Visualizing Occupation Features in Homogenous Sediments. Examples from the Late Middle Palaeolithic of Grotte De La Verpillière II, Burgundy, France

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Abstract: Here, methodological approaches are presented to reveal otherwise-invisible archaeological features in homogenous, fine-grained aeolian/fluvial rock-shelter sediments containing archaeological deposits from the Late Middle Palaeolithic. The excavations and analyses at the site Grotte de la Verpillière II combine multiple technical solutions to build three-dimensional models of archaeological features in these sediments that are difficult or impossible to see by means of conventional observation. The meticulous piece-plotting of thousands of individual charcoal and burnt-bone fragments, lithic and faunal artifacts, and limestone fragments, has allowed fort the identification of distribution patterns of these materials that are supported by additional spatial data, lithic refits, and technological analysis. Detailed mapping and data-analysis has focused on the reconstruction and interpretation of the site occupation to establish a database and reference-site for the Middle Palaeolithic in Southern Burgundy, Saône-et-Loire.

Keywords: Côte chalonnaise, Eastern France, Three-dimensional find distribution, Late Middle Palaeolithic occupation

Introduction

An observable phenomenon of many archaeological layers in sites attributed to the Middle Palaeolithic is the predominant lack of clear, detectable settlement patterns that were accumulated by repeated occupation events. Sedimentary units in caves and rock shelters tend to be highly homogenized, but obviously contain the material remains of multiple occupation events. Identifying distinct horizons within such deposits is a challenging task, even in the case of recent excavations employing modern techniques and elaborate studies in an effort to separate entities that are assumed to be layered within homogenous sedimentary units.

Potential reasons for sedimentary homogeneity are many and varied, and include taphonomic processes (post-depositional mixture of individual occupation events by geological and biological processes), errors in excavation (failure to recognize and separate strata and finds during excavation) or unique and unexpected settlement patterns (frequently and repeated short-term occupation with uneven find-scatters within the same sedimentation process), environmental influences during and after sedimentation (e.g. carnivore and rodent activities, plant growth, wind drift, landslides and events of collapse, or cryoturbation) and even subsequent events of human occupation, which can affect the distribution of materials discarded on the surface of the site.

Here an attempt has been made to develop and apply methods that could aid in solving such clear palimpsest problems and provide high-resolution temporal indicators of occupation events and site-formation processes. In particular, studies of archaeological finds are used in combination with micromorphological and geomorphological studies in an effort to clarify the effects of small- and large-scale geological factors with the ultimate goal of identifying distinctive entities within homogenous sedimentary units. The application of isosurface analysis is used here in combination with three-dimensional studies of material remains in order to reveal patters of accumulation and discrete distributions inside stratified layers of homogenous sediments.

Based on the material record in Palaeolithic sites, archaeological methods were developed to study these materials, especially lithic and faunal refitting, raw-material studies, analyses of litho-technological reduction sequences, archaeozoological studies, but also distribution analyses within sites and layers (e.g. two- and three-dimensional find and finding distribution analyses). The aim here is to find significant patterns that justify the separation of assemblages or explain spatial distribution patterns within sediment units. These patterns can clarify modes of human occupation such as: single, multiple, short-term, long-term, repeated, frequent, erratic.

1 Regional, geological and site setting

The site of interest is the Grotte de la Verpillière II (hereafter VP II) in the Saône-et-Loire department in France. The site is located around 10 km west of Chalon-sur-Saône in the municipal of Mellecy in Germolles at the western cliff-face of the Orbize valley (see Fig. 1).

The site is situated in the eastern cliff-face of the Upper Oxfordian Montadiot massive, which was affected by the formation of Rhine-Saône-Rhône graben. Karstic processes during the Neogene resulted in the formation of a small valley that is traversed by the little creek Orbize (Bons and Wißing, 2009; Cailhol, 2014; Wißing, 2012). Karstic washing occurred along two geological fractures (around N 150° and N 15°) and formed the two sites of Grottes de la Verpillière I and II, situated 50 m apart in the same cliff-face.

VP II was discovered in 2006 by an excavation team from the University of Tübingen, under the direction of H. Floss, and

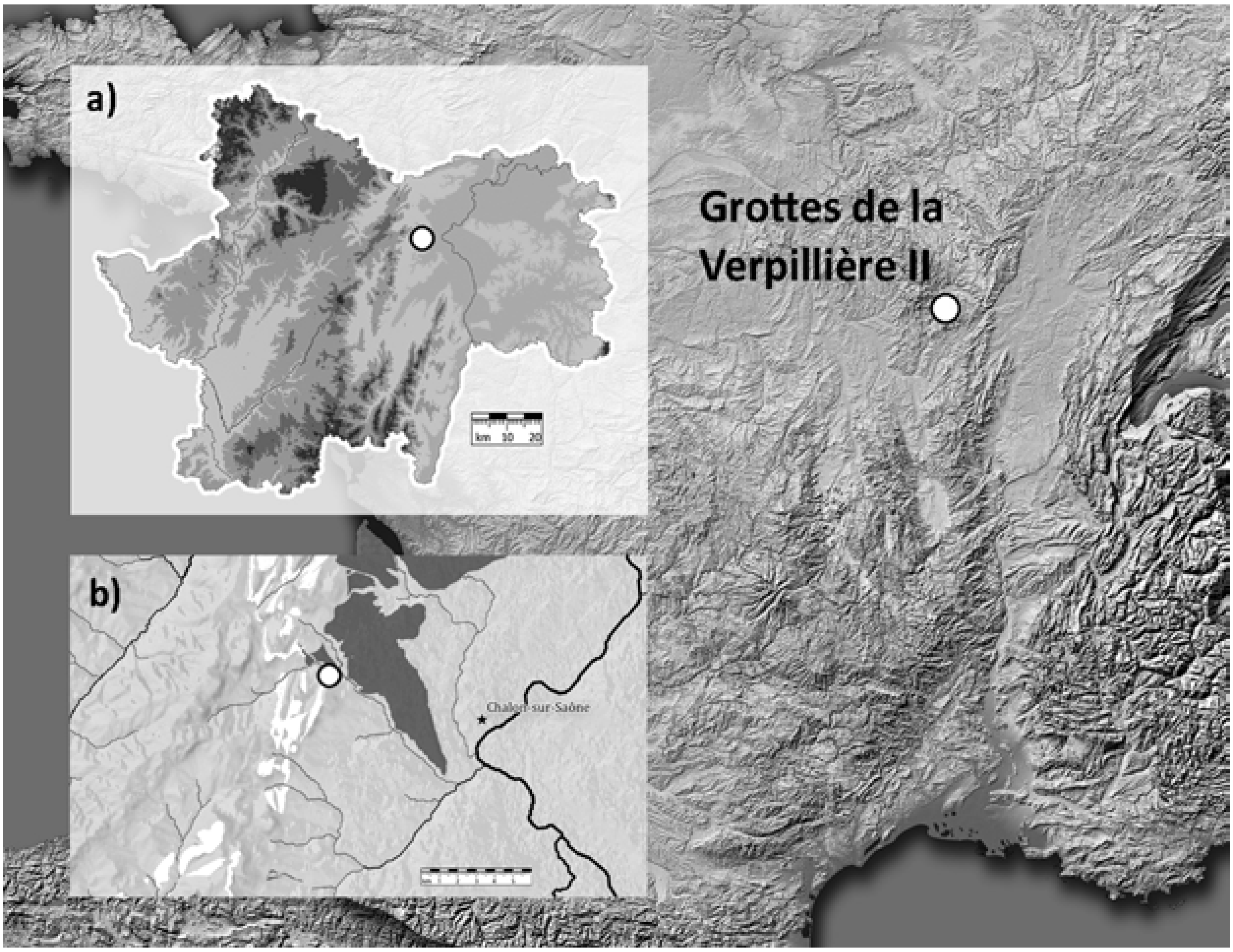

Fig. 1. Location of Grotte de la Verpillière II in France (dots refer to the position of VP II. a) Dept. of Saône-et-Loire; b) Côte chalonnaise (dark grey - distribution of paleogene sediments containing flint of the *Argiles à Silex*; white - distribution of Jurassic bathonian sediments containing chert; bright blue - distribution of jurassic bajocian sediments containing chert). Base map from NASA Shuttle Radar Topography Misson 2000 (eoimages.gsfc.nasa.gov), raw material distribution map from M. Siegeris (SFB 1070 B01) with map data from Jarvis *et al*. (2008).

has since been under excavation in the form of annual field campaigns. After removing overlying beds of humic, mixed sediments (geological units GH 1 and GH 2) and massive limestone blocks from a rock collapse, the team identified stratified, nearly-undisturbed sediments in 2009 that contain Middle Palaeolithic material (GH 3, GH 4x and GH 4). These sediments are still under excavation and therefore the results of spatial analysis are preliminary. In current calculation around 12.5% to 25% of the entire area containing these sediments has been excavated at the time of this publication (see Fig. 2).

