (García et al., 2014; Rodríguez and Sala, 2014). The well-known sites of Atapuerca offer a notable stratified record for almost all the Lower Palaeolithic in the Trinchera cavities: Sima del Elefante, Gran Dolina and Galería (Carbonell et al., 2014).

This article describes some lithic remains found on the higher and middle fluvial terrace levels from the interfluves Cinca-Alcanadre (Las Fitas) and Cinca-Noguera Ribagorzana (San Quílez and Olriols). Previous studies about geomorphological features of the Quaternary deposits from this region offer a spatial and chronological context for these archaeological materials. The lithic collections from Las Fitas and San Quílez have been located on top of the old terraces, while some materials from Olriols appear imbedded into a terrace level that has an accurate chronological assignment. On the other hand, the central Pyrenean piedmont enjoys one of the best alluvial terraces sequence from Iberia, with relevant chronological information to provide relative ages for lithic materials. Ultimately, this ancient alluvial record provides us a time frame for the first people in this area. A good stratified site from this early period is still to be discovered in the middle Ebro Basin.

2. Methodology

At a regional level, there are some lithic materials from the upper terraces of the Ebro River tributaries, although their exact provenance was dubious. After some recent isolated findings, we have undertaken surveying campaigns in different terrace levels. Experts in archaeology, geomorphology, and soil science have joined their efforts to achieve the most precise contextualization of the recovered lithic materials. We have prepared a synthetic map of the regional Quaternary and detailed transversal sections of the terrace system. Pieces found on top of the Quaternary accumulations (Las Fitas, San Quílez) have been georeferenced; their geomorphological and edaphic contexts have been exhaustively described. For the only tool found in its original stratigraphic context (Olriols), we drew a detailed profile of the stratigraphic units that form the fluvial accumulation. Taking into account the topographical position of the alluvial levels and its correlation with the established terrace levels for this region, we could link the pieces to their original strata and their contextual chronology. Being aware of the scarcity of our assemblages, their typological features suggest similarities with other Lower/Middle Palaeolithic sites from the region.

3. Quaternary geomorphological and chronological features of the Pyrenean piedmont

The geological bedrock of the Pyrenean central piedmont is composed of continental sediments, mainly sandstones and clays from the Peraltilla Fm (Oligocene) and Sariñena Fm (Miocene) in the limit with the Pyrenean External Sierras (Riba et al., 1983). The Cenozoic bedrock has been deeply incised by the fluvial network during the Quaternary, producing notable accumulations of fluvial sediments caused by the discharge of the Pyrenean rivers, with important sequences of strath terrace levels in stepped disposition. The older levels are now platforms and isolated hills, around 180–190 m above the main fluvial network. At their feet, new cumulative fluvial levels have been formed, occasionally accompanied by lateral pediments.

The main basins of the Pyrenean central section are those of the rivers Gállego, Cinca-Alcanadre and Segre-Noguera Ribagorzana. Lithic materials analysed here are found in the Quaternary formations of the river Cinca and two of its tributaries, the Alcanadre, that forms a wide basin, and the more modest Olriols.

The alluvial accumulations of this central South Pyrenean area have been extensively studied, especially in the domains of geomorphological cartography, terrace system determination, and chronological assignment. Syntheses were published by Mensua and Ibáñez (1977), Bomer (1978), Alberto et al. (1984), Gutiérrez and Peña-Monné (1994), and sub-regional studies focused in the Gállego basin (Benito, 1989), the central piedmont (Rodríguez-Vidal, 1986), the Cinca valley (Sancho, 1991) and the rivers Segre-Noguera Ribagorzana (Peña-Monné, 1983, 1988). These first works organised the information about the evolutionary steps of Quaternary aggradation and degradation and proposed ages around the Pliocene–Quaternary transition for the older levels. This was based on their great height over the current rivers and their disposition as loosely confined watercourses, in the form of wide alluvial fans. Their ultimate assignment to the Quaternary was established in more recent papers, mainly thanks to OSL and paleomagnetic dates.

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The first dates for Cinca River terraces were published by Sancho et al. (2003, 2004, 2007b) and Lewis et al. (2009). The evolution during the Quaternary of the Gállego River was discussed by Peña-Monné et al. (2004b), Sancho et al. (2007a), Lewis et al. (2009) and Benito et al. (2010). Alcanadre River terrace levels have been systematised and dated by Calle et al. (2013). Peña-Monné and Sancho (2011) have sketched the palaeoenvironmental reconstruction of Gállego and Cinca rivers, starting from the correlation between fluvial terraces and glacial and periglacial deposits. They have established their genetic relationships with cold periods linked to the maximum of the Pyrenean glaciers.

4. Archaeological remains

4.1. Archaeological pieces from Las Fitas

The lithic materials from Las Fitas (Municipality of Villanueva de Sigena) were recovered during several visits in an area around 6 ha. The zone is also called *Saso de las Fitas*: *saso* is the regional name for the high horizontal platforms (Fig. 2). Among the remains (21), we can highlight some choppers (2) and chopping-tools (3) knapped on small size quartzitic cobbles, cores (4), chunks (5) and flakes (5). A hammerstone completes the set (Table 1).

Table 1
Pieces from Las Fitas terrace. IA: elongation index; IE: thickness index (mass in g; measures in mm).

