Harvesting technology during the Neolithic in South-West Europe

Juan José Ibáñez,[a] Ignacio Clemente Conte,[b] Bernard Gassin,[c] Juan Francisco Gibajas,[d] Jesús González Urquijo,[a] Belén Márquez,[e] Sylvie Philibert,[c] Amelia Rodríguez Rodríguez[f]

[a]*Instituto Internacional de Investigaciones Prehistóricas de Cantabria, Universidad de Cantabria, Santander, Spain ibanezjj@unican.es, gonzalje@unican.es*

[b]*Consejo Superior de Investigaciones Científicas, Institución Mila i Fontanals, Barcelona, Spain ignacio@bicat.csic.es*

[c]*Centre d'études Préhistoire Antiquité Moyen-Âge (CEPAM) UMR 6130 CNRS – UNSA, Valbonne, France gassin@cepam.cnrs.fr*

[d]*Becario postdoctoral de FCT, adscrito a la Universidade do Algarve. Faculdade de Ciências Humanas e Sociais, Faro, Portugal. Colaborador del Museu d'Arqueologia de Catalunya, Barcelona, Spain jfgibaja@teleline.es*

[e]*Museo Arqueológico Regional, Alcalá de Henares, Madrid, Spain belen.marquez@madrid.org*

[f]*Grupo Tarha. Departamento de Ciencias Históricas. Universidad de Las Palmas de Gran Canaria, Las Palmas, Gran Canaria arodriguez@dch.ulpgc.es*

Summary. *Agriculture technology during the Neolithic is poorly understood. This topic may be a good way to get some information about the spread of agriculture and the conditions in which agriculture was transmitted and practiced. In this paper we collect the data gathered by several specialists in use-wear analysis about harvesting techniques in different Neolithic sites in Spain and SE France. Three different areas can be clearly distinguished with respect to harvesting techniques: 1) the Lyon Gulf (Catalonia-Languedoc-Provence), where sickle blades in parallel insertion were used and where sickle gloss showed different degrees of abrasion, 2) the Levantine Spanish coast, where bent sickles with dented edges were used and sickle gloss was not abraded, and 3) Cantabrian Spain, where no sickles were used for harvesting. We will try to explain this variability by resorting to ecological conditions, socio-economic contexts and intercultural contacts in which the first agriculture was carried out.*

Résumé. *La technologie agricole pendant le Néolithique est peu connue. Ce sujet peut être une bonne voie pour obtenir des renseignements sur l'expansion de l'agriculture et sur les conditions dans lesquelles l'agriculture a été transmise et pratiquée. Dans cet article nous collectons les informations réunies par quelques spécialistes en analyse fonctionnelle sur les techniques de récolte des céréales dans quelques sites Néolithiques de l'Espagne et du Sud de la France. Nous pouvons distinguer trois zones par rapport à la technique de récolte : 1) le golfe de Lyon (Catalogne-Languedoc-Provence), où les des lames-faucille majoritairement en insertion parallèle ont été utilisées et le lustre de céréale montre plusieurs degrés d'abrasion, 2) la côte levantine espagnole, où les faucilles courbes avec les tranchants dentés ont été utilisées et le lustre de céréale ne montre pas la composante abrasive, et 3) l'Espagne Cantabrique, où les faucilles n'ont pas été utilisées pour la récolte des céréales. Nous essayons d'expliquer cette variabilité en relation avec les conditions écologiques, les contextes socio-économiques et les contacts culturels dans lesquels la première agriculture a été développée.*

Key words: *harvesting techniques, crop agriculture, curved sickles, use-wear analysis, Neolithic.*

Introduction

Crop agriculture was a basic resource among the first farming communities in Europe. Soil tilling and crop sowing, harvesting, processing and stocking were strategic technical activities for these communities. The spread of new crops, brought from the East into Europe, was surely accompanied by the parallel spread of new technologies associated with them. Agriculture was carried out all along Europe in a considerable variability of ecological, economical and social contexts existing among the Neolithic groups. That is why the variability of agriculture technology in Neolithic Europe may be a good way to fathom out the spread of agriculture itself and the conditions in which that new technology was transmitted and practiced.

The reconstruction of agriculture technology should be ascertained through interdisciplinary study including that from archeobotanists, micromorphologists, palynologists, use-wear analysts, etc. In this paper we deal with a part of this massive topic: harvesting technology in SW Europe, according to a group of use-wear analysts who have been working on the subject for the last 15 years. We now show the results of our analysis carried out in Spain and in SE France (Languedoc and Provence).

The archaeological sites (Fig. 1)

In Catalonia, we have analyzed the lithic tools recovered in some Neolithic sites dating[1] from the end of the 6th millennium up to the beginning of the 4th millennium. Some of the sites are domestic habitats in open air sites, as La Draga and Ca n'Isach or cave sites as La Cova del Frare (Martín *et al.* 1985). We have also studied the function of the tools deposited as burial offerings as those recovered in the necropolis of Sant Pau del Camp, Bòbila Madurell and Camí de Can Grau (Martín *et al.*1997. All tools found in the sediments filling the galleries of the variscite mines of Can Tintorer, which have also been submitted to use-wear analysis, should be considered as the rejects of domestic activities in a garbage context (Gibaja 1997, 1999, 2000, 2002, 2003 and 2004).

[1] All the chronological data will be presented in calibrated C^{14} years bC.

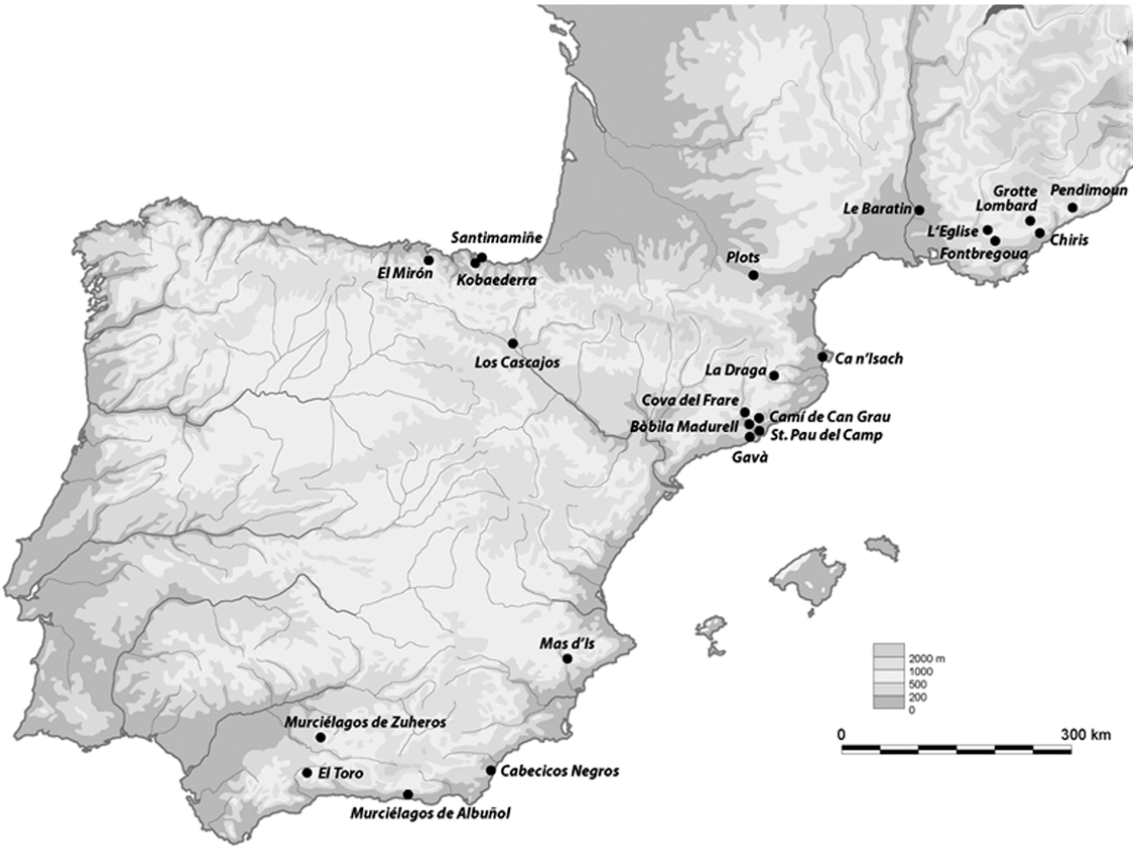

Fig. 1: Location of sites studied.

