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Middle Palaeolithic Mode 3 lithic technology in the rock-shelter of Benzú (North Africa) and its immediate environmental relationships

José Ramos-Muñoz [a,*], Darío Bernal-Casasola [a], Antonio Barrena-Tocino [a], Salvador Domínguez-Bella [b], Ignacio Clemente-Conte [c], Eduardo Vijande-Vila [a], Juan Jesús Cantillo-Duarte [a], Sergio Almisas-Cruz [a]

[a] Departamento de Historia, Geografía y Filosofia, Universidad de Cádiz, Avda. Gómez Ulla s.n, 11010, Cádiz, Spain
[b] Departamento de Ciencias de la Tierra, Universidad de Cádiz, Campus Río San Pedro, Puerto Real, Cádiz, Spain
[c] CSIC-Institución Milá y Fontanals (IMF), Departamento de Arqueología y Antropología, Grupo AGREST, Barcelona, Spain

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ABSTRACT

The rock-shelter of Benzú is located near the city of Ceuta in North Africa. At the rock-shelter of Benzú there is a sequence of 7 archaeological levels, which are associated with a clearly defined Mode 3 lithic technology. The similarities with other assemblages found in the south of the Iberian Peninsula are clear. We emphasise the exploitation of marine resources by these hunter–gatherer societies from the beginning of the Middle Pleistocene sequence. On the basis of this archaeological evidence and in the context of recent studies on North Africa, this work assesses the possible relationships and contacts between societies on both shores of the historical region of the Straits of Gibraltar.

1. The rock-shelter of Benzú: location, stratigraphy, chronology, and faunal and vegetation records

A recent monograph presented the results of 10 years of interdisciplinary research on the rock-shelter and cave of Benzú (Ramos et al., 2013b). This work aims to provide an overview of the lithic technology associated with the site in its regional context.

The rock-shelter of Benzú is located in Ceuta, and it opens onto an abrupt and near-vertical dolostone outcrop (Fig. 1). Part of the cover has collapsed, and its remains may be seen scattered throughout the site. Its current dimensions are 15.52 × 6.2 m. The southeasternmost end forms a small cave (Ramos et al., 2008a, 2014a, 2014b). The archaeological deposit covers an area c. 61.1 m^2 and is over 5.50 m deep. The archaeological sequence consists of layers of cemented breccia with calcareous crust interspersed with layers of calcitic flowstone. Laterally, the depth of the archaeological deposit decreases to just over 1 m, where it sits upon a sub-horizontal platform. The excavation identified 10 strata (Durán, 2003, 2004), 7 of which have evidence of human occupation (Fig. 2). This evidence includes large numbers of worked lithic remains, bones and shells. Micromorphology and the analysis of bioerosion processes have demonstrated that the erosive formation of the rock-shelter took place prior to the earliest human occupation, MIS 9 (Abad et al., 2007). The immediate hinterland of Benzú offered access to abundant food (marine, animal and plant) and lithic and water resources.

In previous works, we have explained in detail the methodology followed in the rock-shelter (Domínguez-Bella et al., 2012; Ramos et al., 2012, 2013b). Concerning chronology, several dating techniques have been applied (Calado, 2006). The sedimentary strata at the base of the sequence have been dated by TL (Bateman and Calado, 2003), and the age of the speleothems has also been calculated by U/Th (Durán, 2004). In parallel, experimental tests have been applied to these in order to calculate their age by TL (Benéitez et al., 2004). The dates recorded run between -(OSL) Shfd 020135: 254 ± 17 ka-in stratum 2 and -(Th/U) IGM: ± 70 ka-in stratum 10. In conclusion, the most recent episodes in the sedimentary and archaeological sequence can be dated to before 70,000 BP, while the record of the earliest human occupation of the rock-shelter dates back approximately 250,000 years.

Considerable efforts have been made to record the micro-spatial distribution of the nearly 40,000 artefacts located on the site (36,092 specimens of worked stone, 3362 fragments of terrestrial fauna, 144 fragments of marine fauna, and other biological remains and samples), which has been very informative concerning the social activities carried out by the human groups that occupied the rock-shelter (Ramos et al., 2013b: 455–477).

* Corresponding author.
E-mail address: jose.ramos@uca.es (J. Ramos-Muñoz).

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Fig. 1. View on the Benzu rockshelter.

The results of the pollen studies are reflective of Mediterranean climatic conditions, with alternation between xeric and steppic taxa and mesophile coastal taxa and Cyperaceae. This is indicative of the alternation of dry and more humid conditions in the sequence. There is also evidence for a drop in temperature, as indicated by the presence of *Pinus* and *Juniperus* (Ruiz Zapata and Gil, 2013: 271–277). Anthracological evidence indicates the presence of bushes: *Erica* sp. in stratum 4 and Fabaceae in stratum 2. These two taxa burn well and could have been used as fuel by the human groups occupying the shelter during these periods (Uzquiano, 2013). Mammal bone remains, in the form of mid-sized fragments and splinters, were brought to the cave by human action. Areas of activity and possible areas of consumption have been recorded in strata 4, 5 and 6. A large number of the bone fragments show signs of intentional breakage and burning. The assemblage is especially rich in ungulate remains – mid-sized bovines and other herbivores (Monclova et al., 2013). Benzú also yields evidence of the exploitation of coastal resources. Malacofauna (essentially *Patella*) is present in the whole sequence (strata 7 to 1). Ichthyofauna is present in level 5a (Cantillo and Soriguer, 2011; Ramos et al., 2011a; Cantillo, 2012).

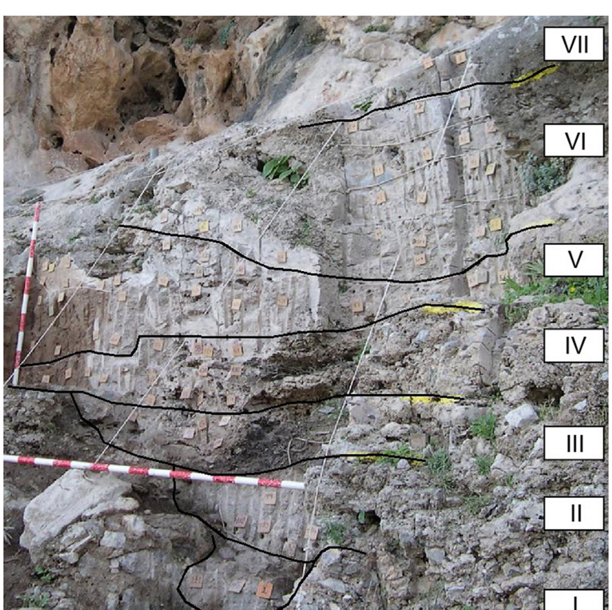


Fig. 2. Stratigraphic profile.

2. Worked lithic remains

The lithic remain assemblage is composed of 36,092 specimens (Ramos et al., 2013b: 339–437), from strata 1 to 7. Strata 4 and 5 have yielded the greatest numbers of such remains, which is indicative of more intense occupation periods.

2.1. Lithology, catchment and use of raw materials

The analysis of the lithic raw materials in Benzú was carried out by applying different archaeometric techniques (Domínguez-Bella, 2004). The target was the analysis of the geological, lithological and geomorphological characteristics of the rock-shelter's immediate environment, as well as the mineralogical, petrological and geochemical examination of the lithic materials found therein. The data collected is relevant for the study of archaeological questions relating to early human mobility. Specifically, the main techniques used were as follows: colorimetric characterisation by *de visu* observations aided by Munsell Soil Color Charts 1994, and petrographic observations, including transmitted-light petrographic microscopy, polarised-light petrographic microscopy, binocular magnifying glasses, electronic scan microscopy with EDS, X-ray diffraction, X-ray fluorescence and emission spectrometry ICP-MS.

We also took thin-section samples from geological materials found in the nearby environment as well as from the rock-shelter's worked stone tools. These thin sections were analysed using a transmitted-light optic microscope, which, using polarised light, yielded significant information regarding the texture, porosity, mineralogy, presence of fossils, etc. of different stone types.

