PATTERNS OF SPATIAL ORGANIZATION AND LAND USE DURING THE EEMIAN INTERGLACIAL IN THE RHINELAND: NEW DATA FROM WALLERTHEIM, GERMANY

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Abstract

Within northwestern Europe the Eemian Interglacial (Oxygen Isotope Stage 5e, 130–116ka) has been characterized as a relatively stable period dominated by warm climates and mixed forests that came to an abrupt end with the onset of Oxygen Isotope Stage 5d roughly 116ka (Kukla et al., 2002 and papers therein; Lehman et al., 2002). Particular aspects of the Eemian environment, notably its dense vegetation, and the modifications to prevailing climates, sea levels, and floral and faunal communities that followed its decline are thought to have had direct effects on the mobility patterns and population densities of archaic hominins throughout much of the Old World. Unfortunately, a clear understanding of the impacts these environmental conditions and changes had on such communities within Europe remains elusive. Much of the ambiguity surrounding this issue is due to the scanty archaeological data preserved at the relatively few Eemian localities identified in Europe. Careful excavation, documentation, and interpretation of sites dating to this period are therefore critical to our overall understanding of archaic hominin behavior at the outset of the Upper Pleistocene. The excavation and analysis of the open-air site of Wallertheim, Rhinehessen, provides key information on the raw material and subsistence economies of hominins during this period in Germany. Find horizon A, correlated with the Eemian Interglacial, represents a rare case in which lithic and faunal material, and a hearth are found in primary context within a floodplain setting. Spatial analyses and lithic refitting studies document local, short-term patterns of lithic reduction and faunal processing, suggesting a moderate degree of mobility within this open portion of the otherwise forested environment. The observations presented here also suggest that local hominin social networks may have remained rather limited in size and scope until climatic alterations following the Eemian restructured the surrounding environment.

INTRODUCTION

Recent researchers have characterized the Eemian Interglacial (OIS 5e, 130–116ka) as a relatively stable, warm, humid period dominated across much of northwestern Europe by mixed forests (Dansgaard et al., 1993; GRIP, 1993; Field et al., 1994; Van Andel and Tzedakis, 1996; Zagwijn, 1996; Frank et al., 2000; Kukla, 2000; Caspers et al., 2002; Kukla et al., 2002; Turner, 2002a, b). It has also been noted that this period was followed by a series of rapid and severe climatic oscillations that ultimately lead to the replacement of the forests by more open environments (GRIP, 1993; Kukla, 2000; Kukla et al., 2002), a claim that has led some Palaeolithic archaeologists to suggest that the impact on hominin communities may have occurred over the course of individual lifetimes (e.g., Gamble, 1999; Gamble and Roebroeks, 1999). Unfortunately, a clear understanding of the changes that these alterations wrought on existing systems of mobility and land use remains elusive. The lack of detailed terrestrial and environmental reconstructions coupled with the scanty archaeological data preserved at the
relatively few known Eemian archaeological localities in Europe compound the situation (Gamble 1986, 1999; Van Andel and Tzedakis 1996, 1998; Tzedakis et al., 2001). Therefore the data discussed in this paper offer a rare opportunity to consider the relationship between archaic hominins and the environments of OIS 5e as they are currently understood.

Providing a brief summary of the climatic and environmental data from the Eemian Interglacial is a difficult task as the diverse information available from numerous environmental proxies is often incomplete or contradictory. For this reason the following discussion is designed to highlight some of the major aspects of the Eemian, without entering into any of the specific ongoing debates. This general treatment is meant to provide a context within which a lengthier discussion of Wallerstein A can take place. The term Eemian was first employed by Harting (1874; cited in Ehlers, 1996) and was later defined by Madsen et al. (1908; cited in Ehlers, 1996) based on marine deposits in Denmark, Northern Germany and the Netherlands. Since this initial period of research the Eemian Interglacial has received considerable attention and its dating, definition, and duration have been refined. No clear consensus exists concerning these basic aspects of the Eemian, however, with the pollen, ice, and deep-sea core, varve and diatom, and terrestrial records derived from individual areas throughout Europe rarely being in complete agreement with one another (see Kukla et al., 2002 and papers therein).

Nonetheless, most researchers agree that the OIS 5e started approximately 130 kya, with its warmest stage dated to approximately 125 kya. By 116 kya the last interglacial gave way to the Early Weichselian (OIS 5d). During the Eemian, prior to the cooling represented by OIS 5d, much of Europe experienced an interglacial vegetational succession that in general began with the dominance of deciduous taxa such as Quercus (oak) and Ulmus (elm), followed by Corylus (hazel), Taxus (yew), Carpinus (hornbeam), Abies (fir), Picea (spruce), and Pinus (pine) (Van Andel and Tzedakis, 1996; Tzedakis et al., 2001; Turner, 2002a, b). The influences of climate change, biotic interactions, and soil maturation are seen as key elements in this succession. Thus, the hominins occupying Europe during this 10–15ky peri-

do persevered through a series of environmental alterations that dramatically restructured their landscapes, providing new opportunities and imposing new limitations that likely influenced their mobility and subsistence strategies as well as their population densities and distributions, and consequently their social networks.

Anthropological and Archaeological Considerations

Issues relating to the organizational, technological, and cognitive capacities of Middle Palaeolithic hominins have received considerable attention in recent years (e.g., Gibson and Ingold, 1993; Kuhn, 1995; Steele and Shennan, 1996; Mellars, 1996; Conard and Adler, 1997; Gamble, 1999; Roebroeks and Gamble, 1999; Bar-Yosef and Pilbeam, 2000; Conard, 2001; Jöris, 2001) and as scholars continue to analyze the distribution of cultural debris and the spatial relationships between different artifact categories and sites, important insights into the social realm of Palaeolithic lifeways are being realized (e.g., Binford 1983; Kroll and Price, 1991; Henry, 1998; Gamble, 1999; Kolen, 1999; Vaquero et al., 2001) contrary to the views of some (e.g., Pettitt, 1997). The main problem often faced by researchers studying this period is the lack of data derived from primary archaeological contexts with which to address such issues. Studies are further hindered by a lack of well preserved open-air sites in spatially unconstrained settings that can be used to test models based on the deep, often time-averaged sequences from caves and rockshelters (Farizy, 1994; Adler, 2002; Adler and Tushabramishvili, in press). These “high resolution” sites provide detailed data on the day-to-day activities of now extinct humans that can be used to calibrate the long-term, coarse-grained behavioral histories constructed around cave and rockshelter deposits.

A number of recent Middle Palaeolithic excavations have been implemented in an attempt to increase our sample of well-preserved sites located in open-air settings. Work at the sites of Maastricht-Belvedere (Roebroeks, 1988) in the Netherlands, Rheindahlener (Thissen, 1986), Tönchesberg (Conard, 1992) and Wallerstein (Conard et al., 1995a, b; Conard and Adler,
1997; Conard and Prindiville, 2000) in Germany, and several important sites in northern France, including Mollons/Le Grand Chanteloup, Bettencourt-Saint-Ouen, and Beauvais (Deloze et al., 1994; Depaepe, 1997, 2001; Locht, 2002) have focused on the excavation of large horizontal surfaces. In this manner researchers are attempting not only the detailed documentation of individual sites, but also the reconstruction of the surrounding landscape, including the scatters, patches, and empty areas, and the interplay between different sites and their Palaeolithic occupants. This “landscape,” “off-site,” or “siteless” archaeology as it is often termed (c.f. Ashmore and Knapp, 1999) allows researchers the opportunity to consider the principal archaeological components of a site or sites and then integrate them into larger systems of mobility and land use, reconstructing what Gamble refers to as a “landscape of habit” (Gamble, 1999: 87–88).

THE EUROPEAN ARCHAEOLOGICAL RECORD OF THE EEMIAN INTERGLACIAL

Within the context of the Eemian Middle Palaeolithic of Western Europe, as defined by Conard and Fischer (2000), sites are relatively rare and few of these are well preserved. Taphonomic forces, including the erosion of Eemian deposits in association with the climatic decline that followed the interglacial may help to explain the lack of Eemian sites outside sediment traps and travertines (Roebroeks et al., 1992b), however, it is unlikely that such forces were capable of erasing the entire state of Eemian occupations on a continental scale. Other factors such as habitat preference, environmental circumscription, site taphonomy, and population density may also affect the frequency of sites on the landscape and their archaeological visibility. Gamble (1984, 1986, 1999) proposes that this low visibility of Eemian sites in Europe is due in large part to environmental preference by hominins. He argues that archaic hominins were not capable of subsisting in the densely wooded environments that dominated the Eemian landscape. This was due to the relative decline in edible and accessible biomass (e.g., red and roe deer, forest bison and aurochs) that resulted from the disappearance of open environments. The growth and spread of dense deciduous forests, and the concomitant disappearance of mosaic environments would also have limited the sizes of animal populations and their distributions, and the propensity of particular species to aggregate in large herds would have been interrupted, thus making animals less numerous and less predictable. Gamble argues that, faced with such potential dietary shortfalls, hominins had to choose between intensifying their exploitative efforts or moving to more productive, less densely forested regions (Gamble, 1999: 229–230).

While it is clear that foraging in dense forests without sophisticated technological and social aids is a difficult proposition, we believe that it is wholly unlikely that such conditions precluded the occupation of large expanses of Europe during OIS 5e. Based on current evidence, it appears that many of the best-known European Eemian sites are intimately associated with sources of water such as rivers, lakes, and springs (Roebroeks and Tuffreau, 1999), all locales that were attractive to a wide array of animal species and that in many instances became focal points of hominin occupation and activity within the larger forested landscape. Many of these sites preserve what are often interpreted as single animal kill or butchery events, such as Lehrengen (Thieme and Veil, 1985), Neumark-Nord (Mania et al., 1990; Mania, 1991; but see Gamble, 1999), and Gröbern (Mania et al., 1990), or diverse, often time-averaged accumulations from sediment traps or travertines, such as those around Weimar (e.g., Behm-Blancke, 1960).

According to Mania et al. (1990) sites such as Neumark-Nord and Gröbern provide episodic evidence for the butchering of animals along lakeshores. Research within a similar environmental setting at Lehrengen lead to the discovery of a yew wood spear associated with butchering implements and fauna (Movius, 1950; Jacob-Friesen, 1956; Thieme and Veil, 1985). Together these sites appear to represent hunting and butchering episodes within lakeshore environments. The travertine sites of Burgtonna, Veltheim, Taubach and those around Weimar (e.g., Beivedere Allee), represent diverse, often time-averaged accumulations near springs, and again document repeated hominin activity in and
around water sources. While sites deposited in such environments (i.e., lake-shores, floodplains, and springs) may experience rapid burial via alluviation and calcite precipitation, and thus be more likely to survive later post-depositional destruction, it is unlikely that this factor alone is the determinant of site visibility and preservation within Europe during OIS 5e. The sites of Grotte Vaufrey (Level IV; Rigaud, 1988) and Seladina Cave (Level 5b; Bocherens et al., 1999) in France and Belgium also contain occupations dated to the Eemian. Therefore, it can be argued that Middle Palaeolithic hominins were not excluded from Eemian Europe, but rather were capable of exploiting particular elements of the Eemian environment, specifically those locales where a suite of key resources were concentrated (Avery, 1995) and where mobility was perhaps facilitated by more open terrain such as floodplains or river drainages (Roebroeks and Tuffreau, 1999).

