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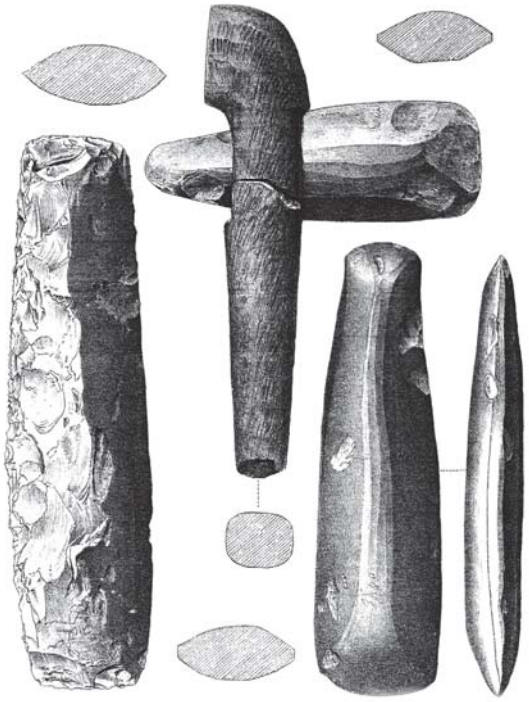
Stone Axe Studies III



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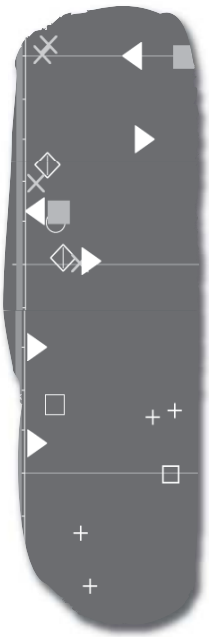

Social and economic organisation of stone axe production and distribution in the western Mediterranean

Abstract

The question of social value is central to the study of stone axe distributions. This paper argues that a dialectical approach to the concept of value, seen as a consequence of the interplay between material constraints, social institutions and individual strategy, is essential for our understanding of prehistoric value systems. With this argument established, the paper goes on to analyse the social value of stone axes on the Northern margins of the Western Mediterranean.

The growing number of petrographic and archaeological studies undertaken during the last decade or so, mean that we can to begin to define the spatial and temporal patterns of axe production and circulation from the Alps to the Sierra Nevada during the 6th to 3rd millennia BCE. This suggests that next to regional supply strategies, long distance exchange networks developed and became the target of political control at particular times and places. However, the economic importance of these exchange relations remained relatively limited, and did not always go hand in hand with the centralisation of power. Expanded exchange could just as well serve as a mechanism to strengthen social bonds in societies where we observe an increasing division of tasks in the economic sphere.

In general, the prehistoric axe distribution patterns of the western Mediterranean, despite their rather uniform appearance, seem to be a consequence of different forms of social organisation and value systems.

Introduction

During the last two decades a growing body of petrographic analysis of stone axes has been presented by different research projects in Italy, France and Spain. The characterisation of hundreds of artefacts has provided detailed information about the range of rocks used by later prehistoric societies in different regions. Moreover, a series of spatial and temporal patterns have been proposed in relation to the circulation of different raw materials from the 6th to the 2nd millennia BCE (Ricq-de Bouard 1996; Orozco-Köhler 2000; Thirault 2005; Risch & Martínez 2008). These results make it possible for the fist time to compare the different regional and inter-regional situations between the Alps, the Pyrenees and the Betic range, which constitute the three large orogenic formations that characterise the northern side of the western Mediterranean.

However, our understanding of the social and economic structures behind the observed spatial and temporal patterns is still too limited. We need to move beyond the dominant "petrographic focus" and pay greater attention to other environmental and social dimensions of axe production, distribution and consumption.

An environmental approach is necessary in order to achieve a better understanding of the areas of raw material extraction as well as the properties of the selected rocks. Both aspects represent *natural constraints* to stone axe production and require a slightly different methodological approach than so far followed by previous researchers. On the other hand, the analysis of the *social dimensions* of axe circulation not only compares the objects and their contexts of production and consumption, but judges the differences found in terms of economic, ideological or political categories that are considered to be historically significant. The criteria for such comparisons and judgements derive from a theoretical discussion that inevitably leads to the concept of *value*. Ultimately, the interpretation of the quantitative data, such as the distance and volume of circulation of materials, and the qualitative information, such as shape, texture or colour of the artefacts, will depend on the *value theory* one implicitly or explicitly uses.

Value theory and archaeological interpretation

At least since Aristotle (336–323 BCE), the idea of economy has been linked to the concept of *use value*. Only those activities that provide useful things should be considered as being of value in a society. For Aristotle, the primary source of wealth was land, which allowed the development of agriculture and husbandry. His critique of trading or *crematism*, as an uncontrolled and illegitimate way to increase wealth separated form economy proper, prevented him from acknowledging the importance of the production processes and of exchange in the formation of social value. Only much later, Adam Smith (1776) proposed that *exchange value* as opposed to *use value* had to be related to the human labour invested in the manufacture of a given object. Ricardo (1817) elaborated this theory of classical economy until the analytical reduction of exchange value to the amount of labour that could be measured in units of time, incorporated in a given product, was achieved. Marx (1867) insisted on the dialectical relationship existing between such an *exchange value* and the *use value* in capitalist economy, thereby establishing the conceptual unity between production and consumption. Moreover, he was the first to fully acknowledge the importance of the means of production in economic development *(constant capital)*, as a factor separated from labour force *(variable capital)* but with a direct repercussion on the value of all products in a society. By the end of the 19th century, but mainly in the 20th century different economists, such as Georgescu Roegen (1971), had in a certain way reassumed an *Aristotelic* view of economy by insisting on the necessity of considering natural resources and their exploitation as an inextricable part of the value of all goods. The awareness of the natural limits of economic development draws attention to the sustainability of the modern economic system, as well as towards questions about the control and management of the resources by different social groups at a global scale.

Meanwhile, the dominant academic thought since the end of the 19th century, known as "marginalism", has in practice abandoned the search for a definition of value as something different from price. The concept *marginal value* considers only the relative differences between commodities resulting from a comparion between their "scarcity" and the "unlimited necessities" of the individual (Menger 1871). As the only objective expression of this comparison is the actual price of commodities, the theory is inevitably tautological and frees economic analysis from considering the material as well as historical conditions in which production takes place.[1] Modelling market behaviour in a neutral and ahistorical space, where individuals

interact under supposedly equal conditions, allows for the application of quantitative methods that confer a "scientific touch" to the analysis, but reduces the possibility to consider, for example, the ecological limits, the existing distribution of private property or unequal technological development in the world economy.

The *marginalist* reduction of the notion of value to the realm of subjective desires and necessities encouraged social scientists to drive the discussion on value into the field of the multiple ways individuals judge their relation with others (Simmel 1900; Appadurai 1986; Humphrey & Hugh-Jones 1992), or to abandon the concept altogether in the conviction that it is impossible to find an easy analytical definition for it. In either case, the dominant trend of "theoretical archaeology" during the last years has been to avoid as far as possible social or historical explanations concerned with the material, environmental and technical constraints of production and consumption, and of social reproduction in general. Even the fact that any power relation must be sustained by some form of economic exploitation and unjust distribution of property, is eluded or deluded. Concepts such as prestige, status or agency, or the ephemeral moments of exchange are much better suited for an in-material view of individual relations and thus a projection of our own values onto the past. Exchange and consumption are often treated as social entities in their own right, independent of the physical conditions – matter and energy – which make them possible, and the social needs they serve. In other words, these discussions are more concerned about the desires and value notions of the individual actors, than about the production and distribution of social values among society, i.e. the social relations of production. It is striking however, that another part of archaeology, which may be seen by some as theoretically less concerned, devotes considerable efforts to a better understanding of technology, function and the social implications of production processes (e.g. Roux & Corbetta 1989, Vidale 1992, 2002; Petrequin & Petrequin 1993; Clemente *et al.* 2002; Longo & Skakun 2008).

The heuristic importance of the notion of social value lies precisely in the fact that its meaning, according to Marx (1867/1962:49–98), emerges from the interplay between production and consumption, between objective material conditions and personal desires, between the power to impose certain economic constrains and the attempts to overcome them. The distinction between an *exchange value*, determined by the production process and most of all the labour force, and a *use value*, expressing the subjective as well as objective perception of the qualitative properties of all goods, underlines the dynamic nature of value systems and hence their historical specificity (Lull 2002:304ff.). It also explains the dialectical construction of value through the interplay between social forces and particular interests. In other words, it unveils, at the level of the specific object and action, the fundamental distinction as well as unity between social production and individual consumption, which perpetually organises the reproductive cycle of human society (Marx 1857–58/1973:84–111). If this cycle, and the very existence of society is negated, as liberals have claimed for a long time, it is no longer possible to approach the question of surplus production and social exploitation otherwise than in purely subjective terms.