Some Provençal Neolithic sites, dating from the beginning of the 6^{th} millennium to the beginning of the 4^{th} millennium BC, have been studied as the rock shelter/cave sites of Lombard (Gassin 1991), Pendimoun, Le Baratin (Gassin *et al.* 2004), La Grotte de l'Eglise supérieure (Gassin 1996) and the open air sites of Giribaldi (Gassin *et al.* 2004), Fontbregoua (Gassin 1999), Chiris (Gassin1997; Beugnier and Gassin unpublished)

In Cantabrian Spain, facing the Atlantic sea, we have studied the tools from the cave sites of Kobaederra (Zapata *et al*. 1997; Ibáñez, 2001), El Mirón (González and Ibáñez, unpublished) and Pico Ramos (Ibáñez and Zapata 2001), dating back to the end of the 5^{th} millennium, representing the first regional Neolithic. Not far from these sites but in the Ebro River basin, in a Mediterranean climatic area, the open air site of Los Cascajos (García Gazólaz and Sesma 1999) has offered an important collection of glossed tools which have been analyzed as well (González and Ibáñez unpublished). Two different habitation levels have been distinguished in this site, an old Neolithic one, dating from the end of the 6^{th} millennium, and another mid Neolithic one dating from the second half of the 5^{th} millennium.

In Andalusia, we have studied the tools coming from two cave sites located on inland mountains: Cueva del Toro (Rodríguez Rodríguez 1994, 2004; Rodríguez Rodríguez *et al*. 1996), dating from the beginning of the 5^{th} millennium and Murciélagos de Zuheros (González Urquijo *et al*, 1994 and 2000), dating between the end of the 6^{th} and the end of the 5^{th} millennium. The open air site of Cabecicos Negros (Goñi Quinteiro *et al*. 1999; Rodríguez Rodríguez 1999), located in the coastal plain is attributed to the regional middle Neolithic. The study of Neolithic tools recovered during the prospecting activities carried out in the Cadiz landscape (Ramos *et al.* 1999), also contributed to this study.[2]

In Valencia, the open air site of Mas d'Is (Bernabeu and Orozco 2005) shows three occupational levels: a first dating from around 5.400 cal. BC; the second one, dating from around 5.100 BC, and the most recent one, dating from around 4.500 BC. The sickle elements that we have studied come from the 6^{th} millennium levels (Gibaja, in García *et al*. in press).

In the French region of Languedoc, the site of Les Plots has been studied, dating from the second half of the 5^{th} millennium BC (Vaquer 1995; Philibert unpublished).

This group of archaeological sites is spread irregularly in a much extended geographical area. Some regions have been intensively studied as Catalonia and Provence, while others have been approached in a more superficial way, as the Cantabrian Spain or Andalusia, both only studied in their western areas. For other regions only one site has

[2] Use-wear analysis was carried out by I. Clemente.

been studied as Valencia or Languedoc. Indeed, some important areas are still completely unexplored as those in Portugal or inland Spain. Given these facts, one should consider all conclusions drawn from this paper as preliminary ones. They are to be corroborated in upcoming studies.

Nevertheless, the work carried out up to the present allows us to show some interesting tendencies dealing with the distribution of different harvesting methods in the area. We are able to distinguish three main areas in this respect: 1) Andalusia and Valencia, that is, the Spanish Levantine coast, 2) Catalonia, Provence and Languedoc, the Lyon Gulf, and 3) Cantabrian Spain.

Curved sickles with dented edges in the Spanish Levantine coast

The sickles used in Andalusia and Valencia were made with wooden curved shafts in which the flint elements were obliquely inserted. These elements were made with fragments of flint blades which were glued to the shaft with mastic. The obliquely inserted elements protruded from the shaft creating a dented edge.

A complete sickle of these characteristics was found in the XIX century in the dry cave of Los Murciélagos de Albuñol, in Granada (Fig. 2). The sickle is lost, but a witness of the discovery depicted it to M. de Góngora, who published it (Góngora 1868: 199; Vayson 1918-19). A similar and also complete sickle was found in the lake site of La Marmotta, near Rome (Fugazzola Delpino and Pessina 1999).

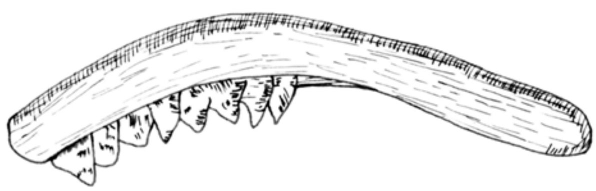

Fig. 2: Reconstruction of the sickle found at Murciélagos de Albuñol (Góngora 1868; Vayson 1912-13).

Fig. 3: Reconstruction of the sickle used at Murciélagos de Zuheros (González *et al*. 2000).

The morphology of the sickle elements and the oblique distribution of the gloss allowed us to infer that in some other Spanish Levantine sites this type of sickle was also in use (Fig. 3). This was the case of 12 sickle elements in the cave site of Los Murciélagos de Zuheros (Fig. 4), one of which was still inserted in the mastic that had glued it to the shaft, clearly indicating an oblique position (González Urquijo et al. 2000). Naked wheat (*T. aestivum/durum*) and barley (*H. vulgare*) were cultivated at the site (Peña-Chocarro 1999). The Neolithic levels of the cave site of Cueva del Toro reflected an occupation focused on the exploitation of animal resources, especially livestock (Martín Socas et al. 1999). Plant remains are very scarce and they mostly correspond to wild species, although einkorn, emmer, naked wheat and barley are present too (Buxó 1997: 164-165). Only one sickle element was found in these levels and the distribution of gloss fits well with the aforementioned model (Rodríguez Rodríguez et al. 1996).

Los Murciélagos de Zuheros, Los Murciélagos de Albuñol and Cueva del Toro are located in a mountainous environment. On the contrary, the open air site of Cabecicos Negros is located on the coast, in the Province (County) of Almeria. The site has been interpreted as a settlement specialized in the craft of mineral objects (ornaments), while the indications of the acquisition of primary resources are scarce (Goñi Quinteiro *et al*. 1999). Again, one isolated sickle element shows the gloss in an oblique disposition (Rodríguez Rodríguez 1999). Surveys carried out in Cadiz allowed the discovery of several Neolithic sites. Among the material of La Mesa site (Ramos et al. 1999), two small sickle elements with the gloss in the same disposition could be found.

In the open air site of Mas d'Is, in Valencia, we found 15 sickle elements made on blades and flakes. This site is located 15 km off the coast, by the Serpis River. The archeobotanical study has documented the use of barley, einkorn (*Triticum monooccum*) and naked wheat (Pérez Jordá 2005). All these elements show the sickle gloss in an oblique position. This distribution of gloss had already been mentioned by Juan Cabanilles (1984) for the sickle elements of Cova de l'Or and Cova de Sarsa. Both sites are located in Valencia and they dated from the end of the 6th millennium. In Cova de l'Or the cultivation of naked (*Hordeum vulgare var. nudum*) and hulled barley (Hordeum vulgare var. vulgare), naked wheat, einkorn and emmer (*Triticum dicoccum*) has been documented (Hopf 1966; López 1980), while in Cova de Sarsa only naked wheat and emmer have been identified (López 1980).

The morphology of the sickles is quite homogenous in these Spanish Levantine sites. The features of the harvesting use-wear traces are also similar. These elements show the typical harvesting polish: shiny, quite flat and with comet-shaped pits. Certain variability was possible with respect to the quantity of striations present on the polished surface, but, in any case, the abrasive component of the polish was not that intensive. The variability in the degree of striations can be explained by the lower or higher harvesting of the plants or by how much loosen the soil was when the cereal was harvested. (Unger-Hamilton 1988; Anderson 1992; Domingo 2005).

Other than this Levantine area, only the older levels of Los Cascajos site, in Navarre, dating from the end of the 6th millennium, show sickle elements that were originally obliquely inserted into the shaft. All the sickle elements recovered in the older levels (no. 21) showed this gloss position. They bear the typical harvesting polish (Fig. 5), again with certain variability in the quantity and intensity of striations. Emmer is the most common cereal in this site, although, einkorn and barley were usual as well (Peña-Chocarro and Lydia Zapata unpublished).

Blades in parallel insertion in Catalonia, Provence and Languedoc

The morphology of sickles must have been quite different in Catalonia, Languedoc and Provence, as the sickle elements were made in longer blades and the harvesting gloss was parallel to the edge, indicating that the blade was inserted in parallel to the shaft (Fig. 6). The characteristics of the use-wear traces also differ from those in southern sites. Although some of the sickle elements show the typical harvesting polish with more or less striations, as in the south, many other tools related to harvesting activities bear an abraded polish, showing this abrasive component different degrees of intensity and disposition along the cutting edge.