In all, the (excavated) stratigraphy of the site is around 7 m thick. The Middle Palaeolithic layers (Geological units, GH 3, 4x and 4) are stratified between two rock collapses and lie under a collapsed rock shelter and in the entrance of a corresponding cave tunnel. The second rock collapse, which sealed the Middle Palaeolithic occupation layers, is covered by mixed sediments (GH 1 and 2) containing material from Middle Palaeolithic, Upper Palaeolithic, Neolithic, Roman, Medieval and modern times. It is assumed that most of these sediments derive from the plateau above the cliff-face and have been altered by animal and floral activities (badger den and vegetation cover). The first rock-collapse (GH 8) underlying the Middle Palaeolithic occupation is covered by a highly altered flowstone (GH 7), yellow weathering sediments (GH 6, in the interior of the cave tunnel), and a sediment altered by formation (GH 5, in the entrance of the cave tunnel). A summarized stratigraphy of the site can be seen in table 1 (see also Frick and Floss 2015) and is illustrated schematically in Fig. 3:

The stratified geological units containing the Middle Palaeolithic occupation layers (GH 3, 4x and 4) are easily distinguished during excavation because of their different colour, grain-size components, and contents of calcite and silica or solidity (Frick and Hoyer 2009; Frick and Hoyer 2011; Frick and Hoyer 2012; Frick *et al*. 2013). In general, the sediment of all three stratified units is composed of a coarse-clay and fine-sand matrix (fine-to-medium quartz sand embedded in coarse clay and fine silt) with some quartz and limestone inclusions of fine gravel size. The differences of the GHs lay mostly in the amount of these coarser components: the deeper in the stratigraphy, the coarser such fragments. The sediments are a combination of a substantial amount of aeolian quartz and mica, combined with fluviatile components such as limestone fragments. Sometimes manganese and iron oxide crusts altered the limestones.

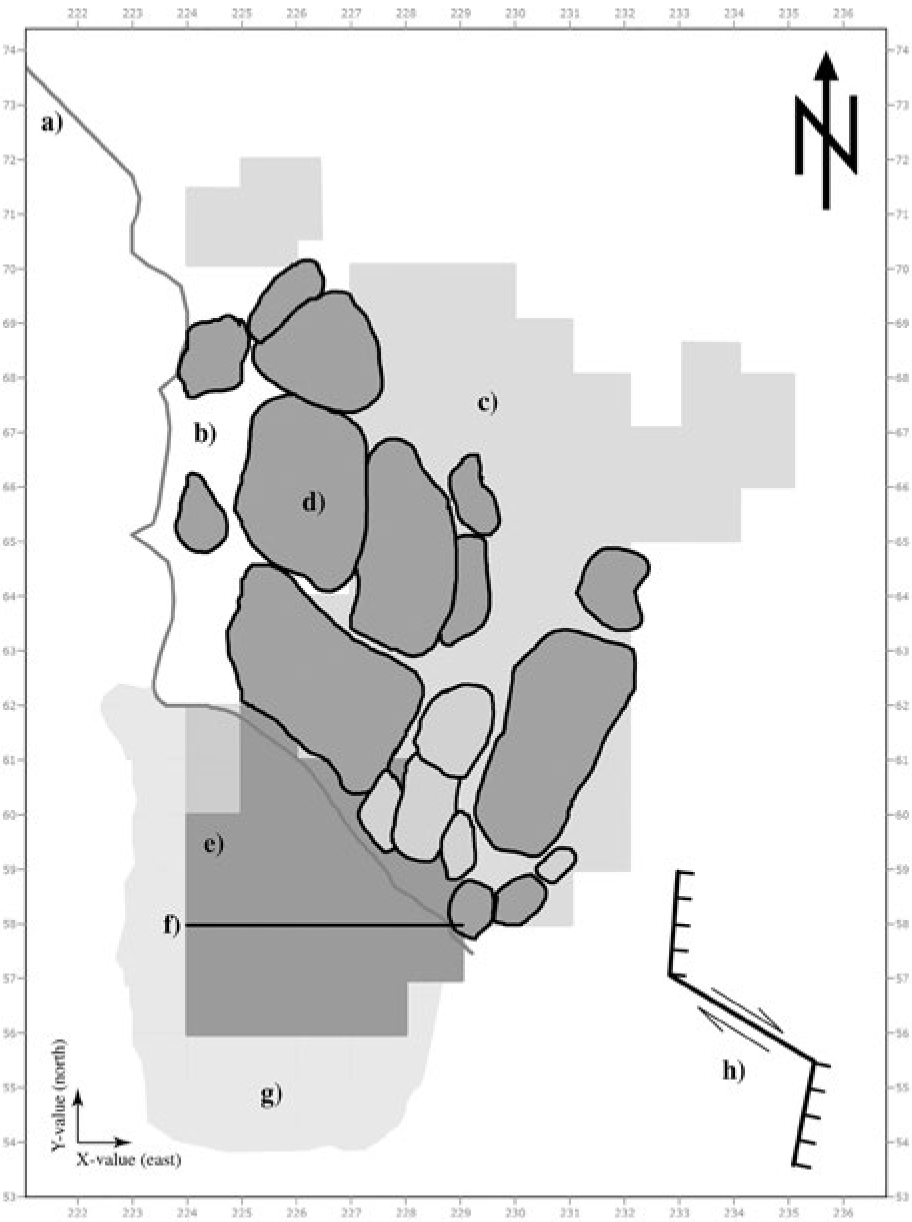

Fig. 2. Schematic map of Grotte de la Verpillière II. a) cliff face in north western direction to VP I; b) area of dense vegetation; c) area where sediments of GH 1 and 2 are almost completely removed (almost equals the potential area of intact sediments); d) area of collapsed rocks that have built the rock shelter (dark grey - blocks still in position, light gray - removed blocks); e) position of the current excavation of GH 3, GH 4x and GH 4; f) position of the schematic profile of the cave tunnel (see Fig. 3); g) size of the cave tunnel as much as could be explored, and h) illustration of geomorphological fracture directions. Basal GIS map from C. T. Hoyer (DFG FL244/5-1).

These geological units represent layers formed under similar geological conditions. Indications of single events like occupation layers are impossible to identify during excavation because of the very homogenous sedimentation and the equally similar chemical interaction of the soil with the archaeological finds (patination and chemical solution of organic material). Micromorphological analysis has shown that GH 3 (in the present-day entrance of the cave tunnel) was slightly altered by bio- and cryoturbation in the form of small root channels and chemical homogenisation (Bons and Wißing 2009; Wißing 2012).

The material from the stratified layers can be exclusively attributed to the Middle Palaeolithic. The lithic artefacts (of GH 3, GH 4x and GH 4) yield a strong Levallois component in the form of heavily centripetally-reduced Levallois cores, core-configuration flakes and finished products like oval and rectangular flakes and blades (Frick and Floss 2015). The richest geological unit (GH 3) contains: n=3,780 lithic elements, n=2,323 faunal components (bone, teeth, antler and ivory) and n=9,509 charcoal fragments (mostly <1cm). In the upper parts of GH 3, bifacial elements occur**,** including *Keilmesser* (n=6, including two with tranchet blows), n=11 bifaces, n=9 tranchet-blow blanks and n=9 preforms that can be attributed to the *Keilmessergruppen* of central Europe (Frick and Floss forthcoming). Hammerstones, anvils and cores of quartzite and sandstone are also present in all three stratified layers.

The main lithic raw material in all three geological units is flint from the *argiles à Silex*, a local material (cretaceous flint that was eroded and deposited in the Eocene) that can be found as near as 150m south and south-west of the site (Frick *et al*. 2012), which could be also detected on nearly all hill ranges of the *Côte chalonnaise*. Another material is Jurassic chert from the Bathonian and Bajocian with its nearest sources as close as 3 km to the east (Siegeris, 2014).