The main theoretical difficulty however is that the concept *exchange value* of Ricardo and Marx is only relevant in a market economy, were all products have become commodities (Gregory 1982). In order to overcome this historical specificity but at the same time to maintain the notion that social objects imply an intentional energetic and material transformation, we have chosen the concept of *production value* (Risch 2002:28–31). It implies that all objects/subjects generated and maintained by a community have a value resulting out of a production process that puts into action specific forces and materials. In this sense, it is not only the social objects but also the actions that generate and maintain them that must be considered as valuables (Graeber 2001:45ff.). The dialectical relation between *production value* and *use value* can be expressed by the term *social value*, as the ever-changing synthesis between production and consumption processes.

Another difficulty faced by any value theory remains the definition of the criteria needed to compare and judge social materiality. Such a request stands in the tradition of economic theory outlined above, rather than in line with post-modern reflections about the value perceptions of people in the past or the present. Its initial and principal target is to understand how economic wealth is generated and distributed inside a society. Even today, most of this process remains obscure to large parts of society, a situation that can well be defined as the "economy of suspicion" (Groys 2000). This lack of distinction between an economic analysis of value, on one side, and the interpretation of economic values, on the other, explains to a large extent the confusion generated by present debates in anthropology and archaeology.

The development of economic theory shows that it is probably a mistake to try to reduce any notion of value to one single economic factor, such as labour force. Basically, it can be proposed that *production value* depends on a series of natural and social constraints:

- *Access to natural resources.* As this accessibility can be limited naturally as well as socially, the value of raw materials and hence of the final products certainly depends on the environmental and social conditions in which their exploitation takes place. Situations of autonomy as opposed to dependency, of unrestricted access as opposed to monopoly, or of competition versus sharing have different effects on production as well as on consumption.

- *The production process.* Labour force, understood in an energetic sense, is an abstraction of the human implication in any economic activity and at the same time the immediate physical limit all societies are faced with. Therefore, the amount of labour force devoted to a specific production necessarily effects the production value of the generated objects or services. Both vary according to the economic productivity achieved through technological development, division of labour and the volume of manufactured goods.

- *The distribution process.* It embraces the mechanisms used inside and between societies in order to provide its members with goods (direct access, reciprocity, redistribution). Not only the distances and means of transportation, but also social and political barriers will have an effect on the value of a given product.

From the point of view of consumption, *use value* can be defined at least in the following two parameters:

- *The material and technical utility* a product provides. This value results out of the human ability to use the properties or the quality of a product to accomplish certain tasks or to satisfy certain needs or desires. At a social, rather than individual level, the use value becomes expressed through the relative importance a product has in a specific society. Contrary to what marginalist thinking might suggest, the most useful goods in a society are the most frequent rather than the *scarce* or rare ones (e.g. water, food, dress, housing.). The use value of the technical means does not depend on their rareness either (e.g. a power station), but on the utility of the products generated by them (e.g. electricity). Archaeology, like other social sciences, generally succumbs to a marginalist perspective when assigning on principle a much higher explicative value to rare and elaborate objects, often made out of particular materials, than to common artefacts. Implicitly a perception is projected, which assumes that the former were as *scarce* in the past as in a modern market of antiquities and therefore represented expressions of "prestige". The explanation of the *relations* necessary in order to claim for scarcity and prestige is generally overlooked.

- *The aesthetic and symbolic utility* a product provides. These are subjective values projected into things, which can provide either social recognition or individual redemption. Such values are either imposed through power or based on conventions inside society, and can at all moments be abolished or transformed. This makes them in fact flexible and, at the same time, indispensable for the organisation of a society at a cognitive and communicative level. From a material perspective, such values can only be approached by comparing the production value and the actual use made out of a specific object. Thus, for example, the meaning of a carefully manufactured product of a material which has circulated over a long distance, but which shows no use wear traces, must have exceeded the sphere of economic production. Frequently, such objects become *fetishes* intended to generate confusion between the actual exercise of power and its representation. Analytically this implies, that the aesthetic or symbolic contribution to value can only be recognised as an *a posteriori* result of the analysis of production and consumption processes in a specific historic context, but not as an explicative device in its own right. These two dimensions of use value (material/technical and aesthetic) would respect the distinction underlined by Graeber (2001) between objects with power to act directly on persons (and things, we would add) and objects with power to inspire actions in others.

In the particular case of the production and distribution of axes of different raw materials, these multiple dimensions of *social value* can be addressed through different analytical procedures:

- The question of the *accessibility* to the rock deposits requires provenience studies as well as a consideration of the implications of the exploitation of different resources and environments. Crucial differences exist between primary and secondary deposits in the way rocks are exploited and social access can be restricted.

- The *dependency* of society with respect to raw materials suitable for producing axes depends on the material and technical choices available. It is particularly important to determine the variety of rocks available in each region or territory.

- Experimental and ethnographic data show that polishing is the most *labour intensive* part of axe production and varies according to the size of the tools. In general, it can be said that larger axes are more difficult to flake and require more time and effort to polish. Size has therefore a similar importance as the provenience of the raw material in the formation of the production value.

- The extension, direction and barriers of *circulation* of raw materials can be reconstructed through characterisation studies of the artefacts and the geo-archaeological identification of the areas of rock extraction.

- Functional analysis would be required in order to determine the *utility* of the axes. The observation of residues as well as traces due to use and maintenance allows distinguishing between a more utilitarian or a more symbolic charged artefacts.

- The *quality of the raw material*, resulting from such variables as mineral composition, texture and fabric of the rocks, has a direct effect on the functional properties and hence on the use value of the artefacts.

- The *symbolic use* of the axes can be derived from the relation observed between distance of circulation of the rock types, their resistance (or lack of it), their size and colour, and their patterns of use wear.

This analytical framework already points to several deficiencies in the current research on axe production and distribution.

- The identification of the areas and procedures of raw material extraction has received insufficient attention, particularly in the case of secondary clast deposits. Geo-archaeological studies, combining petrographic, geomorphological, sedimentological and paleotechnological analyses, are necessary in order to gain a better understanding of the procurement strategies and the organisation of the production of stone axes in the different regions.

- Petrographic characterisation is frequently not combined with a morphological analysis of axes. This limits the possibilities to establish the relation between two parameters that reveal the production value of the objects, such as the size of the artefacts and the distance of circulation from the source.

- There is a general absence of functional analyses of the cutting edges of the tools in order to determine their symbolic or utility value. For the purpose of this study it is assumed that all axes were used for felling trees and working wood, which coincides at least with the observations made on the collections analysed in southeast and northeast Iberia.

- Finally, no study of the mechanical properties of different rocks employed as axes in the western Mediterranean has been undertaken so far. Specific tests are needed to compare these rocks in terms of their robustness (Delgado *et al.* 2009).

Consequently, the following discussion of axe production and distribution in the western Mediterranean will necessarily centre on *production value* through the criteria of the *accessibility* to raw materials, the *dependency* from particular sources, and the *extension* of the distribution network in both spatial and temporal terms. Wherever possible the *dimension* and possible *aesthetic utility* of the axes will also be taken into account as a means to approach their *use value*.

Petrographic information

One methodological difficulty when comparing the main petrographic studies carried out in the western Mediterranean *(Table 1)*, concerns the use of varied terminologies and classificatory criteria, partly due to different research traditions. In the case of the Iberian Peninsula, it has been necessary to revise and organise the nearly 500 available identifications into new lithological groups. In publications that provide no

detailed description of the mineral content and the rock structure, groupings can be based only on general rock classification.[2] This revision of previous groupings has identified six main lithilogical groups in the Mediterranean regions of the Iberian Peninsula.

Iberian Group 1

Micro-gabbros or meta-basites. These are basic rocks (low silica content) which have frequently been metamorphosed. Although the degree of metamorphism, which becomes evident in the formation of secondary amphibole, can be variable, the rock retains its original igneous characteristics, at least in a residual form. Lithologically, rocks in this Group include: dolerites, meta-gabbros, epi-diorites, actinolitic hornfels and ophites. They may occur as plutonic intrusions in some coastal areas and pre-litoral mountain chains of the western Mediterranean, especially in those of Alpine formation, such as the Betic range, the Rif and the Pyrenees.

Iberian Group 2

Amphibolites. Metamorphic rocks formed mainly from amphiboles and plagioclase. They are transitional with regards to Group 1 rocks but with a higher degree of metamorphic alteration. Such rocks outcrop in the Betic Mountains and the Pyrenees, as well as in the west of the Iberian Peninsula.