In the lake site of La Draga (Bosch *et al.* 2005), dating from the end of the 6th millennium, 42 sickle blades have been studied. The most common cereals were hulled barley and naked wheat, while naked barley and emmer were rarer. In the cave site of Cova del Frare (Martín A. *et al.* 1985), located in the middle of a mountain chain and dated from the mid 5th millennium, 12 sickle elements were detected. The sickle blades recovered among the offerings found in the individual graves of the

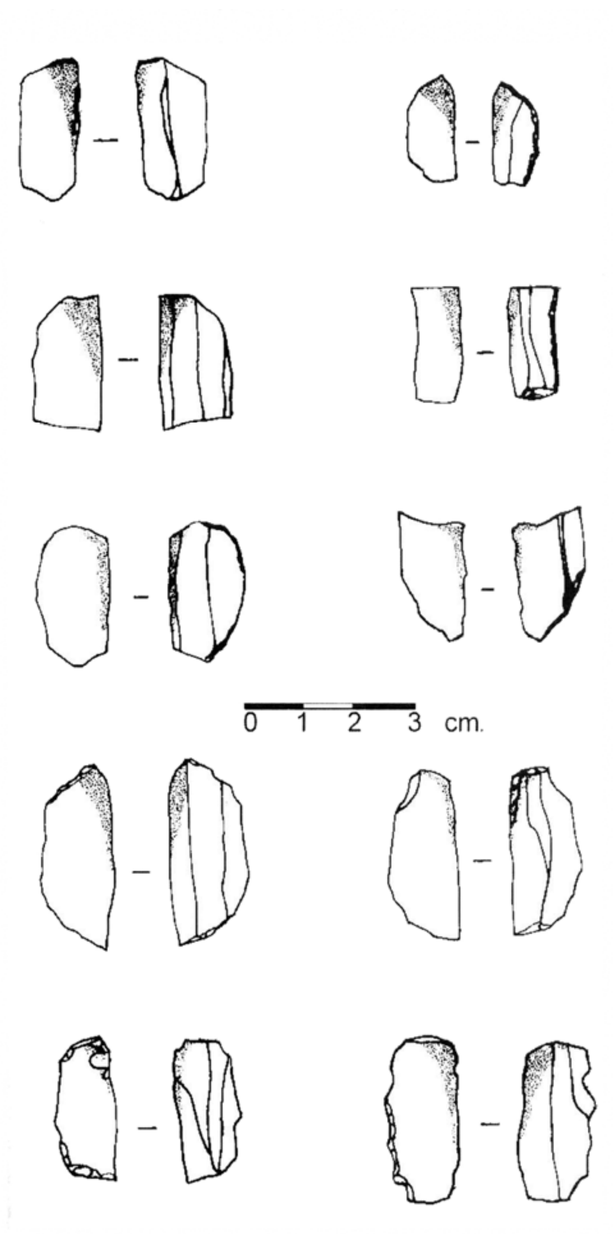

Fig. 4: Sickle elements from Murciélagos de Zuheros.

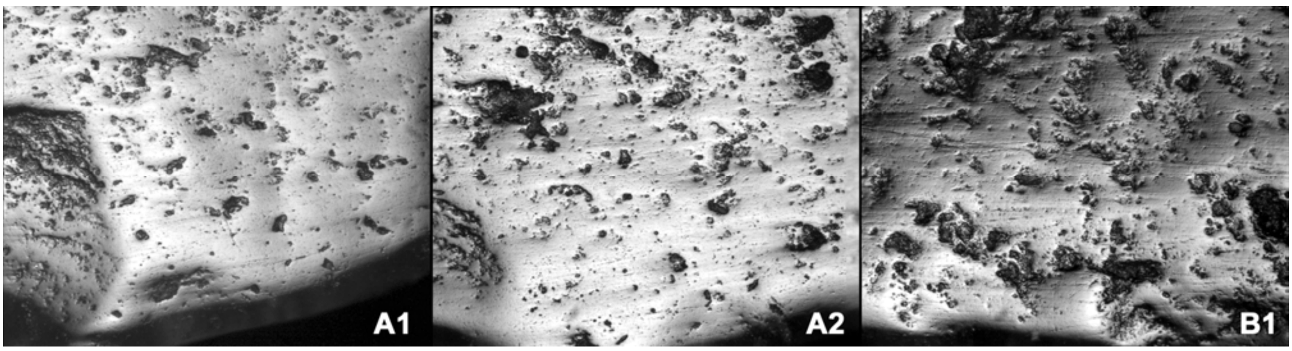

Fig. 5: Typical harvesting traces on two sickle elements from Los Cascajos.
A1: LC239 (100x); A2: LC239 (200x); B1: LC549 (100x).

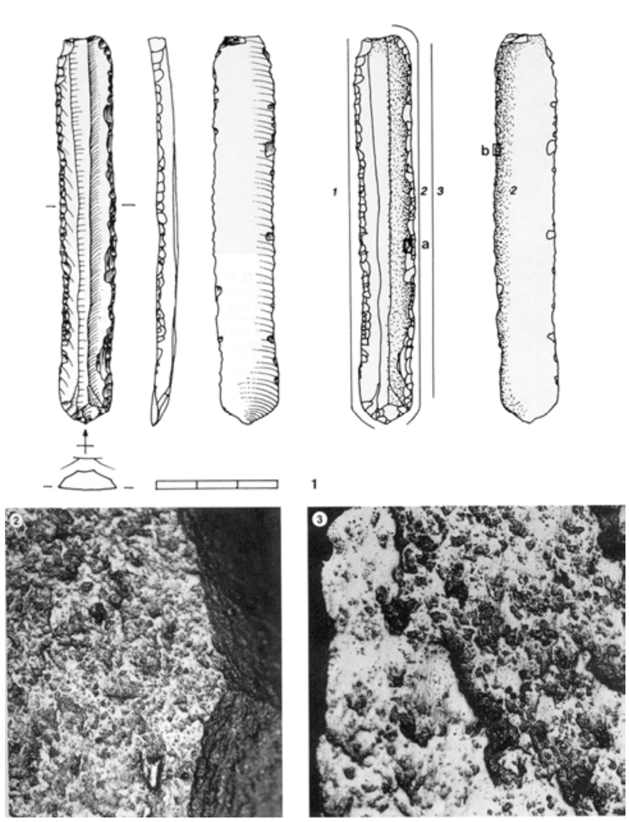

Fig. 6 : Sickle blade from La Grotte de l'Eglise supérieure. Typical harvesting polish.

necropolis of Sant Pau del Camp (Granados *et al*. 1991) (no.13), dating from the 1st half of the 5th millennium (Granados *et al*. 1991), Bòbila Madurell (no. 81), dating from the end of the 5th to the mid 4th millennium, and Camí de Can Grau (Martín M. *et al*. 1997) (no.15), dating from the 1st half of the 4th millennium, have been analyzed too. Garbage pits corresponding to the habitat of Bòbila Madurell (Bordas *et al*. 1993) have also been studied, where 46 sickle blades were found. Einkorn, emmer, naked wheat and barley were the cereals documented for this site. The open air site of Ca n'Isach (Tarrús *et al*. 1996),which is located very close to the northern coast of Catalonia, and has two archaeological levels, the older dating from the 5th millennium and the closest one dating from the 4th millennium, 45 sickle elements have been studied. Pollen analysis documented cereal cultivation in this site (Burjachs, 1990, cited in Tarrús *et al*. 1996). In the variscite mines of Can Tintorer (Villalba *et al.* 1986; Bosch and Estrada 1994) 9 sickle blades were found. Cereal remains consisted of naked barley, hulled barley, naked wheat and emmer.

In Provence, these sickle elements are present from the beginning of the 6th millennium to the 1st half of the 4th millennium. In the early Neolithic rock shelter site of Pendimoun (Alpes Maritimes), in a mountain context, two bladelets with parallel wear are present in the Impressa culture levels, dating from 6000-5500 BC, associated to emmer and naked barley. In the Cardial levels of Pendimoun, dating from 5600 – 5400 BC, 4 short fragments of bladelets with parallel wear are present, one of them bearing a micro-denticulated retouch. Associated cereal remains are naked wheat, naked barley and emmer (Binder *et al.* 1993). In the open air Cardial site of Le Baratin, In the Rhône Valley, near a marsh, dating from 5360 – 5080 BC, 4 blades have a wear resulting from a parallel insertion.

Sickle elements have been found in some sites dating from the 2nd half of the 5th millennium and the 1st half of the 4th millennium: the caves of Fontbregoua (Salernes, Var) and Grotte de l'Eglise supérieure (Baudinard, Var) and the open air sites of Giribaldi (Nice, Alpes Maritimes) and Chiris (Grasse, Alpes-Maritimes). The cave of Fontbregoua was used as a stable in the Middle Neolithic (Pré-Chasséen), in the levels dating from 4600-4300, one bifacial flake with traces showing parallel insertion has been analysed; associated cereals are naked wheat *(Triticum aestivum/durum and Triticum sp)* and, in lower quantity, naked barley *(Hordeum sp. Hordeum vulgare var. nudum)*. The open-air site of Giribaldi, dating from 4600-4200 BC, has been interpreted as a specialized site for intense craft production (mainly ceramic) (Gassin and Binder 2004). Many cereals were consumed: naked wheat, emmer, einkorn and naked barley. One blade shows the gloss in a clear parallel disposition; 3 other blades have probably the same kind of use, but they are fragmented or retouched for recycling and re-use. More sickle elements were found in the Chassey culture levels; most of them show a parallel use-wear. In the cave of Fontbregoua, (4000-3700 B.C.) three blade fragments have a parallel use-wear, but they are broken and the mode of insertion is not sure. Naked wheat was present in the site. In the Grotte de l'Eglise Supérieure, 17 sickle elements were analysed (Gassin 1996). One of them is complete and has a parallel insertion. Three other are broken blades or bladelets and could have the same insertion. At Chiris, 13 sickle elements have been found. They all have a parallel use-wear, but they are so badly damaged that the mode of insertion cannot possibly be inferred.