Piece no.	Raw material	Typology	Weight	Length	Width	Thickness	IA	IE
Fig. 3.1	Quartzite	Core	59	60.4	43	26.5	1.40	1.62
Fig. 3.2	Quartzite	Core	135	55.4	72.2	29.3	0.77	2.46
Fig. 3.3	Chert	Core	203	78.3	56.5	33.8	1.38	1.67
Fig. 3.4	Quartzite	Core	115	52.6	50	38.9	1.1	1.28
Fig. 4.7	Quartzite	Discoid core wind-polish	19	37	33.4	11.9	1.11	2.80
Fig. 3.10	Quartzite	Chunk	66	39.5	41.2	30.7	0.96	1.34
Fig. 3.11	Quartzite	Chunk wind-polish	16	35.1	30.2	16.4	1.16	1.84
Fig. 3.12	Quartzite	Chunk	79	49.1	43.8	28.4	1.12	1.54
Fig. 3.13	Quartzite	Chunk	62	55	37.8	27.4	1.45	1.38
Fig. 3.14	Quartzite	Chunk	75	45.1	50.4	30.7	0.89	1.64
Fig. 3.5	Quartzite	Flake	42	63.9	42.1	15	1.52	2.81
Fig. 3.6	Quartzite	Flake	29	54.1	29	16.6	1.86	1.75
Fig. 3.7	Quartzite	Flake wind-polish	46	52.2	49.8	18.3	1.05	2.72
Fig. 3.8	Quartzite	Flake wind-polish	9	34.3	28.6	11.2	1.20	2.5
Fig. 3.9	Quartzite	Flake	7	31.2	24.8	10.5	1.26	2.36
Fig. 4.1	Quartzite	Chopper	208	69.5	71.9	42.0	0.97	1.71
Fig. 4.2	Quartzite	Chopper wind-polish	76	59.0	58.0	18.8	1.02	3.09
Fig. 4.3	Quartzite	Chopping-tool	347	87.8	93.1	35.4	0.94	2.63
Fig. 4.4	Quartzite	Chopping-tool	146	53.5	63.9	46.4	0.84	1.38
Fig. 4.5	Quartzite	Chopping-tool	67	47.4	56.6	26.0	0.84	2.18
Fig. 4.6	Quartzite	Hammerstone	293	81	63.5	43.4	1.27	1.46

The ensemble of fluvial terraces from the Cinca basin have been correlated to the Segre-Noguera Ribagorzana by Peña-Monné and Sancho (1988), Sancho et al. (2004), Lewis et al. (2009) and Peña-Monné et al. (2011). They form a system of 10 cumulative levels, relatively well linked. Equally, Calle et al. (2013) have proposed for the Alcanadre River a Quaternary sequence that partly coincides with the general overview drawn for the Cinca-Segre ensemble. From its evolutionary point of view, we can differentiate three upper levels, more than 100 m over the current watercourse, with a notable development of petrocalcic horizons (Sancho, 1991; Meléndez et al., 2011). The morphological evolutionary stadium of caliches at these horizons is located above the IV–V stage of Birkeland (1999). Hence, their chronology should be older than 600 ka (Sancho et al., 2007b). Level T1 might even be older than 1000 ka, as its pedogenetic constitution would be at stage VI (Calle et al., 2013). Palaeomagnetic data confirm these ages, as in the upper levels of the Cinca River (Sancho et al., 2007b) the change of magnetic polarity can be found in T3. In the Alcanadre River (Calle et al., 2013), these terraces register reverse polarity (Matuyama chron). Therefore, level T3 can be dated to 780 ka (Brunhes–Matuyama transition), level T1 to ca. 1000 ka, and an intermediate age could be proposed for T2. From level T4 onwards, terraces are dated later than 780 ka, with a lesser development of petrocalcic horizons (stages II to IV), without the presence of caliche from level T8.

All the remains – cores, flakes and cobble-tools- are small-sized, and the ensemble does not seem to be related to a hierarchically organised *chaîne opératoire* of flakes extraction (neither *levallois* nor centripetal, except a discoid exhausted core, Fig. 4.7). The short collection could be related only to cutting/chopping tasks: flakes, cobble-tools and even five chunks, which cannot be considered as true cobble-tools. Developed percussion-cones suggest exclusive employment of hard percussion; butts, when conserved, are non faceted. Cores (Figs. 3.1–4 and 4.7) and chunks (Fig. 3.10–14) are the most frequent remains, but the scarcity of the sample does not allow definitive conclusions: in any case, reduction tasks seem to be limited to the immediate production of usable edges, rather than blanks. The small size and the wide presence of cortex would imply that cores and chunks were the desired product, rather than wastes from an organised flake production strategy. The recovered flakes (Fig. 3.5–9) were never transformed into retouched types. They are characterized by very small sizes, irregular morphologies and presence of cortex. The raw material is quartzite, except for one of the cores (Fig. 3.3), reduced from a very fine-grained chert nodule.

Among the cobble-tools, there is a chopper knapped on a thick cobble (Fig. 4.1), and another made on a large flake that has still some cortical remains and was transformed by two extractions that delineate the edge (Fig. 4.2). Both are affected by wind polish and depositional damage (trampling notches). The chopping-tools are also worn by the climatic elements. One of them (Fig. 4.3) is

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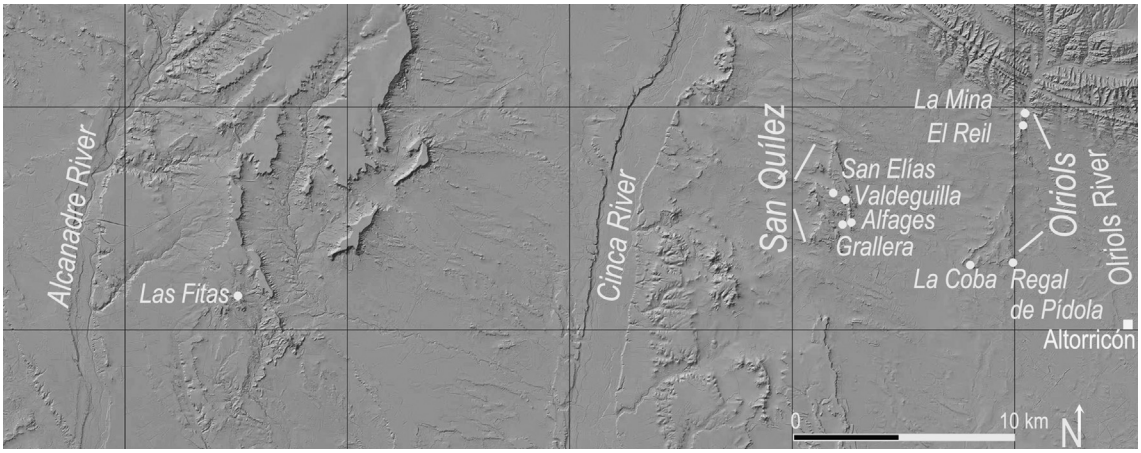

Fig. 2. Digital elevation model showing relief and location of the material findings.

knapped on a flat cobble that is broken at the bottom. Some rough extractions form a sinuous edge. The other two pieces (Fig. 4.4–5) used small cobbles and show irregular edges carelessly sketched by bifacial extractions that do not affect all their surfaces. No. 5 is a cobble split in half, perhaps while being knapped, but nonetheless prehistoric people used it to obtain a tool. Last, a cobble with some extractions shows clear signs of hard and repeated percussion, allowing us to classify it as a hammerstone (Fig. 4.6).

