

The Mid Upper Palaeolithic (Gravettian) sequence of Mitoc-Malu Galben (Romania): New fieldwork between 2013 and 2016 - preliminary results and perspectives

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Abstract

This paper presents preliminary results of fieldwork conducted at the Upper Palaeolithic open-air site Mitoc-Malu Galben in northeastern Romania. The site has a ~14m deep loess-paleosol sequence with a rather high climatic resolution. The chronostratigraphy is well established and embedded in this long sequence are abundant archaeological remains, mostly attributed to the Aurignacian and Gravettian. Our fieldwork between 2013 and 2016 provided new samples of the main Aurignacian and Gravettian layers. Here we provide an overview of our fieldwork activities, the generated archaeological collections, and present a preliminary analysis of raw material economy and blank production and core exploitation strategies of the Gravettian assemblages. We also discuss the Mitoc-Malu Galben Gravettian in its wider regional context and implications for the Aurignacian-Gravettian transition.

1. Introduction

Mitoc-Malu Galben, an Upper Palaeolithic open-air site in northeastern Romania, is characterised by a long loess-paleosol succession and abundant archaeological remains attributed to the Aurignacian and Gravettian. It is a key site for the Early and Mid Upper Palaeolithic of Europe covering roughly the time window between 33 ka uncal BP (37.4 ka cal BP) and 20 ka uncal BP (24 ka cal BP). It provides a unique opportunity to study human behaviours and adaptations in a high-resolution climatic context. Western Eurasian Upper Palaeolithic hunter-gatherer groups experienced quite some changes in environmental and climatic conditions during Marine Isotope Stages (MIS) 3 and 2. Much of this time window is covered by the archaeological technocomplexes Aurignacian and Gravettian. The human groups producing those technocomplexes occupied Europe

under varying climatic conditions, including both interstadial and stadial conditions. In general, we can observe a trend towards lower temperatures and more aridity during MIS 3 and MIS 2, culminating in the Last Glacial Maximum. Some of the key research questions by archaeologists in working on MIS 3 and MIS 2 archaeology include: How did Upper Palaeolithic hunter-gatherers respond to this general trend towards cooler and more arid climatic conditions? Were they only present under interstadial conditions? Are there any significant relationships between human adaptations and changes in climate change among Aurignacian and Gravettian hunter-gatherers? To pursue these and similar questions, we need newly excavated datasets from long stratigraphic sequences with high climatic resolution and a solid chrono-stratigraphic framework. A lot of sites with these characteristics are located in the western Eurasian loess areas and characterised by long loess-paleosol sequences. Good examples of such sequences include Willendorf II in the Middle Danube Region (Nigst et al., 2014), Molodova V in Ukraine (Haesaerts et al., 2003; 2010a), Cosăuți in the Moldavian Republic (Haesaerts et al., 2003; 2010a), Dorochivtsi III in Ukraine (Haesaerts et al., 2020; Kulakovska et al., 2015), and Mitoc-Malu Galben in Romania (Chirica, 2001; Otte et al. 2007) (Figure 1).

In this paper we report on preliminary results of our new collaborative fieldwork at one such site, Mitoc-Malu Galben. We conducted new fieldwork between 2013 and 2016 (Chirica et al., 2014; 2015; 2016; 2017; Libois et al., 2017; 2018; Nigst et al., in press; Noiret et al., 2016) focusing on sampling selected parts of the sequence to collect new archaeological collections to address site formation processes, study human behavioural change through time, and gather insights in lithic technological solutions. In particular, we are interested in getting a better understanding of the production of bladelets in the Aurignacian and Gravettian assemblages at Mitoc-Malu Galben. One of the advantages of Mitoc-Malu Galben is its long sequence that provides a unique opportunity to analyse time trends in bladelet production strategies. We are also interested whether any changes in raw material economy and technological organisation are correlated with changes in environment and climatic conditions.

The goals of this paper are:

- * to provide a first detailed overview of the 2013 to 2016 fieldwork activities;
- * to present the newly excavated Gravettian assemblages and their relationship to the old excavations' archaeological layers;
- * to present preliminary results on raw material economy, blank production and core exploitation strategies.

Below we also summarise information on the site, its research history, and provide an overview of the chronostratigraphy and palaeoenvironmental signal of the sequence. Further, we briefly discuss the regional context for the Gravettian at Mitoc-Malu Galben and the onset of the Gravettian in the wider region. At the end of our paper we provide some perspectives for future research at the site and the collections.

2. Site overview and research conducted to date

2.1 Site location and basic introduction

Mitoc-Malu Galben (48° 05' 52" N, 27° 01' 23" E) is located about 120 km north of Iași on the right bank of the Prut river valley in Botoșani county, northeastern Romania, close to the border with the Republic of Moldova (Figure 1). The site is situated in the Ghireni ravine,

about 450 metres from where the ravine meets the main Prut river valley (Otte et al. 2007) (Figure 2).

The exposed sequence covers a loess-paleosol succession of about 14 m depth (Haesaerts, 2007). In this sequence, a set of archaeological layers has been documented and attributed to the Aurignacian and Gravettian. The chronostratigraphy of the sequence is based on the litho-/pedostratigraphic record, its climatic signal, and more than 40 radiocarbon dates (Haesaerts, 2007; Haesaerts et al., 2003; 2010a).

The entire exposed sequence is currently subdivided in 13 lithostratigraphic units (Figure 3), each representing a distinct sedimentation phase. The lower half of the sequence, i.e., stratigraphic units (SU) 13 to 7, consists of mainly silty deposits; SU 13 to 11 also contain deposits of colluvial origin. SU 7 shows the onset of aeolian input, initiating the deposition phase of loess recorded in the upper half of the sequence, i.e. SU 6 to 1. Each sedimentation phase is usually associated with a stabilization phase marked by pedogenesis (Haesaerts, 2007). Depending on the climatic events, the pedogenesis phases are represented by tundra gleys (e.g., SU 3a), i.e. periglacial conditions, or humic soils (e.g., SU 9a), i.e. subarctic to boreal conditions.

Within this 14 m deep sequence with rather high palaeoenvironmental resolution, a large number of archaeological occurrences has been documented since 1978 (see Otte et al., 2007 for a summary). The archaeological occurrences were grouped by the 1978 to 1995 excavators into packages of 'archaeological layers', including five Aurignacian 'layers' in SU 12b to 8b (from top to bottom: 'Aurignacian III upper', 'Aurignacian III', 'Aurignacian II', and 'Aurignacian I', 'dispersed Aurignacian') and four Gravettian 'layers' in SU 7b to 4a (from top to bottom: 'Gravettian IV', 'Gravettian III', 'Gravettian II', and 'Gravettian I') [See Figure 3 for their exact position in relation to the stratigraphic units]. For our fieldwork, we treat the archaeological objects found in one stratigraphic unit as one assemblage, unless there are reasons to subdivide the archaeological objects within one stratigraphic unit into several assemblages, e.g., when two or more concentrations of objects occur.

2.2 Fieldwork history (Fieldwork until 2013)

Palaeolithic artefacts from the Mitoc area have been reported in the late 19th century and then again in the 1920s (Chirica, 2001; Chirica, 2007; Moroşan, 1938). Later, fieldwork was conducted between 1956 and 1957 (Chirica, 2001). From 1978 to 1990 the site Mitoc-Malu Galben was excavated in yearly fieldwork seasons by V. Chirica (Institute of Archaeology, Iaşi Branch of the Romanian Academy of Sciences) excavating the major part of the nowadays exposed excavation pit (Chirica, 1987; 1989; 1993; 1995; 1996; 2001; 2007). Chirica exposed the entire sequence and identified four Gravettian and Aurignacian layers. From 1991 onwards, Chirica started a collaboration with researchers from the Royal Belgian Institute of Natural Sciences (P. Haesaerts and F. Damblon) and the University of Liège (M. Otte and P. Noiret). This collaboration resulted in geological and stratigraphic fieldwork and archaeological excavations between 1992 and 1995 (Otte et al. 2007) (Figure 4: 1). Following this fieldwork, brief fieldwork seasons (often for geological studies) were conducted in the late 1990s, 2000s and in 2011.