A significant number of the lithic remains have been analysed (3659 specimens); all strata are represented in the sample (Domínguez-Bella et al., 2006, 2013: 316–338). Compacted sandstones are clearly predominant, comprising 61.03% of the sample (the total percentage of sandstones is 61.68%) (Fig. 3: A). Radiolarites (Fig. 3: B) are the second most abundant stone type (red radiolarite 24.84%, greens 8.55%, grey 2.27%, white 0.03%, black 0.68%; total 36.37%). Other lithic types present are (Fig. 3: C, D): large flint fragments (1.12%), dolostone (0.38%), phyllite (0.19%), other metamorphic rocks (0.005%) and limestone (0.005%). Compacted sandstones were most commonly used for the production of stone tools (61.50% of cores, 72.10% of flakes, 54.30% of other debitage and 53.90% of retouched fragments). Radiolarites are again the second most abundant (33.34% of cores, 25.38% of flakes, 43.14% of other debitage and 43.12% of retouched specimens). The two most common raw materials (sandstone and radiolarites) were collected locally and have been found in nearby geological units and along the coastline. Other stone types, which were brought to the site from elsewhere by the occupying groups, are much more rarely documented.

2.2. Lithic technology

Morphological features indicate that slightly abraded pebbles were predominantly selected (99.24%), which explains the absence of evidence of erosive and post-depositional processes. We also examined other features, for example colour and patina, as well as elements such as fire exposure. The use of fire has been abundantly documented (archaeobotanic analysis, raw material analysis, and lithic technology and function analysis). Fire seems to have been used to clean the rock-shelter.

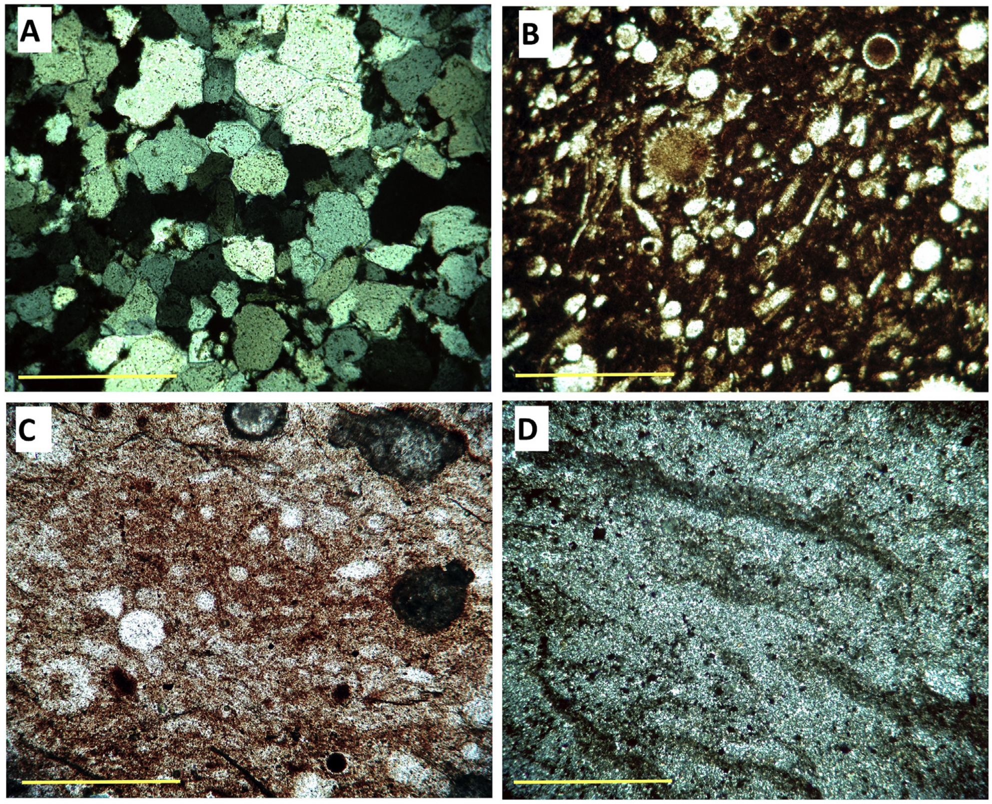


Fig. 3. Optical microscopy view of the main siliceous lithologies in the lithic industry of Benzú rockshelter. A: Silicified sandstones (broad grain) (cross polars), B: Red radiolarites (paralel polars); C: Banded flint with radiolaries or spherical inclusions (paralel polars); D: Massive flint, with inclusions and fossil remains (cross polars). (Scale = 0.5 mm).

Concerning the technical characteristics of lithic technologies at Benzú (Ramos et al., 2013a: 356–437), there is a limited number of natural bases (nB), which we relate to the exhaustion of supply after their systematic use for the production of cores (1GNB-First Generation Negative Base). The analysis of knapping products and retouched pieces (Tables 1 and 2) indicates a clear predominance of the former (35,322 specimens: 97.89%) over the latter (763 specimens: 2.11%). The 7 strata under study have yielded a total of 523 cores (1.45%). Flakes (PB-Positive Bases) are very abundant (11,648 specimens: 32.28%). Other knapping products amount to 23,151 specimens (64.16%): these include discards (7429 specimens), small flakes (15,720 specimens) and tabular plaquettes (2 specimens).

With regard to the technical aspects of production, the analysis of Indirect Technical Operative Themes (ITOTs) points to several techniques being used in order to exploit the bases and cores. The flakes so obtained could be used as tools in their own right or retouched in order to create retouched artefacts (2GNBs-Second Generation Negative Bases) (Ramos et al., 2013b: 678–682). The ITOTs analysis (Carbonell et al., 1999) revealed a clear relationship between cores-1GNB and flakes-PB, including 5 ITOTs: 1-longitudinal, 2-unipolar, 3-centripetal, 4-bipolar and 5-multipolar (Ramos et al., 2013b: 678–682). The distribution of cores, flakes and other knapping products indicates that the knapping operations took place on site.

A total of 523 cores-1GNB have been located at the site (1.45% of the total assemblage). Cores worked by the application of recurrent methods, related to well-defined ITOTs, are clearly predominant. Polyhedric cores are the most abundant, with 207 examples (39.58% of total number of cores). Multipolar centripetal (Fig. 4) are also present in significant numbers (189 specimens: 36.14% of cores). Along with Levallois-cores, they represent 41.71% of the total number of cores present in the assemblage. Eighty-three examples of unipolar cores were recorded (15.81% of 1GNBs). The assemblage also includes 12 bipolar 1GNBs (2.28%), 1 example of a 1GNB on flake (0.19%) and 1 example of crested 1GNBs (0.19%). Other technical features of 1GNB-cores, such as their facial and centripetal character and the obliquity and depth of the front and sagittal edges, were also analysed (Ramos et al., 2013b: 371–372).

Flakes (PB or Positive Bases) are present in very significant numbers (11,648 specimens: 32.27% of the total assemblage). This includes a small number of flakes related to the initial steps in the knapping process: cortical flakes amount to 162 (1.39% of total number of flakes), and semi-cortical flakes to 587 (5.04%). The most abundant type are the internal flakes, with 8560 specimens (69.18%). Levallois flakes (Fig. 5) are the second most abundant type (2267 specimens: 19.48%). Seventy-two crested flakes (0.62%) were also recorded. Flakes are much more abundant than laminar fragments (95.76% and 4.24% respectively) (Ramos et al., 2013a: 376–377). The morphological analysis of the flakes has also revealed a preference for broad, large flakes over small flakes (Bagolini, 1968). Flakes with visible butts are more common than those which have missing butts (78.56% and 21.44% respectively). Among the former, faceted butts are clearly predominant over plain butts. Other technical features were also examined, for example the flakes' dorsal-, ventral- and butt-faces, as well as dimensions, fractures and volume (Ramos et al., 2013a: 377–379).

The application of knapping techniques was very regular, especially concerning the use of centripetal and Levallois cores for the production of Levallois flakes, which were subsequently retouched for the shaping of retouched artefacts (2GNB tools), especially scrapers and points. Retouching always followed highly standardised procedures. It has been detected that certain tools – 2GNB-scrapers (Fig. 6: c-f), 2GNB-notched (Fig. 6: a,b) and

Table 1
Frequencies of lithic production by levels. Bn: Natural Bases, BN1G: Cores: U: Unipolar, B: Bipolar, CM: Centrípetal core, L: Levallois, POL: Multipolar, SL: On flake, C: Crested cores, BP: Flakes, D: Cortical flakes, SD: Semi-cortical flakes, I: Internal flakes, LE: Levallois, C: Crested flakes, ORT: Other debris: DES: Debris, E: Small flakes, PA: Tabular plaquetes, BN2G: Retouched pieces, R: Scrapers, D: Denticulates and Notches, G: End-Scrapers, P: Points, DIV-RU: Diverses.