Two bifaces nowadays kept in the Zaragoza Museum could also be related to this area. Utrilla and Rodanés (1985:33) suggested that these pieces could have been found at the Monte Alto area, in Sena, a village close to Villanueva. Monte Alto is located in the right bank of Alcanadre, while Las Fitas area is on the left, around 10 km to the north.

4.2. The large cutting tools from San Quílez platform

The lithic assemblage from San Quílez (or *Sierra de San Quílez*, as this relief is locally known) was found in several isolated surface locations on the wide platform (Fig. 2): in the basis of two gravel quarries (San Elías and Valdeguilla), in a crop field next to the Alfages trig point, and finally at the feet of this last zone (La Grallera), all in the Municipality of Binaced (Huesca). We have studied the only six tools recovered in this area: two bifaces, a trihedral piece, two choppers, and a core. Their dimensions, weights and indexes are shown in Table 2.

Table 2
Pieces from San Quílez terrace. IA: elongation index; IE: thickness index (mass in g; measures in mm).

Piece no.	Provenance	Typology	Weight	Length	Width	Thickness	IA	IE
Fig. 5.1	Grallera	Handaxe	774.9	136.2	103.5	75.0	1.32	1.38
Fig. 5.2	San Elías	Handaxe	380.1	107.7	74.5	47.1	1.45	1.58
Fig. 5.3	Valdeguilla	Trihedral	679.8	136.7	86.7	64.5	1.58	1.34
Fig. 5.4	Alfages point	Chopper	558.1	87.5	132.9	33.5	0.66	3.97
Fig. 5.5	Alfages point	Chopper	726.9	157.0	94.9	30.3	1.65	3.13
Fig. 5.6	Alfages point	Core	160.5	85.5	56.5	38.1	1.51	1.48

The two bifaces (Fig. 5.1–2) are quite similar in shape and facture. Both are reduced from irregular flint cobbles. The knapping is rough and does not cover the main part of the pieces. They are worn by time and climate (with a white patina in one case, glosses in the other, and rounded arrises and edges in both of them). Their overall profile and the edge are still quite straight. The trihedral piece is similar to the bifaces (Fig. 5.3). It shows a crude shaping: the distal tip is almost pyramidal with 4 faces. The flint surface is deeply covered by a white patina and damaged by climatic alterations. As with the two described bifaces, it has straight edges and almost symmetric profiles. Their conservation state precludes any functional determination based on wear traces.

The wide chopper (Fig. 5.4) is knapped on a well-conserved flat basaltic cobble that presents a long, frontal edge with two convergent sides and a detached point in its centre, sketched by up to 10 extractions. The left part of the edge seems to be worn by use, as it presents many little scars and extractions that could have been produced by its employment. The second chopper (Fig. 5.5) is an elongated piece also formed on a flat basaltic cobble, whose surface is black and smooth. It has been briefly retouched to obtain a straight edge, oblique to the technological axis, which occupies the upper left side of the piece. It also presents a notch at the base, whose aspect is contemporary to the distal extractions; we cannot determine whether this was a functional or an accidental feature. In both cases we envisage the possibility that the user of these pieces was right-handed, as the active, retouched zones are situated in the upper left part of the cobbles.

The last piece from San Quílez, a small discoid flint core, presents a pointed extremity (Fig. 5.6). As other pieces in this collection, is deeply worn by climatic and depositional damage. In its present state, we attribute it a production of no less than 10 flakes.

4.3. The Olriols River terrace and its dispersed pieces

In the Olriols River terrace we studied two cleavers from different locations, and a biface found in Altorricón, which could be also related to this deposit (Fig. 2). By its location, the most interesting piece is the cleaver (Fig. 6.1) from El Reil gravel quarry in Olriols River terrace (Tamarite de Litera), found in stratigraphic context: it protruded from the excavated front of the gravel quarry. So, unlike the other pieces that have been found on top of the terrace levels, this cleaver must be contemporary to the layer. Typologically it is a 0-type cleaver, knapped on a large basaltic flake slightly modified by some lateral extractions. The edge is oblique to the technological axis and is worn on the ventral surface by the hard use of the piece. The great bulb implies a very strong

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Fig. 3. Cores (with diacritic schemes), chunks and flakes from Las Fitas terrace. In the photos, note the glosses and the rounded arrises that characterize the wind polished pieces (7, 8, 11).

percussion, required for extract a large flake from a tenacious rock. The dimensions are 132.8 × 105 × 40.7 mm (IA: 1.26; IE: 2.58), with a mass of 693 g. In the same gravel front, a small bone splinter was recovered, suggesting an archaeological deposit.

The second piece from this area is another 0-type cleaver (Fig. 6.2) found at La Coba (Binéfar), the southern extreme of the Olriols River terrace, 5 km to the south from El Reil. It is lighter, flatter and more compact than the former piece (127.1 × 82 × 34.8 mm; 477 g; IA: 1.55; IE: 2.36) reduced from a green–grey quartzite flake. The retouch is direct on its right edge and inverse on its distal left edge, in order to obtain its sub-rectangular shape. The external side preserves some cortex remains next to the distal edge (Type 0.1), partially lost by prolonged post-depositional and climatic damage: glosses and other elements (trampling notches).

The third piece is a flint biface (Fig. 6.3) located in a building lot at the nearby village of Altorricón. This piece could have been carried with the constructive material employed in the demolished building (the rammed earth – *tapial*- usually contains gravels quarried from the Olriols River terrace levels) or could have been collected as a curious piece by the inhabitants. The biface is deeply altered and shows an almond-like symmetric silhouette from few and wide border extractions defining a straight edge, despite the somewhat thick profile (IE: 1.97). The knapped area does not cover completely either of the two sides, but techno-typologically it is a good-quality piece. Its measurements (Length 127.2 mm; Width 79.1 mm; Thickness 40 mm; Mass 394 g) and elongation index (IA: 1.61) allow us to classify it as a short amygdaloid biface. The arrises and edges, very smoothed, suggest deep-scale depositional damages, and its light weight severe dehydration.

