The Early and Middle Pleistocene archaeological record of Greece : current status and future prospects
Tourloukis, V.

3 – Lower Palaeolithic records of the circum-Mediterranean area

3.1 INTRODUCTION

In this chapter, a critical overview of the circum-Mediterranean Lower Palaeolithic record is presented. The evidence from each region is discussed in relation to the best-studied sites and with regard to broader patterns that can be extracted. One of the main objectives of my research is to examine the early Palaeolithic record of Greece within the framework of the earliest occupation of Europe; to this end, we first need to consider some of the most important aspects characterizing not only the records of neighboring regions, such as the Italian peninsula or the Balkans, but also those of more remote areas, such as the Iberian peninsula. Besides the meager evidence of the Balkans, the circum-Mediterranean area was chosen because it is the most relevant to Greece in many respects, namely in terms of geomorphology, topography, geology, tectonic history and climate. The main conclusions of this examination will serve as a framework of reference, against which the Greek evidence will be compared in chapter 7. The examination here will allow the reader to make her/his own comparisons between the Greek evidence and the Lower Palaeolithic of the rest of the Mediterranean, and the author to refer to sites, dates and contexts from the Mediterranean Lower Palaeolithic, whenever this is necessary for a better understanding of the Greek record.

Additionally, this section serves another purpose, which could be dubbed the 'de-mystification' of the best-studied Lower Palaeolithic records in the Mediterranean. Irrespective of geographical entities but strongly related to research policies and national politics, it is frequently the case that in areas where a couple of uncontested sites exist (and especially, very early sites), the rest of the sites comprising the regional record are unreservedly accepted as sound evidence, simply because of a 'shadow of reliability' cast upon them by the uncontested site(s). Therefore, it is only upon close scrutiny, when the problematic aspects of such well-studied records are brought to light, that a more objective apprehension can be attained for other, less-studied records. In other words, the examination that follows will help us to draw some conclusions also with regard to this question: which of the problems burdening the Greek record are idiosyncratic, and which of them are part of a wider corpus of hindrances, that constrain archaeological studies of the Early and Middle Pleistocene in other regions, too?

The assessment is carried out following two axes of analysis: a site-specific and a regional-specific. In both, the emphasis is given to the three following parameters, assessed in this order of significance:

1. *the depositional environments and geomorphological settings*. The geological context, with which archaeological material is associated, is of crucial importance for the examination and the argumentation that is gradually unfolded in this book. In turn, the geomorphological setting is largely responsible for the nature of the depositional context (primary or secondary). Together they constitute the reference platform for evaluating the next two points.
2. *the dating evidence*. Preferably, the dating of a site should be accomplished by a combination of dating techniques, each one complementing and/or calibrating the others. Nevertheless, 'absolute' dates -and ideally, radiometric ones- are preferred over relative dating; for both cases, what needs to be made clear is the association of the dated event or material with the archaeological finds, the nature of the stratigraphic context from which the samples were obtained, as well as any incon-

sistencies between the available dating readings (which should be more than one, if possible).

3. *the artefactual character and the typo-technological ascription of the lithic material*. For example, wherever the material is associated with secondary/derived contexts, the artificial origin of lithic specimens should be demonstrated. Furthermore, as shown below, the long-lasting tendency of ascribing an early age to morphologically 'simple' artefacts should be treated with caution.

With a focus on these factors, I will examine the record of the Italian Peninsula, and then move to the Iberian Peninsula, the evidence from North Africa and that of the Levant, concluding with the record of Turkey and the Balkans.

3.2 THE ITALIAN PENINSULA

The topography, geography and geology of Italy have a lot in common with Greece, as both countries are characterized by two main features: the predominance of coastal and mountainous areas, and a long history of intense tectonism. On the other hand, certain aspects of Italy's tecto-sedimentary evolution are different from those of Greece. In addition, whereas the history of Palaeolithic research in Italy reaches back to the times when Boucher de Perthes, one of the founders of Palaeolithic archaeology, was investigating in the beginning of the 19th century the area near Rome (Mussi 2001, 8), the Greek landscapes were only much later to be surveyed with a clear focus on Palaeolithic remains (Runnels 1995). Hence, research biases and small but significant discrepancies in their geological trajectories might sufficiently explain the marked contrast in the Lower Palaeolithic records of the two countries, but we shall return to this issue later. For a proper evaluation, it is best to consider first the main quantitative and qualitative facets of the Italian record.

Excluding surface collections but including excavated localities with as few as two artefacts, more than forty sites have been claimed to be earlier than or as early as MIS 9, when the Levallois technique begins to emerge[3] (Fig. 3.1; Mussi 1995). Overall, the chronological framework of the Italian record has been grounded upon various relative and absolute dating methods, including stratigraphic correlations, palaeomagnetism, biochronological indicators and a wealth of radiometric dates. The latter have been in many instances obtained from the dating of effusive products of volcanoes that were deposited during the considerable volcanic activity of the Pliocene and Pleistocene, which was in turn associated with tectonic movements. Related to the orogenesis of the Apennines since the late Miocene, compressive tectonics on the eastern periphery of the mountain range formed an alteration of deepened basins and uplifted areas, while from late Tortonian up to early-middle Pleistocene times, an extensional regime affected the inner (western) part of the Apenninic range, produ-

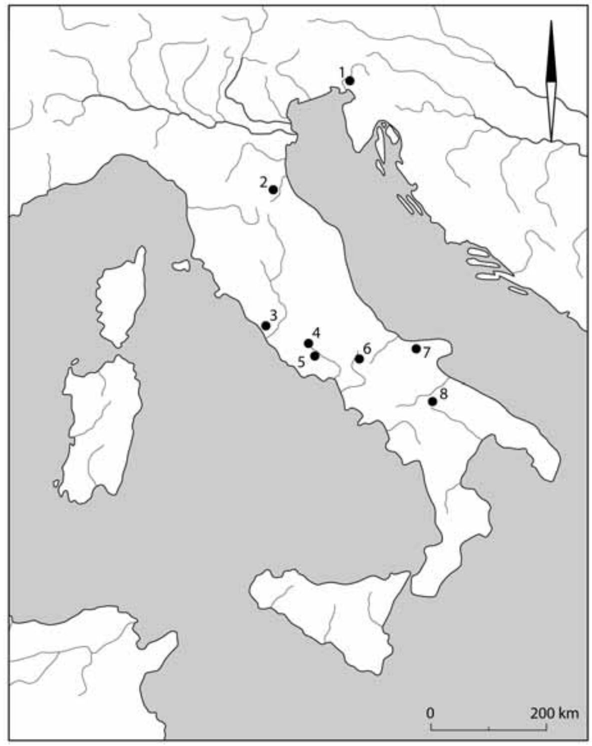

Fig. 3.1 Main Lower Palaeolithic sites of Italy: 1) Visogliano 2) Monte Poggiolo 3) Torre in Pietra, Castel di Guido, La Polledrara 4) Fontana Ranuccio, Colle Marino 5) Ceprano 6) Isernia La Pineta 7) Pirro Nord 8) Venosa Loreto, Notarchirico

3. Mussi (2001, 37) states that "the Levallois technique is not found at any well-dated site prior to stage 9- and possibly even later", explicitly putting the Lower-Middle Palaeolithic boundary upon the appearance of Levallois for organizing her book on the Palaeolithic and Mesolithic of Italy.

cing a series of small basins oriented mostly parallel to the NW-SE orographic trend, such as those of Isernia, Anagni and Venosa (Martini and Sagri 1993; Ghisetti and Vezzani 1999). When at around 1.0 Ma the uplifting of the Apennines was renewed, the landscape became more rugged and the basins were disrupted and drained by rivers: for instance, in the Isernia basin, which was filled by a lake during the Early Pleistocene, neotectonic activity resulted in stream capture and faulting of the Pleistocene deposits (Coltorti *et al*. 1982; Mussi 2001).

Many of those intra- and circum-Apenninic basins have preserved long fauna-yielding sequences: abundant documentation of mammalian localities enabled the construction of detailed biochronological schemes, wherein important faunal events are calibrated by independent chronological controls and compared with the record of small mammals, allowing for biostratigraphic subdivisions, identification of boundaries and correlation between different regions and individual archaeological sites. It is certainly not a coincidence that most mammal ages for both large and small European mammals have been formalized based on Italian type-localities (*e.g.* Villafranchian, Galerian, Aurelian; Raia *et al*. 2006; Sala and Masini 2007; but see also Palombo and Sardella 2007 for the problems of mammalian sequences and their correlations with the geochronological time-scale). The succession of faunal units not only provides an independent means for calibrating ('absolute') dates but it occasionally offers also insights into specific bioevents, which, together with other lines of evidence (*e.g.* palaeobotany, palaeopedology) facilitate the understanding of climatic/environmental changes, thereby allowing for palaeoenvironmental reconstructions.

In the narrow Italian peninsula, a great component of geomorphological and sedimentary processes is related to the presence of *ca.* 9,000 km of coasts and has therefore been considerably influenced by sea-level fluctuations; this affords the Italian Pleistocene archaeology the privilege of correlations with isotopic stages recognized in the marine records, in contrast to other parts of mainland Europe (Mussi 1995). Nevertheless, the 'marine control' of the sedimentation has its own side-effects: the reduction of the sea level forced rivers to incise, rejuvenating and altering their drainage systems, so that erosional planes were developed inland (*e.g.* see Amato *et al*. 2003 for an example of estimated rock volumes that have been eroded since middle Pleistocene times). As a consequence, there is an apparent bias in the archaeological record towards warm climatic phases, when stability generally prevailed over erosion. Accordingly, it is essentially in caves and fluvio-lacustrine basins serving as sedimentary traps, where the geo-archaeological archive is most adequately preserved.

Monte Poggiolo, which is one of the oldest known sites, is located now in the valley of the Po River (currently the largest lowland area of Italy), but when humans were present there, the site is assumed to have been closer to the coast, as the Po valley would have been a gulf of the sea (Mussi 1995). Archaeological remains were found in the fluviatile sandy gravels of a deltaic deposit which is argued to be correlative to littoral sands ('Imola Sands') that crop out in some distance from the site; the latter deposits comprise a supra-regional stratigraphic marker, they yielded a reversed magnetic polarity that is though to indicate a pre-Brunhes age, and have been ESR-dated to the interval between the Jaramillo and the Brunhes (Amorosi *et al*. 1998; Milliken 1999). Thus, the combined dates indicate an age between *ca*. 0.8 to 1.0 Ma, but doubts have been expressed on the validity of the palaeomagnetic measurements, and, importantly, on the fluviatile nature of the sediments and hence the very same correlation with the Imola Sands as well (Roebroeks 1994, 303; Villa 2001, 123). The assemblage of Monte Poggiolo comprises mainly core-choppers and flakes knapped from flint pebbles, which are overall thought to indicate a 'simple and opportunistic lithic technology' (Peretto 2006). Whereas no fauna has been preserved, foraminifera, ostracods and molluscs indicate a marine coastal environment, close to freshwater and brackish marshes (Milliken 1999).

