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The Early and Middle Pleistocene archaeological record of Greece : current status and future prospects

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Citation

Tourloukis, V. (2010, November 17). *The Early and Middle Pleistocene archaeological record of Greece : current status and future prospects*. LUP Dissertations. Retrieved from <https://hdl.handle.net/1887/16150>

Version: Corrected Publisher's Version

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Note: To cite this publication please use the final published version (if applicable).

4 – The Lower Palaeolithic record of Greece

4.1 INTRODUCTION (WITH A SHORT REFERENCE TO THE MIDDLE PALAEOLITHIC)

Unambiguous lithic evidence or human remains dating to the Early and early Middle Pleistocene are so far lacking in Greece. Lithic material that is considered to date to the (late) Middle Pleistocene is scarce and mostly consists of finds that have been chronologically bracketed only in the broadest of terms, with relative dating techniques that are mainly based on the inferred archaic morphology of the artefacts and on usually inadequate stratigraphic correlations. In this light, had the fossils from Megalopolis, Petralona -and perhaps also those from Apidima- never been found, any assertion for a human presence in Greece before the Late Pleistocene would have been only speculative.

In order to assess the validity of this scanty evidence, this chapter aims at providing a critical examination of all reported claims for finds that could be attributed to the Lower Palaeolithic period. Some arguments have been put forth by people who are practicing archaeology on an amateur or semi-professional level, publishing their results in self-funded monographs or semi-popularized archaeology-related journals. As this kind of research is carried out outside the frameworks of academic institutions or the Greek Archaeological Service, the investigators commonly lack the assistance of trained geologists, geomorphologists, palaeontologists or lithic specialists. In effect, their arguments are usually grounded upon their own appreciation of the archaeological context (which is – more often than not – inadequately described), if not solely on the morphology of the artefacts. Thus, although the experience, knowledge and sincere efforts of amateur archaeologists should not be overlooked by the academic community, the way this kind of research is often conducted and pub-

lished renders any re-evaluation considerably difficult (*e.g.* Andreikos 1993; Sarantea 1996). In those cases, either the artefactual character of the finds or the chronological attribution to the Lower Palaeolithic has already been disputed (*e.g.* see Runnels 1995, 708, and Papagianni 2000, 9 for a critique of the two examples of publications cited above).

Meager as the record is, the fact remains that indications for the presence of humans already from the late Middle Pleistocene have been reported from areas that are spread over almost the entire country (Fig. 4.1): the northern parts of Greece (Thrace and Macedonia, section 4.3), the Ionian Islands and Epirus (sections 4.4 and 4.5), up to Central Greece (Thessaly, section 4.6) and the southernmost areas of Peloponnesus (sections 4.2.2 and 4.7); in fact, material that is provisionally ascribed to the Lower Palaeolithic has recently been reported even from the Aegean Islands -from Milos and from places as far as Crete and Gavdos (southernmost Aegean Sea; section 6.4). All of these reports are discussed below, after the examination of the palaeoanthropological testimony (4.2)¹¹. Moreover, a clear emphasis is given here on the finds from Kokkinopilos (Epirus) and Rodia (Thessaly), as these two are the main sites with relatively well-documented stratified occurrences. But before assessing case-by-case the arguments for Lower Palaeolithic remains, it is deemed fruitful to consider first the main characteristics of the Late Pleistocene record of Greece, namely that of the Middle Palaeolithic.

Compared to the highly fragmentary character of the Lower Palaeolithic data set (see below), the Middle Palaeolithic record of Greece is more solid and con-

11. The hominin fossil from Megalopolis is discussed in section 4.7.2 together with the archaeological evidence from this area.



Fig. 4.1 Map of Greece showing key sites examined and discussed in this study. Archaeological sites: 1) Petrola 2) Dombia 3) Siatista 4) Palaeokastro 5) Rodia 6) Korissia 7) Alonaki, Ormos Odysseos 8) Kokkinopilos 9) Nea Skala 10) Triadon Bay 11) Preveli 12) Gavdos. Sites with human remains: P = Petralona Cave; M = Megalopolis; A = Apidima Cave. Sites with pollen records: TP = Tenaghi Philippon; I = Ioannina; K = Kopais

tinuous, yet poorly dated and hitherto not sufficiently documented. Nevertheless, since the onset of the first systematic explorations in the 1960's (for reviews see Kourtessi-Philippakis 1986; Darlas 1994; Runnels 1995; Papagianni 2000), fresh approaches and new perspectives – often aligned with the introduction of methodological and technological advances in archaeological practice – have improved not only the number of known sites, but also their interpretation

(e.g. see papers in Bailey 1997 and Bailey *et al.* 1999; Papagianni 2000; Panagopoulou *et al.* 2002-2004; Richards *et al.* 2008). Then again, despite the fact that Middle Palaeolithic findspots have been routinely identified during nearly all survey projects of the last three decades, few of the *ca.* two hundred open-air Middle Palaeolithic sites and findspots (Harvati *et al.* 2009) have yet been excavated. Moreover, it is only in but a handful of the open-air sites that the



Fig. 4.2 Main Middle Palaeolithic sites of Greece: 1) Theopetra 2) Asprochaliko 3) Kleisoura 4) Lakonis 5) Kalamakia

material considered as of Middle Palaeolithic age has been identified as such on the basis of chronostratigraphic criteria, whilst sites with radiometric dates are even fewer (for notable exceptions see for example Pope *et al.* 1984, and Runnels and van Andel 1993a, 2003). As a consequence, the backbone of the Greek Middle Palaeolithic is essentially restricted to only five cave sequences that have been excavated and are bracketed chronologically with absolute dates, albeit not enough and in cases not unproblematic (Fig. 4.2).

The cave of Asprochaliko was excavated by Higgs and Vita-Finzi (1966) and was for long considered (erroneously) as the reference-site for describing Mousterian variability in Greece (Papakonstantinou and Vassilopoulou 1997; Darlas 2007). Its basal Mousterian levels yielded abundant laminar Levallois products and are dated to *ca.* 90-100 ka by a single TL date (combined measurement on two heated flints; Huxtable *et al.* 1992; Gowlett and Carter 1997), whilst the upper Mousterian industry, dominated by small-sized pseudo-Levallois points, is tentatively dated by ^{14}C to *ca.* 40 ka (Higgs and Vita-

Finzi 1966; Bailey *et al.* 1983; 1992). In central Greece, the Middle Palaeolithic levels in the cave of Theopetra (Kyparissi-Apostolika 2000) document a wide diversity and flexibility in reduction strategies associated with the Levallois technique (Panagopoulou 1999); moreover, the industry includes also a unifacial flake cleaver (so far a unique find in Greece), a cordiform biface made on an 'exotic' raw material, as well as a few chopping tools (*ibid.*). The sequence was originally dated by ^{14}C to 45-33 ka. Recent re-dating of these levels by TL on burned flints yielded coherent results, which place the first human occupation of the cave at the transition from MIS 6 to MIS 5 and more probably the last interglacial itself (Valladas *et al.* 2007), since plant remains from the same strata indicate a mild climate, in accordance with a lack of freeze-thaw sedimentary features that characterize the rest of the sequence (Ntinou 2000; Karkanas 2001). On the basis of these new dates, Theopetra has so far yielded the oldest dated deposits with stratified Middle Palaeolithic artefacts in Greece. Noteworthy is also the preserved footprints at Theopetra: they probably belong to a (Neanderthal?) child, they are associated with Mousterian lithics, and one of them is assumed to have been made by a covered foot, in which case it would be the oldest evidence of footwear (Manolis *et al.* 2000).

The rest of the excavated caves are located in Peloponnesus. The Middle Palaeolithic layers of the cave of Kleisoura, in Argolid, are as yet undated; they have yielded a few bifacial implements, but notable is the fact that a blade-based technology co-occurs in the lower layers with specimens made on flake blanks, and is overlain by artefacts of discoidal and Levallois character in the upper layers (Koumouzelis *et al.* 2001; Sitlivy *et al.* 2007). The caves of Lakonis and Kalamakia are situated in close proximity on the Mani Peninsula and they are formed as part of the karstic system of the area, which includes also the cave of Apidima (see 4.2.2 below). The sequence at Kalamakia is considered to begin in the early part of the last glacial (at *ca.* 100 ka) on the basis of the identification of beach deposits that underlie the first archaeological layers and have been attributed to MIS 5c, whilst a single ^{14}C (AMS) date on charcoal from the last artefact-bearing layer provides an upper limit for the human occupation of the cave at around 40 ka; so far there are no reliable dates available for

the different layers of the sequence (Darlas and de Lumley 1999; Darlas 2007, 357). Hominin fossils that have been discovered at Kalamakia (an upper M^3 and six more teeth, cranial fragments, a fragment of a fibula and a lumbar vertebra) are seen as Neanderthal remains (Darlas 2007) and a more detailed description is currently in preparation (Harvati *et al.* 2009, 139). In contrast to the rare presence of discoidal cores, the Levallois technique is well-represented at Kalamakia, but the technological methods applied are thought to follow the constraints imposed by the raw materials, which include a type of andesitic lava (prevailing also at Lakonis), flint, quartz and quartzite (Darlas 2007). Affinities with Kalamakia, in terms of the raw materials, the identified ungulate species of the fauna and probably also in the technological strategies of the reduction sequence, can be found in the neighboring site of Lakonis (Panagopoulou *et al.* 2002-2004). The sequence of Lakonis I at the eponymous cave complex begins at around MIS 5e, according to U-series dates (two samples from the bottom of the stratigraphy) and ends at *ca.* 40 ka, on the basis of radiocarbon/AMS (six samples from the upper levels), whilst TL and OSL results are pending (*ibid.*, 331; Elefanti *et al.* 2008). The collapsed cave at Lakonis I preserves deposits of almost exclusively anthropogenic origin, with extremely high densities of archaeological remains that find no parallels elsewhere in Greece and are perhaps only comparable to the assemblages of Blombos Cave in south Africa (*ibid.*, 343; Elefanti *et al.* 2008). Lakonis is a 'multiple activity site' with *in situ* hearth complexes and great inter- and intra-assemblage variability throughout its stratigraphic units, a predominance of Levallois (laminar, recurrent, centripetal) in the Middle Palaeolithic assemblages, but also with non-Levallois technological elements (discoidal, Quina, prismatic), as well as a small percentage of bifacial tools. Importantly, Lakonis is one of the few sites in Eurasia where Neanderthal remains (in this case, a lower M^3) have been found in an undisturbed context associated with an Initial Upper Palaeolithic industry, dated at Lakonis to *ca.* 44-38 radiocarbon ka (Harvati *et al.* 2003; Panagopoulou *et al.* 2002-2004; Elefanti *et al.* 2008; Harvati *et al.* 2009). Moreover, measurements of strontium isotope ratios from the Lakonis tooth provided the first direct evidence for Neanderthal mobility, by demonstrating that the individual represented by the M^3 lived for some time in a

region 20 km (or even further) away from the site of Lakonis (Richards *et al.* 2008).

Whereas Lakonis and Kalamakia would have been situated close to the coast at the time of their occupation, Theopetra, Asprochaliko and Klisoura are inland sites, although the latter is also not far from the coast (Fig. 4.2). Furthermore, all of the cave-sites described above occur in low altitudes, namely below *ca.* 300 m asl, and the open-air sites discovered so far appear to follow this altitudinal pattern, at least in their majority. A notable exception regards the Middle Palaeolithic open-air findspots discovered on the highland plateaus of Grevena, at altitudes above 1000–1500 m (Efstratiou *et al.* 2006).

Most of the open-air sites are associated with either coastal or lowland riverine geomorphological and depositional settings, *i.e.* mainly coastal (often alluvial) plains, fossilized sand dunes, marine terraces and beach deposits for the former category (*e.g.* Servais 1961; Leroi-Gourhan 1964; Chavaillon *et al.* 1967, 1969; Sordinas 1969, 1970; Cubuk 1976; Reisch 1982; Kavvadias 1984; Darlas 1994, 1995a; Runnels *et al.* 1999) and river valleys, alluvial fans and -mostly- fluvial terraces for the latter (*e.g.* Milošević *et al.* 1965; Runnels 1988; Runnels and van Andel 1993b; Darlas 1999; Panagopoulou *et al.* 2001). Next to those are, in rather considerable numbers, sites which are situated within karst settings, for instance in karstic basins associated with *terra rossa* fills (*e.g.* Dousougli 1999; Papagianni 2000; Runnels and van Andel 2003; see also 4.5 below), or on plateaus (*e.g.* Efstratiou *et al.* 2006). With a few exceptions regarding chiefly fluvial deposits (*e.g.* Milošević *et al.* 1965), faunal remains are conspicuous by their absence from the lists of finds, whereas lithic artefacts are almost always being discovered from the surfaces of Pleistocene landforms. In the rare cases where artefacts have been found stratified, they are commonly associated with paleosol horizons (*e.g.* Pope *et al.* 1984; van Andel 1998; Runnels and van Andel 2003) or river terrace deposits (*e.g.* Milošević *et al.* 1965; Runnels and van Andel 1993b). Finally, in marked contrast to the wealth of Middle Palaeolithic evidence from coastal, fluvial and karst settings, there are hardly any sites reported from lacustrine depositional settings; exceptions would include the undated and largely non-diagnostic artefacts found as-

sociated with fluvio-lacustrine sediments at the margins of the Megalopolis palaeo-lake, which are discussed separately below (4.7.2), a chopper found close to the lake Korissia in Corfu (section 4.4.2), and a brief report on Levallois implements discovered on the surface of sediments that probably belong to a palaeoshore of Lysimachia lake in Aetoloakarnania (Papakonstantinou 1991). On the other hand, the *terra rossa* deposits of the numerous karst depressions occurring in north-west Greece and some Ionian Islands were accumulating in the subaqueous environments of ephemeral lakes formed within the depressions; in that respect, these are also lacustrine depositional settings *sensu lato*.

With hardly any exceptions, all of the Middle Palaeolithic open-air sites are related to landforms of generally low gradients¹². Clearly, this is the overall result of the combined effects of the altitudinal norm mentioned earlier (because the steepness of the relief is positively correlated with altitude; see 6.5) and the aforementioned prevailing types of geomorphological and/or depositional environments: for instance, coastal areas, palaeo-floodplains and karst plateaus commonly display a gentle relief. Another point that needs to be stressed is that almost none of the open-air Middle Palaeolithic sites have been reported to be associated with landforms *predating the last interglacial*.

This short overview of the Greek Middle Palaeolithic deserves one last comment with regard to the raw materials that were in use during this period. On the current evidence from both the excavated caves and the open-air sites, the raw materials were commonly derived from primary or secondary sources of local origin, usually not further than *ca.* 10–20 km away from the sites, hence in line with the evidence from other European sites (*e.g.* Féblot-Augustins 1999; but see Karkanas *et al.* 2008 for a distance of 5–50 km at Theopetra). Nevertheless, detailed studies of

12. This can be easily seen if one plots the discovered sites on a slope map, or even on a base-map of relief. However, this is a general assessment that aims to underline the prevailing pattern in the distribution of open-air Middle Palaeolithic sites in relation to the relief; in that respect, it does not take into account exceptions that would arise *e.g.* according to the micro-topography at each site.

raw material transport distances are overall lacking in Greece and in most of the cases where 'exotic' materials have been documented, their provenance is yet to be elucidated. The prevailing raw material is flint, occurring in various types and varying degrees of quality (its coarse-grained versions often described as 'chert'), followed by quartz, quartzite, schist, and volcanic materials such as that found at Lakonis and Kalamakia. In some instances, it has been suggested that high-quality raw materials are being selected for (imported?) Levallois blanks, whilst coarser materials are used for artefacts that are less heavily (and more irregularly) re-sharpened and frequently non-Levallois in technology (*e.g.* Gowlett 1999).

In sum, the Middle Palaeolithic of Greece is largely composed of undated and commonly non-provenanced lithic assemblages from open-air sites that lack the necessary contextual information, while problems are extended to the excavated sites as well. With Theopetra being re-dated to *ca.* 130 ka, due to the scarce radiometric dates the rest of the sites are variously (and, more often than not, tentatively) dated to between 100 and 40 ka. One of the most profound characteristics of this period is a marked variability in the applied technological strategies of tool manufacturing, and hence also a morphological diversity in the tool inventories (Panagopoulou *et al.* 2002-2004, 344). The Levallois method appears to be omnipresent, albeit in various frequencies, and yet non-Levallois methods are almost equally frequently encountered (*cf.* Darlas 2007). Be it synchronous or diachronic, this local or regional, inter- and/or intra-site diversity and flexibility in reduction processes (*e.g.* Panagopoulou 1999) may reflect 'cultural-stylistic' variation, functional variation, raw material constraints, differential subsistence patterns (*e.g.* degree of mobility), cognitive abilities, social regimes, or combinations of all of the above (*e.g.* Gowlett 1999; *cf.* Dibble 1991, and Bar-Yosef and van Peer 2009). Additionally, this variability/diversity may be seen as mirroring the environmental diversity and the mosaic character of the Greek landscapes (Panagopoulou *et al.* 2002-2004), but nonetheless, the small sample of well-documented sites and the current chronological resolution precludes any conclusive interpretations.

If the Greek Middle Palaeolithic chipped stone technology and morphotypes emerge in a somewhat 'in-

homogeneous fashion', the same could be expected for its Lower Palaeolithic predecessors, since non-uniform, rather opportunistic and non-standardized technological applications are thought to be the trademark of the latter period. That would in turn pose immense difficulties to those who choose to rely on a 'type-fossil approach'; it would conversely emphasize the need for more rigid analytical procedures in characterizing assemblages. All things considered, it is against this largely fragmentary, highly variable and still enigmatic Middle Palaeolithic background that any purported 'pre-Mousterian' evidence needs to be distinguished from and, if possible, compared with.

4.2 THE PALAEOANTHROPOLOGICAL RECORD

4.2.1 Petralona

In 1960, local villagers discovered a cranium (Fig. 4.3) in the Petralona cavern, which is situated at the north-west margin of the Chalkidiki peninsula (North Greece; for the location of the site see Fig. 4.1). The cavern was tested by excavation in a small area during 1974-1981, but the published results of the excavations (*e.g.* Poulanos 1980, 1982) have provided imprecise and contradictory accounts on the stratigraphy, the associated faunal assemblage and the reported existence of postcranial remains related to the skull (Stringer 2000a; Galanidou 2004). Due to uncertainties surrounding both the circumstances of discovery and the excavator's publications, it is unclear whether the skull was found lying on the flowstone that covers the floor of the chamber or on a layer underlying the flowstone (Grün 1996). The skull is encrusted with calcite (*ibid*) and, most probably, it was stuck (by the calcite flow) against the wall of a diverticule (Darlas 1995a). Nevertheless, the original stratigraphic position of the specimen is unknown; hence it cannot be correlated with any of the twenty-seven layers that have been identified in the deposits of the cave (*ibid*). As a consequence of all the above, a debate continues about the age of the cranium and its taxonomic identity.

Petralona is one of the richest palaeontological caves in Europe, containing abundant remains of both herbivores and carnivores (Tsoukala 1991), although the excavated fauna has not been specified for each stra-



Fig. 4.3 The Petralona cranium. The photograph was provided from and is copyrighted by the Laboratory of Geology and Palaeontology, University of Thessaloniki

tigraphic level (Darlas 1995a, 52; for faunal lists see Kretzoi and Poulianos 1981; Tsoukala 1991; for a summary of those lists see Darlas 1995a). The analysis of the large mammal faunal material distinguished two main groups (Tsoukala 1991): the first one is of early Middle Pleistocene age, possibly bracketed between *ca.* 500-700 ka (Darlas 1995a); the second group includes species of the Late Pleistocene, as well as some transitive taxa from the latest Middle and Late Pleistocene (Tsoukala 1991, 335). Finally, according to Stringer (1983, 734), the bone fragments that were once published as part of human postcranial remains (Poulianos 1980) were not identified as human by any of the anthropologists who examined them; in the same vein, Tsoukala's study of the fauna (1991, 333) did not yield any evidence for the existence of hominin remains.

Lithic material is also reported to be abundant (Poulianos 1982), but it has not been published properly and only some drawings and pictures of a few artefacts are available (Darlas 1995a, 53). Darlas (*ibid*) reports that the industry is mainly made on quartz

and it is dominated by tools made on debris and only rarely on flakes, whereas pebble tools are rare and handaxes are absent. In contrast, Harvati *et al.* (2009) doubt the artefactual status of the published material. Indeed, considering the published drawings, as well as the morphology of the pieces which are on display at the local 'museum' (personal observation), the artificiality of the material from Petralona should be dealt with caution.

The cranium is exceptionally well-preserved, lacking only the incisors, the right zygomatic arch and possibly the mastoid processes (Stringer *et al.* 1979). Since its discovery, the taxonomic classification of the specimen has entailed various assignments, but most of which considered it as representative of a species classifiable between *Homo erectus* and *Homo sapiens*, perhaps belonging to a variant of the Neanderthal lineage or to 'archaic *H. sapiens*' (*e.g.* Stringer *et al.* 1979; Wolpoff 1980; Stringer 1983). The unsatisfactory term 'archaic *H. sapiens*' was for long used to describe fossils such as the Petralona cranium and those from Kabwe (Africa) and Dali (Asia), dating to between 500/400 and 200 ka and exhibiting both primitive, *erectus*-like traits and more 'progressive' ('incipient Neanderthal') features (Stringer 1992). More recently, there is a sort of consensus in interposing a distinct species, *Homo heidelbergensis*, between *H. erectus* (or its African variant *H. ergaster*) and *H. neanderthalensis* (in Europe; in Africa it would be *H. sapiens*), most probably as an (African-)European taxon that is the last common ancestor of Neanderthals and anatomically modern humans (*e.g.* Manzi 2004; Klein 2009; Mounier *et al.* 2009; see also Harvati 2009 for a recent evaluation of the Petralona cranium with regard to other African and European Middle Pleistocene fossils, and compare with Bermudez de Castro *et al.* 1997). In this line, the Petralona cranium would now be included within the grade of *H. heidelbergensis* (Galanidou 2004; Harvati *et al.* 2009).

The Petralona specimen is essentially a 'surface find' without reliable provenience data; hence the long-lasting controversy around its dating (*e.g.* see the correspondence in the journal *Nature*, vol. 299 (issue 281) between A. Poulianos, I. Lyrizis, M. Ikeya and G. Henning *et al.*; for a review see Wintle and Jacobs

1982; and also Latham and Schwarz 1992)¹³. Lacking a position in the stratigraphy, the cranium cannot be associated with the faunal remains, and it was early on demonstrated that any age estimate based on the 'faunal chronology' is misleading (Grün 1996, and references therein). Many of the absolute dating assays with ESR, TL and U-series techniques have also proved to be untrustworthy or controversial (Wintle and Jacobs 1982). The most reliable dates should be those regarding the calcite layer(s) encrusting the skull, which were derived by ESR measurements (Hennig *et al.* 1981). The latter dating results were later reassessed, concluding that the age of the skull is bracketed between about 150 and 250/350 ka (Grün 1996; see also Latham and Schwarz 1992 for a re-analysis of the calcite with Uranium series, chiefly confirming the ESR estimate of 150 ka as the minimum age).

4.2.2 Apidima

The Apidima cave complex is situated in the western coast of the Mani Peninsula, between the Gulfs of Lakonia and Messene, on the southernmost part of Peloponnesus (Fig. 4.1). On the steep cliffs along the coasts of Mani, many of the numerous caverns and cavities that have been formed in the limestone bedrock preserve Quaternary deposits, often containing also archaeological remains, but only a few of them are accessible and/or have escaped erosion (Darlás and de Lumley 1999). Quaternary terrestrial sediments are usually to be found in the form of cemented -and frequently fossiliferous- breccias, or as scree and talus cones (Tsoukala 1999).

The site of Apidima was excavated between 1978 and 1985, it comprises four caves (A to D) and has so far yielded some 30,000 cultural and faunal finds, including human remains that are thought to belong to 6-8 individuals (Pitsios 1999). The caves are at 4

to 24 m asl and their continental fossiliferous deposits display today an irregular configuration, which continues also underwater (Pitsios 1979, 1996). This fragmentary preservation is explained as the result of at least two former sea-level fluctuations that have caused extensive erosion of the stratified sediments; it has thus been estimated that only less than 5% of the original volume of the Pleistocene deposits has escaped the erosive action of the waves, which have washed out most of the Pleistocene layers (Pitsios 1996).

Nonetheless, two human crania were found in 1978 in cave A: the 'Apidima I' skull (LAO 1/S1) was discovered in situ, exposed on the surface of a breccia pocket, wedged between the walls of the cave. The second skull, 'Apidima II' (LAO 1/S2) was later found adjacent to the first cranium, while a block of the breccia was being extracted for laboratory cleaning (Harvati and Delson 1999). The Apidima II cranium is better-preserved than Apidima I, which is less complete and has only recently been cleaned (Harvati *et al.* 2009). Although the site and the crania are of significant importance for the palaeoanthropology of Eurasia, the results of the excavations and the data on the human remains have been published only as preliminary descriptions and short communications (*ibid.*, 137). At yet, there are no 'absolute' dates for the skulls.

The excavator of the site, palaeoanthropologist Th. Pitsios, classifies both crania to archaic forms of *H. sapiens* ('pre-Neanderthals'), and on the basis of the geological context and the morphology of Apidima II, he has suggested that the skulls should be placed chronologically between 100 and 300 ka (Pitsios 1996). During an international conference on the 'Palaeoanthropology of the Mani Peninsula', Apidima II was compared to the Petralona cranium, and Pitsios pointed out that the two skulls share many affinities, although the one from Apidima is more gracile (Harvati and Delson 1999). Similarities with Neanderthal features were also noted and most of the participants agreed that there are some facial characteristics which seem to be clearly Neanderthal-like, albeit not in the fully derived classic morphology (*ibid.*, 345). On the other hand, the researchers also commented on the pronounced prognathism of Apidima II, which is comparable to that of some of the Middle Pleisto-

13. Until the discovery of the crania at Sima de los Huesos, the Petralona skull was the most complete European Middle Pleistocene specimen (Harvati 2009). This status, as well as the fact that it possibly represents a species which could be regarded as the last common ancestor of Neanderthals and anatomically modern humans, has resulted in a list of relevant publications numbering more than two hundred and twenty papers; needless to say, only a few of those have been cited here.

cene remains from Atapuerca (ibid, 344). Recently, Harvati and colleagues (2009) used multivariate statistical analysis to compare facial measurements of Apidima with those from a sample of other relevant fossils (four *H. heidelbergensis*, five Neanderthals and four early modern humans); the principal components (PC) analysis showed that Apidima II falls near the Neanderthal and *H. heidelbergensis* ranges, with its PC 1 score being most similar to that of Petralona and PC 2 nearest the fossils from Kabwe, Arago and Guattari (ibid, 137 and figure 6). Commenting on the 'incipient' Neanderthal facial traits of Apidima II, Harvati *et al.* (2009, 137) suggest that “the Apidima crania might fit into the early part of the temporal trend observed in the European Neanderthal lineage according to the accretion hypothesis of Neanderthal evolution”.

The study of the large mammal faunal remains distinguished between two main assemblages, one of middle to late Middle Pleistocene age, and one dating to the Late Pleistocene (Tsoukala 1999). The fauna is stratigraphically mixed (ibid), and, although it has been suggested that the crania-yielding breccia could be related to the Middle Pleistocene faunal group, there are no fossils securely associated with the breccia (Harvati and Delson 1999). Similar problems apply to the lithic material: Kourtessi-Philippakis' preliminary study indicates that the artefacts from cave A belong to a Middle Palaeolithic assemblage, but their association with the breccia of the crania is uncertain (ibid). A Middle Pleistocene date has nevertheless been evoked for that breccia also on the grounds of geomorphological observations, whereas ESR dating of beach deposits at different elevations indicates ages of 40, 80 and 200 ka, with the latter age possibly correlated to the breccia of cave A (Harvati and Delson 1999, 348).

In sum, the hominin crania are considered to date to the Middle Pleistocene mainly on the basis of their archaic morphology, as well as on geomorphological and stratigraphic considerations (Harvati 2000; Harvati *et al.* 2009). The faunal and lithic material may be seen as providing at best *indications* in support to any chronological estimate and should be treated with caution. Clearly, apart from the much-awaited further clarification of the taxonomic identity of the

crania, radiometric dates are needed for the refinement of their chronological bracketing.

4.3 NORTH GREECE

4.3.1 Thrace

Until the 1990's, the province of Eastern Macedonia and Thrace remained virtually a blank spot on the Palaeolithic map of Greece (Ammerman *et al.* 1999), although it forms a natural corridor in the assumed routes of animal and human dispersals, from both east-to-west and north-to-south. The presence of (Lower) Palaeolithic sites in other Balkan countries to the north, the cave of Petralona in the neighboring Chalkidiki Peninsula to the west, as well as the cave of Yarımburgaz and the numerous sites of the Bosphorus region, directly adjacent to the east of Thrace (Runnels 2003b), altogether underline the importance of the region, highlighting at the same time the paucity of research here.

The prospects of this area for Palaeolithic investigations are also reflected in the fact that it hosts some of the largest Neogene/Quaternary basins in Greece (see also sections 6.3 and 6.4). The three major depressions, namely the basins of Vardar-Axios-Thermaikos, Struma-Serres-Strymon and Nestos-Thassos-Samothraki, are filled with sedimentary sequences of fanglomerates, conglomerates, sandstones and fine clastics, which overall represent complex tecto-sedimentary histories of changing palaeoenvironmental regimes and alternating terrestrial to fluvio-lacustrine depositional settings (Psilovikos and Syrides 1984). Continental zones would have been relatively extensive during the Late Pliocene-Early Pleistocene, whilst subsidence associated with the activity of the North Aegean Trough during the Middle Pleistocene resulted in marine transgressions (from MIS 9 and onwards, Lykousis 2009), the forming of new grabens and the rejuvenation of the relief, alongside a predominantly fluvio-lacustrine sedimentation (Psilovikos and Syrides 1984; Roussos and Lyssimachou 1991; Rondoyianni *et al.* 2004). During the Early and Middle Pleistocene that is of interest here, extensive deltas, lagoons and estuaries were formed, with lakes, marshes and shallow beaches occurring side by side. As discussed further below, such environments are considered to have been

highly productive in terms of water and plant resources, hence attracting both animals and humans. Unfortunately, the greatest portion of the former vast coastal plains and fluvial lowland settings are now either submerged or buried by thick fluvial and fluvio-lacustrine sequences (*e.g.* see Stanley and Perissoratis 1977 for estimated thicknesses). Overall, the northern Aegean presents the highest subsidence rates for the Quaternary (Lykousis 2009), and wherever sedimentation kept pace with subsidence, large amounts of clastic sediments from the hinterland transported by the main rivers (Axios, Strymon, Nestos) filled the depressions rapidly, thereby rendering the older deposits inaccessible today. On the other hand, Pleistocene outcrops do exist, exposed by modern activities (*e.g.* quarries) or natural causes, as with the case of rivers that have incised through the sedimentary infills of the basins. After all, the potentials of this region for future discoveries are reflected also in the presence of important palaeontological sites (*e.g.* Tsoukala 1991; Koufos 2001; Athanassiou and Kostopoulos 2001).