Rovira et al. (1991) published other interesting materials from the Olriols terrace area (Fig. 2): among them a biface and several choppers and sidescrapers, recovered at Mina de Olriols (San Esteban de Litera, 1 km north from El Reil quarry), and a *limande* from Regal de Pídola, located 5 km to the south, close to La Coba, in Tamarite de Litera (Fig. 6.4–5). In both cases, the lithic raw materials are of local provenance and some of the pieces show remains of the caliche crust that covers many of the rocks found in the area. This fact and the relative absence of rolling damage on their surfaces suggested that the lithic material was found in primary position, but due to their open air character the synchrony of the toolkits cannot be assured. The authors discussed the Acheulean or Mousterian chronology of these tool assemblages. Regarding this, we must recall the existence of up to ten Mousterian sites in the Cinca-Segre interfluve, whose oldest chronology is slightly younger than that proposed for Olriols T5 terrace. The nearest, the

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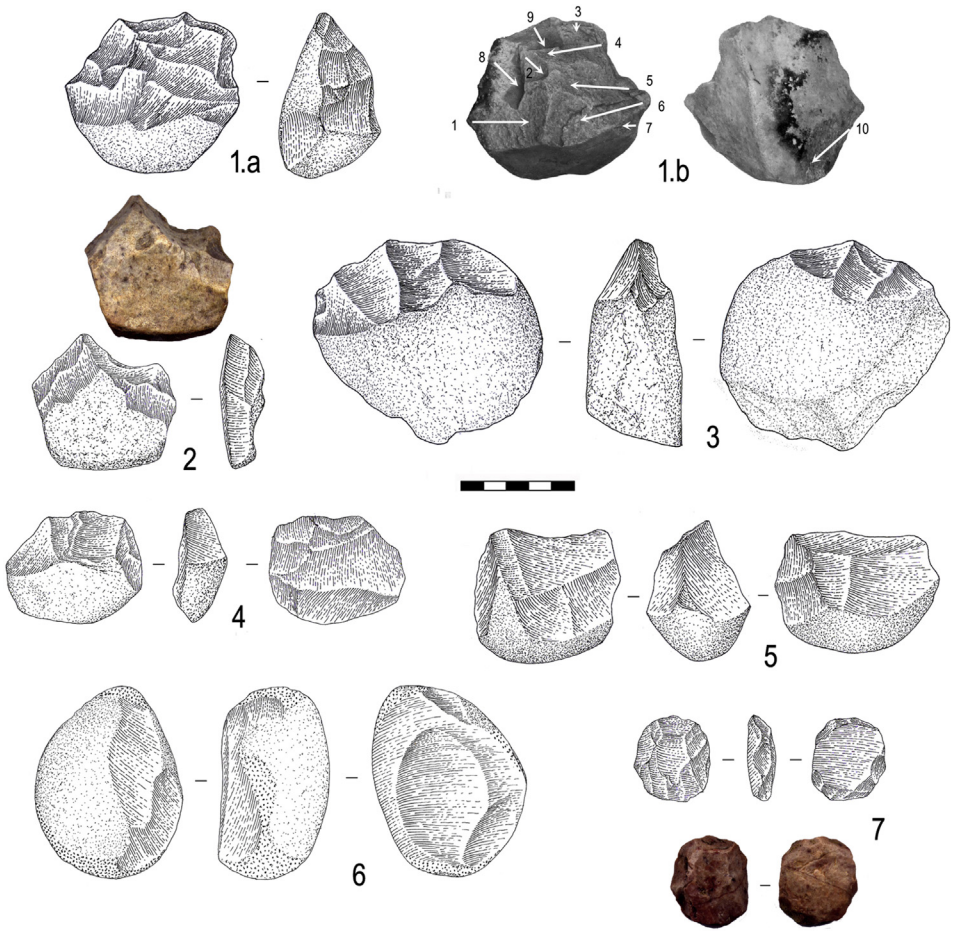

Fig. 4. Pieces from Las Fitas terrace. 1: chopper and its diacritic scheme; 2: wind-polished chopper; 3–5: chopping-tools; 6: hammerstone; 7: wind-polished discoid core. (Drawings, M.C. Sopena).

Mousterian cave of Gabasa, offers a noteworthy collection of massive pieces in its imprecisely dated (MIS 6-5) older level (Montes and Utrilla, 2014; Utrilla et al., 2014).

5. Results

If we take into account the characteristics of the described tools within their geomorphological and chronological contexts, we can propose some results for each of the analysed points.

5.1. Las Fitas terrace (T1)

This terrace is located 180–190 m above the present course of the Alcanadre River, tributary of the Cinca River, close to the town of Sariñena (Fig. 7). It forms a set of detrital platforms with a gentle south slope (average gradient of 4.5–5‰). The lithic remains were recovered in a limited area in the southern sector (Fig. 2), where the cumulative thickness reaches 9–9.5 m. It consists of 5 m of fluvial gravels and sand, and above, a calcic horizon of 4–4.5 m, whose hardness generates a marked escarpment across the margin of this relief (Fig. 8). The caliche is composed of nearly 3 m of powder calcrete, overlapped by 1.5 m of nodular and laminar calcrete, with various structures (Meléndez et al., 2011). From the pedological point of view, this soil is classified by Badia et al. (2014) as a Petric Calcisol. Information obtained from paleomagnetism would place this level during the Matuyama reverse chron, close to Jaramillo subchron (Calle et al., 2013), ca 1000 ka. Moreover, the degree of development of petrocalcic horizons (Birkeland's stage VI (1999)) fits this chronology. Lithic materials located on this terrace are necessarily subsequent to the cumulative level, and to the crust developed above. The only paleoenvironmental indicator located in these materials is the presence of wind polishing and patinas (Figs. 3 and 4) that indicate exposure to wind in an arid environment lacking of vegetation (similar glosses have been described in some Mousterian-like flakes located in a more recent Alcanadre terrace, Cuchí et al., 2012). The absence of traces of carbonate suggests that the blanks for these materials were gathered in lower terraces for their use.