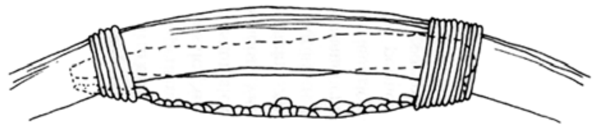

Fig. 7: Reconstruction of sickle blade inserted in a bended shaft (Gassin 1996).

Two sickle blades from L'Eglise and one from Chiris show a particular distribution of gloss. In all three cases the polish is more invasive in the medial zone of the edge, while in both ends it is marginal or simply absent. This distribution should correspond to sickle blades inserted in bended shafts (Fig. 7). One of the blades of L'Eglise and the one from Chiris bear the typical harvesting polish, while the other from L'Eglise show a heavy abrasion in the proximal area of the edge; this abrasion seems to be a voluntary modification of the edge. No information is available about the cereals used in these sites. Most of the sickle blades from these sites are shattered into small fragments showing a parallel wear, so it is impossible to distinguish between the insertion in a straight shaft and the insertion in a bended shaft.

Sickle blades with gloss parallel to the edge are documented at the site of Les Plots at the Early Chassey culture, during the 2nd half of the 5th millennium BC (Vaquer 1995). These unretouched, retouched or micro-denticulated blades, show typical harvesting polish, with a weak abrasive character (Philibert unpublished). This type of sickle coexists with another made out of big blades with gloss disposed in half moon along the edge, as we saw in some blades of L'Eglise and Chiris. Cultivated cereals were naked wheat and naked barley (Marinval unpublished).

In the middle Neolithic levels of Los Cascajos (Navarre), dating from the 2nd half of the 5th millennium, these types of elements are also present. Eleven blades show traces related to harvesting, with different degrees of abrasive component in their polish. Emmer, einkorn and barley were cultivated in this site (Peña-Chocarro and Zapata unpublished).

What was the morphology of the sickles in which these blades were inserted? The length of the blades and the distribution of sickle gloss, parallel to the edge, indicate that the blade was inserted in parallel to a straight shaft. That insertion could correspond to a simple harvesting knife, that is, a straight shaft with two different parts, one intended for handling and one designed for cutting. This harvesting knife might have been used to take the cereal bundles with the free hand and to cut the bundles with the knife. The problem of this harvesting system is that the working motion is quite discontinuous, since the stems have to be gathered before cutting. In fact, the advantage of the bended sickle is that it allows the worker to assemble the stems towards him before cutting the bundle with a sickle. The addition of a specific element to the harvesting knife, a transversal branch, could have been the solution to the problem of gathering the stems. In the lake site of La Draga, five complete sickles have been found so far (Bosch et al. 2005). Three of them show an "L" shape. The straight shaft has a proximal part intended for handling and a distal one to fix the flint blade in parallel, while the perpendicular branch was to be used for gathering the stems together (Fig. 8). Once the stems were assembled with this perpendicular branch, they were fixed with the free hand and they were cut off with the flint blade. This type of sickle, with a lateral branch for gathering the stems has been found in other sites of the Cortaillod culture as well (Schlichtherle 1992). We think that, probably, this was the type of sickle used in the Neolithic sites of Catalonia, Languedoc and Provence,

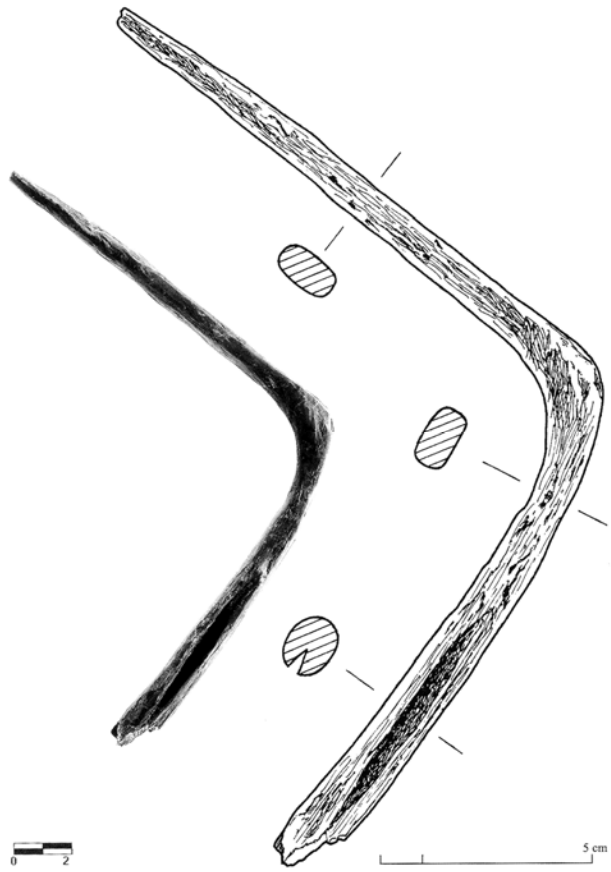

Fig. 8: Sickle with blade in parallel insertion recovered at La Draga (Bosch et al. 2000).

where blades with gloss in parallel to the edge were present.

The use-wear polish of these blades shows certain variability. In some of the blades we observe the typical harvesting polish (Fig. 9A), but other important group of tools show a clear abrasive component related to the plant polish (Fig. 9B). The abrasive component found in the tools is: round edge, deep and numerous striations and pitting. Most of the striations are parallel to the edge, showing the principal component of the motion of the tool, but we also documented oblique and transversal striations, especially near the edge. Thus, we observe some blades in which both the plant and the abrasive polish are interrelated, being the intensity and distribution of the abrasive component variable. Sometimes the abrasive component is limited to the mere edge, being less developed in the inner part of the edge. Other times it is restricted to one end of the edge, in which the abrasive component is progressively replaced by the plant polish, which is dominant in the other end of the edge. The observation of the micro-topography of the polish suggests that the abrasive component scratches the flat plant polish surface.

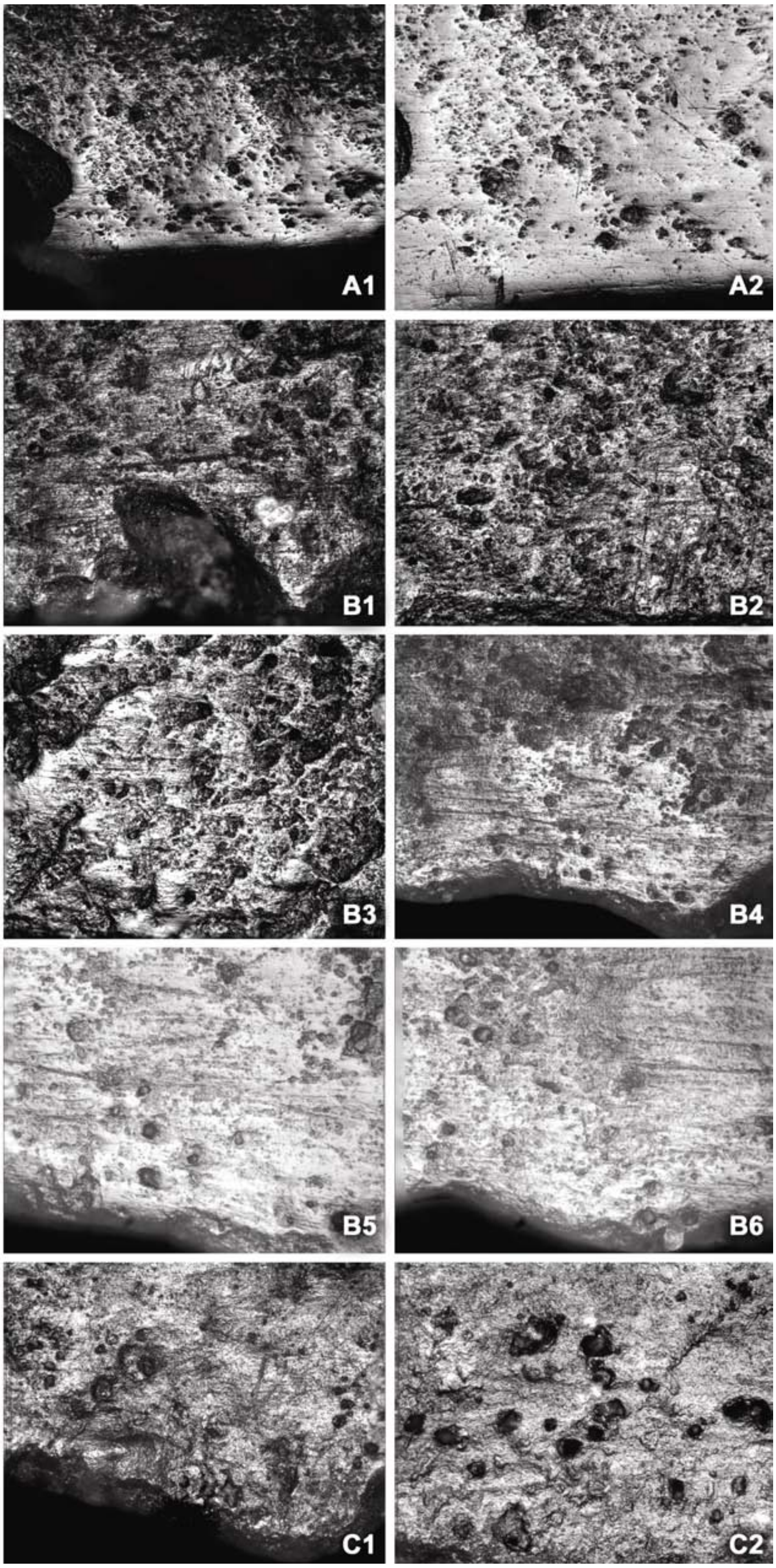

Fig. 9: Use-wear polish in the Middle Neolithic sickle blades from Los Cascajos. A: Typical harvesting polish: A1: LC98 (100x), A2: LC98 (200x). B: Plant polish with abrasive component: B1: LC217 (100x), B2: LC217 (100x), B3: LC217 (200x), B4: LC175 (100x), B5: LC175 (200x), B6 LC175 (200x). C: Abrasive polish: C1: LC404 (100x), C2: LC404 (200x).