Another interesting aspect of the OIS 5e environment is its potential impact on raw material procurement behaviors and the composition of lithic assemblages. Conard and Fischer (2000) have noted the apparent correlation between irregular, at times microlithic assemblages, such as those from Kulna II (Valoch, 1988), and the dense deciduous forests of the Eemian. The authors suggest that such a correlation may indicate the increased use of wood or other plant fibers as tools, or the need to adapt stone tool technologies to specific woodworking tasks. Alternatively, the dense vegetation that characterized the Eemian may have in certain cases limited access to particular raw material resources, thus necessitating the intensified reduction and use of available stone. These authors also suggest that the Eemian environment likely placed new constraints on mobility that ultimately favored the diminution of stone tools, although they admit that such hypotheses are not easily tested with the data presently available.

The excavation of Wallertheim A, an undisturbed Eemian site, provides a near-optimal setting in which to address these issues as well as to investigate the organization of space in an open-air context. The recovery of over 6000 in situ lithic artifacts, roughly 400 macro mammalian remains, and the documentation of a hearth offer a unique opportunity to conduct refitting studies and spatial and technological analyses of a short-term campsite on an open floodplain. When viewed from a broader perspective that considers the entire landscape and the distribution of resources and natural features, a dynamic image of Middle Palaeolithic mobility and land use during OIS 5e becomes tangible.

**SITE LOCATION AND HISTORY OF RESEARCH**

The site of Wallertheim is situated in the Rheinhessen region of Germany in alluvial sediments deposited by the Wiesbach River, a tertiary drainage of the Rhine River (Fig. 1). This locality has been a focus of scientific research since the 1920s, when Otto Schmidigten excavated roughly 375m2 of Middle Palaeolithic deposits in the then active brickyard (Schmidigten and Wagner, 1929). Since this initial investigation Wallertheim has continued to attract the attention of geologists and archaeologists alike (e.g., Fauler, 1938; Schermer, 1949/1950; Leser, 1970; Brunnacker and Tillmanns, 1978; Wintle and Brunnacker, 1982; Bosinski et al., 1985; Gaudzinski, 1995a, b). The results reported here stem from the 1991–1994 archaeological excavations conducted by the University of Connecticut in cooperation with the Römisch-Germanisches Zentralmuseum, and the Landesamt für Bodendenkmalpflege, Mainz (Conard et al., 1995a, b, 1998; Conard and Adler, 1996, 1997; Preuß et al., 1996; Conard and Kandel, 1997).

The primary goals of the 1991–1994 excavations were to recover a wide range of archaeological and environmental data from the well-preserved Pleistocene sediments of the Wiesbach drainage for use in reconstructing the behavioral patterns of the Middle Palaeolithic hominins who occupied the region. During these excavations, six Middle Palaeolithic find horizons (Wal A–F) dating to the period between the Eemian Interglacial and the accumulation of the main early Weichselian humic deposits were documented at the site (Conard et al., 1995a; Conard et al., 1996; Haesaerts et al., 1997) (Figs. 2–3). Wallertheim A (Wal A), the focus of this paper, is comprised of a fine-grained, yellow-brown silt and is correlated with Oxygen Isotope Stage 5e (OIS 5e) via thermoluminscence (Preuß et al., 1996; Zöller, 1997), sedimentology (Becze-Deák
and Langohr, 1997), biostratigraphy (Damblon, 1997; van Kolfschoten and Thomassen, 1997; Mania, 1997; Turner, 1997; Uerpmann and Dehert, 1997), and correlations with the Milankovitch Cycle (Schmidtgen and Wagner, 1929; Conard et al., 1995b) (Fig. 4).

**STRATIGRAPHY AND ENVIRONMENT**

The thick early Upper Pleistocene deposits at Wallertheim have been divided into six sedimentary cycles that correspond to six phases of sediment accumulation and stabilization (Figs. 3, 4). The six archaeological horizons discovered at the site (Wal A–F) fall within sedimentary cycles 1–2 and correspond to a period of alluvial deposition (Conard et al., 1995b). The excavation of Wal A covered an area of 176 m² and led to the discovery of archaeological materials deposited on the agrading floodplain of the Wiesbach (first sedimentary cycle). On this portion of the floodplain, Wal A was deposited unconformably atop
a gray-green Tertiary clay. The undulating contact between Wal B and Wal A (Fig. 3) reflects the disturbance of Wal B due to the frequent passage of animals over its moist sediments (e.g., animal puddling) (Conard et al., 1995a, b). In many instances this puddling pushed archaeological materials from Wal B (lithics and fauna) into the underlying silts of Wal A and also caused the vertical displacement of some of the Wal A fauna; later processes associated with OIS 5d then largely truncated Wal B.

Based on careful excavation techniques, individual find elevations, clear differences in bone preservation and lithic raw materials, and refitting studies we were able to separate much of the archaeological material between the two layers. However, it is still possible that some mixing remains. In the eastern portion of the site (i.e. east of the East=67 Line), Wal B and the younger archaeological layers were truncated by a localized solifluction event associated with the third sedimentary cycle (Weichselian) (Fig. 3). The archaeological materials in this portion of Wal A were spared from this event by as little as 10 cm. Although the thickness of the stratigraphic layer comprising Wal A can exceed one meter, the lithic and faunal remains found within the eastern portion of the find horizon are distributed over 5–10 cm in the vertical dimension while those in the west are scattered over 10–20 cm (Figs 2, 5).

Data from a detailed analysis of the sediments of Wal A indicate that a stable, grassy surface existed on this portion of the Wiesbach floodplain. This low-lying position in the landscape experienced alluvial deposition, probably seasonally, and in the western, more terrestrial portion of the site (i.e. west of the East=67 Line) received a significant contribution of non-calcareous sediments from the surrounding slopes (Becze-Deák and Langohr, 1997). While the largely non-calcareous sediments located in the western portion of the find horizon are not ideal for bone preservation, the generally favorable conditions across the site led to the preservation of numerous skeletal parts, allowing the iden-
Fig. 3. Schematic illustration of the main profile at Wallertheim showing the position of sedimentary cycles 1–6 (top) and the stratigraphic position of archaeological find horizons A–F (bottom) on the north = 41 m line.

tification of several cervids, large bovids, and equids. Based on the faunal analysis presented below, it appears that certain among these finds represent the remains of individuals transported to the site by hominins for processing and consumption.

Carbonized botanical remains recovered from the find horizon indicate the presence of thermophilic species such as Prunus sp. (wild cherry/blackthorn), Populus sp. (poplar), and Populus/Salix (poplar/willow) (Damblon, 1997, in press). Study of the molluscan assemblage documents the presence of 29 species, including both thermophilic and forest elements (Mania, 1997), while analysis of the smaller mammals documents Castor fiber (beaver), Arvicola terrestris (water vole), and Microtus sp. (vole) (van Kolfschoten and Thomassen, 1997). The rich array of opalphytoliths recovered during excavation is indicative of more open grassland (Urban, 1997), while the occurrence of Cervus elaphus (red deer) and Dama dama (fallow deer) indicate the presence of wooded areas adjacent to the site. These combined data suggest that the surrounding environment was composed of a generally open, warm, meadow landscape with significant bush and tree cover in the lower lying areas near the Wiesbach. This environment was
lithic material, as well as faunal remains greater than 4cm, however, within Wal A all faunal remains, regardless of size, were piece plotted. The orientation of finds within the matrix and relevant observations pertaining to changes in sediment color and texture were also recorded.

To monitor the overall recovery of finds from the Wallertheim find horizons, one 20-liter sediment sample per square meter was collected and waterscreened, as were all sediments associated with lithic concentrations. The 334 sediment samples washed and sorted from Wal A yielded 5086 (76%) of the 6686 artifacts recovered from the find horizon (Table 1). This procedure greatly enhanced the recovery of small lithic artifacts, bones, mollusks and micromammals. Over 99 percent of the lithic finds recovered during waterscreening were small débitage (15–5 mm) and microdébitage (<5 mm), which suggests that postdepositional size-sorting via natural or cultural agents (Binford, 1983; Stevenson, 1991) did not occur at the site (Table 1). While not every lithic artifact was recovered, the assemblage from Wal A represents all of the larger débitage and the vast majority of the small débitage and microdébitage. This precise work provides a particularly good starting point from which to address the spatial patterning present within the site.

**CONTEMPORANEITY**

An issue central to any discussion of spatial organization and associated behavioral patterns is that of intra-site contemporaneity. In a previous paper (Conard and Adler, 1997) we developed and defined three general levels of contemporaneity most easily identified on Palaeolithic sites: strict, occupational, and geological. Specifically, we are interested in understanding the temporal relationships between archaeologically identifiable features or events, such as discrete knapping episodes, as a means of gaining further insight into site construction and use, and patterns of landscape use and exploitation. Without such temporal controls it is extremely difficult to offer accurate reconstructions of Palaeolithic lifeways, especially in those contexts with complex occupational or taphonomic histories. The categories used in our discussion of contemporaneity and several of their archaeological manifestations
Fig. 5. Wallertheim under excavation in 1993 (left) and Wal A under excavation in 1994 (right). Wal A is situated directly beneath the small tree in the left picture, roughly at the level of the excavators’ feet.

Table 1

Wallertheim A water-screened lithic material, total number and (weight in grams). Please consult Figure 30 the spatial distribution of artifact categories.

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>Flake</th>
<th>Angular Debris</th>
<th>Small Debris</th>
<th>Microdebitage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agate</td>
<td>0</td>
<td>0</td>
<td>5 (0.28)</td>
<td>9 (0.03)</td>
<td>14 (0.31)</td>
</tr>
<tr>
<td>Andesite</td>
<td>1 (1.45)</td>
<td>0</td>
<td>1 (0.01)</td>
<td>0</td>
<td>2 (1.46)</td>
</tr>
<tr>
<td>Quartz</td>
<td>0</td>
<td>1 (6.24)</td>
<td>2 (0.12)</td>
<td>3 (0.04)</td>
<td>6 (6.37)</td>
</tr>
<tr>
<td>Quartzite</td>
<td>0</td>
<td>1 (0.93)</td>
<td>7 (0.64)</td>
<td>7 (0.07)</td>
<td>15 (1.64)</td>
</tr>
<tr>
<td>Red Rhyolite</td>
<td>2 (1.42)</td>
<td>1 (0.23)</td>
<td>79 (4.28)</td>
<td>173 (1.15)</td>
<td>255 (7.08)</td>
</tr>
<tr>
<td>Tuffaceous Rhyolite</td>
<td>18 (20.38)</td>
<td>4 (2.42)</td>
<td>1068 (46.3)</td>
<td>3701 (16)</td>
<td>4791 (85.1)</td>
</tr>
<tr>
<td>Ind. Vol. Mat.</td>
<td>0</td>
<td>0</td>
<td>3 (0.11)</td>
<td>0</td>
<td>3 (0.11)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21 (23.25)</td>
<td>7 (9.82)</td>
<td>1165 (51.74)</td>
<td>3893 (17.29)</td>
<td>5086 (102.07)</td>
</tr>
</tbody>
</table>

are outlined below. While developing rigid criteria for the identification of contemporaneity within archaeological settings is problematic, detailed stratigraphic analyses, lithic refitting and sourcing studies, technological and typological characteristics, biostratigraphy, spatial patterning, and soil micromorphology are elements that when considered together can help remove much of the ambiguity. Understanding the temporal relatedness of specific artifacts and features is critical for developing reliable spatial and behavioral interpretations.