5.2. San Quílez terrace (T2)

This terrace belongs to the Quaternary Cinca River system (Fig. 7), analysed by Sancho (1991), Sancho et al. (2007), and Lewis et al. (2009). This level is located 170 m above the watercourse; it reaches a lesser altitude than the nearby relief of Las Brujas (T1 level). It forms an elongated table, oriented N to S, around 4.5 km long, which expands towards the Valcarca area in a second table and some inselbergs. The reliefs of San Quílez (402 m) and Las Brujas (420 m) stand above the Binéfar plain (285 m) (Fig. 7). The dominant structures are typical of a braided river, with cross-bedded gravel and sand channels (Fig. 9). In the analysed area, the terrace reaches a visible thickness of 4–5 m, with powdery crust (1.25 m) and nodular crusts (1 m) at the top. Its age should be, after the criteria above, between the limit Brunhes–Matuyama

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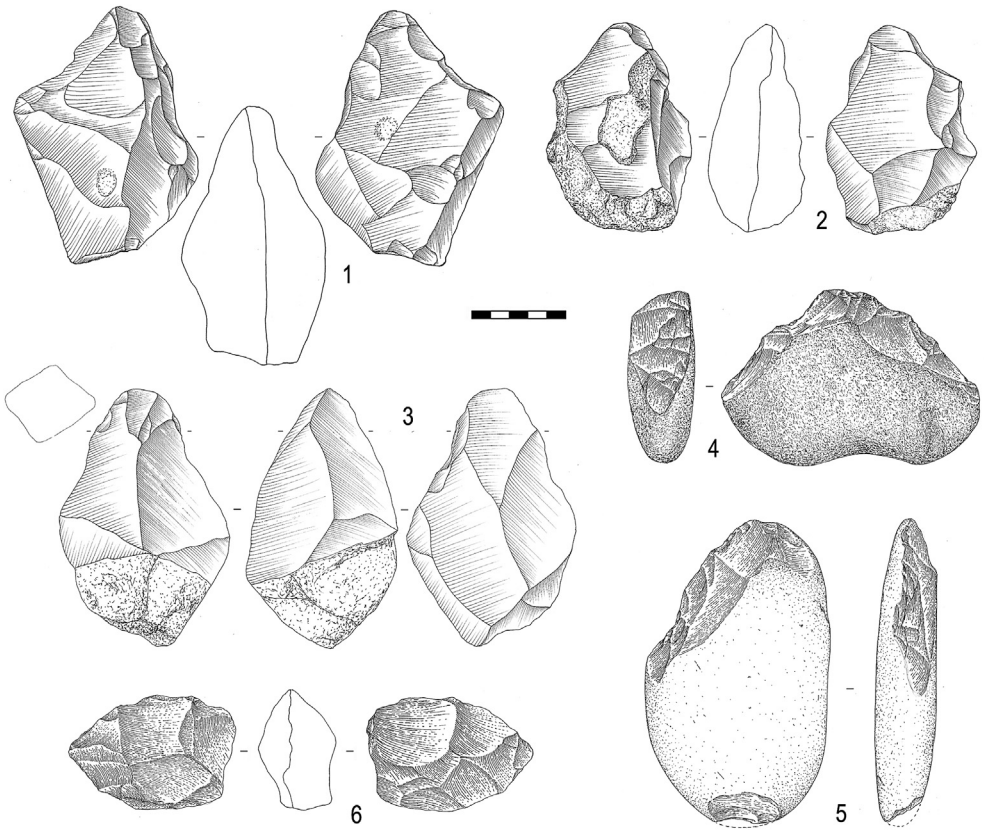

Fig. 5. Lithic material from San Quílez terrace. 1–2: Bifaces; 3: Trihedral piece; 4–5: Choppers; 6: Discoid core. (Drawings: M.C. Sopena).

chrones (780 ka) of terrace T3 and ca. 1000 ka of Cinca level T1 (Sancho et al., 2007b; Calle et al., 2013). Lithic materials (Fig. 5) are strictly on the surface, so we can suppose only a post-T1 age, without further precision, although a biface and the trihedral piece were found on the floor of the gravel quarries.

5.3. Olriols terrace (T5)

This fluvial accumulation appears far from the Cinca River terrace system and also falls behind the complex terrace system of this river. Stratigraphically, it is lower than the other two described here (Fig. 7). Nevertheless, the dominant lithologies in the gravels of the deposit are identical to those found at the Cinca. Hence, we think that it could be material remobilized by an affluent of the Cinca River, the current Olriols River, from older terraces that could have been found in this sector before their erosion. Otherwise, sedimentary structures clearly belong to a less torrential fluvial course, with a lesser discharge capacity. The cumulative profile (around 7.5 m) may be reconstructed through the observation of the basal part in the bottom of the El Reil gravel quarry. The profile continues at the limit of the exposure (Fig. 10). In its base (Fig. 10A) there are numerous fine materials with small gravels, followed by rhythmical alternations of gravels–cobbles and sands in horizontal laminations (Fig. 10B) and finishing with gravel levels of a greater thickness (Fig. 10C). The development of the crust is far less than that detected in the two other deposits, although some evidence indicates that only the basal section of the palaeosol has survived, represented by calcified horizons and power calcrete (Fig. 10D1–D2). After the erosion of the upper levels, its thickness reaches around 1.2 m. Assuming this, the calcrete development must have taken place during stages III–IV of Birkeland (1999). Compared to the petrocalcic horizons of the terraces of the Cinca River in this area (Sancho et al., 2004; Meléndez et al., 2011), the Olriols terrace would present the characteristics of terrace 5. Therefore, it could be dated around 176 ka (MIS 6), following the chronological proposal made by Peña-Monné et al. (2004a) Sancho et al. (2007) and Lewis et al. (2009). The presence of a cleaver (Fig. 6.1) inserted in the upper zone of the basal section of the terrace (Fig. 10A) implies that it would belong to that time, around 176 ka. As tools frequently found in the Lower Palaeolithic of the Iberian Peninsula, cleavers are also common in Middle Palaeolithic contexts, contributing to define the variety called Mousterian of Acheulean Tradition by some scholars, or Vasconian facies by some others.