The abrasive component of some harvesting tools was documented in use-wear studies quite early (Perlès and Vaughan 1983). It was first explained, as the recycling of harvesting tools for dry hide working. Afterwards, the phenomenon reached such an extension all over the Neolithic that a more general theory was needed to explain it. Some of us have experimentally developed how the abrasive component is generated by the contact of the tool with the ground (Clemente and Gibaja 1998). But, what for? It has been suggested that tools with similar traces could have been made part of a tribulum tool (Anderson 1992, 1998). However, this theory does not quite fit with our archaeological tools:

1. The morphology of the blades (usually long and narrow) is not the right one to be deeply inserted into the tribulum,
2. The amount of detected blades in the sites is quite short in comparison to the amount of blades needed for a tribulum;
3. Some tools show a differential distribution of the abrasive component along the edge, while we would expect more even traces along the edge in a *tribulum* wear;
4. The intensity of the traces, especially those of edge rounding and micropitting, is more developed in the ethnographic *tribulum* elements than in the archaeological hypothetical counterparts.

The contact of the tool with the sediment could have taken place when harvesting, if this activity was carried out very close to the ground. This contact could have also taken place after harvesting, when cutting the straw on the ground. Their goal might have been using the straw for different technical activities (actually, in certain Neolithic Swiss sites ears were stocked complete, showing part of the straw still attached to the basal rachis as the result of knife cutting (Maier 1999). The meaning of this abrasive component is not completely clear, but we think that the most probable explanation for such an erosion was the secondary use of the sickle blades in other technical activity as the cutting of the straw on the ground. It could explain the variability in the degree and position of the abrasive component along the active edge, just as the fact that the abrasion would alter the previous plant polish. Some blades only show the abrasive component and no typical plant polish (Fig. 9C). This can be easily explained by the unique use of the tool in the task of straw cutting on the ground.

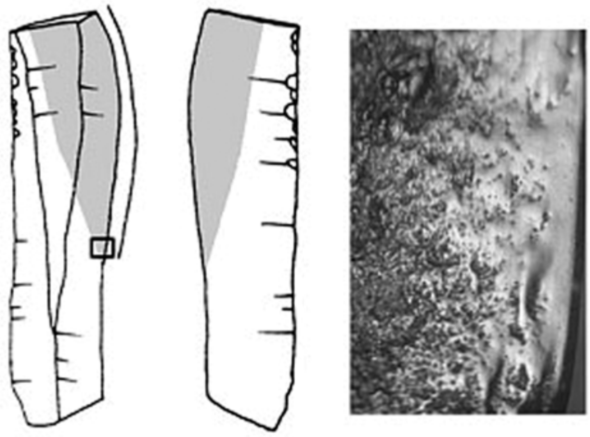

Fig. 10: Sickle with blade in oblique insertion recovered at La Draga (Bosch *et al*. 2000).

Despite most of the sickle elements in these 3 regions show the distribution and nature of use-wear polish that we have pointed out, in some sites, some other types of sickles are also present, although always in a minor proportion. Some of the sickle blades of La Draga, Lombard and Fontbregoua bear an oblique disposition gloss (Fig. 10). Lombard is an early Neolithic cave site, dating from 5300-4850 BC, only occupied for the summer when wild animals were hunted and meat was prepared. No cereal has been found whatsoever (Binder 1991). Fontbregoua is a cave used for shepherding; the oblique sickle element was found in the Chassey culture levels (1st half of the 4th millennium BC), associated to naked wheat.

The length of the blades found in these three sites indicates that they were inserted as unique cutting elements in the sickles. This type of insertion was also present in the site of Egolzwill 3, in the old Cortaillod culture, dating from the 2nd half of the 5th millennium (Schlichtherle 1992). This interpretation is reinforced by the complete sickles recovered in the lake site of La Draga (Bosch et al. 2005). The sickles consisted in a main straight shaft, in which a flint blade was obliquely inserted, and a branch which was transversal to the main shaft, that was used for gathering the cereal stems together when harvesting (Fig. 11). The sickle blades with oblique gloss coming from the 3 mentioned sites, show typical harvesting polish, without any abrasive component.

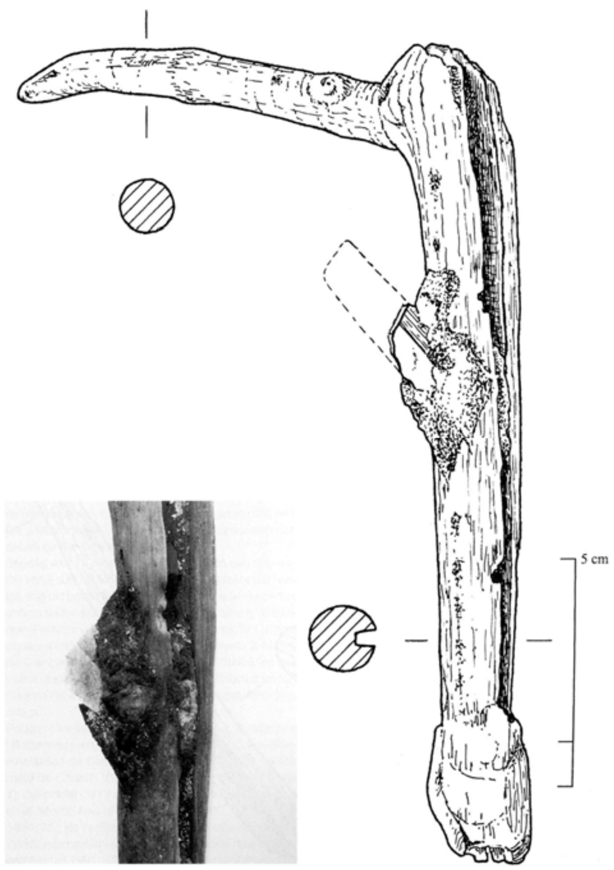

Fig. 11: Sickle blade with oblique gloss distribution from La Draga.

Harvesting without sickles in Cantabrian Spain

For the Cantabrian region the beginning of the Neolithic showed a certain delay with respect to the southern neighbour regions. The first proofs of cereal agriculture date from the end of the 5th millennium, in the sites of Kobaederra (Zapata 2002) and El Mirón (Peña-Chocarro and Zapata, unpublished). Moreover, the process of incorporation of the Neolithic way of living by the Cantabrian populations seems to be quite slow and progressive (González Urquijo et al. 1999). Wild resources (hunting and gathering) are more important than livestock and agriculture at least for 5 centuries approximately. The delay and progressive acceptance of the Neolithic is probably due to the fact that these Atlantic coastal environments are very rich in wild resources, allowing the hunting and gathering economy to be perpetuated. Indeed, these are humid and less insolated environments not making them proper for cereal growing.

Some authors have stressed the absence of sickle elements in the Cantabrian Neolithic, has been interpreted as a proof of the lack of agriculture. However, recent archeobotanical analysis (Zapata 2002) has demonstrated that cereals (emmer, naked wheat and barley) are present in some Neolithic sites as El Mirón, Lumentxa, Pico Ramos and Kobaederra. Our use-wear analysis of the lithic tools recovered in the sites of El Mirón, Kobaederra

Fig. 12: Harvesting einkorn by plant uprooting in Mokrisset (Northern Morocco).

Fig. 13: Harvesting spelt (*Triticum spelta*) with mesorias, in Zureda (Asturias, Spain).

and Pico Ramos has confirmed that sickle elements were not used in these sites. The existence of cereal remains and the lack of flint sickle elements indicate that another alternative method to harvesting with sickles was implemented (Ibáñez et al. 2001).

Alternative methods to sickle harvesting are ear plucking or plant uprooting (Fig. 12). Ear plucking can be applied when harvesting hulled wheat as the basal rachis of the ear is fragile. Ear plucking can be carried out by hand (Peña-Chocarro 1997) or by using a tool to snatch off the ears from the straw. For this activity, two wooden logs of around 50 cm, can be used. This tool is still in use in the Asturias for spelt harvesting (Fig. 13) and is called mesorias (Ortiz and Sigaut 1980; Peña-Chocarro 1996 and 1999). A similar tool is also documented in the Caucasus (Steensberg 1943; Sigaut 1978) and the Nepal (Toffin 1983). The uprooting method is documented by Plinius in the Roman period.