- **Strict Contemporaneity**: This category refers to a group of artifacts or archaeologically identifiable events that were deposited or occurred simultaneously, or in close temporal succession. These events could be ephemeral, taking place over the course of seconds or minutes, or
they could be more lengthy, representing activities that lasted several hours. Examples include the spear, associated butchering implements and fauna discovered at Lehringen, which represent the remains of a single hunting and butchering episode (Movius, 1950; Jacob-Friesen, 1956; Thiem and Veil 1985), the footprints at Laetoli and Roccamontesina (Leakey and Hay, 1979; Mietto et al., 2003), and aspects of the Wal D assemblage (Conard and Adler, 1997). The most common example of strictly contemporaneous finds is refitted artifacts from a single chain of lithic reduction (e.g., Roberts and Parfitt, 1999; Bergman et al., 1990; Roebroeks and Hennekens 1990; Conard and Adler, 1997).

- **Occupational Contemporaneity:** This category, which is often more difficult to identify in the archaeology of hunter-gatherers, refers to archaeologically identifiable events that occurred during a single occupation of a site. These events could conceivably take place over the course of several hours, days, or months depending on the length of the stay. Materials deposited at a site from the time of its initial habitation to the time of its abandonment are all occupationally contemporaneous. It follows that such a site can be comprised of a series of strictly contemporaneous events. Finds from within horizons including Tönchesberg 2B (Conard, 1992), Boxgrove (Roberts and Parfitt, 1999), Pincevent (Leroi-Gourhan and Brézillon, 1966, 1972; Enloe and David, 1992), and Wallertheim (Conard and Adler, 1997) meet these criteria. Obviously the repeated seasonal use of target locations within a landscape complicates matters.

- **Geological Contemporaneity:** This category refers to all archaeological materials preserved within a geological stratum. These finds could span tens, hundreds, thousands, and tens of thousands of years, or longer. Such a deposit could theoretically contain artifacts from a series of strictly, as well as occupationally contemporaneous events, or could be comprised of material from archaeological palimpsests. Finds from undifferentiated gravels, surface accumulations, fluviatile lag deposits, or a single geological stratum can be considered geologically contemporaneous. This is the category in which most archaeological occurrences can be accommodated.

### THE CONSTRUCTED SPACE: HEARTHS AND MANUPORTS

The faunal and lithic remains recovered from Wal A were found in direct association with other important archaeological features, namely a hearth and several large stone manuports. While the routine use of fire during the Middle Palaeolithic is not in doubt, and research on hearth construction and fuel consumption is advanced (e.g., Rigaud et al., 1995; Stiner et al., 1995; Meignen et al., 2001; Théry-Parisot, 2001; Vaquero and Pastó, 2001, Villa et al., 2002; Albert et al., 2003), little is known about the specific use and manipulation of fire during the Eemian Middle Palaeolithic (Callow et al., 1986). Likewise, the transport of large stone blocks to, and their function within, such archaeological contexts is not well understood. For these reasons each element is worthy of individual attention.

The paucity of readily identifiable hearths at early Upper Pleistocene open-air sites in Europe is well documented (Gamble, 1999). Two possible exceptions are Maastricht-Beivedere Site C and Tönchesberg 2B. At Site C, Roebroeks (1988) has interpreted a concentration of several thousand charcoal fragments as the remains of a fire. An associated concentration of stones, several of which are burned, has been interpreted as a natural occurrence unrelated to the charcoal remains. Within Tönchesberg 2B, Conard (1992) has piece plotted thirty burned faunal remains and several burned stone artifacts within a 4m2 concentration. These finds have also been interpreted as the remains of a hearth. Together these two occurrences provide the best evidence to date of open-air hearths in the European early Upper Pleistocene.

The new excavations at Wallertheim provide more evidence for intentional burning by hominins, in particular within Wal A where a minimum of 33 small fragments of calcined bone (3–19 mm in size), most likely attributable to fallow deer based on cortical thickness estimates, were found concentrated within a single square meter area (Fig. 6). The dark brown to white color of the calcined remains can be correlated with burning stages II–IV (Shipman et al., 1984), suggesting a fire that burned at temperatures between 285–940°C. This high temperature
Fig. 6. A close up view of the hearth identified based on the distribution of calcined and charred/burned bone. The associated lithic artifacts are also depicted; scale in meters. Please consult Figures 13 and 31 for the location of these units.

coupled with the small size and friable condition of the bone fragments is indicative of a long burning fire. A similar but much smaller concentration of burned material was also identified 5 meters south of the main hearth area. Recent bone burning experiments conducted by Stiner et al. (1995) indicate that such alterations to bone are most commonly achieved with direct contact to live coals. Also found associated with these calcined bones were 73 charred/burned bone fragments exhibiting a black, brown, or white color and a chalky texture. Although these finds were too small (< 3 mm) and friable to study in detail, based on their distribution we believe that most if not all of them belong to the associated hearth (Fig. 6).

Unlike other examples of hearths from the Middle Palaeolithic, where the association between faunal remains and hearths can sometimes be fortuitous, stemming from the construction of hearths atop previously deposited faunal material (Stiner et al. 1995; Vaquero and Pastó, 2001), all archaeological material within the eastern portion of Wal A (both lithics and fauna) are dis-
tributed in a 5–10 cm thick lens (Fig. 7). No finds were discovered above or below this thin vertical scatter, suggesting that these bones were actually deposited in the hearth while it was burning and are therefore strictly contemporaneous with the majority of the associated lithic materials.

While no charcoal concentrations, soil discolorations, or a depression were observed in the vicinity of the hearth, Schiegl’s (in press) analysis of three sediment samples from Wal A provides interesting results. Two samples from within the hearth (excavation unit 44/68, z=376 and z=382) and a stratigraphically identical control sample located three meters southeast of excavation unit 44/68 (excavation unit 42/70, z=364) were analyzed. Schiegl found that the two hearth-related samples are enriched in the opalphytoliths of woody plants while the control sample is not. Based on preliminary comparison with a modern reference collection, these phytoliths show strong similarities with Fagus sylvatica (common beech). This discovery is noteworthy given that the soil characteristics of Wal A are indicative of a grassland environment (Becze-Deák and Langohr, 1997). Moreover, Schiegl identifies an abundance of carbon-oocluded phytoliths in the two samples associated with the hearth.

Sporadic charcoal finds occur throughout the six find horizons but these are never found in any great frequency or density within the archaeological horizons, leading us to interpret them as the remains of fires that swept across the floodplain periodically or carbonized botanical remains introduced to the site via natural agents such as wind, water, or gravity. Wal A, however, is an exception. Damblon’s (in press) recent analysis of carbonized plant macro-remains from 7 (23.3% of total, n=30) sediment samples allowed the identification of 194 small specimens to three taxa (wild cherry/blackthorn, n=89; poplar, n=10; poplar/willow, n=95). These 30 random sediment samples were collected across the eastern portion of the site and are related intimately with the areas of intensive lithic reduction, however, aside from the association of poplar/willow with the area of intense burning discussed above (excavation unit 44/68), the charcoal remains appear to be distributed randomly (e.g., excavation units 50/66: n=5 wild cherry/blackthorn; 44/68: n=2 poplar/willow; 42/72: n=28 wild cherry/blackthorn; 39/68: n=10 poplar/willow; 39/73: n=56 wild cherry/blackthorn; 38/72: n=41 poplar/willow; 37/70: n=52 poplar/willow). Given the highly fragmented nature of the specimens prior to and following excavation and analysis, Damblon (in press) warns that these quantitative data must be viewed with caution and that it is more important to note the presence of particular species and consider the palaeoenvironmental information they provide. In this regard, Damblon (in press) interprets these data as indicators of riparian woodland, with a deciduous forest environment near the site.

Finally, it is important to add that the associated dense lithic scatters surround but do not mix with the concentration of calcined bones. J. Haneke, Geologisches Landesamt Rheinland-Pfalz, has noted that when heated the associated tuffaceous and red rhyolite turns a whitish color (pers. comm. 1997). None of the lithics
Table 2

Summary data and statistics in millimeters and grams for the unchipped silicified limestone blocks.
The total weight is 11,927 grams

<table>
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recovered during excavation or after the careful waterscreening of all sediments comprising and surrounding the hearth met Hancke’s criteria for burning. The clear spatial segregation between areas of lithic reduction and a single area of intense burning suggests that these features are strictly contemporaneous, reflecting a single short-term occupation during which particular spaces within the site were designated for specific yet associated activities (Stevenson, 1991; Jones 1993). Given these features and the analyses conducted by Schiegl and Dambon, it appears that this was a rather small open hearth (i.e., not excavated or ringed/lined with stone) built directly atop the occupation surface that burned for a relatively short period of time but at high temperatures, and in which wood (common beech) was the main fuel.

Seven large, unburned, silicified limestone blocks (n=6 after refitting) were also found distributed among the lithic and faunal remains in the eastern portion of the site. Given their individual and combined size and weight (Table 2), and their location within the fine-grained, low energy silts of Wal A, we believe that they were intentionally transported to the area of excavation by the site’s occupants. R. Langhor suggests that these blocks originated from neighboring deposits located at the edge of the floodplain, perhaps less than 50 m from the site (pers. comm. 1998). Although their weathered and eroded surfaces do not provide any clues as to their use, it is possible that these blocks functioned as anvils for bone processing and marrow extraction or as weights designed to anchor or otherwise stabilize elements of some sort of windbreak or other structure (see Kolen, 1999 for a detailed discussion of dwellings/nests in the Middle Palaeolithic). Given their small dimensions it is unlikely that they were employed as seating.