TAB. 1. SUMMARIZED GEOLOGICAL UNITS FROM TOP (GH 1) TO BOTTOM (GH 9) AT GROTTE DE LA VERPILLIÈRE II (SEE ALSO FRICK AND FLOSS 2015; FRICK AND FLOSS, IN PRESS).

geological layer (GH)	status	yield	sediment	thickness
1	mixed	modern material, items from the middle ages, upper and middle paleolithic artifacts	cover soil with many limestones and less humus and throw-off of the badger den (maybe also from the top of the plateau)	around 0.1 m
2	mixed	modern material, items from the middle ages, upper and middle paleolithic artifacts	soil with a big humus content, mostly bigger limestones, limestone blocks of the roof collapse, patches of cave sediments, badger den	0.2 to 3 m
3	intact	middle paleolithic artifacts	mostly aerial soil with a small fluvial component, slightly altered through bio- and kryoturbation, very find grained	0.4 to 1 m
4x	intact	middle paleolithic artifacts	mostly aerial soil with a small fluvial component, almost no alteration visible, mid-fine grained	0.05 to 0.1 m
4	intact	middle paleolithic artifacts	mostly aerial soil with a small fluvial component, almost no alteration visible, mid-fine grained	0.1 to 0.4 m
5	intact	sterile	dark-brownish soil horizon under the contemporary entrance	0.05 to 0.1 m
6	intact	sterile	yellow weathering horizon of limestones inside the cave	0.05 to 0.5 m
7	intact	sterile	weathered flowstone	around 0.1 m
8	intact	sterile	concreted limestone blocks	around 0.7 m
9	intact	possibly another find horizon	crusts and blocky deposits of limestone (only in a small depth sondage)	possibly 0.1 m

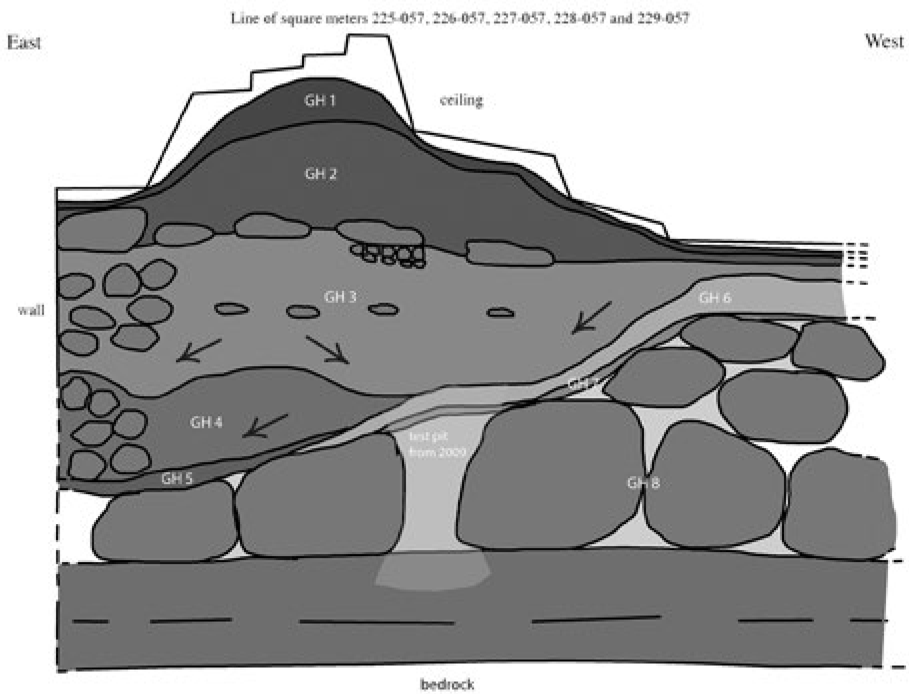

FIG. 3. SCHEMATIC GEOMORPHOLOGICAL AND STRATIGRAPHICAL SETTING OF GROTTE DE LA VERPILLIÈRE II AS DETECTED BY CURRENT EXCAVATION INSIDE THE CAVE TUNNEL (POSITION SEE FIG. 2F). LEFT - SCHEMATIC DRAWING OF SEDIMENTS OVERLAYING THE FIRST ROCK COLLAPSE; RIGHT - ACTUAL PROFILE SHOWING THE HOMOGENOUS SEDIMENT OF GH 3 AND BURROWS.

The faunal component (only in GH 3 and GH 4) includes mostly bone and teeth from larger herbivores like woolly rhino (*Coelodonta antiquitatis*), mammoth (M*ammuthus primigenius*), horse (*Equus ferus*), bovidae (*Bos primigenius*/ *Bison bonasus*), and cervidae (*Cervus elaphus* and *Rangifer tarandus*). Carnivores like hyena (*Crocuta crocuta*) and bear (*Ursus sp.)* are present in small numbers (Wilk 2014). There are slight differences in the faunal components of GH 3 and 4. The analysis of n=696 bones and teeth from GH 4 (campaign 2009 to 2013) showed that woolly rhino and horse represent the biggest weight. GH 3 instead showed by weight more giant deer (*Megaloceros giganteus*), horse, red deer, bovidae and in small amounts, hyena, wolf and bear. Some bones in the size-class of bovidae and cervidae showed impact and cut marks in GH 3 and 4 (Wilk 2014; Wilk 2014).

In addition to the observations made during excavation, several scientific approaches were taken to verify geological and geomorphological and micromorphological interpretations. Ground-penetrating radar surveys (GPR) in 2009 provided insight into the size of the cave tunnel. In 2014, it was demonstrated through additional GPR survey that most of the sediment from the plateau overlying the site was eroded, and likely formed the landslide component of GH 1 and 2 as well as the talus that originally concealed the site. Another cavity was identified to the west that could be connected to the known cavity. It was also confirmed that all massive limestone blocks on the terrace of the site derive from rock collapses and overlie stratified sediments, meaning that the area of potentially-stratified sediment is much larger than expected (Leach 2014; Leach and Miller 2009).

Geomorphological surveys provided data about fractures in the cliff face, sedimentation processes, position of bedrock, stratification of the dolomitic limestones of the cliff face and the collapse of the rock shelter (Bons and Wißing 2009; Cailhol 2014; Frick 2014; Wißing 2012). Preliminary micromorphological studies of samples from sediment under the current entrance of the cave tunnel showed that GH 1 and 2 is highly altered, disturbed, mixed and containing substantial amounts of humus. In contrast, GH 3 showed only slight alteration in the form of small root-channels and a homogenisation due to cryoturbation (Floss 2009; Wißing 2012).

2 Methods

The methodological basis of this study is the meticulous three-dimensional piece-plotting of all artefacts, including traces of fire/heating such as charcoal and burnt bone. This practice is widespread in archaeology, but not universal. One aim of the current study is to explore and demonstrate the informative potential of piece-plotting methods, specifically the potential of these methods to provide insights into patterns that are otherwise impossible to detect. During excavation, the three-dimensional position of every object (mostly >2cm) was measured using a tachymeter and recorded in the excavation database using EDM for Windows (Dibble and McPherron 1996).

At VP II, every effort was made to record the three-dimensional position of all artefacts over 5 mm (e.g. lithic objects, faunal elements, burned sediment, iron oxides, limestones) using a Total Station (Leica tachymetre and laptop with EDM for Windows. Charcoal fragments were spatially measured below this size threshhold, sometimes down to a size of just one or two millimetres. All sediments from GH 3, GH 4x and GH 4 were water-screened with a mesh size of 1 mm. Artefacts from sediment units (e.g. bucket) are called collective finds.

The plotted artefacts and topographical landmarks (e.g. geological units, archaeological features**,** and the geomorphology of the rock shelter) were processed in Voxler™ to display their distributions in three dimensions. To date (campaigns 2006 to 2014), n=49,467 measurement points have been collected from the site (including n=11,793 topographical measurement points and n=17,492 single-finds, see tab. 2).

The protocol was not put in place until systematic excavation began. Restrictively, in the spatial distribution plots, it has to be acknowledged that the test pit of 2009 (indicated as shaded square in Fig. 4) was excavated much faster and mostly collective finds were made (buckets of sediment, water screened or sorted). So all finds >1cm were collected and can only referred to a sub-square metre. The next step in future needs to be to incorporate all small finds from collective finds into the study about spatial distribution.