Trying to explain the variability

In our study of the harvesting methods during the Neolithic in SW Europe, we have detected three different geographical areas. The first one is SE Iberian Peninsula, where curved sickles with dented edges were in use. The second one spreads along the area of the Lyon Gulf, where sickles with straight insertions, and incidentally other types of sickles (with one oblique insertion or with parallel insertion in curved sickles) were preferred. Finally, we noted Cantabrian Spain, where alternative methods to the use of sickles were used.

Let us begin by dealing with the third case. Some regularities are present in our study of the ethnographic cases where ear plucking or plant uprooting were used. In all cases ear plucking and plant uprooting are preferred when the extension of the cultivated fields is limited. Other factors that could induce to the use of these methods are ecological conditions (humid mountain climates play in favour of these methods) or the scarce technical capability of the person who is harvesting (Ibáñez et al. 2001).

During the Neolithic, Cantabrian Spain shared similar features with the ethnographic places where alternative methods to sickle harvesting were used. Neolithic communities settled down in this environment with mountainous humid atmospheres. These people relied in wild resources very much being crops a minor part of daily subsistence. Thus, the extension of the fields was nor that important. Moreover, hulled wheat was the preferred crop, allowing the use of the ear plucking method, either by using a mesorias type of tool or just using their hands. Besides, in this humid environment, the harvesting season was quite long, making it possible to use slower harvesting methods. In fact, sickles allow the development of very quick systems of crop collection, although the post-harvesting activities are heavy duty tasks (threshing, winnowing, etc.). This method is adequate when extended cultivated surfaces must be harvested in a short period of time, especially in dry environments during the harvesting season.

Different types of sickles were used in the area of Catalonia, Languedoc, and Provence with respect to the Spanish Levantine coastal area. The differences in the characteristics of the use-wear polish indicate the way crop processing was also particular to each area. In the North, cereal bundles were probably processed by separating the ears from the straw. This activity must have been used to stock complete ears, which would improve the preservation of the crops in the regions where winters are more humid. When the need arose, these ears could be progressively converted into grain and then the grain into flour during the Autumn-Winter-Summer. This way of stocking the ears and processing the crops is well documented in the Neolithic sites in Switzerland (Maier, 1999). On the contrary, in the South of the Iberian Peninsula the crops must have been threshed and stocked in the form of grain. The use of both types of sickles in each area seems to begin with the appearance of the first farming communities in the two areas, during the 6th millennium, and it remains the same up to the 4th millennium. In this sense, we can speak about the existence of two technical traditions of cereal harvesting, as both are developed in two neighbouring regions during a parallel span of time.

In the site of Los Cascajos we have observed a shift in the technical tradition from the level dating from the 6th millennium with respect to the level dating from the mid 5th millennium. In the older level they would employ the southern sickle type. In the more recent level, the northern type of sickle would be used, and the processing of the crops by cutting the straw on the ground would be carried out. One should notice that this site is located in the Ebro valley, an area that could have been submitted to the cultural influence of both, NE and SE areas. It looks like if for the first Neolithic, the site was more related to the South, as far as harvesting technical tradition is concerned, while in the more recent levels the influence changed, being more related to the North-East.

Besides these two main technical traditions, associated to different types of sickles, we can distinguish the use of other types of sickles in the Catalonia-Languedoc-Provence area. Although the most common sickle in the North was made by inserting flint blades in parallel to the shaft, two other models have been documented in some sites. In La Draga, Lombard and Fontbregoua, isolated sickle blades were obliquely inserted to the shaft. This type of insertion has also been documented in the Swiss site of Egozlwill III (Schlichtherle 1992). We are dealing with two sites of the early Neolithic (La Draga and Lombard), dating from the end of the 6th millennium, and a mid Neolithic one (Fontbregoua) dating from mid 5th millennium. The oblique insertion of one blade seems to allow a deeper cutting capability compared to the straight one. Therefore, this type of insertion might have been used when cereal stems were too scattered. Another type of sickle used in the North was made by inserting flint blades in parallel to curved shafts. This type of blade was used in L’Eglise, Les Plots and Chiris, in a Chassey cultural context, dating from the 1st half of the 4th millennium BC.

Conclusions and perspectives

The variability in the harvesting technology put forward by the first Neolithic communities in SW Europe gives some information about the way in which agriculture was spread to these areas, as the conditions in which this early agriculture was carried out. The distribution in a map of the two main technical traditions shows a dichotomy between the northern and southern Mediterranean areas of SW Europe. These two technical traditions seem to be already present in the older Neolithic communities of both areas, and stay the same for more than one millennium. The site of Los Cascajos, which is in an intermediate area, seems to bear a southern influence for the older periods and a northern influence for the more recent ones. How could all these facts be explained?

If we accept, just as we established at the beginning of this paper, that agriculture technology must be tightly tied to the spread of seeds, then we could infer that this variability might be an indicator of two different origins of agriculture in the Iberian Peninsula and SE France. These two sources remained as two differentiated technical traditions for many centuries. If this were the case, the example of Los Cascajos could suggest that the southern focus was responsible for the spread of agriculture in inland Iberian Peninsula, but in the following centuries the dynamism of the northern focus influenced this area more intensively.

Another alternative or even complementary explanation would deal with the different ecological conditions of both regions or with differences in the most common types of harvested cereals. Maybe the dented edges are more suitable for cutting dry cereal stems. We have observed that a huge variety of cereals were cultivated both, the North and the South, and, at a first glimpse, there does not seem to exist big differences among them. However, this is a qualitative comparison and it could be crucial to evaluate the importance of every type of cereal in both areas.

For the time being, these ideas must be considered as hypothesis of research, as we need to study some more Neolithic sites. We have to gather some information on the harvesting techniques in Portugal and from inland Iberian Peninsula. We are going to develop these lines of explanation in our future research projects, taking into account other factors that could reinforce the definition and possible origin of these two technical traditions. Nevertheless, it is worth mentioning that the distribution of the different models of exploitation of animal resources in western Mediterranean areas during the Neolithic fits well with our model of two technical areas for agriculture (Vigne 1998). Catalonia, Languedoc and Provence constitute a region with similar use of animal resources in contrast with the regions to the South of the Ebro River in the Iberian Peninsula. Another matter to be developed in upcoming papers will be how a similar distribution of sickle morphology might have happened in the Italian Peninsula and the Alps. We assume the curved shaft with dented edges was restricted to the South (example from La Marmotta) and the straight ones with lateral branches spread to the North (Swiss examples).

Harvesting technology in Cantabrian Spain can be explained by the specific characteristics of the regional Neolithic. In a very rich natural environment the last groups of hunter gatherers maintained their way of living longer than in other areas of the Iberian Peninsula. When the Neolithic influences began to be accepted, at the end of the 5th millennium BC, local inhabitants very slowly changed their way of living, still relying on wild resources as a base for their subsistence. At the beginning, the Neolithic must have had a mosaic distribution, showing this way the coexistence of human groups at different levels of acculturation (see for example the contrast of the site of Arenaza with respect to Herriko Barra). This model of cultural change has already been established for other areas of the Atlantic Europe (Arias 1999). In all these areas the first agriculture does not show the use of sickles. We think that the marginal economical relevance of crops and the consequent small size of the fields could have allowed the use of technologies of low technical investment, specially bearing in mind that local humid environments permitted the extension of the harvesting season, and, therefore, the use of slower harvesting methods.

All in all, we have shown some of the complex cultural implications when trying to explain why a precise way of collecting crops was chosen. We would like to finish by stressing the preliminary nature of these reflections, still under research.

Bibliography

ANDERSON, P.C., 1992. Experimental cultivation, harvesting and threshing of wild cereals and their relevance for interpreting the use of Epipaleolithic and Neolithic artifacts. *In*: P.C. ANDERSON, ed. *Prehistoire de l'agriculture: nouvelles approches experimentales et ethnographiques*, 179-210. Paris: Éditions du CNRS, 6.

ANDERSON, P.C., 1998. The history of harvesting and threshing techniques for cereals in the prehistoric Near East. *In*: C.O. QUALSET, G. WILLCOX, AND J. VALKOUN, eds. The Origins of agriculture and crop domestication. Alepo: ICARDA / IPIGRI / GRCP / FAO, 141-155.

ARIAS, P., 1999. The origins of the Neolithic along the Atlantic coast of continental Europe: a survey. Journal of World Prehistory*, 13, 403-464.*

BERNABEU, J. AND OROZCO, T., 2005. Mas d'Is (Penáguila, Alicante): un recinto monumental del VI milenio cal BC. *In*: P. ARIAS, R. ONTAÑÓN AND C. GARCÍA-MONCÓ, eds. *III Congreso del Neolítico en la Península Ibérica*, 485-495. Universidad de Cantabria, Santander.

BINDER, D., 1991. *Une économie de chasse au Néolithique Ancien. La grotte Lombard à Saint-Vallier-de-Thiey (Alpes Maritimes)*. Paris: Éditions du CNRS , 5.