Although the first systematic survey in the region had a primary focus on the later prehistory (Neolithic and Bronze Age), a number of open-air Palaeolithic sites were identified, as the project included also geomorphological investigations and a special attention to Pleistocene formations (Ammerman *et al.* 1999). In the targeted area (Krovili, Rhodope province), the two most important findspots were found on Pleistocene terraces, in close proximity to the 'Graben of Petrotá' (Efstratiou and Ammerman 1996; see Fig. 4.1 for location). The latter is an impressive outcrop of silicified rock of volcanic origin, which was exploited as a source of raw material throughout different periods, including the Neolithic and modern times (*ibid.*). On the basis of techno-morphological characteristics, the lithic material from both findspots has been attributed to the Middle Palaeolithic, and it includes also a small biface with a thick base and a thinned tip (Ammerman *et al.* 1999). At the same location of the biface, a collection of quartzite artefacts allowed the researchers to assume that the site may represent also cultural phases earlier than the Middle Palaeolithic, noting that "at any rate the combined presence of core tools (choppers and chopping tools) and of quartzite flakes indicates that this collection may include earlier material as well as material of

Middle Palaeolithic date as suggested by the other artefacts" (*ibid.*, 214). Noteworthy, it is also stressed that the valley in which the findspots are located would have hosted small lakes and swamps with freshwater resources, whereas the nearby 'Graben of Petrotá' would have offered itself as a readily accessible source of raw material for the production of lithic implements (Efstratiou and Ammerman 1996).

Evidently, the province of Thrace and Eastern Macedonia still lacks solid evidence for a Lower Palaeolithic human presence, but the results from the first systematic exploration of the region can already be seen as promising indications for future research.

4.3.2 Macedonia

In 1963, a handaxe was discovered by a local villager in a locality close to Palaeokastro in Western Macedonia, and was later delivered to E. Higgs who was by that time surveying Epirus and Macedonia with a team from Cambridge (Higgs 1964; Dakaris *et al.* 1964). The artefact (Fig. 4.4) is an elongated amygdaloid biface (length: 15.3 cm; width: 9.6 cm; thickness: 3.1 cm; platform thickness 3.4 cm; all measurements taken by the author according to the criteria of Debénath and Dibble 1994). It has a green colour and Higgs reports that it is made from trachyte (1964, 54); the raw material is certainly a volcanic rock, but probably a type of peridotite (P. Karkanis, pers. comm. while inspecting the specimen in 2005), perhaps dunite, which is the type of rock outcropping at the locality (as indicated also in the geological map of the area).

In this locality, high-level fluvial gravels have been deposited about 60-90 m above the present valley floor, and Higgs suggested that the artefact may have been derived from these gravels (in Dakaris *et al.* 1964). Indeed, the base of the artefact has been left unworked, thereby retaining the cortex, and a careful inspection with a magnifier reveals clear signs of the type of battering that is characteristic of fluvial transport. In 2005, I visited the location that is reported as the findspot of the handaxe, as part of the team of the Aliakmonas Survey Project (see 5.2 below). We were able to confirm the presence of extensive outcrops of the volcanic rock that was used as raw material for the handaxe, but it was not possible to make any as-

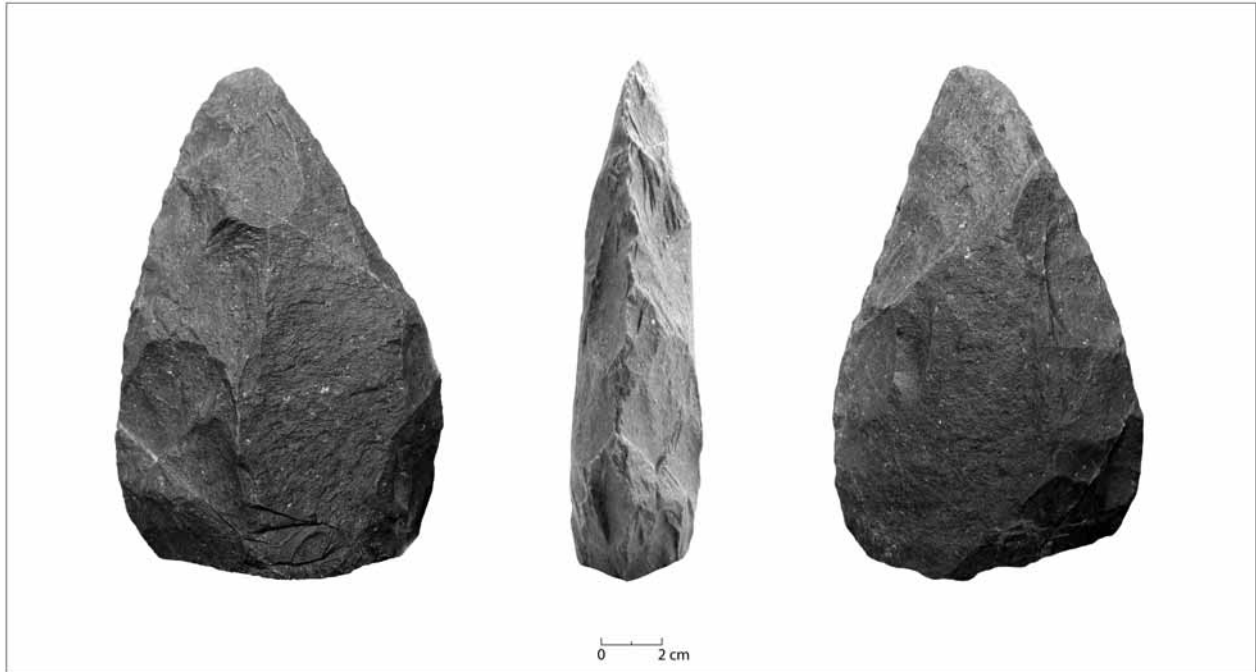


Fig. 4.4 The handaxe from Palaeokastro

assessment regarding its provenance. Consequently, the handaxe remains essentially a 'stray find'.

Higgs did not present any arguments in support to an attribution of the artefact to the Lower Palaeolithic period, nor did he explain the assumption that it derives from the fluvial gravels. Apparently, the very same fact that it is a handaxe (and in fact the first one ever found in Greece) was considered self-explanatory for its presumed Lower Palaeolithic age. Since then, the existence of this specimen has been cited in the literature as (a more or less solid) evidence for a human presence in Greece since the Lower Palaeolithic. The specimen is indeed a typical Acheulean handaxe, but it is an isolated, surface find without sufficient data concerning its provenance, hence lacking a contextual framework that would potentially allow for a chronological bracketing. Therefore, it should be regarded as an *indication* for a human presence during the Lower Palaeolithic, rather than as sound evidence.

Other lithic artefacts of probable Lower Palaeolithic age from Western Macedonia have been collected from several localities on the terraces of the Aliakmon River, but the material discovered so far is too

few to substantiate claims on the existence of Lower Palaeolithic sites or even lithic 'industries' (Darlás 1994)¹⁴. The largest collection was discovered near Siatista (*i.e.* close to Palaeokastro; Fig. 4.1), it was found on the middle terrace of the river and comprises of tools made on flakes, denticulates and notched pieces (*ibid.*, 310). All the same, the material is again undated and any attribution to the Lower Palaeolithic should be considered as only suggestive, if not tenuous.

Finally, mention should be made of the recent discoveries from a regional survey in the area of Langedas, close to Thessaloniki (Andreou and Kotsakis 1994). At the locality of Doumbia (see location in Fig. 4.1), lithic implements made on locally-available milky quartz were found associated with a Pleistocene alluvial fan; the material belongs essentially to a core-and-flake industry, with choppers, chopping tools, denticulates and notched pieces, and the techno-morphological characteristics of the artefacts are

14. The account presented here excludes the material found during the 'Aliakmon Lower Palaeolithic Survey Project', which is discussed separately in section 5.2.

considered to allow comparisons with those from Rodia (Thessaly) and Yarimbuzguz (Turkey) (C. Runnels, pers. comm. 2007). The researchers note that this is a surface collection and the mixing of artefacts from different periods cannot be excluded; moreover, in attributing the artefacts to a cultural period, they prefer to use the term Early Palaeolithic to describe specimens/assemblages such as that from Doumbia, which could be classified under the conventional term of 'Lower Palaeolithic', or alternatively could be seen as a different and/or early facies of the regional Middle Palaeolithic technological tradition (Runnels, pers. comm. 2007).

Notably, the sub-basin of Doumbia, where the site is located, belongs to the wider basin-complex of Pro-Mygdonia, which was filled with fluvio-terrestrial and lacustrine sediments during the early Pleistocene and was later broken-up to smaller basins (Mygdonia, Zagliveri, Marathousa, Doumbia) due to tectonic activity at the end of the early Pleistocene. The largest of all, the Mygdonia basin, hosted a lake that was gradually drained during the middle-late Pleistocene, and the remnants of this palaeo-lake are present today as the lakes of Langadas and Volvi (Koufos *et al.* 1995). Several mammalian localities have been found in the wider Mygdonia basin, including the late Villafranchian site of Apollonia 1 (*ibid.*). The fauna discovered in the latter site includes remains of the saber-tooth *Megantereon whitei* (Martínez-Navarro and Palmqvist 1996). This is an African taxon that dispersed into Europe at around the Pliocene-Pleistocene boundary, and it is also found in Dmanisi (Georgia) and Venta Micena (Orce, Spain; *ibid.*). *M. whitei* is found together with some species of ungulates, together forming an assemblage that marks a faunal turnover at the end of the Villafranchian (*e.g.* Kostopoulos *et al.* 2007) and is considered to be possibly related to the first arrival of hominins in Europe (Martínez-Navarro and Palmqvist 1996). Particularly, *Megantereon* is a hypercarnivorous felid that would have generated large amounts of carrion available for scavenging, a fact that is thought to have facilitated the earliest (attempts of) dispersals of hominins into Eurasia during the Earlier Pleistocene (*ibid.*). Thus, on the basis of the documented co-presence of *M. whitei* with hominin remains (*e.g.* Dmanisi), as well as the location of Mygdonia near the Bosphorus Strait, *i.e.* at the presumed dispersal route of both

early hominins and *M. whitei* (and at a similar latitude with Dmanisi), the researchers note that it would not be surprising to find in the near future hominin remains in one of the localities of the Mygdonia basin (*ibid.*). Such remains are yet to be found, and the artefacts from Doumbia may indeed be pointing to that direction.

4.4 IONIAN ISLANDS

From a geotectonic perspective, the Ionian Islands belong to the Ionian isopic zone, which mainly covers the part of Epirus west of the Pindos Front (see below 6.3), and to the Pre-Apulian zone, which is part of the Apulian platform of Italy (Higgins and Higgins 1996). Similarly to this geotectonic division, the islands on one hand share common geological, geomorphological and climatic characteristics with Western Greece, and on the other hand present cultural features that connect them with both the Greek coastal areas to the east and those of the Italian and Dalmatian coasts to the west. A mountainous landscape predominates mainly in the western parts, whilst a more subdued relief in the eastern parts emphasizes the sense of continuity with the adjacent mainland: Kerkira is practically the geomorphological continuation of Epirus; Lefkada and Ithaki relate to Acarnania, whereas Kephallonia and Zakynthos (mostly their south-eastern areas) are associated with north-western Peloponnesus (Kourtesi-Philippakis 1999). Thus, as it is also the case with western Greece, limestone predominates in the geological substratum, karstic landforms are abundant and the climate is meso-Mediterranean, presenting the highest rainfall values in Greece. Furthermore, the islands are situated between the westernmost part of the Hellenic subduction zone and the continental collision zone: a seismotectonically active area that is subjected to rapid and intense crustal deformation, which is in turn expressed in the islands (except Kerkira) experiencing the highest seismic activity in Europe (Lagios *et al.* 2007; see also 6.3 and references therein).

Already from the 1960's, it has been demonstrated that humans were present on the Ionian Islands during the Middle and Upper Palaeolithic periods (Sordinas 1969, 1970; Kavvadias 1984; Kourtesi-Philippakis 1999; Dousougli 1999). The bulk of the

evidence comes in the form of lithic surface finds, recovered from open-air sites in various depositional settings, such as coastal plains, karst plateaus, alluvial fans and marine terraces. Noteworthy is the discovery of artefacts associated with *terra rossa* deposits that fill karst depressions, much like the ones which dot the landscape of neighbouring Epirus (Sordinas 1970; Dousougli 1999; see also 4.5 below). Some of the artefacts attributed to the Middle Palaeolithic (most notably from Kerkyra, Kephallonia and Zakynthos) have been considered to display affinities with the Pontinian industries of Italy, or with material from the Balkans, and also with industries discovered in Elis (north-western Peloponnesus) or Preveza (south-west Epirus) (Kourtesi-Philippakis 1999; Runnels and van Andel 2003).

4.4.1 Nea Skala, Kephallonia

In 1974, A. Cubuk discovered flint artefacts at a site located in the south-eastern extremity of Kephallonia, *ca.* 1.5 km north of Nea Skala. The artefacts (Fig. 4.5) were collected from the surface of two marine terrace-remnants that are cut into a limestone hill at 85 and 75 m a.s.l. respectively, whilst a third, lower terrace occurs at 20 m a.s.l. and yielded artefacts attributed to the Middle Palaeolithic (Cubuk 1976). Eighteen of the forty-one specimens collected from the highest terrace show clear signs of rolling, whilst all of those from the lower one ($N=44$) were recovered in a fresh condition (*ibid.*). In both assemblages, flakes and chopping-tools predominate, followed by choppers made on flakes, and cores (*ibid.*). In both terrace-remnants, the deposits are described as consisting of loose and well-rolled limestone and flint gravels (*ibid.*: 176).

The fact that rolled artefacts occur only in the higher terrace is taken by Cubuk as an indication that the two terraces were formed in different phases; nevertheless, in lack of any other chronostratigraphic indications (*e.g.* from mollusc or other faunal remains), the researcher notes that it is impossible to place the terraces in a chronological sequence according to their elevations alone (Cubuk 1976, 177). The overall compressional regime and the associated uplift affecting the region (see also 6.3 below), as well as the presence of the Ionian thrust fault a few kilometers to the north-west of the area, makes it reasonable to at-

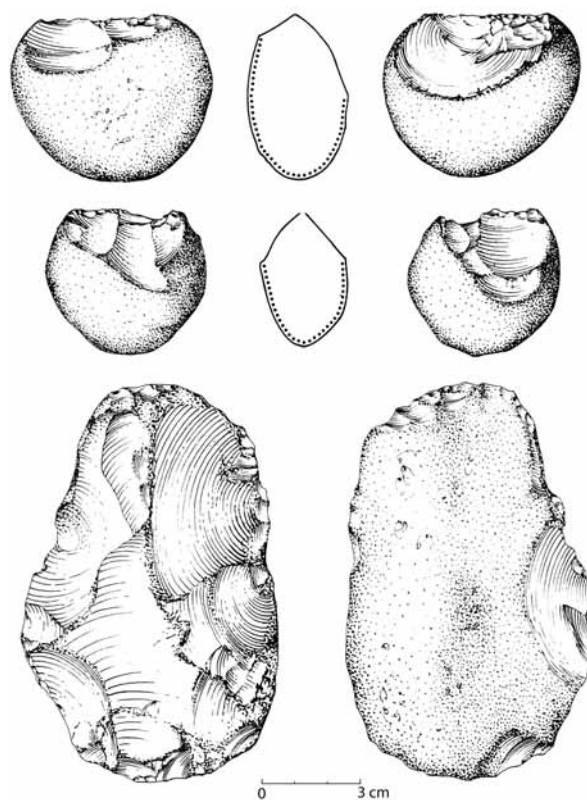


Fig. 4.5 Artefacts from Nea Skala, higher terrace. Redrawn after Cubuk 1976: fig. 4

tribute the formation of these terraces to eustatic sea-level variations resulting in episodes of marine transgressions during sea-level highstands, which were later fossilized and preserved due to uplift. Yet, even if a long-term, largely continuous uplift could securely be assumed, it would not be feasible to attempt any correlation with (dated) raised Quaternary marine terraces preserved elsewhere in Greece, on the basis of their altitudinal occurrence alone and without further study of other morphotectonic indications. For example, in the marine terrace staircase preserved in the southern side of the Corinth Gulf, a terrace correlated with MIS 5 occurs in one locality at 35 m and some 40 kilometers away it is found between 150-169 m asl, due to the effects of differential uplift rates (Keraudren and Sorel 1987, 101).

Cubuk attempted some gross comparisons of the artefacts with similar material ('pebble tools') from Latakia (Syria) and from the eastern coasts of Italy (Cu-

buk 1976, 177). On the basis of the morphology of the artefacts and the altitude of the terraces, he suggested that the latter are likely to be correlative to the ‘Milazzo terraces’ (ibid, 176). As stated previously, comparisons based on altitudinal similarities should be deemed inadequate for a chronological estimation; in any case, it is now known that the marine terraces at Milazzo (north-eastern Sicily) are to be attributed to the sea-level high-stand of MIS 5.5 (e.g. see Antonioli *et al.* 2006). All things considered, if the terraces at Nea Skala remain undated, that is even more true for the artefacts that were found lying upon them: their attribution to the Lower Palaeolithic on the basis of the terrace-heights and the high frequency of pebble tools should be regarded tenuous until their context is better studied and dated.

4.4.2 Korissia, Kerkyra

A chopper was found by two geologists, stratified in clay deposits near the lagoon of Korissia, in south-west Kerkyra. The stratigraphy has been described as following (Kourtesi-Philippakis 1999, 283): Middle Pliocene marls and sandstone are overlain by layers of algae-bearing calcarenites, including gastropods and bivalves that indicate a Quaternary age. Above the latter, there are sandy layers with intercalations of lignite, overlain by a five-meters-thick deposit of grey clays containing *Cardium* and *Cerithium*; the chopper was recovered from these clays. Palaeomagnetic measurements of the clays yielded a normal magnetic polarity, which the researchers attributed to the Brunhes epoch (ibid). As this is the only age-estimate obtained for the deposits, the artifact could date anywhere within the period of the Brunhes: it is therefore not possible at yet to securely attribute the specimen to the Lower Palaeolithic on chronostratigraphic grounds. If the specimen was lying in a primary position, its place in the local stratigraphic sequence indicates a Middle Pleistocene age (cf. Darlas *et al.* 2007). However, a recent revisit at the chopper’s findspot raised some doubts about the *in situ* character of the implement (Darlas *et al.* 2007). Erosional products of loose material, including lithic artefacts, derive from a vertical cliff that is formed above the coastline, and these end up to the level from which the chopper was retrieved (ibid, 29); as the chopper-bearing layer displays numerous cracks due to the swelling of the clays (P. Karkanias, pers.

comm. 2010), it is probable that the artifact derives from younger, overlying strata and was later engulfed in the clays (Darlas *et al.* 2007, 29).

4.5 EPIRUS

4.5.1 Introduction

The rockshelter of Asprochaliko, the cave of Kastritsa and the open-air site of Kokkinopilos are the principal sites that provided for the first time a relatively solid framework for a stratified Palaeolithic sequence in Greece (Bailey *et al.* 1992; see App. I: 34 for locations of sites). Since its discovery by Eric Higgs in the 1960’s, Kokkinopilos has yielded more than 10,000 lithic specimens made on a local variety of bluish-grey, relatively fine-grained nodular flint, which permitted the manufacturing of artefacts that are “in quantity, quality of workmanship and preservation unique” (Higgs 1963, 2). Apart from a small Upper Palaeolithic component, the bulk of the Kokkinopilos material was initially described as ‘Levallois-Mousterian’ with bifacial leafpoints and a preponderance of racloirs (Higgs and Mellars in Dakaris *et al.* 1964); later, it was made clear that the collected pieces should not be considered as representing one single Mousterian industry, but rather a mixture of artefacts from different localities within the site, reflecting a high degree of technological and typological variability, to the point that “Kokkinopilos is better viewed as a sort of two-dimensional Combe-Grenal” (Papakonstantinou and Vassilopoulou 1997, 466; Papagianni 2000). Mellars included a few ‘Clactonian’ and chopper-like cores among the unclassified pieces (Dakaris *et al.* 1964, 235) and Higgs mentioned already in 1963 a broken tip from a handaxe, but in neither case was any remark expressed for a possible presence of material earlier than the Mousterian. Such a claim was first put forth in 1993 by Runnels and van Andel in their publication of their work at Kokkinopilos and the discovery of a ‘Micoquian’ handaxe. However, in contrast to earlier studies of lithic assemblages from Kokkinopilos and other redbed sites of Epirus, in which typological assessments predominated (Papagianni 2000), the attribution of this handaxe to the Lower Palaeolithic was in this case based on stratigraphic grounds (Runnels and van Andel 1993a).

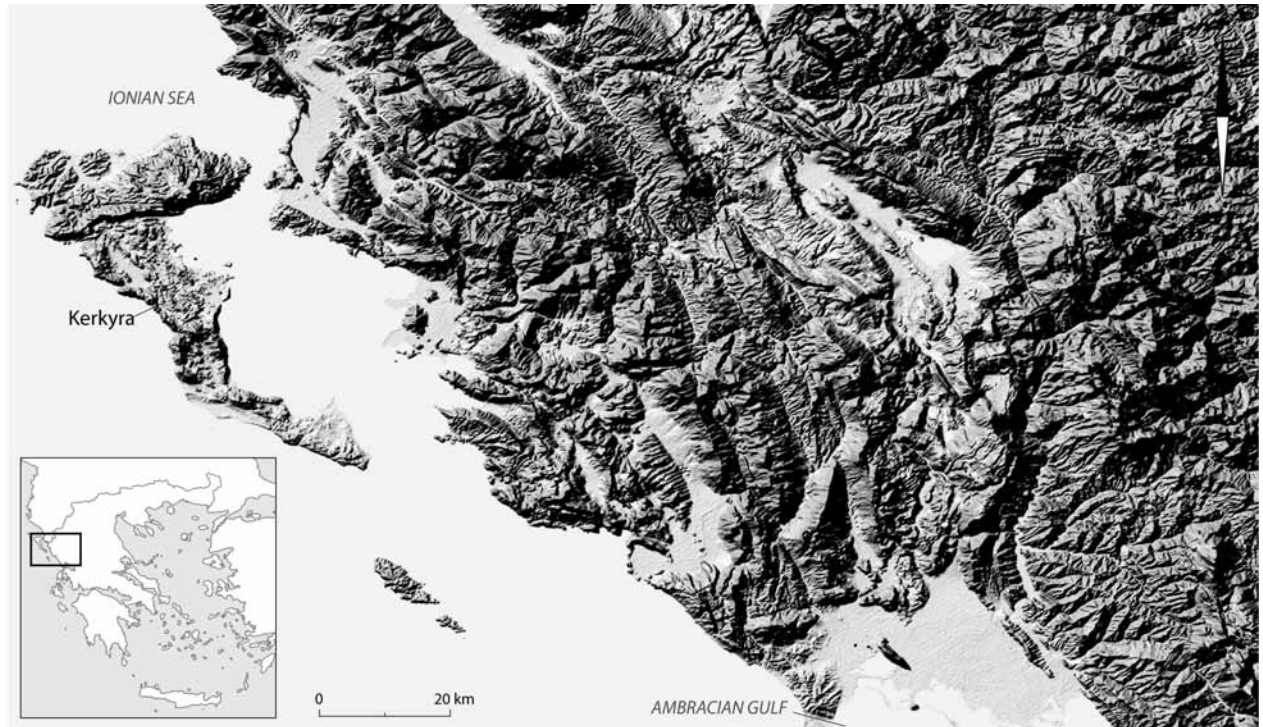


Fig. 4.6 Relief map of Epirus, based on data from Shuttle Radar Topography Mission (SRTM), version 2, available at <http://www2.jpl.nasa.gov/srtm>

Epirus not only possesses the largest Palaeolithic database but has also yielded the largest sample of artefacts with a bifacial technology, which is so far rare in the eastern part of Greece and overall scanty in the Balkan Peninsula (*cf.* Runnels 2003b). Any alleged affinities of these few handaxes to an ‘Acheulean technocomplex’ seem probable, but without a solid chronostratigraphic framework such inferences remain intuitive and highly tenuous. As with the case of Alonaki examined below, until further evidence comes to light, the possibility that such ‘primitive-looking’ material is part of an early Mousterian continuum, remains open. Interpretations based on typotechnological criteria are further hampered by the fact that sites like Kokkinopilos undoubtedly represent a significant focus of occupation and/or exploitation during repeated visits of human groups over time-periods that range from the (Lower?) Palaeolithic up to the Roman times; therefore, a palimpsest character of the record is expectable, and the only means to unravel the emerging complexity is by investigating the existing as well as potential inter- and intra-site stratigraphic associations. Kokkinopilos

has suffered much from erosion, but being a relatively large open-air site, it still affords the potential of separating distinct ‘occupation events’ in both a vertical and a horizontal axis. Obviously, this requires that the stratigraphic integrity of the site is *not* overall questionable. It is mainly on this issue that the results from the recent research carried out by the author are hoped to shed some light.

4.5.2 Geology, geomorphology and geoarchaeology of Epirus

In contrast to the smoothly undulating, riverine landscape of Thessaly, Epirus is characterized by a complex topography and a rugged relief (Fig. 4.6). This is a land of steep mountains, many streams but few rivers, narrow valleys, coastal plains and lagoons, and it presents the highest precipitation values in Greece. In the northern and eastern parts, the mountain range of Pindus, the ‘backbone’ of mainland Greece, defines the region’s boundaries and exemplifies the high-relief face of Epirus, where peaks up to 2600 m alternate with deeply incised river gorges. To

the west of the Pindus Front Range, the western and southern parts of the region are bounded by the Ionian Sea and the Ambracian Gulf. Here lies a karst landscape of carbonate platforms and flysch basins, separated by high and narrow limestone ridges, whilst the terrain becomes more subdued towards the coastal zone in the west and the south, especially in areas where river deltas are formed (*cf.* App. I: 35). This topographically diverse landscape with a plethora of alternating micro-environments served as a refugium area for trees, protecting them from the effects of Quaternary climate changes, and it is still considered a 'hot spot' of endemism for plants and animals (Tzedakis *et al.* 2002b).

Overall, the plateau-ridge system with Late Neogene to Pleistocene intramontane basins can be understood in terms of an intense tectonic history (see section 6.3), particularly since Epirus is situated at the point where three tectonic plates meet, making it one of the most active regions in Eurasia (Bailey *et al.* 1993). As a result of plate convergence between the Apulian plate and the Aegean plate, north-western Greece has been subjected to east-west shortening, which is manifested by a predominantly compressional regime, especially to the west of the Pindus thrust belt zone (Doutsos *et al.* 1987); notably, compression still continues today (Higgins and Higgins 1996). Regional uplift associated with compression contributed significantly to the high topographic relief, and, whilst most researchers emphasize thrusting and folding, producing both anticlines and synclines, others stress also the influence of strike-slip faulting and the role of Plio-Pleistocene extensional tectonics (King *et al.* 1993; Doutsos and Kokkalas 2001; van Hinsbergen *et al.* 2006). Whereas most of mainland Epirus has been undergoing uplift at least since the Pliocene, there is evidence to suggest that some areas, such as the Ambracian Gulf, the lower Acheron valley, the valley of river Thyamis and much of the coastal zone, are either subsiding or static, thereby preserving thick deposits of Quaternary sediments (King and Bailey 1985; Besonen *et al.* 2003, 208).

Bailey and coworkers argued that widespread deformation associated with intense uplift (and subsidence) would have had a substantial impact on Palaeolithic landscapes of Epirus, affecting resource availability and use, but Runnels and van Andel

(2003) challenged the high values for uplift and subsidence rates proposed by Bailey and his team (King and Bailey 1985; Bailey *et al.* 1993). Nonetheless, the latter researchers convincingly show how tectonic activity may have had aspects that were advantageous for hunter-gatherer economy: geological structures created by normal faulting or compressional folding can serve as sedimentary traps, which are able to maintain stable environmental conditions for plant and animal communities by acquiring a degree of insensitivity to changes of climate and land use (Bailey *et al.* 1993). For example, areas upstream from an uplift zone can be subject to ponding by the damming effects of tectonic vertical motion; ponding may in turn be preserved throughout the course of climatic changes and attain the character of a persistent and/or recurrent feature in the landscape, thereby attracting animals and humans. This was postulated to explain persistence of human presence in the cave of Asprochaliko and the open-air site of Kokkinopilos (King and Bailey 1985, 280). In addition, tectonic structures and their topographic expressions, such as limestone ridges produced by faults, can form topographic closures and barriers dictating animal movements; the latter can then be predicted and monitored by humans, and this is thought to be reflected in the patterned relationship of Palaeolithic rockshelters (Asprochaliko, Klithi, Kastritsa) with regional features of points of entry/exit for animal herds (Bailey *et al.* 1993, 304). Although not so much in connection to tectonics, the role of a closed topography (providing also diverse resources over short distances) was noted by Higgs' team as well, with regard to the location of Kokkinopilos (Dakaris *et al.* 1964, 213).

Runnels and van Andel (2003) recognize the importance of tectonism in the configuration of the Epirote landscape as regards both preservation factors in depositional settings and the creation of landscape attributes that would be attractive to early humans, but their contribution to the discussion comes with their investigation of the role of karst features. Limestone and flysch are the dominant substrate types of the region and, whereas limestone plateaus are relatively undisturbed today, the flysch basins are tectonically very active (Bailey *et al.* 1993). Flysch is very susceptible to erosion and prone to form heavily gullied badlands, and this may be seen as explaining the gen-

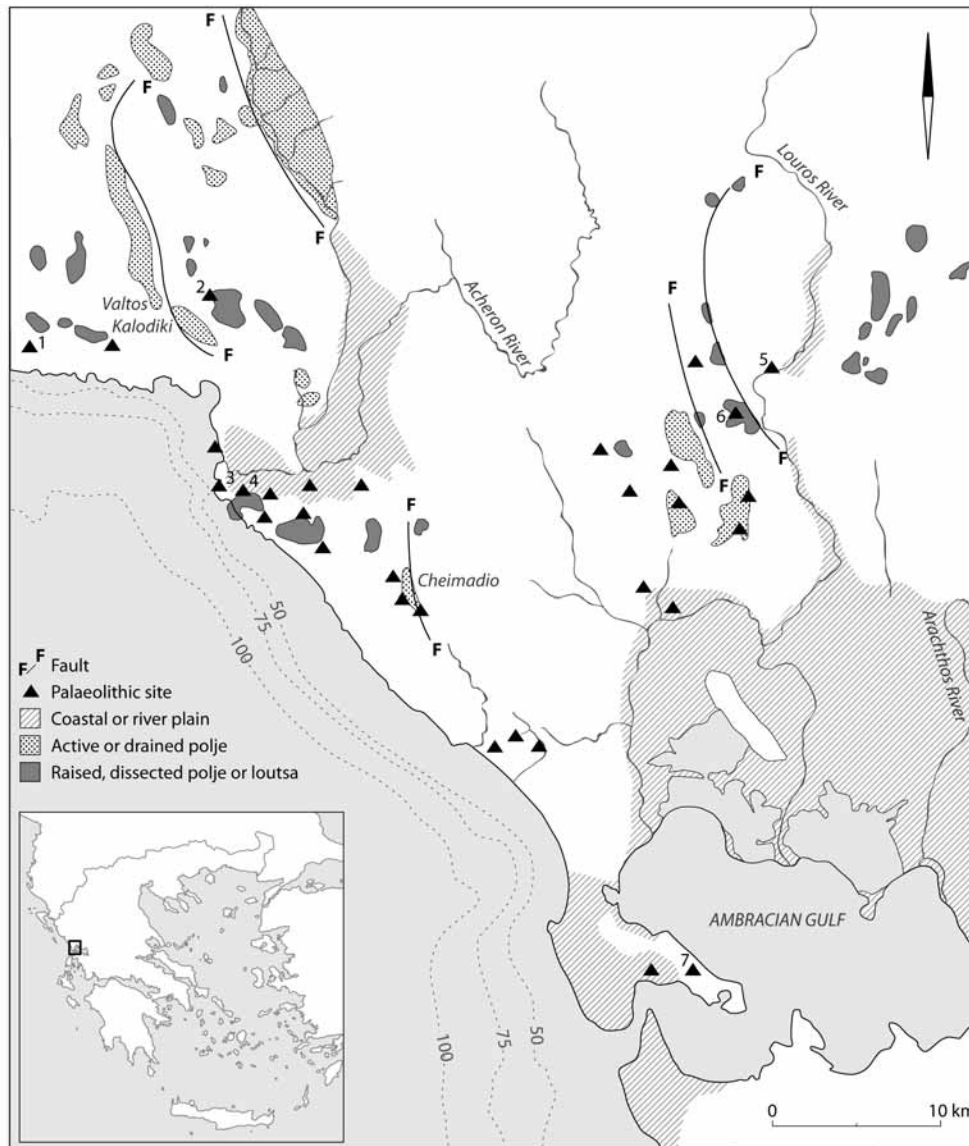


Fig. 4.7 Map of south-western Epirus showing the association of Palaeolithic sites with poljes and 'loutsas'. Numbered sites (mentioned in text): 1) Ayia 2) Morphi 3) Ormos Odysseos 4) Alonaki 5) Asprochaliko 6) Kokkinopilos 7) Ayios Thomas. Modified after Runnels and van Andel 2003: fig. 3.8 and van Andel and Runnels 2005: fig. 7

eral absence of Palaeolithic finds from the flysch basins (*ibid*; but see Efstratiou *et al.* 2006 for the presence of Middle Palaeolithic sites in the flysch landscapes of the Grevena uplands in Macedonia). On the other hand, land surfaces shaped by the dissolution of limestone, namely karst landforms, are not deformed by horizontal concentrated flow of surface water; rather, the water here drains mostly downwards through cracks and fissures into subterranean conduits. Thus, it is mainly the action of water and

tectonic activity, which form those conspicuous landscape features of Epirus, the karst depressions, with which most Palaeolithic sites of Epirus are associated (Fig. 4.7). *Poljes* are enclosed, often fault-bounded, flat-floored basins surrounded by hills with rather steep slopes; they are drained by sinkholes in the floor rather than by rivers or streams, and because drainage is inadequate, they are usually flooded in winter but can be dry in the summer, namely hosting either permanent or seasonal lakes. In contrast to the



Fig. 4.8 Oblique aerial view showing the wider area of Kokkinopilos. Lines denote major faults. The river Louros runs parallel to the road visible as a white line to the right of the picture

tectonic origin of the poljes, *loutsas* (singular: *loutsa*) are small and shallow solution basins fed by winter and spring runoff.