Isernia La Pineta, located in the Upper Volturno Basin in the center of Italy, has been for long regarded as the 'flagship' site for the Italian Lower Palaeolithic, mainly because of its primary fluvio-lacustrine context, which yielded an impressive core-and-flake industry associated with abundant faunal remains that provide possible evidence for butchering; yet, the identification of distinctive 'living floors' is not unproblematic (Villa 1996; Mussi 2001; Coltorti *et al*. 2005). Four archaeological layers that are believed to be close in time have been found sandwiched between the earliest fluvial deposits and the latest episodes of lacustrine sedimentation (Mussi 2001). The dating of these layers is considered to be controversial (Villa 2001). A K/Ar date of *ca*. 730 ka was obtained from volcanic particles, which according to the excavators are fresh and not reworked (Coltorti *et al.* 1982; but see also Mussi 1995, 30). More recent and more detailed Ar/Ar data are thought to better refine the age of the site at around 600 ka (Coltorti *et al*. 2005), an estimate that is closer to the chronological indications deriving from the macro- and micro-fauna (notably, due to the presence of *Arvicola terrestris cantiana*; Roebroeks and van Kolfschoten 1994).

In another basin, that of Venosa, the archaeological finds from the site of Notarchirico were recovered from lacustrine and fluvio-lacustrine deposits rich in pyroclastics and they include a human femur and nine bifaces, among assemblages dominated by chopping tools on pebbles (Sala 1991; Milliken 1999). The combined results from an array of absolute dating techniques (U-series, TL, Ar-Ar), biochronological indicators (*e.g. Arvicola cantiana*) and correlations with episodes of volcanism, altogether suggest an early Middle Pleistocene age for Notarchirico, perhaps close to 650-600 ka (Sala 1991; Villa 2001). The rest of the main Lower Palaeolithic sites date to the middle and late Middle Pleistocene, with ages generally clustering between *ca*. 500 and 300 ka: Loreto in Venosa basin (Mussi 2001); Fontana Rannucio and Colle Marino in the Anagni basin (Biddittu *et al*. 1979; Segre and Ascenzi 1984; Villa 2001) and Ceprano from the eponymous basin (Ascenzi *et al*. 1996; Muttoni *et al*. 2009) (both of the latter basins being located in the valley of the Sacco and Liri rivers); Torre in Pietra, La Polledrara and Castel di Guido in the valleys of 'Via Aurelia' (Anzidei and Arnoldus-Huyzenveld 1992; Mussi 1995; Constantini *et al.* 2001). The site of Visogliano is also noteworthy: it is located in a karstic depression on the side of a small doline in the Trieste Karst, it has yielded human remains from the filling of a rockshelter and a breccia outside the rockshelter, and it is radiometrically dated (U-series, ESR) to between *ca*. 500-300 ka, with the mammalian assemblage pointing to the middle part of the Middle Pleistocene (Abbazzi *et al*. 2000; Falgueres *et al*. 2008).

Besides Visogliano, all other sites are open-air sites associated with fluvial, lacustrine or fluvio-lacustrine depositional settings, within or at the margins of Apenninic basins and/or along former coastlines, as with the case of Monte Poggiolo and the sites of Via Aurelia; moreover, all are located *below the altitude of ca. 500 m*. Considering the indications provided by the study of tectonic activity and associated geomorphological processes, it can be said that none of the sites were situated in mountainous areas at the time of their occupation; instead, the reconstructed topographic settings suggest "flat or gently undulating parts of the territory" (Mussi 2001, 42). According to the emerging pattern of distribution, all sites relate to water bodies (lakes, rivers, coasts) and are located in lowland settings. Nonetheless, it is difficult to assess whether this reflects a preservation bias or hominin site location preferences, or (most probably) both, because there are negative and positive arguments for both cases (*cf*. Mussi 2001). On one hand, the inner mountainous areas with a rugged relief would have been prone to erosion, especially during glacial periods, frequently disturbed due to tectonism and its associated effects, such as drainage diversions and stream incision; in contrast, depressed terrains trapped sediments and protected them from erosion, whilst sites close to river mouths would have been quickly buried by alluvial deposits. On the other hand, wherever environmental palaeo-reconstructions are available, they seem to suggest that those basinal features (*e.g.* lakes) provided habitats rich in resources, hence probably favorable to hominins. Alternatively, the Aurelian sites indicate that not all water-bodies may have been equally attractive: the densely forested, 'closed' environment of the Riano lake appears to have been avoided, in contrast to the nearby lacustrine areas of La Polledrara and Castel di Guido, where an open landscape seems to have been preferred (Anzidei and Arnoldus-Huyzenveld 1992; Mussi 2001). Furthermore, it is important to note here that hominins continued to 'settle' within those tectonically-controlled basins and lakes in the folds of the Apennines also during the Middle Palaeolithic, in environments not very different from those of the earlier periods (Mussi 2001, 59). In contrast, the Lower Palaeolithic altitudinal threshold of *ca*. 500

m. is exceeded after about 300 ka, when Middle Palaeolithic sites are found equally on hilly, mountainous landscapes. In addition, the overall scarce evidence for the use of caves in the Italian Lower Palaeolithic may be reflecting a preference for open-air environments -perhaps also 'open' ones as opposed to 'closed' in terms of vegetation cover- but it could equally be the result of behavioral constraints or preservation biases, among other reasons. The fact remains that the Middle Palaeolithic of Italy is indeed predominated by cave-sites, although their overwhelming majority (a minimum of seventy) date to the last glacial (which could be also an artefact of preservation; Mussi 1999). All things considered, the current state of knowledge does not allow for a more detailed comparison of Lower versus Middle Palaeolithic sites with regard to site preservation and distribution, and hominin preferences (Mussi 2001).

As regards the lithic industries, there seems to be no considerable preferences on raw materials, since poor quality chert and limestone were being habitually used. The rather crude knapping techniques, the apparent predominance of core-and-flake (often designated as 'Mode 1') assemblages, and the relatively opportunistic flaking considered to be evident in some of these early sites, could be related to the properties of the raw materials, or to specific activities and functional needs. Handaxes are present, albeit rare, as for example in Notarchiricho and Fontana Ranuccio, and they are the only component for ascribing the Acheulean label to some assemblages. So-called 'proto-handaxes' are reported from Monte Poggiolo and Visogliano, whereas bifaces are found interstratified with core-and-flake industries at Notarchirico (Mussi 2001). A chronological sequencing with 'core-chopper industries' preceding those with handaxes has been convincingly proved to be no longer tenable (Villa 2001 *contra* Peretto 2006), whilst the earliest-dated biface assemblages do not show any traits pointing to the African Acheulean (Villa 2001). Finally, there is also a chronological trend, as handaxes become less frequent and (nearly) disappear from later sites, *e.g.* from Middle Palaeolithic sites of MIS 7 such as those buried by loess in north-eastern Italy[4] (Mussi 2001).

Recently, three flint cores and six flakes were recovered from fossiliferous karst fissures at the site of Pirro Nord, and were dated to *ca.* 1.7-1.3 Ma on the basis of the associated mammal biostratigraphy (Arzarello *et al*. 2007, 2009). However, the published photographs and drawings of the specimens (Arzarello *et al*. 2009, fig. 1 and 3) cast some doubts on their artificiality[5], whilst the biochronology-based suggested age needs also further calibration, as some researchers argue that the mammal assemblage does not preclude an upper age limit of *ca*. 0.87 Ma (Muttoni *et al.* 2009, 267). Thus, excluding Pirro Nord, if we accept the correlation of the artefact-yielding deposits at Monte Poggiolo with the Imola Sands, the latter would be the only relatively well-dated site of the (late) Early Pleistocene in Italy. Villa (2001, 126) stresses that the existing four sites for the time span between 0.8 and 0.5 Ma (*i.e.* Monte Poggiolo, Isernia, Notarchirico and Ceprano, although the latter is recently re-dated to somewhat later, at 0.45 Ma) yield an average of one site for every 100 ka. This fact, together with the observation that the density of sites only increases in the second half of the Middle Pleistocene (after *ca*. 450 ka), indicates "multiple, sporadic, and discontinuous episodes of settlement into the peninsula until higher densities of population allowed the formation of a more stable prehistoric record and more distinct tool-making patterns" (Villa 2001, 126). Nonetheless, there appear to be no significant changes in the density of sites and the resources that were used, when the pre-300 ka record is compared to the last part of the Middle Pleistocene at *ca*. 300-130 ka and the beginning of the Middle Palaeolithic period (Mussi 1999, 2001).

Whilst some would interpret the Italian record as pointing to multiple episodes of migration (*e.g*. Villa 2001), others would agree to a twofold scenario of colonization at around 1 Ma and then later at around

4. Interestingly, Mussi (2001, 78) notes that those -more than a hundred- sites buried by loess in the margins of the Po plain "are labeled as Acheulean because of the few handaxes sometimes found but are clearly Middle Palaeolithic in all respects".

5. The researchers argue against any transport of the lithics and the possibility of dealing with geofacts. In my view, the conglomeratic matrix of the fissure filling in which these lithics were found requires a better argumentation on their artificiality; even if fluvial transport can be excluded (as the researchers suggest) the filling of the fissure is bound to have included some sort of mass transport, whilst the clast size of the matrix indicates a high-energy transport agent.

650 ka BP (Palombo and Mussi 2006). Although both views are ready to associate human dispersal with faunal migrations, it is in the second hypothesis that human colonization is directly linked with animal migrations and faunal renewals, when human subsistence and survival would have been assisted by an increase of middle-sized herbivores and a concomitant decrease of carnivores (Palombo and Mussi 2006). Faunal composition and diversity regulates the animal biomass available for hominins, and it is in turn depended on the type of climatic-environmental belts. The richness of the Italian record may well be attributed to the mosaic character of the environment, as suggested by Mussi (1995, 2001): the varied topography and climate of Italy is accentuated by the marked altitudinal gradient and the presence of the Apennines, providing a variety of heterogeneous and rich resources over short distances. If early humans were indeed 'generalists' in their diet and used a non-specialized tool-kit, then the mosaic landscapes of Italy would have been be best suitable for them, and not only in periods that these environments would have acted as refugia.

3.3 THE IBERIAN PENINSULA

The Iberian Peninsula (*ca*. 580,000 km^2) can be divided into the following main geographical regions (Raposo and Santonja 1995): 1) the northern part of Portugal, Galicia, and the Cantabrian Range and littoral zone 2) the northern Meseta, a flat area with a mean elevation of 800 m asl, and the Iberian Chain, in the center of the peninsula 3) the western Portuguese littoral and the lower Tagus basin, in the west 4) the southern Meseta, which is separated from the northern by the mountains of the Central System, and includes the Tagus and Guadiana basins, as well as the Extremadura plateau 5) the Ebro basin and the zone of the Pyrenees in the northeast 7) the basins of Algavre, Segura and Andalusia in the south.

Although the Mediterranean coasts of Spain have been adequately investigated, Lower Palaeolithic sites have not been found there; similarly, sites on the Cantabrian and western Portuguese coasts have yielded either non-stratified artefacts and/or assemblages that have been assigned an age according to their typological classification, hence with a problematic dating (Santonja and Villa 1990; see for example Rios *et al*. 2008 for a recently found 'Lower Palaeolithic site' in the Biscay province). Overall, the earliest sites in entire western Iberia are on the current evidence not older than MIS 8-9; they have yielded mainly surface finds and their chronological attribution is deemed only tentative, as it is essentially based on the typological characteristics of the artefacts (Oosterbeek *et al.* 2010). In short, the best-documented Lower Palaeolithic evidence of Iberia comes from sites that are located in the continental interior (Fig. 3.2).