BINDER, D., BROCHIER, J. E., DUDAY, H., HELMER, D., MARINVAL, P., THIÉBAULT, S. AND WATTEZ, J., 1993. L'abri Pendimoun à Castellar (Alpes-Maritimes) : nouvelles données sur le complexe culturel de la céramique imprimée méditerranéenne dans son contexte stratigraphique. *Gallia Préhistoire*, 35, 177-251.

BORDAS, A., DIAZ, J., POU, R., PARPAL, A. AND MARTIN, A. (1993). "Excavacions arqueològiques 1991-1992 a la Bòbila Madurell-Mas Duran (Sant Quirze del Vallès, Vallès Occidental)". *Tribuna d'Arqueologia*, 1991/1992, 31-47.

BOSCH, J. AND ESTRADA, A., 1994. El Neolític Postcardial a les mines prehistòriques de Gavà (Baix Llobregat), *Rubricatum 0,* Museu de Gavà.

BOSCH, A, TARRÚS, J. AND CHINCHILLA, J., 2000. *El poblat lacustre neolític de la Draga. Excavacions de 1990 a 1998*. Girona: Monografies del CASC 2.

BOSCH, A, TARRÚS, J.Y., CHINCHILLA, J.J. AND PALOMO, A., 2005. Nuevas aportaciones del yacimiento lacustre de La Draga (Banyoles, Girona) al Neolítico Antiguo peninsular. Las campañas del 2000 al 2003. *In*: P. ARIAS, R. ONTAÑÓN, AND C. GARCÍA-MONCÓ, eds. *III Congreso del Neolítico en la Península Ibérica*, 497-507. Universidad de Cantabria, Santander.

BUXÓ, R., 1997. *Arqueología de las plantas*. Barcelona: Crítica.

BUXÓ, R., ROVIRA, N. AND SAÜCH, C., 2000. Les restes vegetals de llavors i fruits. *In*: A. BOSCH, J.Y. TARRÚS AND J. CHINCHILLA, eds. *El poblat lacustre neolític de la Draga. Excavacions de 1990 a 1998*. Girona: Monografies del CASC 2, 129-139.

CLEMENTE, I. AND GIBAJA, J.F., 1998. Working processes on cereals: an approach through microwear analysis. *Journal of Archaeological Science*, 25 (5), 457-464.

DOMINGO, R.A., 2005. La funcionalidad de los microlitos geométricos: bases experimentales para su estudio. *Monograías arqueológicas*, 41. Zaragoza: Universidad de Zaragoza,.

FUGAZZOLA DELPINO, M.A. AND PESSINA, A., 1999. Le village néolithique submergè de La Marmotta. *In*: *Le Néolithique du Nord-Ouest méditerranéen. Actes du XXIV Congès Préhistorique de France*. Carcassonne, 26-30 septembre1994, 35-38.

GARCÍA, O., GIBAJA, J.F., BERNABEU, J. AND OROZCO, T., in press. Tecno-tipología y funcionalidad de los utensilios líticos tallados en las primeras ocupaciones del Neolítico Antiguo del Mas d'Is (Penáguila, Alacant). 4º Congreso de Arqueología Peninsular. Faro, 2004.

GARCÍA GAZÓLAZ, J. AND SESMA, J., 1999. Talleres de sílex versus lugares de habitación. Los Cascajos (Los Arcos, Navarra), un ejemplo de neolitización en el alto valle del Ebro. II Congrés del Neolitic à la Peninsula Ibèrica. *Saguntum-Plav, extra 2,* 343-350.

GASSIN, B., 1991. Etude fonctionnelle. *In*: D. BINDER, ed. *Une économie de chasse au Néolithique ancien. La grotte Lombard à Saint-Vallier-de-Thiey (Alpes Maritimes).* Paris: Éditions du CNRS, 5, 51-60.

GASSIN, B., 1996. *Évolution socio-économique dans le Chasséen de la grotte de l'Église supérieure (Var). Apport de l'analyse fonctionnelle des industries lithiques.* Paris: Éditions du CNRS, 17.

GASSIN, B., ed., 1997. *Grasse «Usine Chiris». Les occupations préhistoriques*. DFS de fouille préventive. Aix-en-Provence: SRA-PACA.

GASSIN, B., 1999. La structure fonctionnelle des industries lithiques du complexe chasséen en Provence. *In*: *XXIV Congrès préhistorique de France, Le Néolithique du Nord-Ouest méditerranéen*. Carcassonne, septembre 1994, 119-128.

GASSIN, B. AND BINDER, D., avec la collaboration de SENEPART, I., 2004. Statut et fonction des productions d'éclats au Néolithique: exemples provençaux. *In*: *Congrès Préhistorique de France, Nanterre, novembre 2000.*

GIBAJA, J.F., 1997. Anàlisi funcional del material lític de la necròpolis del Camí de Can Grau. *In*: M. MARTI, R. POU

AND X. CARLUS, eds. *Excavacions arqueològiques a la Ronda Sud de Granollers, 1994. La necròpolis del Neolític Mitjà i les restes romanes del Camí de Can Grau (La Roca del Vallès, Vallès Oriental) i els jaciments de Cal Jardiner (Granollers, Vallès Oriental)*. Excavacions Arqueològiques a Catalunya. 14, 128-141.

GIBAJA, J.F., 1999. Análisis del utillaje lítico de la necrópolis de Sant Pau del Camp (Barcelona): estudio morfológico y funcional. *In*: *II Congrés del Neolític a la Península Ibèrica (Valencia, 1999.)*. *Saguntum*, extra 2, 187-192.

GIBAJA, J.F., 2000. La función del instrumental lítico tallado de la Draga (Banyoles, Pla de l´Estany). *In*: A. BOSCH, J. CHINCHILLA AND J. TARRÚS, eds. *El poblat lacustre neolític de la Draga. Excavacions de 1990-1998.* Monografies del Casc. 2, 206-213.

GIBAJA, J.F., 2002. Las hoces neolíticas del noreste de la Península Ibérica. *Préhistoire Anthropologie Méditerranéennes*, 10, 83-96.

GIBAJA, J.F., 2003. *Comunidades Neolíticas del Noreste de la Península Ibérica. Una aproximación socio-económica a partir del estudio de la función de los útiles líticos*. BAR International series, 1140. Oxford: Hadrian Books Ltd.

GIBAJA, J.F, 2004. Neolithic Communities of the Northeastern Iberian Peninsula: Burials, Grave Goods, and Lithic Tools. *Current Anthropology*, 45, 679-685.

GÓNGORA, M., ed., 1868/1991. *Antigüedades prehistóricas de Andalucía*. Universidad de Granada, Edición facsimil.

GONZÁLEZ URQUIJO, J.E., IBÁÑEZ, J.J., PEÑA, L., GAVILAN, B. AND VERA, J.C., 1994. Harvesting tasks in the Neolithic levels of 'Los Murcielagos' Cave. An Archeobotanical and Functional approach. *Helinium*, 34 (2), 322-341.

GONZÁLEZ URQUIJO, J.E., IBÁÑEZ, J.J., PEÑA, L., GAVILAN, B. AND VERA, J.C., (2000). El aprovechamiento de recursos vegetales en los niveles neolíticos del yacimiento de Los Murciélagos, en Zuheros (Córdoba). Estudio arqueobotánico y de la función del utillaje. *Complutum*, 11, 171-189.

GONZALEZ, J.E., IBAÑEZ, J.J. AND ZAPATA, L., 1999. El V milenio Cal. BC en el País Vasco atlántico: la introducción de la agricultura y la ganadería. II Congreso de Neolítico en la Península Ibérica, *Saguntum-Plav*, extra 2, 559-564.

GOÑI QUINTEIRO, A., RODRÍGUEZ RODRÍGUEZ, A., CAMALICH MASSIEU, M.D., MARTÍN SOCAS, D. and FRANCISCO ORTEGA, M.I., 1999. La tecnología de los elementos de adorno personal en materias minerales durante el Neolítico Medio. El ejemplo del poblado de Cabecicos Negros (Almería). II Congrés del Neolitic à la Peninsula Ibèrica. *Saguntum-Plav*, extra 2, 163-170.

GRANADOS, O., PUIG, F. AND FARRÉ, R., 1991. La intervenció arqueològica a Sant Pau del Camp: un nou jaciment prehistòric al Pla de Barcelona. *Tribuna d'Arqueologia*, 1990-1991, 27-32.

HOPF, M., 1966. Triticum monococcum y Triticum dicoccum en el Neolítico Antiguo español. *Archivo de Prehistoria Levantina*, XI, 53-80.

IBÁÑEZ, J.J., 2001. La función de los útiles retocados del yacimiento de Kobaederra (Oma, Bizkaia). Campañas de 1995,96 y 97. *Isturitz*, 11, 225-244.

IBÁÑEZ, J.J. AND ZAPATA, L., 2001. La función de los útiles de sílex del yacimiento de Pico Ramos (Muzkiz, Bizkaia). *Isturitz*, 11, 245-257.