Iberian Group 3

Eclogites. These are unusually dense rocks. In general terms, this group consists manly of highly metamorphosed gabbros and basalts. The mineral composition of these rocks normally contains garnet and sodic pyroxene, which can be associated to amphibole, quartz and rutile. On the Iberian Peninsula they are restricted to the most deformed and metamorphosed parts of the domains of the Nevado-Filabride Formation of the Betic Range.

Iberian Group 4

Sillimanitic gneisses and schists. These high temperature metamorphic rocks are characterised by the presence of sillimanite needles. These rocks appear occasionally in the Alpujarride Formation of the Betic Mountains, as well as in the Central Spanish range.

Iberian Group 5

Olivine basalts. These are mainly volcanic rocks rich in plagioclase, clinopyroxenes and olivine. Their most probable sources are the volcanic formations of the Campo de Calatrava (Ciudad Real), although certain exposures around Cartagena and Mazarón in Southeast Iberia, should also be considered.

Iberian Group 6

Hornfels. These are rocks produced by contact metamorphism, and are normally rich in cordierite and/or andalusite. The eastern Pyrenees and the coastal and pre-litoral mountains of Catalonia contain abundant exposures of hornfels.

Besides these six principal lithological groups, other rocks, such as serpentinite and metamorphosed micro-conglomerate, have been used in the production of axes in Iberia, but less commonly.

Two lithological groups of stone axes and adzes occur beyond the Iberian Peninsula. The first group, calcitic amphibolite, consists mainly of hornblende, actinolite and plagioclase, and outcrop on the northern side of the Pyrenees. The second comprises the well-known eclog-

Table 1. Importance (expressed in %) of the principal lithological categories used for the production of polished stone axes in different regions of the western Mediterranean (N = number of petrographic identifications).

Region	Gr. 1	Gr. 2	Gr. 3	Gr. 4	Gr. 5	Gr. 6	Other	N	Bibliography
Granada	39	29	17	5	5	0	5	41	Carrión & Gómez 1983
Almería & Murcia (coast)	67	22	3	6	1	0	1	73	Gusi & Olaria 1991; Risch 1995; Martínez & Risch 1999; García *et al.* 2005
Murcia (interior)	62	22	0	14	2	0	0	63	Barrera *et al.* 1987
Southern Levante	58	18	2	14	<1	1	6	455	Orozco 2000: 143
Cuenca	23	36	0	31	2	6	2	48	Barrera y Martínez 1980
Soria (Ambrona)	29	3	0	58	0	11	0	38	Orozco 2005
Catalunya	3	1	0	<1	0	90	6	477	Clop 2004; Risch & Martínez 2008
	CaAmphibolite		**Eclogite / Jadeite**						
Rosellón	36		14			31	15	207	Ricq-de Bouard 1996
East Lanquedoc	15		36			10	41	209	Ricq-de Bouard 1996
Rhone valley	3		48			<1	48	189	Ricq-de Bouard 1996
North Italy	0		80			0	20	680	D'Amico 2005: table 2
Corsica	0		10			0	90	49	Colonna 2007: table 9

ites and jadeites from sources in the western Alps and northern Apennines. Of less importance in terms of their limited distribution, is a group of glaucophane-rich rocks ,which were mainly used around Durance and the Rhone valley.

In order to allow a quantitative analysis of the petrographic data the information has been organised into regional units, instead of single archaeological sites *(Table 1)*. In this way, the sample size becomes larger and sample bias resulting from discard patterns, recovery processes (ranging from systematic excavation to private collections) and different petrographic samplig strategies, is reduced.

Spatial and temporal patterns

In general, the available petrographic data suggests three main geographical areas along the northern coast of the Mediterranean basin where axe production was dominated by a particular type of rock. At the margins of these areas, some rock types seem to have a more local distribution *(Fig. 1)*.

The most important and extensive geographical area embraces the western part of the Alps and the adjacent regions, mainly the Po valley and Provence *(Fig. 1)*. In this area, metamorphic meta-basites, such as eclogites and, more occasionally, jadeites were employed extensively from the 6th to the 3rd millennium BCE. Such rocks crop out in the western Alps and the northern Appenines. However, they can also be found in the glacial and fluvial deposits of Liguria, Piamonte, Val d'Aosta and the upper Rhone Valley (D'Amico 2005; Thirault 2005). Moreover, in recent years, several prehistoric quarries have been discovered in the area around Monte Viso (Pétrequin *et al.* 2006). From their location between 1800 and 2450 meter O.D., and the relatively small sizes of the primary outcrops and boulders, it seems clear that the access to the outcrop of this raw material was highly restricted. Although the exploitation of clast deposits cannot be ruled out, until a detailed analysis of the work traces on the worn surfaces of the axes is carried out, the relative importance of other rock types in this region, such as amphibolites or serpentinites, suggests that society was dependent to a large extent on the rocks obtained from these high mountain quarries.

From here, eclogite and jadeite axes were distributed in all directions, although more often towards the west and the north, reaching areas as far away as Scotland and Ireland some 1600 km distant (Petrequin *et al.* 2002). Along the Mediteranean coast these axes even reached Catalunya. In this direction, their circulation follows a typical fall off pattern *(Fig. 2)*. Although the main phase of production of Alpine axes took place between 5200–3500 cal

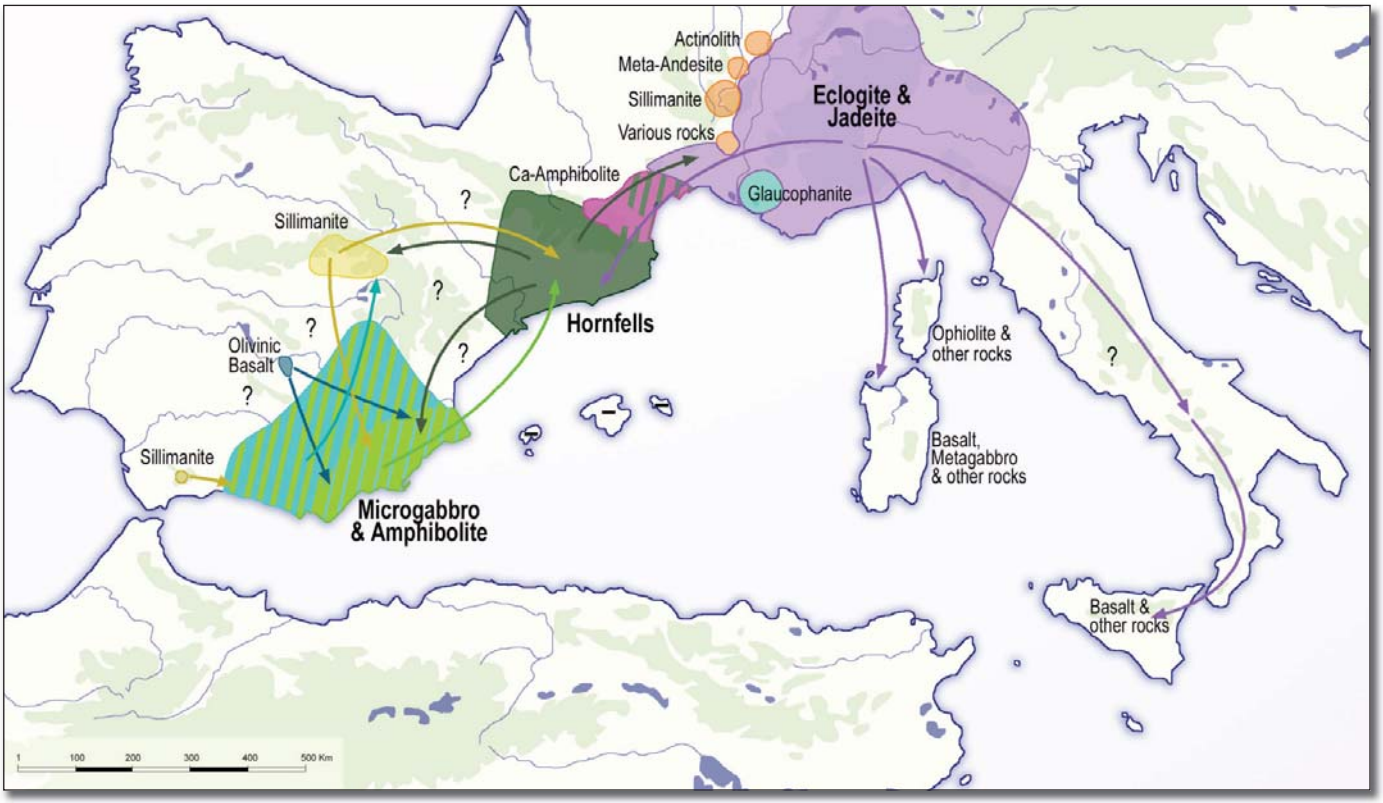

Fig. 1:
Principal supply areas and circulation of stone axes in the western Mediterranean.
(? = no systematic petrographic studies available; - = absence of Neolithic axes).