The oldest known sites of Iberia have been discovered in the intramontane basinal complex of Guadix-Baza (GB), a depression controlled by a set of normal faults, situated in the Betic Cordillera of southern Spain (province of Granada). Sedimentation in the GB basin was almost continuous from Late Miocene up to the Late Pleistocene, forming depositional cycles that begin with fluvial sediments of fans and fan deltas and end with lacustrine deposits of ephemeral lakes; overall, the sedimentary strata are flat-lying and display only localized deformation (Martínez -Navarro *et al*. 1997; Gibert *et al*. 1998b; Oms *et al.* 2000). Significant tectonic events are generally not recorded in the basin, and the most prominent tectonic feature is the Baza fault, which separates the Guadix sub-basin in the west from that of Baza in the east (Pérez-Peña *et al*. 2009). The palaeotopography entails a division of the continental sediments into a marginal and a distal environment: the former is mainly represented by the fluviatile sediments of the conglomeratic Guadix Formation, whereas the distal domain consists largely of lacustrine deposits of the Baza Formation (Agustí *et al*. 1999). The sedimentary sequence of the latter domain is locally over 100 m-thick and includes exceptional exposures of horizontal deposits, in which numerous palaeontological sites have been found: the micro- and macro-faunal assemblages of the Baza basin have been for long under study, producing an extensive literature on micromammal systematics, biostratigraphy and faunal replacements, often directly touching upon early human dispersals (Gibert *et al*. 2006 and references therein).

Located in the northeastern sector of the Baza basin and close to the town of Orce, Fuente Nueva 3 (FN3) and Barranco León (BL) are the most important sites

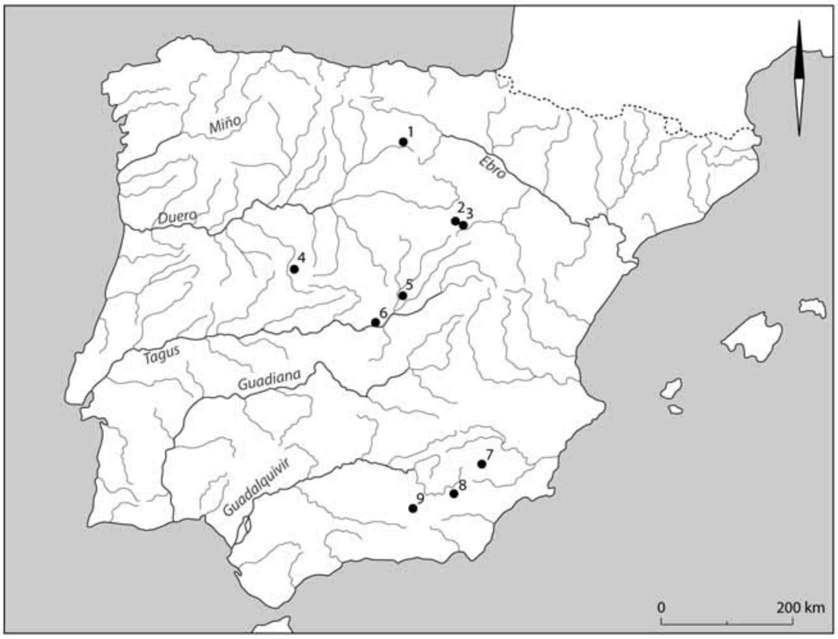

Fig. 3.2 Main Lower Palaeolithic sites of Iberia: 1) Atapuerca sites: Trinchera Dolina, Sima del Elefante, Sima de los Huesos 2) Ambrona 3) Torralba 4) La Maya 5) Aridos 6) Pinedo 7) Estrecho del Quípar 8) Orce sites: Fuente Nueva 3, Barranco León 9) Solana del Zamborino

with faunal and lithic material. Both are situated along tributary creeks of the Orce river and they belong to the upper, 'silty calcareous member' of the formation, which was deposited in a lacustrine environment and consists of limestone, carbonate silts and mudstones (Oms *et al.* 2000). The artefact-bearing deposit at BL contains fine-grained sands of the distal part of a small alluvial system, whilst the sediments of FN3 belong to a marginal lacustrine setting (Gibert *et al*. 1998b). Until 2002, 295 artefacts had been recovered from the excavations at BL, most of them made on flint, but also on quartz, quartzite and limestone pebbles; notably, according to Santonja and Villa (2006, 432) the assemblage includes discoid cores, flakes used as cores, well-configured scrapers and proportions of facetted butts approaching 8%. The lithic artefacts of FN3 are similarly manufactured mainly on flint and less on limestone cobbles, they exclusively comprise of cores and flakes, and they include pieces with a blade-like tendency and products indicative of centripetal flaking from discoid cores (Martínez -Navarro *et al*. 1997; Santonja and Villa 2006). Due to their core-and-flake character and the absence of handaxes, the industries from both sites have been described as 'Oldowan / evolved Oldowan' and they are thought to signify the existence of a pre-Acheulean technological stage in Europe, which is purportedly related with a distinct dispersal event from Africa into Europe by hominins carrying a 'Mode 1' toolkit[6] (Martínez -Navarro *et al*. 1997; Gibert *et al*. 1998b; Carbonell *et al.* 1999; Carbonell and Rodríguez 2006). The vertebrate fauna from both sites, and most notably the morphology and degree of evolution of some arvicolids, like *Allophaiomys bourgoundiae* (*cf*. *lavocasti*) and *A. chalinei*, indicates an age in the Early Pleistocene, which is refined to *ca*. 1.4 Ma on the basis of the regional biozonation along with other biostratigraphical data and biochronological comparisons and correlations with other early sites, such as Le Vallonet or Dmanisi (Martínez -Navarro *et al*. 1997; Oms *et al.* 2000; Agusti *et al*. 2010). Extensive magnetostratigraphic studies were carried out in various localities within the basin but also directly in the sediments containing the lithic industries; a reverse magnetization that was recorded throughout the stratigraphic sections is correlated with the Matuyama Chron, ascribing the archaeological levels between the Jaramillo and Olduvai Subchrons, *i.e.* in accor-

6. A recent technological study of the artefacts from the two sites by Barsky *et al*. (2010) recognizes a grouping of raw material types with specific technological characteristics: flint was mostly used for the production of flakes, whilst limestone was preferred for percussion implements and worked cobbles; nevertheless, this study essentially retains the tagging of Mode 1 (as opposed to Mode 2), as well as its supposed relation with hominin phylogeny and discrete colonization episodes.

dance with the age-estimate suggested by the biostratigraphy[7] (Oms *et al*. 2000; see also Scott *et al*. 2007).

The locality of Venta Micena, found in deposits of the Baza formation, yielded a faunal assemblage of more than 15,000 fossils including some highly controversial ones: some humeral diaphyses and a cranial fragment have been reported to belong to either *Homo* (Gibert *et al*. 1998a, with a history of the reports and references therein; Gibert *et al.* 2008) or *Equus* (Palmqvist 1997; Palmqvist *et al.* 2005). The faunal material resembles French Villafrancian assemblages dated to 1.6 to 0.9 Ma, and record a faunal break with the arrival of Asian and African species (ibid; Palmqvist 1997, 83). Venta Micena records a reversed magnetization (Oms *et al*. 2000) and its fauna contains taxa that appear also in Dmanisi (Georgia) and Apollonia-1 (Greece) (Martinez-Navarro *et al*. 1997, 616). Similar problems apply to the cave site of Cueva Victoria, located also in southeastern Spain. A phalanx that was found there was first assigned to *Homo* (*e.g*. Palmqvist *et al*. 1996), but recently it has been re-assessed and is now considered to belong to *Theropithecus oswaldi* (Palmqvist *et al*. 2005), although the controversy continues (*e.g*. see Gibert *et al*. 2008 *versus* Martínez -Navarro *et al*. 2008).

Solana del Zamborino, situated at the Guadix Basin, is an open-air site with a sequence of fluvial and lacustrine deposits that yielded a rich Acheulean assemblage. Although the site was for long ascribed an age at *ca*. 200 ka on the basis of the Acheulean typology, recent magnetostratigraphic analysis by Scott and Gibert (2009) showed that the artefact-bearing layers are positioned immediately above the Matuyama-Brunhes polarity reversal, hence they are now considered to date to *ca*. 770 ka. The same researchers carried out palaeomagnetic examinations at another site, Estrecho del Quípar, which is a rockshelter situated on the northeastern margin of the Baza Basin. The lithic artifacts here include pieces with prepared platforms, centripetal and recurrent flaking and disc-cores, but also a handaxe made on limestone (Scott and Gibert 2009). Here, the entire sequence is reversely magnetized and the researchers assigned the artefact-bearing strata to the late Matuyama subchron, at *ca*. 900 ka (ibid, 84). Therefore, Solana del Zamborino and Estrecho del Quipar are now considered to provide the earliest-known evidence for the presence of handaxes in Europe (ibid).

Next to the Orce sites, the Iberian contribution to the discussion on the earliest occupation of Europe consists of a number of archaeological and palaeontological sites discovered in the karst system of Sierra de Atapuerca, a small mountain range between the basins of the Duero and Ebro rivers, at the northeastern border of the Iberian Meseta (*e.g*. Bermúdez de Castro *et al*. 2004). The sites are grouped into two main cave systems, the Cueva del Silo and the Cueva Mayor; the site of Gran Dolina (or, 'Trinchera Dolina', hereafter referred to as TD) and those of the Galeria complex could belong to a separate system, while Sima de los Huesos and Sima del Elefante are the most famous sites from Cueva Mayor. Exposed due to the opening of a railway trench, the filling of the Gran Dolina karst revealed an 18-meters section of 11 lithostratigraphic units, numbered from bottom to the top, with sediments of interior (TD1 and TD2) and exterior facies (TD3-4 to TD11), with the latter, allochthonous deposits of TD3-4 to TD11 representing clast and mud gravity flows from the surroundings of TD (Parés and Pérez-Gonzales 1999).

Human fossils from a minimum of ten individuals together with faunal remains and lithic artefacts of 'Mode 1' technology have been recovered so far from unit TD6 (Carbonell *et al.* 1995; Bermúdez de Castro *et al*. 2008). The human remains of Atapuerca have been considered to represent a new species, named *Homo antecessor*, which is thought to be distinct from *Homo erectus* and may have been ancestral to both *Homo heidelbergensis* and the Neanderthals (Bermúdez de Castro *et al*. 1997). Palaeomagnetic measurements document a reversed pa-

7. Note however that "lateral facies changes are significant throughout the GB basin, hampering physical correlation between strata from these two locations [i.e. BL and FN3]" (Oms *et al*. 2000, 10667); moreover, palaeomagnetic determinations demonstrated the occurrence of re-magnetizations in some localities of the basin, which overall call for attention when using magnetostratigraphic correlations. See for example the discussion and disagreements between Martinez-Navarro *et al*. 1997 and Gibert *et al*. 1998a, and between Gibert *et al*. 2006 and Agusti *et al*. 2007, the latter also with regard to issues concerning the biostratigraphic data.

laeomagnetic signal which, coupled with ESR and U-series dating, suggested an age in the range of 857-780 ka for TD6 (Falgueres *et al*. 1999). The microfauna has been attributed to the end of the Biharian biozone based on the evolutionary stage of the Arvicolids (Cuenca-Bescós *et al*. 1999; López-Antoñanzas and Cuenca-Bescós 2002), but this chronological placement has been contested by van Kolfschoten (1998), who argues that the fauna does not contain species restricted to the Early Pleistocene but, rather, it includes taxa which in Europe occur during the early Middle Pleistocene; in extent, this could suggest that the reversed-polarized sediments record an intra-Brunhes magnetic event. Arribas and Palmqvist (1999, 575) also stress that, whereas typical Middle Pleistocene taxa originating in Asia are included in the TD6 level, early Galerian species are lacking as it would be expected due to the proposed age; on the contrary, mammals which first appear during the Middle Galerian are represented, which suggest that "from a biostratigraphical point of view, this assemblage should therefore be included within the Middle Galerian, in the base of the Middle Pleistocene" [8].