SUBSISTENCE ECONOMY, FAUNAL PROCESSING, AND TAPHONOMY

The frequency of ungulate species, especially bovidae, equidae and cervidae, in many European Pleistocene archaeological sites is a feature that can offer detailed information about Palaeolithic hunting economies and subsistence strategies (e.g., Jaubert et al., 1990; Conard, 1992; Farizy et al., 1994; Stiner, 1994, 2002; Conard and Prindiville, 2000; Gaudzinski, 2000; Gaudzinski and Roebroeks, 2000; Hoffecker and Cleghorn, 2000; Bar-Oz et al., 2002; Grayson and Delpech, 2002), and one that highlights the relative dietary importance of such resources to Middle Palaeolithic hominins (e.g., Bocherens 1997; Bocherens et al., 1999; Richards et al., 2000). Unfortunately, the relative rarity of well-preserved Eemian sites has limited our ability to develop a detailed understanding of these practices during the OIS 5e, and the general lack
of data concerning the floral component of the diet, a particularly robust and sensitive form of data indicating the relative breadth of a foraging economy (Flannery, 1969), is entirely lacking but clearly of potential significance (e.g., Madella et al., 2002; Pérez-Pérez et al., 2003).

Species representation, number of identified specimens (NISP), and minimum number of individuals (MNI)

Of the 382 bones and bone fragments recovered from Wal A, 95 (24.9%) could be identified to element and species (Table 3). Although poor bone preservation often made the species identification of individual specimens difficult, it was possible to assign most finds to specific size categories. For example, the majority of the 99 unidentifiable size-class 3 bone fragments are likely attributable to Bos/Bison (aurochs/bison) and the 31 specimens assigned to size-class 2 likely represent the remains of fallow deer (see Conard and Prindiville, 2000); the remaining unidentifiable specimens were too fragmentary to assign to a size-class. The remains of adult fallow deer (NISP 23/ MNI 5), aurochs/bison (NISP 46, MNI 4) and Equus ferus (wild horse) (NISP 13, MNI 1) are the most numerous, however, based on the limited tooth wear and fusion data it was not possible to identify any sub-adult individuals within these taxa. Remains of Cervus elaphus (red deer) (NISP 5, MNI 1), Canis lupus (wolf) (NISP 3, MNI 3), and Castor fiber (beaver) (NISP 1, MNI 1) were also recovered in low frequencies (Table 3).

Skeletal abundance, bone modification, and seasonality

All major body parts are represented among the remains of large bovids (Fig. 8), however, appendicular elements and teeth occur at a higher frequency than ribs, cranial elements or vertebrae. Although this may be the result of selective transport of high utility body parts, it may also reflect the preferential preservation of animal remains with higher bone densities (Brain, 1981; Lyman, 1984, 1994); a similar pattern can be observed among the remains of fallow deer (Fig. 9) and wild horse (Fig. 10). The vast majority, but not all of the identified specimens represent high survival, low cost elements as defined by Marean and Cleghorn (2003), suggesting that taphonomic forces have had an important impact on the assemblage. Finally, the presence of high utility elements and a relative paucity of toe bones suggest that entire carcasses may not have been transported regularly to the site or, as suggested above, post-depositional forces, such carnivore ravaging or trampling, lead to the preferential destruction of the more delicate elements. Unfortunately, the small sample of identified and unidentified specimens limits our ability to conduct a more rigorous taphonomic analysis of the faunal remains.

Various types of modifications to the fauna have been identified (Fig. 11). One definite and two probable cut-marked long bone fragments assigned to size-class 3 could be identified. This low figure may be the product of poor bone preservation in the layer where many outer surfaces are soft and eroded due to post-depositional forces and the input of non-calcareous sediments in the west (Behrensmeyer, 1978; Shipman and Rose, 1988). Four hind limb bones attributed to large bovids as well as three size-class 3 and one size-class 2 specimens exhibit impact fractures associated with dynamic loading (Johnson, 1985; Villa and Mahieu, 1991) (Fig. 12). Although two specimens from excavation unit 45/62 assigned to size-class 3 could be refitted, the origin of the break is uncertain (Fig. 12). One tibia shaft fragment of fallow deer exhibits impact scars, and nine specimens were broken in a fresh state (Fig. 12). Since eighteen of the shaft fragments of large bovid were also fractured in a fresh state, but do not show unmistakable impact fractures, we believed that some portion of this assemblage is the result of hominin agency. Six limb bone fragments assigned to equids (33.3%) and size-class 3 individuals (66.7%) show traces of carnivore chewing at their extremities (50%) and along the shaft (50%), however no digested bone was recovered (Horwitz, 1990; Fisher, 1995) (Fig. 11). All of these specimens, save one (excavation unit 42/60), are found in a small concentration within excavation units 44/65, 45/64, 45/65, and 46/64 (Fig. 13). These data suggest that the large bovids and cervids are likely of anthropogenic origin while the equids appear to result from carnivore activity. The wild horse material may also repre-
### Wallertheim A fauna, with NISP, MNI, and weight

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<tr>
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<th>Bos/ Bison</th>
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<th>Dama dama</th>
<th>Cervidac sp.</th>
<th>Equus ferus</th>
<th>Equus sp.</th>
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Fig. 8. Large bovid skeletal part representation, MNI, and the location of impact damage. Please consult Table 3

Fig. 9. Fallow deer skeletal part representation, MNI, and the location of impact damage. Please consult Table 3
sent bones damaged by carnivores following site abandonment but we did not find clear evidence to support this hypothesis.

Analysis of cementum annuli from prime age specimens of fallow deer and large bovid suggests that Wal A was occupied during the summer (Pike-Tay, 1997; but see Stutz, 2002 for a recent critique of this technique). If accurate, this pattern of seasonal floodplain exploitation is mirrored in Wal D–F, where prime age specimens documenting a summer season of death have also been identified (Burke, 1997; Pike-Tay, 1997). Aside from severe drought or a catastrophic event, the most common cause of death among prime age individuals during summer is hunting by hominins (Stiner, 2002). This pattern has been documented among several sites within the Central Rhine Valley (Gaudzinski, 1995a, b; Conard, 1992; Conard and Prindiville, 2000), and appears to have been an important aspect of Middle Palaeolithic hominin hunting patterns.

**SPATIAL DISTRIBUTION OF THE FAUNA**

Careful consideration of the faunal remains recovered from Wal A and their distribution within the site is integral to any interpretation of site use or the organizational capacities of the site's inhabitants. The faunal remains are distributed across the entirety of the excavation but many of the specimens appear to cluster in two main areas, perhaps indicating functional zones within the site (Fig. 13). The hearth and the hearth-based lithic scatters located in the eastern portion of the site (east of the East=67 Line) retain much if not all of their spatial integrity, suggesting that post-depositional disturbances here have been minimal. The faunal remains recovered from this portion of the site bear few overt traces of human modification save for those located within or adjacent to the hearth.

The second major concentration of faunal material is located several meters to the west
Figure 7 does indicate that the occupation surface dips from the northwest to the southeast toward the Wiesbach, perhaps indicating the edge of seasonal riverbank or some other minor topographic feature. Therefore, the greater vertical displacement among the finds in the western, more terrestrial portion of the site may be due to slower rates of mainly colluvial sedimentation and burial (Becze-Deák and Langohr, 1997) or the episodes of post-depositional animal puddling identified in Wal B (Conard et al., 1995b). If the former hypothesis is correct, then there is a greater likelihood that these finds were exposed on an active surface for a longer period of time and thus represent a palimpsest. It is also likely that their vertical distribution has been exaggerated due to the post-depositional force just mentioned. The tight vertical distribution of the finds in the east and the preservation of the friable calcined and charred/burned bones is probably the result of more rapid rates of low-energy fluvial sedimentation and burial. Unfortunately,
Fig. 12. Fauna exhibiting impact and other damage (1, 3–7: impact damage; 2: unknown break; 1–6: large bovid or size-class 3; 7: fallow deer; 2: two refitted specimens of size-class 3 from excavation unit 45/62)
such details of site formation and taphonomy are particularly difficult to resolve, yet an attempt will be made later in the paper to readdress the faunal distribution in light of the lithics data discussed below.

RAW MATERIAL ECONOMY AND LITHIC REDUCTION

Analysis of the lithic assemblage from Wal A was conducted with an eye towards highlighting all phases of lithic economy, including raw material acquisition, blank and tool production, and tool use, recycling, and discard. This chaîne opératoire approach was greatly facilitated by the diversity of raw materials present at Wal A, a detailed raw material sourcing study of the surrounding landscape, and the refitting of over 600 artifacts. In a previous paper (Conard and Adler, 1997) we framed our discussion of raw material economy and lithic reduction in a generalized classificatory system for the various phases in an idealized lithic reduction sequence. This model, which is outlined in Table 4 and illustrated in
Figure 14, has been used to study the reduction sequence of the two major raw materials identified at Wal A, namely the tuffaceous and red rhyolites, and the assemblage of finds produced on diverse raw materials.

Phases A–I represent the major steps in a lithic reduction sequence. These divisions trace the path of reduction from the earliest phase, acquisition, to the final phase, discard or transport off site. Associated with phases A–I are twelve activities that can be correlated with the archaeological material. Based on available archaeological evidence, the objective of a specific knapping episode and the degree of curation it indicates can be approximated by its placement within this scheme. For example, a complete sequence that begins with the transport of an unmodified cobble to a site (Phase B) and terminates with on site use and discard (Phase D) represents a production-oriented episode with no evidence for maintenance, recycling, or curation. A sequence that begins with the arrival of finished tools on site followed by resharpening and recycling (Phase F) and transport off site represents a maintenance-oriented episode. Such assessments are, of course, context dependent and must consider factors including the amount of material transported and the distance of transport. As noted in Table 4, transport on site, transport off site, and discard can occur at any time in a reduction sequence. Figure 14 represents the generalized reduction sequence outlined in Table 4, with numbers one through twelve referring to the various activities outlined therein.

**Raw material units (RMU’s) and refit groups (RG’s)**

The study of the lithic assemblage from Wal A was facilitated by a detailed raw material survey conducted by J. Hanke and M. Wiedenfeller of the Geologisches Landesamt Rheinland-Pfalz (Figs 15–16). These researchers determined that the main raw materials found at Wal A were derived from two distinct source areas; one located within roughly 100 meters of the site and comprised of gravel deposits, the other located no closer than 6 kilometers away and

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Acquisition</td>
<td>1: Raw Material Procurement</td>
</tr>
<tr>
<td>B: Transport</td>
<td>2: Transport On Site *</td>
</tr>
<tr>
<td>C: Preparation</td>
<td>3: Decortification**</td>
</tr>
<tr>
<td>D: Production</td>
<td>4: Core Preparation</td>
</tr>
<tr>
<td>E: Use</td>
<td>5: Blank Manufacture</td>
</tr>
<tr>
<td>F: Maintenance</td>
<td>6: Tool Manufacture</td>
</tr>
<tr>
<td>G: Use</td>
<td>7: Diverse</td>
</tr>
<tr>
<td>H: Discard</td>
<td>8: Resharpening/Modification</td>
</tr>
<tr>
<td>I: Transport</td>
<td>9: Recycling</td>
</tr>
<tr>
<td>Technological Orientation</td>
<td>10: Diverse</td>
</tr>
<tr>
<td></td>
<td>11: Discard *</td>
</tr>
<tr>
<td></td>
<td>12: Transport Off Site *</td>
</tr>
<tr>
<td></td>
<td>?</td>
</tr>
</tbody>
</table>

* Transport on off site, and discard can occur at any time in a reduction sequence.
** Decortification can also occur during the acquisition phase.
comprised of primary source material (Haneke and Weidenfeller, in press; Fig. 16). The raw materials found within the Wiesbach gravels include quartz, quartzite, agate, andesite, and a variety of volcanic materials. These river cobbles resources, which appear in a variety of shapes, sizes, and textures, would have been immediately accessible to hominins in the exposed gravels in the Wiesbach drainage. Primary source materials are located in elevated positions beyond the floodplain, in an area drained by the Wiesbach (Fig. 16). The distinctive lithological characteristics of the raw materials allowed the identification of specific raw material units (RMUs), the attribution of individual finds to these RMU’s, and the reconstruction of individual knapping sequences. The ability to identify distinct raw material groups within the assemblage has allowed us to address more thoroughly issues of resource preference, acquisition, transport, and exploitation.