	Bn	BN1G							Total BN1G	BP					Total BP	ORT			Total ORT	BN2G					Total BN2G	Total
		U	B	CM	L	POL	SL	C		D	SD	I	LE	C		DES	E	PA		R	D	G	P	DIV-RU		
LEVEL 7		11	3	36	2	49			**101**	3	88	1218	270	10	**1589**	962	2142		**3104**	51	126	2	2		**181**	**4975**
LEVEL 6		7	1	7	1	22			**38**	2	46	769	290	1	**1108**	798	1621		**2419**	18	39				**57**	**3622**
LEVEL 5	1	19	5	60		42			**126**	43	144	2228	544	28	**2987**	1825	3945	1	**5771**	96	79	2	5		**182**	**9067**
LEVEL 4	3	18		55	10	44	1	1	**129**	45	201	2622	640	17	**3525**	1661	4336	1	**5998**	112	68		8	1	**189**	**9844**
LEVEL 3	2	14	3	10	11	10			**48**	14	48	900	208	4	**1174**	1007	1801		**2808**	43	34	1	3		**81**	**4113**
LEVEL 2		4		8	4	22			**38**	39	38	629	223	5	**934**	864	1477		**2341**	15	33				**48**	**3361**
LEVEL 1	1	10		13	2	18			**43**	16	22	194	92	7	**331**	312	398		**710**	8	17				**25**	**1110**
TOTAL	**7**	**83**	**12**	**189**	**30**	**207**	**1**	**1**	**523**	**162**	**587**	**8560**	**2267**	**72**	**11,648**	**7429**	**15,720**	**2**	**23,151**	**343**	**396**	**5**	**18**	**1**	**763**	**36,092**

denticulated tools, and 2GNB-points – were especially often knapped from radiolarite or sandstone, internal or Levallois, medium-to-large flakes. They generally feature 3 or more edges, 4 to 5 extractions and different kinds of well-faceted butts.

Among BN2G-retouched flakes, a clear predominance of simple over multiple retouch can be noted, as well as deep over marginal, direct over inverse, and straight over denticulated retouches (Laplace, 1972: 113), including scrapers, denticulated tools and points (Ramos et al., 2013a: 392). In short, all strata present the typical typological features of Mode 3 technologies. Scrapers are predominant (343 examples: 44.95%) in strata 3, 4 and 5, while notched tools (396: 51.90%) predominate in strata 1, 2, 6 and 7. Points are present in significant quantities (18: 2.36%), and a number of end-scrapers have also been recorded (5: 0.65%).

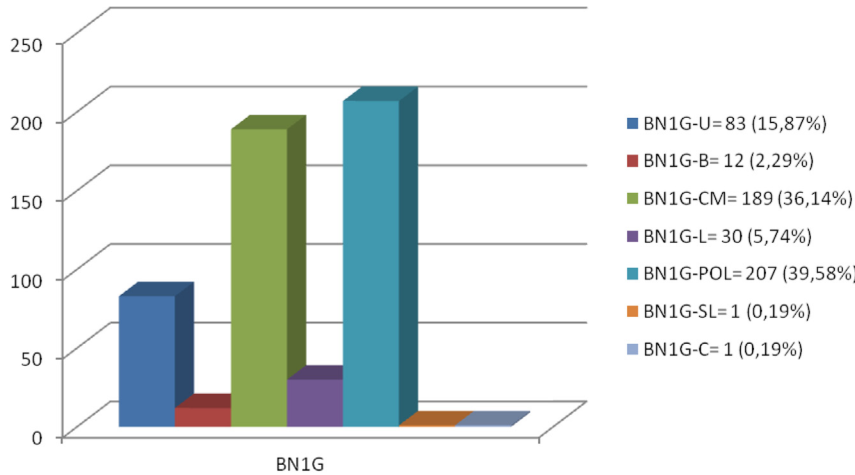
2.3. *Micro- and macro-analysis of lithic remains*

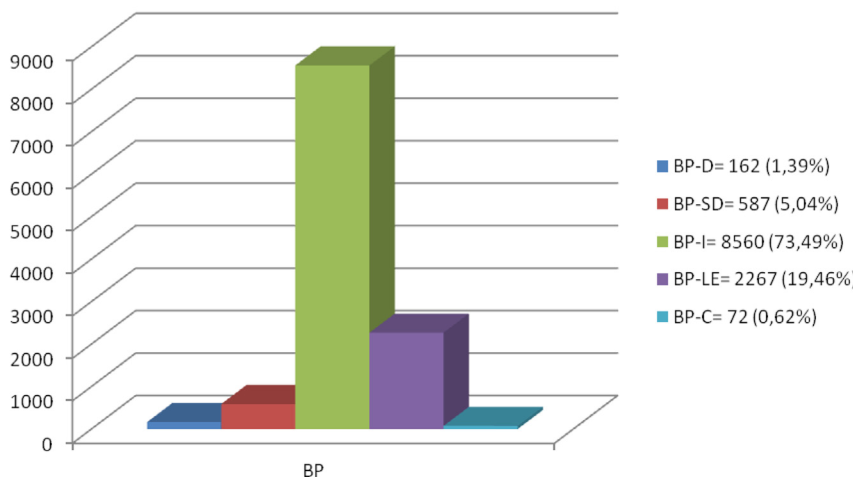
Wear trace analysis was carried out on a sample of tools which represented all 7 levels of human occupation in the sequence (Clemente, 2006, 2013: 438–454). This analysis resulted in the following conclusions:

1. Despite the hardness of the sediment – breccia – which required the application of unusual excavation strategies (Domínguez-Bella et al., 2012), the lithic artefacts suffered little because of this. Only a low percentage of artefacts suffered cuts or perforations during the process of block extraction. Another low percentage suffered some surface damage caused by the electrical chisels and metallic brushes used in the excavation of the blocks in the laboratory. This is especially evident in stratum 7, which was exceptionally hard to excavate.
2. The lithic artefacts in Benzú present no evidence of damage due to sedimentary pressure or dragging. Generally, edges are neither abraded nor rounded. The fractures in the sandstone-encrusted quartz crystals appear to be quite fresh, which is ideal for microscopic analysis. Homogenous stones (flint and radiolarite), however, are more vulnerable to taphonomic and post-depositional processes, and often have a glossy appearance. These kinds of rock are also more prone to suffering thermal alterations, or at least to showing clearer signs of them, including colour change, thermal gloss, cracking and thermal spots (Clemente, 1997a). We think that these thermal alterations could have been caused by direct contact with fire: according to our hypothesis, the occupants set the rock-shelter on fire every time they arrived with the intention of settling there. This had a prophylactic effect and would have facilitated settlement. On several occasions, especially in stratum 5, tools that had been shaped previously and left on site (probably during the time period corresponding to stratum 4) were exposed to the action of fire and then retouched and used. This reuse of tools after they had suffered thermal alteration has been documented in other Middle Palaeolithic sites on the Iberian Peninsula (Clemente, 1995).
3. The lithic technology documented at Benzú was used in a variety of economic activities related to the exploitation of both animal (Fig. 7) and plant resources. Use wear has been detected in nearly 20% of the specimens included in the total sample analysed. It has been concluded that woodworking was carried out with scrapers and also with other types of tool; scrapers were used both for cutting longitudinally (sawing) and for scraping transversally (Fig. 8). Soft tissues were cut using tools whose active edges had not been retouched, in contrast to tools used for cutting hides; in these cases, the retouch is generally direct and deep. Wear trace analysis also indicates that, in most strata, the proportion of tools used for processing animal tissues

Table 2

Histograms. Graphical representation of frequency of stone products by levels, BN1G: Cores: U: Unipolar, B: Bipolar, CM: Centrípetal core, L: Levallois, POL: Multipolar, SL: On flake, C: Crested cores, BP: Flakes, D: Cortical flakes, SD: Semi-cortical flakes, I: Internal flakes, LE: Levallois, C: Crested flakes, ORT: Other debris: DES: Debris, E: Small flakes, PA: Tabular plaquetes, BN2G: Retouched pieces, R: Scrapers, D: Denticulates and Notches, G: End-Scrapers, P: Points, DIV-RU: Diverses.





is similar to that of tools used for processing vegetal resources. However, the tools recovered from stratum 3 are mostly related to the processing of animal tissues.