2.3 The fieldwork conducted between 2013 and 2016

The field- and laboratory work since 2013 has been a collaboration of V. Chirica (Institute of Archaeology, Iaşi Branch of the Romanian Academy of Sciences, Iaşi, Romania), P. Noiret (Department of Prehistory, University of Liège, Belgium), P. Haesaerts (Royal Belgian

Institute for Natural Sciences, Brussels, Belgium) and Philip R. Nigst (Department of Archaeology, University of Cambridge, Cambridge, UK). We conducted four excavation seasons between 2013 and 2016 (Chirica et al., 2014; 2015; 2016; 2017) (Figure 4: 2). Since 2016, our research focused on studying our newly excavated collections as well as samples of the previous excavations' collections.

The four excavations between 2013 and 2016 were limited to two-week-long excavation campaigns, always in the first half of July. In total, we excavated 22 trenches (Figure 5, Table 1), which include 15 trenches for geological and stratigraphic studies (labelled with numbers, e.g., Trench 13-1) and seven trenches for sampling archaeological materials (labelled with letters, e.g., Trench 13-A).

Trenches for geological/stratigraphic work (Trench 13-1 to 13-13 and Trench 16-1 and 16-2) were located close to sections excavated during previous excavations and Haesaerts' fieldwork in 2007 and 2011, and the goal was to provide easy access to those sections for (i) relocation of the old grid of squares (square boundaries) used by Chirica and later Chirica, Otte and Noiret as well as the height used by Haesaerts, and (ii) detailed geological and stratigraphic studies by Haesaerts to verify the observations in 2007 with regard of stratigraphic unit 5 (humic horizon of 5b) and in 2011 with regard of stratigraphic unit 11 (humic horizon of 11a and silt of 11b). Within those trenches we removed backdirt and exposed and renewed previous excavations' sections with minimal necessity to excavate archaeological materials. However, depending on the state of erosion of the particular area some excavation of in situ deposits was necessary. Given the state of the site after several years of no fieldwork between 1995 and 2012 (with the exception of a brief fieldwork season in 2007 and 2011 [see above] for stratigraphic studies and collection of samples for palaeomagnetic and other analyses), the old sections and trenches had eroded to various degrees (compare photos of 1992 and 2013 in Figure 4).

Our archaeological trenches (Trenches 13-A, 14-A, 14-B, 15-A, 15-B, 16-A, and 16-B) targeted areas to (i) sample archaeological materials known from the old excavations, (ii) test areas with well-preserved deposits for their archaeological potential, and (iii) excavate back some old exposed and eroding sections that lead to exposure of abundant archaeological materials out of context on the slope below those sections. The excavation process in the archaeological trenches started with removing backdirt and then excavating back old sections through either horizontal or vertical excavations. Subsequently, the newly produced sections were analysed and documented.

Below we give a brief overview of the work conducted per excavation year:

2013: During our first fieldwork campaign (Figure 5: red coloured trenches) we focused our efforts - besides relocating the 1978 to 1995 excavations' squares and grid system as well as the height used by Haesaerts - on (i) a re-analysis of SU 4 and SU 5 in the northern section with the goal to understand the exact stratigraphic position of the bioturbated humiferous horizon SU 5b, which had not been observed in previous work and hence was missing in Haesaerts (2007), and (ii) excavate a block of sediment that otherwise likely would have collapsed due to erosion (abundant lithic artefacts were collected on the slope below) resulting in Trench 13-A. This latter work also allowed us to sample two of the Gravettian so-called 'workshops' (i.e., high density accumulations of lithic artefacts) of the previous fieldwork along the northern section of the site in SU 7a and 6c.

2014: Our second excavation season (Figure 5: green coloured trenches) extended the work in Trench 13-A to in western and southwestern direction (Trench 14-B) and we started an

excavation in the southwestern area of the site aiming at the lower Aurignacian archaeological layers.

2015: During the 2015 excavation (Figure 5: blue coloured trenches) our team tried to locate archaeological materials in SU 10a to 7b along the central part of the southern section (Trench 15-A) and extended the excavation of the lower Aurignacian archaeological layers in the southwestern corner of the site by a small area (Trench 15-B).

2016: Our excavations in 2016 (Figure 5: orange coloured trenches) extended the excavation of the Aurignacian materials in the southwestern corner of the site by excavating Trench 16-B with abundant material. We also explored the presence of the later Aurignacian archaeological layers in the area underlying the one excavated in 2013 and 2014 along the northern section with a new trench (Trench 16-A) extending Trench 14-B to the south and significantly in depth). In addition, we excavated two trenches for geological/stratigraphic work (Trenches 16-1 and 16-2) to examine the lower part of the stratigraphic sequence.

3. Methods of field- and laboratory work since 2013

A key aspect of our first excavation season in summer 2013 was the relocation (see Appendix A1) of the square system and altitude used in the previous excavations between 1978 and 1990 and 1992 and 1995 in order to facilitate comparisons between the old collections and our datasets. Regarding the altitude, it is worth noting that the previous fieldwork at the site utilized several different altitudes as zero (see Otte et al., 2007). We used for our fieldwork the altitude used by Haesaerts because of its precise linkage with the stratigraphic, palaeoenvironmental, and chronological record generated by Haesaerts and Damblon. The squares, however, were identical between all the previous fieldwork. Excavation and documentation methods applied during the fieldwork at Mitoc-Malu Galben followed the approach described in Nigst et al. (2014) including stratigraphic excavations taking into consideration the lithostratigraphic boundaries and pedological horizons, 3D piece-plotting of all objects and samples using totalstations and EDM Mobile software (<http://www.oldstoneage.com/software/edm-mobile.shtml>)(McPherron and Dibble, 2002), as well as wet-sieving all excavated sediment. We use a system of units (and sub-units) to label lithostratigraphic units and provide unique identification for each of such units/sub-units. (For a full description of the fieldwork methodology see Appendix A2). The methods used to analyse faunal remains, lithic artefacts, and ochre are described in Appendix A3.

4. Stratigraphy, Environment, and Chronostratigraphy of the Mitoc-Malu Galben sequence: overview and updates during the new fieldwork

The basic sequence of Mitoc-Malu Galben was studied and the stratigraphy worked out between 1991 and 1997 by P. Haesaerts. In 2007, 2011, and 2013 additional fieldwork by Haesaerts completed the record and resulted in an update of the sequence as originally published in Haesaerts (2007). Specifically, the 2007 fieldwork in the right corner of the southern wall of the excavation pit revealed a thick humic horizon of chernozem type (SU 11a) that developed in a loessic silt (SU 11b). These two units bevel laterally between SU 10b and the underlying SU 11c. The 2011 fieldwork and the first excavation season of our project in 2013 provided evidence for the presence of an additional bioturbated humiferous horizon (SU 5b), bevelled between the gley of SU 5a and the underlying loess (SU 5c) in several sections along the northern wall of the excavation pit (Figure 6).

The pedo-sedimentary record of the site has a cumulative thickness of approximately 14 m, and is divided in 13 stratigraphic units, which are for the most part representing one episode of sedimentation followed by a stabilisation phase with pedogenesis (Figure 3). Each stratigraphic unit is further subdivided in subunits.

The lower part of the sequence begins with colluvial deposits (stratigraphic units 13b, 12b and 11c), which are associated with two well-expressed humiferous horizons (SU 13a and 12a). These deposits are followed by silty deposits (SU 11b, 10b, 9b, and 8b), each carrying a humiferous horizon about 10 cm (SU 10a, 9a, and 8a) or about 20 cm thick (SU 11a). On top of these units we find another silty unit with increasing wind-blown component (SU 7b), which is capped by a thick tundra gley (SU 7a) that is penetrated by a network of deep frost cracks.

The upper part of the sequence consists of six loess units (SU 6 to 1), which are mostly associated with tundra gleys (SU 6a, 5a, 4a, 3a, 2a and 1b upper). It also records three humiferous horizons, of which the lowermost one (SU 6c) is strongly stretched. The other two are bioturbated humic horizons (SU 5b upper and 4b), which developed on top of the underlying loess (SU 5b lower and SU 4c, respectively).