4.5.3 Previous research and interpretations¹⁵

With a few exceptions, most of the open-air Palaeolithic sites in north-west Greece are associated with red sediments, the so-called ‘redbeds’ of Epirus, and E. Higgs was one of the first to recognize this association (Dakaris *et al.* 1964; Higgs and Vita-Finzi 1966). Since the 1960’s, there has been a long-lasting debate over the chronological and depositional relationship between artefacts and sediments at all red-bed sites of Epirus. The key points of this discussion refer to the origin of the red sediments, their depositional context and the processes involved in their accumulation, as well as the time-span represented by the deposits. Obviously, possible answers to those

geological questions will dictate the resolution of the main archaeological inquiries, of which the most important regards the chronological relationship between the lithic artefacts and the red sediments, and if there is any potential for recovering artefacts from geologically undisturbed contexts; or, alternatively, whether erosion and redeposition have resulted in the mixing of the deposits (and hence of artefacts as well) in all the sites (*cf.* Papagianni 2000). Because Kokkinopilos has acquired a central role in this discussion, and interpretations based on geoarchaeological work at this site have been extended to all other open-air ‘redbed sites’ in Epirus (*ibid.* 29), the models developed to answer the above questions will be examined in conjunction with the investigations at Kokkinopilos.

Kokkinopilos is situated at *ca.* 120-150 m asl in a valley to the west of the Louros river, from which it is separated by a limestone ridge that runs parallel to a fault (Fig. 4.8). The deposits of the site consist of *ca.* 30-40 m-thick consolidated clayey silts and silty clays of uniform lithology, they cover about 1 km² and are currently being rapidly eroded in an extensive network of gullies, which altogether make up

15. Research in Epirus is extensively reviewed by Papagianni (2000) and Runnels and van Andel (2003). The limited space available here allows only for a synoptic consideration of this discussion.

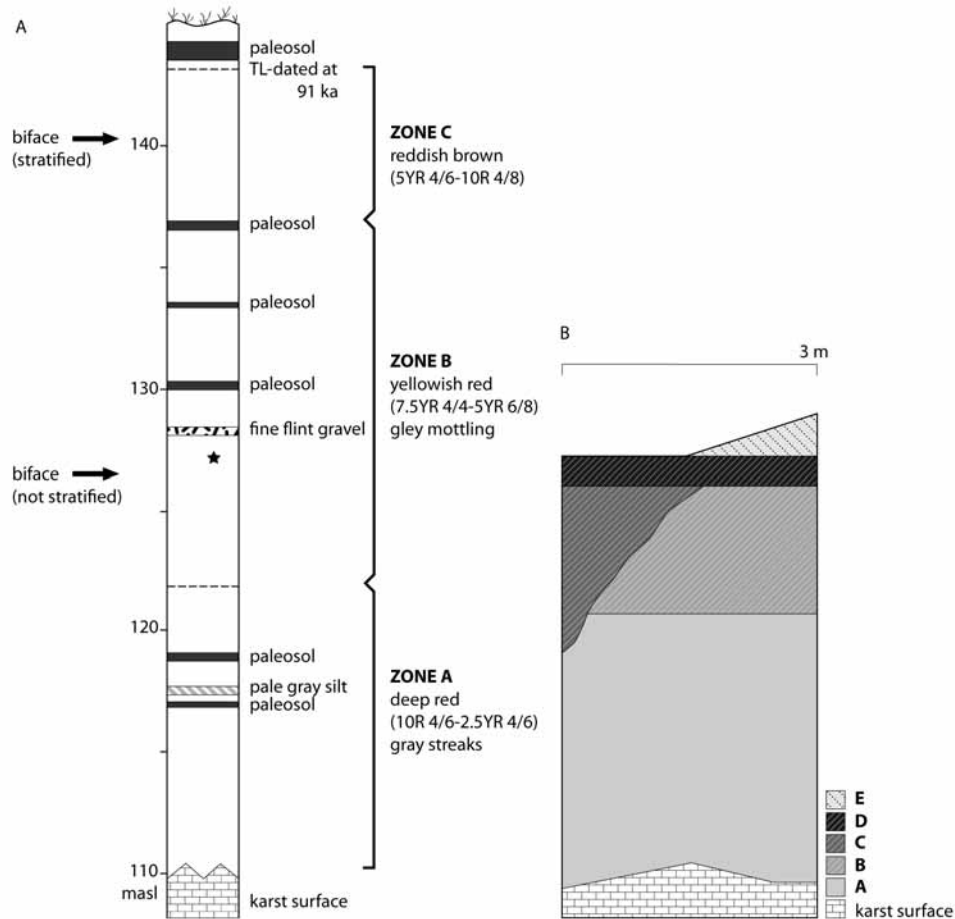


Fig. 4.9 Schematic cross sections of Kokkinopilos: A) modified after Runnels and van Andel 2003: fig. 3.17; this is the zonation adopted in this study; the stratigraphic positions of the two bifaces that I discovered (see text) are indicated, whilst the asterisk marks the position of the handaxe found by Runnels and van Andel (1993a). B) cross section after Bailey *et al.* 1992: fig. 4

the appearance of a badland landscape (App. I: 1, 2). As discussed below, the site is part of a fault-bounded depression, a polje which, in its later stage of evolution, was uplifted and in turn dissected by headward stream incision. The instability of the land surface is reflected in the scarcity of vegetation, which is restricted to only a few thickets where soil has been retained, whilst the degree of erosion can be apprehended in the undercutting and exposure of the root systems (Harris and Vita-Finzi 1968; App. I: 3). In Roman times, tunnels were dug through the deposits to conduct water from the Louros river to the city of Nikopolis, and the towers of the ventilation shafts of the aqueduct are still partly in place. Locally, the bases of the shafts lie ten or more meters above the floors of the gullies, and this has been con-

sidered as an indication that the dramatic erosion seen today is of post-Roman age (Dakaris *et al.* 1964, 213). However, at another location in the western part, a tunnel emerges at the foot of a gully, suggesting that erosion may have been initiated before Roman times (Harris and Vita-Finzi 1968, 539). By studying the profile of the Louros river, King and Bailey (1985) suggested that the transition from deposition to downcutting in this part of the river's course must have occurred after Upper Palaeolithic times and before the Bronze Age. Artefacts most probably dating to the Bronze Age are being found on and occasionally inside the 'topsoil' (see below), indicating that this was a relatively intact surface up to that period. Even if erosion was affecting the site already during Palaeolithic times, all researchers

agree that the dramatic erosion creating this badland-landscape should be post-Roman, and probably was accelerated even much later, namely after the 1950's, as suggested by different lines of evidence (Harris and Vita-Finzi 1968, 541; Bailey *et al.* 1992, 143).

The original division of the stratigraphy into three main zones (Fig. 4.9), A, B and C from bottom to top is mainly based on colour differences (Dakaris *et al.* 1964). It has been retained in all subsequent studies and it is described in detail by Tippet (ibid, 221-225) and Runnels and van Andel (1993a; 2003). Zone A rests on the limestone bedrock and is uniformly deep red (2.5YR 4/6) with few grey veins and streaks; no artefacts have been found in this zone. Zone B is more yellowish red (7.5YR 4/4 to 5YR 6/8), displaying abundant grey veins and mottled bands, whilst zone C has a reddish-brown colour (5YR 4/6 to 10R 4/8) and is marked by grey stripes similar to those of zone B, albeit usually thinner (App. I: 4). A fourth 'layer D' of dark red colour was identified overlying zone C but it was left unnamed by Tippet (and largely ignored); later, Bailey *et al.* (1992) described it as a *soil* locally overlying either zone B or zone C (but see below). A fifth layer, reported by Bailey *et al.* as a slopewash deposit 'E' (ibid; Fig. 4.9), is not mentioned by Runnels and van Andel (1993a; 2003), and I was not able to confirm its existence. Black manganiferous bands marking the boundaries between zones A – B, and B – C, are thought to indicate interruptions of the sedimentation by erosional periods of unknown duration, but as Tippet notes, "despite these breaks, and the differences of color, [...] this is essentially a single deposit" (Dakaris *et al.* 1964, 225).

Originally, Higgs and colleagues (in Dakaris *et al.* 1964) suggested an aeolian origin for the sediments, the deposition of which was thought to have occurred between two cold spells of the 'Last Glaciation'. Later on, they postulated an alluvial origin, reporting that "water-laid gravels were found intercalated with the 'red earth' deposits", and explaining the apparent lack of bedding by invoking the effects of physical/chemical post-depositional processes that have erased the traces of the original stratification (Higgs and Vita-Finzi 1966, 3-4). In this new appraisal, part of the sequence was considered to have been formed "before the Mousterian occupation", whilst "the

Upper Palaeolithic occupation came towards the end of the Red Bed deposition" (ibid, 5-6).

Most of the surface finds were collected from the erosion gullies and were described as heavily patinated -but in sharp condition- 'Mousterian pieces', whilst an industry of unpatinated, smaller artefacts was found "*in situ* in a gully side" and was ascribed to the Upper Palaeolithic; a few Bronze Age artefacts were (and are still being) found always on the modern surface (Higgs 1963; Dakaris *et al.* 1964, 215). Already in his first, preliminary report, Higgs notes the presence of 'chipping floors' that "lie in thin horizons some four inches in thickness" (1963, 2). Such chipping floors were identified in thirteen locations, where "the artefacts could be seen *in situ* in the gully sides" (Dakaris *et al.* 1964, 215). Test trenches were opened in two of these locations (Sites α and β) but they were never put on a map and there is some confusion with regard to their precise positions and the number of the associated lithic material (due to curation problems; see Papagianni 2000, 70-77). At Site β , the excavation cut through deposits of zone B and into zone A, while most of the recovered artefacts (collectively described as Mousterian) were found at the base of zone B, immediately above the junction with zone A; Higgs reports that "some 800 artefacts were found *in situ*" in this trench, all from zone B (Dakaris *et al.* 1964, 215). The trench of Site α was cut in the place where the 'Upper Palaeolithic material' was identified in 1962 *in situ* in a gully side. A concentration of *ca.* 500 lithic tools and debris was found at 3.5 m below the surface at the base of zone C, where the artefacts "appeared to follow the line of an old erosion gully cut into zone B and subsequently filled by the zone C deposit" (ibid, 217). In the next publication, Higgs noted that this is "either a chipping floor *in situ* in an ancient gully or (as there has been no sorting of the flints) one which has not traveled very far" (Higgs and Vita-Finzi 1966, 5). Overall, the results from the two excavated sites led Higgs to conclude that

"after a basal breccia a red clay [*i.e.* zone A] had been deposited. Deposition had ceased and a minor erosion had taken place. After this erosion a very similar yellowish-red clay had been deposited and at the beginning of its deposition there had occurred a Middle Palaeolithic occupa-

tion. This deposition had continued until the layer was 12-20 feet [*i.e.* 3.7-6.1 m] in depth. At this point a cessation of deposition had occurred and a blade industry had occupied the eroding surface. Subsequently Zone C, a reddish-brown clay had been laid down to a depth of some 11 feet [*i.e.* 3.4 m] above the blade industry which included, at 2 feet from the surface, a band of angular stones” (Dakaris *et al.* 1964, 217-219).

After the death of E. Higgs, research resumed in Epirus with another team from Cambridge under the direction of G. Bailey. King and Bailey (1985) accepted the model for an alluvial origin of the sediments, but they suggested that the Kokkinopilos redbeds were deposited by the Louros river itself, which, in this scenario, would be flowing at a higher level than today. As the redbeds occur today at *ca.* 50-100 m above the river level, considering them as part of the valley fill would imply that the cave of Asprochaliko (which is now 20 m above the river) was buried by the same fill at a time when it was inhabited. To explain this contradiction, King and Bailey (*ibid*) proposed that the high level of the deposits is a result of local tectonic uplift. Papagianni (2000, 30) notes that this scenario was later criticized by the same team (D. Sturdy cited as ‘pers. comm.’ in Papagianni 2000), because of the high values of localized uplift that would have been required to lift Kokkinopilos 50-60 m higher than Asprochaliko within the last 40,000 years. Later, Bailey and colleagues abandoned the ‘alluvial hypothesis’, suggesting colluvial deposition of the redbeds, which were viewed now as “chemical or biochemical byproducts of limestone degradation” deposited “in a shallow, seasonal lake or marsh”, or “by heavy seasonal rainstorms as the shallow distal edge of a fan” (Bailey *et al.* 1992, 142). Yet, the most important aspect of this latter re-assessment regarded the *dating* of the redbed formation: rather than the time-frame of the Last Glacial invoked earlier, Bailey *et al.* advocated that the sediments of Kokkinopilos “are at least of Middle Pleistocene date and may be very much older” (*ibid*, 140). They regarded zone B as pedogenically altered zone A, and the occasional small lenses of fine gravel in zone C as “gully fill deposits representing reworking of the main clays by seasonal streams” (*ibid*). Additionally, Bailey and co-workers argued that both *Site α* and *β* were excavated in disturbed

deposits, thereby dismissing the claims for artefacts being found *in situ*. In fact, Bailey *et al.* explicitly concluded that “none of the artefacts recovered from Kokkinopilos can be demonstrated to be geologically *in situ*”, that “the artefacts form a mixture of materials from many different periods” and “do not date the accumulation of the main body of red clays at all, but postdate them by an unknown interval” (*ibid*, 142). Importantly, they also stated that “essentially the same point could be made about the other open-air sites in Epirus” (*ibid*).

Notwithstanding the importance of these early contributions, it was with the work of Runnels and van Andel in the frames of the Nikopolis Survey Project that a thorough interpretative model was put forth to explain all major geo-archaeological questions surrounding the ‘redbed sites’ of Epirus. Their analyses and argumentation have been described in great detail in a series of publications (Runnels and van Andel 1993a; van Andel 1998; Runnels *et al.* 1999; Runnels and van Andel 2003; van Andel and Runnels 2005), the main points of which are reviewed below.

Runnels and van Andel (2003; van Andel 1998) distinguish three main types of red deposits: (1) primary *terra rossa*, which is the insoluble weathering residue produced (*in situ*) by the dissolution of limestone¹⁶ (see also Yassoglou *et al.* 1997; Yaalon 1997; Durn 2003); due to Quaternary erosion, *terra rossa* is rarely preserved in primary locations, usually to be found in small, localized karst depressions; (2) redeposited *terra rossa*, namely *terra rossa* washed down from primary locations into karst basinal features, such as poljes; (3) colluvial red beds, which, unlike the other two types, include coarse-grained material transported by mass wasting processes and/or running water (App. I: 5). Another important and yet tricky distinction is between red sediments and paleosols, since the latter are often as red as *terra rossa*. Building on their previous research elsewhere in Greece (*e.g.* Pope and van Andel 1984; Runnels and van Andel 1993b) Runnels and van Andel (2003: Table 3.11) used paleosol stratigraphy,

16. Primary *terra rossa* is itself a paleosol (van Andel 1998, 362).

aided by TL and IRSL dating (see below), in order to compile a chronostratigraphic scheme for archaeological sites, sediments and paleosols in southern Epirus.

The latter researchers showed that the red sediments of Kokkinopilos and most of the other ‘redbed sites’ with Palaeolithic finds are in fact *terra rossa redeposited* in the depositional environment of karst depressions, namely that of poljes and loutses. Being fine-grained, as the mantle of *terra rossa* slowly thickens in primary locations, infiltration is reduced, allowing surface runoff to transfer it into the depressions. Uplift accelerates weathering and slope wash, resulting in the filling of poljes and loutses with secondary (redeposited) *terra rossa*; continued uplift raises the poljes and forces streams to cut back upstream, capturing the poljes, dissecting their surfaces and draining any water bodies (App. I: 36). Thus, nearly all of *terra rossa* in Epirus is to be found in secondary locations, and whilst some of it may be in colluvial deposits and alluvial fans, most of it occurs in poljes or loutses. Because the latter host seasonal or permanent lakes, water reduces the dark red colour of *terra rossa* into paler hues, whilst under dry conditions (e.g. due to uplift or during drought intervals) the discolouration process can be reversed, re-reddening the sediments (van Andel 1998, 377). Inadequate understanding of the role of karstic depressions as the main depositional environments of redeposited *terra rossa*, and failure to recognize the discolourations of the latter by varying groundwater levels in poljes/loutses, led previous researchers to erroneous and often contrasting interpretations of the redbed sites.

New and detailed grain size analyses carried out by Runnels and van Andel demonstrated that *terra rossa*, primary or redeposited, exhibits two size frequency modes: clay (50 to >90%), produced by the dissolution of limestone, and silt (5-30%), consisting almost entirely of quartz (Runnels and van Andel 2003, 66-67). In accordance with the suggestion for a windblown origin of the silt mode, first noted by Tippet and Hey (Dakaris *et al.* 1964), Runnels and van Andel (*ibid.*, 69) confirmed that the silt component has an aeolian origin, probably from the Sahara (Yaalon 1997, 2009). Complete bleaching during aerial transport renders the material suitable for TL and

IRSL dating, allowing for a luminescence dating program for western Epirus (*ibid.*, 91; Zhou *et al.* 2000).

In 1991, Runnels and van Andel (1993a) discovered a patinated, Micoquian-type handaxe that was stratified *in situ* within deposits of zone B. The artefact was found in a horizontal position, lacking traces of abrasive damage or weathering (*ibid.*). Large and heavily patinated artefacts were seen at almost the same or slightly higher stratigraphic levels in other localities to the south and south-west of the handaxe-findspot, whilst large flake tools (including denticulates and notches) were observed “eroding from the sediments in the northwest part of the deposit and perhaps similar to the ‘chipping floors’ described by Higgs in the northeast part of the site some 300 m away”; due to permit issues those artefacts were not collected (Runnels and van Andel 2003, 99). Importantly, it was noted that the artefacts were separated by clay matrix from each other and there was no size sorting or any mixing with unpatinated specimens, as it would be expected if they were included in the fill of an erosional gully (Runnels and van Andel 1993a, 192). Runnels and van Andel (1993a, 194) recognized that the deposit overlying zone C (Fig. 4.9) is in fact the Bt horizon of a paleosol – a recognition that was not included in Tippet’s account of the stratigraphy (in Dakaris *et al.* 1964, 222) and was largely ignored by Bailey *et al.* (1992). Heavily patinated artefacts of Middle Palaeolithic technology were observed locally, occurring *in situ* within the paleosol, which is preserved mainly along the edges of the polje, capping the entire stratigraphy¹⁷ (Runnels and van Andel 1993a). This paleosol was TL-dated at 91 ka (Zhou *et al.* 2000). The latter dating, together with extrapolated sedimentation rates (corrected by the variations of the clay/silt ratio) allowed the researchers to estimate the age of the handaxe-bearing layer at *ca.* 150-250 ka (*ibid.*; Runnels *et al.* 1999; Runnels and van Andel 2003).

17. A modern ‘topsoil’ overlies this paleosol. Unpatinated artefacts can be found on the surface of the topsoil (e.g. App. I: 19), whilst the paleosol yielded only patinated specimens; this suggests that the latter were not incorporated recently into the paleosol (Runnels and van Andel 1993, 194).

Another paleosol was identified at the junction of zones B and C, whilst two moderately mature¹⁸ paleosols, reported to be “associated with thin, discontinuous gravel lenses rich in small flint fragments, many of them [being] Palaeolithic artifacts”, occur in zone B, and two more are present in zone A (ibid, 70, 73; Fig. 4.9). These paleosols, together with the black manganiferous bands and/or desiccation zones at the boundaries of zones A-B and B-C, indicate interruptions of the sedimentation and intervals when dry surfaces were exposed. Alternatively, the diffuse gray mottled bands and gley zones designate fluctuations in groundwater level during and after deposition, whilst sub-vertical grey stripes probably denote the presence of water circulating in root channels; particularly in zone B, subhorizontal laminations suggest that deposition took place mainly under water. Overall, the fine-scale stratification, observed also in the localities where artefact scatters were identified, points to a depositional environment of very low-energy conditions, “far too low to entrain even the smallest flint debitage” (Runnels and van Andel 2003, 76). Similar conclusions were derived from the study of other poljes and loutsas: notwithstanding the sporadic occurrences of bands with fine to medium gravels, probably indicating thin debris flows or the action of small ephemeral streams, as in the case of the polje of Ayia, the fine bedding strongly suggests “slow, non-erosive, seasonally-interrupted depositions” (van Andel and Runnels 2005, 377).

In sum, Runnels and van Andel suggested (and largely proved) that the fill of the redbed sites refers to *terra rossa* (consisting of clay from the limestone dissolution, washed down from the flanks of the basins, and silt of windblown origin), which has been redeposited in runoff-collecting karst depressions. Such enclosed, flat-floored basins formed shallow, seasonal or perennial lakes and marshes, which would entail low-energy transporting agents and depositional environments. In these settings, artefacts resting on or within paleosols point to human pre-

sence during brief dry periods, whilst lithic scatters *not* associated with paleosols indicate exploitation of the lacustrine resources while the lakes were active.

4.5.4 Revisiting Kokkinopilos: fieldwork results

Essentially, the main point of contrast between the model proposed by Bailey and colleagues (1992) and that of Runnels and van Andel (1993a; 2003) regards the chronological relationship between the deposition of the red sediments and the discarding of the flint artefacts. In effect, the former researchers argued that the artefacts were discarded long after deposition had ceased and that all of the material is in secondary locations, buried by reworked sediments; whilst the latter scholars advocated human presence at Kokkinopilos while either deposition or soil formation was still ongoing, thereby suggesting the possibility of finding intact deposits with stratified artefacts, for which an age estimate can be assigned by dating the associated deposits.

In 2007 and 2008, I visited the site of Kokkinopilos with the aim of evaluating the aforementioned contrasting interpretations on the integrity of the site and the prospects of finding archaeological material that can be demonstrated to be geologically *in situ*. Kokkinopilos has been designated a National Monument by the Greek Ministry of Culture and it should be noted here that the permission I was granted did not allow the excavation of test trenches nor the collection of material¹⁹. Detailed grain-size analyses and numerous colour readings according to Munsell Hue had already been carried out by Tippet (Dakaris *et al.* 1964) and Runnels and van Andel (1993, 2003), whilst the lithic material had been studied by P. Melars (in Dakaris *et al.* 1964), Papakonstantinou and Vassilopoulou (1997) and D. Papagianni (2000). Consequently, the revisit was restricted to macroscopic observations at the site (including sampling for dating purposes after a new permission was issued, see below), as well as a brief inspection of a small sample of relevant lithic material in the museum of Ioannina.

18. For the meaning and value of paleosol maturity stages and paleosol chronosequences see Harden 1982, van Andel 1998, Magaldi and Tallini 2000, Retallack 2001, Runnels and van Andel 2003.

19. That is, excluding the bifaces that I discovered (see below), which were deemed important enough to be collected.

Considering that all previous researchers report that zone A is archaeologically sterile, most of my efforts concentrated on the examination of zones B and C. In the few places where the transition from zone A to zone B was identified, it was confirmed that the upper part of zone A follows an irregular line, as it is noted also by Tippet (Dakaris *et al.* 1964) and Runnels and van Andel (1993a). Presumably, this could mean that, after the accumulation of zone A-sediments had ceased, followed a period when no deposition, but instead, erosion was prevailing; sedimentation resumed again with the accumulation of zone B sediments directly on this eroded surface. An immature paleosol and a desiccation band, both indicating relatively brief hiatuses in the sedimentation, mark the boundaries of zones B and C. However, in this latter case (transition from zone B to C; App. I: 4) there is no 'uneven surface' formed as in the case of the junction between zones A and B mentioned above. This probably suggests that when sedimentation of zone B halted, the land surface was stable enough for soils to start forming, and it was either not affected by erosion at all, or erosion was too mild to have a significant impact on the morphology of the exposed surface. Alternatively, this difference between the two transitional parts of the sequence (A-B and B-C) may be seen as representing differences in the palaeotopography: early in the history of the polje, sediments of zone A were being deposited directly on the limestone bedrock and, although the floor of the newborn polje would have been relatively flat, it still involved irregularities inherited by the original, jagged morphology of the karst. However, after deposition of zone A, and especially upon and after deposition of zone B, the floor of the basin was already smoothed and leveled by slow, low-energy sedimentation.

Indeed, zone B deposits are characterized by abundant grey veins, mottles and gley streaks (App. I: 6, 7); gleying indicates water-logging, and the subhorizontal laminations first stressed by Runnels and van Andel (2003) provide firm evidence that zone B was mainly deposited under standing water, hence under conditions of low-energy, allowing for fine stratification. As regards the two "moderately mature, truncated paleosols" recognized by Runnels and van Andel (*ibid.*, 70) within the main part of zone B, only one (most likely the upper) could be tentatively iden-

tified (App. I: 4a). The association with gravel lenses and flint fragments ("many of them Palaeolithic artefacts": *ibid.*) could not be verified for that paleosol. However, it has to be appreciated that paleosol occurrences are very localized and hard to discern. In this badland landscape, paleosols are discontinuous, patchily exposed and truncated; moreover, their formation upon sediments that were already red makes their recognition very difficult even for the most experienced eyes - a fact that largely explains why both teams from Cambridge were essentially silent about the paleosols occurring in redbed sites²⁰. Apart from paleosols, the other major indication of dry, subaerial surfaces comes in the form of desiccation zones and bands of black (manganiferous) concretions that indicate oxidation of sediments; fortunately, these are more conspicuous than the paleosols (App. I: 8, 9). Clear signs of desiccation denote in a circular fashion the boundaries of a grey layer resting upon deposits of zone B, in a restricted area of a few square meters in the central part to the east of the main divide (App. I: 10, 11). This layer was not identified in any of the exposed cross-sections, but was seen only in horizontal association with zone B deposits and it is unlikely that it corresponds to the layer of 'pale gray silt' that is noted in the stratigraphic scheme of Runnels and van Andel, because the latter is shown to be included in zone A (see cross-section of Fig. 4.9). A concentration of patinated lithic artefacts of Middle Palaeolithic morphology was observed lying on that layer (App. I: 12). The surface condition and spatial distribution of the flints does not point to clustering due to the action of water, and, in contrast to other artefact clusters seen occasionally in gully floors, this one seems indicative of low-energy uncovering and minimum horizontal displacements as it would be, for instance, in the case of deflating processes. However, without the aid of excavation and as this is an assemblage seen on the surface and not in cross-section, very little can be said with certainty about its taphonomic significance.

20. An additional explanation could be that (some of) the soil profiles were not exposed in the 1960's, but were revealed only later, in the 1990's, due to erosion (*cf.* Runnels and van Andel 1993a, 200).



Fig. 4.10 Valtos Kalodiki: an active polje, exemplifying how Kokkinopilos, Morphi, Karvounari and the other 'redbed sites' would have been in their early stages of development, *i.e.* before the accumulation of thick, redeposited *terra rossa* fills, and before uplift, stream incision and dissection. Note that, despite the overall flatness of the polje's floor, water is not retained equally throughout the extent of the depression

Although seen in a horizontal, rather than vertical association with the stratigraphy, it can be suggested that this layer most probably belongs to zone B. Considering the evidence discussed previously about periods of subaqueous deposition alternating with intervals of subaerial exposure of the land-surfaces, it is reasonable to assume that the grey colour of this layer is a result of anaerobic (reduction) conditions and bleaching by water, whilst the circular feature of desiccated sediments marks the boundaries of a dry surface, most likely the periphery of the water-logged area. Notably, the desiccated surface continuous into zone B, away from the grey outcrop, marking a substantial hiatus. If this was indeed a small, localized pond inside the broader lacustrine environment of the polje, it could prove to be very informative for both the evolution of the polje and the taphonomic circumstances of the deposition of the lithics. For instance, when we envisage the polje of Kokkinopilos as a lake that was at times filled with water and at other times drying out, it should be taken into consideration that such alternations might have had different and varying life-histories in both space and time: whilst at one locality a deep depression would be able to retain water for a considerable time-span and/or in a large spatial extent, draining might have been more successful in the temporal and/or spatial

dimension for another, shallower locality. Such a situation does not necessarily require large differences in the relief of the two localities mentioned in this example, as subtle topographical differences may well do the work. This picture can be seen in the existing active poljes and loutses of Epirus: whereas their floor would be described as generally 'flat', slight differences in their topography make up for a complex setting of marshy spots neighbouring dry surfaces (Fig. 4.10). For loutses, which are rain-fed and hold water mostly in winter and spring, it can be argued that a water-logged place may change to dry land seasonally. Poljes tend to retain water for longer periods and the largest ones form permanent lakes now. Yet the same hypothesis may be invoked also for poljes, if only in a longer-term consideration. As a general scheme, we can assume that poljes preserved perennial water (*cf.* van Andel and Runnels 2005). However, in the dynamic environment of active tectonics and karst landscapes of Epirus, 'permanence' of water is also rather relative spatially, geomorphologically speaking. In the long-term and within the morphological borders of a polje, a localized tectonic disruption is able to lift a locality high enough for it to be above groundwater-level and dry out; alternatively, a solution hollow may collapse if an internal threshold is crossed, thereby deepening

or enlarging a depression, turning it from a previously seasonally-dry surface into a more sustainable water-collecting feature. In short, dry-wet alterations inside poljes may have had a dynamic temporal and spatial character, and this could be exactly the story which the gray layer may prove to be revealing.