Detailed lithic refitting studies led to the conjoinning of over six hundred individual artifacts (Fig. 17) and the identification of one hundred and eleven refit groups (RGs). RGs are defined as individual groups of refitting artifacts; the number of artifacts involved in a given RG can range from a minimum of two up to more than one hundred (e.g., RG 1). The majority of RGs contains 2–5 individual artifacts (n=87), with increasingly lower frequencies of larger RGs (6–10: n=14; 11–15: n=7; >15: n=3). Based on several of the RGs illustrated below, it was possible to reconstruct all stages of lithic reduction that occurred at the site, including, production, use, and discard. We also recorded the nature of the refit between any two individual artifacts, distinguishing between reduction refits (n=1419, 66.7%) and refitted breaks (n=710, 33.3%). The former group represents refits between two distinct artifacts along dorsal and ventral surfaces, while the latter includes the refitting of an individual broken artifact. Since any given specimen could theoretically be refit to many other specimens, the number of refits reported above far exceeds the total number of individual conjoined artifacts (n=623).

Raw Material Procurement and Reduction

The 6,686 lithic artifacts recovered from Wal A (Table 5) document two different systems of reduction: a) the flexible, primary reduction of two low-quality raw materials transported from primary sources no less than 6 kilometers away (tuffaceous rhyolite and red rhyolite), and b) the ephemeral, poorly-defined use of locally available river cobbles from the Wiesbach (e.g. quartzite, quartz, indeterminate volcanic materials, agate, and andesite). Although both systems of reduction are represented within the same, thin
archaeological deposit, their technological differences are related primarily to: a) raw material quality (i.e. fracture mechanics); b) the proximity of the two raw material sources to the site; and c) the specific mobility practices of the site’s occupants. These differences and their impact on the raw economy are discussed below.

**Tuffaceous rhyolite** (*n=6094*) and **red rhyolite** (*n=483*)

These artifacts document the on-site reduction of 2 to 3 blocks of raw material derived from primary sources located no nearer than 6 kilometers to the south (Fig. 16). This is a production oriented reduction system, with larger blanks being chosen for retouch and transport off site (Table 6, Fig. 18). Small debitage (<15–5 mm, 30.1% of...
Fig. 16. The location of Wallertheim in relation to various villages and particular primary source raw materials that were likely available during the Eemian (after Haneke and Weidenfeller, in press). The tuffaceous deposits marked in yellow indicate the locations from which the main primary source raw materials at Wal A could have been procured. Arkose is a sandstone rich in feldspars. Rotliegend is an early phase of the Permian.
total) and microdebitage (<5 mm, 60.3% of total) dominate the assemblage. These materials can be very fine-grained but differential rates of cooling during their formation led to a heterogeneous texture within individual blocks that can shift from very fine-grained to coarse-grained within millimeters. A similar pattern in color (bright red to pale yellow) was also observed, leading us to conclude that these materials were likely formed at the same time under the same conditions. Structural irregularities present within both raw materials are due to the periodic deposition and later silicification of sediments between episodes of volcanic activity (pers. comm. Haneke, 1998; Haneke and Weidenfeller, in press). Such irregularities cause these materials to fracture in an unpredictable manner, rendering technological interpretations problematic. It is this unpredictability that has led us to classify these materials as low quality and which probably limited the ability of hominins to impose clear systems of reduction on the material. However, 59% of the finds larger than 15 mm could be refitted, and in several instances the general sequence of reduc-
Table 5

Wallerstein A Lithics: Wt=weight, AD=angular debris, SD=small debris (<15–<5mm), MD=microdebitage (<5mm). Counts are in boldface, weight is in grams, and (%) is calculated by vertical category. The total row at the bottom reflects the total counts and (%) of the entire assemblage (n=6686; g=2678.27).

<table>
<thead>
<tr>
<th>Core</th>
<th>Wt</th>
<th>Tool</th>
<th>Wt</th>
<th>AD</th>
<th>Wt</th>
<th>Flake</th>
<th>Wt</th>
<th>SD</th>
<th>Wt</th>
<th>MD</th>
<th>Wt</th>
<th>Count</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>Agate</td>
<td>-</td>
<td>-</td>
<td>1 (3.9)</td>
<td>4.11 (2.5)</td>
<td>1 (1.3)</td>
<td>3.31 (1.1)</td>
<td>2 (0.36)</td>
<td>4.94 (0.32)</td>
<td>7 (0.4)</td>
<td>0.43 (0.3)</td>
<td>10 (0.25)</td>
<td>0.035 (0.2)</td>
<td>21 (0.31)</td>
</tr>
<tr>
<td>Andesite</td>
<td>1 (12.5)</td>
<td>71.3 (13.92)</td>
<td>-</td>
<td>-</td>
<td>3 (3.7)</td>
<td>13.68 (8)</td>
<td>1 (0.18)</td>
<td>1.45 (0.09)</td>
<td>2 (0.01)</td>
<td>0.07 (0.05)</td>
<td>-</td>
<td>-</td>
<td>7 (0.1)</td>
</tr>
<tr>
<td>Quartz</td>
<td>-</td>
<td>-</td>
<td>1 (5.9)</td>
<td>26.01 (15.9)</td>
<td>2 (2.5)</td>
<td>10.25 (3.5)</td>
<td>2 (0.36)</td>
<td>4.65 (0.3)</td>
<td>19 (0.9)</td>
<td>1.7 (1.2)</td>
<td>9 (0.22)</td>
<td>0.1 (0.5)</td>
<td>33 (0.5)</td>
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<tr>
<td>Quartzite</td>
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<td>91.67 (17.90)</td>
<td>2 (11.8)</td>
<td>18.74 (11.4)</td>
<td>1 (1.3)</td>
<td>0.93 (0.3)</td>
<td>1 (1.97)</td>
<td>33.25 (2.15)</td>
<td>13 (0.6)</td>
<td>1.54 (1.1)</td>
<td>7 (0.2)</td>
<td>0.07 (0.4)</td>
<td>35 (0.52)</td>
</tr>
<tr>
<td>Red Rhyolite</td>
<td>3 (37.5)</td>
<td>77.03 (15.64)</td>
<td>5 (29.4)</td>
<td>18.45 (11.2)</td>
<td>21 (26.3)</td>
<td>62.4 (21.3)</td>
<td>86 (15.41)</td>
<td>207.97 (13.45)</td>
<td>183 (9)</td>
<td>16.11 (11.3)</td>
<td>190 (4.8)</td>
<td>1.32 (7.2)</td>
<td>488 (7.3)</td>
</tr>
<tr>
<td>Tuffaceous Rhyolite</td>
<td>3 (37.5)</td>
<td>272.13 (53.14)</td>
<td>7 (41.2)</td>
<td>84.46 (51.6)</td>
<td>52 (85)</td>
<td>194.84 (66)</td>
<td>454 (81.36)</td>
<td>1288.96 (83.38)</td>
<td>1798 (887)</td>
<td>122.26 (85.6)</td>
<td>3780 (94.6)</td>
<td>16.8 (91.7)</td>
<td>6094 (91.1)</td>
</tr>
<tr>
<td>Volcanic Materials</td>
<td>-</td>
<td>-</td>
<td>1 (5.9)</td>
<td>11.93 (7.3)</td>
<td>-</td>
<td>-</td>
<td>2 (0.36)</td>
<td>4.7 (0.3)</td>
<td>5 (0.2)</td>
<td>0.68 (0.5)</td>
<td>-</td>
<td>-</td>
<td>8 (0.12)</td>
</tr>
<tr>
<td>Total</td>
<td>8 (0.12)</td>
<td>512.13 (19.12)</td>
<td>17 (6.1)</td>
<td>162.7 (1.2)</td>
<td>80 (11)</td>
<td>295.41 (8.35)</td>
<td>558 (57.72)</td>
<td>1545.92 (30.3)</td>
<td>2027 (53)</td>
<td>147.79 (59.8)</td>
<td>3996 (9.7)</td>
<td>18.32 (9.7)</td>
<td>6686</td>
</tr>
</tbody>
</table>

...tion could be established (Figs 19–24). These reconstructions point to a flexible approach to lithic reduction that attempted to maximize the flaking potential of these otherwise heterogeneous raw materials.

In the majority of cases flakes were struck from unprepared platforms or the remnants of natural cleavage planes formed by silicified sediments within the material. The cores were rotated frequently to exploit the most suitable and reliable flaking surfaces (e.g., Fig. 23). This process of frequent rotation allowed the knappers to avoid many of the natural cleavage planes within the material, thus maximizing the number of large, usable blanks available from each core. During reduction, cores often fractured along these cleavage planes with the resulting fragments also being called into service as cores and further reduced in a similar manner. In one case an irregular core fragment was discarded eight to ten meters west of the main area of reduction (Fig. 17).

The flakes produced during reduction can be characterized as short and wide, bordering on the circular, however elongated elements are also represented (Table 7, Figs 25–27). In certain instances flakes shattered on impact, rendering many of them unusable and difficult to categorize without the aid of refitting. An example of what we refer to as a syn-reduction break can be seen in Figure 26.4. A series of t-tests comparing the tuffaceous and red rhyolite flakes did not indicate statistically significant metrical differences between these two materials (Table 7).

Three denticulates and their associated retouching debitage could be refitted and placed within the reduction sequence outlined above (Fig. 20 illustrates 2 of these). As might be expected in an undisturbed assemblage such as this, the overall frequency of retouched tools is quite low when compared to that of the debitage (tools: n=12, wt=62.9g; debitage: n=6564, wt=2231.7g). Many of the recovered tools vary considerably among certain metrical attributes (Table 8), although the small sample size available for analysis weakens this apparent pattern. Among the unretouched flakes, only fifteen (3% of flakes) exhibit clear macro use-wear damage caused by contact with a hard surface (Steguweit, 2003; Steguweit and Adler, in press) (Fig. 28). Therefore, it appears that formal tool production or casual tool/flake use and consumption was not
very high on-site. There is little doubt that lithics were transported off site at the close of the occupation, however, it is not possible to estimate the amount or types of material removed.