The paleoenvironmental signal of the sequence is characterised by a succession of pedogenesis horizons, comprising of nine humiferous horizons (SU 13a, 12a, 11a, 10a, 9a, 8a, 6c, 5b, and 4b) and 10 deferrified horizons of tundra gley type (SU 11c upper, 9b lower, 7a, 6a, 5c upper, 5a, 4a, 3a, 2a, and 1b upper). The degree of development of the humiferous horizons varies from chernozem (SU 11a) to an incipient horizon of para-rendzina type (SU 8a). They record phases of stabilization of the landscape under herbaceous cover, in good agreement with the increase in the contents of organic matter recorded at their level. They suggest medium-cold to boreal-cold type environmental conditions depending on their degree of development and are related to interstadial episodes labelled MG-13 to MG-4 by reference to their stratigraphic position. In contrast, the tundra gley horizons record landscape stabilisation phases under very cold and moist conditions, and can be related to episodes of deep frost or even permafrost (Van Vliet-Lanoë, 1985; see also Haesaerts et al., 2020). This is particularly the case for tundra gley horizons 7a and 4a, which are well documented in the south, west, and north sections of the site.

The revised sequence of Mitoc-Malu Galben provides a rather high resolution pedo-sedimentary record that is well dated between ~33 and ~20 ka uncal BP (~37.4 and ~24 ka cal BP) (for full list of the radiocarbon dates, their evaluation and position in the stratigraphy see Haesaerts (2007) and Damblon & Haesaerts (2007)). While the basal unit 13 remains undated, the base of the directly overlying SU 12b is dated to ~32.75 ka uncal BP (~37.1 ka cal BP). Several dates between ~31.2 ka uncal BP (35.5 ka cal BP) and ~31 ka uncal BP (35.35 ka cal BP) are distributed between the humiferous horizon 12a and the interface of SUs 11c and 10b, where dense lithic accumulations ('workshops') have been observed in the previous excavations. Charcoal from SU 9b provided an age of ~29.9 ka uncal BP (~34.4 ka cal BP). The basal part of the silty SU 8b is dated to ~27.7 ka uncal BP (~31.6 ka cal BP) and ~27.75 ka uncal BP (~31.7 ka cal BP) on two samples, which is in good agreement with the date of ~27.4 ka uncal BP (~31.3 ka cal BP) obtained for the middle part of SU 8b. Several dates between 31.16 ka uncal BP (35.5 ka cal BP) and 31 ka uncal BP (35.35 ka cal BP) are equally distributed between the humiferous horizon 12a and the workshops located at the interface of units 11 and 10b. This is the case in particular of the workshop dated 31.16 ka

uncal BP (35.5 ka cal BP) in the north wall; this is distinctly located in the upper part of the bedded silt 11c and therefore proves to be earlier than the humiferous horizon 11a encountered in the south wall in 1998, whose lateral extension could be followed in 2012 in the west wall (Noiret et al., 2016).

From SU 7 to SU 4, the concentrations of charcoal are relatively abundant and provided a chronological framework based on a coherent series of dates, starting with the upper part of SU 7b dated to ~26.5 ka uncal BP (~30.85 ka cal BP), followed by dates of ~26.2 ka uncal BP (~30.5 ka cal BP) for the top of the tundra gley 7a and the dates of ~25.6 ka uncal BP (~30 ka cal BP) and ~25.5 ka uncal BP (~29.9 ka cal BP) for the stretched humic horizon 6b. On top the base of SU 5b is dated to ~24.8 ka uncal BP (~29.1 ka cal BP), the base of SU 5a to ~23.8 ka uncal BP (~27.9 ka cal BP), and loess of SU 4c to ~23.4 ka uncal BP (~27.7 ka cal BP) and ~23.3 ka uncal BP (~27.5 ka cal BP).

5. Excavations between 2013 and 2016: an overview of the main excavation areas

Our excavations between 2013 and 2016 resulted in 15 trenches for geological and stratigraphic studies and seven trenches for sampling archaeological materials, which have been described in more detail above (see also Table 1 and Figure 5). In this section we focus on four areas within the site, which have provided archaeological material: the southwestern area, the central part of the southern section (southern area), the central part of the northern section (northern area), and the northeastern area. The Gravettian archaeological material of those four areas will be discussed in more detail in below. We present our assemblages below per stratigraphic unit and not according to the archaeological layers defined by the previous excavations, i.e. 'Aurignacian dispersed', 'Aurignacian I', 'Aurignacian II', 'Aurignacian III', 'Aurignacian III upper', 'Gravettian I', 'Gravettian II', 'Gravettian III', and 'Gravettian IV'. The correlation between our new assemblages and the archaeological layers of the previous excavations can be inferred from the figures in Otte et al. (2007). In addition, we list for the larger assemblages to which old excavations' archaeological layers they correspond.

5.1 Trenches 13-A, 14-B, and 16-A in northern area

Our excavation in the central part of the northern section, i.e. Trenches 13-A, 14-B, and 16-A, covers parts of squares L3, L4, M1, M2, M3, M4, N1, N2, N3, and N4 (Figure 5). Large parts of especially the extension of Trench 13-A in 2014 and 2016, i.e. Trench 14-B and 16-A respectively, cover removal of backfill and collapsed old section parts to get access to in situ, unexcavated deposits. Trench 13-A was placed in a position where abundant archaeological material, especially lithic artefacts, were exposed and eroded out of an old section.

In total, 2598 objects were piece-plotted during excavations in 2013, 2014, 2015 and 2016 in Trenches 13-A, 14-B, and 16-A (Table 2). Those objects include faunal remains (mostly probably bone), lithic artefacts, stones, small pieces of ochre, and charcoals. Lithic artefacts are clearly dominating with 2481 pieces (Table 2). All excavated sediment was wet-sieved, the small fraction material from wet-sieving is not included in the archaeological object counts as analysis is in progress. Most archaeological piece-potted objects belong to the SU 6c (n = 1564; corresponds to old excavations' archaeological layer 'Gravettian II'), followed by SU 7a (n = 644; corresponds to old excavations' archaeological layer 'Gravettian I'), SU 9b (n = 202; corresponds to old excavations' archaeological layer 'Aurignacian III'), and SU 11b (n = 112; corresponds to old excavations' archaeological layer 'Aurignacian I'). All other stratigraphic units provided less than 100 archaeological objects.

Figure 7 shows all piece-plotted artefacts in section view. The base of the stratigraphic sequence exposed in Trenches 13-A, 14-B, and 16-A is a yellow-brown silt (SU 11b), which contains a number of archaeological objects ($n = 112$) that are mainly clustered vertically within a few centimetres in the middle part of the here exposed SU 11b (it should be noted here that the lower limit of SU 11b was not exposed in Trenches 13-A, 14-B, and 16-A). On top we have a pale yellow-brown silt (SU 10b) that is carrying an approximately 10 cm thick dark grey humiferous horizon (SU 10a). In those stratigraphic units we documented two objects and one object, respectively. Next in the sequence is the pale yellow-brown silty deposit SU 9b of approximately 90 cm thickness, which carries with SU 9a a grey-brown humiferous horizon of about 10 cm thickness. In the middle part of SU 9b we documented two accumulations of archaeological objects ($n = 204$) - the objects in each accumulation scattered vertically only over a few centimetres. SU 9a yielded only one lithic artefact. On top in SU 8b, a pale yellow-brown silty deposit of approximately 40 cm thickness, no archaeological objects were identified. SU 8b carries the grey-brown humiferous horizon SU 8a, which provided two lithic artefacts. On top of these units we find another silty unit of pale yellow-brown colour with an increasing wind-blown component (SU 7b), which is capped by a thick, light grey tundra gley (SU 7a). While SU 7b did not contain any archaeological objects, SU 7a was rich in material ($n = 644$). Most of this material is located as a dense accumulation of lithic artefacts in the lower part of the stratigraphic unit. SU 7a is covered by a stretched humiferous horizon of brown-ochre colouring, SU 6c, which is very rich in archaeological material ($n = 1562$). Most of the 1562 archaeological objects occur in two dense lenses of mainly lithic artefacts, one in the lower and one in the upper part of SU 6c. The overlying unit is the pale yellow silty loess of SU 6b that carries with SU 6a a light grey deferrified horizon of tundra gley type. Both stratigraphic units yielded archaeological objects ($n = 46$ [SU 6b] and $n = 16$ [SU 6a]). The top of the exposed sequence in Trenches 13-A, 14-B, and 16-A is formed by the pale yellow-ochre silty loess of SU 5c, in which we documented 8 lithic artefacts.