In the Sima de los Huesos, the enigmatic accumulation of human remains from 28 individuals is still puzzling archaeologists, and various explanations have been proposed to explain this taphonomic mystery, which is accentuated also by the presence of one, single artefact: a handaxe made on quartz, a material that is uncommon in the Atapuerca sites (Arsuaga *et al.* 1997). The hominins represented by the Sima de los Huesos sample display Neanderthal-derived features together with more incipient traits, and are thought to be ancestral to Neanderthals –most probably *H. heidelbergensis.* Such a possibility makes the recent dating of the site at *ca*. 600 ka even more fascinating, as this is the time when the Neanderthal lineage begins, according to DNA studies (Bischoff *et al*. 2007).

Last but not least, the cavity infilling at Sima del Elefante recently yielded a human mandible that is provisionally assigned to *Homo antecessor* (hence in line with the remains from Gran Dolina), with an associated lithic assemblage consisting of 32 artefacts, mainly small and simple flakes; based on combined results from palaeomagnetism, cosmogenic nuclides and biostratigraphy, the hominin-bearing level has been dated to 1.2-1.1 Ma (Parés *et al*. 2006; Carbonell *et al*. 2008). Consequently, Sima del Elefante provides so far the oldest *direct* evidence for a human presence in Europe in the Early Pleistocene.

The next important sites are those of Torralba and Ambrona, located at an altitude of *ca*. 1110 m in the valley of the Rio Masegar, between the basins of the Duero, Tagus and Ebro rivers, in the northern Meseta (Butzer 1965; Freeman 1975). Although at both sites the depositional environment of the archaeological levels refers to fluvial/fluvio-lacustrine deposits, it is important to note their geomorphological setting: Ambrona is situated in a polje and Torralba lies on the edge of a doline (Santonja and Villa 2006). The earliest lithic assemblages from the two sites are generally described as late Acheulean (Santonja and Villa 1990), with that of Torralba containing discoid cores and highly standardized flake tools (Freeman 1975; Santonja and Villa 2006). Combined ESR/U-series dating indicates a minimum age of 350 ka for Ambrona, whilst Torralba is younger (ibid; Falgueres *et al*. 2006). Noteworthy, Ambrona had for some time a central position in the debate about early human hunting- *versus* scavenging-based meat procurement (see Villa *et al*. 2005 for a recent evaluation).

As becomes apparent from this short overview, there appears to be a small group of sites dating to the Early Pleistocene (Fuente Nueva, Barranco Leon and Sima del Elefante, all dated at *ca*. 1.3-1.2 Ma), whilst another group would involve a few late Early-early Middle Pleistocene sites (Atapuerca's TD6 at *ca*. 0.8 ka and Sima de los Huesos at *ca*. 0.6 ka); the rest of the Iberian Lower Palaeolithic record is -by and large- comprised of sites which have been loosely and/or tentatively dated to the late Middle Pleistocene (Santonja and Villa 1990; Raposo and Santonja 1995; Santonja and Villa 2006; Santonja and Pérez-Gonzáles 2010). The vast majority of those sites (1) occur in the continental interior and mostly on the Meseta (2) are described as 'Acheulean' (3) are associated with fluvial settings, and (4) usually lack preserved fauna. Intensive surveys car-

8. For concerns raised with regard to the (biochronological) dating of Atapuerca see also Roebroeks and van Kolfschoten 1995, 305, and Dennell and Roebroeks 1996, 536.

ried out on the Iberian river basins have demonstrated an overall lack of stratified occurrences in the middle-high and high river terraces; instead, almost all known sites -be that with or without stratified finds- appear in the levels of the *middle terraces* (*e.g.* at +30 m, as is mostly the case with the sites in the Tajo, Duero and Mino river basins), often associated with high-energy deposits (*e.g.* Pinedo, La Maya, Torralba), whilst others relate to low energy, primary contexts (*e.g.* Aridos I and specific levels of Ambrona) (Santonja and Villa 2006; Santonja and Pérez-Gonzáles 2010). This strong association of sites with fluvial settings is explained as the result of alluvial geomorphic processes that "generate deposits and conserve remains" (Santonja and Pérez-Gonzáles 2010). On the other hand, the fact that sites are usually found related to second and third order confluences of fluvial systems and/or on the vestibular areas of secondary valleys, is thought to reflect hominin preferences (Raposo and Santonja 1995, 9). In this line, the scantiness of the record from, for instance, the Mediterranean and Cantabrian coasts or Galicia, is explained by the fact that Middle and Early Pleistocene river deposits either have not been preserved there (Santonja and Pérez-Gonzáles 2010), or the irregular discharge regime of rivers and the frequent floods did not favor the preservation of archaeological material (Santonja and Villa 2006). In contrast to the latter case, syn-sedimentary subsidence could account for the high density of finds in fine-grained floodplain sediments in the terraces of the Manzanares River (ibid). On the other hand, the basin of the river Ebro includes well-developed Middle Pleistocene deposits, and yet the area is virtually devoid of early Palaeolithic remains (Raposo and Santonja 1995, 15).

In sum, although the earliest-dated and best-preserved sites are associated with karstic or lacustrine settings, the Iberian Lower Palaeolithic record is predominated by fluvial depositional environments. The available chronological framework is principally based on relative chronologies derived from the study of fluvial morphostratigraphic sequences, which in some cases afford calibration by other dating techniques, most notably palaeomagnetism and biochronology. Terrace formation is thought to have been controlled more by tectonic processes and the nature of the geological substratum and less by climatic fluctuations (Raposo and Santonja 1995). Similarly, differences in surface (*e.g.* Duero) or stratigraphic (*e.g.* Tagus) positions of artefacts are seen as reflecting temporal differences in aggradation and incision cycles between the hydrographic systems (Santonja and Villa 2006).

3.4 NORTH AFRICA

Although North Africa is rich in palaeontological and early Palaeolithic sites, its chronological framework for the Early and Middle Pleistocene is still poorly established, or at least quite contentious. One of the reasons is that material suitable for absolute dating (*e.g.* volcanic rocks) is generally lacking, and most dating methods, as for example Uranium-series, are appropriate mainly for the final part of the Lower Palaeolithic sequences; furthermore, biostratigraphic correlations are often controversial, especially when they involve long distances between localities, whereas palaeomagnetic results are usually open to contrasting interpretations (*e.g.* Clark 1992; Raynal *et al*. 1995). Another reason would be the orientation of the earliest investigations towards a cultural-historical sequencing of the sites based on typological categorizations of the lithic assemblages, with a concomitant overlooking of chronostratigraphic data, whilst most of the earliest-found localities have not been revisited since the 1950s (Sahnouni 1998, 3). Hence, one is left with only a handful of sites untouched by uncertainties, insofar one excludes the following (ibid): surface finds; reworked materials from secondary and/or high-energy matrix or polycyclic colluviums, and pseudo-artefacts (Raynal and Texier 1989, 1744); selectively collected artefacts (*e.g.* only the 'pebble tools').

Thus, serious doubts have been expressed on the dating of the palaeontological locality of Ain Boucherit and the early Palaeolithic sites of Ain Hanech and El-Kherba, all three contained in the newly defined Ain Hanech Formation (Sahnouni *et al*. in press). When it was discovered in 1947, Ain Hanech was the first site in N. Africa to yield a Plio-Pleistocene fauna associated with Lower Palaeolithic artefacts. After new archaeological investigations (Sahnouni 1998; Sahnouni and de Heinzelin 1998), the site is currently thought to record the oldest archaeological occurrence in N. Africa, with a coherent 'Mode I' assemblage similar to industries found in East African Plio-cene-Pleistocene sites, and with an assigned age of *ca*. 1.8 Ma (Sahnouni *et al*. 2002; but see below).

East of the Atlas Mountains, Ain Hanech and El-Kherba are located at about 1200 m asl on the Ain Boucherit valley, within the Beni Fouda basin, which is one of the several basins of the Eastern Algerian high plateau, with ages ranging from the Late Miocene to the Late Pleistocene (Sahnouni 1998). The localities are in a sedimentary outcrop cut by a deep ravine of the intermittent Ain Boucherit stream, and are surrounded by a series of highlands. Stratigraphically, El-Kherba and Ain Hanech are laterally equivalent and were formed in the fluvio-lacustrine depositional environment of the Beni Fuda Plio-Pleistocene basin (Sahnouni and de Heinzelin 1998). Similar stone artefacts were retrieved from three strata (A, B and C) that are present at both localities. Overall, the deposits of these layers indicate an alluvial floodplain cut by a meandering river channel. The researchers suppose that, during the deposition of level A, the river had created an oxbow lake and hominin activities took place on the floodplain proper, whilst during level B human activity occurred on the riverbank (ibid; Sahnouni *et al*. 2002). They conclude that the artefact-bearing deposits are indicative of repeated visits of hominins at a shallow river embankment -a location preferred for the availability of good quality raw materials in the nearby river bed, and the passage of game. The raw materials are flint and limestone, whilst flaking patterns and typologies of artefacts from both sites are seen as resembling those from upper Bed I and lower Bed II of Olduvai; notably, Acheulean artefacts occur only in the uppermost part of the sequence and are considerably younger. The 'Oldowan' artefacts occur in deposits with a normal palaeomagnetic polarity and overlie reverse-polarized sediments. The normal polarity is correlated with the Olduvai subchron (1.95-1.78 Ma) on the basis of biostratigraphic indications deriving from the fauna that was found in Ain Hanech and Ain Boucherit Formations (Sahnouni *et al*. 2002). Geraads *et al.* (2004) criticized the correlation with the Olduvai subchron, stressing that the Jaramillo normal subchron is not discussed as a possibility by Sahnouni and colleagues; furthermore, they disagree on the biostratigraphic arguments that have been presented in support to the proposed age of ~1.8 Ma (but see Sahnouni *et al*. 2004 for a reply). As Sahnouni *et al*. (in press) admit, many of the faunal species have a wide chronological distribution and the suggested age-estimate is essentially based on three or four taxa; furthermore, some long-distance correlations (e.g. for the suid *Kolpochoerus* from zones at Koobi Fora; Sahnouni *et al* 2002, 930) might be seen as problematic.

Besides the aforementioned Algerian sites, most of the North African best-studied sites, namely Thomas-I Quarry, Grotte des Rhinocéros (formerly Thomas-III quarry) and Sidi-Abderrahman, are part of a series of localities clustered in the vicinity of Casablanca, on the Atlantic coast of Morocco. The region preserves an exceptional succession of littoral formations, exposed in large quarries (Raynal *et al*. 2001). This series of marine deposits interbedded with terrestrial sediments, was used by Biberson (1961) to construct a stratigraphical and sedimentological sequence for the marine stages of the Pleistocene in the Maghreb, showing also the successive stages of the Lower Palaeolithic industries through time. His classic work on the basic classification of the littoral-marine record is still being used as a yardstick, if not re-examined by other researchers (Texier *et al*. 1985; 1994; Lefevre and Raynal 2002) and incorporated in a new lithostratigraphical, biochronological and archaeological framework (Raynal *et al.* 1995). In their revision of Biberson's work, these scholars (Raynal and Texier 1989; Raynal *et al.* 1995) have questioned the antiquity of the earliest-claimed assemblages: in fact, they have shown that, so far, there is no 'Pebble Culture' recorded *in situ* at Casablanca and no important fossiliferous site is known yet for the early and middle Early Pleistocene of the region. Accordingly, although the Atlantic littoral of Morocco has been considered as providing one of the most complete Pleistocene successions of the world (Howell 1962 quoted in Stearns 1978, 1630), an early or middle Early Pleistocene age for the archaeological horizons in the Casablanca sequence is now doubted (Raynal and Texier 1989; Raynal *et al*. 1995; 2001; 2002). The picture changes in the Middle Pleistocene, when traces of human occupation increase substantially. Well-developed deposits allow for a detailed lithostratigraphic analysis, where seven marine units are identified, which are stepped between 9 and

35 m above sea level and covered by continental fossiliferous deposits (Texier *et al*. 1994).