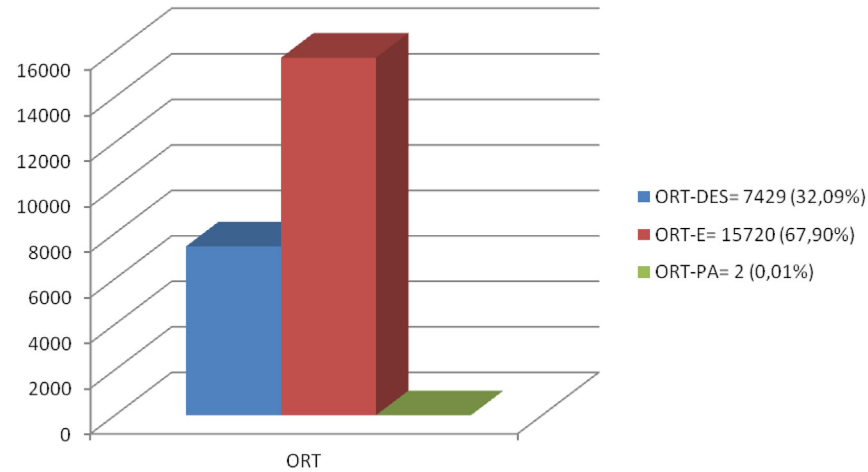
4. Hafting was a technological leap forward for prehistoric societies: it allowed for more efficient tools at a lower labour cost. Archaeologists have found very early evidence for this practice (Rots and Van Peer, 2006; Rots, 2010), and residues of the mastic used as glue have even been found in Near Eastern Middle Palaeolithic contexts (Boëda et al., 1998). On both sides of a pointed flake found in Benzú we can note a series of extractions – these were aimed at trimming down the area were the shaft was located. Moreover, one of the edges presents evidence of micropolishing and some crystal alteration that can be associated with its sustained contact with a wooden shaft (Fig. 8).
5. The hinterland of Benzú has ample supplies of lithic raw material. For this reason, blunt tools were not reshaped of sharpened, but replaced by fresh tools; this is especially the case with sandstone tools, which are particularly prone to blunting. As a consequence, sandstone tools were used for short periods of time, and the traces of wear are tenuous, which makes their detection difficult. Heterogeneous stone types, in contrast, are more resistant to blunting and wear traces are easier to identify (Clemente, 1997b; Clemente and Gibaja, 2009).

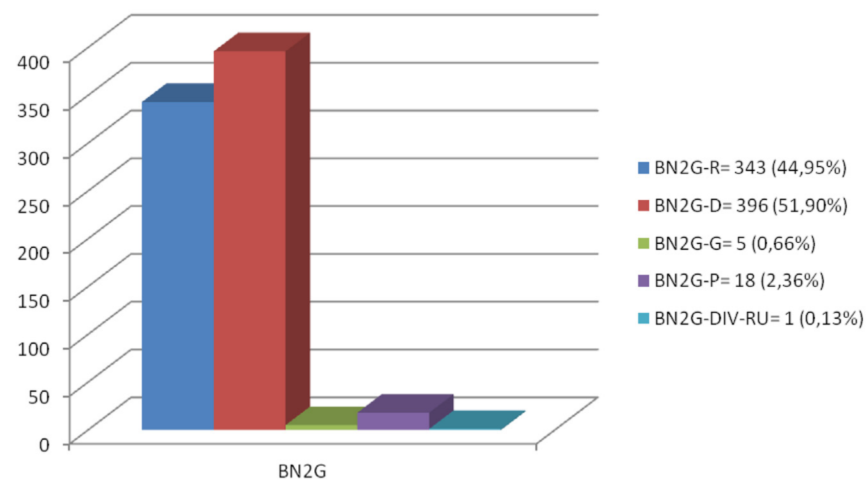
3. Synthesis of lithic technology at Benzú

We may say that the settlement is rich in natural bases (nB) with which cores were elaborated (1GNB). These, in turn, were knapped for the production of flakes (PB), a process that also produced large quantities of debitage. Flakes were later used for the production of retouched artefacts (2GNB), including scrapers, notched tools, denticulated tools and points. Both flakes and 2GNB tools were used in the economic activities characteristic of hunter-gatherer groups (Ramos et al., 2013b: 339–437).

No significant technical changes can be attested in the sequence, which is of great interest concerning Mousterian technologies in general (Bordes, 1978; Binford, 1983, 1985; Geneste, 1991; Stiner and Kuhn, 1992; Kuhn, 1995; Mora et al., 2008; Villaverde et al., 2012). It seems fairly clear that this regularity was caused by the intergenerational transmission of knowledge: these groups were technologically conservative and adapted their instruments to their economic needs (hunting, gathering and the exploitation of marine resources).

Table 2
(*continued*)





The functional analysis of the knapped products reveals that woodworking was practised in all seven archaeological strata to a greater extent than either butchering or hide processing. In stratum 3, however, butchering was the most common activity. Furthermore, it was also the only level in which the scraping of an animal hard tissue has been documented. Thermal alterations were present to a significant degree, which indicates the burning of the rock-shelter at the beginning of each habitation episode. In stratum 4, there is evidence for the hafting of an instrument (Clemente, 2013).

In conclusion, lithic technology in Benzú is uniformly characteristic of Mode 3, with a clear predominance of the Levallois technique and centripetal cores. Concerning flakes, internal flakes are predominant, but both those generated in the early stages of knapping and Levallois flakes are also well represented. With regard to retouched products, scrapers are particularly abundant, along with points and, to a lesser extent, notched and denticulated tools. Within the overall homogeneity of stone tools, some variation exists, as demonstrated by the percentage of Levallois productions between levels 3 and 4.

4. Benzú's territory

The Rock-shelter of Benzú is not an isolated site, as a large number of sites with similar technology (Mode 3) have been found in the regions of Ceuta and Tétouan (Garriga and Tarradell, 1951; Posac, 1981; Ramos and Cantillo, 2011 c). Specifically, two survey campaigns carried out in Ceuta in 2001 and 2010 identified nine such sites (Fig. 9): 22-Loma de los Hornillos, 23-Tiro Pichón I, 25-Playa Benítez, 73-Calamocarro, 74-Altabacal, 75-Punta de la Cabeza, 76-Zapatero III, 80-Los Olivillos and 81-Topete. The survey also encountered six instances of isolated finds: I.F. 8-Playa de Cala Mocarro, I.F. 17-Barranco de las Lanzas, I.F. 22-San Amaro, I.F. 23-Hacho II-, I.F. 32-Casa de Zapatero IV and I.F. 33-Casa de Zapatero V (Bernal et al., 2003; Vijande et al., 2011). All of these sites and isolated finds are located in foothill areas of quaternary terrace deposits between Calamocarro and Benzú and on the hilly slopes of Ceuta's mountainous interior. Around Tétouan, up to 49 Mode 3-related sites have been identified; these sites are located between Oued Liane and the coast of Tétouan and are informative concerning the mobility of the human groups that occupied Benzú and the rock-shelter's immediate hinterland (Ramos et al., 2008b, 2011b).

The excavation of Benzú yielded no evidence for the existence of Aterian technology at the site. Around Ceuta, the only evidence for Aterian technology was found in contexts in Cerro de Isabel II-Estación Radio (Bernal et al., 2003); also, an Aterian-type notched point was found in 78-Loma del Tío Díaz IV (Ramos et al., 2011c). Around Tétouan, evidence for Aterian industries was found in three