6. Discussion

Higher terraces at the Ebro Basin usually exceed 170–200 m elevation above the current watercourses. They represent the first cumulative morphologies generated by the fluvial network after the beginning of the development of the Basin during the Pliocene (García-Castellanos et al., 2003). The sedimentary environment for terraces T1 and T2 of the Cinca and Alcanadre rivers suggest open landscapes with non-confined watercourses that had a high capacity of lateral displacement. The strong ramp between the high Pyrenean peaks and the Mediterranean base level caused the existence of massive sediment discharges towards the Ebro River, which was still settling down and organising its network in the basin. This situation started ca. 1000 ka. As the Pyrenean rivers were digging their courses, new levels evolved into more confined situations, in valleys that were increasingly narrower and more stable. The development of calcretes is maximal in levels T1 and T2,

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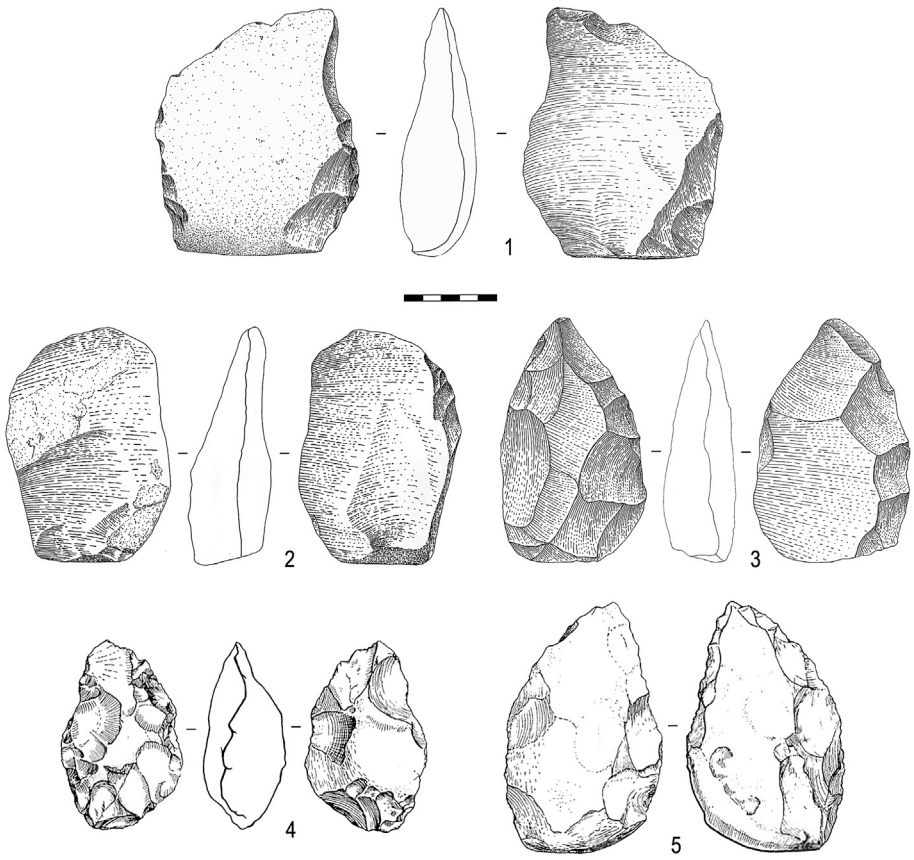

Fig. 6. Cleavers and bifaces from Olriols area. 1: El Reil gravel quarry; 2: La Coba; 3: Altorricón; 4: Mina de Olriols; 5: Regal de Pídola. (Drawings: 1–3 M.C. Sopena; 4–5 after Rovira et al., 1991).

and their thickness and evolutionary degree decreases in lower terrace levels (Sancho et al., 2004; Meléndez et al., 2011). Both Las Fitas (T1) and San Quílez (T2) have notable calcretes and complex structures that reflect a longer evolution, whether Olriols River, in level T5, shows a lesser development of this carbonate formation. This pedomorphologic criterion confirms the general terrace system based on the relative altitude of the terrace levels with respect to the current main watercourse.

However, the superficial position of the materials from Las Fitas and San Quílez only implies a younger age than that of the levels themselves. The absence of carbonate remains on the tools would indicate that they were never embedded in a petrocalcic soil. The presence of thick external crusts prevents the acquisition of raw material from the terraces, so we must link those pieces to more recent evolutionary periods of the river, perhaps during the formation of terraces T2/T3 or subsequent. The presence at Las Fitas of wind polish in some lithic tools but also in local gravels suggests that the terrace surface suffered a period of high aridity, that eliminated the vegetal cover, sometime after those materials were knapped, employed and abandoned there. Therefore, we cannot determine with greater accuracy the chronology of the materials found at Las Fitas and San Quílez.

Concerning Olriols, the position of the cleaver in a stratum of unit B from level T5 assures its direct relationship with the aggradation period of this terrace. Lewis et al. (2009) proposed for this terrace in the lower course of Cinca River an age between 171 ± 22 and 180 ± 22 ka, by OSL dating. In other nearby rivers, also by OSL, this terrace was dated between 140 ± 18 and 156 ± 10 in the upper course of the Gállego River (Sancho et al., 2007a; Lewis et al., 2009); in its lower course level T5 was dated by Benito et al. (2010) between 147 ± 16 and 181 ± 33 ka; in the Aragón River is dated by García-Ruiz et al. (2012) to 171 ± 22 ka. In the Segre River, Stange et al. (2013) gave an age of 138.8 ka (+46.7/−22.8) for this terrace level by terrestrial nuclide cosmogenic data (^{10}Be). At a regional scale, age for T5 ranges from 140 to 181 ka, with dates more frequent in the ranges between 171 and 180 ka. Therefore, this terrace can be dated to MIS 6, as well as the lithic material found in it. This phase is marked by one of the most important glacial periods in the Pyrenees (Peña-Monné et al., 2004b) that caused a well-developed terrace system in its piedmont (Peña-Monné et al., 2011).