Initial observation of the distribution of all find-categories (see Fig. 4) specific distribution zones to be further investigated. In order to do so, two find categories at a time were plotted against

Tab. 2. Exemplary extract of numbers of measurements (non-exhaustive) from VP II.

category	GH 3	GH 4x	GH 4	stratified units (GH 3, 4x and 4)	total (including all units and features
single finds	16812	55	523	17390	17492
botanic/osseous burnt material	9509	32	284	9825	9828
lithic objects (measured as single finds)	2968	27	59	3054	3104
faunal elements, like bones, teeth, antler and ivory (measured as single finds)	2221	0	159	2380	2441
limestone fragments (measured as single finds)	1520	2	19	1541	1877

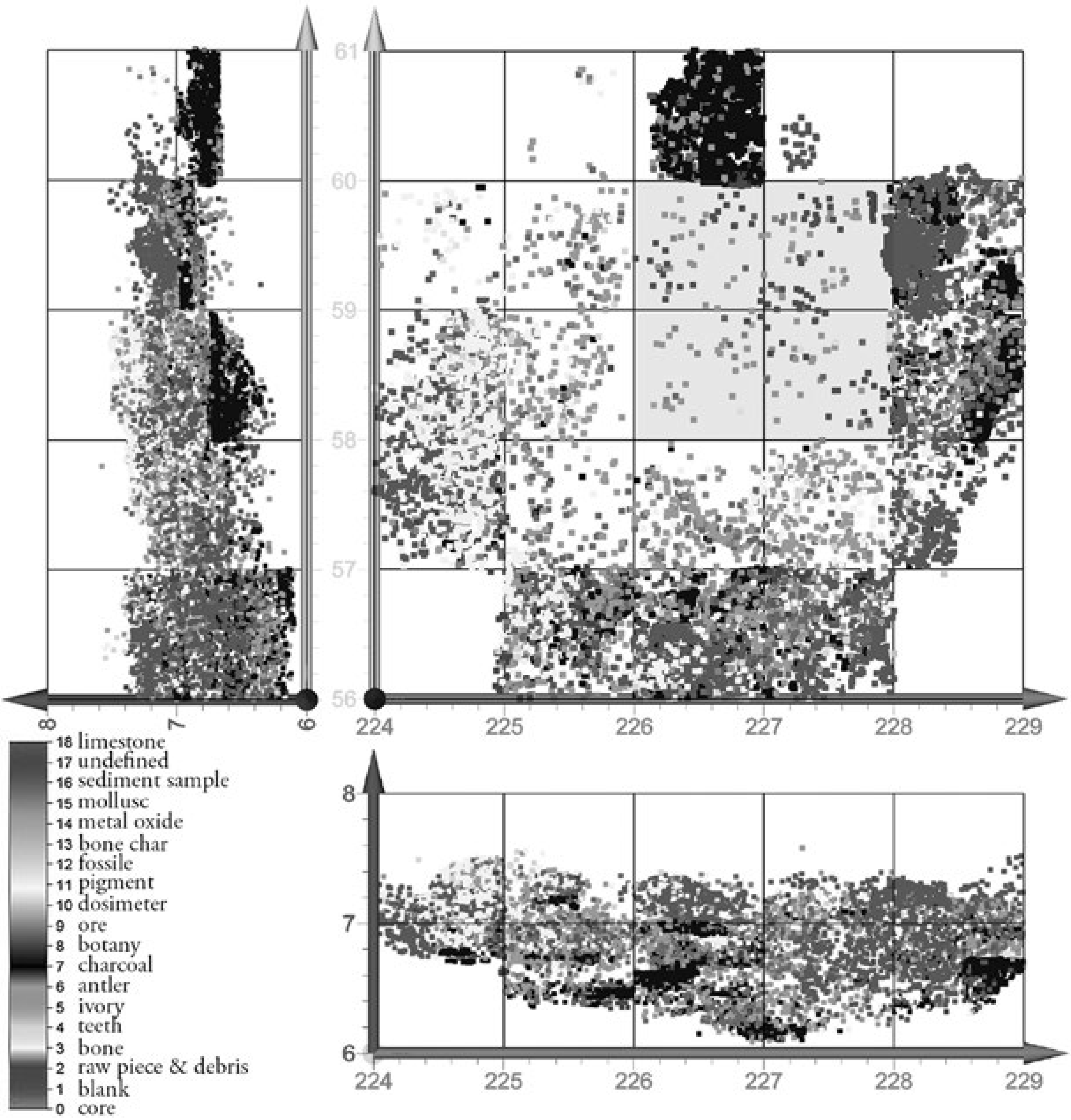

Fig. 4. Distribution of all find categories from GH 3 in top view (top right), view from east to west (top left) and south to north (bottom right). The grey-shaded square indicates the test pit from 2009, where mostly collective finds were measured.

each other (see Fig. 5 to 8 and 10), and the Voxler™ program calculated a surface (called an isosurface) that separated these two clusters from each other on the basis of points of a constant value within a volume of a three-dimensional space.

In the following section we describe the preliminary results of the spatial-distribution analysis of GH 3. As noted above, this layer is a geologically homogenous unit with minimal post-depositional disturbance, containing Middle Palaeolithic lithic artefacts and cold-weather fauna. By applying the analyses described above to a series of categorical pairs (ex: charcoal and limestone, lithic-objects and faunal-remains), we build a case for internal stratification within this homogenous sedimentary unit.

3 Results

Three-dimensional plots showing the spatial distribution of particular single-finds from GH 3 are presented in Figures 4 to 10. All three-dimensional plots are oriented in the same way (top left: view from east to west; top right: top view; bottom left: legend; bottom right: view from south to north).

The first clear separation of archaeological single-finds can be seen by plotting faunal material against lithic material (Fig. 5). Here, it can be seen that in the lower part of GH 3 the vast majority of artefacts are lithic objects. Faunal components can be found in the upper components of the layer, and primarily in

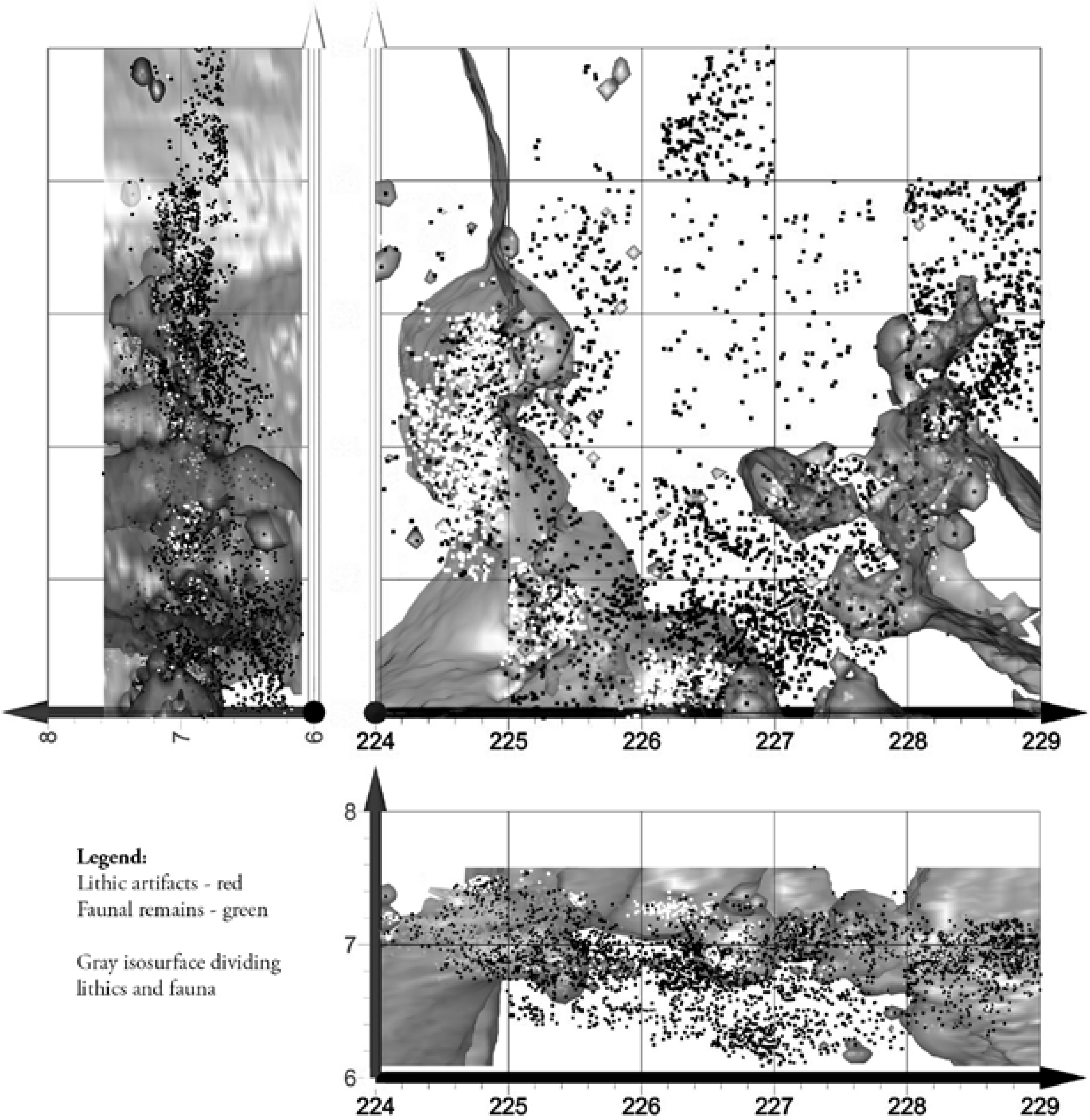

Fig. 5. Spatial distribution of lithic artefacts (Black dots) and faunal remains (white dots) inside GH 3. Grey isosurface shows the spatial division of these objects.

the western (and to a smaller extent the southern) zones of the excavation area.