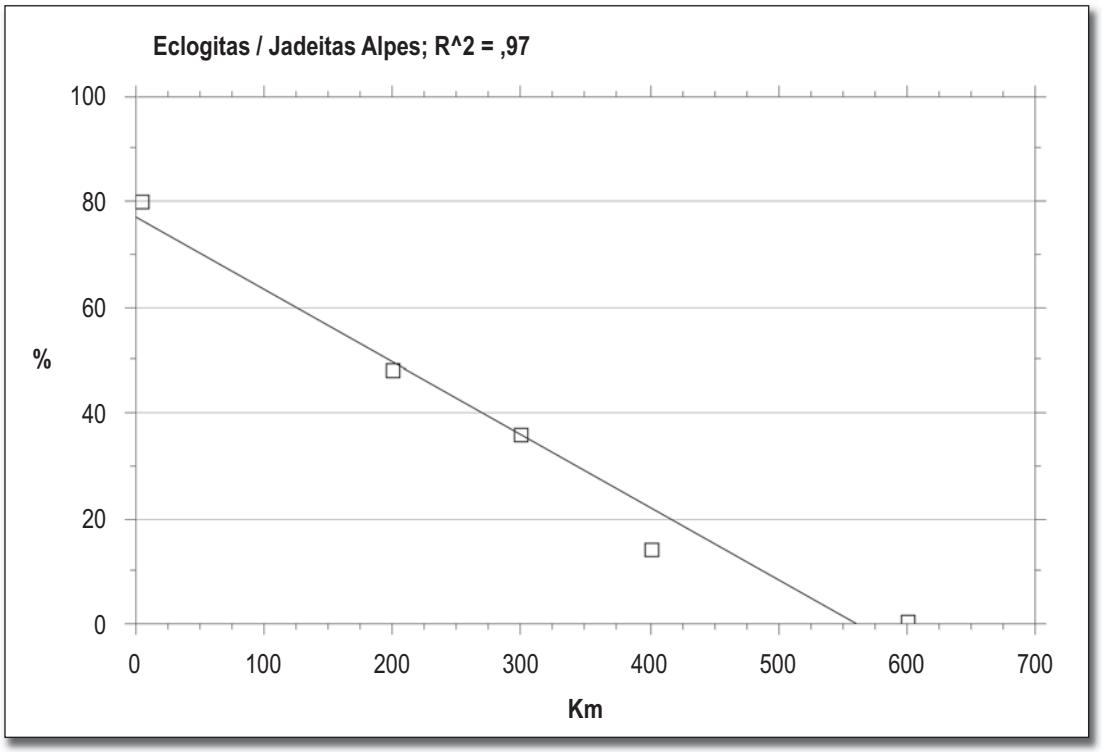

Fig. 2:
Importance of the circulation of eclogite and jadeite axes in the western Mediterranean (values according to *Table 1*).

The proportion (%) has been calculated in relation to the totality of axes analysed, while the distance (km) corresponds to a straight line best fit between the probable supply areas and the central geographical point of the established regions.

BCE (Petrequin *et al.* 2002, 2006; Thirault 2005), in the Mediterranean regions, such as the lower Rhone Valley and the Languedoc, they were still important until the final Neolithic or Chalcolithic (Ricq-de Bouard 1996:221).

Eclogite and jadeite are extremely resistant rocks formed by high grade metamorphism. Therefore, they are particularly well suited to the production of axes of more than 14 cm in length, and require a considerable amount of effort. The difficulty of the procurement of the raw material, the skilled preparation of the blanks, and the intensity of the polishing processes contributed to the high production value of Alpine axes; their circulation network extended throughout most of western Europe. Although such axes were well suited for felling trees or working wood, this in itself does not explain their occurrence in areas with raw materials of similar quality. Consequently, the use value of the Alpine axes may have included a high symbolic component.

Moving westwards from the Alpine production sites towards the lower Rhone valley, the use of rocks from local sources for the production of polished axes, increases *(Fig. 1)*. These include glaucophane schist, tremolite schist and basalts (Lazard 1993; Ricq-de Bouard 1996; Ricq-de Bouard *et al.* 1998). The morphology of some artefacts as well as the location of some workshops strongly suggests that the raw materials for stone tool manufacture were obtained mainly from secondary deposits along local rivers. Their distribution was regionally restricted in scale and they rarely represented more than 50% of the used stone axes used in any area. During the Middle Neolithic (c. 4600–3300 cal BCE), when the distribution of Alpine axes was at its height, the importance of such local resources decreased (Ricq-de Bouard 1996; Thirault 2005). Generally, these rocks were not, or could not, be made into axes greater than 14 cm in length. Their low metrical standardisation compared to axes manufactured from rock of an Alpine origin (Ricq-de Bouard 1996:151, 215) is often explained by the use of suitable clasts.

The second large geographical area is located around the Pyrenees, and is dominated by hornfels axes (Iberian Group 6). A combined petrographic and geomorphological study of the Catalan hornfels has shown that only certain secondary deposits, most of them located along the river Segre (Inner Catalonia), were exploited periodically by small communities (Risch & Martínez 2008). According to the geological and archaeological evidence, hornfels was not exploited systematically on the northern side of the Pyrenees, probably due to the lack of contact metamorphism and the lower quality of rocks suitable for tool manufacture in this area. Here, calcitic amphibolite, which provides a suitable alternative for axe production, is found in the stone tool record alongside honfels along the lower Rhone Valley. The distribution curves of both raw materials are very similar, *(Fig. 3)*.

Whilst the use of hornfels seems to have

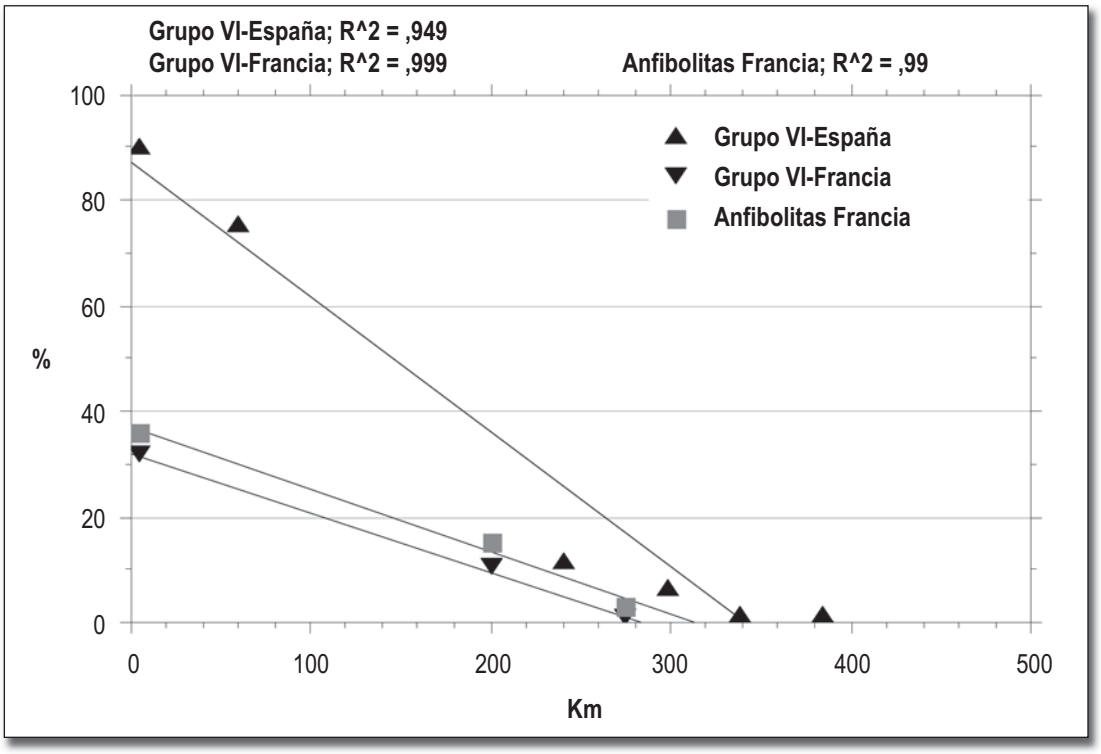

Fig. 3:
Importance of the circulation of hornfels axes (Iberian Group VI) and Ca-amphibolite from the Pyrenees in southeast France and eastern Iberia.