A series of formations is identified, and these correspond to regressive sequences, which overall indicate a succession of marine foreshore/backshore and aeolian (dune) depositional environments (Texier *et al*. 1994). In Thomas Quarry-I (TQ-I), level L of Formation 1 of the Oulad-Hamida Group furnished with its late Early Pleistocene deposits the best evidence of the Early-Middle Pleistocene transition, yielding the oldest lithic assemblage of the Casablanca sequence (Raynal *et al*. 2001). The industry consists of Acheulean artefacts made of quartzite and flint. Level L corresponds to the beginning of the Amirian continental phase, when sandstones and limestones were formed over a long period of time (Raynal and Texier 1989); this allowed the formation of karstic caves, subsequently occupied by humans and animals (Clark 1992). The overlying level M2 contains marine sands and records the ultimate 'Maarifian' high sea-level marine phase (close to MIS 21;Texier *et al*. 1985, 184; Stearns 1978; but see also Texier *et al*. 1994, 1248). Thus, as included in Formation 1, which is considered to be older than MIS 21 (between 1.4-0.8 Ma; Raynal *et al.* 2001: Table 1), Level L has been assigned an age between 1.0 and 0.7 Ma. The minimum age of 0.7 Ma is in accordance with Stearns' hypothesis (1978) about layers in a similar stratigraphic position at Sidi-Abderrahmane Quarry (Raynal and Texier 1989). On the grounds of palaeomagnetic and biostratigraphic data, a date close to 1.0 Ma seems reasonable to Raynal *et al*. (2001); more recently, Geraads *et al*. (2004) opt for an age between 1.5-1.0 Ma, which they consider to be in accordance with OSL dating results, too. The presence of the suid *Kolpochoerus*, absent from the rest of the levels in Thomas/Oulad Hamida Quarries and from Ternifine[9], is thought to be in accordance with the proposed age around 1.0 Ma (Raynal *et al*. 2002).

Further up in the stratigraphy, unit M^3 of marine fine sands represents a high sea level shoreline, which is part of a major morphogenetic phase in the Middle Anfatian (which corresponds, roughly, to the Holsteinian of the European chronostratigraphy; see table in Texier *et al*. 1985). Thomas Quarry I- Hominid Cave ('Grotte à Hominidés') belongs to this shoreline; there, in 1969 a hominid mandible was discovered and attributed to *Homo erectus*, whereas more recently, three new teeth of *Homo* were found. According to Raynal and Texier (1989, 1743), the filling of this 'marine cave' postdates the beginning of the Middle Anfatian. Raynal *et al*. (2001; 2002) have suggested an age of 0.4-0.6 Ma as a *minimum*, on the basis of litho- and biostratigraphic data; moreover, they report that the macrofauna is similar in composition to that of the 'GDR Cave' (see below), and shares some taxa with the locality of Ternifine. Nevertheless, the provenance of the mandible has been (Jaeger 1975, 411) and still is considered to be problematic (Raynal *et al*. 2001), whereas Jaeger (ibid.) had also raised doubts on the derivation of the macrofauna.

The Grotte des Rhinocéros (GDR) is part of the Oulad Hamida 1 Quarry, where in the 1980s remains of *Homo erectus* associated with a 'Middle Acheulean' assemblage and fauna were discovered. The stratigraphy of the cave resembles that of Thomas I Quarry and most of the units have the same chronology. The excavated strata are part of a marine cave on a Middle Pleistocene shoreline, most probably occupied during an arid period with low sea-level (Raynal *et al*. 1993). The results of ESR-dating gave an age of about 0.4 Ma, which is considered to be in accordance with the overall evidence of the fauna (Rhodes *et. al* 1994). Lately, Raynal *et al*. (2002: 69) refer to unpublished lithostratigraphical data that could increase the minimum age of GDR at 0.6 Ma.

Biberson's 'Acheulean sequence', especially the last phases, is best represented in the Sidi Abderrahman localities: Schneider Quarry, Grande Exploitation, Cap Chatelier, Grotte des Littorines, Bears Cave and Sidi Abderrahman Extension (Raynal *et al*. 2001). These quarries expose a complex series of marine and aeolian beds (Stearns 1978), the oldest of which represent a late regressive stage of the 'Maarifian' transgression. In 'Bears Cave', dated at the boundary of MIS 12 and 11, a recent phase of the Middle Acheulean is represented, whereas Cap Chatelier exemplifies an upper stage of the Acheulean and it is

9. This is another Algerian site with hominin remains, dated at 1.0-0.6 or at 0.7 Ma.

older than MIS 9, according to OSL dates (Raynal *et al*. 2002).

The long sequence at Casablanca covers the last six million years. Although Miocene-Pliocene environments are well-represented by rich palaeontological sites, like Lissasfa (considered as 5.5 Ma old) and Ahl-Al-Oughlam (dated at *ca*. 2.5 Ma), the first traces of human presence come from deposits which are substantially later: the late Early Pleistocene layers in unit L of Thomas Quarry I have yielded the oldest lithic assemblages of 'Lower Acheulean' artefacts, whereas the first human remains come from the same quarry and were found in Middle Pleistocene deposits, associated with 'Middle Acheulean' lithic tools. The terraces which provide this exceptional record stretch from 180 m asl down to the present sea-level, and are associated with intertidal depositional units, dune formations, alteration facies (karsts, palaeosols), and reworked deposits (Raynal *et al.* 2001). Overall, the littoral deposits record transgressions and regressions which presumably reflect global and local fluctuations in sea-level. Previous studies considered that the Moroccan strandline sequence could use a broad chronological framework based on the assumption of uniform rates of emergence and in correspondence with a general history of sea-level changes (Stearns 1975). Alternatively, Texier *et al*. (1994) call for attention to the fact that the exact role of tectonic and glacio-eustatic processes, which probably controlled the formation of those littoral deposits, are not well-understood. Consequently, the identified events (transgressions, regressions, dune formations, etc) cannot be directly and securely correlated with marine isotope stages.

In the case of the Ahl-Al-Oughlam Quarry, littoral dunes and cliffs within a mosaic environment can be reconstructed for the period around *ca*. 2.5 Ma, based on the fauna. This karstic fissure-filling is the richest fossiliferous locality of this time period in North Africa and it records a humid palaeoclimate and open woodland (Raynal *et al*. 1990). Pebble tools, discovered by Biberson in a high energy marine layer, are now considered to be geofacts by Raynal *et al*. (2001, 68), who stress that, despite the diversity of the fauna, human remains were not found –a fact that is regarded as evidence of hominin absence (Geraads *et al*. 2004). The fauna of Ahl-Al-Oughlam includes *Macaca* and *Theropithecus* species, which have also been found in Early Pleistocene localities of southeastern Spain. Other Maghrebian Plio-Pleistocene localities have yielded some Holarctic mammalian taxa, but as it is in the case of African species that reached Europe, their presence cannot *prove* crossings of the Gibraltar Straits, especially when one considers that the Levantine route offers an undisputable alternative (*cf.* Straus 2001; but see Arribas and Palmqvist 1999 for a different view). Nonetheless, the antiquity of the quoted ages for Ain Hanech has revived the claims for crossings of the Gibraltar Straits by early hominins (*e.g.* Gibert *et al*. 2008).

Yet, if we are to treat with caution the palaeomagnetic results and the controversy around the biostratigraphic data from the Algerian sites, then the most reliable dates (*i.e.* including radiometric assays) come from the Atlantic Moroccan sites. The latter suggest that the earliest human presence in North Africa did not occur before the late Early Pleistocene (Thomas Quarry I), whilst the most reliable dates would put this earliest presence well within the Middle Pleistocene (Grotte des Rhinocéros). Moreover, in contrast to the 'Oldowan' assemblages from the Algerian sites, the evidence from Morocco suggests that the initial occupation of North Africa is associated with human groups carrying an Acheulean toolkit.

3.5 THE LEVANT

The Levant occupies a central place in the debate about Pliocene-Pleistocene migration routes between Africa and Eurasia, as it provides the only secure biogeographical bridge amongst the two continents: either across the Suez region, or via the southernmost part of the Arabian peninsula and then across the Bab-el-Mandeb Strait, movements of animal and human groups would have continued along the Red Sea into the Levantine corridor, which would in turn facilitate their spreading both eastwards and westwards. Yielding age estimates that are widely accepted, and containing cultural and faunal material indicative of both African and Eurasian affinities, key Levantine sites like 'Ubeidiya and Gesher Benot Ya'aqov (see below) constitute strong proof of the role of this corridor; particularly those two sites have been interpreted as evidence of two distinct waves of African migrations, with separate and culturally different entities (Goren-Inbar *et al*. 2000; Bar-Yosef and Belfer-Cohen 2001).

At the site of Yiron, a few flakes found in a gravel bed that is seen as underlying a basalt layer are claimed to be older than 2.4 Ma based on the age of the basalt (Ronen 2006). Similarly, cores and flakes occurring in the Erq-el-Ahmar Formation in sediments of normal geomagnetic polarity are considered to date to *ca.* 1.77–1.95 Ma (Olduvai Subchron), given the age of a covering basalt (Ron and Levi 2001). However, the evidence from both Yiron and Erq-el-Ahmar have not yet gained wide acceptance from the palaeoanthropological community. Other noteworthy evidence from the Levant include the handaxes and the exceptionally small implements from the Evron Quarry, loosely dated to between 1.0 and 0.78 Ma but, on the basis of the fauna, possibly being slightly younger than 'Ubeidiya (Ronen 2003; Ron *et al*. 2003); and the site of Ruhama, also tentatively dated to *ca*. 0.9-0.87 Ma (Ronen 2006; Laukhin *et al*. 2007).