The next case (Fig. 6) shows that limestone fragments and charcoals are also clearly three-dimensionally separated. In the upper parts of GH 3 many more limestone fragments are visible (mostly deriving from collapsed and dissolved blocks) than in the lower zones. The charcoal fragments are consistently clustered in distinct zones and in the lower parts of GH 3. This further suggests internal stratification within GH 3.

In the subsequent example (Fig. 7), the distribution of bones and teeth is displayed against that of charcoal fragments. Here the spatial separation of unburned faunal components and burned botanic/osseous(?) material is clearly visible.

We also examined whether a specific lithic component (Levallois elements) was spatially-clustered or not (Fig. 8). The Levallois elements derive here from single-finds and collective finds. As the Fig. 8 indicates there is little patterned distribution of these elements, aside from a restriction for the most part to the upper zones of GH 3.

This seems also to be the case for bifacial elements. Figure 9 shows the distribution of all lithic single-finds vs. the distribution of strictly bifacial elements (see Frick and Floss, in press).

The final example (Fig. 10) shows the spatial distribution of burnt/heated material (bones n=8, lithic objects n=200 and sediment n=69) plotted against the distribution of charcoal

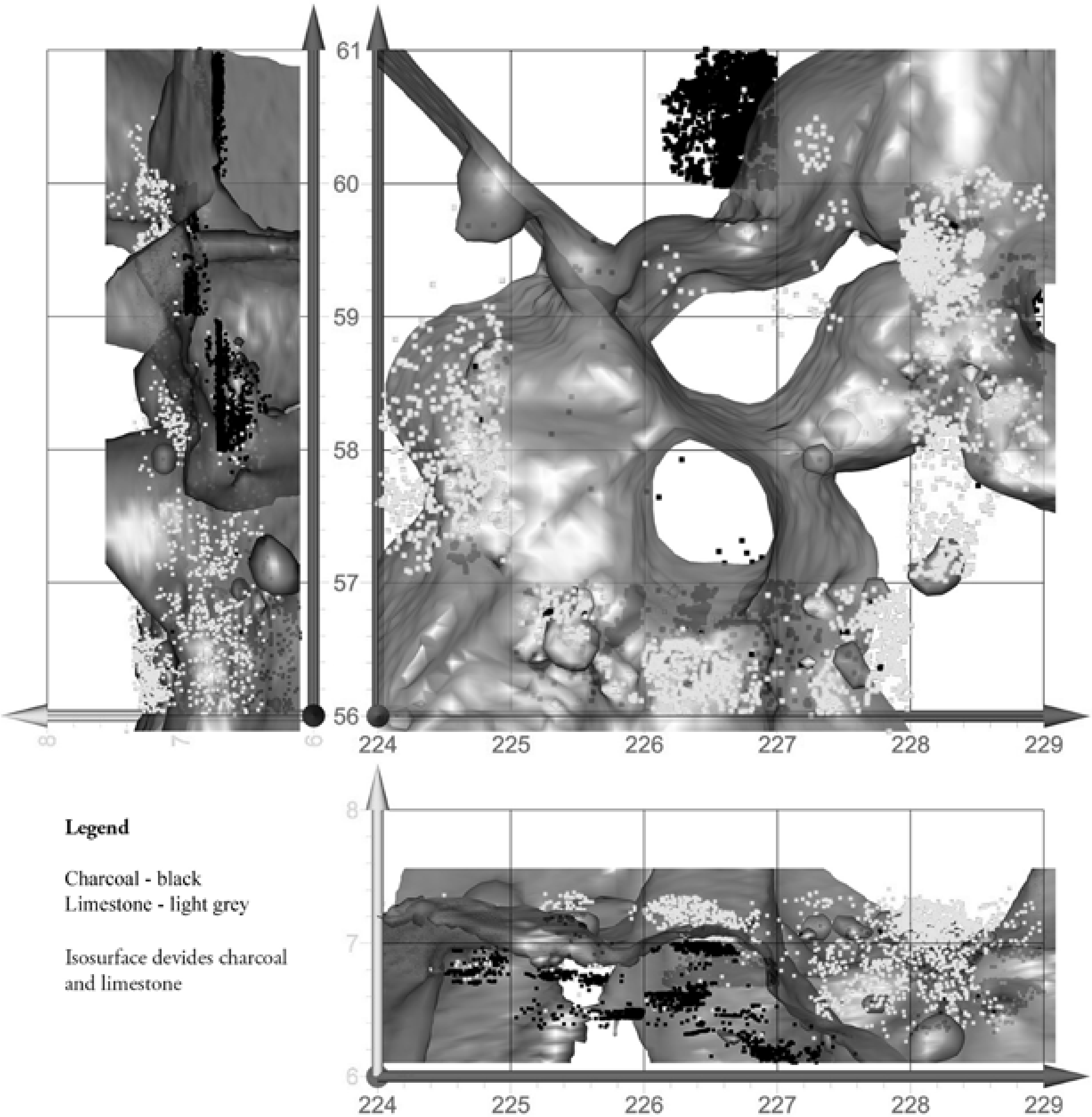

Fig. 6. Spatial distribution limestone and charcoal fragments inside GH 3. Isosurface divides them clearly.

fragments. Interestingly, the distributions of charcoal fragments and of other burned/heated material are mutually exclusive.

4 Discussion

The presented three-dimensional plots of find-categories from GH 3 indicate distinct patterns of distribution within an otherwise homogenous sedimentary matrix. If two find categories at the same time are plotted against each other and Voxler™ calculates a surface, there are some clear visible gaps in the spatial distribution of artefacts. Indications derive here from fauna vs. lithic (Fig. 5), limestone vs. charcoal fragments (Fig. 6) and fauna vs. charcoal (Fig. 7) and botanic/osseous vs. burnt stone and sediments (Fig. 10). There are distinctive distribution patterns visible. By plotting artefacts from the same category (here: Levallois components and bifacial elements), this spatial distribution pattern is not visible. These artefacts seem to be erratic distributed (Fig. 9 and 8).

The spatial patterning of burnt material and charcoal fragments (Fig. 10) offers new insights into the processes that formed and affected GH 3. In the case of *in situ* fireplaces, we would expect all classes of burned material to be clustered (with the inclusion of ashes and rubified sediments).