In the main part of Kokkinopilos, the contact between zones B and C was found at *ca.* 136 m asl (App. I: 13), confirming the altitude of the boundary shown in fig. 3.17 of Runnels and van Andel (2003). The mapping of this contact could not be extended to the entire area of the site and was restricted to a small part of the central area, because of the brief time available and the immense difficulties arising due to the badland morphology, the often hardly discernible differences in colour, and the fragmented occurrence of the paleosol that can be used as a stratigraphic marker for distinguishing the contact between the two zones (App. I: 14). Nevertheless, as noted earlier, at first sight this contact appears as a rather even line, suggesting perhaps a quite smooth, low-gradient morphology in this stage of the polje's evolution. Above this contact lies zone C with a maximum thickness up to 8-10 meters, displaying also diffuse grey veins that can be interpreted as signs of gleying by fluctuating water levels (App. I: 15; *cf.* Runnels and van Andel 2003, 70, 73). The mature paleosol capping zone C and dated at 91 ka (hereafter, it will be referred to as 'Mid-Palaeolithic Soil', as it was designated for convenience by Runnels and van Andel 1993a, 198) is clearly visible on the east-facing slope of the main divide, but appears also in varying thicknesses on parts of the eastern slope, at the foothills of the limestone ridge (App. I: 16). Neither flint fragments nor artefacts were found in direct association with this paleosol, as claimed by Runnels and van Andel (1993a, 2003). But again, as mentioned earlier with regard to the paleosol(s) of zone B, this 'absence of evidence' may simply be an artefact of the limited time available for investigations and/or of the fragmented nature of paleosol occurrences (*e.g.* App. I: 17a) -let alone the on-going erosion. Furthermore, it could not be ascertained whether the 'Mid-Palaeolithic Soil' was formed directly on zone C deposits or on a layer overlying zone C (App. I: 18), the latter layer perhaps coinciding with 'Layer D' of Bailey *et al.* (1992). According to Bailey and colleagues (*ibid.*, 140) layer D is a *soil* "which locally overlies either

Layer B or Layer C deposits". The latter researchers also note that "the top of this soil forms the old land surface, which can be traced over large areas and which was certainly present in Roman times" (*ibid.*, 141). Regardless of whether this 'soil' ('Layer D') is the same entity as Runnels and van Andel's 'Mid-Palaeolithic Soil', or a separate (*sedimentary*) body underlying the 91 ka-soil, the above-cited proposition of Bailey *et al.* seems to contradict their view of widespread erosion and reworking of the deposits (Papagianni 2000, 30). Moreover, the next sentence following the aforementioned assertion of Bailey *et al.* (*ibid.*) states that "Arrowheads attributed to the Bronze Age, pottery, and Mousterian artefacts including disc cores are found on this surface". There is definitely some confusion here. Above 'Layer D' of Bailey and colleagues (1992) and/or above the 'Mid-Palaeolithic Soil' of Runnels and van Andel (1993), there is the modern, still-forming soil that we can call 'topsoil' for convenience. As noted by both Higgs' team (Dakaris *et al.* 1964, 214, 222) and Runnels and van Andel (1993a), unpatinated artefacts of either Bronze Age or Upper Palaeolithic morphology appear only *on* (and locally inside) *this topsoil* (App. I: 19). Consequently, it should not be confused with the mature soil dated at 91 ka, in which only patinated artefacts (attributed to the Middle Palaeolithic) occur (*cf.* Runnels and van Andel 1993a, 2003). To add to confusion, Harris and Vita-Finzi (1968, 539, 541) also talk about a "zone D" deposit between zone C and the modern topsoil; they regarded it as an alluvial deposit, correlative to Vita-Finzi's 'Younger fill' (of post-Roman age; Vita-Finzi 1969). In any case, it could not be securely assessed whether this is a fourth sedimentary layer upon which the 'Mid-Palaeolithic soil' was formed. Interestingly, a Bt horizon comparable in maturity with that of the 'Mid-Palaeolithic Soil' -as it is exposed in the east-facing slope of the main divide- was seen in the west-facing slope overlying a separate layer that rests here disconformably on zone C (App. I: 16b). It could not be ascertained whether this is a pedogenic horizon (Btk or Bc?) or a relict bed from sedimentary parent materials not yet obliterated by soil formation. In contrast to the columnar structure of the overlying Bt horizon, this 'layer' displays fine bedding, but its overall appearance (structure, texture, colour) differs substantially from the alleged 'Layer D' seen in the western slope; its boundary with the overlying Bt



Fig. 4.11 Biface found on the surface of reworked deposits

horizon is rather gradual, whilst the truncated appearance of the boundary with zone C indicates a hiatus (see also App. I: 17).

During my first visit at Kokkinopilos I found a biface lying on the surface (Tourloukis 2009), a few meters from the place where Runnels and van Andel (1993a) discovered the Micoquian handaxe and at *ca.* 127 m asl, namely at about the same stratigraphic level as the latter find (Fig. 4.11). The specimen is a patinated “amygdaloid à talon” (Debénath and Dibble 1994) with a cortical base, made on bluish-grey, fine-grained flint; typologically, it can be described as a typical Acheulean biface (Fig. 4.12). As it is shown in Fig. 4.11, the sediments with which the biface is associated belong to *reworked* deposits, most

probably deriving from zone B and most likely pertaining to the fill of an erosional gully (App. I: 20). That being said, the artefact is preserved in a mint condition, which suggests minimum transport (App. I: 21b).

Another biface (or, ‘bifacial core’; Fig. 4.13) was discovered during my second visit at the site, this time together with the geologist P. Karkanias. The artefact seems to have been made on a flake-blank and it displays a flat bifacial retouch, whereas on one side, large parts have been left unretouched and there is a breakage on the left lateral edge; the base looks as if it has been deliberately left unworked, or, alternatively, it broke in the process of manufacture and it was then left unretouched. The tip is triangular in



Fig. 4.12 The biface shown in Fig. 4.11



Fig. 4.13 Biface found *in situ*, embedded in deposits of zone C

section, one cutting edge is sinuous, while the other is essentially straight, largely because of the break that occurs there. Metrical data classify it to Bordes' 'thick bifaces' with a cordiform aspect²¹. The specimen is in a fresh to mint condition, with its cutting

edges still sharp and the ridges of the flake-scars clearly visible, albeit slightly worn locally. It is heavily patinated and displays red stains on both surfaces due to contact with Fe- and Mg-oxides. Overall, there are no signs of weathering, polishing or abrasion, and the general appearance of the artefact disproves the case of significant rolling, neither by running water

21. Length: 13.02 cm; Width: 10.00 cm; Thickness: 4.9 cm; distance from base to maximum width: 4.4 cm; width at midpoint of length axis: 8.6 cm; width at $\frac{3}{4}$ of the length from the base: 6.7 cm; Elongation Index: 1.30; Flatness Ratio: 2.04;

location of maximum width: 2.95; roundness of the edges: 0.86; Pointedness: 0.67



Fig. 4.14 The biface of Fig. 4.13 as it was found upon discovery

nor by large-scale gravity-induced downslope movement.

The artefact was found lying horizontally with half of its surface buried by the sediments, embedded within *non-reworked* deposits, in the upper part of zone C and at an altitude of 140 m asl, namely some five meters below the ‘Mid-Palaeolithic Soil’ (Fig. 4.14; App. I: 22). Gleyzation of the sediments occurred after the deposition of the artefact and the drab halos wrap around the specimen. The condition of the artefact, as described above, as well as the fine bedding of the deposits and the lack of any other signs that could indicate reworking, altogether suggest that this biface is geologically *in situ* (App. I: 21a). When the findspot was later re-visited for sediment sampling (see below), a flake was also found *in situ* in the same sediments (App. I: 33b).

The recently discovered bifaces add two more implements to a meager sample of five in total from Kokkinopilos: apart from the Micoquian handaxe of Runnels and van Andel (1993), another, very rolled and worn biface has been found on the surface

(Adam 1998), whilst there is also a handaxe-tip found during the early investigations of E. Higgs (1963; Dakaris *et al.* 1964, 219). Excluding the bifacial implements (most of which are handaxes) that have recently been reported from Crete (Strasser *et al.* 2010), the bifaces from Kokkinopilos account to about half of the total number of published bifaces/handaxes recovered thus far from the entire Greek territory. Bifaces cannot be used as chronological markers (see section 2.1) and it is not possible to ascribe the Kokkinopilos specimens to a (late?) Lower or (early?) Middle Palaeolithic techno-complex. However, it is beyond doubt that the artefact reported by Runnels and van Andel (1993a) as well as that of Fig. 4.12 (this study; Tourloukis 2009) can be described as *bifaces*; specifically, in most publications and textbooks of lithic typology, such implements are characterized as Acheulean bifaces. Recently, Otte (2010) argued that these specimens are not (Acheulean) bifaces, but, rather, (Mousterian) bifacial foliates. Unless Otte has published his own definition of foliates and bifaces (that I am not aware of), it is hard to see what he means here. If one compares Fig. 4.12 (this study) and figures 2 and 3 of Runnels

and van Andel (1993a) with figure 21 of Dakaris *et al.* (1964), in which five foliate pieces from Kokkinopilos are depicted, one can see that the specimens are clearly different. In short, to my eyes, the artefact found by Runnels and van Andel and that shown in Fig. 4.12 are Acheulean bifaces, the artefact shown in Fig. 4.13 is also a biface or bifacial core; none of them should be confused with foliates and none of them acquires a chronological value because of its morphology. Their importance lies in their stratigraphic significance.

Then, how do these new bifaces contribute to the discussion on the reworked vs. *in situ* finds from redbed sites in general and Kokkinopilos in particular? The biface found associated with reworked sediments will detain us first. Indeed, the site is a treeless badland dissected by numerous rills and gullies. There are many parts at the site where modern in-fills of reworked deposits can be discerned through the loose texture of the sediments, the darker brownish colour, the overall structure of the deposit (*e.g.* channel and scour fills following the present topography) as well as the absence of pedogenic features (*e.g.* gleying). Considering too that the redbeds are virtually stone-free (apart from the flints), it is important to note that, wherever limestone fragments occur, they are usually associated with reworked deposits (App. I: 23).

Nonetheless, it needs to be stressed that it can occasionally be extremely difficult to differentiate between intact deposits and reworked sediments of a gully fill. It is undoubtedly easier to identify a 'modern' fill of, for example, a few hundred- or thousand-years-old, as seems to be the case with the reworked sediments of the first biface; than a reworked deposit that dates back to a hundred thousand years ago or more. In the course of time, a very old gully infill could have been subjected to the same pedo-sedimentary processes affecting the surrounding (intact) deposits as well, thereby acquiring characteristics similar to those of undisturbed sediments (*e.g.* App. I: 24). Obviously, in such cases the distinction can be attested only with the resolution provided by excavation, and even then, the aid of micromorphology and laboratory analyses might be deemed indispensable. For instance, to what degree can the effects of gleying, affecting an originally undisturbed deposit, be retained when the same deposit becomes reworked?

Or, alternatively, what are the qualitative differences between the mottling of an *in situ* deposit and that of a reworked fill, assuming that the latter has been mottled *after* being re-deposited into a secondary location? Such concerns have been at best briefly mentioned by previous researchers (*e.g.* Bailey *et al.* 1992: 141 with regard to Higgs' Site β) and they have certainly not been resolved, whereas other issues have not been yet addressed at all. For example, gleying (or, gleization) is a general term used to describe processes that produce these bluish-grey colourations due to water-logging, when micro-organisms reduce oxidized minerals (*e.g.* iron hydroxides and oxides such as hematite, which cause the characteristic red colour) under anaerobic conditions (Retzlack 2001); although originally coined to characterize *soils*, the same term is used (Runnels and van Andel 1993a; this study) to describe (parts of) the Kokkinopilos *sediments*. In all likelihood, most of the Kokkinopilos deposits accumulated within the zone of water-table fluctuation, hence the drab-haloed root traces and grey mottles alongside ferruginous coatings. In places, iron-manganese oxides are abundant, forming hardpanized zones such as that shown in App. I: 8, 9, which are macroscopically similar to some paleosol horizons at Morphi (App. I: 32; see also App. I: 28, 29 for an analogous zone in the redbeds of Ayia). Should these hardpans be regarded as pedogenically acquired features, such as petroferic horizons developed by precipitation of hematite-cements, which were gleyed during saturation and then became subaerially exposed, indurated and stained with Mn- and Fe-coatings? Moreover, would it be possible to distinguish between *groundwater gley* (due to high water-table) and possible *surface-water gley* from stagnant water (due to impeded drainage *e.g.* by the impermeable clays and/or during periods of excessive rainfall)? Potential geochemical signatures may help to answer such questions and clarify which features are the results of pedogenic processes and which ones resulted from syn/post-depositional sedimentary processes of chemical weathering affecting buried and/or exposed sediments. In turn, this sort of clarifications will enhance our understanding not only when distinguishing between soils and sediments, especially since pedogenesis is now accepted to occur also in shallow submersed environments (*e.g.* Demas and Rabenhorst 2001); but also when assessing rates of soil formation versus sedimentation

rates. The latter appraisal (how fast was deposition relative to soil formation) is crucial in explaining how artefacts became incorporated into paleosols (see van Andel 1998, 383; Runnels and van Andel 2003, 93-94); and it is also related to assessing the hiatuses reflected in the evidence for breaks in the sedimentation. A better knowledge of all the above is also needed for the reconstruction of the palaeotopography of the site, the determination of the poljes' (active) margins and the evolution of both of the latter across space and time. Needless to stress, these queries are closely related to the main archaeological problems – a fact that is dramatically illustrated by the history of the relevant, previous interpretations.

Evidently, many issues related to the older investigations will remain unresolved, as with the case of Higgs' test trenches, for which the published accounts do not permit a proper re-evaluation. Papaïanni (2000, 71) remarks that the excavation notebook and a report written by the excavator of the trench at *Site α* argue that the excavated deposits had been reworked – a view that was afterwards maintained by Bailey *et al.* (1992); and her own analysis of the lithic material from *Site α* suggested that the artefacts from that trench were not found *in situ*. Papaïanni (*ibid.*, 73) considers the lack of refits in *Site β* as supporting the claims of Bailey *et al.* (1992) that the deposits are here reworked, too. However, the presence of refits does not warrant an undisturbed context and, similarly, the absence of refits is not in itself strong evidence for a disturbed context. In any case, Higgs explicitly mentions the presence of “a more recent erosion gully cut into [...] Zone B” (Dakaris *et al.* 1964, 215) which he distinguishes from the rest of the deposits in that trench; this distinction is clearly visible in the published photograph of the trench and it supports the opinion that, in an excavation, it is easier to recognize reworked sediments. Notwithstanding this clear distinction made by Higgs, it could be very well possible that, similar to the case of *Site α*, the trench of *Site β* was also cut in redeposited sediments.

Is it then true that none of the artefacts from Kokkinopilos are geologically *in situ*, as Bailey *et al.* (1992) argue? The recovery of the second biface from what macroscopically are undisturbed deposits seems to prove otherwise: it supports the argumenta-

tion of Runnels and van Andel for the presence of artefact occurrences in the stratigraphic sequence. Even if we disregard Higgs' claims for the identification of ‘chipping floors’, the research carried out recently (Runnels and van Andel 2003; this study) provides strong evidence for *in situ* lithic occurrences in zone B, which is the thickest of the three stratigraphic zones, the one most widely exposed and perhaps most valuable for the archaeology of the early Palaeolithic. The recent recovery of another biface (Tourloukis 2009) and a flake from undisturbed deposits of zone C may be viewed as *extending the claims for stratigraphic integrity to this uppermost zone as well*; furthermore, these finds suggest that zone C is not archaeologically sterile, as postulated by Runnels and van Andel (1993, 200). That being said, the re-evaluation of the earlier arguments for *in situ* finds, together with the observations made during the latest revisits, altogether serve as a warning against premature generalizations. Large parts of the site – and perhaps most notably those consisting of zone B deposits – seem to be stratigraphically undisturbed, but other parts are covered by sediments that have been redeposited in secondary locations.

Together with the finding of some more artefacts from undisturbed deposits, my assessment of the stratigraphy (and its overall integrity) at Kokkinopilos can be seen as having wider implications for all redbed sites of Epirus and the discussion about their archaeological contexts. Conceivably the closest parallel to Higgs' ‘chipping floors’ that was observed during my revisits is the concentration of lithic artefacts that was documented for the grey layer of Kokkinopilos' zone B deposits, mentioned above. At least one artifact concentration similar to (but more extensive than) the latter was found in Mikro Karvounari, another redbed site some 30 km to the north-west of Kokkinopilos (App. I: 25). In 2005, I surveyed this site as a member of the ‘Thesprotian Expedition’ survey team; there, we encountered a ‘carpet’ of thousands of lithic implements in a locality which was later given the code-name PS23/Unit 5 (App. I: 26; see <http://www.finninstitute.gr/Thesprotia/texts/Report.htm>, for preliminary reports). The locality was intensively sampled and a preliminary analysis of a small part of the assemblage (*ca.* 2000 specimens) was undertaken by the author together with O. Palli (32nd Ephorate of Prehistoric and Clas-

sical Archaeology, Greek Ministry of Culture). The greatest bulk of the assemblage(s) collected from Karvounari consists of -rather variably, yet mostly heavily patinated- artefacts of Middle Palaeolithic typology (cf. Papakonstantinou and Vassilopoulou 1997), whilst most of the few unpatinated pieces can be attributed to later periods (Upper Palaeolithic, Neolithic, Bronze Age). The material includes also pieces that lack Mousterian technological characteristics and, had they been found in an excavation, they would fit well to a Lower Palaeolithic context, but nothing more can be said with certainty. Evidently, a mixture of artefacts from different periods is almost definite as regards the surface collections, but in other parts of the site I observed stratified occurrences of lithics in apparently undisturbed deposits (App. I: 27). Test trenches were opened in the aforementioned locality in 2008 but the results have not been published yet. The excavations are expected to shed light to these enigmatic artefact concentrations, which locally include pieces that stand out as outliers with regard to the rest of the assemblage, in terms of their lack of patina, their typo-technological characteristics and often the raw material as well.

Flint fragments and possible worked pieces were seen embedded also in the *terra rossa* fill of the raised loutsa of Ayia (App. I: 28, 29), but without the relevant permission it was not possible to scratch the surface of the deposits in order to remove the flints and examine them; therefore, the claims of Runnels and van Andel (2003, 75) for artefact-bearing layers could only tentatively be confirmed. Equally tentative is the identification of artefact occurrences in the thin bands of fine to medium flint gravels and sand, intercalated within yellowish-red *terra rossa* sediments in another raised and dissected polje at Morphi (App. I: 30). Here, the redbed zone (ca. 12 m-thick) is indeed very similar to zone B of Kokkinopilos (Runnels and van Andel 2003, 72), is marked by paleosol horizons and it overlies a 2.5-m-thick tephra deposit that has been dated by Ar-Ar to ca. 374 ka (App. I: 31, 32; Pyle *et al.* 1998). Importantly, the dating of the Morphi tephra *challenges the view of Bailey et al. (1992) that the redbeds of Kokkinopilos (and of the other redbed sites) are much older than Middle Pleistocene* (Pyle *et al.* 1998, 285). Furthermore, I did not identify any alluvial deposits in none of the aforementioned poljes and loutsas, in contrast

to Bailey *et al.*'s (1992) arguments for streams incising the allegedly pre-Middle Pleistocene redbeds and re-depositing the artefacts. The bands of fine gravel seen at Morphi -and occasionally in other poljes as well- are too thin, rare and patchy to indicate major alluvial events; instead, following Runnels and van Andel (2003), I consider them as the depositional products of small ephemeral streams or thin, distal debris flows that sporadically interrupted an otherwise slow sedimentation by low-energy agents. The fact that such gravel bands are reported to occur at the margins of the main deposits at Kokkinopilos (Harris and Vita-Finzi 1968, 539) comes in support of the above interpretation.

4.5.5 Conclusions and discussion

The investigations of Runnels and van Andel, and most prominently their discovery of a handaxe stratified in undisturbed sediments, revived the claims first expressed by Higgs and his team for *in situ* lithic occurrences at Kokkinopilos²², and provided for the first time convincing arguments for stratified lithic occurrences that can be attributed to the Lower Palaeolithic on chronostratigraphic grounds. Preliminary results from the latest surveys carried out by the author (Tourloukis 2009) suggest that undisturbed sediments occur over large -if not most- parts of the site. In accordance with Runnels and van Andel (2003), there is ample stratigraphic and sedimentological data pointing to the low-energy depositional environment of a lake, which was formed in a tectonic basin (a polje) and was at times drying out either locally or entirely. Signs of gleying and mottling attest to sedimentation under wet conditions, whilst paleosols, black colour bandings and desiccation surfaces mark depositional breaks and designate subaerially exposed surfaces upon which artefacts (could) have been discarded. In other words, there are depositional units in stratigraphic order bounded by unconformities and marked by paleosols that may contain geologically *in situ* archaeological finds. Artefacts asso-

22. Note that, with the exception of the handaxe found by Runnels and van Andel (1993), a biface found by E. Adam (1998), as well as the two new bifaces reported here, no other documented collection of material took place in Kokkinopilos after the 1960's (Papagianni 2000, 70).

Site	Sample	Method	Age (ka)	References
Kokkinopilos <i>Site Beta, Layer A</i> (= zone A)	KOK 13	TL	> 150	Bailey <i>et al.</i> 1992
Kokkinopilos <i>Site Beta, Layer B/C</i> (= zone B)	KOK 14	TL	> 150	Bailey <i>et al.</i> 1992
Kokkinopilos uppermost paleosol	VA93-05	TLr	91 ± 14	Zhou <i>et al.</i> 2000 Runnels and van Andel 2003
Morphi tephra layer	20A-A	40Ar-39Ar	374 ± 7 (plateau age, interpreted as the eruption age)	Pyle <i>et al.</i> 1998
Ayia upper paleosol	VA94-27	IRSLa IRSLr	6.1 ± 0.6 7 ± 1	Zhou <i>et al.</i> 2000 Runnels and van Andel 2003
Ayia lower paleosol	VA94-29	IRSLa IRSLr	65.5 ± 6.8 84 ± 11	Zhou <i>et al.</i> 2000 Runnels and van Andel 2003
Ayia lower paleosol	VA94-30	IRSLr	83.1 ± 12	Zhou <i>et al.</i> 2000 Runnels and van Andel 2003
Alonaki redeposited terra rossa	VA94-32	TLa TLr IRSLa	10 ± 2 10 ± 2 9 ± 2	Zhou <i>et al.</i> 2000 Runnels and van Andel 2003
Loutsa surface paleosol	VA94-36	TLa TLr IRSLr	59 ± 9 51 ± 8 52 ± 8	Zhou <i>et al.</i> 2000 Runnels and van Andel 2003

Table 4.1 Radiometric dates for redeposited *terra rossa* ('redbeds') and/or paleosols formed on redbeds. The table includes all published accounts up to 2009. TL = thermoluminescence, IRSL = infrared stimulated luminescence, a = additive method, r = regeneration method, Ar-Ar = Argon-Argon radiometric dating

ciated with paleosols and/or desiccation surfaces indicate the presence of hominins when the land-surfaces of the poljes were dry and stable, whilst artefacts found in sediments that were deposited underwater point to exploitation of the poljes (obviously, their margins) during wet conditions. The fine-grained nature of the sediments and the overall condition of the recovered artefacts suggest transportational agents of very low energy and hence support the claims for minimum transport of the lithics from their original places of discard. Clearly, further investigations are much needed in order to assess site formation processes and the possibility of discovering *archaeologically in situ* assemblages (primary contexts). At the moment, however, what is most important (and implied in the assertion of *geologically in situ* finds) is that, for the appropriate, undisturbed localities, the dating of the engulfing sediments could furnish age-estimates for the associated artefacts.

Bailey and colleagues report on two TL-dates of >150 ka for samples taken from sediments of zone A

and zone B at Kokkinopilos, which they regarded as inconclusive, if not suggesting that sediments at both sampling sites are older than 150 ka (Bailey *et al.* 1992, 141-142). Excluding the aforementioned dates, thus far the available dating controls for Kokkinopilos and the other redbed sites are restricted to: the date of 91 ka for the paleosol capping the sequence at Kokkinopilos, the (Ar-Ar) 374 ka-date of the tephra directly underlying the redbeds at Morphi, as well as a few more dates from the sites of Ayia, Alonaki and Loutsa, the latter ranging from the middle Late Pleistocene up to the early Holocene (Table 4.1; Zhou *et al.* 2000; Runnels and van Andel 2003: Table 3.10). All of the most recent dates are the outcomes of a thermoluminescence (TL and IRSL) dating program carried out by Runnels, van Andel and colleagues (*ibid*), which provided pioneering evidence for the potentials and the restrictions in dating the open-air sites of Epirus (see also Zhou *et al.* 2000 for more details on the comparison between the two methods and their limitations when applied in the context of karst basins). Following this line of re-

search and considering that the chronological bracketing of the deposits at Kokkinopilos has been the core of the heated debate, it was decided to sample carefully selected sediments at this site and date them with the method of Optically Stimulated Luminescence. Of the six samples taken in total, three have been submitted for dating at the Netherlands Center for Luminescence (Dr. J. Wallinga), and those were taken from: 1) zone C, some centimeters below the 'Mid-Palaeolithic Soil', in the uppermost part of the sequence; 2) the findspot of the biface in zone C, and 3) deposits of zone B, stratigraphically and spatially close to the findspot of the 'Micoquian' handaxe (App. I: 33). Results are still pending and luminescence dating proved to be challenging, as the quartz OSL signals were in saturation. Given the saturation characteristics and environmental dose rate, a minimum age of 40 ka is preliminary indicated, while additional experiments are underway in order to obtain a more precise chronological estimate (J. Wallinga, pers. comm. 2010).

The refinement of the Kokkinopilos chronostratigraphy will have major implications for the interpretation of the redbed sites in north-west Greece. Any conclusive results from the latest OSL dating, which is still in progress, will test the earlier TL-date for the paleosol capping the sequence, and, as long as the actual age of the sediments does not exceed the limits of this method, they may provide *the first direct chronological evaluation* not only for the deposits of zones C and B, but also for the newly discovered biface from zone C, as well as that found by Runnels and van Andel in zone B. Thus, the results may help to substantially refine the age estimate for the 'Micoquian' handaxe, which is as yet the only stratified implement that can be attributed to the Lower Palaeolithic on stratigraphic grounds. In that sense, even if the stratified biface from zone C cannot be itself attributed to the Lower Palaeolithic, it does acquire a direct stratigraphic value of great importance with respect to the discussion on the integrity of the site, as well as an indirect merit regarding the placing of the Lower Palaeolithic find(s) into a local chronostratigraphic scheme. In turn, an improved local chronostratigraphy at Kokkinopilos can serve as the basis for regional chronostratigraphic comparisons and correlations between the numerous redbed sites of Epirus. Effectively, this would advance the assessment of

geological interpretations and at the same time it will set 'anchor points' for resolving long-lasting archaeological inquiries that cannot be otherwise deciphered. For instance, typological characteristics, degree of patination and raw materials of artefacts are not reliable markers for solid interpretations and provide only first-order indications for seriating individual artefacts and/or assemblages into a chronological order, let alone for spatial patterns and inter- and intra-site distributions²³ (cf. Papagianni 2000).

Establishing a chronostratigraphic framework for the open-air sites of Epirus becomes a primary research objective with implications that may be seen as reaching beyond the geographical boundaries of this district, considering that Greece is still lacking such frameworks for any pre-Mousterian evidence. Epirus remains the best-studied region in Greece in terms of Palaeolithic investigations and it has also provided invaluable palaeoenvironmental data sets, such as the long pollen records from Lake Ioannina and the glacial record of Mountain Tymphi, both of wider (at least European) significance (e.g. Tzedakis 1994; Hughes *et al.* 2006c; see section 6.2). It is indeed the richest area in Palaeolithic remains, and, as Runnels and van Andel rightfully note (2003, 125), this can no longer be attributed to a lack of systematic research elsewhere in Greece. For instance, a total number of *ca.* 30 findspots in Thessaly has yielded fewer than 1,000 lithic artefacts, whilst a similar number of findspots discovered during the Nikopolis survey project alone produced artefacts 100 times more numerous; and such comparisons can be even more dramatic when they involve surveyed regions of southern Greece (*ibid.*).

Based on the accounts of Bailey *et al.* (1997) and Runnels and van Andel (2003), it can be estimated

23. A dirt-road that has cut through the Kokkinopilos deposits (see App. I: 22b) was paved with gravels of unknown origin that contain numerous 'fresh' and unpatinated flint fragments and nodules, a lot of which are being eroded down to the gullies. Although the presence or absence of patination works well as a thumb-rule, the case of the flints deriving from the dirt-road shows how tentative and illusive such associations may be (e.g. when considering unpatinated artefacts as of Upper Palaeolithic age). For a more thorough account on the issues around patination see Papagianni 2000.

Period	Open-air		Rockshelter / Cave		Total	
	N	%	N	%	N	%
Lower Pal.	3	2.4	-	-	3	2.2
Middle and Upper Pal.	121	97.6	9	100.0	130	97.8
Total	124	100.0	9	100.0	133	100.0

Table 4.2 Distribution of open-air sites and rockshelters of Epirus by archaeological period. Data compiled from Bailey *et al.* 1997: Table 27.3, and Runnels and van Andel 2003: 134. Note that this is not meant to be a precise account in the first place, and there may be slight mistakes in the actual number of the 'Middle and Upper Palaeolithic' sites (most probably there may be a few more), due to small inconsistencies arising from generalizations made in the published sources. 'Middle and Upper Palaeolithic' includes also sites of Palaeolithic age that were not datable to a finer resolution

Period	Stratified / Datable				Non- Stratified / Non-Datable				Total	
	Open-Air		Rockshelter / Cave		Open-Air		Rockshelter / Cave		N	%
	N	%	N	%	N	%	N	%		
Lower Pal.	3	30.0	-	-	-	-	-	-	3	2.2
Middle and Upper Pal.	7	70.0	6	100.0	114	100.0	3	100.0	130	97.8
Total	10	100.0	6	100.0	114	100.0	3	100.0	133	100.0

Table 4.3 Distribution of stratified / datable sites vs. non-stratified / non-datable sites by archaeological period and site type. As in the case of Table 4.1, this account should be regarded as an approximate one, aiming to portray general patterns. Data compiled based on Bailey *et al.* (1997) and Runnels and van Andel (2003)

that the total number of Epirote sites dating to the Palaeolithic amounts to 133 (Table 4.2). Of these 133 sites, only three produced material that was tentatively assigned to the Lower and/or 'Early Palaeolithic', namely Kokkinopilos, Alonaki and Ormos Odysseos (see 4.5.6 for the latter two sites). In total, it is only sixteen sites where the material was found stratified *and/or* could be assigned an age-estimate with either relative or absolute dating techniques (Table 4.3): six of these are rockshelters and caves, the remaining ten being the open-air sites of Kokkinopilos, Alonaki, Ormos Odysseos, Ayia, Rodaki, Galatas, Kranea, Anavatis, Loutsas and a site in the Voidomatis Basin²⁴ (Bailey *et al.* 1997; Runnels and van

Andel 2003). All of the latter ten sites, but also most of those where the material was not found stratified and/or was not datable, are associated with localities of redeposited *terra rossa*, found either inside poljes/loutsas or on their margins.