Together these finds document the reduction of 2–3 blocks of material (>2.4 kilograms) transported from primary sources located no less than 6 kilometers to the south. It is clear from its heterogeneous nature that the efficient reduction of this raw material was by no means a straightforward task. Rather, the successful knapping of the rhyolite required a keen understanding of its properties, including its flaws, as well as a preconceived plan for its exploitation. Without this
prior knowledge it seems unlikely that a raw material of this quality would have been transported such a distance when more homogenous materials of more predictable quality were available in the local gravels of the Wiesbach. Therefore, it seems likely that the occupants of Wal A were well acquainted with this raw material and its peculiarities and/or they were provisioning themselves in the uplands with a fresh supply of raw material prior to their journey on to the Wiesbach floodplain.

Background lithic assemblage

Associated both horizontally and vertically with the concentration of rhyolite is an assemblage of 104 artifacts (measured and water-screened finds) produced on a diverse array of raw materials (e.g., quartzite, andesite, indeterminate volcanic materials, agate, and quartz) (Fig. 29). As mentioned above, these materials are derived from the Wiesbach gravels, which at the time of occupation were probably located within 100 meters of the site. These finds, among which no reduction refits were identified, include small debitage (44%), microdebitage (25%), flakes (17%), angular debris (7%), retouched tools (5%), and cores (2%) (Table 5). Based on raw material characteristics such as texture, color, inclusions, and cortex it was possible to conclude that these finds are derived from at least 22 individual river cobbles, with the average number of finds per individual cobble ranging from 2.3 (andesite) to 7.0 (agate) (group mean=4.6, sd=2.2, n=5) (Table 9).

The clear vertical and horizontal association of these finds with the tuffaceous rhyolite and red rhyolite suggests that these finds were buried together rather rapidly. But many of these finds were likely not part of the main occupation identified and discussed above as they are distributed over a larger area of the site and do not appear in any clear clusters. Instead such finds likely docu-
ment the repeated, albeit ephemeral use of this portion of the floodplain and can be considered analogous to Isaac’s Type A sites or, employing our taxonomy, geologically contemporaneous finds (Isaac, 1981, 1984; Roebroeks et al., 1992a; Conard and Adler, 1997; Conard, 1998). A consideration of find densities highlights this point. Assuming a mean vertical distribution of 10cm we calculated the average number of finds per square-meter (n=176) according to two raw material categories. The tuffaceous and red rhyolite were found in considerable frequencies (n=6686; 37.4 finds/m^2) in comparison to the other raw materials (n=104; 0.6 finds/m^2), indicating that the latter group represents items that were lost or discarded on this portion of the landscape, perhaps over the course of a single season or year, rather than items produced and discarded during a single event or occupation (Table 6; Fig. 18). In this regard, the dense accumulations of rhyolite and a portion of the fauna at the site represent a single, short-term occupation (Stevenson, 1991; Jones 1993) within a landscape regularly and repeatedly traversed by hominins. We conclude that the association of the diverse lithic materials with the hearth, the tuffaceous and red rhyolite, and a certain percentage of the fauna is utterly fortuitous. This pattern has been observed in
Fig. 20. Refit Group 1, tuffaceous rhyolite. Dots indicate impact locations and arrows indicate direction of detachment. Two denticulates and their retouchingdebitage are included. Please consult Figure 19.

Fig. 21. Refit Group 47, tuffaceous rhyolite. Dots indicate impact locations and arrows indicate direction of detachment. Please consult Figure 19.
the other find horizons analyzed at Wallertheim (Conard and Adler, 1997; Conard, 1998)

**SPATIAL DISTRIBUTION OF THE LITHICS**

Within the scatter of tuffaceous and red rhyolite several related areas of reduction are visible (Figs 17 and 30). These areas are most clearly visible in Figure 30 where the highest density of finds cluster in three distinct yet related areas. This pattern is mirrored among the distribution of both the measured and water-screened finds, indicating individual yet overlapping reduction areas that are strictly contemporaneous and represent a single short-term occupation. One of these is located immediately adjacent to the hearth while the other areas are dispersed to the south of this feature. The distributions of particular refit groups (Fig. 17) and the refitted artifacts as a whole (Fig. 19) suggest a degree of interplay between the various reduction areas, perhaps in relation to the movement of cores or people around this small portion of the site. The overall impression given by these combined archaeological elements is of a semi-circular or crescent-shaped distribution of material similar to that documented ethnographically and described by Binford (1978, 1983).

However, the hearth-related assemblage of lithics identified at Wal A differs in several salient ways from Binford’s model (Binford, 1983) and the expectations of Stapert’s ring and sector model (Stapert, 1990; as cited in Gamble, 1999). Binford (1983) predicts that hearth-related assemblages will be deposited in two distinct zones. The first (drop zone), located nearest the hearth, is composed of in situ smaller material dropped during the execution of particular activities such as lithic reduction and tool manufacture. The second (toss zone), located some distance away from the hearth, is composed of larger material redeposited outside the activity area as the duration of occupation increases. At Wal A we only find evidence for Binford’s drop zone, suggesting, following his model, that the duration of the occupation was not lengthy enough to warrant the intentional redistribution of larger lithic material beyond the areas of activity or the establishment of specialized discard areas such as that identified at Kebbara Cave (e.g., Bar-Yosef et al., 1992; Kolen, 1999). Moreover, the hearth identified at Wal A is not centrally located within the area of excavation but is found on the northern edge of the dense archaeological distribution. Because of this arrangement Stapert’s ring and sector method of identifying prehistoric structures,
Fig. 23. Refit Group 76, tuffaceous rhyolite. Numbers 1–7 indicate the reconstructed sequence of detachments. Dots indicate impact locations and arrows indicate direction of detachment. Please consult Figure 19.
which relies on the central location of a hearth, cannot be employed.

Therefore, it appears that something other than the hearth, perhaps a shade tree or an archaeologically ephemeral activity such as meat drying or hide or wood working, "anchored" these short-term activities to this portion of the site, resulting in the crescent-shaped distribution of archaeological materials around a largely "empty" zone in an otherwise unconstrained setting (i.e. units 43/71–43/72, 42/70–42/73, and 41/71–41/73). If space and activities were organized around the hearth, we would expect to see a different pattern more similar to that predicted by Binford (1983) and reported at other Middle Palaeolithic sites such as Tor Faraj (Henry, 1998), Les Canalettes (Meignen, 1993), and the Abric Romani (Vaquero and Pastó, 2001; Vaquero et al., 2001). Instead, the hearth at Wal A appears to be peripheral to the major areas of lithic reduction.

It is possible that this distribution was affected by the location of a shade tree within the excavation units mentioned above, however, we have no direct evidence for such a feature and, since the northern and eastern edges of the excavation were truncated many decades ago and areas to the southern remain unexcavated, the true shape and size of the original distribution cannot be estimated with absolute certainty.

Considering the distribution of the lithics across the site, we used the largely sterile and topographically significant East=67 Line as a boundary, divided the site into two zones (east and west), and calculated the relative frequency of lithics in each zone based on two raw material groupings, the rhyolites (n=6582) and the other diverse lithics (n=104). These data indicate that the distribution of the lithics is not random (X²: 125.62, df=1, p<0.001, n=6686), with the majority of the finds being located in the eastern por-
Summary statistics for key attributes measured on the unbroken tuffaceous and red rhyolite flakes (>15mm), with results from two sample t-tests comparing the two materials (boldfaced t values indicate a significant statistical difference at 0.05 sigma). Surface Areal (SA1) was measured on all unbroken pieces, while Surface Area2 (SA2) was measured on unbroken pieces with complete striking platforms. This distinction allowed a more accurate measure of the surface area to platform area (SA2/PA). All measures are in millimeters or millimeters² unless otherwise noted.

<table>
<thead>
<tr>
<th>Flake</th>
<th>Tuffaceous Rhyolite</th>
<th>Red Rhyolite</th>
<th>T-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>mean</td>
<td>t-test</td>
</tr>
<tr>
<td>Length</td>
<td>20.6</td>
<td>22.1</td>
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</tr>
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<td></td>
<td>9.6</td>
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<td>0.2726182</td>
</tr>
<tr>
<td>Unbroken n</td>
<td>223</td>
<td>54</td>
<td>df=275</td>
</tr>
<tr>
<td>Width</td>
<td>20.2</td>
<td>20.1</td>
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</tr>
<tr>
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<tr>
<td>Unbroken n</td>
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<tr>
<td></td>
<td>6.2</td>
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</tr>
<tr>
<td>Unbroken n</td>
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<td>54</td>
<td>df=275</td>
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<tr>
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<td>269.0</td>
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<tr>
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<td>54</td>
<td>df=275</td>
</tr>
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<td>496.7</td>
<td>-0.5476884</td>
</tr>
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<td>409.8</td>
<td>304.7</td>
<td>0.5844464</td>
</tr>
<tr>
<td>Unbroken n</td>
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<td>48</td>
<td>df=226</td>
</tr>
<tr>
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<td>-1.20918</td>
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<td>70.2</td>
<td>42.7</td>
<td>0.2278579</td>
</tr>
<tr>
<td>Unbroken n</td>
<td>180</td>
<td>48</td>
<td>df=226</td>
</tr>
<tr>
<td>SA2/PA</td>
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<td>19.4</td>
<td>0.4769115</td>
</tr>
<tr>
<td></td>
<td>28.1</td>
<td>30.4</td>
<td>0.633886</td>
</tr>
<tr>
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<td>180</td>
<td>48</td>
<td>df=226</td>
</tr>
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<td>0.4</td>
<td>0.3024741</td>
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<tr>
<td>Unbroken n</td>
<td>223</td>
<td>54</td>
<td>df=275</td>
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</table>
Fig. 25. Tuffaceous Rhyolite (1–18: flakes; 14: RG 35 = refitted blade; 15: RG 58 = refitted blade and flake). Hatching indicates bedding plains/silicified sediments.
Fig. 26. Tuffaceous Rhyolite (1: RG 23= 3 refitted flakes; 2: RG 29= 3 refitted flakes; 3: RG 22= 4 refitted flakes; 4: RG 19= refitted shattered flake and 2 refitted flakes; 5: RG 78= 4 refitted flakes; 6: RG 1= Refitted denticulate [see Figure 20]; 7: RG 80= denticulate with refitted flake; 8–9: denticulate and RG 1= denticulate with 5 pieces of retouching debitage [see Figure 20]; 10: RG 20= 3 refitted flakes; 11: scraper). Hatching indicates bedding plains/silicified sediments.
Fig. 27. Red Rhyolite (1: retouched blade fragment; 2–4: flakes; 5: retouched piece; 6: RG 96 = 2 refitted flakes; 7: flake; 8: retouched piece; 9: RG 97 = refitted denticulate and 2 flakes; 10–12: flakes; 13: RG 86 = refitted core anddebitage; 14: denticulate; 15: RG 91 = refitted core and debitage). Hatching indicates bedding planes/silicified sediments.
Summary statistics for key attributes measured on the tuffaceous and red rhyolite retouched tools, with results from two sample $t$-tests comparing the two materials (boldfaced $t$ values indicate a significant statistical difference at 0.05 sigma). Surface Areal (SA1) was measured on all unbroken pieces, while Surface Area2 (SA2) was measured on unbroken pieces with complete striking platforms. This distinction allowed a more accurate measure of the surface area to platform area (SA2/PA). All measures are in millimeters or millimeters$^2$ unless otherwise noted.