The graphic representation follows the same criteria as *Fig. 2* (values according to *Table 1*).

extended beyond the Pyrenees into southeastern France, a similar pattern did not occur with the amphibolite in the opposite direction. Also, the Alpine eclogite axes, which make up 22–27% of the raw materials used in the Languedoc between 4500–2200 cal BCE, rarely represent more than 1% of the axes analysed from Catalonia (Ricq-de Bouard 1996; Clop 2004). This comparative lack of axes coming from the north does not seem to be the result of qualitative differences between the raw materials. Rather, social factors may explain such spatial patterns. Somehow, the communities in the valleys south of the Pyrenees were not only in control of the secondary deposits, which included hornfels, but they also managed to limit the circulation of equivalent materials from the north. Direct access to the important rock salt deposits of Cardona in Inner Catalonia may have resulted in the exercise of stronger control within the exchange network which linked to the valleys and plains located south of the Pyrenees (Weller & Fíguls 2007). As a result, 90% of all the prehistoric stone axes in the northeast of the Iberian Peninsula were manufactured from hornfels (Clop 2004). Alternative local raw materials, such as diorite, was of only minor importance. Elsewhere, for example in the south of Catalonia, at a distance of more than 50 km from the workshops of the Segre, metamorphic conglomerates from the lower Carboniferous were utilised for tool making (Risch & Martínez 2008). However, even in the area of the Sierra de Prades, where this material was collected from secondary deposits, these rocks only represent 25% of the polished axes.

The distribution of hornfels axes, coming from the workshops of the rivers Cinca, Ter and especially the Segre, seem to have reached its height in Iberia between c. 3750 and 2850 cal BCE, at the same time as it diminished in the Languedoc (Risch & Martínez 2008). These axes were distributed to central Spain as well as along the Spanish Levantine coast *(Table 1)*. So far, no petrographic studies are available, for the geographical area between the rivers Ebro and Júcar in Valencia, that could provide a better explanation for the fall-off curve of the hornfels and the meta-basites coming from southeast Iberia *(Fig. 1)*. However, at a distance of over 200 km from the source, hornfels tends to represent less than 10% of the artefacts *(Fig. 3)*. Although hornfels clasts could be manufactured in the Catalan workshops into axes measuring over 15 cm length, the few complete artefacts found in central Spain and the southern Levante usually only measure 4.5–7 cm (Barrera & Martínez 1980:75; Orozco 2002: 200ff.; Rojo *et al.* 2005:119).

The third geographical area covers the whole of southeast Iberia *(Fig. 1)*. In this area, more than 70% of all the axes were manufactured from metamorphosed intrusive igneous rocks (Iberian groups 1 and 2). Fine grained gabbros, dolerites, epi-diorites or amphibolites were obtained from secondary deposits. This has been shown convincingly by the study of axe

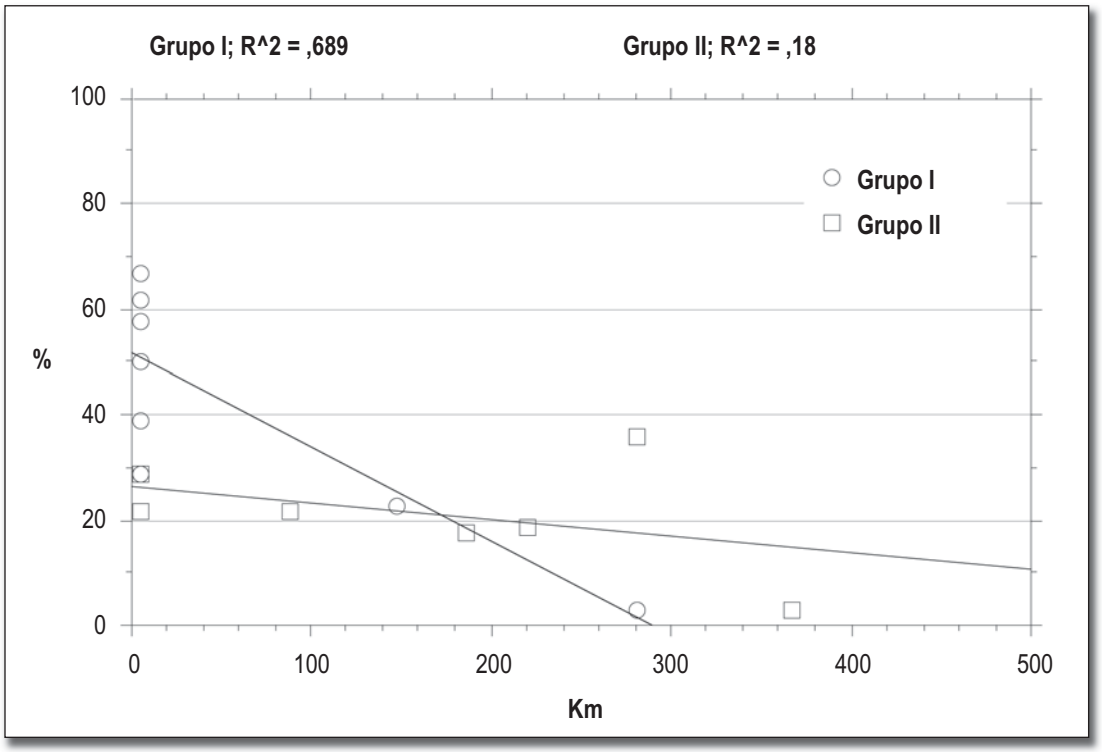

Fig. 4:
Importance of the circulation of microgabbro (Iberian Group I) and amphibolite axes (Iberian Group II) from the Betic area in eastern Iberia.

The graphic representation follows the same criteria as *Fig. 2* (values according to *Table 1*).

morphology (Risch 1995:252–330). Many river deposits containing fine-grained and resistant clasts, were probably exploited for axe making; some direct evidence of axe production occurs in form of blanks or polishing slabs recorded in settlements close to the river Almanzora, Almería (Siret & Siret 1890:30; Risch 1995:343) and in Ereta del Pedregal, Valencia (Orozco 2002:115–117). In these settlements, low scale production took place in a household context, suggesting that many communities in southeast Iberia seem to have had direct access to these raw materials. So far, there is very little to suggest that large scale quarries, such as those documented in the western Alps, or specialised workshops along the rivers, as seen in Catalonia, existed in the Levante and the Southeast of Iberia.

As one approaches Sierra Nevada, the importance of eclogites increases (Iberian Group 3), which seems to correlate with the higher degree of metamorphism of this orogenic formation. West of Sierra Nevada serpentinite axes appear occasionally (e.g. Gómez in Pellicer & Acosta 1997:177f.), and a local exploitation of sillimanite schist nodules has recently be reported from the Sierra de Ronda, Malaga (Aguayo *et al.* 2007). However, all these rocks are of only minor importance, and they rarely represent more than 20% of the axes found in the different sites.

Regarding the use and distribution of microgabbros and amphibolites originating from the fluvial deposits of Southeastern area, it can be observed that the former seem to have a greater importance at the local level, while the latter are more likely to be distributed over greater distances *(Fig. 4)*. Amphibolite from sources in the Southeast was the dominant raw material used in the area of Cuenca, which is located in the eastern part of the central Spanish plateau, and where no suitable raw materials for axe making was readily available (Barrera & Martínez Navarrete 1980). Elsewhere, in the settlement of Ereta del Pedregal (Valencia) 20% of the complete axes have been identified as amphibolite, although a local manufacture of dolerite axes is also a feature of this site (Orozco 2000:115–117). Apparently, in the Southeast a twofold value system emerged in relation to the different raw materials available. Although medium to fine-grained igneous rocks were abundant and easily accessible, the less common metamorphic amphibolite was more highly valued for exchange, perhaps due to its superior technical or aesthetic value. In terms of chronology, the use and distribution of Iberian Groups 1, 2 and 3 axes started in the Neolithic, but reached its climax during the 3rd millennium cal BCE. At this time, around 70% of the material analysed from the southern Levante had come from the Southeast (Orozco 2002:181ff.).