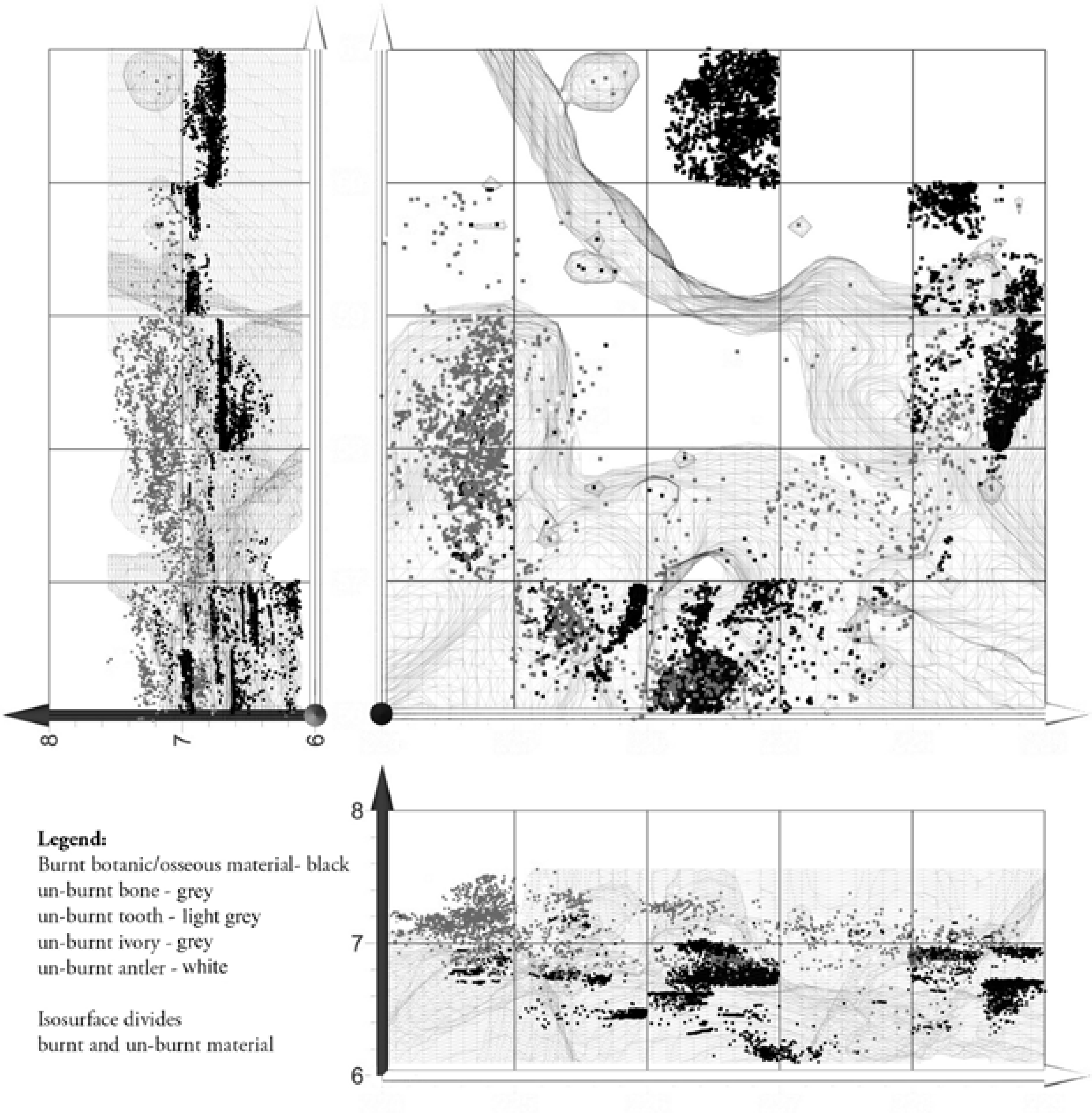

Fig. 7. Spatial distribution of un-burnt faunal remains (bones, teeth, ivory and antler) and burned botanic/osseous fragments. Isosurface divides them clearly.

What we observe in GH3 are horizontal lenses of the lighter components of burning events: smaller particles of charcoal and sometimes burnt bone. Our geomorphological and micromorphological observations (e.g. Wißing 2012) show that the sediment of GH 3 contains a major aeolian component, and GPR suggests that a large area of the Pleistocene rock shelter now lies under the collapsed shelter-roof in front of the excavated area. Based on these observations, we conclude that the lenses of charcoal/burnt-bone that we see in the plots shown above are the result of wind-transportation of these materials from hearths positioned to the northeast. The spatial distribution of the charcoal fragments also indicates, if it was transported and deposited by aeolian sedimentation, that the sedimentation was low-energetic, of close distance and quite homogenous. Evidence against causes of natural fire is indicated in the presence of more than 200 heat-altered lithic objects from GH 3.

A potential explanation for the mutually-exclusive distribution zones of charcoal and limestone-fragments (Fig. 6) could be that in times and places of charcoal sedimentation no limestone were deposited. This could easily be the case if we assume that the charcoal was deposited during and shortly after occupation events (cold to very cold climate) and the limestones were

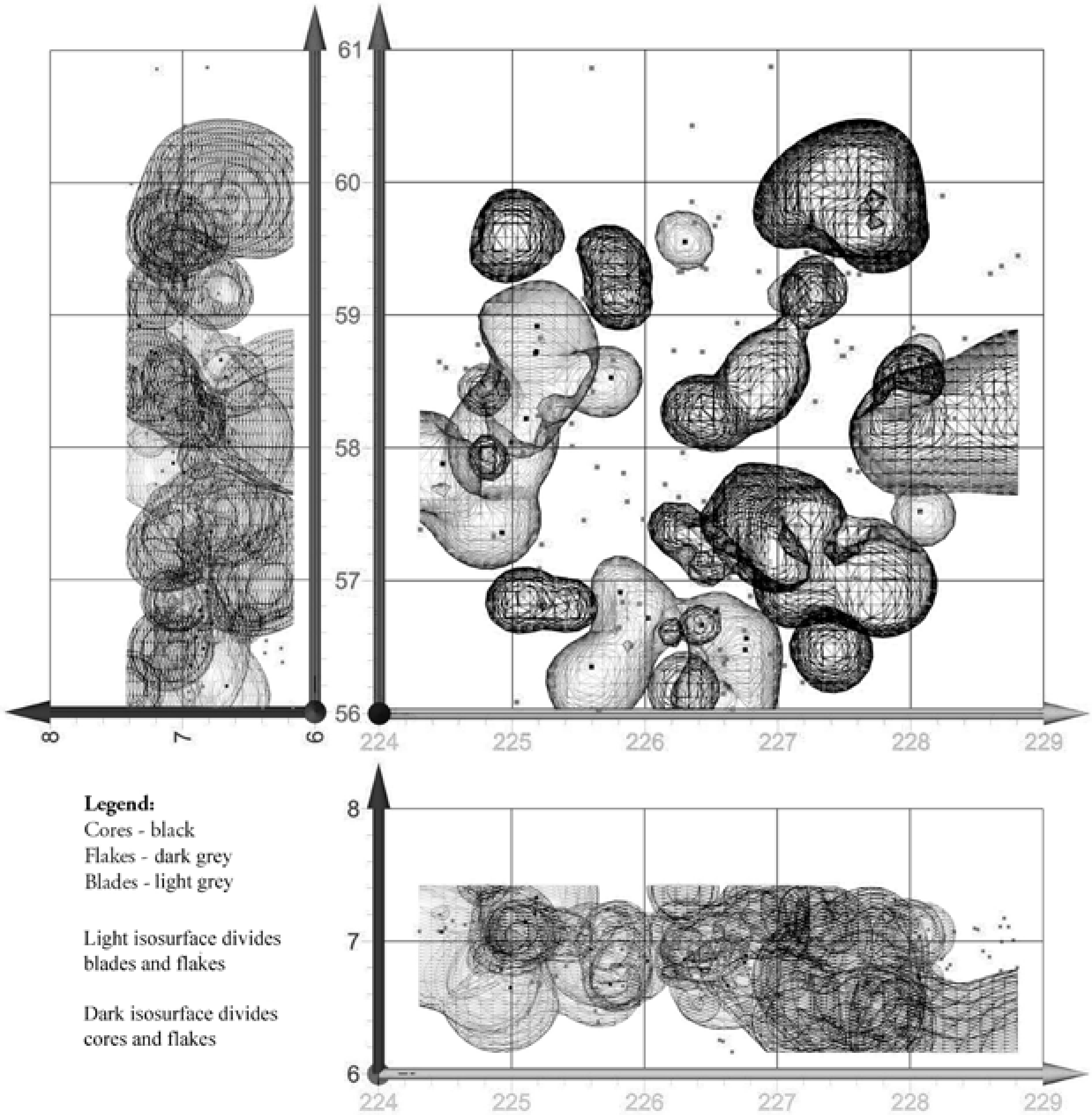

Fig. 8. Spatial distribution of Levallois elements inside GH 3. Spatial distribution and isosurfaces show no clear division between these elements.

deposited by rockfall events (defrosting during the beginning of warmer climates).

The accumulation of faunal components in the upper part of GH 3 and in the western part of the cave-tunnel could be explained by a phenomenon that can be detected in other cave sites, such as Kebara Cave (Speth *et al*. 2012) or Abric Romaní (Carbonell 2012). If we assume that the main occupation occurred under the rock shelter, the far interior of the shelter and the area of the cave tunnel make logical areas for toss-zones and rubbish dump, further from the active occupation area and less likely to attract carnivores.

At this juncture, refitted lithic objects (refitting sessions conducted in 2010 and 2013) do not provide much additional information. As can be seen in Fig. 11, some broken pieces lying next to each other could be identified and refitted. In general, refitted objects presenting reduction sequences are distributed horizontally, or at least in distinguishable layers. Only one thermal refit contradicts this picture (violet line in Fig. 11). If further refits support horizontal distribution patterns, we would expect that animal activities (or other bioturbation) account for this fact.