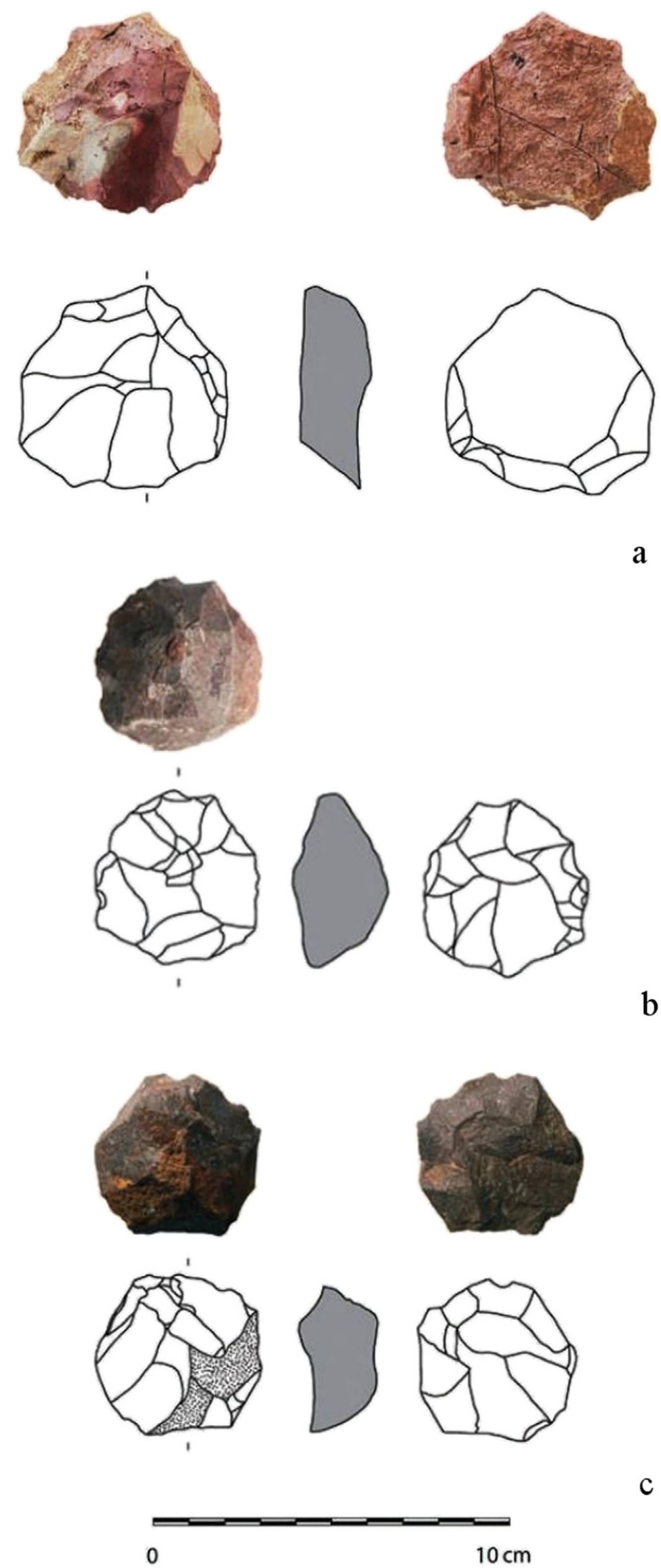


Fig. 4. Centripetal cores. (a) Level 2, (b) Level 3, (c) Level 4.

surface locations (Ramos et al., 2008b, 2011b). In addition, several excavations yielded stratigraphic evidence of Palaeolithic sequences, for example in the caves of Caf That el Gahr (Tarradell, 1958; Ramos et al., 2008c), Gar Cahal, Kehf el Hammar and Hattab 2 (Barton et al., 2005; Bouzouggar and Barton, 2006; Bouzouggar et al., 2006), and also, near Tangier, in Cap Achakar and the cave of Mugaret el'Aliya (Otte et al., 2004; Bouzouggar and Barton, 2006: 123).

Recent evidence suggests that the chronology of North African Aterian technologies is higher than was previously thought (Nespoulet et al., 2008a, 2008b; Garcea, 2010; El Hajraoui and Nespoulet, 2012). In the important sequence of Ifri N'amar (Nami and Moser, 2010), tanged tools have been dated to as early as 145 ± 9 ka, which is even earlier than Mode 3 and demonstrates the technological and chronostratigraphic variability of North African Middle Palaeolithic sequences (Nami and Moser, 2010: 263; Linstädter et al., 2012). The intermingling of Aterian and Mode 3 North African Middle Palaeolithic sequences is becoming increasingly clear (Collina-Girard and Bouzouggar, 2013). Aterian technology is also part of the Mode 3 Lithic technology.

In addition, we must also stress the clear relationship between lithic technologies in this region of North Africa and those found in the south of the Iberian Peninsula (Lumley, 1969; Botella and Martínez, 1979; Vallespí, 1986; Vega et al., 1988; Barroso and De Lumley, 2006; Medianero et al., 2011; Ramos Fernández et al., 2011–2012; Cortés et al., 2011, 2011–2012), especially the area around the Straits of Gibraltar (Ramos, 2008; Jennings et al., 2009; Bernal Gómez, 2012; Giles et al., 2012).

5. Regional contextualisation of Mode 3 hunter-gatherer groups in NW of Africa

The definition, distribution and composition of Mode 3 technologies in North Africa (Fig. 10) is a classic archaeological problem (Balout, 1955; Vaufrey, 1955; Camps, 1974; Bordes, 1976–1977). Most sites that have been identified to date are open-air and stratified, and well-dated sites are scarce. Generally, identification has relied on the presence of points and scrapers. The site of Djebel Irhoud yielded a standard Mousterian assemblage found in association with anthropological remains, which were initially identified as Neanderthals (Ennouchi, 1962). Another example is the Cave of Dar es-Soltan, the study of which began in the 1950s, where Mousterian, Aterian and Neolithic technologies were found (Ruhlmann, 1951). These technologies have also been found in the vicinity of Ceuta and on the terraces of the Martil River, near Tétouan (Tarradell and Garriga, 1951), as well as on the coastal terraces near Ceuta and Beni Gorfet (Morán, 1941). Posac (1956) also identified Mousterian technologies near Melilla and Nador (Bravo and Bellver, 2004). Pericot and Tarradell (1962) compiled the results of the investigations carried out in the 1950s on the origin of these industries, as well as on their technological definition, stratification and relationship with previous technologies.

In 1984, Hahn constructed a general overview of the Palaeolithic sequence in North Africa and southern Europe (Hahn, 1984) followed in 1992 by Nehren, who synthesised the problems of interpretation that exist around Mousterian technology; in his opinion, Mousterian technologies began before 100 ka and were related to the Late Acheulean period (Nehren, 1992).

In recent years, there has been renewed interest in the issue, as shown by the works of several archaeological projects. The work of the Mission Archéologique et Paléontologique Française au Maroc has generated new data. In this context, The Mission au Maroc Oriental has undertaken the synthesis of the evidence from the caves of Djebel Irhoud, Kifan Bel Ghomari and Pigeons in Taforalt (Wengler, 2001), as well as a detailed analysis of the Cave of Rhafas (Wengler et al., 2001; Mercier et al., 2007). The French-Moroccan mission has also worked in the region of Rabat-Témara, where very interesting results are being obtained, including evidence for the high chronology of Aterian technologies (Nespoulet et al., 2008a, 2008b, 2011; Schwenninger et al., 2010; El Hajraoui and Nespoulet, 2012).

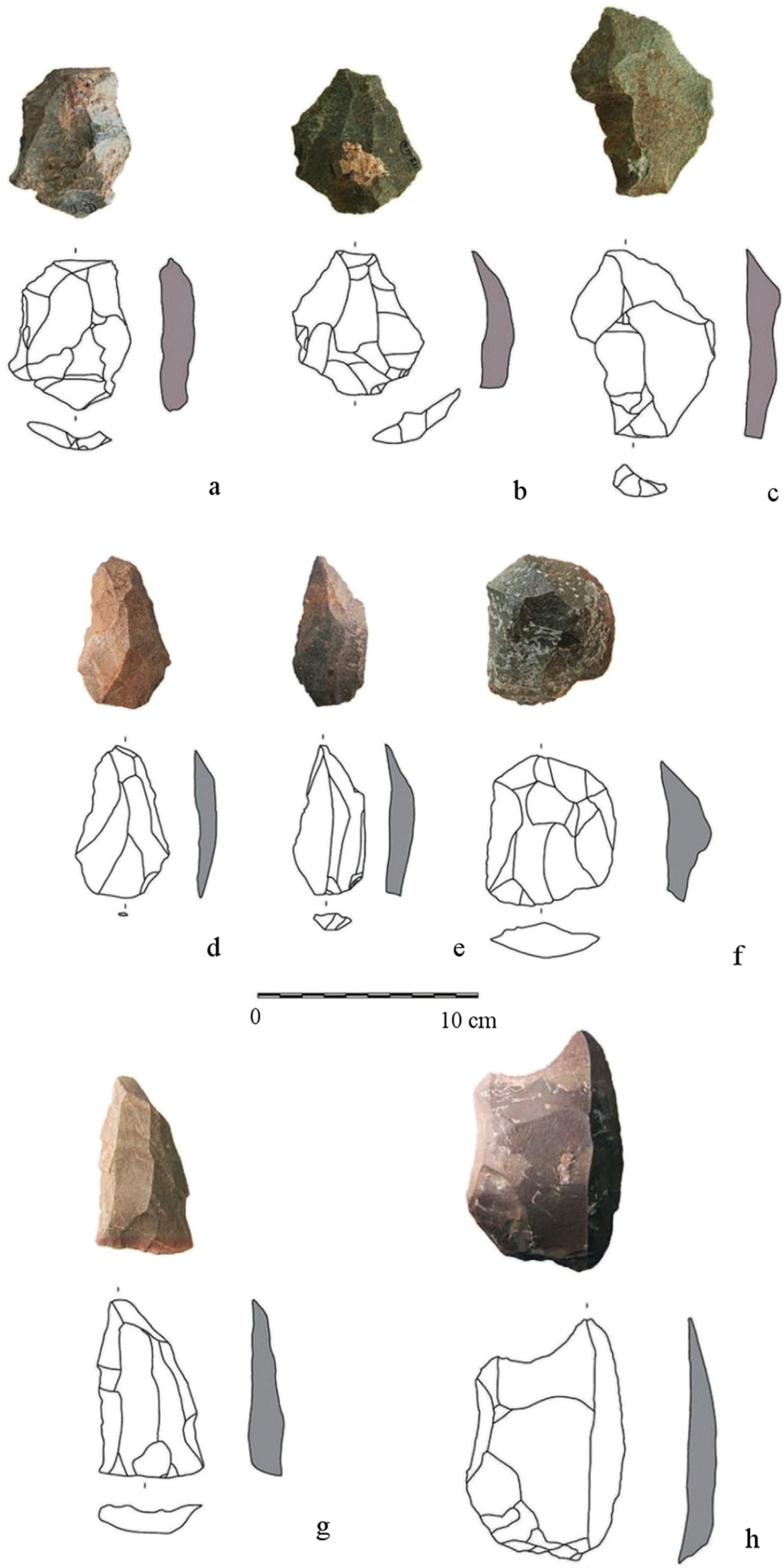


Fig. 5. BP: Levallois flakes. (a–b) Level 1, (c–e) Level 2, (f–g) Level 3.