So far, no significant dimensional differences can be observed between axes based only on the raw material used in their manufacture.. The mean length of the axes with a symmetrical cutting edge is 9.3±2.6 cm in southeast Iberia,

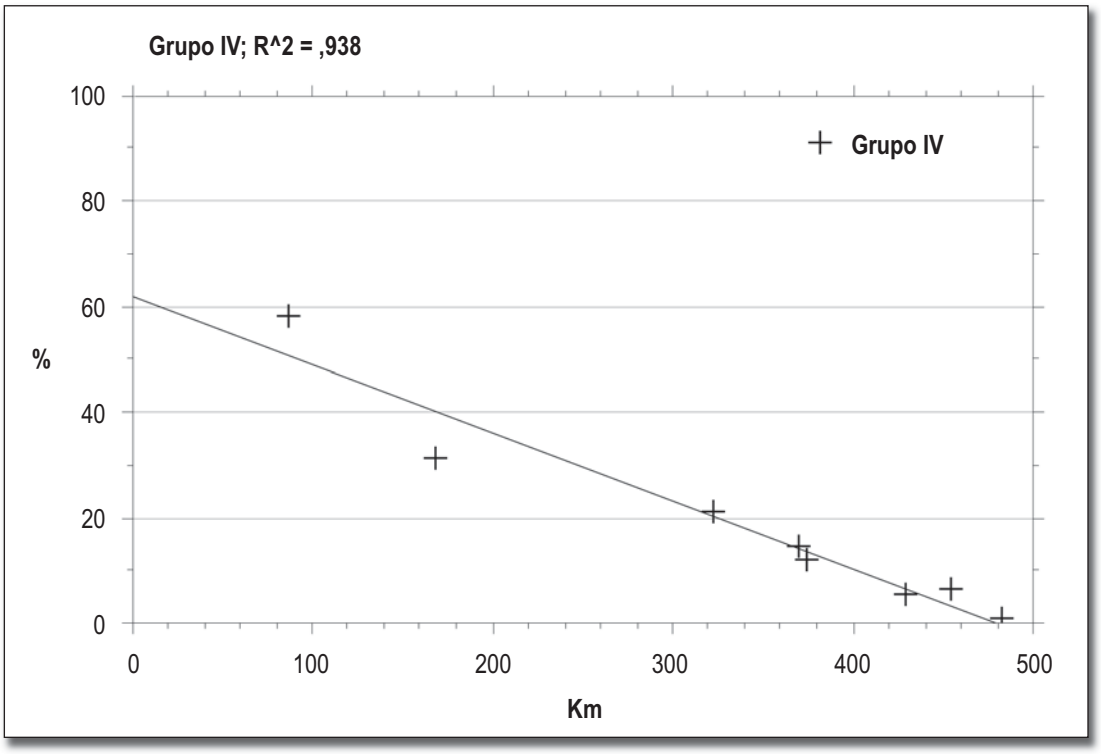

Fig. 5:
Importance of the circulation of sillimanite probably coming from the Central Spanish range (Iberian Group IV).

The graphic representation follows the same criteria as *Fig. 2* (values according to *Table 1*).

while the asymmetrical adzes measure about 7.0±1.3 cm (Risch 1995:200f.). Although a small number of axes measure over 15 cm in length, these artefacts are not distributed differently than smaller artefacts. In general, neither the contexts of deposition, nor the raw material suggests that longer axes were valued more highly to the south of Catalonia or towards central Spain.

The overall distribution pattern for small-size sillimanite adzes is unlike those for other geographical areas or petrographic groups. Nodules of pure sillimanite (Iberian Group 4) occur in secondary deposits around Somosierra, in the central Spanish mountain ranges (Barrera & Navarrete 1980:76).[3] These nodules, which occur in surface deposits, seem to have been the dominant raw material used for stone tool making in north-central Iberia, probably forming another geographical area of axe production and distribution (Delibes 1975; Orozco 2005). The fall-off curve for sillimanite in the western and southern parts of Iberia would be consistent with such an origin in central Spain *(Fig. 5)*. Petrographic analysis confirms that axes of pure sillimanite reached at least the provinces of Alicante an Murcia, nearly 400 km away from the proposed source (Barrera *et al.* 1987; Orozco 2000). The distribution of these axes into the Levante and the Southeast was particularly important during the Copper Age, c. 3000–2200 cal BCE, but ceased abruptly early in the Bronze Age.

The sillimanite axes can be distinguished from other materials because of their light colouring (white-yellowish to pale brown), thinness and small size. In this case, particularly small tools, rather than large ones, were valued as exchange objects. Whereas in central Spain, where axes of more than 7 cm in length were produced, the western regions, adzes with a mean length of 3.9±1.1 cm. seem to predominate. No statistically significant differences have been observed between the material from Cuenca, the southern Levante and the Southeast. This could be interpreted as an indication of a simple distribution from the production areas to the distant communities (Hodder & Lane 1982).

Given this overview, it is worth considering the geological and archaeological aspects of the western Mediterranean islands. The societies of the major islands – Sicily, Sardinia & Corsica – manufactured axes from basalt, gabbro, amphibolite, serpentinite, schist and other local igneous and metamorphic rocks (Leighton 1989; Lugliè 2000; Costa 2007; Colonna 2007). A recent petrographic study carried out on Corsica reveals that at least 18 different local rock types were made into axes on the island (Colonna 2007:249). This again illustrates the gathering of river clasts rather than the quarrying of rock from primary outcrops. However, all these islands also received some artefacts made from Alpine rocks. On Corsica, imported material represented around 10% of the axes *(idem)*. The smaller islands of the Tyrrenean Sea were either supplied from the mainland and

the larger islands, or used local material (Leighton 1989:142).

The situation on the Balearic Islands is quite different. The Balearics are formed mainly of sedimentary rocks. Even the Palaeozoic schists and basalts of the northern coast of Mallorca and Menorca are intensely altered and do not display suitable working properties for axe manufacture (Gómez-Gras 1993; Fornós 1998). So far, only two prehistoric stone axes have been recorded, both coming from Mallorca. The first is a small adze of unknown provenience and raw material; it is kept in the Museum of Lluc, Mallorca (Veny 1968:367). The other is an unpublished hornfels axe stored in the Archaeological Museum of Catalunya.[4] The hornfels must have reached the island from the Catalan coast, which implies a sea voyage of at least 180 km. This "negative evidence" of axe production and use on the Balearic has particular significance for our understanding of the organisation of the prehistoric stone axe distribution (see below).

Comparing axe distribution patterns

If we compare the different production and distribution patterns of the western Mediterranean, leaving aside for the moment their temporal dimension, a series of general trends seem to be valid for the majority of regions and lithologies:

1. Most of the raw materials used for axe production in the Western Mediterranean were obtained from secondary deposits. Small temporary workshops on river terraces and along the riverbeds, rather than large scale extraction sites, seem to have been the most usual places where axe blanks were flaked. The few polishing sites documented so far suggest that this activity was carried out at a low production scale in the domestic context.

2. A very different form of organisation was associated with the extraction of jadeite and eclogite around Monte Viso in the Piedmont. Although clasts of the same materials occur in fluvial deposits, the stone quarries discovered in the Alpine mountains suggest a specialised production of axe blanks between 5200–4000 cal BCE (Petrequin *et al.* 2006). In the context of the western Mediterranean, where the exploitation of river deposits was the main procurement strategy, high mountain quarrying must have been perceived as an exceptional activity of a special social and political character.

3. Apart from the Alpine rocks, hornfels and a variety of gabbros/amphibolites were the principal raw materials used in the production of adzes and axes. They were used extensively across an area of c. 100 km around the areas of extraction or the production workshops. Factors such as the accessibility and variability of rock types in the local Quaternary deposits, their different working properties, and social preferences explain some of the differences in the ways in which different rock types were exploited. This system of dispersal would have ensured access to a highly sophisticated distribution of labour and technology between the 6th and the 3rd millennia BCE.

4. In the case of the Alpine rocks, the main geographical area of supply (where alpine stone accounts for more than 50%of axes) extends up to a radius of 200 km (*Fig. 2*; also Thirault 2005). Moreover, this raw material circulated over greater distances than any other rock type, reaching Catalonia in the West or Sicily in the South.

5. At the fringes of these three main 'supply territories', organised respectively around the Alpine eclogite/jadeite, the hornfels from the Pyrenees and the Betic micro-gabbros/amphibolites, one notes the search for local resources *(Fig. 1)*. The use of material from local secondary sources was restricted to local or regional needs, apparently due to the lower quality of stone tools manufactured from these rocks.