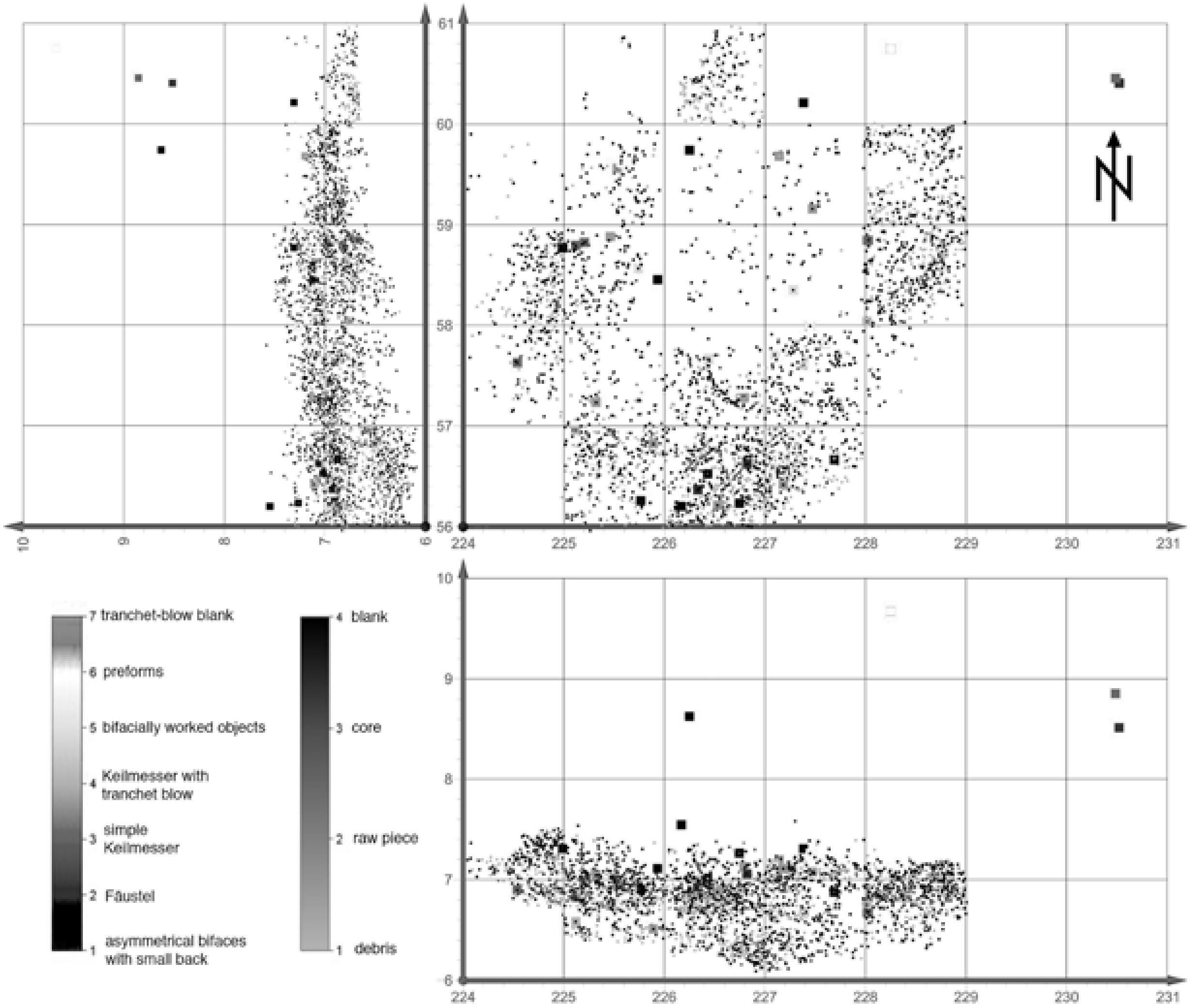

Fig. 9. Spatial distribution of bifacial elements inside GH 3. They are also randomly scattered in X and Y, only by height can they be attributed to the upper parts of GH 3 (see Frick and Floss, in press).

5 Conclusion

The primary research question driving this study is: Does GH3 represent a mixture of discarded materials from many occupation events, or can distinct stratigraphic units be identified within it in spite of its sedimentary homogeneity? At present, we cannot answer this question definitively. The visualisation of particular patterns of spatial distribution show that the archaeological material found in these layers is not thoroughly mixed, and that discrete patterns can be identified through the methods described above. At present, we are lacking important components of the archaeological record at VP II, and hope that continued excavation will provide a more complete picture.

Nonetheless, this paper demonstrates the utility of careful piece-plotting and of the mapping of isosurfaces within homogenous sedimentary units. If we take it that this scattered material is only minimally post-depositional altered in its position, as micromorphological and geomorphological observation indicate (Floss 2009; Wißing 2012), we could denominate these layers as a cumulative palimpsest (following Bailey 2007). Refining models of site use in the Middle Palaeolithic through these and related approaches has important implications for our understanding of Neanderthal behaviour at the local scale. One potential interpretation of the patterns suggested at VP II is one of repeated site use, frequently or seasonally, but without the systematic performance of the same tasks at the same places in the camp as has been demonstrated for example at extensively-used Magdalenian base camps like Pincevent (Bodu *et al.* 2006) or Gönnersdorf (Bosinski 1979). Archaeological sites like Abric Romaní (e.g. Carbonell 2012) demonstrate that clear, visible occupation structures can be detected by meticulous, long-term, and interdisciplinary studies. Reasearch at VP II is ongoing, and the study presented here is one component of a project that aims to add substantially to current knowledge about Neanderthal behaviour, including landscape-use, subsistence, and technology, in Eastern France.

Grotte de la Verpillière I and II are important sites in the Palaeolithic landscape of southern Burgundy containing hundreds of sites, which is otherwise mostly composed of un-

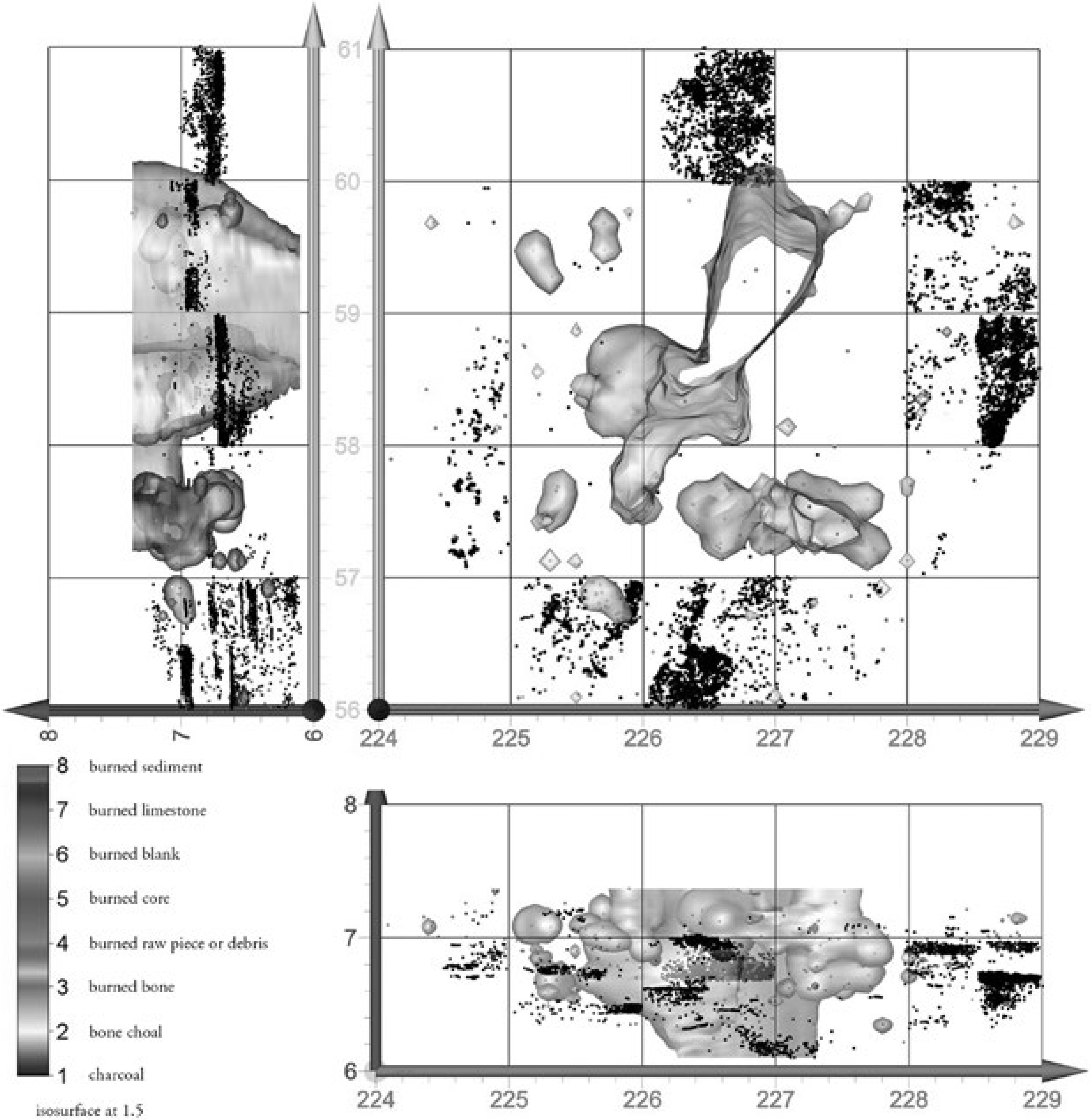

Fig. 10. Spatial distribution of all burned material. Interestingly, the distribution of charcoal fragments does not correspond to the distribution of the other burned materials.