On the current evidence, the best-dated, earliest known site in the Levant is 'Ubeidiya. The site of 'Ubeidiya is situated in the central Jordan valley (a segment of the Dead Sea Rift), on the flanks of the western escarpment of the Jordan Rift. There, the 150 m-thick sedimentary sequence of the 'Ubeidiya Formation (Fm) crops out, exposing an alteration of fluviatile and lacustrine members (Goren-Inbar 1995). Post-depositional tectonic movements resulted in the folding and faulting of the sediments, which were tilted in dips of up to 90°, forming two anticlines (ibid). The archaeological material is embedded in two main depositional environments, a lacustrine with low-energy silts and clays, and a fluvial with high-energy conglomerates and sands (Belmaker *et al*. 2002). Palaeoenvironmental reconstruction indicates a delta of an ephemeral stream debouching into a freshwater lake, whose shores fluctuated during alternating episodes of regression and transgression; when the lake receded, early humans are envisaged to have camped on its shores, at the edges of an alluvial fan and on mud flats or temporarily dried swamps (Bar-Yosef 1994, 231). Avian and mammalian species of the faunal assemblage point to diverse biogeographical areas of origin and suggest a wide range of ecological niches (Goren-Inbar 1995). Importantly, the fauna contains a mixture of African (*e.g. Megantereon whitei*) and Eurasian taxa (Martínez -Navarro *et al*. 2009); moreover, a hominin incisor has also been identified (Belmaker *et al.* 2002). The lithic assemblages have been originally considered to fall within the categories of 'Developed Oldowan' and 'Early Acheulean', as they include chopping tools, discoids, polyhedrons and spheroids that resemble those from Olduvai Bed II, but also numerous handaxes; however, the recognition of two distinct cultural entities was soon to be reconsidered, and the Ubeidiya assemblages are now seen as belonging to a single continuous tradition, as part of the 'Acheulean Industrial Complex' (Goren-Inbar 1995, 106). On the basis of the biostratigraphy, palaeomagnetic determinations (a reversed polarity) and the position of the Ubeidiya Fm between two dated basalts, the site was initially dated to between 1.4-1.0 Ma; recently, a new biochronological analysis of the fauna refined the age for the fossil- and artefact-bearing strata to 1.5-1.2 Ma (Martínez -Navarro *et al.* 2009).

The other important site of the Levant, Gesher Benot Ya'aqov (GBY), is located in the Dead Sea Rift, in a narrow valley south of the former shoreline of the Hula palaeo-lake, on the banks of the Jordan River. In the Hula Basin, freshwater lakes and marshes were formed as the basin began to subside, with lacustrine and paludine sediments becoming interstratified with basalt flows. As in the case of 'Ubeidiya, tectonic movements resulted in the faulting and folding of the lacustrine deposits and the formation of the GBY Embayment, which is now the only location where the GBY Fm crops out (Goren-Inbar *et al.* 1992). The exposed sequence documents a change in the depositional setting of the embayment, when the quiet domain of a marshy lake gave way to an environment of pronounced fluvial activity (ibid). Thus, fluvial conglomerates are found at the bottom and top of the sequence, while the intermediate layers are wholly lacustrine or lake-margin in character (Goren-Inbar *et al.* 2000). More than thirteen archaeological horizons have been identified within the sequence, representing repeated occupations on the shores of the palaeo-lake, whereas dense concentrations of burned artefacts are thought to document recurrent use of fire by hominins (Alperson-Afil 2008). The artefact assemblages are characterized by a strong bifacial component (with a high ratio of cleavers) and are assigned to the Acheulean Industrial Complex. It has been argued that the African traits recognized in the lithic industry represent a diffusion of ideas and populations from Africa, instead of a locally-evolved phenomenon (Saragusti and Goren-Inbar 2001). The site is also rich in palaeobotanical remains: among seeds, fruit, and pollen, noteworthy are the exceptionally preserved waterlogged fragments of wood (Goren-Inbar *et al*. 2000). The fauna includes Asian and African taxa and is described as Galerian (Bar-Yosef 1994). Both normal and reversed magnetic polarity zones are recorded at the site and the polarity boundary is situated below the primary archaeological horizons. On the grounds of the biostratigraphic indications and the lithic evidence, the polarity boundary is interpreted as the Matuyama-Brunhes Chron boundary, hence assigning the site to *ca.* 0.8-0.7 Ma (Goren-Inbar *et al*. 2000).

As for the rest of the Levantine Lower Palaeolithic sites, it is rather difficult to discuss their spatio-temporal distribution or technological variability, mainly because the existing chronological and classificatory schemes are still grounded on the sequencing of 'cultural entities' according to typological -and to a lesser extent technological- characteristics of the lithic assemblages: the use of terms such as Early, Middle and Late Acheulean, or Tayacian, Tabunian, Achelo-Yabrudian and Amudian, may be nowadays less favored, yet it still complicates the assessment of old collections (*cf*. Goren-Inbar 1995). Nevertheless, the Levantine record essentially appears to be as fragmentary as most of the other circum-Mediterranean records: apart from the aforementioned Early Pleistocene evidence and that of the late Middle Pleistocene (*e.g*. from Tabun E, Yabrud I and Qesem caves), there seem to be substantial gaps as far as the early and middle Middle Pleistocene are concerned (*cf.* Bar-Yosef 1994; 1998; Goren-Inbar 1995).

An emphasis on the investigation of cave sites has resulted in an apparently biased over-representation of this site-type, whilst fluvio-lacustrine open-air sites like 'Ubeidiya and GBY may be demonstrating the importance of locales that were in direct association with water bodies. Be it an artefact of preservation, or a reflection of hominin preferences, the fact is that occupation of caves in the Levant emerges as a relatively recent phenomenon (Goldberg 1995, 53). Research biases aside, the uneven nature of the record calls for an examination of topographical, geological and geomorphological features, of which the distribution, degree of preservation and heterogeneity may have also been filtering the broader picture with respect to both chronological frameworks and depositional settings.

The topography of the Levant is marked by coastal and inland mountain ranges, the Dead Sea Rift (the rift of the Orontes-Jordan valleys), and plateaus which are dissected by streams that flow to the east into the Syro-Arabian desert (Bar-Yosef 1994). Upland areas include the Judea and Samaria mountains, the Galilee, the Golan, and the Central Negev Highlands, whereas lowland regions are found in the coastal plain and the Western Negev. Today, the wider zone of the Mediterranean Levant is covered by Eu-Mediterranean vegetation of woodlands and open parklands on and along the coastal areas.

There is a wide variation in past landscape-types, including lacustrine, fluvial, coastal, and karstic environments. Of particular interest is the area of the Rift Valley, where many lakes were formed throughout the Quaternary. Lacustrine environments associated with archaeological material are primarily limited to this part of the Levant, particularly in the Jordan valley and its northern segment, the Hulla valley, where the sites of 'Ubeidiya and GBY have been found, respectively. In the central Jordan valley, the Erq-el-Ahmar Formation is a good example of a Plio-Pleistocene fluvial landscape associated with a Lower Palaeolithic site; other examples would include the Acheulean artefacts recovered from the fluvial deposits of the Nahariyim Fm, which post-dates 'Ubeidiya, and the assemblages found in the gravels of the Orontes river at Latamne in Syria (Goldberg 1995). However, fluvial settings are overall patchy in their spatial and temporal distribution (ibid).

The coastal zones are relatively flat, whilst their width has been controlled by sea level fluctuations. Coastal landscapes are marked by the so-called *kurkar* sediments, which are cemented calcareous sandstone ridges, and the *hamra*, red loam deposits; both are products of transgressive-regressive sedimentation cycles and are often associated with Palaeolithic artefacts, mainly resting on or embedded in hamras (Laukhin *et al*. 2007). Acheulean artefacts related to hamras have been found in the Evron Quarry, as well as at Ruhama and Revadim (ibid). Researchers agree that hamras represent a type of paleosol, but their origin and environment of formation, likewise those of the kurkar sandstones, are still under discussion; it is generally assumed, though, that stabilization due to vegetation cover during wetter periods caused the development of hamra reddened soil horizons, which were subsequently eroded locally and redeposited (Goldberg 1995, 50). Finally, besides surface and *in situ* sites in hamras, the coastal zone preserves residues of human presence also within caves.

The chronological framework of the Levant is thus based mainly on lacustrine and fluvial sequences, marine shorelines and coastal formations, aided by correlations based on magnetostratigraphic and biochronological evidence, as well as with palaeoclimatic chronologies from the deep-sea cores or the European terrestrial sequences (Bar-Yosef 1994). The division of Quaternary cycles on the grounds of marine raised beaches and coastal sequences, and inland sequences of river terraces, cannot always provide direct correlations between, for instance, the Dead Sea Rift sites and the coastal plain, due to the biasing effects of geological processes (Goren-Inbar 1995).

Indeed, it is essentially the geomorphic processes that are responsible for the fragmentation of the geo-archaeological archive. As Goldberg (1995) shows, the temporal distribution of Quaternary landforms and deposits is marked by considerable gaps in all geomorphological settings. For example, most of the extant cave deposits represent less than 10% of the Quaternary time-scale (ibid, 53). Similarly, lakes were in existence for less than half of the Quaternary, and many of them, as for example those of the Negev area, appear only in the late Pleistocene. In the same line, the geological signature of fluvial and alluvial activity is also much discontinuous, especially with regard to the Middle Pleistocene, for which alluvial occurrences are extremely patchy (Goldberg 1995, 45). Likewise, coastal landforms lack stratigraphic continuity; although the kurkar/hamra couples appear to have a long-lasting existence, Goldberg notes (1995, 53) that usually they cannot be temporally differentiated and in reality they are distributed in a much more punctuated fashion –an observation which is in accordance with a recent study of these features and their correlation with Palaeolithic sites (Laukhin *et al*. 2007).

3.6 BALKANS AND TURKEY

In the Balkans, the evidence for an Early and Middle Pleistocene human presence is still sparse and inconclusive (*e.g*. Galanidou 2004). In marked contrast to the long history of Palaeolithic investigations in most of the rest of Europe, research in the Balkan region lagged considerably behind and it is only in the last couple of decades that projects targeting the Palaeolithic are being launched, although in a still slow pace. Isolated finds and assemblages of lithic artefacts that were collected in the beginning of the 20th century and up till the 1970's suffer from a poor documentation, which is commonly restricted to a typological description of the specimens, a few drawings and the assigning of the finds to a 'cultural period' (*e.g.* 'Abbevillian', 'Clactonian', etc); particularly the latter, a classification according to morphological criteria, was commonly the major concern, outweighing the recording of stratigraphic data (*e.g*. Doboş 2008). Moreover, there is a general lack of publications by Balkan scholars in languages such as English or French, which would make their reports more widely accessible. For all the above reasons, and due to the paucity of published accounts, an overview of the 'Balkan Lower Palaeolithic' is bound to be short and sketchy.

Itself a notable exception, a recent review of the Lower Palaeolithic of Romania illustrates dramatically the above-mentioned problems (Doboş 2008). Firstly, there is the issue of old -and now obsolete-terminology that has not been completely abandoned, as with the case of the term 'Osteodontokeratic industries' (alleged tools on bones, supposedly preceding the use of stone-tool technology), or the 'Tres Ancien Palèolithique' ('TAP', supposedly preceding the Acheulean) and the 'Premousterian'. Secondly, all of the artefacts that have been found *in situ* either have not been documented adequately (or at all), or their artefactual character would now be considered uncertain, let alone that the finds are usually limited to 2-3 specimens (ibid). Thirdly, excluding the '*in situ* finds', most of the locations reported as Lower Palaeolithic involve disturbed contexts, mainly related to river terraces; 'choppers' and 'chopping tools' in these cases are essentially stray finds, with many of them being of a dubious anthropogenic origin, whilst the remaining pieces "should not be used as chrono-cultural markers" (Doboş 2008, 230). The conclusion of this examination was that the existence of the Lower Palaeolithic in Romania is doubtful.