6. About 200 km from its source – 300 km in the case of the Alpine materials – a rock type rarely represents more than 20% of the circulating axes *(Fig. 6)*. Only in areas lacking an adequate supply of suitable raw materials, such as the south-eastern part of the Spanish Meseta or the eastern Languedoc, do particular rock types occupy a dominant position among the used raw materials. On the one hand, this suggests, that diversity of raw materials and, hence, of proveniences, was favoured above specialization on, and dependency for, one particular source and circulation network. On the other hand, this pattern points to a general difficulty to guarantee a regular supply of rocks and axes over large distances. Formulated differently,

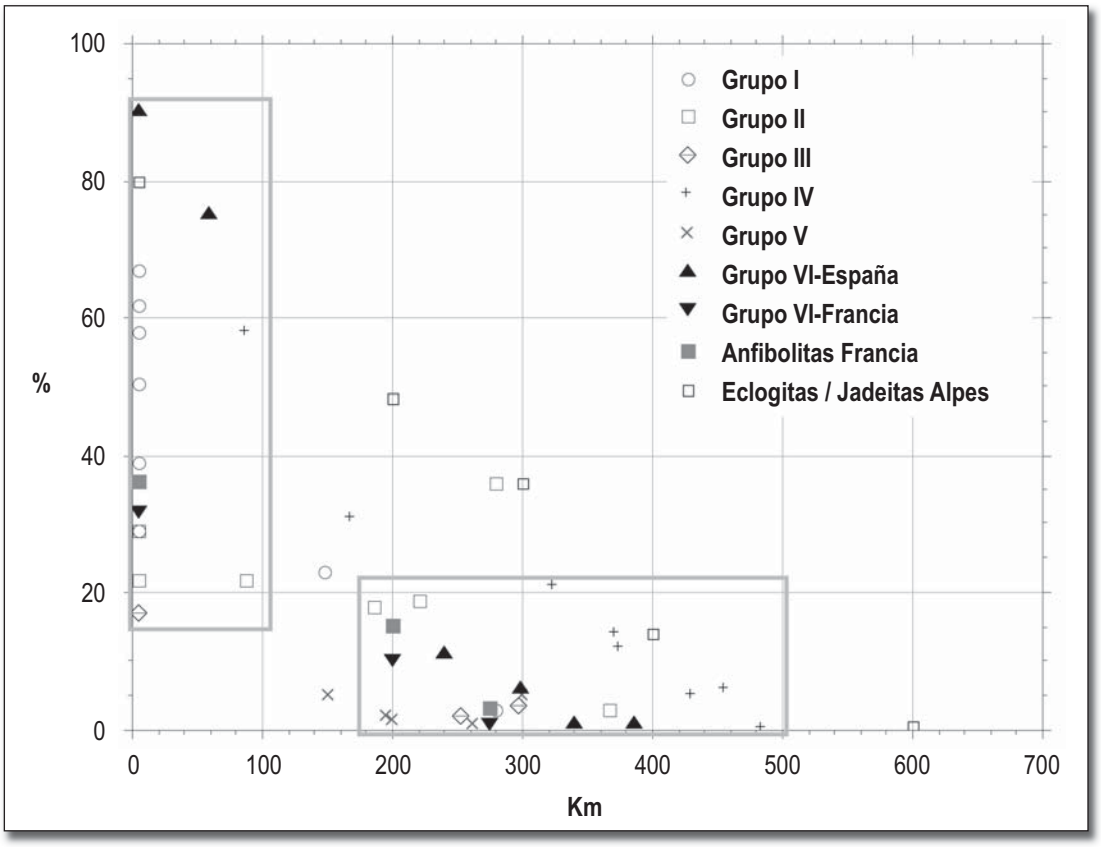

Fig. 6:
Importance of the circulation axes of different rock types on the northern side of the western Mediterranean. The proportions (%) are calculated in relation to the total numbers of identifications available for each region *(Table 1)*.

The graphic representation follows the same criteria as used in *Fig. 2*.

this could mean that long-distance distribution further than 200 km, or 300 km in the case of Alpine materials was in most cases, not an economic necessity but rather a social or political event.

7. From a chronological perspective, it can be concluded that the territorial supply strategy based on the exploitation of secondary clast deposits seems to have been followed throughout the Neolithic and Chalcolithic. However, the distribution networks of the different western Mediterranean rock types went through cycles of expansion and contraction. Starting in the northeast, the known eclogite/jadeite quarries are dated to the first half of the 5th millennium cal BCE, while the maximum circulation of these axes occurred between 4500–3500 cal BCE (Pétrequin *et al.* 2002, 2006). The exchange of Catalan hornfels axes reached its peak in Iberia at a slightly later date (c. 3750–2850 cal BCE). Finally, the most important exchange network between c. 3000–2200 cal BCE developed in central and southeast Iberia, when axes of micro-gabbro, amphibolite, sillimanite and olivine basalt were widely distributed. This gradual displacement of the long distance axe exchange networks from the Alps towards the Betic Mountains seems to coincide in each region with periods of economic intensification and social dynamism, such as the Atlantic Megalithism, which attracted considerable quantities of Alpine material; the Catalan Fosa Culture, in the case of the hornfels axes; and the Los Millares phenomenon in southeast Iberia in relation to micro-gabbro and amphibolite tools. The observed patterns can thus indicate very different causes; they need to be interpreted and explained in their respective regional and temporal contexts, as discussed below.

Further implications

The general conclusions derived from the analysis of the axe and adze distributions between northern Italy and southern Spain have important implications for one of the unresolved archaeological questions in this area, which concerns the surprisingly late colonisation of the Balearic Islands in comparison to other Mediterranean islands (e.g. Vigne 2000:Fig. 2). Although the possibility of "accidental visits" in earlier times cannot be ruled out (Lull *et al.* 1999:20), the available information suggests that the first stable occupation of the four major Islands occurred during the second half of the third millennium (Ramis & Alcover 2001; Lull *et al.* 2004; Micó 2005). The

central geographical position of Mallorca and Menorca in the western Mediterranean and, hence, their relative remoteness from the mainland, definitely limited accessibility to the islands (Cherry 1984). However, geographical factors alone cannot explain such social isolation (Lull *et al.* 2002), especially if one takes into account that Ibiza is visible from Alicante, and that, under optimal conditions, Mallorca can be seen from the coastal mountain chain of Catalonia. Moreover, the Balearic Islands would have had a high agricultural potential, given the necessary means for clearing the land from its middle Holocene vegetation cover.

In the Neolithic, the absence on the islands of fine grained and resistant raw materials, necessary for the production of stone axes, would have been a much more critical problem for permanent occupants, than the straight-line distance from the mainland alone. Difficulties in providing a massive supply of stone axes further away than 200–300 km would have dissuaded early colonization by agricultural communities, which depended on these tools in order to clear the Mediterranean evergreen oak forests and the dense maquia dominated by wild olive and mastic (Piqué & Noguera 2002; Pérez-Obiol & Sadori 2006). Fire alone is not sufficient to remove this type of hard wood. The rarity of stone axes on the Balearic Islands confirms that permanent settlement, especially of Mallorca and Menorca, could only develop when either exchange networks were sufficiently in place to provide a regular supply of tools, or when axes could be manufactured from other materials, e.g. metal.

Both conditions seem to have been fulfilled in the western Mediterranean for the first time during the 3rd millennium BCE. The earliest evidence of metallurgy close to the Balearic islands occurred in the region of Cabrières (Languedoc), where an important copper production centre developed between c. 3200–2400 cal BCE (Ambert *et al.* 1998, 2005). It might be no coincidence that the end of the metallurgical activities around Cabriers coincided approximately with the beginning of permanent occupation on Mallorca, taking into account that several archaeological elements point to the Languedoc and northern Catalonia as the probable origin of the first settlers (Lull *et al.* 2004; Micó 2005). It is also clear that these communities were engaged in copper production, as confirmed by the discovery of crucibles with Beaker-style decoration in a rock shelter at Son Matge on Mallorca (Waldren 1979), and apparently mined small copper ore deposits along the northern coast (Ramis *et al.* 2005; Alcover 2008). For the first time, the smelting of these ores could have allowed local (metal) axe production which did not depend on the supply of raw materials shipped from the mainland. A further advantage of the use of metal in comparison to stone in a situation of limited supply, is the possibility of the recycling of the former through melting and forging, irrespective of the provenience of the original raw material.

On the other hand, it is generally accepted that the second half of the 3rd millennium and, specially, the Bell Beaker period, was a phase of intense movement of social groups, materials and information in western Europe. Rather than unknown islands, because of their biogeographical conditions, the Balearic archipelago could have been seen during the Neolithic as remote and inhospitable islands. The moment the technical possibilities and the social organization led to an intensification of production and to a widening of the exchange networks, their colonization was no longer delayed. It was favoured moreover by a situation of social conflict and violence which occurred across the continent (Lull *et al.* 2004).

Discussion

Patterns of axe production and distribution in the Western Mediterranean regions raise questions about the value of the exchanged products, that is, about their significance in the social contexts in which they circulated. With the exception of Alpine jadeite production during the fifth millennium, *the dominant form of stone axe production in prehistoric western Mediterranean did not involve a marked technical specialization, nor a centralised social control.* The *production value* of axes, defined in terms of the *accessibility* to raw materials, the *dependency* from particular sources and the *extension* of the distribution network, was limited by means of a particular economic organisation. Crucial to this organisation was the exploitation of clasts from local fluvial deposits and the limited importance of the circulation of these axes beyond c. 200 km from their sources. This strategy considerably limited the efforts required both by the production and distribution process, and the possibilities to restrict access to the raw materials. Moreover, communities seem to have avoided dependency on single raw material sources when these occurred at distances outside the local area, in order to have a reliable supply of stone tools. This led to the notable diversification of the rock types and provenances for axes from regions located more

than 200 km away from the raw material sources. It is precisely this difficulty to organise, in economic as well as social terms, regular supply networks over larger distances, which explains the exceptionally late colonisation of the Balearic islands, which have excellent soils and climatic conditions but lack suitable rocks for a local axe production.