5.2 Trenches 13-1, 13-2, and 15-A in the southern area

In the central part of the southern section we excavated two geological trenches, Trenches 13-1 and 13-2, and one archaeological trench, Trench 15-A. The excavated area covers parts of squares I1, I2, I3, I4, I5, and K5.

We recovered a total of 475 archaeological objects in Trenches 13-1, 13-2 and 15-A. This number represents the piece-plotted objects only, as the analysis of the small fraction material from wet-sieving the excavated sediment is in progress. The majority of the piece-plotted objects are lithic artefacts ($n = 429$). There are also 37 charcoals, seven faunal remains, one piece of ochre and one stone (Table 3).

The base of the stratigraphic sequence exposed in Trenches 13-A, 14-B, and 16-A is represented by the pale yellow-brown silty SU 10b, which carries a dark grey humiferous horizon SU 10a. We documented two lithic artefacts in SU 10b and no archaeological objects in SU 10a. The stratigraphic sequence is continued by another pale yellow-brown silty deposit (SU 9b), which yielded eight objects, including five faunal remains. On top of SU 9b the grey-brown humiferous horizon SU 9a provided the vast majority of archaeological objects ($n = 433$; corresponds to old excavations' archaeological layer 'Aurignacian III upper'), including 404 lithic artefacts (Figure 8), 27 charcoals, one piece of ochre, and one faunal remain. Most of these objects are located in the top part of SU 9a and form a concentration in square I2. Next in the sequence is with SU 8b a pale yellow-brown silty

deposit, which carries a grey-brown humiferous horizon (SU 8a). In SU 8b we documented 30 archaeological objects (corresponds to old excavations' archaeological layer 'Aurignacian III upper'). Most of them are located at the very bottom of SU 8b. The top of the exposed sequence is formed by SU 7b (pale yellow-brown silty deposit), which contained 1 lithic artefact, and the lower part of the light grey SU 7a (tundra gley), which did not contain any archaeological material.

5.3 Trenches 13-3, 13-4, 13-5, 14-A, 15-B, and 16-B in the southwestern area

Our excavation in the southwestern area/corner of the site, i.e. Trenches 13-3, 13-4, 13-5, 14-A, 15-B, and 16-B, covers parts of squares A10, A11, A12, B11, H10, H11, H12, I7, I8, I9, I10, I11, K7, K8, K9, K10, and K11. Large parts of especially Trenches 13-3, 13-4, 13-5, 15-B, and 14-A cover removal of backfill and collapsed old section parts to get access to in situ, unexcavated deposits.

During the excavation we piece-plotted a total of 2928 archaeological objects, including 2842 lithic artefacts, two faunal remains, three charcoals, and 81 stones (Table 4). As with the other trenches, the small fraction materials from wet-sieving are currently being analysed and, hence, no final counts are available.

In Trenches 13-3, 13-4, 13-5, 14-A, 15-B, and 16-B we exposed a stratigraphic sequence, starting with SU 11b, a yellow-brown silt, at the bottom. Within SU 11b - and mostly towards its upper part - we documented 83 objects comprising 48 lithic artefacts and 35 stones (this assemblage corresponds to old excavations' archaeological layer Aurignacian I). SU 11b carries a brownish grey humiferous horizon (SU 11a) of approximately 20 cm thickness. In the lower part of this humiferous horizon contains an accumulation of archaeological objects (n = 2638; corresponds to old excavations' archaeological layer 'Aurignacian I'), mostly lithic artefacts (n = 2599) (Figure 9), but also one faunal remain, three charcoals, and 35 stones. On top follows with SU 10b a pale yellow-brown silt, which included 193 archaeological objects (this assemblage corresponds to old excavations' archaeological layer 'Aurignacian I'), mostly lithic artefacts (n = 181) but also one faunal remain and 10 stones, and with SU 10a an approximately 10 cm thick dark grey humiferous horizon. Within SU 10a we documented 11 lithic artefacts and one stone. The top of the exposed sequence is formed by SU 9b, a pale yellow-brown silty deposit, which contained three lithic artefacts.

5.4 Trench 13-13 in the northeastern area

The geological/stratigraphic Trench 13-13 is the renewal of a trench produced by previous fieldwork, and, therefore, we only renewed the sections after removing backfill of those older excavations. The archaeological objects documented in Trench 13-13 are from this renewal of the sections and hence limited to 55 lithic artefacts, two charcoals, and one piece of ochre (Table 5).

The base of the exposed sequence in Trench 13-13 is formed by a tundra gley (SU 7a), followed by the stretched brown-ochre humiferous horizon SU 6c. Within SU 6c we documented 36 objects, including 33 lithic artefacts, two charcoals and one piece of ochre (this assemblage corresponds to old excavations' archaeological layer 'Gravettian II'). On top we find SU 6b, a pale yellow silty loess, and SU 6a, a light grey tundra gley, both without any archaeological objects. The pale yellow-ochre silty loess of SU 5c contained one lithic artefact (corresponds to old excavations' archaeological layer 'Gravettian III'). The overlying pale yellow loess (SU 4c) and grey-brown humiferous horizon (SU 4b) are archaeological

sterile in our section, while the pale grey tundra gley on top (SU 4a) contained 21 lithic artefacts (this assemblage corresponds to old excavations' archaeological layer 'Gravettian IV'). The sequence exposed by us in Trench 13-13 finished with SU 3b, a pale yellow sandy silt, which is archaeologically sterile.

6. The Gravettian archaeological assemblages sampled between 2013 and 2016

During our fieldwork we sampled Gravettian archaeological occurrences in the stratigraphic sequence in several of our trenches, specifically along the central part of the northern section, i.e. Trenches 13-A, 14-B, and 16-A, in the central part of the southern section, i.e. Trench 15-A, and in the northeastern area of the site, i.e. Trench 13-13. In the latter trench, we only removed backdirt and renewed the sections for stratigraphic work as part of our 2013 fieldwork season and during this work collected material from stratigraphic units 4a, 5c and 6c. Below we present the Gravettian assemblages in detail focusing on raw material economy and blank production and core exploitation.

6.1 The assemblages of SU 4a, SU 5c and SU 6c in Trench 13-13

The three assemblages from SU 4a, SU 5c, and SU 6c are small (Table 5) and can be attributed to the previous excavations' archaeological layers 'Gravettian II' (SU 6c), 'Gravettian III' (SU 5c), and the 'Gravettian IV' (SU 4a) according to the stratigraphic correlations by Haesaerts (2007). SU 4a contains 21 lithic artefacts, which include 14 flakes, five shattered pieces, one core tablet and one chip. Within SU 5c we documented only one piece of shatter. From SU 6c we were able to collect 33 lithic artefacts, two charcoals and one piece of ochre. The small lithic assemblages comprises 24 flakes, five shattered pieces, one blade, one crested flake, one blade core, and one core shatter. The ochre specimen is composed of a red homogenous, fine-grained and ferruginous clay-related raw material (H. Salomon, personal communication), which is similar in colour and texture to the ones retrieved in SU 7a in Trenches 13-A, 14-B and 16-A (see below). However, it is partially covered by a black coating, suggesting a link with fire activity. A fine striation is present on a plane surface, but cannot be linked to human activity with certainty.

6.2 The assemblage of SU 7b in Trench 15-A

The archaeological material attributed to the Gravettian from Trench 15-A in the central part of the southern section is limited to one lithic artefact (Table 3), which can be classified as a distal blade fragment.