IBÁÑEZ, J.J., GONZÁLEZ URQUIJO, J., PEÑA-CHOCARRO, L., ZAPATA, L. AND BEUGNIER,V., 2001. Harvesting without sickles. Neolithic examples from humid mountain areas. *In*: S. BEYRIES AND P. PETREQUIN, eds. *Ethno-Archaeology and its Transfers*. BAR International Series 983.

JUAN CABANILLES, J., 1984. El utillaje neolítico en sílex del litoral mediterráneo peninsular. *Saguntum*, 18, 49-102.

LÓPEZ, P., 1980. Estudio de semillas prehistóricas en algunos yacimientos españoles. *Trabajos de Prehistoria*, 37, 419-432.

MAIER,U., 1999. Agricultural activities and land use in a Neolithic village around 3900 BC: Hornstaad Hörnle I A, Lake Constance, Germany. *Vegetation History and Archaeobotany*, 8, 87-94.

MARINVAL, P., unpublished. *Semences archéologiques du Chasséen ancien aux Plots, Berriac (Aude)*. Toulouse: Centre d'Anthropologie.

MARTÍ, M., POU, R. AND CARLÚS, X., 1997. *Excavacions arqueològiques a la Ronda Sud de Granollers, 1994. La necròpolis del Neolític Mitjà i les restes romanes del Camí de Can Grau (La Roca del Vallès, Vallès Oriental) i els jaciments de Cal Jardiner (Granollers, Vallès Oriental).* Barcelona: Excavacions Arqueològiques a Catalunya, 14.

MARTÍN SOCAS, D., BUXÓ I CAPDEVILA, R., CÁMALICH MASSIEU, M.D. AND GOÑI QUINTEIRO, A., 1999. Estrategias subsistenciales en Andalucía Oriental durante el Neolítico. Actes del II Congrès del Neolític a la Península Ibérica. Actas del II Congrés del Neolític a la Península Ibérica (Valencia, 1999). *Saguntum-Plav*, Extra 2, 25-30.

MARTÍN, A., BIOSCA, A. AND ALBAREDA, M.J., 1985. Excavacions a la Cova del Frare (Matadepera, Vallès Occidental). Dinàmica ecològica, seqüència cultural i cronologia absoluta. *Tribuna d'Arqueologia*, 1983-1984, 91-103.

ORTIZ, F. AND SIGAUT, F., 1980. La moisson de l'epeautre avec les 'mesorias' dans deux villages asturiens. *Bulletin de la Societé d'Ethnozoologie et d'Ethnobotanique*, 8, 2-4.

PEÑA CHOCARRO, L., 1996. *In situ* conservation of hulled wheats species: the case of Spain. *In*: S. PADULOSI, K. HAMMER AND J. HELLER, eds. *Hulled Wheats*. Rome, 129-146.

PEÑA-CHOCARRO, L. 1999. *Prehistoric Agriculture in Southern Spain during the Neolithic and the Bronze Age. The application of ethnographic models*. BAR International Series 818. Oxford: Archaeopress.

PEÑA-CHOCARRO, L., ZAPATA, L., GONZALEZ, G. AND IBAÑEZ, J.J., 2000. Agricultura, alimentación y uso del combustible: aplicación de modelos etnográficos en arqueobotánica. Ibers, agricultors, artesans i comerciants. 2ª Reunió sobre economia en el món ibèric. *Saguntum*, extra 3, 403-422.

PÉREZ JORDÁ, G., 2005. Nuevos datos paleocarpológicos en niveles neolíticos del País valenciano. *In*: P. ARIAS, R. ONTAÑÓN AND C. GARCÍA-MONCÓ, eds. *III Congreso del Neolítico en la Península Ibérica*. Santander, 73-81.

PERLES, C. AND VAUGHAN, P.C., 1983. Pieces lustrees, travail des plantes et moissons a Franchthi (Grece) (Xeme-IVeme mill. B.C.). *In*: M.C. CAUVIN, ed. *Traces d'utilisation sur les outils néolithiques du Proche Orient*, Travaux de la Maison de l'Orient, 5, 209-224.

PHILIBERT, S., unpublished. *Les activités et leur répartition spatiale sur le camp néolithique des Plots (Berriac, Aude). Analyse fonctionnelle de l'industrie lithique*. Toulouse: Centre d'Anthropologie.

RAMOS, J., MONTAÑÉS, M., PÉREZ, M., CASTAÑEDA, V., HERRERO, N.,GARCÍA, M.E. AND CÁCERES, I., eds., 1999. *Excavaciones arqueológicas en La Mesa (Chiclana de la frontera, Cádiz). Aproximación al estudio del proceso histórico de su ocupación. Campaña de 1998*. Serie Monográfica. Arqueología en Chiclana de la Frontera nº 1. Exmo. Ayuntamiento de Chiclana de la Frontera, Fundación VIPREN.

RODRIGUEZ RODRIGUEZ, A.C., 1994. À propos de lames à bords fortement émoussés du Néolithique et du Chalcolithique andalou. *Helinium*, 34 (2), 225-234.

RODRÍGUEZ RODRÍGUEZ, A., 1999. Análisis funcional del instrumental lítico tallado del poblado de Cacecicos Negros. *In*: M.D. CAMALICH MASSIEU AND D. MARTÍN SOCAS, eds. *El territorio almeriense desde los inicios de la producción hasta fines de la Antigüedad. Un modelo: la depresión de Vera y cuenca del Almanzora*. Arqueología Monografías. Sevilla: Junta de Andalucía, 225-235.

RODRÍGUEZ RODRÍGUEZ, A.C. 2004. Análisis funcional de los instrumentos líticos tallados. *In*: D. MARTÍN SOCAS, ed. *La Cueva de El Toro (Sierra de El Torcal, Antequera-Málaga). Un modelo de ocupación ganadera en territorio andaluz: entre el VI y II milenios A.N.E.* Arqueología Monografías. Junta de Andalucía, Consejería de Cultura.

RODRÍGUEZ RODRÍGUEZ, A.C., MARTÍN SOCAS, D., CÁMALICH MASSIEU, M.D. AND GONZÁLEZ QUINTERO, P., 1996. Las actividades tecnoeconómicas en "Cueva del Toro" (Antequera - Málaga) a través del análisis funcional. *Actas del I Congrès de Neolític a la Península Ibèrica, Formació i implantació de les comunitats agrícoles*. Gavà-Bellaterra, 1995. *Rubricatum*, 1, 161-167.

SAVARD, M., 2000. Etude carpologique de la Baume de Fontbrégoua, Salernes (Var.). Paris : Mémoire de DEA.

SCHLICHTHERLE, H., 1992. Jungsteinzeitliche Entergeräte am Bodensee. *Plattform,* 1/1992, Unteruldingen, 22-44.

SIGAUT, F., 1978. Identification des techniques de récolte des graines alimentaires. *Journal d'agriculture traditionnelle et de botanique appliqué*, 25, 3, 146-161.

STEENSBERG, A., 1943. *Ancient harvesting implements. A study on archaeology and human geography.* Copenhagen.

TARRÚS, J., CHINCHILLA, J., MERCADAL, O. AND ALIAGA, S., 1996. Fases estructurals i cronològiques a l'habitat neolític de Ca N'Isach (Palau-Savardera, Alt Empordà). I Congrés del Neolític a la Península Ibèrica. *Rubricatum*, 1, 429-438.

TOFFIN, G., 1983. Moisson aux baguettes au Népal central. *Objets et Mondes*, 23 (3-4), 173-176.

UNGER-HAMILTON, R., (1988). *Method in Mocrowear Analysis. Prehistoric Sickles and Other Stone Tools from Arjoune, Syria*. BAR International Series 435.

VAQUER, J., 1995. Les Plots (Berriac). *In*: J. GUILAINE, ed. *Temps et espace dans le bassin de l'Aude du Néolithique à l'Age du fer*. Toulouse: Centre d'Anthropologie, 14-17.

VAYSON, A., 1918-1919. Faucille préhistorique de Solferino. Etude comparative. L'Anthropologie*, 29, 393-422.*

VIGNE, J.-D., 1998. Faciès culturels et sous-système technique de l'acquisition des ressources animales. Application au Néolithique ancien méditerranéen. *In*: A. D'ANNA AND D. BINDER, eds. *Production et identité culturelle*. Actes de la deuxième session des Rencontres méridionales de préhistoire récente. Antibes: APDCA, 27-46.

VILLALBA, M.J, BAÑOLAS, L., ARENAS, J. AND ALONSO, M., 1986. *Les mines neolítiques de Can Tintorer. Gavà*. Excavacions 1978-1980, Barcelona, Exacavacions arqueològiques a Catalunya, 6, Generalitat de Catalunya.

ZAPATA, L., IBÁÑEZ, J.J. AND GONZÁLEZ URQUIJO, J.E., 1997. El yacimiento de la cueva de Kobaederra (Oma, Kortezubi, Bizkaia). Resultados preliminares de las campañas de excavación 1995-1997. *Munibe*, 49, 51-63.

ZAPATA, L., 2002. *Origen de la agricultura en el País Vasco y transformaciones en el paisaje: Análisis de restos vegetales arqueológicos*. Kobie. Anejo 4. Bilbao: Diputación Foral de Bizkaia.