Including rockshelters and caves, the sites with stratified/datable material account for 12% of the total (16 out of 133); if we exclude rockshelters and caves, then the number falls to 7.5%. Notwithstanding the richness of Epirus in Palaeolithic finds and putting aside issues regarding overall research biases (*e.g.* survey strategies, such as sampling methods, survey intensity and coverage, documentation etc, which are on the whole difficult to assess; *e.g.* see Bailey *et al.* 1997) both numbers can be regarded as vividly reflecting the *general rarity of geological opportu-*

24. In their account, Bailey *et al.* (1997) use the term 'site' to include also findspots with only one find. Apart from the site in the Voidomatis basin and Kokkinopilos, all other open-air stratified and/or datable sites were discovered during the Nikopolis Project. In the terminology of the Nikopolis Project these are called 'site/scatters' and may include localities with a single find (*e.g.* the biface from Ormos Odysseos). Runnels and van Andel (2003: Appendix) give a list of 36 site/scatters that are 'datable', but it was decided to include here only those sites that were explicitly either reported as yielding stratified artefacts, or considered datable by relative dating (*e.g.* with the use of paleosols) or were actually dated by 'absolute' dating (TL,

IRSL); thus, sites that were dated and/or considered datable on the basis of their typological characteristics are *not* (meant to be) included here. Mesolithic sites are also excluded. Ten more open-air sites, which were discovered during road constructions and yielded Middle and Upper Palaeolithic material, are reported by Palli and Papadea (2004); as this publication was pointed out to me while the thesis was upon completion, these sites have not been included in Tables 4.2 and 4.3

nities for finding sites with material *in situ* and/or datable by geochronological means (for matters of convenience, these are hereafter referred to as ‘S/D’ sites, meaning ‘stratified and/or datable’). Sites that can be regarded as S/D and yielded ‘Lower Palaeolithic’ material represent some 2% of the total number of Palaeolithic sites in Epirus. However, they account for 30% of the open-air S/D sites (3 out of 10), or some 19% of the S/D sites if we include also caves and rockshelters (3 out of 16; Table 4.3). Then, if Lower Palaeolithic material has been recovered in one out of three S/D open-air sites, it appears that wherever there are geological opportunities good enough for S/D sites to be found, there are also good chances that some of those will yield Lower Palaeolithic finds.

Yet, it is extremely difficult to rigidly evaluate whether the above assertion is more apparent than real. Definite conclusions are hindered by the ‘background noise’ generated from an array of interrelated factors: preservation and taphonomic biases (including visibility and accessibility of sites) versus preferences from the part of early humans, and research biases arising from differentially designed survey projects, to name only the most important ones²⁵. Runnels and van Andel (2003) suggested that the strong association of lithic artefacts with redeposited *terra rossa* (‘redbeds’) should be attributed to a combination of preservation issues and the attractiveness of those environments due to the presence of water (and all other resources associated to water bodies)²⁶. In another publication they seem to somehow undermine the preservation factor, when stating that “the

negative results of the searching by survey teams of many areas lying between poljes and loutses reinforces our belief that the association of sites with karstic features is due to prehistoric human behavior and not the result of the chance of preservation or the vagaries of research design” (van Andel and Runnels 2005, 374). Nonetheless, karst depressions do tend to act as sediment traps that collect sediments from the surrounding slopes, concealing and protecting them from erosion, thereby favoring also the burial and preservation of archaeological material; a view that is shared by most scholars that worked in Epirus (*cf.* Runnels and van Andel 2003, 125; Bailey *et al.* 1993; Bailey *et al.* 1997). Similar problems apply to the other side of the coin, namely the evaluation of negative evidence from certain regions. Flysch areas are notable for the absence of sites, and for this conclusion at least research biases can be ruled out, as those areas have been repeatedly surveyed exactly to test that assessment (*ibid.*). In this case the balance between preservation and preference (to put it rather schematically) has been assumed to lean more in favor of the latter factor: certain edaphic properties and the thinness of flysch soils result in an overall low economic potential for the flysch regions, making them unfavorable to animals and hence to humans as well (Bailey *et al.* 1993). The fact that flysch is extremely erodible (*e.g.* Koukis and Ziourkas 1991) is also thought by Bailey *et al.* (1997) to be a factor affecting archaeological visibility and preservation, but, according to the same researchers, this is probably not as decisive as its unattractiveness for human occupation: referring to the erosion of the ‘redbeds’, the latter scholars argue that “indeed, it is this erosion, often producing deeply dissected and dramatic gullies, that has exposed Palaeolithic artefacts and contributed to the visibility of sites[...] We see no obvious reason why this should not have been equally the case of the flysch slopes...” (*ibid.*, 529). However, even if erosion may have been “equally” affecting both types of geological areas (limestone areas with redbeds *vs.* flysch areas), the *mode* of erosion differs substantially in many respects – a fact that has been overlooked in the explanation of Bailey *et al.* (1997). By nature of its structure (sandy layers sandwiched between clayey layers), flysch is mostly eroded through slides and slumps, whilst redbeds are eroded mainly by the action of surface runoff, creep, gully-ing and slope wash. In the former case, slope failures

25. The discussion here focuses more on the role of geological and geomorphological factors affecting site taphonomy and distribution, rather than the differences in any discernible patterns between site distribution in the Middle versus the Upper Palaeolithic, or with regard to open-air sites versus rockshelters/caves. For the latter issues see Bailey *et al.* 1997 and Sturdy *et al.* 1997. Additionally, this discussion involves more the Middle rather than the Upper Palaeolithic evidence, as the former period is more closely related and comparable to the Lower Palaeolithic in all respects (geological formations, behavioral inferences, etc).

26. Note that poljes would have equally attracted other predators apart from humans, and the presence of the former could have rendered these localities dangerous places as ‘residential camps’ for human groups, a fact that is not discussed by van Andel and Runnels (2005).

are more prone to occur, and in a catastrophic and episodic manner (*e.g.* landslides of blocks of sediments), whereas redbeds are more likely to experience a milder type of erosion (*e.g.* debris flows and removal of sediments by gully incision), albeit in a more constant and still vigorous mode. Such differences have hardly been investigated²⁷. Another potential disparity would be with regard to the *onset* and *duration* of erosion in each of the two categories. As discussed earlier, the erosion responsible for the badland-landscape of –for instance– Kokkinopilos was initiated rather late, *i.e.* in the Holocene, and so it can be regarded as a recent phenomenon, namely of relatively short duration. In contrast, erosion of flysch “extends well back into the Pleistocene” (Bailey *et al.* 1993, 301), and this may be responsible for the differential preservation conditions in the flysch areas. Yet, the picture becomes even more blurred if we consider the assertion of Bailey and colleagues (1997, 525) that “the repeated association of [...] artefacts with eroding red sediments in lowland areas of Epirus breaks down when one moves into the Epirus hinterland, where similar deposits are equally extensive but rarely yield flint artefacts”. Unfortunately the researchers provide no other information in support of this observation, which makes it difficult to evaluate it. For instance, in what stage of their evolution do these ‘hinterland-redbeds’ occur? Are they uplifted and dissected similarly to (most of) their lowland counterparts, such as Kokkinopilos, so that they can be comparable in terms of preservation and visibility? Alternatively, do they present evidence of past wet conditions, in order to assess their former attractiveness as wetland environments, as it is stressed by van Andel and Runnels (2005)? A third explanation for the apparent absence of evidence in hinterland-redbeds could involve other constraints, such as behavioral issues related to altitude-thresholds, since the evidence from inland and/or upland

(above 600 m.) areas are overall poor of Middle Palaeolithic evidence as well, irrespective of depositional contexts (Bailey *et al.* 1997).

All the same, the distribution of Palaeolithic open-air sites is patterned very closely to the distribution of karst depressions in limestone areas, whilst sites are rare in other contexts, namely the intervening areas with flysch and flysch-like bedrock, which display clear evidence of intense erosion and disturbance, chiefly attributed to a combination of soft lithologies, reduced vegetation cover and tectonic activity. Although the role of the geological factors has been accounted for in almost all previous investigations, much more needs to be researched in this direction, to elucidate differential site preservation and visibility and test the existing interpretations. What seems to have been largely ignored is how sites like Kokkinopilos may serve as ‘windows of opportunity’ in combining good preservation with adequate visibility. As described earlier, taphonomic observations, such as the fresh to mint condition and the horizontal position in which the artefacts are usually being recovered, together with stratigraphic accounts such as the fine stratification, all point to low-energy depositional processes: altogether, these factors are responsible for a fairly good degree of preservation, which can be attributed to the fact that the artefacts were being discarded on (and subsequently buried in) an essentially *low-gradient terrain*. The raising of the polje by uplift resulted in dissection and exposure of the stratigraphy, which is in turn responsible for a fairly good degree of visibility, too. As mentioned earlier, although erosion may have started already in Palaeolithic times; and notwithstanding differences in the degree of erosion west and east of the main divide, *accelerated* erosion with severe gullying exposing deep sections is in most probability a very recent phenomenon, *i.e.* most likely post-Roman and possibly accentuated after the 1950’s (*cf.* Dakaris *et al.* 1964, 213-214; Harris and Vita-Finzi 1968; Bailey *et al.* 1992, 143). Locally, large parts of the uppermost zone C have already been eroded away, and it can be expected that, at this pace, soon (geologically speaking) the entire deposit will be removed by the gullies into the Louros valley, through a gap in the limestone ridge that serves as the main outflow. However, the point to be stressed is that for a long time the archaeological material has been protected

27. For example, one may add that “flysch basins are unlikely to have supported anything other than sparse open vegetation” (Sturdy *et al.* 1997, 595), in contrast to the redbeds, say of Kokkinopilos, for which Harris and Vita-Finzi (1968, 544) assume that in the absence of anthropogenic disturbance it would have supported a closed cover of mixed oak forest. Qualitative and quantitative differences in vegetation cover would have resulted in differential erosional behavior of the two contrasting landscapes (see also section 6.2).



Fig. 4.15 'Chert' artefacts from Alonaki. Lower row: flakes. Upper row: retouched tools (notched pieces and denticulates)

in this closed depression, and luckily for today's archaeologists, the stratigraphy is being exposed only recently; and this is even more true for the lowest (and hence oldest) parts of the sequence. Thus, a 'recently-acquired visibility' is the second factor that makes Kokkinopilos such a valuable 'window of opportunity'. In sum, this would be one of the rare instances where archaeological material has been buried in a flat-floored terrain, remained protected from erosion for thousands of years (either covered by sediments or concealed within paleosols), and it is only lately being uncovered again.

4.5.6 Alonaki

The findspot of Alonaki is situated in the southern part of the Acheron valley (south-western Epirus), at a very close distance from the Ionian Sea and it was discovered during the surveys carried out by the teams of the Nikopolis Project. The depositional set-

ting of the site belongs to an infill of redeposited terra rossa that has accumulated within a karst depression (a 'loutsa'; Runnels and van Andel 2003; see location in Fig. 4.7). In the examined outcrop of the deposits, two distinct Bt paleosol horizons were identified (*ibid.*, 100): the lower has a Maturity Stage (MS) 4/5 or 5, whilst the upper a MS 4. Lithic artefacts (total number: 204, according to Papagianni 2000) were found both on the surface and embedded within the outcrop, as well as in a modern clay extraction pit. The researchers argue that the material belongs to two separate lithic facies, each one associated with one of the two Bt horizons; apart from this stratigraphic distinction, the two industries are thought to be distinguishable on the basis of differences in the raw material and the techno-morphological characteristics of the artefacts (Runnels and van Andel 2003), although both groups are almost uniformly heavily patinated.

Runnels and van Andel (2003, 103) correlate the lower Bt horizon at Alonaki with another (truncated) paleosol horizon displaying similar maturity indicators, which is overlain by a coastal sand dune in a profile exposed *ca.* 500 m to the west of Alonaki, at Ormos Odysseos; the researchers assume that the sand dune dates to either the last interglacial or “an even earlier interglacial”. There, Palaeolithic artefacts and a small handaxe were found on deposits that are thought to be associated with this paleosol horizon. Thus, on the basis of the maturity of the paleosol horizon (the lower Bt) and its stratigraphic position below a sand dune of possible last interglacial age, Runnels and van Andel suggest that the chert artefacts at Alonaki and the biface from Ormos Odysseos most likely pre-date the last interglacial and are older than *ca.* 130 ka, possibly approaching the age estimate for the Kokkinopilos handaxe (*i.e.* 150-250 ka).

At Alonaki, the lower horizon industry, considered to be of Lower/‘Early’ Palaeolithic age, is basically a ‘core-and-flake’ assemblage, consisting of large flakes with wide, thick, unprepared platforms and large bulbs of percussion; large cores on cobbles with wide and deep flake-scars (Fig. 4.16); core-choppers; tools predominated by notched pieces and denticulates with notches formed by the so-called ‘Clactonian technique’; whilst retouch on scrapers is commonly direct and invasive²⁸ (Fig. 4.15). Overall, there are traits pointing to the use of hard-hammer direct percussion, and a knapping sequence oriented mostly in the production of large flakes and flake-tools (Runnels and van Andel 2003). These artefacts are made on a coarse-grained fossiliferous Eocene chert that is generally uncommon in Epirus and as yet of unknown origin. Noteworthy is also the identification of dense concentrations of angular stones (found in association with the artefacts of the lower horizon), which are seen as reminiscent of ‘stone clusters’ recognized at other early sites (*e.g.* Hoxne; Runnels and van Andel 2003, 100).

In contrast to the latter group of lithics, the artefacts associated with the upper Bt horizon have been manufactured on a bluish-grey, nodular fine-grained flint that derives from Mesozoic limestone and was widely used throughout Epirus during the Middle and Upper Palaeolithic. Runnels and van Andel consider these flint pieces as belonging to a “conventional Middle Palaeolithic Mousterian”, and, while stressing the differences with the chert artefacts described above, they note that “in the lower levels of the deposit [*viz.* the lower Bt horizon] wherever in situ artefacts were observed, they were always of the non-Levallois big flake type” (2003, 100-101). Papagianni (2000) carried out a typo-technological analysis of the Alonaki material, examining it also with regard to the division into the coarse-grained chert pieces of the lower horizon versus the fine-grained flint artefacts of Mousterian character from the upper horizon. Her remark (*ibid.* 56) that “radial cores on coarse raw materials [*viz.* chert] were worked with a variety of methods: lineal or recurrent centripetal Levallois and discoid” is in contrast to the assertion of Runnels and van Andel that the chert artefacts are lacking the Levallois method. On the other hand, my own inspection of part of the collected material and the artefacts that I recognized at the site, failed to identify Levallois characteristics on the chert artefacts, and even the ‘flint group’ presents only a few pieces with unequivocal evidence of classic Levallois features *sensu stricto* (*cf.* Boëda 1995). Papagianni concludes that “the only differences between the two raw material groups [...] are that artefacts made on coarse raw materials are larger and have a higher representation of plain, unprepared platforms” (2000, 57). According to Papagianni, the differences between the two groups are most likely a function of raw material properties and a distinction between two lithic facies does not find support on the basis of the typo-technological analysis.

When I examined the site I was not able to identify with certainty the exact outcrop where Runnels and van Andel observed the two paleosol horizons and the associated lithic industries. Most probably, the deposits that were investigated in 1992-1993 have since been so much eroded that, when I visited the site in 2007, there was no vertical exposure for a proper examination of the stratigraphy. Consequently, it was not possible to securely assess the ex-

28. My own observations after inspecting the material stored in the museum of Ioannina generally concur with the descriptions of Runnels and van Andel (2003, 101) and Papagianni (2000, 55-57).

istence of two distinct Bt horizons. Large parts of the exposed deposits seem to preserve an undisturbed stratigraphy, but at a few other places there appears to be either eroded remnants of paleosol horizons or reworked sediments deriving from paleosols that were disturbed by past erosional events. That being said, the deposits still reach a thickness of 2-3 m (hence in accordance with the reported total depth of the sequence); undisturbed occurrences are considerably indurated and display all characteristics of mature Bt horizons as described by Runnels and van Andel (*e.g.* with an angular blocky structure and thick, abundant clay films). The deposits could only be coarsely divided into an upper and a lower stratigraphic level, presumably corresponding to the two reported Bt horizons, but as already stated, this is a tenuous assessment. In accordance with the view of the researchers, coarse-grained lithic material (hereafter ‘chert artefacts’) are almost exclusively associated with the lower levels (lower Bt?), whilst fine-grained material (‘flint artefacts’) are associated with the upper levels (upper Bt?); however, a few flint pieces were found also in the lower levels of the deposit, whereas the opposite situation (chert artefacts in the upper levels) did not seem to occur.

The inspection of the coastal sequence outcropping at Ormos Odysseos did not yield any conclusive results: a paleosol (Bt) horizon was tentatively identified, intercalated between layers of sands and clays in the lower part of the exposure, and overlain by sandy deposits of the sand dune attributed by Runnels and van Andel to the last interglacial; whereas another, less mature horizon appears to occur above the sand dune. Due to permit-constraints it was not possible to systematically clean the section, which would allow for a better examination of the stratigraphy; therefore, it was not feasible to assess the correlation suggested by Runnels and van Andel between the Bt horizon occurring at the lower part of the sequence of Ormos Odysseos with the lower Bt at Alonaki. At first sight, however, such a correlation appears to be most likely valid, supporting an attribution of the lower Bt artefact-yielding horizon at Alonaki to a fossilized palaeo-surface that pre-dates the last interglacial.

Overall, the study of the stratigraphy at Alonaki and the nearby locality of Ormos Odysseos encountered significant difficulties, mainly arising from the fact

that in both places the pedo-sedimentary associations have been considerably disturbed by erosional processes. Moreover, in some instances it was clear that such disturbances were caused by old -rather than recent- erosional episodes: for example, the lower paleosol horizon at Ormos Odysseos appears to have been locally reworked by marine transgression(s). All in all, Runnels and van Andel (2003, 100) explicitly acknowledged these problems, and especially with regard to the Alonaki stratigraphy, for which they state that “[...] our ability to correlate the industries with outcrops of different depths is limited”. In sum, their correlation of the two lithic facies with the two Bt horizons could not be neither falsified nor confidently verified by this recent re-examination, although it is believed here that it most probably holds well, as far as macroscopic observations are concerned.

Nevertheless, even if we accept that the chert artefacts from Alonaki and Ormos Odysseos predate the last interglacial, it is still not possible to securely attribute them to the Lower Palaeolithic, as Papagianni’s analysis also implied. In fact, Runnels and van Andel themselves carefully remark that the ‘chert group’ may equally be seen as belonging to a “late Acheulean technocomplex” or to a “variant of an early Mousterian” (2003, 126). Interestingly, the latter researchers report also that they did not identify any similar artefacts among the material collected in Epirus by E. Higgs (*ibid.*, 105). Indeed, in terms of raw material and typo-technological characteristics, the ‘chert group’ from Alonaki differs from all other Epirote assemblages, of which I personally examined some samples, either in Ioannina or at the sites, while doing fieldwork (*e.g.* from Kokkinopilos, Karvounari, Morphi and Ayia). Papagianni’s study of Middle Palaeolithic technology in Epirus also reveals a number of techno-morphological traits that, in many respects, distinguish this material from that of the rest of the Epirote sites (2000, 55-57), when the former is viewed as one unit (*i.e.* chert and flint ‘groups’ together): for example, the Alonaki collection has the highest frequency of cores among the sites studied by Papagianni, and the lowest frequency of elongated flakes and tools in all coastal sites of Epirus (with specimens with blade proportions being particularly rare); very few prepared platforms (occurring mostly in the ‘flint group’); highest frequency of notched



Fig. 4.16 Cores of the 'chert group' from Alonaki. A: disc-like core. B: discoidal (?) core

pieces and denticulates and highest frequency of re-touch invasiveness in all coastal sites of Epirus; and highest number of large artefacts.

As already discussed in section 2.1, although core reduction techniques are a primary study-focus for distinguishing between Levallois and non-Levallois (or, in this context, 'pre-Mousterian') assemblages, such a distinction remains provisional if it relies solely on core properties. Nevertheless, the interpretation of core technology is critical in the case of the 'chert group' from Alonaki, since Levallois features are either missing or doubtful for the rest of the coarse-grained artefacts. Some of the cores and 'core-choppers' that I examined in the Ioannina museum and at the site would be described as 'migrating platform

cores' reduced by alternate flaking, which point to a reduction strategy wherein flakes are removed in an invasive fashion from the volume, rather than the surface of the core, and in a non-standardized manner (*cf.* White and Ashton 2003). Yet, next to the latter are cores which could be described as 'simple prepared cores' and/or discoidal (*e.g.* the latter term is used also in Papagianni 2000, 56); these are generally flatter (in contrast to the chunky appearance of the former type) and seem to indicate a better control on flaking (Fig. 4.16). Considering, however, that this is essentially a surface material lacking refits, and most likely biased by not only collection strategies but also by a degree of post-depositional mixing (*cf.* Papagianni 2000), such remarks should be taken with caution. Furthermore, methods of core reduc-

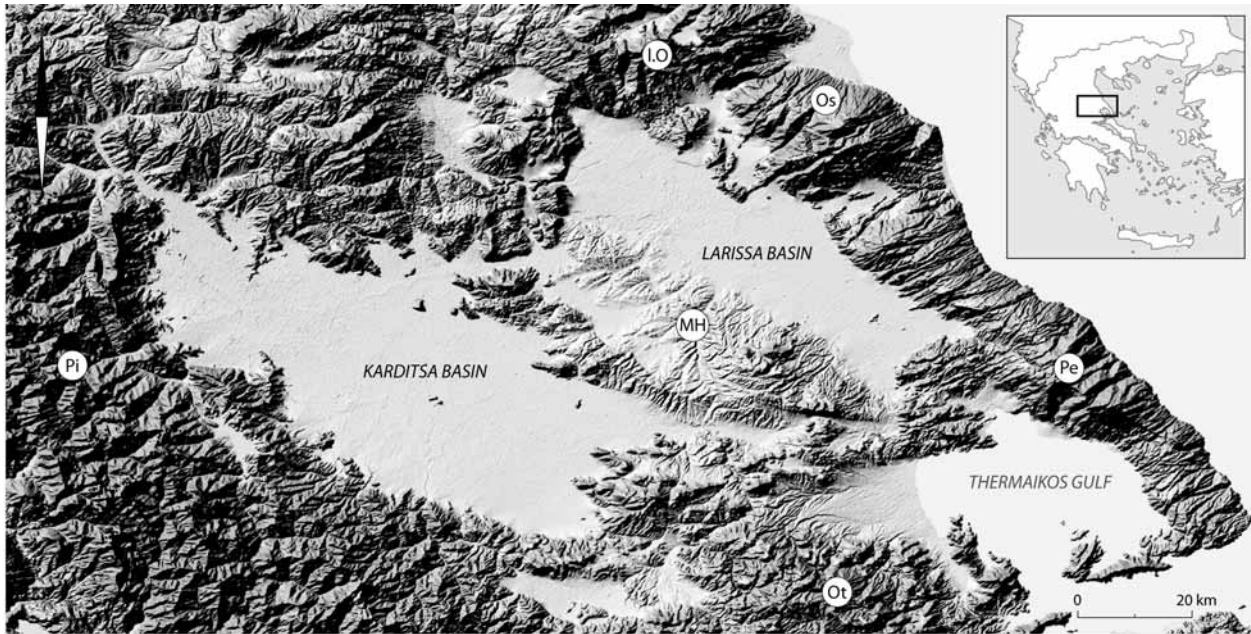


Fig. 4.17 Relief map of Thessaly, based on data from SRTM v.2.0. Pi: Pindus Mountains; I.O: Mt. Lower Olympus; Os: Mt. Ossa; Pe: Mt. Pelion; Ot: Mt. Othrys; MH: Middle (Thessalian) Hills

tion can change while the core is being knapped, and so its final form reveals only the last method applied (*e.g.* Kuhn 1995). Even more important for the case of Alonaki are the constraints imposed by the properties of the raw material, as Papagianni discusses also in more detail (*ibid*; see also Dibble 1991; Kuhn 1991, 1995; Andrefsky 2008). Notwithstanding all the above, the geometry of the two main types of cores described earlier can be seen as indicative of a technological tradition which could be attributed to the transition from the Lower to the Middle Palaeolithic. Needless to say, the issues related to the raw material, the small size of the assemblage, and the fact that it consists of surface finds, renders any such attribution highly hypothetical; following Papagianni, there are no clear-cut differences in the technology of knapping between the ‘chert’ and the ‘flint group’, and both could belong to a ‘Mousterian tradition’ even if they are indeed separated in time, as the stratigraphy seems to suggest. On the other hand, it has already been noted (sections 2.1 and 3.3) that, for instance, discoid cores have been documented at sites as old as the ones at Orce, whilst the latest analysis of the Dmanisi lithic material remarks on the presence of cores, which typologically and/or volumetrically could be considered as discoid.

Noteworthy, at the peninsula of Ayios Thomas (see Fig. 4.7 for location), large flakes and an amygdaloid biface or bifacial core made on chert similar to that used at Alonaki, were collected from a paleosol that is associated with marine deposits of Eemian age (Runnels and van Andel 2003). These, too, could be tentatively attributed to a late Lower Palaeolithic or an early (?) Mousterian industry, or to a technocomplex that is transitional between these two.

In sum, at Alonaki, it was not possible to neither confirm nor falsify an attribution of the material to the Lower Palaeolithic. What is observable is that the ‘chert group’ displays characteristics that distinguish it from the known Mousterian assemblages of Epirus and lacks any traits indicative of a ‘post-Mousterian’ period. Although the Alonaki material clearly belongs to a core-and-flake industry, bifaces are not absent from the immediate surroundings (Ormos Odysseos), or from the wider area (Ayios Thomas, Kokkinopilos).

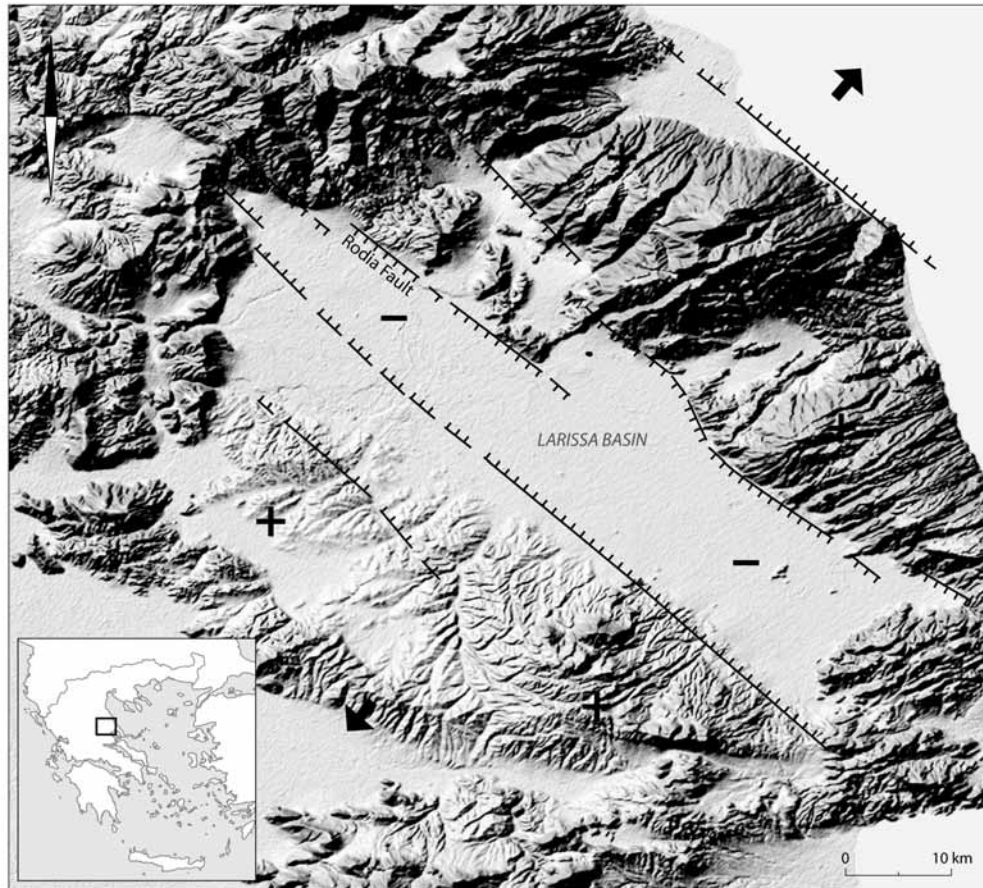


Fig. 4.18 Pliocene-Early Pleistocene extensional regime (first tectonic phase). Arrows indicate the direction of crustal extension, plus and minus signs indicate uplift and subsidence, respectively. Note the Rodia Fault cutting across the entrance of the Narrows. Modified after Caputo *et al.* 1994: fig. 2

4.6 THESSALY

4.6.1 Introduction

The province of Thessaly lies in central Greece and is the largest lowland region of the Greek peninsula (Fig. 4.17). With the Larissa Plain being the most significant geomorphological feature, the area hosts wide plains and meandering rivers, surrounded by high mountains. To the east, the ranges of Mt. Olympus, Mt. Ossa and Mt. Pelion form an almost continuous chain, whereas the region is bordered to the west by the Pindus mountain chain and to the south by Mt. Othrys. The Pineios River has its headwaters in the Pindus, from where it runs south, then east and northeast to pass through the Vale of Tempe between Mt. Olympus and Mt. Ossa and meet the sea of Ther-

maikos Gulf. At least from the Middle Pleistocene onwards, the Pineios has been the primary source of drainage, forming extensive alluvial plains mostly at the central and eastern part of Thessaly. The NW-SE trending 'Middle Thessalian Hills' divide the region into the plain of Larissa in the east and the plain of Karditsa in the west, whereas two smaller basins, those of Almyros and Volos, are to be found further southeast.

The rich alluvium, deposited by streams from the surrounding mountains, and the vast, low-relief floodplains of Pineios and its tributaries (*e.g.* Titarisios River), have been acknowledged for their fertility already from the Neolithic period. Indeed, some of the most important Neolithic settlements of Greece are situated on the Thessalian plains, and the

first Palaeolithic investigations of the region were conducted in the frameworks of projects that were primarily concerned with research on Neolithic sites. The point to be stressed is that, if not from the Neolithic onwards, the plains of Thessaly are in modern times being intensively exploited for agricultural purposes, with considerable implications for the preservation –and hence visibility– of (Lower) Palaeolithic material. In fact, it is possible that even the Neolithic land use may have affected the rate of aggradation – as well as its spatial distribution– during the latest recorded episode of alluviation (*ca.* 7000 BP), through cultivation, deforestation and pasturage (van Andel *et al.* 1990a; Demitrac 1986).

4.6.2 Geology and geomorphology of Thessaly

Most of the substratum of Thessaly (*i.e.* the Alpidic and pre-Alpidic series) belongs –from east to west– to the Pelagonian, Sub-Pelagonian and Pindos isopic zones (Higgins and Higgins 1996). The Pelagonian zone consists mainly of shallow-water limestones and is at present exposed in the northern and eastern parts of the region, from the Pagasitikos Gulf up to the north-west past Mt. Olympus. The Sub-Pelagonian zone runs from Mt. Orthrys to the north of the Karditsa basin and it forms a large belt of ophiolites, limestones and cherts. A deep, continental trough that continues northwards into Albania was developed during the Oligocene and Miocene, when compression changed to extension. Molassic sediments (conglomerates, sandstones and marls) were shed from the adjacent mountains to fill this trough, which is the largest molassic basin in the Greek peninsula (known also as Meso-hellenic Trench; Higgins and Higgins 1996).