6.3 The assemblage of SU 7a in Trenches 13-A, 14-B and 16-A

The assemblage of SU 7a in Trenches 13-A, 14-B and 16-A, which corresponds to old excavations' archaeological layer 'Gravettian I', comprises lithic artefacts (n = 642) and pieces of ochre (n = 2) (Table 2).

Preliminary observation (H. Salomon, personal communication) of the two pieces of ochre reveals they are composed of a red homogenous, fine-grained and ferruginous clay-related raw material; exact raw material attribution is impossible based on macroscopic observation only. It shows no modification. Given the low amount of artefacts and their features, an anthropogenic origin and/or use is not confirmed.

The lithic artefacts (large fraction) have been studied in more detail (but currently we have detailed data only on 642 of them). Refitting studies have not been conducted yet, but are

planned for the future. Small fraction (< 10 mm; from wet-sieving) lithic analysis is in progress.

The large fraction of lithic artefacts presented here (n = 642) represents only piece-plotted lithics, which in general are > 10 mm but can also include some lithics < 10 mm in case they have been piece-plotted during excavation. They amount to a total weight of 4450.64 g. The minimum weight is 0.01 g and the maximum weight is 419.00 g, while the average weight is 6.93 g (sd = 29.54).

Dataclasses: The lithic assemblage of SU 7a is dominated by flakes (n = 427, 66.51%). The second largest category is shatter (n = 114, 17.76%), followed by chips (n = 42, 6.54%), blades (n = 21, 3.27%) and bladelets (n = 16, 2.49%) (Table 6). Cores are with four pieces (0.62%) represented. It should be noted that chips are probably underrepresented due to the fact that we did not include the small fraction assemblage from wet-sieving in the analysis presented here.

Raw material groups and cortex: In SU 7a, most lithics are made on our group of 'black' raw material (n = 359, 55.92%) followed by 'grey-translucent' (n = 161, 25.08%) and 'grey' (n = 96, 14.95%) raw material groups, while 26 lithics (4.05%) were not assigned to any raw material group (Table 7). Weight shows a similar distribution (Table 7).

For the analysis of the cortex coverage, we have removed the lithics with unidentified raw material, making the analysis total for this section 616. The majority of the lithics (n = 375, 60.88%) has no cortex, while 165 pieces (26.79%) have up to 33% cortex, followed by 37 lithics (6.01%) with 33-66% cortex and 30 (4.87%) with 66-99% cortex. Nine lithics (1.46%) show 100% cortex (Table 8). The three raw material groups black, grey, and grey-translucent show a roughly similar pattern with lithics with 0% cortex dominating each raw material group (between 51.55% and 71.88%) and the 1-33% cortex category ranging between 22.92% and 33.54%. To test whether the cortex coverage distribution differs between the raw material groups, we used a Chi-square test with Monte Carlo simulation of the p-value (100,000 replicates), which showed no significant difference ($\chi^2 = 15.287$, $p = 0.0531$). Cortex coverage per dataclass shows that blades and bladelets have 0% or 1-33% cortex but not more cortex coverage, while among the flakes 11.01% show 33% or more cortex including some specimens with 100% cortex (Table 9). However, among blades and bladelets this could also be related to sample size, something suggested by the fact that a Chi-square test with Monte Carlo simulation of the p-value (100,000 replicates) showed no significant difference between cortex coverage of flakes, blades and bladelets ($\chi^2 = 12.337$, $p = 0.142$). Among the shattered pieces, 54.55% show some cortex and 29.55% show 33% or more cortex.

While - as mentioned above - the majority of lithic artefacts have no cortex, there are also some pieces with 100% cortex coverage in all raw material groups. Therefore, it is suggested that for all raw material groups nodules/cores were brought to the site in an early stage of the reduction process, but they might have been tested and/or prepared elsewhere first. Some cortex remained definitely on the cores when they were introduced into the site. The vast majority of lithic artefacts have no cortex and, therefore, demonstrate an intense reduction process of the cores.

Blank production and core exploitation: The blanks are dominated by flakes, followed by chips, blades and bladelets. Flakes, crested flakes and core maintenance flakes make a total of 433 objects, of which 192 are complete. The length of the complete flake group ranges from 6.98 mm to 93.25 mm with a mean length of 27.74 mm (sd = 17.10), suggesting a large variability in flake size. In total, 278 have a proximal end preserved. Of those, 39.21% (n =

109) show a plain platform, followed by linear (n = 51, 18.35%) and punctiform platforms (n = 30, 10.79%) (Table 10). Most flakes have no lip (n = 170, 61.15%) and no bulb of percussion (n = 181, 65.11%).

Blades are represented by 26 objects, of which 5 are crested blades. Only three blades are complete, the remainder (including all crested blades) are fragmented (Figure 10: 1-4). Most bladelets are fragmented (12 out of 16) (Figure 10: 5).

The assemblage contains four cores, including the two cores MMG-N3-1196 and MMG-N3-1438 shown in Figure 11, ranging between 62.79 mm and 105.35 mm in length and 135.60 g and 392.00 g in weight. Three of the cores are blade cores and one is a flake core. The three blade cores show a parallel core orientation and all show plain platforms. The length of the last removal of the blade cores ranges between 50.70 mm and 85.3 mm, while the length of the last removal of the flake core is 31.52 mm.

While blade production from special blade cores is evident, the question remains whether a special flake production existed. The flakes could just represent the shaping and maintenance of the blocks/cores for blade production. However, there exists one flake core in the assemblage, which has only flake scars visible, but this is its final state, which might not be representative for the entire core reduction process.

Blade production is evidenced by the blades themselves, blade cores and crested elements, even if all of them are not very frequent. The blade cores suggest that the core exploitation is always frontal (even, ultimately, semi-frontal) and unipolar. One of the cores also has a second platform and scars in the opposite direction, but this could be related to the preparation of the distal convexity. It is therefore questionable if this core represents bipolar production, especially since no blades show an opposite or bipolar dorsal scar pattern. Blades are mostly fragmented and are therefore of limited use for a reconstruction of the core exploitation.

There are a few bladelets in the assemblage raising the question of their production as part of the blade production ('accidental' by-products or end of blade core reduction) or the presence of a special bladelet production. The absence of bladelet cores, any crested bladelets, and their triangular cross sections might suggest that the bladelets are part of the blade production process. However, we have to keep in mind the low sample size and, hence, the possibility that we miss elements diagnostic of a special bladelet production.

There are a lot of shattered pieces in the assemblage, most of them without cortex, suggesting their production is not related to testing of raw material nodules or the early stage of nodule exploitation.

Eight blanks - comprising six flakes, one blade and one bladelet - are retouched. The retouch on all eight lithics is fine edge retouch resulting in no formal tool types.

6.4 The assemblage of SU 6c in Trenches 13-A, 14-B and 16-A

The SU 6c assemblage in Trenches 13-A, 14-B and 16-A, which corresponds to old excavations' archaeological layer 'Gravettian II', consists of lithics (n = 1520), bones (n = 14), charcoal pieces (n = 20), and stones (n = 8), amounting to a total of 1562 piece-plotted objects (Table 2).

The faunal remains include 13 specimens from the 2013 fieldwork season, which have not been studied up to now due to logistical reasons; the one specimen from the 2016 fieldwork season is an ungulate size class 3 longbone fragment showing dry breaks, stage 2 weathering and no burning, no human and carnivore modifications.

As with the assemblage of SU 7a, the lithics (large fraction) have been studied while the small fraction (< 10mm; from wet-sieving) lithic analysis is in progress. Refitting studies have not been started yet, but are planned. Stones and charcoals have not yet been analysed. The 1520 lithic artefacts have a total weight of 11,013.39 g. The average weight is 7.21 g (sd = 43.98), with a range from 0.07 g to 1047.00 g, suggesting a lot of variation in weight (and probably size) of lithics artefacts in SU 6c. As mentioned with SU 7a above, the large lithic fraction represents all piece-plotted lithics, which are in general > 10 mm but can also include some lithics < 10 mm in case they have been piece-plotted during excavation.