In addition to the correlation between Quaternary deposits and the archaeological materials, the technological and typological features of the lithic assemblages allow us to propose an approximate chronological frame. All pieces from the Las Fitas poor ensemble can be classified into the cobble and core technology complex. The pieces from San Quílez, meanwhile, could be related to the large cutting tools horizon. Despite the numerical limitations of both ensembles, their air fits well with the contextual chronology suggested by their location. Regarding the pieces from the Olriols terrace, the imbedded location of a cleaver in the T5 stratum, would imply a more recent chronology for the human occupation. As with most of the cleavers, the two described pieces (Fig. 6.1–2) were formed on non-flint rock. It has been proposed (Utrilla and Mazo, 1996) that the tasks (mainly woodcutting and butchery after the functional determinations made by Mazo) undertaken with cleavers are too demanding, in terms or resilience of the tools, to be achieved with flint pieces. Hence the employment of other coarse-grained rocks even in places where flint can be found everywhere, as in the Najerilla assemblages, where handaxes are strictly

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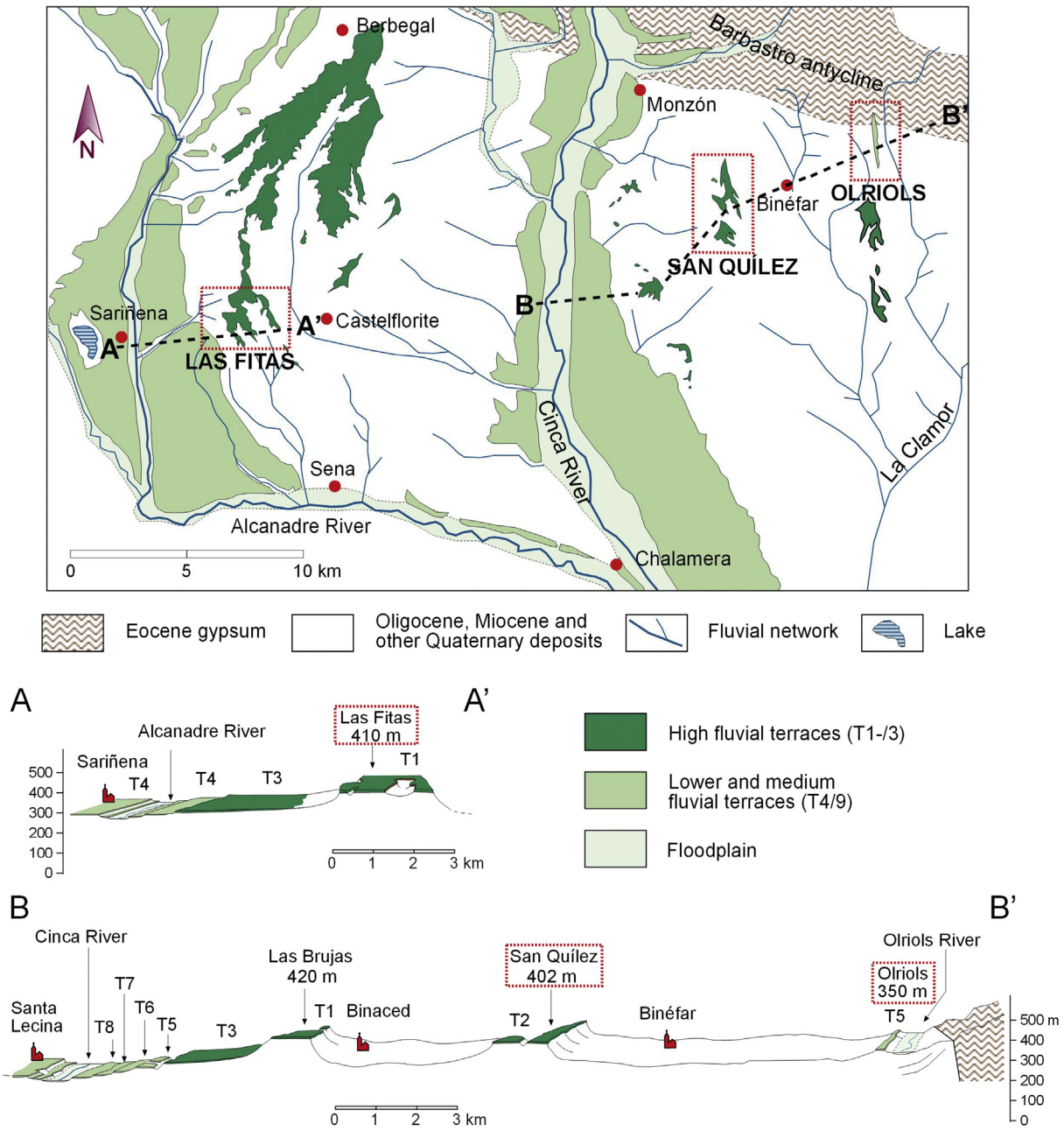

Fig. 7. Synthetic map and sections of the terraces of Alcanadre, Cinca, and Olriols rivers. Dotted lines A–A'and B–B' points the outline of the sections depicted in the lower part of the figure.

knapped on flint, and cleavers on quartzitic rocks, regardless of the abundant outcrops of flint available in the neighbourhoods.

7. Conclusion

Today, the reliefs of Las Fitas and San Quílez are platforms and isolated hills around 200 m above the main rivers. They are composed of gravels that come from the Pyrenean and Pre-Pyrenean ranges and are capped by thick petrocalcic horizons *(caliches)* that can measure between 2 and 5 m. Their development degree and paleomagnetism date the high terrace (T1) around one million years in Las Fitas; San Quílez (T2) should be younger. Olriols, by its position, altitude, and lesser thickness of the caliche could be dated to the Middle Pleistocene, related to the Cinca River T5 terrace levels (178/151 ka).

The provenance of the archaeological remains is different: surface findings in the case of Las Fitas and San Quílez ancient terraces, and an in situ location in the more recent assemblage from Olriols deposit. Therefore, strategies for dating or establishing their cultural affiliation must be different.

The soil study and the analysis of the wind polished pieces helped us to suggest a chronology for the prehistoric remains from Las Fitas and San Quílez. The common patterns of resource acquisition and territory exploitation suggest that people who used these tools must have lived close to the river course, so they would have frequented these areas when the watercourse was not far below the T1-T2 elevation. A supposed synchrony of these

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Fig. 8. Escarpment of terrace level T1 at Las Fitas. Above the basal gravels, we can appreciate the great thickness of calcrete, whose nodular upper levels are responsible for the great escarpment.

Fig. 9. Terrace level T2 at San Quílez, in San Elías gravel quarry. Braided gravel channels and the base of the crust, very eroded, with remain of a more recent soil. The biface from Fig. 5.2 was found at the floor of this quarry.

occupations with T2 for Las Fitas and T3/T4 for San Quílez should be considered. The presence of patinas, smoothed arrises, rounded edges with trampling notches and other damage would support the frame time proposed for the tools, which suffered a prolonged exposure to climatic and depositional elements.