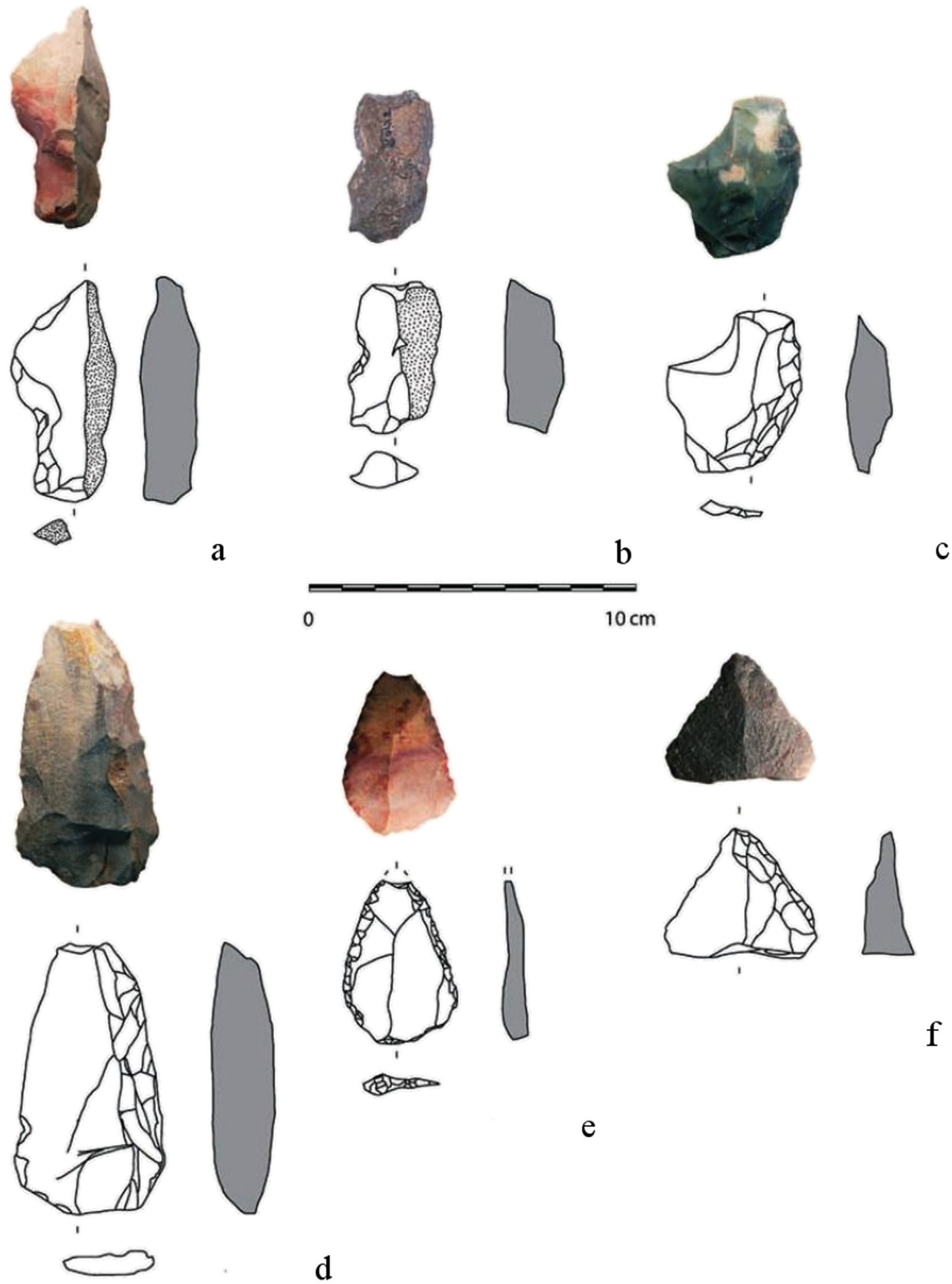


Fig. 6. BN2G: Retouched pieces. Notches (a–c), scrapers (d–f). Level 4.

The cooperative project carried out by the Institut National des Sciences de l'Archéologie et du Patrimoine (INSAP, Rabat) and the Kommission für Archäologie Ausereuropäischer Kulturen (KAAK, Bonn) des Deutschen Archäologischen Instituts in the eastern Rif (Mikdad et al., 2000, 2004; Eiwanger, 2001, 2004; Mikdad and Eiwanger, 2005; Linstädter et al., 2012) is also yielding good results, as are the projects initiated in northern Morocco by the universities of Cádiz and Abdelmalek Esaadi (Tétouan) and INSAP (Rabat) (Ramos et al., 2008b, 2011b), the cooperative project carried out in Tangier by INSAP and Université de Liège (Bouzouggar, 2003; Otte et al., 2004), and the project run by the University of the Basque Country in the region of Tiris (Sáenz de Buruaga, 2008, 2014).

These international projects have found new Middle Palaeolithic sites in caves, rock-shelters and open-air locations, and great progress is being made with regard to the chronostratigraphy of North African Late Middle and Upper Palaeolithic contexts. Especially important are the stratified sites of Ifri El Baroud and Ifri n'Ammar (Eiwanger, 2001, 2004; Mikdad et al., 2004; Nami and Moser, 2010) in the eastern Rif. Ifri n'Ammar presents the alternation of Middle Palaeolithic and Aterian strata, which are dated to between 171 ± 6

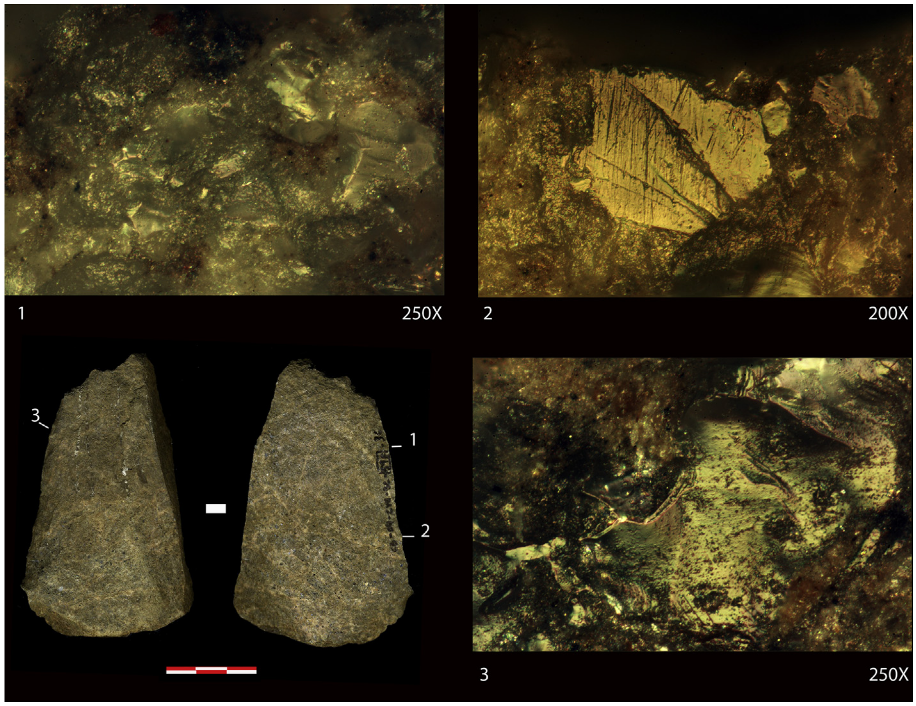


Fig. 7. R21-Scraper with a straight edge and left retouched used to process material soft-medium hard animal. The actions carried out are both longitudinal (photos 1 and 3) and transverse (photo 2).