After the Alpidic orogenesis, Thessaly was affected by extensional tectonic movements (Caputo and Pavlides 1993). This is the first phase of Neogene stretching affecting the region and it is chronologically bracketed between the Late Miocene/Pliocene and Early Pleistocene (*ibid.*). During this tectonic regime (Fig. 4.18), NE-SW tension resulted in the formation of a series of NW-SE elongated horsts and grabens, bounded by large normal faults that run parallel to the boundaries of the isopic zones (Caputo *et al.* 1994). The Larissa Basin, the dominant geomorphological feature of Thessaly, essentially corre-

sponding to the present Larissa Plain, is formed during this phase, when the structural system of the entire region is being shaped in the form of a range-and-plain topography, with its ‘highs’ and ‘lows’: from east to west, we find the crustal blocks of Olympus-Ossa-Pelion Range, and then the basin of Larissa, separated from the Karditsa Basin by the horst of the Middle Thessalian Hills. Sedimentary conditions were affected by the uplift and subsidence of the aforementioned structural highs and tectonic depressions, respectively. Specifically, during the Pliocene and until the end of the Villafranchian²⁹, the palaeogeography of the region is marked by prevailing lacustrine conditions, when a large lake was covering most of eastern Thessaly (*i.e.* the entire Larissa Basin and most of the Middle Thessalian Hills; Fig. 4.18). At around the end of the Villafranchian, a new drainage pattern emerges, as the Pineios river began to form its delta at the Aegean coast, along with the opening of the Vale of Tempe across the mountains of Ossa and Olympus; consequently, the Pliocene lake occupying the Larissa Basin began to empty (Caputo *et al.* 1994, 220).

The second extensional tectonic activity, this time with an N-S stretching direction, started during the Middle-Late Pleistocene and it continues up to the present (Fig. 4.19). Within these new geodynamic conditions, some of the older, Pliocene normal faults were reactivated, whilst a new system of E-W trending normal faults was being formed and imposed onto the older structures, inherited from the earlier tectonic phase (Caputo and Pavlides 1993, 354). A significant change in the palaeogeography of the region occurs during this phase, as the Larissa basin is now being fragmented into three separate physiographic domains: the Tyrnavos Basin to the north, which coincides with the alluvial plain of the Pineios and Titarissios rivers, the Karla lake to the south, and the Chasambali bulge in between, which forms a system of northwards down-stepping normal faults that impose a temporary hydrographic divide between the other two main sectors (Caputo *et al.* 1994). This recent ‘breaking-up’ of the Thessalian

29. The term is retained here as it is used by Caputo and colleagues (1994), who originally assessed the chronological bracketing of the main tectonic phases affecting Thessaly.

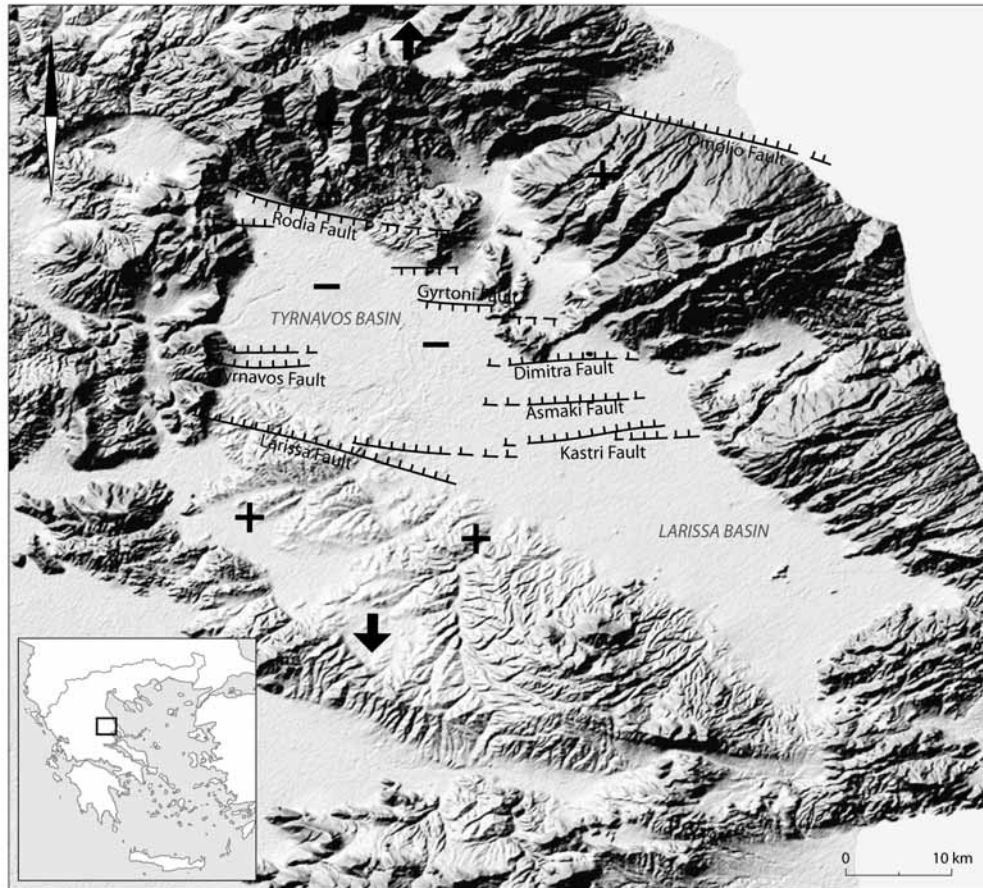


Fig. 4.19 Middle Pleistocene to Holocene extensional regime (second tectonic phase). Modified after Caputo *et al.* 1994: fig. 4

system was accentuated by a new uplift of the Gonoio Horst (that is, practically the south-western parts of Lower Olympus and Ossa) and the northern part of the Middle Thessalian Hills, along with a continuous subsidence of the Tyrnavos Basin (*ibid.*). It is stressed here because it had significant implications for the distribution and preservation of the Quaternary sediments: whereas from the Middle-Late Pleistocene onwards the Tyrnavos Basin was strongly subsiding, thereby forming a significant sediment trap, the northern parts of the Middle Thessalian Hills were being uplifted, whilst the area south of the Larissa Fault remained almost undeformed.

4.6.3 Previous research and interpretations

Palaeolithic research in Thessaly was initiated in 1958 by a German team under the direction of V. Miložević and it was the outcome of those investigations that gave way to the publication of the first monograph on a Greek Palaeolithic project (Miložević *et al.* 1965). The researchers surveyed along the banks of Pineios from the town of Larissa up to the village of Amygdalia (previously known as Gounitsa), and located twenty open-air sites with lithic and faunal material. The sites were studied and interpreted on the basis of the typological characteristics of the *ca.* 600 flint artefacts, the faunal analysis and the geological stratigraphy. At three sites, flints and bones were found *in situ*, embedded in the profiles, and their archaeological layers were used as anchor points for relative chronostratigraphic subdivisions and inter-

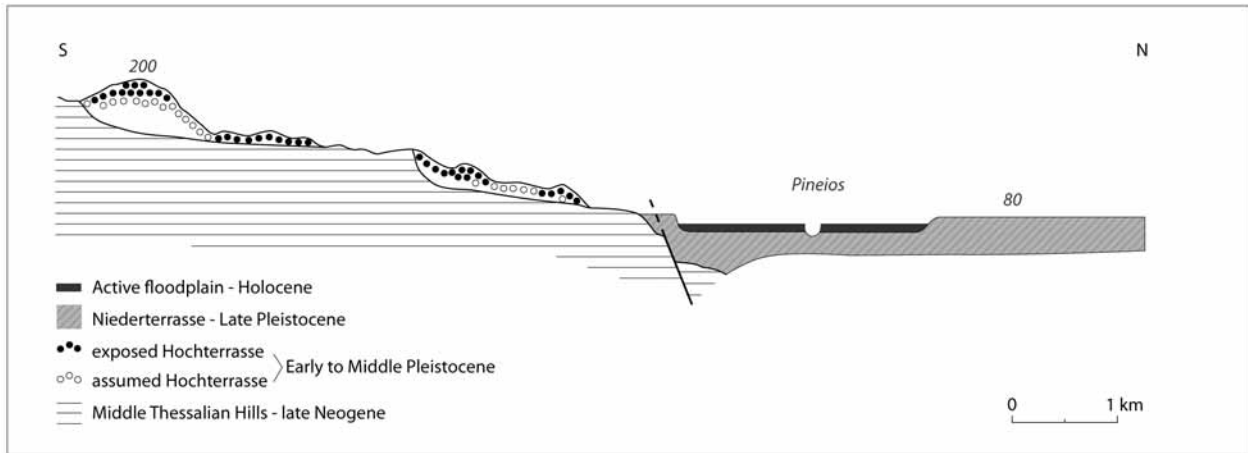


Fig. 4.20 The fluvial sequence in Thessaly as documented by Schneider (1968: Table 4)

site lithostratigraphic correlations³⁰. Nevertheless, most of the artefacts were found on the surface of fluvial deposits that were interpreted mainly as remnants of old (inactive) gravel bars, whilst lacustrine facies and deltaic deposits were invoked for layers with clays and molluscs, and coarse sands and gravels respectively. The researchers assumed that the finds were being exposed and then eroded away by the Pineios at times of excessive discharge when the river's level is rising. Most of the surface finds lacked any traces of rolling and they were usually to be found at the exits of river loops, whereas they were in turn missing further downstream; hence the investigators concluded that -in their majority- they derive from artefact-rich layers that are broached by the river at periods of high water level (*e.g.* in spring and autumn). Interestingly, a bone-rich layer which at site I yielded also numerous flint artefacts could be identified at other localities (*i.e.* at site V and profile 6/7) located more than 3 km away. Both the faunal and the lithic material from this 'bone-layer' ("Knochenbank" in the publication) lacked any traces of rolling or reworking. Consequently, the researchers considered the (stratified) finds as being geologically *in situ*, *i.e.* of the same age with the sedimentary matrix: "Transport over short distances, relocation within a gravel-surface and thus a dispersion of the remainders of a skeleton or of tools over a more or less

expanded range before the final embedding are quite possible, but without any disturbance of the synchronicity between sediments and fossils" (Milojčić *et al.* 1965, 15, translated from German).

D. Jung and H. Schneider, the geologists of the German survey team, were the first who studied in a relative detail the Thessalian fluvial stratigraphical sequence. As discussed below, the geological examination deduced a broad subdivision of the stratigraphy into four fluvial terraces (fig. 4.20; Milojčić *et al.* 1965, 8-20; Schneider 1968). The *Hochterrasse* ('high terrace') is the oldest, presumably spanning the Early to Middle Pleistocene and it can be further subdivided into a *lower* and an *upper* unit. The next terrace is the *Niederterrasse* ('low terrace'), formed by three successive alluvial episodes during the Late Pleistocene to Middle Holocene; almost all of the findspots discovered during this first phase of research were proved to be associated with the *Niederterrasse*. The fourth and youngest terrace is formed by the modern, active floodplain of the Pineios.

The results of the faunal analysis indicated a 'warm type' of fauna from the sites associated with the *Niederterrasse*, and this fauna was considered to date from the Last Interglacial up to the beginning of the Last Glacial (Milojčić *et al.* 1965, 58). This view, and particularly the presumed occurrence of Last Interglacial taxa, was later further elaborated by Schneider, also based on the presence of molluscs and lignite layers, which he considered indicative of

30. Theocharis (1967, 18-19) reports that there was only one site with *in situ* artefacts (site 7).

temperate climatic conditions, although he acknowledged the ambiguities in these conclusions³¹ (Schneider 1968, 31-35 and 37-42). Schneider's excellent study on the geological evolution of the Thessalian landscapes established a relative chronological framework for the fluvial sequence and offered insightful observations on the links between tectonics and climate as driving forces behind river behavior and related sedimentary environments.

A few more findspots were discovered in 1960 by the Greek archaeologist D. Theocharis, who surveyed essentially the same part of the river valley, adding more than 250 lithic artefacts to the total collection, as well as an unspecified number of fossil bones (Theocharis 1967, 20). Noteworthy is the recovery of a human calvaria fragment, found in site E (at the northern bank of Pineios, close to Larissa town) embedded in a sandy layer *ca.* 3.5 m under the surface of the river bank. Three flint tools³² were found in the same layer, but they were recovered "from different parts of the layer" and their association with the skull fragment is dubious (*ibid.*, 32-33). J. L. Angel, the anthropologist who examined the fossil in 1965, concluded that it "does not look like a Neanderthal in the classical sense of the term", and that some of its features are reminiscent of the specimens from Swanscombe and Krapina (*ibid.*, 33). Perhaps even more remarkable than the find itself is the fact that, apart from a very brief reference by G. Freund (1971, 183), the human fragment seems to have been not only unexamined, but also unnoticed in the literature since Theocharis' publication in 1967. In their analysis of the lithic material, both Milošević and Theocharis assigned a Middle Palaeolithic age to the majority of the collection, and argued for the existence of an Upper Palaeolithic component as well, albeit with a weaker 'signal'. Following Freund (1971, 186), the identification of a Middle and -most

probably- also an Upper Palaeolithic constituent in the collection is by no means doubtful, but the secure stratigraphic points are seemingly too few to allow for a solid chronological assessment of the surface material. This regards mainly the identification of a 'younger' Middle Palaeolithic facies and perhaps also the argumentation for a stratigraphic position of the Upper Palaeolithic component. The stratified artefacts in 'zone a' (*i.e.* the stratigraphical anchor for the Upper Palaeolithic occurrences) were no more than six pieces, which, according to Freund (1971, 186), could be Upper, late Upper Palaeolithic "or even younger". Furthermore, aside from the few sites with embedded lithics, almost all of the localities yielded assemblages in which 'Middle Palaeolithic' artefacts are found mixed with 'Upper Palaeolithic' pieces, if not also with specimens that probably belong to the Bronze Age (as in site 0). In fact, Freund's assertion that "*de facto* ist das saemtliche Material verlagert, auch das stratigraphisch gesicherte"³³ (1971, 194) draws our attention not only to the deduced culture-specific classification of the total collection, but perhaps also to the very same stratigraphic correlations that presumably permitted this sort of classification.

Overall, it seems that during these two first expeditions in Thessaly the investigators aimed primarily at the bank exposures of Pineios, whereas the higher terraces (the 'Hochterrasse') were visited chiefly for geological reconnaissance purposes and were not thoroughly scanned for artefacts. However, the geologists mention the presence of "atypical" (*sic*) lithic artefacts on the surfaces of the *lower Hochterrasse*, which were found "always lying loose on the surface and never in situ" (Milošević *et al.* 1965, 17; Freund 1971, 194). Although Schneider was apparently familiar with recognizing flint artefacts, in his 1968 publication there is no report on any find from the Hochterrasse, which he assumingly investigated thoroughly in order to map it. The Middle and Upper Palaeolithic specimens are made on radiolarite, ranging in colours from ochre (rarely) to red-brown (the majority) and dark red; raw material occurrences were readily available in the form of fluvial gravels

31. "The molluscs found in the layers of the 'Knochenbank' give little hope for a more precise dating. As a whole, they represent a Pleistocene-Holocene fauna without a high stratigraphical value, but they point to an interglacial age" (*ibid.*).

32. Drawings of two of the three lithic implements are presented in the publication and, in accordance with the interpretation of Theocharis, these appear to be a discoidal (Middle Palaeolithic?) core and a burin (Theocharis 1967, Fig. 1, 3 and 22, 1).

33. "All of the material is *de facto* relocated ["derived"], also that which is stratigraphically secured."

on and within the Hochterrasse deposits a few kilometers away from the findspots (Schneider 1968, 38). Noteworthy is a point made on quartz, which is included in the material collected by Theocharis (Freund 1971, 189), and is so far the only reported quartz-artefact from a (presumably) Late Pleistocene context: as it is discussed later, the 'Lower Palaeolithic' assemblage from Rodia is made on quartz, and this is contrasted to the raw material of the Middle and Upper Palaeolithic specimens which are worked exclusively on radiolarite.

During the next phase of Palaeolithic research in Thessaly in the mid 1980's and early 1990's, new search strategies were being applied for the identification and interpretation of open-air Quaternary archaeology (Runnels 2003a). Thus, when in 1987 C. Runnels undertook a survey in the Larissa district with the aim of clarifying the Greek Middle Palaeolithic framework, the targeted areas included locations and landscape features that were deemed promising for yielding finds, based on the geological maps that A. Demitrack had prepared (Runnels 1988, 278; Demitrack 1986). Demitrack's soil-stratigraphic study of the Late Pleistocene Larissa Plain coincided with an increasing understanding of soil chronosequences and their value in dating open-air sites (e.g. Pope *et al.* 1984), the latter gradually gaining appreciation in research designs, as the archaeological paradigm started to shift away from the long-persistent focus in caves and rockshelters (Runnels 2003a, 189).

Runnels revisited some of the known findspots and discovered thirty-two new ones, producing a collection of 211 flint artefacts, which he attributed to the Middle and Upper Palaeolithic (Runnels 1988). For the dating of the material Runnels used the radiocarbon and Uranium-series dates obtained by Demitrack (1986) on molluscs and pedogenic carbonates, which bracket the deposition of the associated (Niederterrasse) deposits between *ca.* 45-27 Ka (Runnels 1988, 283-284). The specimens were found "on the gravel bars in the Pineios riverbed or on the fossil terraces [*i.e.* the Niederterrasse] preserved in the river gorges west and north of Larissa at a height of *ca.* 15-40 m above the present river" and "some [of the findspots] could be correlated with the stratification visible in the river banks of the lowest terrace of the river"

(*ibid.*, 279). There is only one findspot (No. 17) for which flints (of Upper Palaeolithic morphology) are reported to have been recovered from a conglomerate layer (*ibid.*, 283). Otherwise, the artefacts are again surface finds, considered to be deriving from conglomerates exposed in the river banks, assuming little transport of low velocity based on artefact-preservation conditions (Runnels 1988, 280). With regard to "the position of the lithic-bearing deposits within the fluvial sequence", it is implied that this should be correlative with the stratigraphic position of the *in situ* material found by Milojević at *ca.* 6-9 m below the surface (*ibid.*, 283), which essentially refers to the 'bone-layer' ("Knochenbank"); conglomerate adhering to the surface of bones and flints found in 1987, as well as the fact that there are no rolling traces, come in support of this argument. It is worth noting here that the "Knochenbank", this artifact-yielding layer of conglomerates was the main paradigm to claim that probably most of the surface material derives from similar (if not, in cases, the same) conglomeratic layers, a view that was supported and elaborated by Schneider as well: consolidation of the sediments through a carbonate-rich matrix preserved artefacts and fossils, until the erosive power of Pineios recently exposed the layer(s) on the banks of the river (Milojević *et al.* 1965; Schneider 1968, 42).

In addition to the surveys along the Pineios river in the Larissa district, the 1987 survey included eleven other areas with Pleistocene alluvial fans, focusing on relict alluvial paleosols (Runnels 1988, 278). Although nothing is reported from these investigations, a findspot was located to the northeast of Larissa and close to the village of Rodia, at the point where the river enters the Rodia Narrows, which is the gorge that connects the eastern Thessalian plain with the Vale of Tempe. Overlooking the entrance to the gorge and situated on a gravel terrace, Findspot 30 (FS 30) yielded artefacts of Middle and Upper Palaeolithic morphology made on radiolarite. 'Tested pieces' (radiolarite pebbles with two or three flake removals) were included in the finds and hence the site was interpreted as an 'atelier' that could have been revisited in many periods for flint acquisition and testing (Runnels 1988, 282-283). The site was revisited in 1989, and again in 1991, when C. Runnels and Tj. van Andel (1993b) carried out one last survey in Thessaly with the aim of clarifying the geo-

logical context of the Middle Palaeolithic sites and search for Lower Palaeolithic findspots, as well as re-inspecting FS 30 at Rodia. The revisit of FS 30 resulted in the finding of a new lithic assemblage, markedly different from the collection of 1987: instead of radiolarite, these artefacts are made on massive white quartz; they display different technological attributes (*e.g.* the Levallois technique is absent here, in contrast to the previously recovered radiolarite material); and there were specimens found embedded *in* the terrace-profile, a fact which distinguishes their provenance from the radiolarite pieces which were found lying *on* the terrace gravels and in a different part of the site (Runnels 2004, pers. comm.).

Runnels and van Andel employed Schneider's scheme for the Thessalian fluvial succession, noting, however, that his lithostratigraphic subdivisions of the Niederterrasse "are not entirely convincing" (1993b, 299). Aided obviously by Demitrack's (1986) soil maps and descriptions, they interpreted Schneider's "Kalkkrusten" (calcrete) and "brown loams" -identified either within or capping the Niederterrasse deposits- as the Bca / K and Bt horizons of *paleosols*, respectively. In this line, Runnels and van Andel postulate that high interfluvies, submerged only at high flood stages, may have provided surfaces stable enough for soils to grow and humans to use as seasonal hunting camps or kill sites, discarding their artefacts on top of the loam, which would be later washed away by channel migration, thus "leaving the artefacts...in situ on the underlying harder surface of the Bca horizon or even on the gravel" (1993b, 303). Alternatively, artefacts may have been discarded directly on gravel bars, which were exposed at times of low water-level, thereby offering attractive locations for short-term sites and/or hunting stands (*ibid.*). Evidently, this interpretation is somehow contrasted to that of Milojević and his associates. The latter assumed that the finds have most probably been re-located from their original places of discard (and therefore implying a certain degree of reworking; *e.g.* see Freund 1971, 187) but the absence of rolling traces and the crusts of matrix that was still adhering to their surfaces indicate little transport and, most importantly, that artefacts and fossils belong to the same time-slice with that represented by the sediments.

4.6.4 Revisiting Thessaly: fieldwork results

During 2007 and 2008 I visited Thessaly four times, in order to assess the fluvial stratigraphy and the context of site FS30 at Rodia. In three of these visits, I was accompanied by Dr. P. Karkanas, Prof. Dr. R. Caputo and Prof. Dr. W. Roebroeks, respectively; the above scholars offered me invaluable help and thoughtful insights while doing fieldwork, yet any mistakes here are entirely my own. Before presenting the results from the revisits, I will first summarize the main points that the reader needs to bear in mind with regard to the Quaternary in this region.

The Quaternary in Thessaly is essentially represented by the fluvial terraces of the Pineios and its tributaries and to a lesser degree by other landforms of alluvial deposits, such as alluvial fans. Moreover, a small percentage of Pleistocene sediments occur also as fillings of fissures in the limestone and marble bedrock, which often preserve faunal remains. Besides the modern, active floodplain of the Pineios, there are two prominent terraces that mark the Thessalian landscape (Fig. 4.20), and these have been designated by Schneider as the 'Niederterrasse' and the 'Hochterrasse' (Schneider's (1968) nomenclature in German is retained here for convenience). The younger terrace, the Niederterrasse, was active through the Late Pleistocene and early Holocene and currently covers more than half of the floodplain north of Larissa, *i.e.* most of the Tyrnavos Basin. It lies *ca.* 5 to 15 m. above the present, active floodplain and its stratigraphy reveals well-bedded, well-sorted gravels, sands, silts and clays (App. II: 1), which belong to three separate fills, from older to younger (Demitrack 1986):

1. The *Agia Sofia alluvium* accumulated during *ca.* 42 to 27 ka, it is the most extensively aerially exposed Niederterrasse-fill and contains findspots with Middle and Upper Palaeolithic material.
2. The *Mikrolithos alluvium* was deposited between *ca.* 14 to 10 ka, it is always found buried under a younger fill and its deposition is considered to reflect the climatic shift from the late Glacial to post-Glacial conditions.
3. The *Girtoni alluvium* was laid down during *ca.* 7-6 ka, it now covers entirely the Mikrolithos alluvium as well as part of the Agia Sofia; Middle

and Late Neolithic settlements were founded upon it, during and after its deposition.

Late Pleistocene deposits occur also as alluvial fans ('Old' and 'New Red Fan') which are found in a narrow zone, parallel to the mountain front that borders the plain to the east and north (Demitrack 1986; Fig. 4.21). The fans are poorly preserved, and it is only their proximal parts that remain at the surface and always on the up-thrown blocks of faults that cut across them. Episodes of deposition were interrupted by long periods of soil formation, as it can be envisaged by the occurrence of paleosols within the fans. Evidence of two episodes of faulting is also visible in those fans.

Assessing the relative and absolute dating of the Hochterrasse sediments

The Early Pleistocene sediments are patchily found as relict deposits of the Hochterrasse, mainly overlying the Late Miocene-Pliocene sediments of the Middle Thessalian Hills, which separate the basin of Larissa to the east from the basin of Karditsa to the west, and belong to the depositional environment of the palaeo-lake (Fig. 4.21; App. II: 2). Due to the general scarcity of faunal material and lack of dating projects, the age of the Hochterrasse is furnished in the broadest of terms. Possible age estimates are further complicated by the difficulty in identifying a precise litho- and chronostratigraphic boundary between the Late Miocene-Pliocene sediments and the overlying Pleistocene gravels. The palaeo-lake is thought to have persisted until around the end of the Villafranchian; at about that time, the depositional environment changed from (predominantly) lacustrine to fluvial-terrestrial conditions, when Pineios began to establish the new hydrographic system. However, this shift was probably gradual and, consequently, there are sedimentary facies which reflect these boundary-conditions, hence characterized as fluvio-lacustrine. Schneider (1968, 15) comments that in all previous geological works which include Thessaly, the Neogene is referred as 'undivided', and even in the most classic studies, such as that of Philippson (1950), both the Pliocene and Quaternary deposits are left without any further subdivision and/or dating. Importantly, he also stresses that the Quaternary deposits share many affinities with those of the Plio-

cene in terms of their lithographic components (clay, loam, sand, gravels), whereas both the Quaternary and the earlier sediments are associated in their distribution and have both experienced comparable displacements due to tectonic movements (ibid). Nonetheless, Schneider (ibid, 17) attempted a gross subdivision of the Neogene deposits into two parts, based on differences in the stratification, colour, petrography, and tectonic deformation. The *lower thessalian layers* comprise of light-coloured, sandy conglomeratic fluvial-lacustrine sediments that are attributed to the Late Miocene-Early Pliocene based on the presence of a 'Pikermi fauna'. The *upper thessalian layers* consist of fluvial-terrestrial loamy 'red-beds' that are seen as re-worked and eroded remnants of paleosols; for them, Schneider assumes a Plio-Pleistocene age (*sensu lato* Villafranchian), as they are capped by the Early Pleistocene fluvial gravels of the Pineios. It is though obvious that this chronological subdivision does not resolve the problem: the upper parts of what is considered to be the 'Neogene deposits' are thought to span the Plio-Pleistocene boundary, whilst the overlying fluvial gravels of the Pineios are also assigned an age under the term 'Villafranchian' (*i.e.* again Plio-Pleistocene). This is nonetheless partly understandable, since the Pleistocene overall seems to be in stratigraphic continuity with the underlying, Pliocene sediments (Caputo and Pavlides 1993).

Apart from (litho)stratigraphic indications based on the fluvial sequence, the attribution of the Hochterrasse to the Early-early Middle Pleistocene is thought to be supported by a fragment of an elephant molar (M²) that Schneider (1968, 25) assigned to the species *Archidiskodon (Elephas) meridionalis cf. cromerensis* (this species is referred to as *Mammuthus meridionalis* in current nomenclature). The tooth was found before World War I by an amateur, who in 1968 showed Schneider the exact location of the find, some 1.5 km south of Larissa at *ca.* 90-100 m. asl on the Middle Thessalian Hills; the findspot is recognized as belonging to the lower members of the Hochterrasse ('Untere Hochterrasse', ibid; see below). Athanassiou (2002, 290) considers the relatively narrow occlusal surface and the increased crown height of the molar as evidence of a more advanced elephant species, while stressing the difficulties in the determination of such a partly preserved

specimen. Hans van Essen (pers. comm., 2008), after inspecting a photograph of the specimen, noted that it could be an M³ instead of an M² (hence with implications in the validity and the meaning of Schneider's measurements), and while pointing out the possible presence of a V-shaped central loop on the occlusal surface, he considers the tooth as probably belonging to *Elephas (Palaeoloxodon) antiquus*.

Mammuthus meridionalis is a late Pliocene to early Middle Pleistocene species, and its first occurrence in Europe (together with *Equus*, known as the 'elephant-*Equus* event') marks the transition from the early to middle Villafranchian (van Kolfschoten 2007). Recent studies have demonstrated that the transformations within the *Mammuthus* lineage (*M. meridionalis* – *M. trogontherii* – *M. primigenius*) were more multifaceted than a simple gradual phenomenon, simultaneous across the species' range (ibid). The interval between 1.0–0.7 Ma, during which *meridionalis* evolves into *trogontherii*, is a complex transitional period and the transitional forms "do not follow each other in an orderly chronological succession, but overlap in time" (Lister *et al.* 2005, 57). At about the beginning of the Middle Pleistocene and/or slightly earlier, a faunal change occurs, during which the straight-tusked elephant *Elephas (Palaeoloxodon) antiquus* arrives in Europe; in Italy, it is first found within the Slivia/Ponte Galeria Faunal Unit(s), bracketed between 1.1–0.6 Ma (Palombo and Ferretti 2005, 128; Sardella *et al.* 2006). *E. (P.) antiquus* is a relatively widespread species in the Middle and Late Pleistocene, with most of its occurrences associated with a regional temperate forest, although in southern Europe (Iberia, Italy and southern Balkans) it was related to Mediterranean evergreen woodland (Stuart 2005, 173). The refugial status of the latter regions have been called upon to infer a (possibly later than in the north) survival of *E. (P.) antiquus* in the south, while withdrawing from most of the rest of Europe after the end of the Eemian (Stuart 2005). The evidence from Iberia points to a presence of *E. (P.) antiquus* at ca. 40–50 ka or even later (ca. 30 ka) but is still inconclusive (ibid), whereas nothing is known of a possible late survival in the Balkans, and in Italy the species occurs at sites tentatively assigned to MIS 5a or 4, but not during MIS 3 (Palombo and Ferretti 2005). The range of *E. antiquus* in Italy overlaps that of the con-

temporaneous (Middle and Late Pleistocene) woolly mammoth (*M. primigenius*), which is a cold-adapted, open-grassland dweller, although at some sites the co-occurrence in the same stratigraphic levels is tenuous and at others it could be an artifact of time-averaging (Palombo and Ferretti 2005). In Thessaly, *E. (P.) antiquus* is well attested in the Late Pleistocene faunal list of the Niederterrasse (Milojčić *et al.* 1965; Schneider 1968; Athanassiou 2001). In 'absolute' ages, the Niederterrasse is bracketed between ca. 45 and 27 to 18 ka, on the basis of radiocarbon dates on mollusc shells (Demitrack 1986; Runnels 1988) and a lignite sample (Schneider 1968). Runnels and van Andel (1993b, 302) suggest that the earlier limit should be regarded as a minimum age and assign a tentative time-range at ca. 30 to 60 ka for the deposition of the Niederterrasse, by inferring similarities with other Greek Mousterian industries. On the basis of stratigraphic, faunal and dating evidence, the same researchers disagree with Schneider's view that the 'warm' character of the mammalian and molluscan fauna of the Niederterrasse points to a Last Interglacial age, stressing that it is in fact a "incongruous mélange of warm and cold, steppe and forest types" which may as well fit to interstadial and stadial conditions (ibid). With regard to the environmental tolerances of *E. (P.) antiquus*, Athanassiou notes (2000, 70) that the milder conditions of the glacials in south Europe would have made the area tolerable for this species even during cold stages, and hence it is not surprising to find it during MIS 6 in the Grevena basin (to the NE of and close to Thessaly).