Similarly, only a few Palaeolithic sites have been recorded so far in the (Former Yugoslav) Republic of Macedonia but none of them has been assigned a secure age estimate (Kuzman 1993). The picture is much better in Albania, partly as a result of a recent survey project, which investigated intensively the hinterland of the Fier Province in central Albania (Runnels *et al*. 2009). There, only thirteen artefacts (including three bifaces) were assigned a Lower Palaeolithic age; these are surface finds discovered at four sites, all of which are situated on or between anticlinal ridges that run down to a valley (ibid). At one of the sites (Rusinja), an eroded paleosol that is exposed on the summit of an anticlinal ridge is estimated to be older than *ca*. 100 ka; the deposition of the artefacts on the surface is thought to pre-date the formation of the paleosol, which in that case provides a *minimum ante quem* for the age of the artefacts (ibid, 157). Yet, apart from this relative dating, the attribution of the artefacts to the Lower Palaeolithic is obviously based on the typological characteristics of the specimens and the occurrence of certain morphotypes (*e.g*. bifaces).

Recently, excavations in the cave of Kozarnika in north-east Bulgaria unearthed from the lowest layers core-and-flake lithic assemblages as well as a human tooth, all attributed to the Lower Palaeolithic (Guadelli *et al*. 2005). The artefacts are made on local flint and their artefactual character seems to be beyond doubt. On the basis of the macro - and microfaunal remains (which include *inter alia* the rodent *Mimomys savini*), as well as preliminary palaeomagnetic results, the researchers suggested an age between 1.4-0.8 Ma for the lowermost layers (13 to 11c) and 0.6-0.4 Ma for the upper layers (11b and a) of the 'Lower Palaeolithic levels' (ibid). In the latest publication, the age of the site is pushed back to 1.6-1.4 Ma; in the table showing identified faunal taxa, a question mark is placed next to the *Homo* specimen, which is not discussed in the text (Sirakov *et al*. 2010). Thus, further research that would refine the age of the artefact-bearing layers and clarify the identification of the hominin tooth is much awaited.

Moving into Turkey, the data-set becomes significantly richer than that of the Balkans, but it is still conspicuously fragmented if we consider the time-span covered by the Early and Middle Pleistocene and the size of the country (see Fig. 2.1 for locations of main sites). Although a substantial number of surface finds of handaxes and other potential Lower Palaeolithic artefacts have been collected (*e.g.* Kuhn 2002; Taskiran 2008), there are currently only four/five sites with Lower Palaeolithic material from a documented and secure geological context. The gaps in the Turkish / Anatolian record can be largely attributed to the degree of research intensity and coverage, but for some areas, such as the Central Anatolian Plateau, geological factors mainly account for the scarcity of sites: for large parts of the plateau, Miocene strata are exposed on the surface and Pleistocene deposits are absent, whilst in other parts the Pleistocene is buried by thick sequences of younger sediments; alternatively, the few identified sites are associated with margins of Pleistocene lakes or with outcrops of limestone or volcanic rocks (Kuhn 2002).

The latter association is seen at the site of Dursunlu, situated on the Lycaonian plateau in south-central Anatolia, where purported artefacts were recovered from the lacustrine sediments of lignite beds that have been exploited in a lignite mine (Güleç *et al*. 2009). Palaeomagnetic measurements did not document the Brunhes-Matuyama boundary, but recorded two normal-polarity episodes that have been interpreted as the Jaramillo and Olduvai subchrons, respectively; the fauna- and lithics-bearing layers are said to be situated well within an upper interval of reversed polarity and above the normal-polarized sediments, hence they are thought to predate the Brunhes-Matuyama boundary and post-date the Jaramillo (*i.e.* between 0.99 and 0.78 Ma). The age-range of microfauna (including *Mimomys savini*) and macrofauna fossils are seen as supporting this chronological estimation (ibid). The dating of the site may prove to be correct, but there seem to be problems concerning both the provenance and the artefactual character of the archaeological material. The lithic pieces were collected "within and around large blocks of consolidated sediments that had been abandoned on the surface after quarrying operations ceased...Many of the artefacts were excavated from the intact sediment blocks […] although the blocks themselves were not observed in their original positions, because the primary deposits are now inaccessible due to the flooding of the quarry" (Güleç *et al*. 2009, 15-16). Moreover, the upper lignite unit, with which the archaeological finds are correlated, did not yield any artefacts when it was excavated. Apart from five pieces on flint, the artefacts are made on milky white quartz, and the researchers stress the difficulty in discriminating artefacts from geofacts. From a total of 135 potential artefacts, only 28 had a high score as probable artefacts (ibid: Table 1). In short, there are a number of issues that cast doubts on the artefactual character of the assemblage including the following: few artefacts preserve platforms and, those that do, have plain or crushed platforms; 36% of the total is fragments or 'chips' without neither proximal nor distal ends; "pieces with retouch or secondary modification are few and largely undiagnostic"; only three ("polyhedral") cores are reported (Güleç *et al*. 2009, 18). Moreover, although it is argued that "there is no natural agency that could have brought large pieces of vein quartz to this location" (ibid, 16), it is then stated that "occasional small, unmodified quartz clasts found within intact blocks of lignite are not rolled" (ibid, 17).

Much more solid evidence of human presence is to be found in the site of Kaletepe Deresi 3 (KD3), which was discovered in the course of investigations on Neolithic obsidian workshops, in a volcanic region of Central Anatolia (Slimak *et al.* 2008). The site is close to a large obsidian source and its archaeological horizons are embedded within a 7 m-thick series of alluvial and colluvial layers of volcanic origin that contains also tephras. The earliest archaeological levels yielded Acheulean assemblages consisting of handaxes that were shaped exclusively in obsidian, a few cleavers, but also chopper/chopping tools and numerous polyhedrons; the raw materials are all local volcanic types: obsidian, andesite, basalt and rhyolite. Noteworthy is a flake pattern that occurs here, which is executed in obsidian and resembles Levallois technology (Kuhn 2010). Faunal material is hardly preserved and the age of the Acheulean levels remains uncertain; only the rhyolitic bedrock is dated to >1.0 Ma, providing a maximum age for the finds (Slimak *et al.* 2008).

Problems surround the dating of another excavated site, the cave of Yarimburgaz in eastern Thrace. The cave is situated close to Istanbul, at the northern shores of Küçükçekmece lagoon, which is an embayment on the northern coast of the Sea of Marmara. It consists of several halls in different levels, of which the lower and the upper chamber, both with entrances towards the river Sazlidere, have been excavated (Kuhn *et al.* 1996). In front of the cave, what is today a marshy floodplain of the Sazlidere was a valley with a quartzitic alluvium floor, which may have provided the raw material for stone tools (Arsebük and Özbaşaran 1999). Geomorphological studies have shown that the valley has been heavily eroded during glacial cycles. Thus, the excavators suppose that both chambers would have extended farther than their present entrances: the lower one could have had an additional length of 300 m. beyond its present mouth, hence well into the valley (ibid). The lithic assemblage attributed to the Lower Palaeolithic was unearthed from the deposits of the lower chamber, which was also rich in faunal remains. Retouched flake tools dominate the lithic industry, which includes also a small component of core-tools with little morphological standardization and many tested pebbles, whereas the most abundant formal cores are centripetally-worked or discoid specimens (Kuhn *et al*. 1996). The observed wide variety of blank production and core reduction is probably related to the properties and clast shape of the different raw materials that were in use: flint, quartz and quartzite occur in this order of abundance and are followed by jasper and unidentified metamorphic rocks (ibid). Flakes and tool blanks tend to be thick and blocky and usually have either cortical or plain platforms; moreover, the degree of elongation is restricted, bifacial and Levallois technologies are absent, whilst 'heavy-duty' tools are not uncommon (*e.g.* choppers and chopping tools, denticulates and side-scrapers with scalar, stepped/undercut and abrupt retouch). These features are stressed here because, as mentioned later, the quartz assemblages from the Greek sites of Rodia (Thessaly) and Doumbia (Macedonia) are considered to display similarities with that from Yarimburgaz.

A deposit with sand and fine gravel that is exposed only in the upper chamber is thought to correspond to a last interglacial beach (Tyrrhenian) and helps to date the archaeology-yielding strata of the lower chamber as older than the last interglacial (Arsebük and Özbaşaran 1999). However, this deposit does not occur neither in the lower chamber nor in the passage connecting the two chambers; furthermore, the Pleistocene sediments of the upper chamber have been reworked by more recent (post-Pleistocene) inhabitants of the cave and it is acknowledged that any correlation of the sequences from the two chambers is problematic (ibid, 63). ESR dates from *Ursus deningeri* teeth "range from Oxygen Isotope Stage 6 back through Stage 9" (Kuhn *et al.* 1996, 34). Even though this dating technique is not ideally applied on cave-bear teeth, both the ESR results and palaeontological indications point to the latter half of the Middle Pleistocene (Kuhn 2002).

The difficulties in acquiring solid dating results are not restricted to the aforementioned sites, but include also the best-studied Palaeolithic locality in Turkey, the cave of Karain. This is again a multi-chambered cave situated on the south-facing flanks of the Taurus range and close to the Mediterranean coast, in a calcareous area with numerous cavities, rockshelters and springs (Otte *et al*. 1995). Karain E is the main chamber with Lower and Middle Palaeolithic deposits, in a sequence composed of interfingering colluvial, travertines, clayey-silty layers and calcitic concretions associated with paleosols (ibid). The lowermost, archaeological unit A yielded an assemblage that was termed 'Clactonian' and consists of a few artefacts made on radiolarites; cores exhibit a rough centripetal or polyhedral shape, flakes are short and thick and the toolkit is dominated by denticulates and notched pieces (Otte *et al*. 1998). The layers of this unit were estimated to date around 400-370 ka (see below). The next units, B to E, contained assemblages that were termed (proto-) 'Charentian', as they exhibit a more elaborate debitage rich in side-scrapers but still including denticulate forms; these assemblages were considered similar to the 'Achelo-Yabrudian' of the Levant and were estimated to date around 350-300 ka (ibid). Notably, a few fragmented human remains were also found in unit E, but they have not yet been taxonomically determined (Otte *et al*. 1998). With the beginning of the next group of units (F through I), a major change is seen in the sequence of knapping techniques: the Levallois method appears, together with materials from extra-local sources; average ages from ESR and TL datings place the appearance of Levallois and the beginning of these 'Typical Mousterian' assemblages' at *ca.* 250-200 ka (Otte *et al.* 1998, 419). The age-estimates suggested for the Lower Palaeolithic assemblages of unit A and B to E were "estimated on the basis of correlation with oxygen isotope stages" (ibid: Table 1). These correlations were based on the following argumentation: ESR dates on teeth gave ages averaging 120 and 110 ka for layer I.2 (unit I), which was therefore correlated to the Last Interglacial; then, "these readings may indicate that the underlying consolidated travertine layers represent preceding interglacial phases and thus their age may be estimated by correlation with the isotope curve established by Shackleton and Opdyke" (Otte *et al*. 1999, 77). In my view, whereas the ESR/TL average ages of 250-200 ka for the earliest Middle Palaeolithic levels may be seen as secure enough, the proposed estimations for the underlying Lower Palaeolithic levels should be dealt with caution.

Although tentative, the above-mentioned chronological estimation for the earliest Lower Palaeolithic assemblage of Karain is not unreasonable and one might say that it finds some support from another age estimate, this time concerning a travertine that contained a fragmented hominin calvaria attributed to *Homo erectus* (Kappelman *et al*. 2007). The specimen was found in the Büyük Menderes valley in western Turkey, and it was recovered from a block of travertine mined from a quarry. Travertine sediments in this area have been TL-dated between *ca.* 510-330 ka, whilst the most likely date for the travertine that yielded the fossil ranges from around 510 to 490 ka (Kappelman *et al*. 2007 and references therein). The latter estimate falls near the interglacial period that is represented by MIS 13 and this is also the isotopic stage with which the lowest layers at Karain are correlated. Although the age estimates in the two cases broadly match, the problem is that (1) in both sites direct dating evidence is lacking, and (2) in the case of Karain, a direct correlation of terrestrial sediments (travertine) with marine isotopic stages is in itself problematic.