It is possible to infer several different forms of political relation based on this economic organisation. What is clear is that the potential to impose relations of social exploitation through the control of polished artefacts must have remained limited throughout the western Mediterranean. On the one hand, it is questionable whether or not the *production value*, understood in the sense of the *efforts and means* implied in manufacture, accompanied the axes in their circulation beyond a certain point in space and time. Communities were probably not aware of the specificities of the production processes of the few axes that arrived from distant sources. On the other hand, all rock types chosen in the western Mediterranean seem to have made reliable tools. Although the mechanical properties of the rocks still need to be tested, signs of intense use suggest that all tools had a similar *use value*, understood in the sense of the *material or technical utility* of the products. Consequently, if the axes circulating beyond 200–300 km had any particular social value, it could only emerge out of their *limited accessibility* and a higher *aesthetic utility*. The observation that the rocks with the most distinctive colours and textures, i.e. jadeite/eclogite and sillimanite, were also travelling over the largest distances supports such a symbolic meaning of axe exchange. These networks seem to have been influenced by categories such as rareness and formal distinctiveness of the products, rather than dependency and improved productivity. We might rather understand such objects as *fetishes* masking political control over intercommunal exchange and communication. This would explain why unequal access to "wealth" becomes expressed in Neolithic and Chalcolithic funerary contexts principally by objects or raw materials of distant origin.

However, the observed tendency to rely for the most part on easily accessible local resources, and to receive axes from different distant sources, must have undermined the expansion of these forms of power towards more exploitative structures within the communities. The accumulation of axes shown by the distribution patterns confirms that the powerful positions derived from the control of these exchange products was uneven in space and limited in time (see also Pétrequin *et al.* 2002). In this sense, it can be argued that the particular situation of the Bretagne in the fifth millennium, with its exceptional capacity to attract Alpine axes (Klassen *et al.*, in press), was caused by the attempt to narrow the variability and meaning of *fetishes*, thereby increasing the dependency on one particular exchange object, route and accompanying information.

In the fourth millenium, when the Catalan hornfels network was at its height, two separate regions are distinguished by an uneven accumulation of wealth in some single burials characterising the *Fosa Grave culture*. These were the Vallès region around Barcelona, which had direct access to the variscite deposits of Gavá as well as to marine resources, both used for the manufacture of ornaments (Bosch & Estrada 1994) and the Solsonès region in the inner part of Catalonia, where communities obtained excellent hornfels clasts from the middle Segre river (Risch & Fernández 2008), as well as salt form Cardona (Weller & Figols 2007). Artefacts manufactured in both regions were involved in long-distance distribution networks, and were placed in graves often associated with other exchange goods, such as obsidian from Sardinia, jadeite from the Alps or "silex blonde" thought to come from southern France. *This clear link between wealth and exchange values expressed mainly in male burials supports the idea that economic and probably also political power emerged during the Neolithic and in certain regions from the control of exchange relations between more or less distant regions, and not from the appropriation of the means of production inside the communities.* While exchange values could be manipulated up to a certain extent in order to achieve certain privileges, and some communities accepted such manipulation and privileges on behalf of diverse social or ideological networks (e.g. collectiveness, solidarity, transcendence), a *direct* economic exploitation would still have been difficult to impose materially and conceptually on small scale communities with access to alternative resources and supply strategies.

However, *one should be cautious not to interpret all concentrations of elaborate artefacts of distant origin as signs of incipient political power*. A very different situation seems to have emerged during the third millennium in Southeast Iberia. The metabasites and amphibolites of this area started to dominate the exchange systems in the eastern part of the Iberian Peninsula while the long distance exchange of Catalan hornfels declined. At the same time, the Southeast and the Spanish Levante attracted

other rocks, such as sillimanite from central Spain and olivine basalt from the Southern Meseta *(Fig. 1)*. All these axes and adzes were part of an economic system which produced and circulated an exceptionally large variety of objects of stone, bone, pottery, metal and probably also of wood and cloth throughout southern Iberia, particularly in the area of the so called Los Millares archaeological complex (3000–2200 cal BCE) (e.g. Ramos Millan 1998; Risch 1995:136–157; Orozco *et al.* 2001).

The production of these valued objects relied on part-time specialisation among communities and between regions, as well as on a diversified and highly productive subsistence production (for a general discussion of this model, see Risch 1995:528–541). Some of these objects had an *instrumental value* as labour means, but in many cases their *use value* is defined in purely aesthetic and symbolic terms. Their spatial distribution suggests that access to this form of material wealth was not politically restricted, but depended most of all on the size of the community. The appearance of these symbolically laden objects in all types of environmental and archaeological contexts does not support the notion of a centralised control exercised on production, circulation or consumption.

The constant supply of the social networks with a growing variety of elaborate objects may have resulted in the first place in a situation defined today as *inflationist* with regards to a specific type of social values. The second effect is that these values become *incommensurable*. In view of the diversity of raw materials, manufacturing techniques, textures and shapes, it becomes impossible to find common ground for comparing and judging the different objects. Finally, the existence of innumerable small-scale production centres in a wide-ranging and territorially unrestricted distribution network emphasises the *de-personalised character* of the products being circulated. *The sharing of collective values in the form of fetishes prevails over the identity of particular persons, groups or regions.*

In this situation, the distribution of polished axes over great distances does not seem to have been controlled by the supply of adequate raw materials, available in many parts of Iberia. Nor did it foster politically dominant positions through the control of exchange goods. Rather, *the creation and circulation of wealth through exceptional objects with a high production value, but of limited or replaceable economic importance appears as a mechanism to prevent the concentration of economic and political power*. The symbolic emphasis of this form of wealth production seems to require the transmission of common concepts and values over wider regions. Such a strategy might have been particularly important at a time when southern Iberia experienced an exceptional demographic growth and economic development. *In a world of strong expansion of the forces of production and growing division of labour, the production and circulation of exotic and elaborate objects can be conceived as a form of creating wealth with strong social links, which at the same time inhibits surplus production, i.e. the appropriation of the productive forces by a few.*

The 3rd millennium in southeast Iberia provides an archaeological example where division of labour was not aimed at increased productivity, as most modern economic thinking since Adam Smith (1776) assumes. Rather, it became a mechanism to foster social communication and integration into a common value system, as Emil Durkheim (1893) has argued. In summary, this work suggests that polished artefacts participated in and generated different social relations, each being *complex* in its own distinct way. Apart from their dominant functional value for the working of wood, axes could be used as symbols of emerging political differentiation inside societies based on the control of exchange networks, or as fetishes shared among communities over wide areas. But common in all communities was the need to avoid as far as possible a dependency on single resources; to simplify access to raw materials through the exploitation of secondary clast deposits; and to limit the transportation of bulk materials. Only in the second half of the 3rd millennium, do we see major departures from this pattern; the truncation of systems of communal wealth and symbolism and the assertion by groups in some areas, of direct control over production inside their own communities. The substitution of stone by metal artefacts was probably of crucial importance in this decisive historical break.

Notes

1 The following standpoints of the founders of modern economic theory expresses very clearly this split between the material world and the proposed notion of value: *"In a society which disposes of all types of goods always above their needs, there would be no economic goods nor wealth"* (Menger 1871/1985:97ff); *"Useful things which are not scarce do not form part of the social wealth"* (Walras 1874/1952:21ff).

2 This revision has counted with the inestimable help of Francisco Martínez Fernández from the Department of Geology of the Universitat Autònoma de Barcelona. For a first discussion of this problematic see Risch (1995:136–141).

3 The above mentioned sillimanite schist of the Sierra de Ronda can be distinguished from this material by the presence of garnet, biotite and iron oxide (Aguayo *et al.* 2007). So far, this composition has only been documented among axes found in the provinces of Malaga and western Granada (Carrion & Gómez 1983; Gómez in Pellicer & Acosta 1997:178).

4 According to the documentation available at the museum this axe comes from Ca S'Hereu (Llucmajor, Mallorca). At this place a Bronze Age rock cut tomb is known, but it is uncertain if the axe was found in this tomb or comes from a different site. We wish to thank Nuria Rafel and Carmen Rovira for the possibility to analyse this artefact.

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