'*Archidiskodon meridionalis archaicus*' (i.e. 'primitive *M. meridionalis*') is reported from sites in the valley of the Aliakmon river (Macedonia), where *Palaeoloxodon antiquus* is also present, whilst '*Archidiskodon meridionalis*' has been found together with '*Mammontheus trogontherii*' and '*Palaeoloxodon antiquus antiquus*' at sites in the Florina district (Doukas and Athanassiou 2003, with references therein). With respect to the elephant-representatives, such a cloudy picture is not surprising. For instance, in the early Middle Pleistocene of Italy, the possible (co-)occurrence of three taxa – *M. meridionalis*, *M. trogontherii* and *E. (P.) antiquus* (Palombo and Ferretti 2005)–, may serve as a warning. In other words, it is not impossible at all that Schneider was wrong, and the elephant molar actually belongs to *E. (P.)*

antiquus. But even if this is the case, contemplating the age of *ca.* 210 ka (provided by U/Th and discussed below) as a minimum age for the Hochterrasse is not contradicted by a possible occurrence of *E. (P.) antiquus* in its lower members. Admittedly, the problem is that such an estimate cannot be supported by the elephant molar either: the straight-tusked elephant can be found in deposits of any date between *ca.* 700 to 40 (?) ka.

In general, the mammal record of Thessaly is rather scanty and as yet poorly understood, mainly because it is for the greatest part composed of isolated finds from old collections made by amateurs or during geological fieldwork and always without a proper excavation that would provide the necessary stratigraphical data. A Late Pliocene fauna from the excavated locality of Sesklo (Athanassiou 2002) was found in deposits that are equivalent to Schneider's upper Neogene layers of the Middle Thessalian Hills, thus corroborating the chronological estimation of the latter researcher. With the exception of the aforementioned elephant molar, faunal representatives of the Early and Middle Pleistocene are missing. The Late Pleistocene fauna is better represented in a number of sites located along the banks of the Pineios to the east of Larissa, in Niederterrasse deposits, where bone material was in some instances found associated with Middle (and perhaps also Upper) Palaeolithic lithic assemblages (Milojčić *et al.* 1965; Schneider 1968; Athanassiou 2001).

In the context of a scanty faunal record, composed of isolated, unstratified finds most often collected by amateurs, and marked by significant 'gaps', (e.g. Early Pleistocene occurrences are either absent or with no value for stratigraphic correlations with the Pineios gravels, and Middle Pleistocene taxa *sensu stricto* are overall lacking), the attribution of the Hochterrasse to the Villafranchian is deemed unsatisfactory, especially since it relies on a single specimen. The age of the Hochterrasse has been refined by a U/Th disequilibrium date of ≤ 210 ka on a CaCO_3 crust from a paleosol that developed on Hochterrasse remains on the Middle Thessalian Hills (Demitrack 1986, 42). The sample was taken from a thick, truncated B horizon, of 5YR hue, with pervasive, medium-thick to thick clay films and multiple carbonate crusts (*ibid*). The soil is described as "yel-

lowish-red, clay-rich and calcic, with prominent multiple calcium carbonate crusts", the uppermost of which yielded the date (*ibid*). Another, older paleosol of "dark red, non-calcic clay with grussified clasts", is reported to be exposed against the mountain front to the north of Rodia (probably at the foothills of Mt. Lower Olympus; Demitrack 1986). In light of the soil stratigraphic approach that comprised a major part of Demitrack's work in Thessaly, her remark (*ibid*) on the poor preservation and visibility (exposure) of the Early and Middle Pleistocene soils acquires an important significance.

An U/Th date from the pedogenic calcrete coating or crust of a nodule records the time at which carbonate precipitated in this nodule; hence, the dated event postdates by at least a few thousand years the deposition of the parent material and the subsequent subaerial exposure of the deposit (and hence the onset of soil formation). To evaluate the accuracy of the U/Th method, Demitrack (1986, 22) compared U/Th dates from a paleosol, with radiocarbon dates on shells from the alluvial sediments that contain the paleosol; she considers the inferred time lag (11 to 15 ka) -between the deposition of the alluvium and the precipitation of carbonate in the soil- as correctly reflecting the necessary time for the formation of a large carbonate nodule. Although Demitrack does not specify the maturity stage of the paleosol, the Hochterrasse deposit with which it is associated would be much older, accounting for the time-span needed for the growth of the nodule and the maturation of the engulfing soil horizon. Therefore, the reported date of ≤ 210 ka furnishes a *minimum date* for the age of the Hochterrasse (*cf.* Demitrack 1986, 22); moreover, the age provided here may be substantially separated by the timing of original terrace aggradation (*cf.* Runnels and van Andel 1993b, 308; Santisteban and Schulte 2007, 2747). For the correction of the detrital Th, Demitrack adapted the method of Ku and Liang (1983) who use alpha spectrometry (AS). U-series dates obtained by AS-analyses have been recently seen as likely to represent mixed and/or low precision ages, resulting from poor sampling resolution, as AS requires large samples that may include material with complex and extended depositional histories (Sharp *et al.* 2003). Caution is drawn to such complexities that arise from the polygenetic processes of calcium carbonate mobilization and deposi-

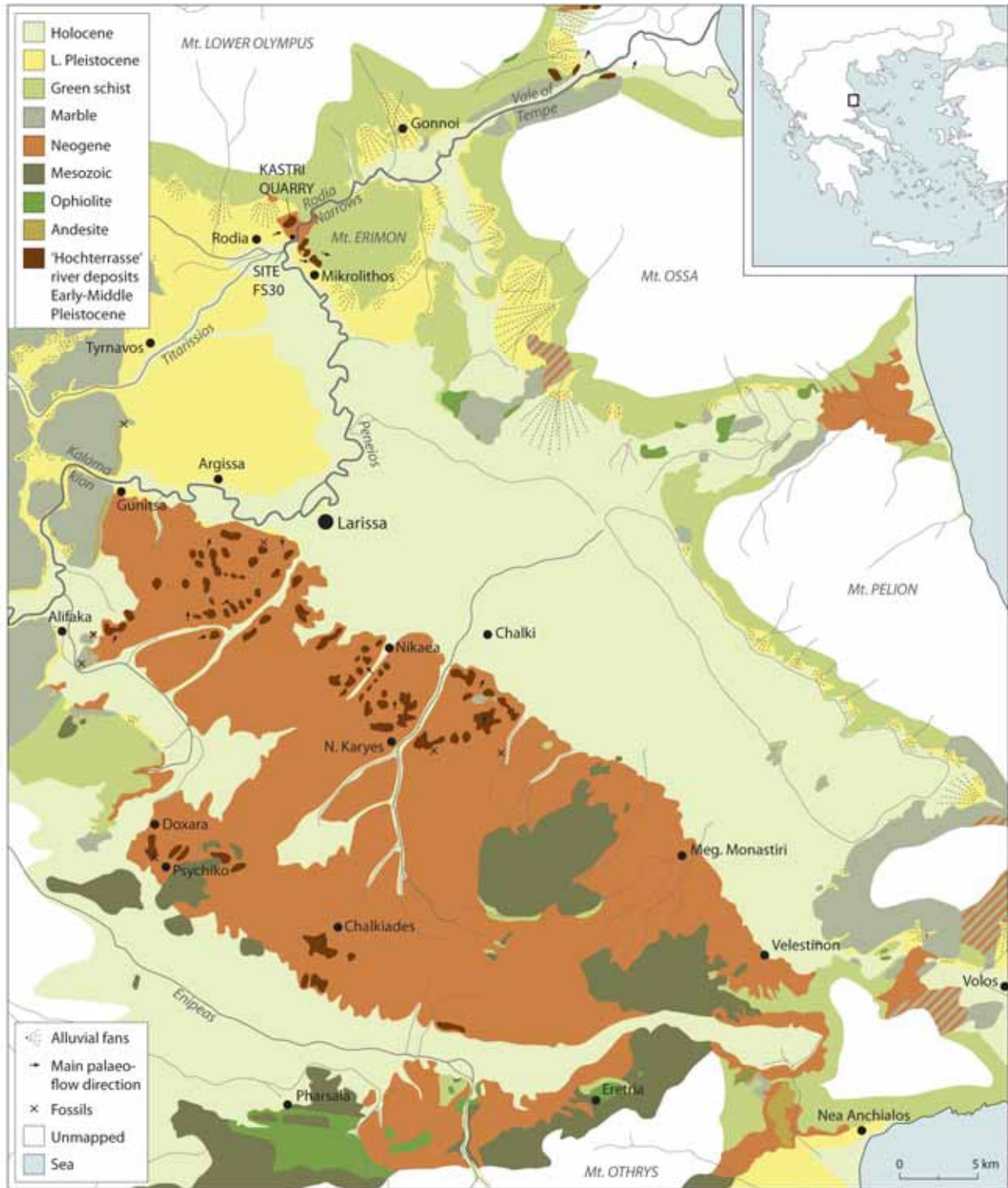


Fig. 4.21 Geological map of Thessaly, modified after Schneider 1968: Plate 66

tion, and the results can be tested against data for palaeoclimatic conditions in order to account for factors such as groundwater circulation and the overall in-

tensity of pedogenic processes (Sanisteban and Schulte 2007, 2747).

Nonetheless, the date fits well into the current chronostratigraphic framework of Thessaly, considering also that the sampled soil belongs to lower Hochterrasse deposits, for which there is another chronological indication, albeit of coarse resolution, provided by the elephant fossil (if it indeed derives from a lower unit of the Hochterrasse). It is precarious to speculate whether the dated carbonates were formed during a glacial or an interglacial climate; nonetheless, recent research on calcrete development from Spanish fluvial settings comparable to that of Thessaly showed that it is usually a phenomenon occurring during warm stages (Candy and Black 2009). As already noted though, the age of *ca.* 210 ka fits well into the general chronological framework and can be seen as an average-age constraining the upper end of Hochterrasse deposition, with a confidence level that, albeit tenuous, can be provisionally accepted.

Assessing the distribution and preservation of the Hochterrasse

Schneider's (1968) fieldwork in Thessaly included the mapping of the Early-Middle Pleistocene deposits (the Hochterrasse), as they occur on the surface, overlying the (Late Miocene-) Pliocene, predominantly lacustrine sediments. The Hochterrasse sediments are found distributed in two main areas: the first occupies part of the south-western section of the Middle Thessalian Hills, between the villages of Doxara and Chalkiades, whilst the second is on the northern border of the hills, to the west of the plain of Larissa (Fig. 4.21; App. II: 3); Schneider 1968, 22-23). The sediments of the south-west area are seen as material deposited by the Enipeas river, a tributary of the Pineios that transported gravels of chalky rocks of Mesozoic age, silicified sandstone (flysch?) and very few radiolarites from Othrys. In this area, the gravels reach altitudes up to 360 m asl and their high position can be explained by tectonic uplift (Philippon 1950), presumably related to the first tectonic phase that affected the area (*i.e.* Late Miocene/Pliocene-Early Pleistocene).

The Hochterrasse deposits of the northern distribution area belong to material accumulated by the Pineios and they are distinguished from those of the Enipeas, not only in terms of their lower elevations, but also by their greater thickness and extent of distribu-

tion, as well as by specific petrographic constituents and the degree of rolling that is evident in the gravels. Medium- to well-sorted gravels of limestone, chert, sandstone, quartzite, milky-quartz, diabase, mica schist, gneiss and granite constitute the main components, whereas thin lenses of coarse- to fine-sand and clay are found intercalated, but they usually thin out laterally.

Post-depositional, erosional surface processes have much disturbed the geometry of the original fluvial landscape, and as a consequence, it is nowadays difficult -if not impossible- to macroscopically ascertain the initial extent and thickness of morphological terraces. Schneider (1968, 23) explicitly addresses this point when he reports that a precise separation of different terrace-levels is problematic. Whereas in some places the terrace-deposits are now found as a mere thin mantle of shallow thickness (just a few meters), they are locally present in considerable thickness (*e.g.* about 25 m to the north of Neae Kariae). Owing to erosion and tectonic displacements, this discontinuity in both the horizontal and the vertical arrangement of the river gravels hampers the identification of river terraces, and, that is, also their altitudinal levels and their stratigraphic relationships (*cf.* Milojević *et al.* 1965, 9-10). This is probably why Schneider did not attempt to discriminate between 'cut-in-fill' (erosional) and 'aggradational' ('fill' or 'depositional') terrace-treads³⁴. Nonetheless, the mapping allowed him to recognize two broad subdivisions of the Hochterrasse according to the elevations of the gravel-occurrences, at 30 to 60 m (lower Hochterrasse) and at 70 to 130 m (upper Hochterrasse) above the modern Pineios floodplain, *i.e.* at 100-130 m and 140-200 m asl respectively, as the Pineios floodplain level is at *ca.* 70 m. asl at the region of Larissa. The complexity of the stratigraphic associations between the different terrace treads and their corresponding sediments -*i.e.* the questions of which treads are erosional, how many depositional fills/events are they represented, what is their chronostratigraphic ordering- is dramatically illustrated in exactly this subdivision of the Hochterrasse gravels by Jung and Schneider, after their inspection of the area in 1959: "Die

34. See section 5.2 for the nomenclature of erosional and depositional terraces.

Terrassen von 70-130 m und von 30-60 m wurden *aus Gründen einer zweckmaessigen Beschreibung, und ohne damit eine zeitliche Einordnung suggerieren zu wollen*, obere und untere Hochterrasse genannt...Alle erwähnten Terrassen sind *Akkumulationsterrassen*, (Milojčić *et al.* 1965, 8; emphasis added). The terrace-treads of both the modern, active floodplain (Late Holocene to present) and the Niederterrasse (Late Pleistocene to Middle Holocene) can be generally regarded as representing fill terraces (*i.e.* depositional or “Akkumulationsterrasse”). However, there are exceptions where the surfaces of the latter have been locally truncated by the former. In this case, the active floodplain rests discomformably on truncated Niederterrasse surfaces (*cf.* Demitrack 1986, 33); such erosional/truncated surfaces, whether refilled by modern floodplain sediments or not, represent (erosional) events that postdate the depositional fill of the underlying (Niederterrasse) sediments (App. II: 4). Therefore, even in the relatively straightforward cases of the latest two alluviation episodes of Thessaly (the Niederterrasse and the modern), terrace-levels do not necessarily represent “Akkumulationsterrassen”. This situation is even more complex with regard to the ‘upper’ and ‘lower’ Hochterrasse. For the former, whereas the base lies at *ca.* 140 m asl and its upper end rises to *ca.* 200 m asl or more, thus implying a thickness of at least 60 m, nowhere could such a thickness be securely detected. The researchers could not explain this adequately and they assumed that either the thickness is indeed 60 m (but nowhere entirely exposed), or “there are several terrace-levels inserted into each other”, or the original altitude of the terraces has been locally changed due to tectonic uplift and subsidence (Milojčić *et al.* 1965, 10). The latter two explanations imply the possible existence of erosional terrace-treads. In other words, were it not that the Hochterrasse has been poorly preserved, its reconstruction being essentially depended on isolated, discontinuous ‘gravel-pockets’, Schneider and Jung would not be so wavering in considering the *upper* Hochterrasse as *older than its lower counterpart*, as it would be the normal situation within a stepwise-terraced floodplain setting, especially when they claim that “all of the mentioned terraces are aggradation-terraces”.

Both the lower and the upper units of the Hochterrasse share practically similar lithographic compo-

nents. One significant difference in this respect is that the ‘red chert’ (radiolarite) is rare in the lower Hochterrasse. Apart from that, there is only slight divergence in terms of their general sedimentary structure and bedding, the texture, and the degree of rolling that is evident in the gravels (see and compare exposed sediments in App. II: 5, 6, 7). Most importantly, the upper Hochterrasse includes a “lime bank” and two distinct “red loam” horizons, whereas a loam-horizon “with a structure completely similar” is to be found within the lower Hochterrasse gravels as well (Milojčić *et al.* 1965, 10). I consider the lime-bank as the Bca or K horizon of a paleosol, and the red loam as corresponding to a pedogenic Bt horizon (App. II: 8). In fact, Demitrack’s (Early-) Middle Pleistocene soil “on terrace fragments upon the Pliocene hills”, from which she obtained the U/Th date, fits the descriptions of Schneider and Jung, although the latter did not recognize it as a soil (compare Demitrack 1986, 42 and Table 3 with Milojčić *et al.* 1965, 9-10).

Revisiting findspot FS 30 at Rodia: the geomorphological setting, the role of tectonism and the argumentation for an attribution to the Lower Palaeolithic

Apart from the above-described Hochterrasse deposits on the Middle Thessalian Hills, early Pleistocene fluvial sediments have been preserved on the north-eastern border of the Larissa Plain, specifically to the NE of the village of Rodia, at the point where Pineios enters the Rodia Narrows (see Fig. 4.21). The river cuts through a southern-projecting spur of the lower Olympus to the NW and the mountain ridge of Erimon to the SE, then it continues through the Vale of Tempe and finally forms its delta at the Aegean coast. According to Schneider (1968, 64), Neogene sediments up to 45-60 m-thick that are exposed at the entrance of the Rodia Narrows, testify to the existence of an older valley-remnant occupying the lowland area between lower Olympus and Erimon mountains, which was cleared-out and then partly refilled by the Pineios river in the early Pleistocene. The Neogene bedrock comprises mainly of conglomerates, with pebbles of various lithological origins intercalated with more fine-grained, medium-consolidated pebbles. The gravels of the Hochterrasse, for

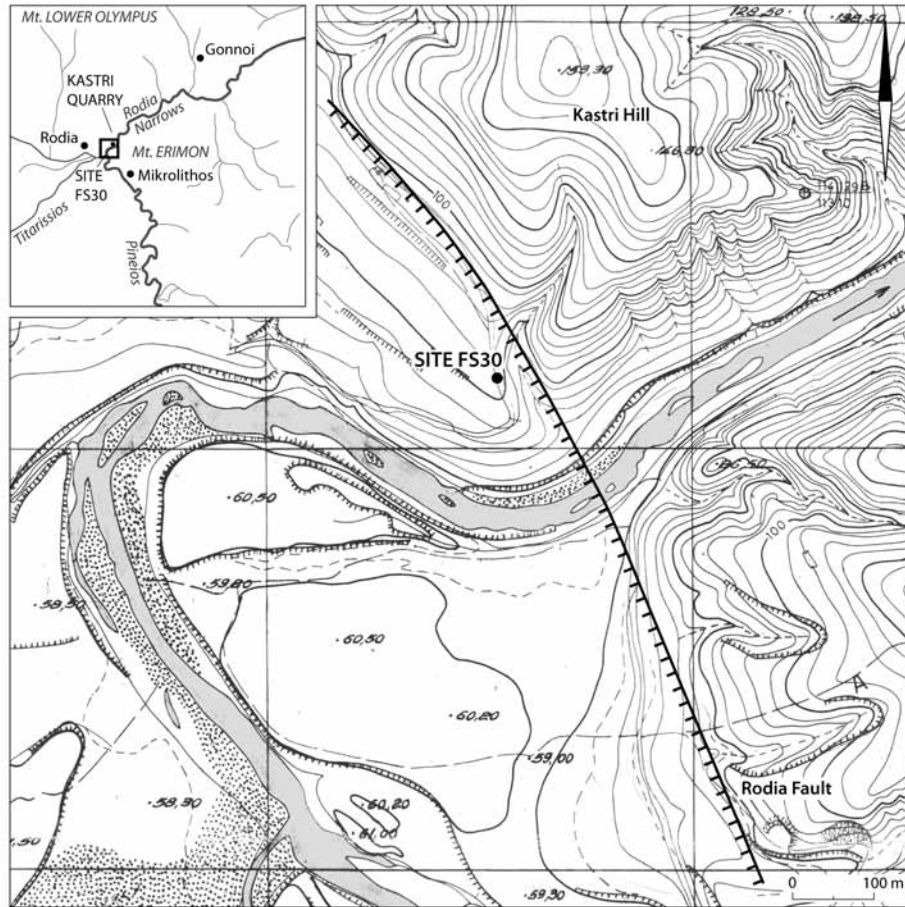


Fig. 4.22 The location of FS 30 and Kastri Hill. The main segment of the Rodia Fault System affecting the fluvial deposits at and around FS 30 is also shown

which the abbreviation HT is used hereafter, lie directly upon those sediments.

The FS 30 site is located at the west entrance of the Rodia Narrows, 20 to 40 m above the river level and around 100 m to the north of the first meander-loop of Pineios as it enters the gorge (Fig. 4.22). Runnels and van Andel (1993b, 303) report that most of the artefacts were collected from the surface of a river terrace, but some of them were found stratified in an exposed profile of that terrace. Upon discovery, more than a few of the surface finds were still embedded in outcrops of the terrace deposits, whilst some were still covered with calcium carbonate, which is the cementing material of the matrix (*ibid*). Both surface and stratified finds are in “fresh, mint condition with no signs of weathering or battering from transport downslope by erosion” (*ibid*, 304). According to the

latter researchers, all of the above observations indicate that the assemblage as a whole should be viewed as deriving from the terrace. My inspection of the assemblage (total: 65) in the storage-rooms of Larissa’s Archaeological Service corroborates the assessments of Runnels and van Andel (1993b). The material consists of large flakes with large platforms and bulbs indicative of hard percussion, bifacially flaked cores and core-choppers, but also globular or amorphous cores, and retouched pieces predominated by notched and denticulate specimens, often displaying the so-called Clactonian notches, while the Levallois technique is absent; the artefacts are overall in a fresh condition and many of them retain on their surfaces sediment-crusts from the matrix in which they were once embedded (Fig. 4.23).



Fig. 4.23 Quartz artefacts from site FS 30

The stratigraphy of the exposed section is described as “CaCO₃-cemented, medium to well-sorted, coarse sands and sandy gravels”, with “sub-rounded to rounded pebbles of limestone and quartz, ophiolites and a distinctive reddish-brown radiolarite” (Runnels and van Andel 1993b, 305). Based on this lithological composition, the researchers correlated the artifact-yielding terrace deposits of FS 30 to Schneider’s Hochterrasse. This correlation is thought to be supported by the identification of HT gravels some hundreds of meters higher upslope from the findspot, where sands and gravels lithologically identical to those exposed at FS 30, crop out, in accordance with the position of the Hochterrasse remnants in Schneider’s map (Runnels and van Andel 1993b, 307).

Schneider observed four HT levels and the Niederterrasse in the area to the north of Mikrolithos and before the Rodia Narrows, so, most probably to the east of the river before it enters the Narrows, at the foothills of Erimon Mt (App. II: 9). In this region, the terrace-development of the Hochterrasse is, at least morphologically speaking, better preserved. Indeed, (HT?) terrace-treads can be identified already with a superficial look at the 1/5000 topographic map. Although it is impossible to conclude on the precise elevations without detailed fieldwork, the map indicates that the most prominent terrace-treads lie at elevations of *ca.* 62 m, 75 m, 88 m, 99 m and 110-113 m above the river (122 m, 135 m, 148 m, 159 m, and 170-173 m asl respectively). The four Hochterrasse levels that Schneider reports (1968, 25-26) occur at

the following elevations (all counted as above the river level, which is at *ca.* 60 m at Rodia): (1) 55 m (2) 60-62 m (3) 75 m (4) 85 m, whereas the Niederterrasse is at 15-20 m (60-80 m a.s.l.). Runnels and van Andel (1993b, 307-308) assume that the FS 30 deposits would correlate to one of these four HT-levels, “probably to one of the younger ones”, thereby implying the lowest ones; that is, either the one at 55 m or the next one, at 60-62 m. Since the FS 30 gravels are spread at 20-40 m above the river level, and the Niederterrasse is reported to occur at 15-20 m, the findspot is only a few meters above the altitude at which the Niederterrasse is deposited. To explain this, Runnels and van Andel (*ibid*) note that the findspot’s strata are tilted 12°-15° southward due to down-faulting, by faults that are visible at the gravel/Neogene contact at the entrance of the Narrows.

In search of the Hochterrasse gravels with which the FS 30 deposits have been correlated, I surveyed the ‘Kastri hill’, directly adjacent to the reported location of FS 30 (Fig. 4.22). This is a generally gently sloping hill, with three prominent peaks at 138 m, 143 m and 153 m asl. Two ravines dissect the hill in directions N-S and NW-SE, respectively. Fluvial gravels are being found at various parts of the hill’s surface and in different densities, whereas overland flow channels the gravels inside the ravines, transporting them down to the river level. At the NW side of the hill there is a large quarry (hereafter referred to as ‘Kastri Quarry’), which is the place where Runnels

and van Andel identified the Hochterrasse deposits (Runnels, personal communication 2007).

A dirt road leading inside the Rodia gorge separates the quarry into two parts, northern and southern. At both sides of the quarry there are long sections (*e.g.* up to 30 m long at the northern side) exposing fluvial deposits that cap the Neogene substratum. Because both exposures (north and south) apparently belong to a single formation, they are grouped here under the name Kastri Quarry (App. II: 10). The section of the southern side (App. II: 11) is about 10 m high, with its exposed base at 60 m above the river (120 m asl) and its top at 70 m (130 m asl). These fluvial sediments most probably represent channel- and bar-deposits of a high-energy braided river, as their bedding and structure seem to suggest. Coarse sands and gravels, well-rounded and medium- to well-sorted, are in places cross-stratified, and occasionally intercalated with lenses of clay and/or loam, as well as with layers of organic material with a characteristic dark colour (App. II: 12). The stratigraphy of the section at the northern side of the quarry is almost identical to the one described above for its southern counterpart (App. II: 13). The base of the section is at *ca.* 45 m above the river (105 m asl), whereas its top is at about 75 m (135 m asl). At least four normal faults are visible on this profile, and the cumulative fault-throw observed was estimated to be *ca.* 12 m (App. II: 14). Two (antithetic?) normal faults are exposed in the southern section as well.

The exposed gravels are small in size -the largest ones with an average diameter of less than 5 cm- and comprise basically of radiolarite, limestone, quartz, schist, serpentine, gneiss, gabbros, as well as other types of ophiolites. This lithological composition is in marked contrast to that of the Niederterrasse and leaves no doubt that the sediments exposed at Kastri Quarry belong to fluvial deposits other than that of the Niederterrasse. As they lie directly over the Neogene sediments, it is reasonable to assume that they are part of the Hochterrasse, in accordance with Schneider's cartographic indications and the assertion of Runnels and van Andel (1993b). On the other hand, it is difficult to macroscopically assess to which of the two HT units (lower and upper) they should be attributed (*if* such an attribution is deemed both realistic and necessary for Rodia in the first

place; see below). Besides the fact that the two HT units share a similar petrographic make-up, the faulting visible in the exposures has obliterated the original altitudes of the levels of the terrace-treads. In fact, at least two of the four terrace-treads designated by Schneider in his cross-section of the stratigraphy (the one exposed to the north of Mikrolithos mentioned previously, see App. II: 9), have been subjected to down-faulting, as Schneider indicates with the faults shown in his section. The profiles seen at Kastri quarry and the broader region of Findspot FS 30 reflect a similar situation, where the effects of tectonism are now masking the original stratigraphic sequence and associations. Fluvial gravels are lying even on the top of the Kastri hill (at about 150 m asl), thereby implying a thickness of more than 45 m for the deposits that crop out at the adjacent quarry. Indeed, it is very likely that the >30 m-thick deposits exposed here represent one single terrace fill (*i.e.* a 'depositional terrace'); if this is the case, then the only depositional terrace-tread belonging to this fill is the uppermost (at *ca.* 145-153 asl, *i.e.* 90-98 m above river level; App. II: 10); whilst the other observable levels are erosional, 'cut-in-fill' surfaces, *or*, alternatively, 'terrace-treads' that have been formed as a result of *faulting*, similar to that of T4 and perhaps also T2 depicted in Schneider's cross-section. Should the terrace treads visible at Kastri represent different depositional events, their associated sediments would differ in their lithological composition and/or structure, but this does not seem to be the case (hence their characterization as 'erosional terrace treads in App. II: 10); unless they are so akin that only detailed analyses could make a distinction possible, as it was mentioned before for the similarities between the lower and the upper units of the Hochterrasse. All the same, there may be considerable differences in the fluvial stratigraphy of the Rodia area compared to that of the Middle Thessalian Hills, reflecting disparities in generic/processual factors (*e.g.* local river pattern, hydrological regime, tectonic control on river's base-level) or variation in preservation conditions (tectonic displacements triggered by faults and more intense slope / erosional processes at the entrance of the Rodia Narrows). In other words, the subdivision of the 'Hochterrasse' at the area of Rodia could entail more and/or different units than the sequence seen at the Middle Thessalian Hills, and con-



Fig. 4.24 Exposed profile at FS 30. The dashed line shows the approximate position of the boundary between the two layers. 'Layer B' is overlain by recent debris from construction works

sequently it may not fit exactly into a twofold distinction between one 'upper' and one 'lower' unit.

On the other hand, should a stratigraphic partitioning of the Kastri gravels be considered possible, the Kastri terrace-fill would most likely correlate to the upper unit of the Hochterrasse, as the latter is exposed on the Middle Thessalian Hills. Notwithstanding the difficulties mentioned previously, the altitudinal occurrence of the gravels and the overall characteristics of the deposits (*e.g.* the abundance of radiolarite in the lithological composition and the exposed thickness of deposits) support an attribution to a fluvial landform equivalent to Schneider's 'upper Hochterrasse'. R. Caputo (1993; *pers. comm.* while inspecting together the stratigraphy at Rodia in 2008) considers the Kastri deposits as part of the Rodia Formation (formally defined in Caputo 1990), which represents a Pliocene palaeo-delta prograding southwards into the Pliocene-Early Pleistocene palaeo-lake. According to Caputo (2008, *pers. comm.*), the gravels at Kastri belong to the *upper Rodia Formation*, whilst their underlying red-coloured sandy sediments (mentioned above as 'Neogene') correspond to the *lower Rodia Formation*. In short, whether we consider them as the equivalent of the upper Hochterrasse, or as the upper Rodia Forma-

tion, the fluvial deposits exposed at Kastri Quarry would most probably be attributed to an Early Pleistocene depositional event (see also discussion below).

The area between the foothills of Kastri and Pineios has recently been leveled down by bulldozers for making it suitable for cultivation. As a consequence, the surfaces that once presumably belonged to a river terrace are now covered by ploughed fields. The deposits are therefore much disturbed and any attempt to macroscopically understand their original stratification or study their lithology is hampered by the fact that the sediments are highly mixed with earth-material and debris that has been transported from nearby sources. Nevertheless, radiolarite- and quartz-gravels are widely spread on those fields, but it is now impossible to unravel their provenance and association with river terraces. Although the area was carefully investigated, no artifacts were found.

The section of FS 30 is a small exposure situated at the western entrance of a ravine, at an elevation of *ca.* 20 m above river (80 m asl). Most of the section is now covered by debris, dumped here after the works for making the fields arable. Thus, only a small part of it remains exposed, with two sides at right angles, each of which is no more than 3 m long



Fig. 4.25 Closer view of the fluvial gravels of 'layer A' at the exposed section of FS 30

and 1-1,5 m high (Fig. 4.24). Notwithstanding their restricted extent, these two small profiles reveal the presence of fluvial sediments in the lowest part of the section (Fig. 4.24, 'layer A'; Fig. 4.25).

Coarse sands and gravels in various sizes are visible in what I designate here as 'Layer A'; the lithology includes all Hochterrasse-diagnostic elements, as the gravels consist mainly of radiolarite, limestone, quartz and schist (Fig. 4.25). Furthermore, the structure of the deposit is similar to that seen at Kastri Quarry, although in the latter case the gravels are generally better sorted and bedded (for a comparison see App. II: 15). Cross-stratification and clay/loam intercalations are not visible at FS 30 simply because the exposed profile is too small to include all elements seen at the >30 m-thick sections of the Kastri Quarry. Nevertheless, the general characteristics of

this layer, as well as its lithological components, provide secure evidence for a correlation with the Kastri deposits.