and 83 ± 6 ka (Nami and Moser, 2010: 35). According to the excavators, the industry of the site represents a distinct Mousterian facies (Linstädter et al., 2012). Also of interest is the identification of a large number of open-air sites in the Oujda hills, which are yielding considerable palaeobotanic, faunal, technological and lithological evidence (Wengler et al., 2001). The Cave of Guenfouda (Aouraghe et al., 2008), an investigation of which was begun recently, is also located in this region. Concerning the region around Tétouan, considerable evidence related to Mode 3 Middle Palaeolithic technologies has been attested on alluvial terraces (Ramos et al., 2008b, 2011b). The excavations that are being carried out in the Cave of Taforalt – another example of international cooperation (between

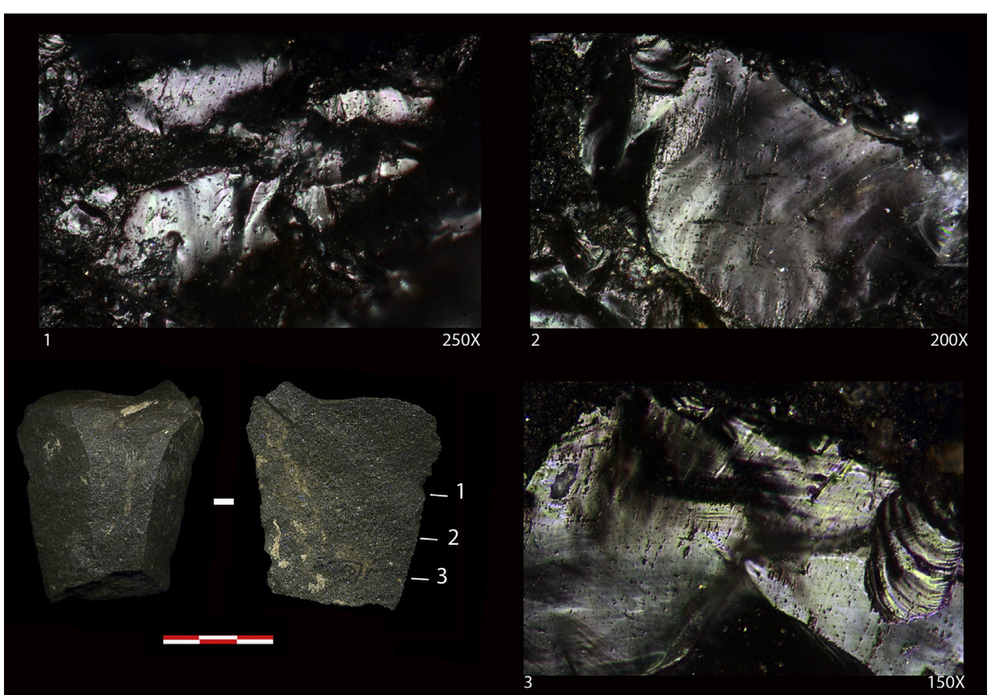


Fig. 8. Use wear at scraping wood in the surface of the tool (R21-Scraper).

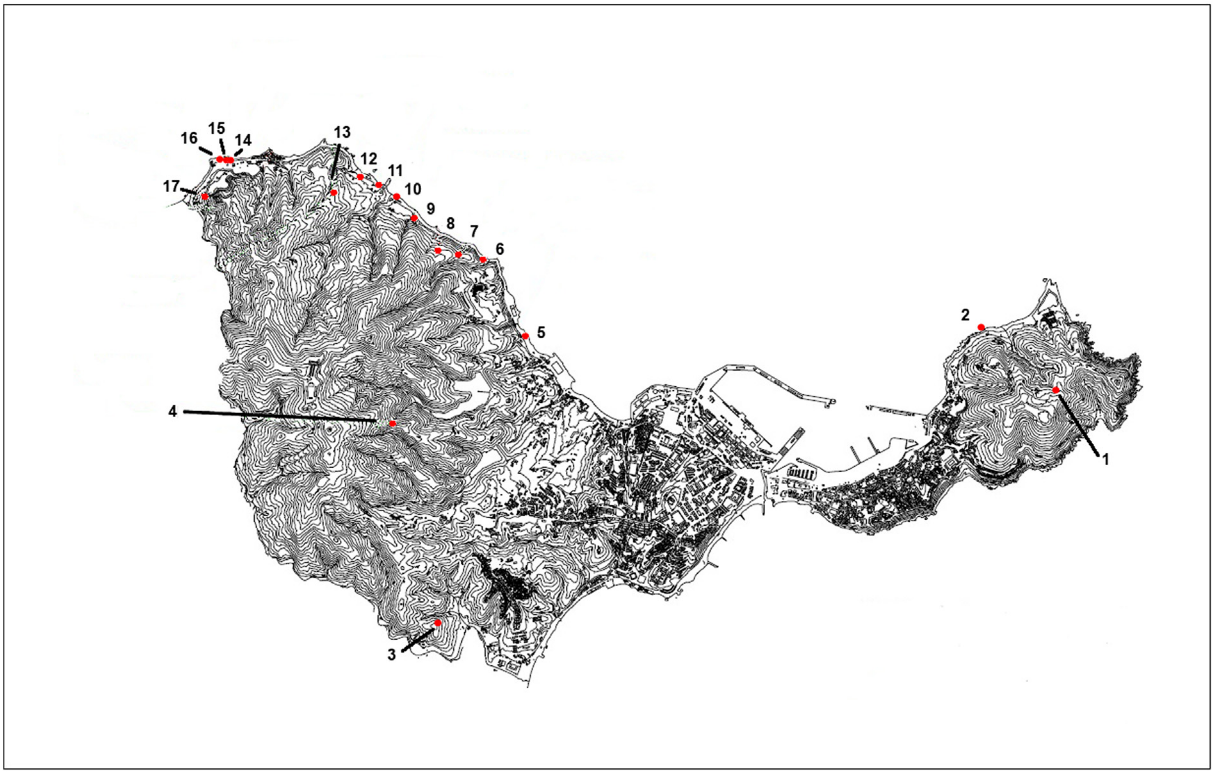


Fig. 9. Map showing location of Prehistoric Sites and Isolated Find in the territory of Ceuta.1: I.F. 23-Hacho II; 2: I.F. 22-San Amaro; 3: I.F. 17-Barranco de las Lanzas; 4: 81-Topete; 5: 25-Playa Benítez; 6: 23-Tiro Pichón I; 7: 80-Los Olivillos; 8: 22-Loma de los Hornillos; 9: 73- Calamocarro; 10: I.F. 8- Playa de Cala Mocarro; 11: 75- Punta de la Cabeza; 12: 74-Altabacal; 13: 80-Los Olivillos; 14: 76-Zapatero III; 15: I.F. 33-Casa de Zapatero V; 16: I.F. 32-Casa de Zapatero IV; 17: Rock-shelter of Benzú.

INSAP and the University of Oxford) — are also expected to have positive results (Bouzouggar and Barton, 2005, 2012).

All of this evidence clearly indicates the presence of Mode 3 Middle Palaeolithic industries in North Africa. Although the number of stratified sites identified is low, the expansion of research to areas such as central Tunisia, the Algerian coast and both western and eastern Morocco has provided an increasing amount of evidence for Mode 3 technologies dating to the Middle