Dataclasses: The dominating dataclass are flakes with 65.46% (n = 995). Shatter amounts to 170 pieces (11.18%), blades to 144 pieces (9.47%), while all other dataclasses including bladelets, chips and cores are represented by less than 5% (Table 6). We should note here - as we did above with SU 7a - that chips do not include the small fraction from wet-sieving (analysis ongoing) and, hence, this category is most probably underrepresented.

Raw material and cortex: The majority of lithics are made on our group of 'black' raw material (n = 1030, 67.76%) followed by 'grey' (n = 220, 14.47%) and 'grey-translucent' (n = 205, 13.49%). A total of 65 lithics (4.28%) were not assigned to any raw material (Table 7). Weight shows a similar distribution with black raw material dominating with 8237.88g (74.78%) (Table 7).

For the analysis of the cortex coverage, we have removed the lithics with unidentified raw material, resulting in a total of 1455 for this section. Among the lithics, 28.18% (n = 410) show some cortex, while 71.82% (n = 1045) exhibit no cortex (Table 8).

Among the black, grey, and grey-translucent raw material categories all three are dominated by lithics without any cortex (between 65.91% and 85.85%). The second largest category is across all three raw materials the 1-33% cortex category (ranging between 10.24% and 21.82%). It seems that the grey raw material category shows less lithics with cortex (14.15%) than the black and grey-translucent categories (29.71% and 34.09%, respectively), which is confirmed by a Chi-square test with Monte Carlo simulation of the p-value (100,000 replicates) showing significant difference ($\chi^2 = 30.165$, $p = 0.00051$). The distribution of cortex coverage of the entire assemblage shows no difference to the one of flakes and blades (Table 11). Bladelets (n = 71) have never more than 33% cortex on their dorsal face. The other frequent dataclass is shatter (n = 121) with 44.63% of all shattered pieces showing at least 1% cortex and 23.97% showing at least 33% cortex.

All raw material groups are dominated by pieces without cortex, but each of the groups also have some pieces with 100% cortex. While it is evident that there was intense core reduction for all raw material groups (majority of pieces does not show cortex at all), the pieces with 100% cortex or 66-99% cortex show that nodule exploitation at the site started in an early stage, at least for some nodules. However, the grey raw material group shows less specimens with cortex than the other raw material groups, suggesting it might have been brought to the site in a more reduced stage, especially when compared to the black raw material group.

Blank production and core exploitation: The dominating blank category are flakes with 65.46% (n = 995), followed by blades with 9.47% (n = 144), bladelets with 4.67% (n = 71), and chips with 4.01% (n = 61) (Table 6). Flakes, crested flakes and core maintenance flakes together amount to 1023 objects, of which 507 are complete specimens. The complete flakes, crested flakes and core maintenance flakes have a mean length of 28.25 mm (sd = 15.66) and the length measurements range between 7.14 mm and 94.10 mm. On the proximally preserved flakes, crested flakes and core maintenance flakes (n = 718), 38.02% (n

= 273) of the platforms were identified as plain, 12.53% (n = 90) as linear, and 11.28% (n = 81) as punctiform (Table 12). Bulbs of percussion are lacking in 69.06% (n = 453) of all flakes with at least a proximal end (n = 656). Lips are absent in 63.15% (n = 437) of flakes with preserved interior platform edge (n = 692).

In the assemblage there are 144 blades (Figure 12: 4, 5) and 16 crested blades, amounting together to 10.51% of all lithics. 69 (43.13%) of them are complete. Of the blades with proximal end, 44% have a plain platform, followed by 17% for linear and 11% for punctiform platforms (Table 12). Among the 71 bladelets (Figure 12: 6-8) and 6 crested bladelets, which together represent 5.05% of all lithics, 49 specimens are fragmented. Most bladelets (45%) have punctiform platforms (Table 12).

Eleven lithics are classified as cores and range from 39.02 mm to 100.84 mm in length and 5.24 g to 1047.00 g in weight. Five of them are blade cores, including the examples MMG-N2-106 shown in Figure 12: 2, five flake cores (of which one is a core-on-flake, MMG-N2-126, Figure 12: 1), and one bladelet core of burin-type. The five blade cores show a parallel core orientation and three have plain platforms, while the other two have faceted platforms. The length of the last removal on the blade cores ranges between 32.76 mm and 93.83 mm. On the five flake cores the length of the last removal ranges between 16.94 mm and 42.25 mm.

A look at the produced blank categories shows that flakes, blades and bladelets have been produced. As mentioned above, there are blade cores, one flake core and one bladelet core of burin type in the assemblage. While the flake core has indeed only flake scars visible, this is its final state, which might not be representative for the entire core reduction process.

The retouched flakes or those with non-recent edge damage seem to be picked from any flakes related to shaping of blade cores. Based on the currently available data, it is difficult to argue for or against a separate flake production on special flake cores.

The blade cores and the blades produced clearly demonstrate that a large part of the core reduction processes was geared towards blade blank production. We will summarise some aspects of the blade production below in more detail.

Bladelets are well represented in the assemblage, some with trapezoidal cross-section. In addition, we have crested bladelets, and we have one special bladelet core of burin type. While some bladelets seem to be produced as part of the blade blank production - either as an 'accidental' byproduct during the blade production or through intense reduction of blade cores - we also have evidence for a special bladelet production utilizing the burin core concept. For the production of bladelets as part of the blade blank production speaks that the average bladelet width is quite large.

With regard to blade production, cores show different dynamics in terms of volume management, with the exploitation of either the narrow face or the wide face of a nodule/block. The morphology of the blade release surfaces is variable, with in the first case a tendency to very little convexity, while in the second case the lateral and longitudinal convexities are much more marked. In all cases, the organization of the surfaces is similar, with the inclusion of the blade release surface between two lateral surfaces, occasionally converging, and the use of a preferential platform. Some cores also have a second opposite platform. However, bipolar or opposite dorsal scar patterns are rare, most blanks show unipolar dorsal scar patterns. The use of an opposite platform therefore does not result in a bipolar exploitation with rapid alternation of the platforms, but in a slow alternation of the platforms or is related to a maintenance of the distal convexities.

The reduction sequence starts as soon as the cortex is or large parts of the cortex are removed. The cores are not very thoroughly prepared and, if there is a hierarchy of surfaces, these remain largely untouched. Crest preparation was utilized as crested elements demonstrate. One-sided and two-sided crests are documented, but also cortical blades suggesting blade production without prior crest preparation but utilizing natural 'crests'/surfaces with the right convexity.

The blades have various morphological and metric characteristics, which might be related to the fact that target products, byproducts (maintenance, edge of blade release surface) or accidents are all classified as blades. But we have also to keep in mind that this might be caused equally by whether the blades come from the early, middle or late stages of core reduction. In general, blades are on average 5-6 cm long, show straight but also curved profiles, and the cross sections are both triangular and trapezoidal.

To label a set of specific morphological characteristics as the target blade morphology is difficult if not impossible, especially in absence of refitting studies, which could allow an interpretation as target product from their location in the reduction system, and the lack of retouched blades, which could allow an interpretation as target product due to their selection for use. However, both approaches are problematic and can only suggest possible target products. On the other hand, cutting edge is produced by blades of all morphologies. The average length of blades might be an underestimation, as certain blades, including crested specimens, reach 8-9 cm in length, which indicates the maximum dimension probably at the start of the core reduction process. There are only a few complete large blades and it is entirely possible that they might have been transported off site.

The core morphologies and the blades themselves suggest two types of blades: on the one hand, thin, wide, curved blades with a trapezoidal cross section and, on the other hand, straight, thick blades, less wide and with a triangular cross section. To understand their role in the reduction process, further studies are needed.

Of 1520 lithics only 15 specimens (0.99%) are retouched, comprising one endscraper and 14 edge retouched pieces.

6.5 The assemblages of SU 6b, SU 6a, and SU 5c in Trenches 13-A, 14-B and 16-A

Stratigraphic unit 6b provided 46 lithic artefacts, including two bladelets, two cores, one core tablet, 26 flakes, and 12 shattered pieces. The two cores are one blade and one flake core. None of the blanks is retouched. This assemblage corresponds to old excavations' archaeological layer 'Gravettian II'.