<table>
<thead>
<tr>
<th>Tool</th>
<th>Tuffaceous Rhyolite</th>
<th>Red Rhyolite</th>
<th>T-test</th>
</tr>
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<tr>
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<td>$sd$</td>
<td>11.6</td>
<td>6.2</td>
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<td>5</td>
<td></td>
</tr>
<tr>
<td>Width $\text{mean}$</td>
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<td>21.2</td>
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<td>$sd$</td>
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<td>4.9</td>
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<td></td>
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<tr>
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<td>7.0</td>
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<tr>
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<td>2.1</td>
<td></td>
</tr>
<tr>
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<td>5</td>
<td></td>
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<tr>
<td>Max. Dimension $\text{mean}$</td>
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<td>29.6</td>
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<tr>
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<td>3.1</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Weight (grams) $\text{mean}$</td>
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<td>3.7</td>
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<tr>
<td>$sd$</td>
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<td>1.9</td>
<td></td>
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<tr>
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<td>5</td>
<td></td>
</tr>
<tr>
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<tr>
<td>$sd$</td>
<td>615.9</td>
<td>134.9</td>
<td></td>
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<tr>
<td>Unbroken n</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Surface Area2 $\text{mean}$</td>
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<td>517</td>
<td>$t=-2.45787$</td>
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<tr>
<td>$sd$</td>
<td>615.9</td>
<td>105.7</td>
<td></td>
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<td>Unbroken n</td>
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<td>4</td>
<td></td>
</tr>
<tr>
<td>Platform Area $\text{mean}$</td>
<td>227.2</td>
<td>68.8</td>
<td>$t=-1.31474$</td>
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<tr>
<td>$sd$</td>
<td>229.6</td>
<td>69.0</td>
<td></td>
</tr>
<tr>
<td>Unbroken n</td>
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<td>5</td>
<td></td>
</tr>
<tr>
<td>SA2/PA $\text{mean}$</td>
<td>39.0</td>
<td>15.1</td>
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<td></td>
</tr>
<tr>
<td>Length/Width $\text{mean}$</td>
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<td>1.4</td>
<td>$t=2.186125$</td>
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<tr>
<td>$sd$</td>
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</tr>
<tr>
<td>Unbroken n</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

The overall distribution of the diverse raw materials is wider than that of the rhyolites, with 16.3% of these finds being located in the west in comparison to only 1.6% of the rhyolites. Based on analogies with modern and historical hunter-gatherer (e.g., Yellen, 1977; Binford, 1978, 1983; Kelly, 1983, 1992, 1995; O'Connell, 1987; Fisher and Strickland, 1991; Jones 1993), some researchers believe that a spatial pattern such as that reported here can be used to estimate group social structure or the number of individuals that originally occupied a site (e.g., Yellen, 1996). While the application of such analogies are tempting, it is difficult to assess whether or not these ethnographic analogies accurately...
Fig. 28. Use damage, Red Rhyolite: 1–6; Tuffaceous Rhyolite: 7–15 (1–6: flakes; 7–12: flakes; 13: RG 18–2 refitted flakes; 14: flake; 15: RG 69= notched piece with refitted debitage). Dots indicate area(s) of use damage. Hatching indicates bedding plains (silicified sediments).
Fig. 29. Other raw materials (1: quartzite core on flake; 2: quartz scraper; 3: RG 108= quartzite flake with refitted break; 4: quartzite convergent scraper; 5: quartzite scraper; 6: agate double scraper; 7: volcanic transverse scraper)
Minimum Number of Cobbles (MNC) per raw material, with the average number of finds per cobbles

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>No. Finds</th>
<th>MNC</th>
<th>Average No. of Finds/Cobble</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Rhyolite</td>
<td>488</td>
<td>1</td>
<td>488</td>
</tr>
<tr>
<td>Tuffaceous Rhyolite</td>
<td>6094</td>
<td>1</td>
<td>6094</td>
</tr>
<tr>
<td>Agate</td>
<td>21</td>
<td>3</td>
<td>7.0</td>
</tr>
<tr>
<td>Quartzite</td>
<td>35</td>
<td>8</td>
<td>4.4</td>
</tr>
<tr>
<td>Andesite</td>
<td>7</td>
<td>3</td>
<td>2.3</td>
</tr>
<tr>
<td>Ind. Vol. Mat.</td>
<td>8</td>
<td>3</td>
<td>2.7</td>
</tr>
<tr>
<td>Quartz</td>
<td>33</td>
<td>5</td>
<td>6.6</td>
</tr>
<tr>
<td><strong>Total (All)</strong></td>
<td>6686</td>
<td>24</td>
<td>278.6</td>
</tr>
<tr>
<td><strong>Total (Background)</strong></td>
<td>104</td>
<td>22</td>
<td>4.7</td>
</tr>
</tbody>
</table>

reflect Eemian Middle Palaeolithic lifeways and social structures. Therefore we make no attempt to estimate original group size or the number of knappers at Wal A.

**INTRASITE SPATIAL PATTERNING AND CONTEMPORANEITY**

When we consider the integrated datasets from Wal A we are confronted with several interesting problems (Fig. 31). First, although we can document human agency among many of the faunal remains, we are not able to demonstrate strict contemporaneity among these finds as easily as we did among the assemblages of rhyolite and the hearth. Without the benefit of refitting it is very difficult to estimate what proportion of the fauna represents a background assemblage similar in form and content to the one identified among the assemblages of diverse lithic raw materials, and what proportion represents the remains of a single short-term occupation associated with the rhyolite and the hearth. This is a problem that plagues most archaeological investigations but one that is very often overlooked.

When we consider the size distribution of the fauna we find that these data conform better to the expectations of Binford's (1983) drop and toss zone model than the lithics discussed above. Using the largely sterile and topographically significant East=67 Line as a boundary we divided the site into two faunal zones, east and west, and calculated the relative frequency of three size categories among the fauna based on measures of maximum dimension (>100 mm, 100–51 mm, 50–1 mm). These data indicate that the distribution of the fauna is not random (X²: 73.20, df=2, p≤0.001, n=377), with larger specimens preferentially distributed in the west and smaller specimens to the east. This pattern appears to correlate well with Binford’s toss zone predictions and patterns identified at the Abric Romani (Vaquero and Pastó, 2001). Omitting from this analysis the 106 calcined and charred/burned finds associated with the hearth in the east (eastern n=132) does not alter the significance of this test (X²: 24.92, df=2, p≤0.001, n=271). If we assume that all of the fauna and the assemblage of rhyolite stem from the same occupation, then this analysis suggests the possible redeposition of larger faunal specimens away from the central portion of the site where most of the domestic activities occurred.

Further analyses reveal that the distribution of the specimens identified to the three main species categories (teeth included, total n=85) is not random (X²: 11.88, df=2, p≤0.01), with large bovids (i.e. the largest group) and fallow deer (i.e. the smallest species) distributed rather evenly across the site, while all of the equid re-
remains are restricted to the west. If we remove the equids from the analysis, the distribution of large bovids and fallow deer are clearly random (X²: 2.46, df=1, p≤0.2). These data suggest a tighter horizontal distribution of equids in the west, and a wider horizontal scatter of large bovids and fallow deer across the area of excavation. This conclusion is supported by an analysis of the distribution of large bovids across the site by the three size categories mentioned above (X²: 2.25, df=2, p≤0.10, n=46), however, results obtained for specimens identified to size-class 3 suggest a concentration of larger fragments to the west (X²: 28.03, df=2, p≤0.001, n=99). The sample sizes of fallow deer (n=23), equids (n=16), and size-class 2 (n=31) specimens were too small for similar analyses.

These data suggest that the remains of large bovids and fallow deer are distributed randomly across the area of excavation while equid remains are limited to the west. When fragment size is considered, either with respect to the assemblage as a whole or according to size class groups, there is a general preference for larger specimens to be...
concentrated in the west, however, the frequency of fallow deer, equid, and size-class 2 specimens was too low to allow testing. Therefore the main question remains whether or not these patterns reflect human agency or the vagaries of site formation processes and taphonomy. If also remains unclear whether or not all of the fauna are strictly contemporaneous and whether distinct activity zones other than that identified around the hearth can be discerned.

Finally, if we accept that the large bovid and fallow deer were deposited on site during the same period of occupation (combined MNI=9), we must explain the obvious discrepancy between the large amount of meat that would have been available to the site’s inhabitants and the ephemeral, short-term character of the main areas of lithic reduction and burning. If all of these animal resources were procured, processed, and consumed over the course of a single occupation, we would expect to see evidence for a larger, more diverse, more heavily consumed, and more dispersed lithic assemblage, and perhaps the use of multiple hearths. Such evidence is lacking entirely in the area of excavation. We believe that it is very unlikely that a small group of hominins
could have taken full advantage of such abundant resources over the short span of time suggested by the relatively small, homogenous assemblage of rhyolite and the single hearth. Beyond this logical objection, it is also difficult to imagine a situation in which a handful of hominins could have or would have wanted to procure so much animal protein over a short period of time. Potential scenarios to explain such a pattern include the early access to and scavenging of high utility body parts or a catastrophic event that presented a punctuated abundance of animal protein.

Barring such explanations we conclude that a large, undefined and likely indefinable component of the faunal assemblage is representative of a background assemblage related in part to repeated, albeit low level hominin activity on the landscape prior to or following the main occupation associated with the rhyolites and the hearth. We also believe that natural deaths and/or carnivore activity may have played an important role in the composition and eventual distribution of this background assemblage. Since the hearth and the assemblage of rhyolite are clearly contemporaneous, we feel most secure in distinguishing a single short-term occupation during which the remains of at least one fallow deer were processed, roasted, and consumed in association with the reduction of primary source lithic material. However, we do not feel comfortable suggesting the presence of any architectural features, and instead prefer use of the term “centrifugal living structure” as defined by Kolen (1999: 155) to describe the distribution of cultural material.

Our ability to identify the occupation event described above is enhanced to some degree by the more favorable taphonomic history of the eastern portion of the site. We also identify multiple, unrelated, brief occupations that likely include the butchering and processing of several large bovid and fallow deer carcasses accompanied by phases of tool use and discard but not sequences of intensive lithic reduction or tool production. Based on patterns of spatial distribution and the mode and frequency of faunal modification we believe that the equids identified at Wal A, in particular wild horse (MNI=1) likely resulted from carnivore activity and/or natural attrition. At least in this case we find no convincing evidence for the exploitation of species that prefer open habitats and that tend to aggregate in herds (e.g., equids). Instead the data suggest that more solitary, forest-dwelling species may have been preferentially targeted for exploitation. The complex depositional and taphonomic history of the western portion of the site, and the relatively small sample of faunal material available from the site as a whole limits our ability to propose a more detailed interpretation. In a mosaic environment such as that within which Wal A was situated, we feel that these are the most parsimonious, albeit conservative interpretations that the present data can support.