The two sides of the section display a dipping of the sediments towards south/southwest, in accordance with the reported "southward tilting" of the findspot strata (Runnels and van Andel 1993, 307). However, the fault that is responsible for the tilting is not exposed in those small profiles. 'Layer A' is conformably overlain by a partly brecciated layer ('B' in Fig. 4.24), the latter consisting of CaCO_3 -cemented, rounded, sub-rounded and angular stones, which include schist, quartz, limestone and ophiolites. In the photographs of the section published by Runnels and van Andel (1993b: fig. 5 and 16), it is not clear whether the artefacts were recovered from what is named here 'layer A' or 'layer B', or from both; in



Fig. 4.26 Closer view of 'Layer B'. The contact with the underlying 'layer A' is visible a little lower from the middle of the picture, immediately below the scale-bar, although it is hardly discernible because it is gradual. The scale-bar is 30 cm

fact, according to the captions of the photographs, the designated as the artefact-bearing part of the section probably *includes* what is denoted in Fig. 4.24 as 'layer B'. This layer displays essentially the same lithological composition with that of the underlying fluvial sands and gravels of 'layer A', although it appears to contain less radiolarites. However, its semi-chaotic structure (Fig. 4.26) is contrasted to that of layer A, where the gravels are medium- to well-sorted and better bedded.

The overall appearance and structure of 'layer B' (most notably the lack of clear sorting and bedding) may be seen as indicating an episode of colluviation. If this is the case, and if the stratified artefacts found by Runnels and van Andel did belong to this layer, then the postulated provenance of the artefacts from

a Hochterrasse deposit should be deemed dubious, and (some of?) the artefacts should be considered as deriving from a more or less reworked deposit. On the other hand, my inspection of the collected artefacts at the local museum confirmed that the material lacks evidence of battering and rolling by transport (*cf.* Runnels and van Andel 1993, 305), as it would be the case with a large-scale colluvial event. Furthermore, the boundary between the two layers is gradual to diffuse, implying no substantial hiatus, whilst the tilting due to down-faulting appears to have affected both layers equally (and/or simultaneously?). Taken together, these latter observations may be considered as indicating that, if there was a colluvial episode represented by 'layer B', then it could have occurred very close either to the time of

deposition of the underlying fluvial sediments or to the time of their exposure.

Another profile, 'Section C', is exposed between the FS 30 section and the river. It has a thickness of *ca.* 7 m, its base lying at about the river level (60 m asl) and its top at *ca.* 7 m (67 m asl). Here, Neogene deposits with coarse-grained sands and gravels are overlain by 'Hochterrasse gravels' that have been much eroded, down-faulted, as well as quarried in recent times (App. II: 16, 17). The attribution of the fluvial gravels to Hochterrasse deposits is again based on their diagnostic lithology, namely the presence of the distinctive reddish radiolarite, as well as quartz, limestone and schist. The bedding and structure of the deposit are reminiscent of those described for the Kastri Quarry, and leaves no doubt that these sediments, above the Neogene strata, belong to the Hochterrasse and not to the Niederterrasse. Three fault planes (and associated slickensides) of three, almost parallel faults, are visible in this section. The fluvial sediments have been down-faulted and tilted as part of the hanging-wall of the last, southernmost fault. The presence of these faults and the occurrence of river deposits equivalent to the Hochterrasse (or, the upper Rodia Formation?) at almost the river level provide direct evidence for the effects of tectonism at the region of Rodia.

4.6.5 Conclusions and discussion

The fluvial gravels at FS 30 (*i.e.* 'layer A' in Fig. 4.24) have been correctly correlated by Runnels and van Andel (1993b) with the terrace deposits exposed at Kastri Quarry; both belong to (sediments correlative to) the Hochterrasse and most probably to a HT-fill equivalent to Schneider's upper unit, *or*, to the upper part of Caputo's (1990) Rodia Formation. In either case, their age is in all likelihood older than originally suggested (200–400 ka), probably reaching back to the Early Pleistocene, particularly if they should be regarded as part of the upper Rodia Formation. Yet, this chronological estimation still relies on a relative dating that is essentially based on the tectosedimentary history of the area and the meager indications provided by palaeontological evidence³⁵ (*cf.* Schneider 1968; Caputo 1990; 1993; Caputo *et al.* 1994). Still, if the artefacts collected by Runnels and van Andel derive from the fluvial sediments exposed

at FS 30, namely from what was called here 'layer A', they could be seen as the earliest artefacts in Greece. For the time being, however, this cannot be neither confirmed nor falsified. The artificiality of the artefacts from FS 30 is beyond doubt, the Levallois technique is indeed absent from the assemblage, the condition of the specimens precludes any large-scale reworking, and the typo-technological characteristics of the implements would support an attribution to the Lower Palaeolithic. Nevertheless, due to the recognition of what I designate here as 'layer B' and because it is possible that the artefacts may have been retrieved from that layer, the stratigraphic context of FS 30 should be deemed dubious, for it may represent a reworked deposit; in effect, the assemblage cannot be attributed to the Lower Palaeolithic *on secure chronostratigraphic grounds*. Having said that, I still consider the Thessalian basin in general and the area around Rodia and the Middle Thessalian Hills in particular as a region that needs to be further investigated for Lower Palaeolithic sites. The large lake of the Early Pleistocene would have served as a productive habitat, attracting animals and humans. Even if associated with an equivocal context, the quartz artefacts from FS 30 certainly differ from the Middle Palaeolithic specimens of the Larissa district (which are made on flint) and could be seen as at least underlying the prospects of Thessaly in contributing to the Lower Palaeolithic record of Greece.

Fault planes were identified at the Kastri Quarry at *ca.* 70 m above the river level (130 asl) and at section C at almost the river level (60 asl), whilst the presence of a fault somewhere close to the FS 30 profile at *ca.* 20 m above river (80 m asl) can be securely assumed by a number of morphotectonic indications, as well as the tilting of the gravels (R. Caputo 2008, *pers. comm.*). These faults are most probably part of the Rodia Fault System, which is a 15 km-long composite fault zone (*ibid*; App. II: 18). It includes different segments that were formed during the two major

35. Apart from the faunal remains discussed in 4.6.4, Caputo (1993, 447) cites a written communication by D. Esu for "micropaleontological dating of some samples collected in the northern Larissa plain" which confirms a "Late? Villafranchian" age for the "higher lacustrine layers", *i.e.* presumably for the upper parts of the lower Rodia Formation.

Geological Formations	Extent (km ²)	Percentage on total (%)
Quaternary ¹	1165	27. 6
Neogene ²	647	15. 3
Holocene alluvium ³	2375	56. 3
Hochterrasse outcrops ⁴	34	0. 8
Total⁵	4221	99. 0

Table 4.4 Distribution of Neogene and Quaternary formations in the lowlands of Thessaly. 1) fluvial deposits of the Larissa Plain, *i.e.* the Niederterrasse (mainly in the Tyrnavos basin) and the Holocene alluvia 2) Late Miocene to Late Pliocene (?) fluvio-lacustrine deposits outcropping on the Middle Thessalian Hills, measured on the map of Schneider (1968; scale 1: 150,000) 3) Holocene fluvial sediments of the Karditsa basin 4) Hochterrasse (*i.e.* Early and Middle Pleistocene) deposits measured on the map of Schneider (1968) 5) In total, all of the above account for the deposits covering the main lowlands of Thessaly. (1) and (3) were measured on the Geological Map of Greece (scale 1: 500,000). All measurements taken with planimeter 'HAFF no. 317'; accuracy checks by comparing readings taken on the two different maps showed insignificantly small variations in the results. Nonetheless, the values cited here are not meant to represent high-accuracy readings, but rather the general pattern of distribution.

tectonic phases: the first occurred during Pliocene to Early Pleistocene and resulted in extension with a NE-SW direction, whilst the second phase took place during Middle Pleistocene to Holocene and had a N-S direction of extension (Caputo and Helly 2005, 154). According to previous detailed morphotectonic investigations, the abovementioned faults trending NW-SE (exposed at Kasti Quarry; at section C; and indirectly at FS 30), were activated during the first tectonic phase (Caputo 1993, 453 and his fig. 5). In so far as the age of the faulting is considered well-constrained (*cf.* *ibid*; Caputo and Helly 2005), it provides a *terminus ante quem* for the age of the deposits that it affected. In fact, Caputo (1993, 453) states that “this set of faults was undoubtedly active during the Pliocene and probably later (Early Pleistocene?)”; nonetheless, there remains a possibility that some of these fault-segments were *re-activated* during the second phase (Middle Pleistocene).

Can down-faulting explain the altitudinal occurrence of ‘Hochterrasse-type’ gravels as low as 20-40 m above the river level (FS 30 section) and even at almost the river level (section C)? Caputo (1993, 455) notes that “according to the age of the involved materials, all these features quantitatively indicate some tens of meters of displacement since Late Pleistocene and some hundred since Pliocene”. Therefore, by assuming a *minimum* dislocation of about 10-20 m. we can adequately explain the occurrence of fluvial material exposed at FS 30 at *ca.* 20 m above the present river level.

The abundant evidence of faulting at the region of Rodia provides direct and indirect indications on the efficacy of tectonism in disrupting and dislocating the sediments accumulated by the ancient Pineios River. The Rodia Fault System affects the equilibrium conditions of the hydrographic system in this area, by mainly controlling the base-level of Pineios, as the activation of the fault causes a segmentation of the river’s profile upstream and downstream with respect to the fault (Caputo *et al.* 1994, 227). Subsidence caused by the Rodia Fault forces the river to aggrade in the northern part of the Tyrnavos basin, whilst subsidence related to the activity of the Omolios Fault results in regressive erosion and incision along the Rodia Narrows (*ibid*). In the former case, re-activation of the fault system from the Middle Pleistocene up to the present can be seen as responsible for the burying of the older, Early Pleistocene fluvial deposits of the Tyrnavos basin; whereas in the latter case, the movements along the Omolios fault generate erosion of the fluvial deposits in the area of Rodia. In turn, it is such erosional cycles that, on one hand obscure the geometry of the fluvial stratigraphy (*e.g.* any development of terrace-staircases), but, on the other, expose the Early Pleistocene sediments and any associated archaeological material (hence increasing their visibility).

Fluvial sedimentary sequences can be divided in two main groups according to their style of preservation (*e.g.* Bridgland and Westaway 2008a): 1) stacked deposits in superposition 2) terraced sequences. Both of these two types of alluvial preservation is found in

Thessaly: the former involves the subsiding Larissa Basin, in which the earlier phases (Early and Middle Pleistocene) are buried under the younger alluvia (Niederterrasse and modern floodplain deposits), whilst the latter entails uplifted regions and engages the Hochterrasse remains at the Middle Thessalian Hills, as well as those at the north-eastern margin of the plain, to the NE and SE of Rodia. Therefore, it is this tecto-sedimentary evolution, coupled by climatic and sea-level controls (and altogether acting upon an inherited Pliocene palaeotopography), which explains the current pattern of preservation and visibility of Early and Middle Pleistocene sediments in Thessaly. Although this is the largest lowland district, filled with fluvial deposits of the third largest river in Greece, hence a potential target for Lower Palaeolithic investigations, the available geological opportunities for the discovery of Lower Palaeolithic material are dramatically too few (Table 4.4).

Thus, the exposed Early-Middle Pleistocene sediments account for only 0.8 percent (*at most*) of the main basinal, low-gradient areas of Thessaly, whilst a more detailed mapping and/or measurement would most probably *decrease* this percentage even further. Viewed both as a net value (34 km²) and as a percentage on the total amount of lowland areas (0.8%), this figure vividly shows the restricted exposure of Early-Middle Pleistocene deposits, and hence also how exceptional the recovery of Lower Palaeolithic archaeological material is.

Key-issues for future research

Empirical evidence has led to the consensus that fluvial terrace-staircases are the result of the combined effects of surface uplift (of either tectonic or isostatic origin), which provides the impetus for incision, and the cyclic climatic triggering of fluvial activity, which largely drives the balance between depositional and erosional river behavior (*e.g.* Bridgland *et al.* 2004). On these grounds, future research on the fluvial stratigraphy of Thessaly in general and the (terrace-) development of the Hochterrasse in particular (*viz.* the pre-Niederterrasse fluvial deposits) needs to address the following central points:

1. How many glacial-interglacial cycles and/or transitions are represented by the Hochterrasse-type deposits, and to what degree was climatic

forcing coupled with tectonic controls? Terrace formation requires uplift mechanisms, related to either regional uplift or localized tectonic effects (and both can be potentially demonstrated to be affecting the course of Pineios through the Thessalian plains), but also climate-induced changes in sediment supply (*e.g.* Bridgland and Westaway 2008b). Is the formation of terraces in Thessaly a climatic or a tectonic phenomenon, or does it involve equally both factors? Schneider noted that there is no clear and conclusive evidence to answer this question, but he explicitly favored climate as the prime agent. Archives of climate change such as the pollen records of Ioannina and Kopais show that during cold spells, reduced and open vegetation cover promoted slope destabilization and enhanced erosion, resulting in relatively high levels of sediment transport and deposition (*e.g.* Tzedakis 1994; Roucoux *et al.* 2008; see also section 6.2). It is thus possible that many Hochterrasse fills may be reflecting such increased discharge regimes, prevailing either during cold periods or in cold-to-warm transitions, whilst cut-in-fill terraces could be attributed to warmer periods of reduced sediment supply and episodes of incision. Much due to their threshold-dominated nature, fluvial systems entail complex responses to climatic fluctuations and tectonic forcing, but it would not be unanticipated to find both climate and tectonic controls (periodically) acting somewhat in phase. Moreover, there is ample evidence to suggest that pre-Middle Pleistocene terraces indicate extensive alluviation and wide palaeo-floodplains, in contrast to terraces younger than *ca.* 900 ka, which designate greater vertical incision and the development of narrower valleys (Bridgland and Westaway 2008b). Future investigations can test whether such a picture is also demonstrable for the Thessalian fluvial sequence, perhaps reflected in the differences in preservation of what Schneider identified as the upper and lower units of the Hochterrasse. Within the catchment, differences in HT terrace morphology/preservation (for instance regarding their separation in vertical extent mentioned earlier) could reflect the changes in climatic periodicity/intensity introduced by the 'Mid-Pleistocene Transition', coinciding with a global increase in uplift rates

(Westaway 2002)³⁶; alternatively, this could be an artifact of preservation due to differences in channel types (*i.e.* braided versus meandering; *e.g.* Vandenberghe 2008). The study of the longitudinal profile of the Pineios, especially in places where it cuts across fault lines, could also provide further indications on the effects of tectonism in the river's history and the sedimentation/incision cycles.

2. When was the Pineios-dominated hydrological regime first established and how was the palaeotopography that it inherited? In discussing the fluvial deposits at the Rodia area, Schneider (1968, 64) notes the evidence for a (Late?) Pliocene valley remnant, through which material from lower Olympus was once transported in the Larissa basin, namely *in opposing direction to the later course of the Pineios*. Caputo and Helly (2005, 154) consider the Rodia Formation as belonging to a “palaeo-delta prograding southwards into the Pliocene-Early Quaternary Thessalian Lake”, whilst Caputo (1993, 447) asserts that “only in Middle Pleistocene the environmental conditions became typically subaerial”. Lithological analyses could aid in distinguishing different sources of the transported material (from the Pindus Mountains versus the lower Olympus) and shed light to the timing of potential drainage diversion, the emptying of the Pliocene palaeo-lake and the formation of the Middle Thessalian Hills.
3. Any resolving of the Early-Middle Pleistocene stratigraphy of Thessaly is fundamentally dependent upon the improvement of the regional chronostratigraphic framework. To this end, apart from possible applications of numerical-age dating techniques, a combination of various lines of indirect dating evidence may be applicable, albeit in varying degrees of potential success, wherever biostratigraphic, pedostratigraphic and palaeomagnetic data can be used as chronological reference-points in the ‘sequencing’ of events. For instance, Smith *et al.* (1997) have already

attempted a tentative correlation of the Olympus piedmont deposits with the soils developed on the alluvial sediments of the Larissa Basin. Palaeopedological comparisons with paleosol chronosequences from the nearby Olympus or Pindus Mountains may prove to be problematic and indeed questionable, *e.g.* by only considering the differences in geomorphological settings, but they may still yield valuable data, especially in cases where radiometric assays cannot provide conclusive results. In this respect, future attempts to better date the Thessalian fluvial sequence could take into account the relevant indications provided by the pollen records of Ioannina and Kopais (Tzedakis *et al.* 2002b; Okuda *et al.* 2001), the glacio-fluvial stratigraphy of Pindus (Woodward *et al.* 2008), and perhaps also any correlative sea-level data from the Gulfs of Pagasitikos and Thermaikos³⁷ (Lykousis 2009).

4.7 PELOPONNESUS

4.7.1 Peiros River valley

A. Darlas (1999) reports on a (unspecified) number of artefacts that he collected from the terraces of the Peiros river in western Achaia; as he notes, “most of them were discovered on the surface, a few within sections, while others were collected in the refuse left by industrial construction” (*ibid*, 307). The middle of the three fluvial terraces was the one most intensively surveyed, producing the largest number of artefacts, including those that have been attributed by the researcher to the Lower Palaeolithic period. These are “rolled and very altered artefacts”, mainly “pebble-tools and elementary cores”, thought to be derived from a “dark red clayey deposit”, although it is not specified whether the specimens were found stratified or on the surface (*ibid*). Some much rolled pebble-tools that were found elsewhere on the same terrace are considered to be also attributable to the Lower Palaeolithic (*ibid*). The middle terrace where

36. It is interesting to note here that the observed global increase in surface uplift rates around the Late Pliocene and early Middle Pleistocene largely coincides with the two major tectonic phases affecting the Thessalian landscape.

37. It would not be unreasonable to assume that sea-level oscillations might have had a direct influence on Pineios' profile downstream from the western entrance of the Rodia Narrows, perhaps indirectly affecting also its base-level upstream from the entrance of the Narrow (*cf.* Caputo *et al.* 1994, 227).

the artefacts were found is considered to date to the 'Riss' (Dufaure 1975 cited in Darlas 1999), but apart from this chronological estimation, there is essentially no other information in support of an attribution of the artefacts to the Lower Palaeolithic period. Importantly, there is also no argumentation on whether the tread of the respected terrace has been formed as a result of an erosional or a depositional event; if this is an erosional, 'cut-in-fill' terrace-level, it is of little value whether the terrace dates to somewhere between MIS 6 to 10, as implied by the ascription to the 'Riss'³⁸. All the same, it appears that the attribution of the artefacts to the Lower Palaeolithic period is in this case mostly based on typo-technological criteria, hence it remains tenuous.

4.7.2 Megalopolis Basin

Already from the beginning of the 20th century, the Megalopolis Basin (Fig. 4.27) has been repeatedly studied, first and foremost as an important palaeontological site, but also with regard to palaeoenvironmental, geophysical and magnetostratigraphic analyses, while the thick lignite seams of the basin are being exploited in opencast mines since the 1960's (e.g. Skuphos 1905; Melentis 1961; Vinken 1965; van Vugt *et al.* 2000; Okuda *et al.* 2002; Siavalas *et al.* 2009). This intramontane depression was formed during the Late Miocene-Pliocene as a result of extensional tectonic movements along a series of normal faults that define its eastern boundary (Vinken 1965). Subsistence continued in Pliocene-Pleistocene times and the basin hosted a large lake, which covered mostly the western part of the depression and was periodically turned into a shallow swamp (*ibid.*). As a result of the half-graben configuration, the lake bottom dipped gently along the western margin, where organic material accumulated, whereas detrital sediments are more abundant in the eastern part, where subsidence was more intense along the steep faults. At some point, probably in the late Pleistocene, the present drainage system was established

and the Alfeios river drained the lake, incised into the lacustrine sediments and formed river terraces.

The Pliocene-Pleistocene sedimentary sequence includes lacustrine and fluvial deposits that reach an aggregate thickness of more than 250 m. and are divided into six Formations (Vinken 1965): the Makrision and Trilofon Fm's date to the Pliocene and consist of lacustrine (lignite, marl) and fluvial (sands, gravels) sediments, respectively; the Apiditsa Fm is more than 70 m-thick and comprises fluvial sands and gravels of Early Pleistocene age; the Choremi Fm dates to the early and middle Pleistocene and is subdivided into the Marathousa and Megalopolis Members, which include lacustrine and fluvial sediments, respectively; the Potamia and Thoknia Fm's date to the Middle-Late Pleistocene and essentially mark the end of the limnic conditions and the development of a fluvio-terrestrial depositional regime; finally, the latter Fm's are overlain by Holocene coarse clastic sediments deposited by Alfeios and its tributaries. Of particular interest to this study and to future archaeological investigations is the middle Pleistocene Marathousa Member, which contains lacustrine clay, silt and sand beds with freshwater bivalves and ostracods, intercalated with thick lignite seams (Vinken 1965). The rhythmic alteration of lignite seams with detrital layers reveals a pattern of large- and small-scale lithological cycles. Cyclostratigraphic and palynological studies (van Vugt *et al.* 2000; Okuda *et al.* 2002) indicate that the large-scale cycles represent glacial-interglacial alternations related to the eccentricity-forced periodization (*ca.* 100 kyr), while the small-scale cycles relate to precessional forcing (*ca.* 20 kyr). Most likely, the detrital beds were formed during cold and dry periods when reduced vegetation promoted erosion, whilst lignite and organic layers accumulated during periods of warmer and more humid conditions (van Vugt *et al.* 2000).

Sickenberg (1975) identified eleven species of large mammals from the Marathousa Member, including *Mammuthus (Archidiscodon) meridionalis*, *Hippopotamus antiquus*, *Praemegaceros verticornis* and *Stephanorhinus etruscus*; based on correlations with other European faunal assemblages (e.g. Ponte Galeria, Voigtstedt, Petralona) he dated the fauna to the Early Biharian (Early and Middle Pleistocene). A more recent study of the Marathousa fauna identified

38. For artefacts found on the surface of fluvial terraces, it is important to distinguish between fill (depositional) terraces from 'cut-in-fill' (erosional) terrace-treads. This is discussed further in section 5.3.

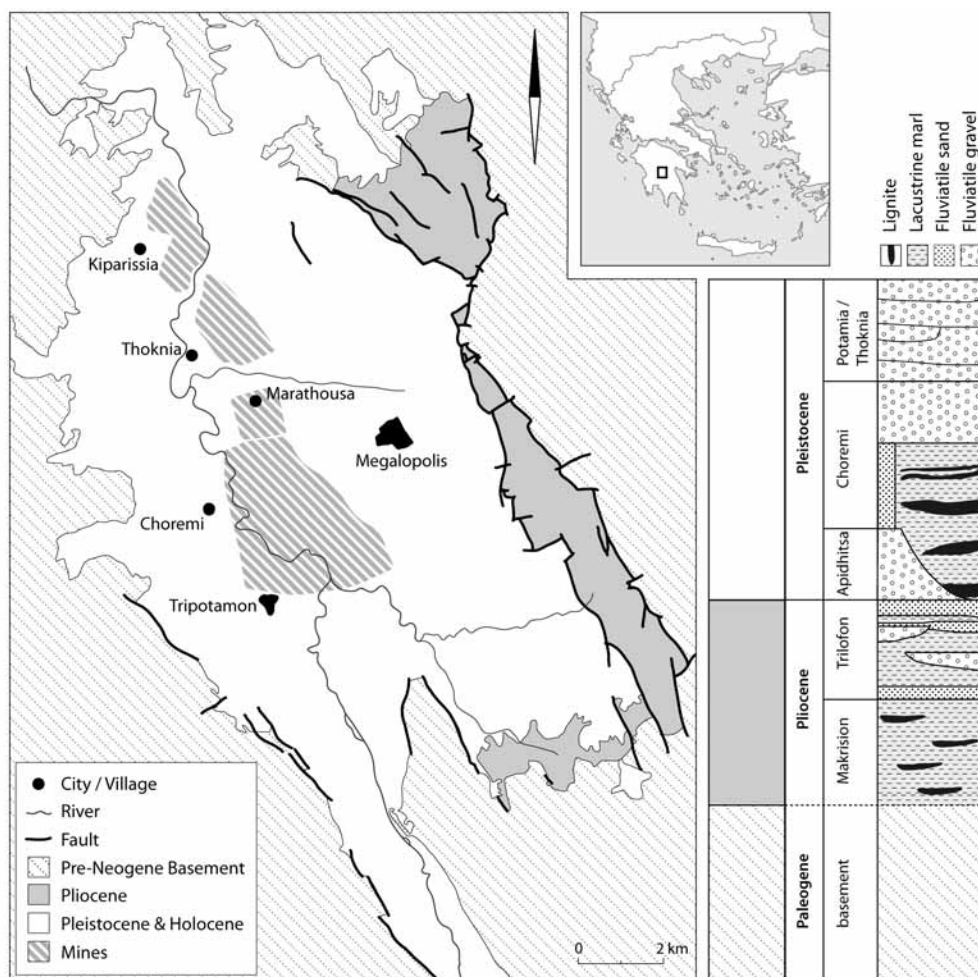


Fig. 4.27 Geological map and stratigraphic column of the Megalopolis basin. Modified after van Vugt *et al.* 2000: fig. 1

the voles *Pliomys* aff. *episcopalis*, *Mimomys* aff. *savini*, *Mus* cf. *spretus*; on the basis of the faunal composition (particularly the representatives of the genus *Mus*) and an assumed continuity in the studied section, it was concluded that either the entire Marathousa Member dates to the Late Biharian, or the lower part is of late Early Biharian and the upper part of Late Biharian age (van Vugt *et al.* 2000). Although the correlation of a small-mammal biozonation (Biharian) to a large-mammal biozonation can be problematic, the chronological estimations of the two studies are not contradictory (*ibid*). Moreover, a magnetostratigraphic analysis identified the Matuyama-Brunhes polarity reversal near the base of the section (*ibid*). Thus, on the basis of the palaeomagnetic and palaeontological data, as well as an ESR date (of ca. 370 ka) from the upper part of the se-

quence (Okuda *et al.* 2002), the Marathousa Member is considered to date to the middle Pleistocene (ca. 950-300 ka; van Vugt *et al.* 2000).

The faunal material that Sickenberg (1975) studied is considered to have been retrieved from the Marathousa layers. Most of the fossils from this collection were not found *in situ* in the exposed sections, but were collected from secondary deposits “*within colluvium which has accumulated at the slope of a ridge formed of the silt, clay and marl in the Marathousa beds*” (Sickenberg 1975, 62); therefore, the fauna is considered to “*originate from the Marathousa layers*” (*ibid*, 26, translated from German). The researcher notes that it is not the aim of his study to investigate the primary locations of the material, but he remarks that the fossils’ state of preservation indi-

cates short-distance transport from the immediate surroundings (ibid). If I read Sickenberg correctly, he considers that the faunal assemblage certainly derives from the Marathousa Member, but it is not possible to pinpoint the exact primary location of each fossil in the individual layers of the Member. In support to this conclusion, he notes the ‘unity’ (“Einheitlichkeit”) of the fauna, the lack of evidence for contamination by more recent deposits and the absence of any subfossils. That said, two more of Sickenberg’s remarks need to be noted here (ibid, 26): (1) “*Blossgelegt und verschwemmt konnten auch einzelne Knochen und Zähne in einigen der zahlreichen kleinen Wasserrisse aufgelesen werden*”, and (2) “*Es [i.e. das Fundgut] kann vielmehr als synchron – (z. T. allochthon, da teilweise etwas umgelagert) – bezeichnet werden*”. The aforementioned remarks are important because Sickenberg also identified a human upper third molar among the faunal material; as with the rest of the assemblage, he considered that the tooth derives from the Marathousa Member (excerpt of Sickenberg’s letter to G. Marinis in 1973, cited in Sickenberg 1975). Sickenberg (ibid) wrote that this could represent the oldest evidence for the presence of hominins in Europe and that an assessment of the tooth would be presented in a separate study. Sickenberg’s study never came out due to his sudden death in 1974 and it was only in 1979 that Xirotiris and colleagues published the first study of the human molar. Xirotiris *et al.* (1979) carried out a microscopic and comparative odontometric analysis, and they were able to confirm the hominin status of the tooth, but could not assess its phylogenetic classification. After about thirty years since that first and only study, the tooth is currently being re-examined (Harvati *et al.* in prep.).

Despite this uncontested type of evidence for the presence of hominins in Megalopolis, systematic archaeological investigations have not been carried out in the basin yet. However, Darlas published in 2003 a report on Palaeolithic finds from Megalopolis. Darlas (2003) investigated the fluvio-lacustrine deposits near the village of Isoma Karyon (nearby and to the west of Thoknia village; Fig. 4.27) at a locality where in the early 1900’s Skuphos unearthed abundant faunal remains, including fossils of *Archidiscodon meridionalis cromerensis*, *Paleoloxodon antiquus antiquus* and *Mammuthus primigenius*. From a total of

thirty-seven lithic implements, twelve were found by Darlas stratified, half of them in an exposed profile that yielded also a fossil of a large mammal; the condition of those implements indicates that they have not been transported (ibid, 30). The rest twenty-five lithics were collected from the surface, some of them close to the aforementioned section and others from the top of the fossiliferous deposits, as well as from other nearby locations (ibid). Darlas discusses several problems pertaining to the provenance and the relative dating of the lithics (ibid, 30, 34-35): firstly, the place that Skuphos excavated has been destroyed by erosion and road constructions, and it is impossible to correlate the artefact-bearing stratigraphy with the one that yielded the fossils found by Skuphos; secondly, it is not clear whether the sediments that Darlas observed are in a primary or secondary position; and thirdly, the lithic artefacts are too few and non-diagnostic in terms of their typo-technological characteristics, although the researcher notes that the overall picture would suggest an attribution close to the Middle-Late Pleistocene boundary. Darlas also remarks (2003, 35) that all geological studies correlate the so-called ‘Isoma layers’ (namely the layers at the locality where Skuphos unearthed the fossils) with layers of the Marathousa Member, but Dufaure (cited by Darlas) correlates them with layers of the Megalopolis Member. Finally, it has to be underlined here that, according to Darlas (ibid), lithic artefacts have been found also in other locations of the basin; importantly, a flake made on flint and three mammalian bone shafts, which bear traces of anthropogenic fracturing, were found within lignite layers of the Thoknia mine.

Clearly, further work needs to be done in order to test the possibility that the artefacts found by Darlas date to the Middle or even to the Early Pleistocene, which would be the case if the associated sediments could be securely shown to be in primary positions and correlative to the stratigraphy revealed by the excavations of Skuphos (Darlas 2003, 35)³⁹. Evidently, the basin of Megalopolis is one of the most promising (if

39. Darlas notes that according to Melentis, who later studied the fauna from the investigations of Skuphos, the condition of the fossils indicates that they were collected from undisturbed deposits (see references in Darlas 2003).

not *the* most promising) place for future archaeological research in mainland Greece. It is one of the few basins of Greece where thick lacustrine deposits have been preserved, potentially burying archaeological material in primary contexts of fine-grained sediments, accumulated in a low-energy environment with a rather continuous sedimentation; this is important not only for the degree of preservation of anthropogenic material, but also with regard to plant and faunal remains that are valuable for palaeoclimatic and palaeoenvironmental reconstructions. This is also the only lacustrine basin in Greece which has yielded both human remains and lithic artefacts. Although the faunal assemblage that Sickenberg (1975) studied was not retrieved from primary locations, there are credible arguments to consider it as

deriving from the Marathousa Member and, in this case, the hominin molar should date somewhere between *ca.* 350-900 ka, according to the latest chronological constraints on the Marathousa Member by van Vugt *et al.* 2000. Hence, on the current evidence, and considering the date of 350 ka as a *terminus ante quem*, the tooth from Megalopolis is in all likelihood the oldest hominin fossil in Greece. In sum, the evidence for an early-middle Pleistocene human presence in a palaeo-lake setting, for which a relatively well-established chronostratigraphic framework is already in place, exemplifies the potential of Megalopolis for yielding Lower Palaeolithic sites as old and as important as the famous sites of Isernia in Italy or Gesher Benot Ya'aqov and even 'Ubeidiya in the Levant.