The assemblage of SU 6a comprises 14 lithic artefacts, one faunal remain, and one charcoal. The faunal specimen is a right proximal tibia shaft fragment that is fully fused and attributed to an adult *Equus ferus*. It shows dry and recent breaks, stage 4 weathering, and no burning, human or carnivore modifications. Among the 14 lithic artefacts are three blades, six flakes, and two shattered pieces.

Stratigraphic unit 5c provided a small assemblage of eight lithic artefacts (six flakes, one blade, and one chip).

7. Perspectives and Conclusion

Above we have provided an overview of our fieldwork and updates on the stratigraphic sequence, as well as a brief overview of the assemblages excavated. We then presented in detail the Gravettian archaeological assemblages excavated during our fieldwork between

2013 and 2016. Our Gravettian samples are well stratified in one of the longer and high-resolution sequences of the European Upper Palaeolithic. While most Mitoc-Malu Galben's archaeological material as well as the stratigraphic and palaeoenvironmental record was generated by the previous excavations (see Otte et al. (2007) for a summary), our new fieldwork provides crucial new information on a range of issues including raw material economy, the onset of the Gravettian, and the environmental context of human occupation in the Late Pleistocene. Below we discuss some of these and provide a brief overview of the Gravettian of Mitoc-Malu Galben in its wider regional context.

7.1 Observations on lithic raw material exploitation

The raw material groups ('black', 'grey', and 'grey-translucent') used in our analysis to date are very broad categories, all of which belong to what has often been described as 'Prut flint', suggesting a local origin (e.g., Moroşan, 1938; Chirica et al., 2014; Lazarovici et al., 2018). This type of flint - which occurs in blackish, greyish, and brownish varieties - can be described as a very fine-grained siliceous raw material (e.g., Moreau et al., 2019). It is found in primary sources in the Upper Cretaceous deposits of chalky limestone along the Middle Prut, specifically in an approximately 30km long part of the valley between Rădăuţi and Liveni. Secondary sources, i.e. reworked 'Prut flint', have been documented in conglomerates, which are of Badenian age and can be observed on top of the Upper Cretaceous flint deposits, and in the terrace gravels of the Prut south of the Rădăuţi–Liveni part of the Middle Prut valley (Moreau et al., 2019).

Our 'black', 'grey', and 'grey-translucent' raw material groups fit the description and variation known from different varieties of 'Prut flint' and we, therefore, assume that they are sourced locally, something that has been observed by others (e.g., Văleanu, 2015). Cortical parts on lithics suggest that secondary outcrops have been utilised as source by Upper Palaeolithic hunter-gatherers. A first geochemical study on 'Prut flint' archaeological samples from Mitoc-Malu Galben and two geological sources close to Mitoc-Malu Galben interestingly demonstrates that these two geological sources are geochemically not similar to the analysed 'Prut flint' samples from Mitoc-Malu Galben (Moreau et al., 2019). This might suggest that hunter-gatherers supplied themselves not locally with 'Prut flint', but further afield. However - as Moreau et al. (2019) note - that either the flint has been geochemically altered in secondary deposits (although they mention this is unlikely) or that not the entire variability in geochemical composition of the local 'Prut flint' has been sampled by the samples available at the two geological sources used. Besides this first case study (Moreau et al., 2019) - showing potential and limitations of the approach - more work on sourcing using various different approaches might be most beneficial for future studies of the question of the local vs nonlocal supply of raw material by Upper Palaeolithic hunter-gatherers at Mitoc-Malu Galben. In this context it also should be mentioned that the difference between 'Prut flint' and some of the so-called 'Dniester flint' is not known and should be investigated in the future.

For Mitoc-Malu Galben, we assume for now - in agreement with the discussion in Moreau et al. (2019) - that the raw material was locally sourced. The representation of our three raw material groups - 'black', 'grey', and 'grey-translucent' - in our newly excavated assemblages varies. Specifically, our 'black' and 'grey' raw material groups are represented in all assemblages. However, if present, all raw material groups show some pieces with cortex suggesting that initial or only partly prepared nodules were introduced into the site. The

data also shows for most assemblages that pieces without cortex dominate and, hence, reduction intensity was sufficient to remove most of cortex on the cores. We reconstruct that local raw material was brought in as either intact nodules, tested nodules, or (partially) prepared cores. This seems in some instances to have differed between raw material groups. A good example is the Gravettian assemblage of SU 6c; the 'grey' group of raw material shows less cortex than the other represented raw material groups, suggesting it was introduced in a more reduced stage.

Interesting in the context of lithic technology and raw material economy is the relative frequency and the role of shattered pieces. We record as shatter any lithic object that does not fit any other definition of a basic dataclass, i.e. not cores, blanks, etc. While flakes are dominating most assemblages, shattered pieces are quite frequent, i.e. between 11% and 18% for the two larger assemblages in our sample, i.e. the assemblages of SU 6c and SU 7a (Table 13). On the one hand this pattern could be related to raw material quality, on the other hand it could be related to testing of nodules and/or breaking down large nodules in blocks for shaping into cores.

One way to assess raw material quality is via amount of lithics showing one or more joint planes. While in general the raw materials used at Mitoc-Malu Galben can be considered of good quality (i.e., fine-grained, homogeneous cherts), we note that between 9% and 11% of all lithics exhibit at least one joint surface feature (Table 13). Many joint planes can lead to more shattering in the knapping process resulting in more shattered. However, in our sample the percentage of lithic with joint plane is more or less the same for both SU 6c and SU 7a, while the relative frequency of shatter differs between the assemblages. This might suggest that presence of joint planes does not lead to more shatter being produced. This needs to be tested in future with more assemblages and larger sample sizes.

If higher relative frequencies of shattered pieces are related to testing of nodules and/or breaking down large nodules in blocks for shaping into cores, we would expect that most shattered pieces show at least some cortex. In our dataset the shatter with cortex amounts to ~44% in SU 6c and ~66% in SU 7a (see Tables 9 and 11). These values for shatter with cortex are higher than for flakes, blades and bladelets of those assemblages. And, indeed, this might suggest that the production of shatter has something to do with testing of nodules and/or breaking down large nodules in blocks for shaping into cores. However, refitting studies will have to test this suggestion in the future. While we are not aware of detailed studies dealing with the relative frequency of shattered pieces and its relationship to testing of nodules and/or breaking down large nodules in blocks for shaping into cores, it is entirely possible that the pattern observed in our samples at Mitoc-Malu Galben is typical for sites located close to the raw material sources.

7.2 Chronostratigraphy, palaeoenvironment and regional sequence

The sequence of Mitoc-Malu Galben forms together with the sequences of Molodova V (Ukraine), Cosautsi (Cosăuți; Moldova), and Dorochivtsi III (Ukraine) the regional sequence for the East Carpathian area between ~ 33 ka uncal BP (~37.4 ka cal BP) to the onset of the Holocene (Haesaerts et al., 2004; 2009; 2010a; 2020). While Mitoc-Malu Galben covers the period ~33 ka uncal BP (~37.4 ka cal BP) to ~20 ka uncal BP (~24 ka cal BP), Molodova V covers ~33 ka uncal BP (~37.4 ka cal BP) to ~10 ka uncal BP (~11.5 ka cal BP), Cosautsi covers ~20 ka uncal BP (~24 ka cal BP) to ~10 ka uncal BP (~11.5 ka cal BP), and Dorochivtsi III covers ~24 ka uncal BP (~28.1 ka cal BP) to 13 ka uncal BP (~15.6 ka cal BP) (Haesaerts et al., 2004; 2020). The correlations between these four key sequences are mainly based on a

comparison of the pedo-sedimentary signatures of the different units and their respective radiocarbon dates. Within the regional sequence 15 interstadial periods have been identified and precisely positioned in radiocarbon chronology. The regional sequence can be correlated (Haesaerts et al., 2009; 2020) with the climatic episodes of the Greenland ice (Rasmussen et al., 2014), covering roughly Greenland Interstadial 8 to Greenland Interstadial 1.