excavated open-air sites (surface collections) or sites that were excavated prior to modern excavation techniques. In a radius of 50 km, these sites are the only high-resolution sources for the study of Late Middle Palaeolithic and early Upper Palaeolithic occupations of this region (Frick and Floss 2015). The data that comes out of continued excavation at VP II has potential to provide regionally-specific insight into Neanderthal behaviour and site-use.

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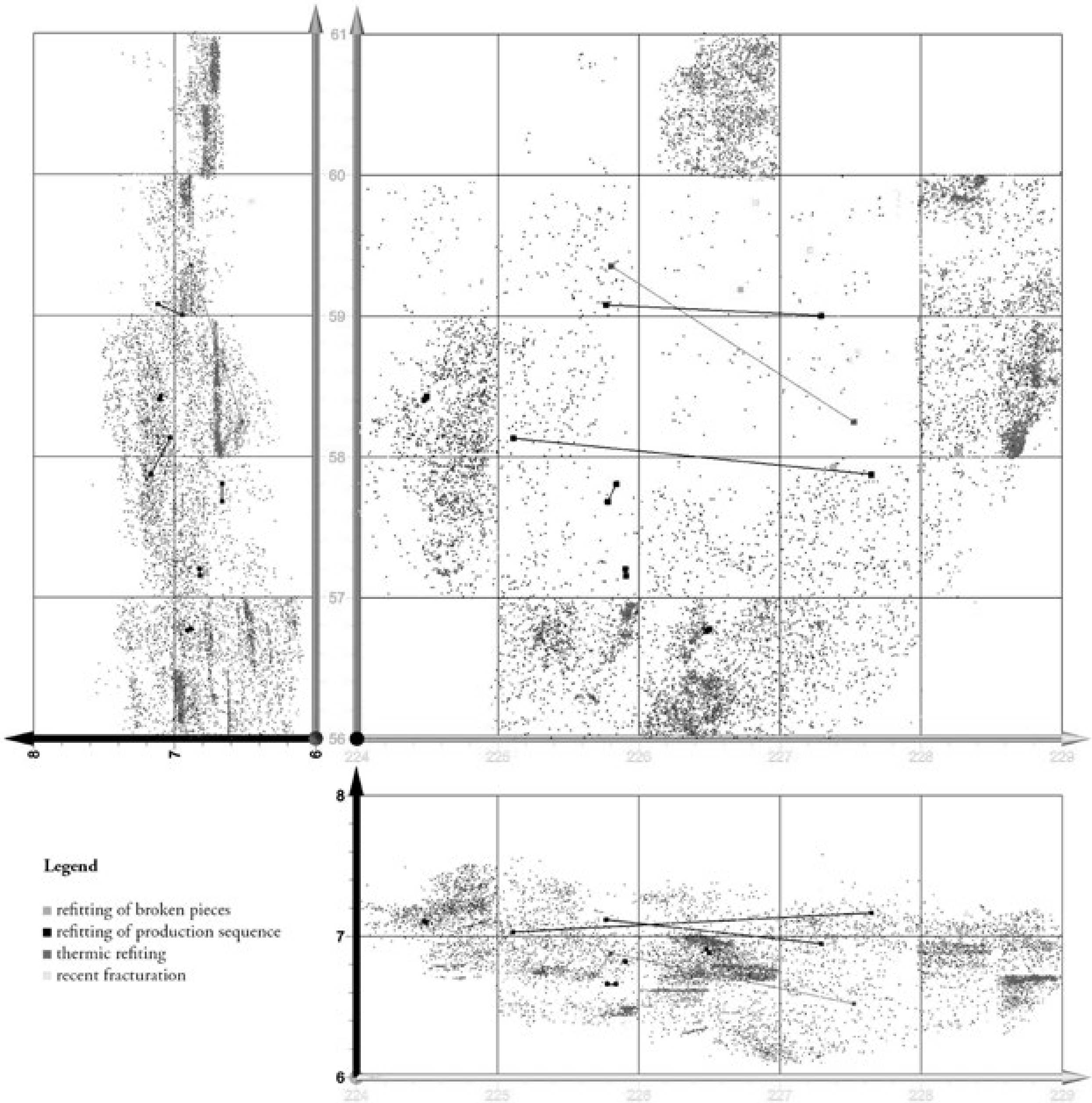

Fig. 11. Refitted lithic objects from sessions conducted in 2010 and 2013. The refits (depicting production sequence) indicate the option of layers inside the sediments. Note the single thermic refit that contradicts this picture. Smaller dots display the total single find distribution of GH 3, GH 4x and GH 4.

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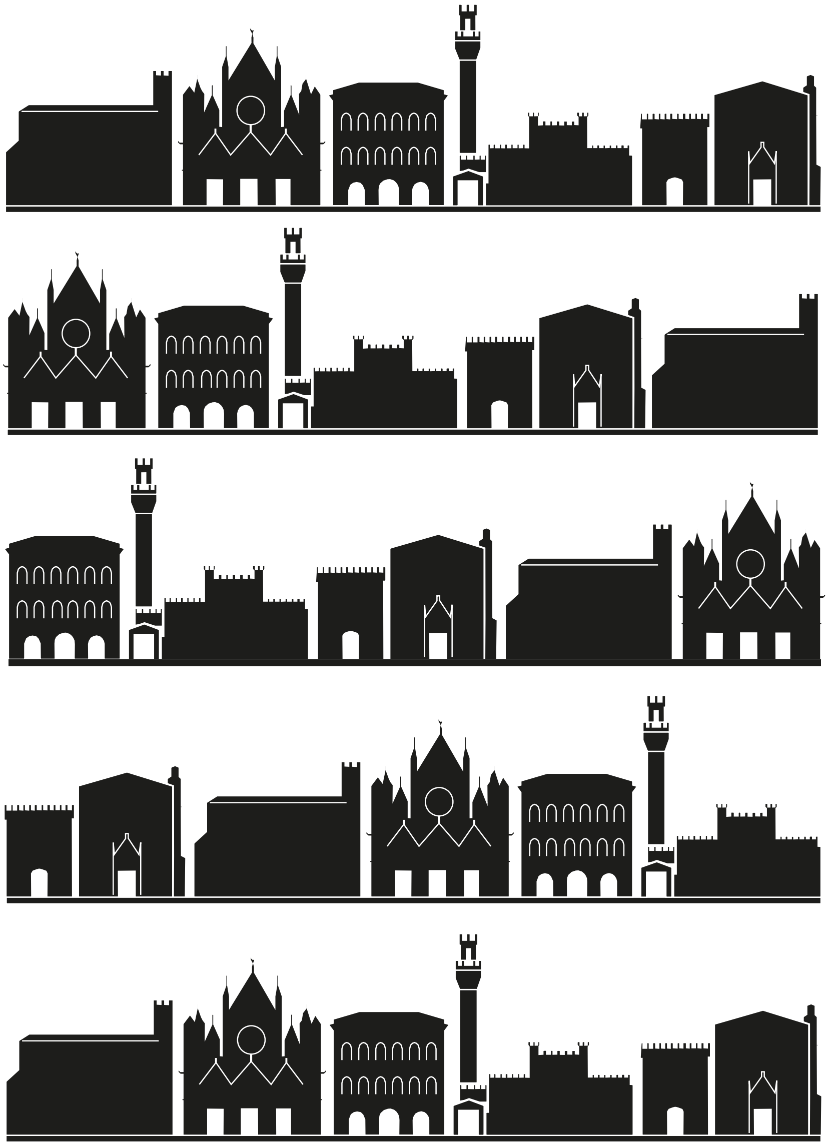

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