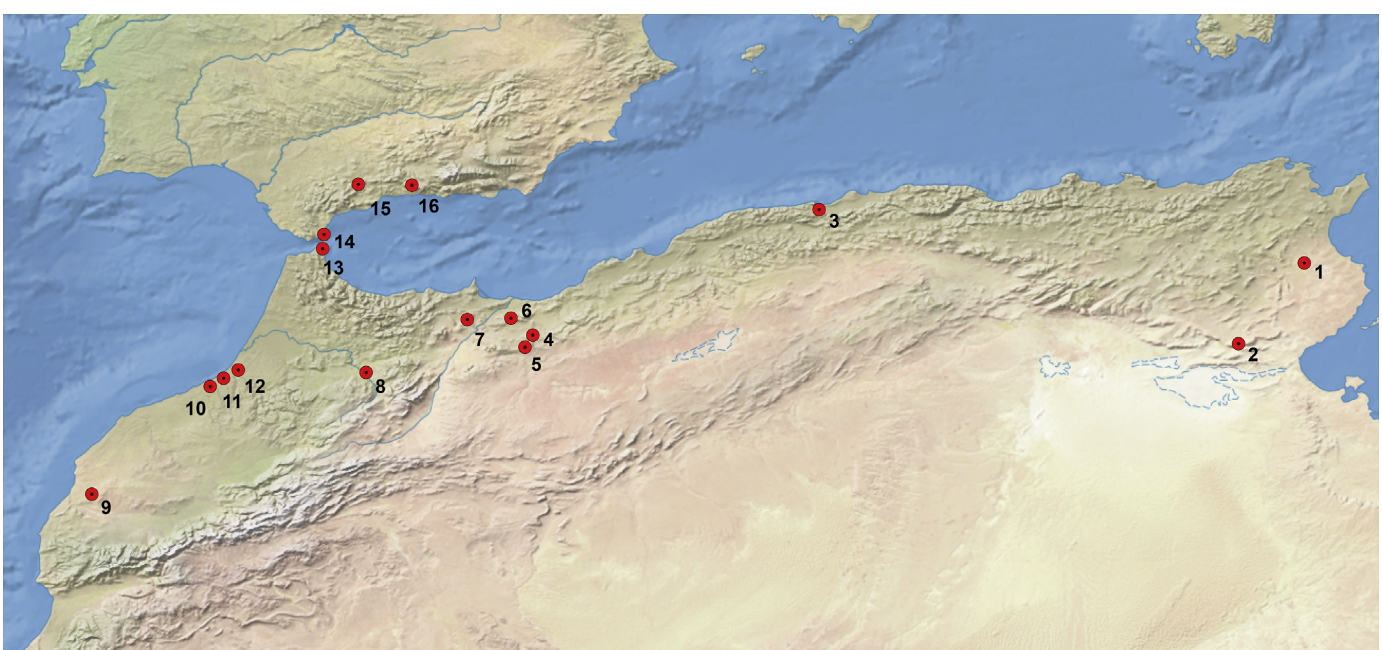


Fig. 10. Map of sites with Mode 3 lithic technology. NW of Africa and the South Iberian. 1: Aïn El Guettar, 2: Sidi Said, 3: Aïn Metherchem, 4: Rhafas, 5: Guenfouda, 6: Taforalt, 7: Ifri 'Ammar, 8: Kifan Bel Ghomari, 9: Djebel Irhoud, 10: El Mnasra, 11: El Harhoura 2, 12: Dar es Soltan, 13: Benzú, 14: Gibraltar Caves, 15: Guadalteba Caves: Ardales Cave, Sima de las Palomas, 16: Deposits of the Axarquía.

Pleistocene. Work is being done in Aïn Metherchem (Hajri, 2007), Aïn El Guettar (Belhouchet and Aouadi, 2007) and Témara, El Mnasra, El Harhoura 2 (Nespoulet et al., 2008a, 2008b, 2011; El Hajraoui and Nespoulet, 2012) and Dar es Soltane (Barton et al., 2009). Chronologies obtained in Benzú — - 254 ± 17 ka BP (stratum 2) and 70 ka BP (stratum 7): Ramos et al., 2008b, 2013b; 2011b — suggest a high chronology for Mode 3 technologies and find confirmation in other sites, for example Ifri n'Ammar — between 171 ± 12 and 83 ± 6 ka (Nami and Moser, 2010: 35) — and Djebel Iroud — between 190 and 106 ka (Grün and Stringer, 1991; Smith et al., 2007).

The human groups attested for the Iberian Peninsula in these chronologies are regarded as descendants from the *Homo heidelbergensis* and the *Homo sapiens neanderthalensis* (De Lumley, 1998: 131; Arsuaga et al., 2001; Garralda, 2005—2006; Barroso, C., Lumley, H. De, 2006; Walker et al., 2008; Finlayson et al., 2008; Finlayson, 2009; Zilhao et al., 2010; Baena et al., 2014). Initially, it was believed that North Africa was colonised by groups of Neanderthals during this period, but later studies suggest that these groups were early *Homo sapiens sapiens* (Hublin, 1989; Debénath, 2001; Zouak, 2001: 154) related to Aterian technology (Zouak, 2001: 155; 2007). It is hoped that the recent research burst will be a means of collecting further technological and anthropological evidence for these groups and their possible relationship with groups on the Iberian Peninsula.

Based on the available evidence, Mode 3 Mousterian Middle Palaeolithic technology in North Africa can be ascribed a high chronology (starting over 200 ka). This is in contrast to chronologies recorded in the south of the Iberian Peninsula, which are lower (Finlayson et al., 2006; Wood et al., 2013).

Research has to tackle significant problems: for example the relationship between mode 2 and mode 3 technologies, the origins of Aterian technologies and the alternation of Aterian and Middle Palaeolithic technologies (Dibble et al., 2013) in sites such as Sidi Said (Tipasa, Algeria) (Hajri, 2007) and Ifri n'Ammar (Nami and Moser, 2010: 35). These problems are associated with that of the occupation of the southern Iberian Peninsula, which is itself a problem. One fact can hardly be denied in the light of recent evidence: Mode 3 Mousterian Middle Palaeolithic contexts in North Africa are older.

6. Human diversity in the framework of a similar technological and economic framework on both shores of the Straits of Gibraltar

The chronology of Mode 3-Middle Palaeolithic in the Iberian Peninsula (Barroso and De Lumley, 2006; Finlayson et al., 2006; Cortés et al., 2012) is more recent than that of MSA-Middle-Palaeolithic in NW Africa (Nami and Moser, 2010; Bouzouggar and Barton, 2012; Linstädter et al., 2012; Dibble et al., 2013). Palaeo-environmental evidence in both regions shows some similarities, as recently demonstrated by archaeo-botanical analyses (Ruiz Zapata and Gil, 2013, 2014, 2015; Uzquiano, 2013).

The similarity of Mode 3 Middle Palaeolithic technologies in the south of the Iberian Peninsula (Cortés et al., 2011—2012: 77) and in North Africa (Nami and Moser, 2010; Linstädter et al., 2012; Collina-Girard and Bouzouggar, 2013; Ramos et al., 2013b) must be stressed. In both regions, these technologies are characterised by the production of scrapers and Mousterian points, and also by the techniques used in their production, including core preparation and preliminary flaking. In our opinion, these technical similarities are more than mere polygenic convergence, and must be explained in terms of sociocultural relationships. These contacts could have taken place during cold Pleistocene phases, when the coastlines were closer to one another (Collina-Girard, 2001; Flemming et al., 2003; Rodríguez Vidal et al., 2004; Abad et al., 2013; Collina-Girard and Bouzouggar, 2013).

The direct analysis of sites in the south of the Iberian Peninsula - region of Axarquía (Malaga) (Ramos, 1988), Cadiz's Atlantic coast (Ramos, 2008) and the region of Guadalteba (in cooperation with Gerd Weniger) (Medianero et al., 2011; Kehl et al., 2013; Weniger and Ramos, 2014) —, the rock-shelter of Benzú (Ramos et al., 2013b) and the region around Tétouan (Ramos et al., 2008b, 2011b) in North Africa demonstrated the similarity between cores, flakes and retouched products on both shores. Furthermore, the evidence suggests that the techniques used for their production were also very similar. On the other hand, both the mode of organisation of these societies (Otte, 1995) and their nomadic lifestyle (Weniger, 1991; Estévez et al., 1998) would have created plentiful opportunities for social contact and the dissemination of technology.

In addition, the evidence suggests that the similarities did not stop at technology; recent studies indicate that Middle and Upper Pleistocene societies on both shores of the Straits of Gibraltar exploited marine resources (Finlayson, 2009; Zilhao et al., 2010; Colonese et al., 2011; Cortés et al., 2011; Ramos and Cantillo, 2011; Ramos et al., 2011a; Cantillo, 2012). In the south of the Iberian Peninsula, these activities were carried out by Neanderthal groups (Stringer et al., 2008; Finlayson, 2009; Cortés et al., 2011), whereas in North Africa these activities, as well as Middle Palaeolithic and Aterian technologies, are thought to have been performed by *Homo sapiens sapiens* (Hublin, 1989; Zouak, 2001, 2007; Garcea, 2004; Barton et al., 2008). Mode 3 technologies and the exploitation of marine and coastal resources are documented in association in both regions (Cortés et al., 2011; Ramos and Cantillo, 2011; Ramos et al., 2011a). In our opinion (Arteaga et al., 1998; Ramos, 1999), the evidence indicates that the groups on both shores of the Straits of Gibraltar practised the same activities, even if they have traditionally been interpreted separately.

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