Apart from the excavated sites overviewed above, a notable number of surface finds from Turkey has been attributed to the Lower Palaeolithic period. A prominent example, much relevant to the picture of the Greek record, regards the artefacts discovered during survey projects on the Asian side of the Bosphorus, and in the area of eastern Thrace and the Sea of Marmara (Runnels and Özdoğan 2001). Bifaces (handaxes), core-choppers and bifacial tools were discovered at a few sites, of which the most important are Eskice Sirti on the European side and Göksu on the Asian side of Bosphorus. The latter site was first documented in 1964 and a more recent revisit confirmed the initial account by Jelinek that the artefacts derive from paleosol exposures; specifically, the findspots at Göksu are located in erosional gullies that cut through mature paleosols formed on the Pleistocene terraces above the Göksu river (Runnels and Özdoğan 2001, 73). The researchers assume that the artefacts are residues from eroded sites that were subsequently incorporated in the soils, in the course of pedogenesis (ibid). The implements are made on chert and quartzite and their typo-technological characteristics allow comparisons with the assemblage from the nearby cave of Yarimburgaz. Most importantly, the core-and-flake component of the industry resembles that from the site of Rodia in Thessaly, Greece (see below 6.4). Similar forms and technological traits are noted in the material from Eskice Sirti and it is assumed that both sites could be chronologically comparable with Yarimburgaz and Rodia in Thessaly (at *ca*. 350 ka).

3.7 CONCLUSIONS AND DISCUSSION

The preceding examination of some of the best-studied Lower Palaeolithic Mediterranean sites and the regional records in which they are encompassed, allows us to draw a number of conclusions with regard to the parameters that were mentioned in the introduction as being the focus in this review.

As a general rule, all of those regional records are dominated by open-air sites that are associated with fluvial, lacustrine and fluvio-lacustrine depositional environments. The latter are commonly related to basinal geomorphological settings, usually of tectonic origin. Most of the sites are located at relatively low elevations, far below 1000 m above sea level, and usually below *ca*. 500 m, as the Italian record vividly exemplifies. All of the exceptions to this altitudinal pattern regard sites that are situated on upland plateaus, and all of them are in altitudes ranging between 1000-1200 m: Torralba and Ambrona on the Iberian Meseta, Ain Hanech and El-Kherba on the eastern Algerian high Plateau, and Dursunlu on the Central Anatolian Plateau. In examining the geography of the European occupation in the Lower and Middle Palaeolithic, also with regard to settlement ecology and landscape use, Hopkinson (2007) arrives at the same conclusion: before around 200 ka, hominin groups seem to have avoided upland regions, and his assertion considers archaeological sites also in northern, central and eastern Europe. Hence, rather than restricted to the Mediterranean, this altitudinal boundary appears to reflect a wider reality in the Lower Palaeolithic of Europe. I would agree with Hopkinson that the explanation of this picture is strongly linked to the ecological dynamics of mosaic landscapes in upland regions: the distributions of plants and animals and the configuration of patches available in these environments were obviously eco-environmental barriers that early hominins could not overcome, probably because of the nature of their social organizations, conceptual abilities and behavioral capacities; thus, Lower Palaeolithic hominins appear to have been confined to lowland habitats where resources were distributed closely in space and time. The same author argues that the Lower Palaeolithic occupation of the Italian Apennines is the exception that proves the rule, because those localities were associated with fine-grained mosaic landscapes, perhaps benefited by the positive effects of volcanism; moreover, he claims that the Apenninic record shows that erosional processes have not biased this picture, which in turn proves that the pattern is real. However, there is not any evidence of human presence in the Italian mountainous landscapes before *ca*. 300 ka (*cf*. Mussi 2001)[10]; therefore, instead of the Italian

10. That is, if we consider that 500 m. of altitude is a generally accepted geomorphological boundary for distinguishing between upland and lowland regions in the Mediterranean; it could be

sites, I would consider the aforementioned *sites on the plateaus* as the only significant 'exceptions to the rule'. The breaking of this altitudinal limitation with the onset of the Middle Palaeolithic may have been real (Hopkinson 2007), but, in my opinion, the Italian record is probably exemplifying exactly the biasing effects of erosional geomorphic agents active in upland landscapes (*contra* Hopkinson 2007). The few Lower Palaeolithic sites of the Iberian, Maghrebian and Anatolian upland plateaus can be seen as supporting this argument, because they are situated on flat or gently undulating terrains.

Wherever equally researched areas with comparable geomorphological and depositional settings can be contrasted, it seems that open woodlands close to water bodies would have been preferred locations. Whilst the Iberian record stresses the significance of subsidiary fluvial systems, confluences of rivers and entrances of valleys; the Italian evidence points to the importance of mosaic landscapes. The relevance of those indications for the Greek record is discussed further in chapter 7. Here, it is important to realize that the distribution of sites essentially matches the spatial patterns of fluvial and lacustrine drainage systems. This highlights the importance of drainage catchments in dictating natural routes for inter- and intra-regional human and animal movements: rivers that dissect bedrock and cut through mountain ranges facilitate dispersal events. Lakes, swamps, marshes, riverine and riparian zones are all considered as ecologically highly productive environments; these are commonly hosted within larger topographical depressions, which usually serve as biogeographical corridors. Alternatively, the strong association of sites with fluvio-lacustrine depositional regimes can be explained by inferring their preservation potential as repositories of early human activity (*e.g.* Mishra *et al*. 2007). This would imply a positive bias: sites have been found in those depositional contexts, and in those corresponding geomorphological settings (*i.e.* topographic depressions: river basins, former lakes, coastal areas), because of specific properties that favor preservation. On the other hand, the work of Goldberg (1995) in the Levant indicates what can be seen as a negative bias: those landscape features were discontinuous in space and ephemeral in time for most of the Quaternary, hence the gaps in the archaeological signal may be related to the gaps in the geomorphological archive, when the aforementioned landforms were not in existence or they were not active (*e.g.* dry valleys and lakes). Another negative bias is exemplified by the Iberian record, where most of the evidence is associated with the middle terraces of rivers. This probably suggests that, before the time-periods represented by the middle terraces, river behavior was overall too dynamic to allow for the preservation of archaeological material. Interestingly, the latter observation concerns the vast majority of the Iberian river systems, although terrace flights in the interior are better preserved than those of the coastal lowlands (Santisteban and Schulte 2007).

The use of caves appears to have been a marginal and/or chronologically late phenomenon: with very few exceptions (Atapuerca in Spain, Kozarnika in Bulgaria and the caves in the Casablanca area), the use of caves appears in the latter half of the Middle Pleistocene. Again, it is difficult to explain whether this is an artifact of preservation or a consequence of hominin preference on open-air locales, like lake margins and riverine habitats. First steps in testing the preservation argument would be (1) to see how many of the excavated caves preserve earlier deposits (and whether the latter were excavated and proved to be sterile, or not) and (2) to assess how many of those caves were a) in existence for the period under question (*e.g.* Early and early-middle Middle Pleistocene) and b) accessible to hominins (admittedly, a difficult issue to confirm). With regard to the Greek record, the role of caves and rockshelters as both sedimentary archives and landscape features available for habitation, hence as potentially promising areas for investigations, is discussed later in chapter 7; for the purpose of the discussion here and in the following chapters, suffice it to conclude that a lack of cave-sites in the Lower Palaeolithic of Greece would not be surprising.

With regard to chronological frameworks, the following points need to be stressed:

1. Early Pleistocene sites are few and their dating is only rarely uncontested

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argued that this boundary holds well also with regard to ecological structuring of landscapes.

2. the number of sites increases in the early-middle Middle Pleistocene, but
3. it is only from the middle and chiefly the latest part of the Middle Pleistocene that the archaeological signal becomes substantiated.

Obviously, this picture is inherently related to the fragmented nature of terrestrial sedimentary archives of the earliest parts of the Pleistocene, and is also associated with the methodological constraints of the available dating techniques and datable materials (*e.g.* Goldberg 1995; Mussi 2001; Santisteban and Schulte 2007). Problematic as they are, it is with those geochronological schemes that archaeologists are building regional chronosequences; it thus has to be appreciated that even the Iberian record, holding now a prominent position in the Eurasian Early Palaeolithic, is by far *based on relative chronologies mostly with regard to fluvial sequences*. Biostratigraphy is a powerful dating tool but it is not devoid of problems and it is often the crux of heated debates. Lithic typology has been -and to some extent is still being- used as a means to 'date' assemblages, a fact that is being repeatedly criticized, hopefully leading to a progressive abandonment of type-fossil approaches.

'Oviously technological evolution, on the other hand, provides more solid grounds for coarse-grained chronological estimations and even a sequencing of assemblages through time, wherever samples are large enough and methodological biases have been excluded. It also assists in identifying patterns of hominin subsistence, land-use and dispersals in space and time and, ultimately, cognitive and social developments; yet, technical systems identified in artefactual assemblages cannot themselves (alone) explain those patterns. Technical strategies reflected in stone tools can be viewed from an evolutionary perspective, but their trajectories are not unidirectional and are driven by multi-causal factors. Hence, in my reading of the circum-Mediterranean evidence, I do not see a justified reason for arguing neither in favor nor against a precedence of 'Mode I' over 'Mode II' assemblages. The earliest (on the current evidence) dispersals in the Mediterranean appear to involve 'Mode I' assemblages in some records (*e.g.* Iberia); in other records this long-assumed association has been convincingly criticized (*e.g.* for the Italian Peninsula and the Maghreb); in Anatolia there are indications for a very early appearance of 'Mode II' industries; in the Levant, the core-and-flake component at 'Ubeidiya is considered as part of a broader 'Acheulean complex'; and for the material of Kozarnika cave, it is stressed that the core-and-flake industry is not replaced by the Acheulean but "ends directly in the Mousterian/Levallois" (Sirakov *et al.* 2010, 105). Insofar as we accept that (1) there is not any uncontested one-to-one correlation between a hominin taxon and a 'lithic tradition' (let alone that both concepts -hominin taxonomy and lithic traditions- face serious problems with definitions and terminology) (2) the available resolution cannot confirm or falsify any association between specific lithic 'Modes' and separate dispersal events; then, we can only assume multiple, sporadic and discontinuous episodes of dispersals in the peopling of the circum-Mediterranean, as Dennell (2003) suggests for Eurasia in general and Villa (2001) for Italy in particular. Arguably, this sort of patterns cannot be firmly deciphered when their interpretations are implicitly based on lithic evidence that lacks contextual data, exhibits a dubious artificiality or derives from erosional palimpsests, as it is often the case with surface collections; an example of how surface finds may lead to an erroneous construal was given with regard to the alleged 'Pebble Culture' in the area of the Maghreb.

And yet it is mostly surface lithic artefacts that constitute the largest parts of all the records examined here. In lack of stratigraphic control, surface material is endowed with a low time-resolution. Nonetheless, it can still provide first-order indications on human presence/absence and on how the signal for identifying the latter might have been biased by geomorphic agents. Bearing all the above in mind, we can now turn our look into a record that is dominated by surface material and is indeed complicated by tecto-sedimentary perplexities: the Lower Palaeolithic record of Greece.