**DISCUSSION**

Based on the data presented here we interpret the main component of Wal A as a small camp on the Wiesbach floodplain where hominins processed primary source rhyolites and at least one fallow deer in association with a hearth, perhaps during the summer. The surrounding mosaic environment and the site’s position on the landscape made it an ideal location for settlement; it was well watered, but not marshy, and provided a wide array of plant and animal resources for exploitation. Suitable lithic raw materials of various kinds were available a short distance from the site within the Wiesbach gravels and at primary sources located to the south. While group size and the duration of the occupation are difficult to assess, the presence of an in situ knapping scatter, a moderate amount of processed animal remains from at least one individual, and a lack of lithic material from other intense episodes suggest a single short-term occupation by a relatively small group of individuals lasting perhaps a day or two. Although all of the lithic material, save that comprising the background assemblage, can be linked to this occupation, it is unlikely that much of the fauna deposited in the west resulted from activities associated with this main occupation. We believe that at least one fallow deer was introduced to the site by hominins and is strictly contemporaneous with the associated knapping scatter and hearth.

There is clear evidence for several ephemeral visits to this portion of the landscape prior to and/or following the main occupation outlined
above, but the intensity and duration of these “occupations” appear rather limited. The presence of a background lithic scatter, stemming from many unrelated, short-term visits points to the repeated passage of hominins across this stretch of the floodplain. Given the rapid rate of sedimentation documented at Wal A and the geological contemporaneity of these finds, the dense lithic scatters, and the hearth, it seems likely that these visits (both major and minor) occurred over the course of a single year and were buried together as a single archaeological unit during a seasonal over-bank event.

In an unconstrained floodplain setting such as this it is not surprising to find patches of intense activity distributed amidst the more ephemeral, generalized signature of hominin activity left across the landscape (Isaac, 1989; Conard, 1998). In fact an analogous situation has already been identified in Wal D where an occupation broadly similar to that discussed here has been discovered in close association with other background assemblages of lithics and fauna (Conard and Adler, 1997). At the opposite end of the spectrum, Wal E and Wal F contain only background lithic and faunal assemblages, with no clear evidence for distinct occupations (Conard et al., 1995a; Conard, 1998). In such situations, sorting out which materials reflect single occupations and which do not can be facilitated by the raw material diversity observed within an assemblage as well as refitting and taphonomic studies.

Another intriguing aspect of Wal A is the lack of on-site evidence for the exploitation of distant resources and habitats. Although archaeological data sensitive to patterns of land-use and mobility are difficult to derive from many Palaeolithic contexts, lithic raw material procurement, reduction, and consumption behaviors can be used to gauge territory size or the frequency or scale of prehistoric mobility (Binford, 1977, 1979, 1980; Kuhn, 1992, 1994, 1995; Gamble, 1999). Several important studies of European Middle Palaeolithic raw material transfers illustrate the movement of materials over substantial distances (sometimes >100 km) and their intensive reduction (e.g., Gamble, 1986; Geneste, 1988a, 1988b; Roebroeks et al., 1988; Conard, 1992; Kuhn, 1992; Floss, 1994; Conard and Adler, 1997; Adler, 2002), however such cases are exceptional (Féblot-Augustins, 1993, 1997, 1999). Based on the raw material sourcing study discussed above it appears that the hominins who occupied Wal A and during the Eemian routinely procured materials from local sources (<20 km), whether they be the ubiquitous Wiesbach gravels or nearby primary source materials. We do not find any evidence at Wal A for long distance raw material transfers (>20 km), however, this does not mean that they never occurred. Taken as a whole, the available data regarding raw material diversity, frequency, and distribution at Wal A, suggest that hominins within the surrounding region may have structured their activities and social relations within relatively small territories that could be covered in a single day’s trek. According to Gamble (1999), a reliance on local commodities (e.g., primary or secondary lithic sources, key ambush or habitation sites, animal and plant resources, or mating and exchange networks) appears to characterize much of the European Middle Palaeolithic. However, the ephemeral, short-term nature of the occupations at Wal A suggest that local groups may not have always stayed in one place very long and may instead have been highly mobile, perhaps seasonally, within their otherwise small territories. The faunal data suggest that they may have relied more heavily on forest species than those commonly associated with more open environments.

An exception to this general pattern was identified at Wal D, an overlying layer correlated with OIS 5c and dated to roughly 100ka (Figs 2–4) from which were recovered a faunal assemblage dominated by wild horse (NISP=100, 56.5% of total NISP, MNI=1 adult, 2 sub-adults) (Conard and Prindiville, 2000) and an assemblage of 97 heavily curated tools and reshaping debitage on a red rhyolite; no cores or flakes of this material were found (Conard and Adler, 1997). Although 14 specimens of wild horse, including a pelvis, several vertebrae, and a scapula exhibit unambiguous cut-marks, and a further six shaft fragments exhibit impact fractures (Conard and Prindiville, 2000), it remains difficult to assess what proportion of this assemblage can be associated with specific lithic scatters identified within the find horizon. It is also worth noting that cementum analysis of a single tooth attributed to wild horse indicates a summer death (Burke,
and that only a single specimen of fallow deer was identified in the entire assemblage.

The heavily reduced lithic artifacts recovered from Wal D were produced on Donnersberg rhyolite, a material procured from primary sources located approximately 25 kilometers away. This assemblage arrived on-site in an exhausted form, indicating that it had experienced considerable resharpening, recycling, and use since its initial manufacture. Many of these tools were discarded on-site after a failed attempt at recycling and rejuvenation while others were transported off-site following their successful transformation into burins. This assemblage is strictly contemporaneous with an associated lithic assemblage produced during the primary, mostly laminar reduction of an andesite cobble derived from the neighboring Wiesbach gravels. The two assemblages appear to represent a retouching episode during which many of the exhausted rhyolite tools were replaced with fresh implements of andesite (Conard and Adler, 1997). These finds are geologically contemporaneous with another assemblage of andesite as well as a background lithic assemblage very similar to that described for Wal A. As might be expected the assemblage of exotic (>20 km) raw material (Donnersberg rhyolite) is represented only by the latest stages of reduction (Fig. 14, stages 6–12), suggesting that a small group of highly mobile foragers provisioned themselves with finished tools prior to entering the Wiesbach floodplain and re-supplied themselves with new retouched implements before leaving the area. Damblon’s analysis of carbonized botanical remains from Wal D identified Pinus t. sylvestris (Scots pine), Betula sp. (birch), Picea/Larix (spruce/European larch), and Poaceae (grasses) in the area (1997, in press), suggesting a cooler, more open environment than that which prevailed during OIS 5e.

If we assume that the archaeological occurrences documented in Wal A and Wal D are generally representative of their respective time periods, an assumption not without its dangers, then we can attempt to compare particular aspects of hominin behavior (e.g., mobility, land use, and social network size) over time. Gamble refers to these combined behavioral features as the “landscape of habit,” that is “The wider region, traversed by the individual and all those with whom he or she interacts, [that] forms a spatial network of intersecting paths” (Gamble, 1999: 87). As discussed above the hominin “landscape of habit” within the local Eemian environment appears to have been rather limited in extent and diversity while that which prevailed during OIS 5e appears to have grown to include more distant regions, resources, and perhaps individuals, although in keeping with general observations the overall pattern still retains a very local flavor. Maintaining the assumption made above, these data suggest that OIS 5c populations may have adapted to the more open environment that characterized the period by exploiting larger territories and provisioning individuals with durable, portable implements, perhaps as a periodic, seasonally oriented strategy. It is also possible that the disappearance of the dense Eemian forests allowed hominins to traverse and exploit a wider array of landscapes and thus extend their social network, as well as reorganize their subsistence strategies, at least in part, around the hunting of equids on the open grasslands that dominated the post-Eemian landscape. Ultimately, however, based on a handful of artifact clusters from a single site, with no other contemporaneous archaeological points of reference, we are unable to determine the precise nature or extent of Middle Palaeolithic mobility and land use in this region during or following the Eemian. Thus the ideas presented here should be viewed as working hypotheses that can only be tested through the careful excavation and analysis of more archaeological sites dated to the Eemian and periods immediately there after.

CONCLUSIONS

Wal A represents one of the few well-preserved Eemian occupations in Europe and suggests a moderate degree of mobility within a resource rich, densely forested environment where diverse lithic, faunal, and floral resources were readily available. Several aspects of the lithic and faunal assemblages lend support to this conclusion. Raw material procurement occurred within the vicinity of the site at nearby primary sources and within the adjacent Wiesbach gravels. The former source material arrived on site in unmodified blocks and experienced thorough reduction within the area of excavation. The low
number of finds made on materials derived from
the Wiesbach gravel may indicate a preference
for materials from nearby primary sources even
though these are of inferior quality in specific
respects. Lithic reduction and use was not maxi-
mized, as indicated by the rarity of retouched
and utilized pieces and the ubiquity of unused blanks,
suggesting that raw material constraints were not
pronounced.

The faunal assemblage recovered from Wal
A contains the remains of fallow deer, large bov-
id, and wild horse, with the latter species showing
no evidence of human modification. While the
state of preservation among these finds is gener-
ally poor, based on preliminary taphonomic study
it does appear that the remains of fallow deer and
large bovid represent archaeofaunas, while the
equid remains likely represent a palaecological
background assemblage. Whether this pattern
may also be related to particular hunting prefer-
ences cannot be determined with certainty.

Together these data document raw mate-
rial and subsistence economies focused on the
exploitation of rich and immediately available
resources located on and around the Wiesbach
floodplain during the Last Interglacial. The
successful implementation of such economies
does not appear to have been reliant upon long-
distance residential moves or the use of curated
technologies. The data from Wal D suggest that
during OIS 5e hominins may have reorganized
their foraging behaviors to take advantage of
more open landscapes, perhaps by exploiting
larger territories, relying periodically on curated
technologies, provisioning individuals, and pre-
ferritionally targeting specific animal species such
as equids. This may in turn have fostered larger
social networks.

Developing clear insights into the impact of
Eemian climate and environment on the organiza-
tion and distribution of hominin communities in
Europe is an admittedly difficult task, especially
when one considers the limited number of sites
available for study as well as the diverse, often
course-grained nature of the available datasets.
In this paper we have attempted to place a single
archaeological occurrence from the Rhineland
within the larger framework of Eemian Middle
Palaeolithic lifeways as they are now understood,
and to highlight some of the main contributions
our research can make to larger behavioral is-
ues. Ultimately, a study such as ours, based on
the careful analysis of high-resolution data from
a single site, cannot serve as the foundation for
a broad reinterpretation of the period, however it
does provide new perspectives on regional hom-
inin behavioral patterns as expressed at the outset
of the Upper Pleistocene.

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