In the absence of good contemporary stratified sites in the region, these materials offer a valuable glance – even if a very limited one-to the first hominins who lived in the territory of the Middle Ebro Basin. For the first time in this environment, we have been able to estimate a chronological range for these surface findings, whose dating is difficult in the absence of a stratigraphic context. Prehistoric groups who frequented Las Fitas area should be chronologically between the formation of Alcanadre terrace level T1 (ca. 1000 ka) and the Matuyama-Brunhes boundary (ca. 780 ka), recorded at the T3 level in this system. This range allows relating the materials recovered in Las Fitas with the cobble and core technology complex (PBC), the TD4 and TD6 levels of Gran Dolina and Vallparadís 10. San Quílez materials can be considered more recent than the Matuyama-Brunhes boundary located between levels T2 and T3 in the Cinca River terrace system. People who knapped and used these tools could have lived around ca. 580 ka, average dating for T3 terrace. In this case, the large cutting tools complex (LCT) should be considered as technological frame, like at Ambrona, Cansaladeta, or EVT3 at Vallparadís, in Llobregat basin, whose base shows the last polarity reversal. Intensive surveys on these two reliefs are to be developed in a forthcoming future, in order to improve our knowledge.

As for El Reil gravel quarry in Olriols, we seek to assess the chronology of the geological strata by means of OSL dating, in order to confirm the relationship between this area and the dated

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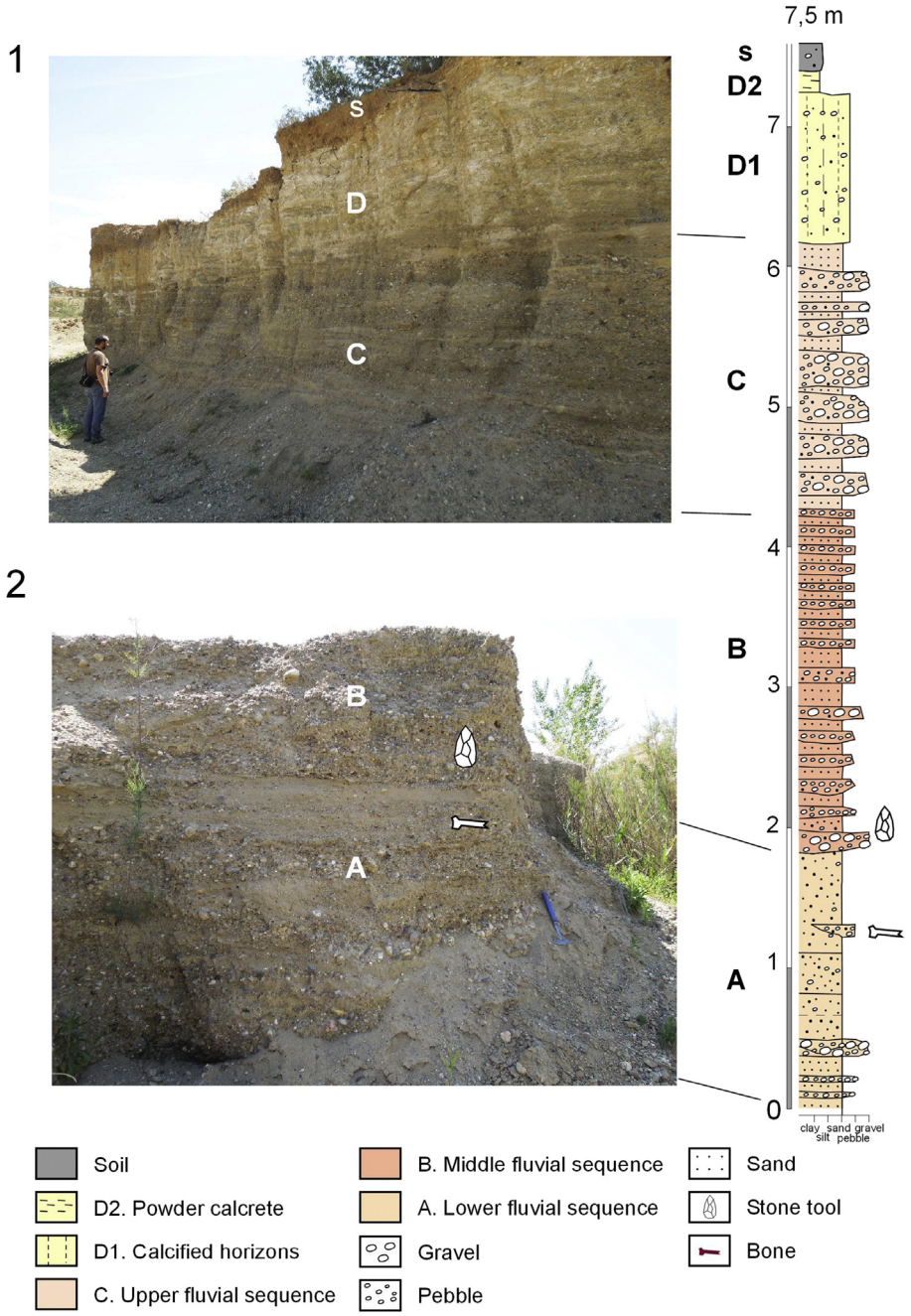

Fig. 10. Images and detailed sedimentological profile of the Olriols terrace at the El Reil gravel quarry, and location of the cleaver.

Quaternary T5 terrace. The 0-type cleavers, such as that found embedded in Olriols, are the most common ones in the Iberian Peninsula. Although a great antiquity has been usually proposed for these pieces, they have no definitive chronology. The suggested time frame for this deposit falls into the Middle Palaeolithic, accurately characterised by recent reviews concerning the Iberian Peninsula (Santonja and Pérez-González, 2002, 2010; Álvarez-Alonso, 2014). An intensive archaeological excavation is envisaged to confirm and characterise the site and the human groups who used these tools. In this area, Mousterian-like elements are commonly found, as well as in the stratified deposits in caves and rock-shelters in the PrePyrenean reliefs, located 30–50 km to the northeast. Neanderthal groups seem to have extensively exploited this zone from MIS 5 to MIS 3, as shown by the stratified sites in the Cinca-Segre interfluve: i.e. Roca dels Bous, Estret de Tragó, or Gabasa cave.

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