In this context, the addition of the paleosol SU 11a, a chernozem, and the insertion of the paleosol SU 5a in the Mitoc-Malu Galben sequence are of particular interest as they reinforce the correlation between the sequences proposed earlier (e.g., Haesaerts et al., 2003). The chernozem of SU 11a is correlated with the humic horizon of SU 10-2 of Molodova V dated to ~30.4 ka uncal BP (~34.7 ka cal BP). The insertion of the humic horizon SU 5b in the Mitoc-Malu Galben sequence, allows positioning the loess SU 4c between 23.4 ka uncal BP and 23.3 ka uncal BP (27.7 ka cal BP and 27.6 ka cal BP), and, hence, suggests to correlate the gley of SU 4a of the Mitoc-Malu Galben sequence with the gley of SU 12-2 at Molodova V (see also Haesaerts et al., 2018).

7.3 The Gravettian of Mitoc-Malu Galben in its wider context

The Gravettian is documented at Mitoc-Malu Galben from SU 7b to SU 4a (in the SUs above only small, non-diagnostic assemblages have been documented in the previous excavations, but they well could belong to a late Gravettian or alternatively to an early Epigravettian), so roughly from 27 to 23/22 ka uncal BP (31.1 to 27.3/26.2 ka cal BP) or - based on the above reported correlations - from Greenland Stadial 5.2 to Greenland Stadial 3. Below we compare the Gravettian of Mitoc-Malu Galben in the wider regional Mid-Upper Palaeolithic context.

North of Mitoc-Malu Galben important Gravettian occupation is known from the Middle Dniester valley (Ukraine) at Molodova V (Chernysh, 1961; Ivanova and Tzeitlin 1987) and Korman IV (Goretski and Tzeitlin 1977). At Molodova V the first Gravettian is documented in Layers 9 and 10, which are located stratigraphically in the lower part of Unit 10-3, dated between 29.7 and 29.4 ka uncal BP (34.3 and 34 ka cal BP) (Haesaerts et al., 2003; 2010a; Noiret, 2007), and is significantly older than the onset of the Gravettian at Mitoc-Malu Galben. The Middle Gravettian of Layer 8 is located in Unit 11-2, dated to around 25.5 ka uncal BP (29.9 ka cal BP) (Haesaerts et al., 2003). At Korman IV Gravettian assemblages are reported from Layer 7 and 6 (Goretski and Tzeitlin 1977; Noiret, 2007).

To the west of Mitoc-Malu Galben, we have the record of open-air sites in the Bistrița valley (Romania) (e.g., Anghelinu et al., 2012; 2018). The Gravettian occupations at those sites seems to span from a Gravettian around 28/26 ka uncal BP (31.9/30.2 ka cal BP) to much later occupations typical of Late Gravettian and Epigravettian (Anghelinu et al., 2012; 2018; Cărciumaru et al., 2006; Nițu et al., 2019). While appearance of the Gravettian in the Bistrița valley roughly overlaps with the appearance of the Gravettian at Mitoc-Malu Galben, a more detailed comparison is difficult due to the lower palaeoclimatic resolution and lack of good climatic markers at the Bistrița valley sites.

Further to the west, we have the record of the Middle Danube region, including the Carpathian basin and the Austrian Danube valley as well as southern Moravia. For the Carpathian basin only a handful of Gravettian sites are documented (e.g., Lengyel and Wilczyński, 2017; Lengyel, 2018; Lengyel et al., 2016). Most Gravettian sites belong to the later stages of the technocomplex (Lengyel, 2018), this includes Bodrogheresztúr, which previously was attributed to the Pavlovian (Dobosi, 2000), but more recently it has been

argued based on typological grounds that it should be attributed to the late Gravettian (Lengyel, 2015; 2018), which is confirmed by new radiocarbon dates (Wilczyński et al., 2020). A detailed comparison of the Hungarian Gravettian with the sequence of Mitoc-Malu Galben to the east and Willendorf II to the west (see below) is hampered by the low chronostratigraphic resolution of the Hungarian sites.

In the Austrian Danube valley and southern Moravia, the Gravettian seems to first appear around 30.5 ka uncal BP (34.9 ka cal BP) as documented at Willendorf II, where AH 5 is located in Unit C2 dated to 30.5 ka uncal BP (34.9 ka cal BP) (Haesaerts et al., 1996; Nigst et al., 2014). This first Gravettian can be classified as early Gravettian and is argued to be distinct and preceding the Pavlovian (Moreau, 2009; 2010; 2012). It is followed by the Pavlovian (27 ka uncal BP to 25 ka uncal BP [31.1 to 29.2 ka cal BP]) and the late Gravettian or Willendorf-Kostenkian (25 ka uncal BP to 20 ka uncal BP [31.9 to 24 ka cal BP]) (e.g., Haesaerts et al., 1996; 2010b; Schmid et al., 2019; Svoboda, 2007; Svoboda and Sedláčková, 2004; Svoboda et al., 1999). Compared with MMG, the Middle Danube region provides with Willendorf II, AH5, evidence of an early Gravettian predating the onset of the Gravettian at Mitoc-Malu Galben.

To the east of Mitoc-Malu Galben, a Gravettian-like assemblage is documented at cultural layer II/2 of Mira (Ukraine) and dated to 27.8 to 27.2 ka uncal BP (31.7 to 31.2 ka cal BP) (Haesaerts et al., 2014). In the northeast of Mitoc-Malu Galben, Gravettian is reported from the Middle Desna river valley (Russia) with rather late Gravettian around 24/23 ka uncal BP (28.1/27.3 ka cal BP) at, e.g., Khotylevo 2 (Gavrilov et al., 2015). Further northeast, in the Kostenki-Borshchevo site complex, Gravettian is documented at Kostenki 8, Cultural Layer II, with an early Gravettian dated to ~27.7 ka uncal BP (~31.6 ka cal BP) (e.g., Sinitsyn 2015), and then especially as a late Gravettian (Willendorf-Kostenkian or Willendorf-Kostenki-Avdeev culture) at sites including Borshchevo 5, Cultural Layers 1a and 1b, Kostenki 14, Cultural Layer I (e.g., Sinitsyn, 1996), Kostenki 1, Cultural Layer I, Kostenki 4, Cultural Layer II, Kostenki 21, Cultural Layer III, Kostenki 11, Cultural Layer II (e.g., Lisitsyn, 2015; Reynolds et al., 2015; Sinitsyn, 2010; 2015). The onset of the Gravettian between 28 and 27 ka uncal BP (31.8 and 31.1 ka cal BP) in the Kostenki-Borshchevo region is slightly earlier than at Mitoc-Malu Galben, but comparable to or later than what is known from other regions of Europe. The brief comparison with selected sites in regions east, northeast, north, and west of Mitoc-Malu Galben shows that the sequence of MMG is quite interesting for our understanding of the Gravettian in general for several reasons. First, we rarely have such a long, high-resolution sequence with multiple Gravettian occupations. Especially interesting in this context is the high-resolution palaeoenvironmental and climatic signal of the MMG sequence, which will provide us in the future with the ability to study human behaviour in a changing environmental and climatic context. Besides the high-resolution environmental and climatic context, which has up to now not been fully explored, the sequence of Mitoc-Malu Galben also provides us with a detailed chronology/chronostratigraphy for the Gravettian in the East Carpathian region. This allows us to study changes in human behaviour, including technological organisation, mobility and subsistence behaviours, through time and across stages or phases of the Gravettian (e.g., Nigst and Bosch, in press). The sequence of Mitoc-Malu Galben provides interesting perspectives on the issue of the appearance of the Gravettian technocomplex. While a full discussion or review of the debate around the appearance of the Gravettian is much beyond the current paper, we want to briefly mention here, that the first Gravettian at Mitoc-Malu Galben in SU 7 appears only around 27 ka uncal BP (31.1 ka cal BP), which is late compared to the regional evidence

from Molodova V, Layers 9 and 10. The Gravettian at Molodova V, Layers 9 and 10, appears earlier between 29.7 and 29.4 ka uncal BP (34.3 and 34 ka cal BP), when we have still late Aurignacian at Mitoc-Malu Galben. This situation is quite similar to what we know from the Middle Danube region where we have with Willendorf II, AH 5, an early Gravettian dated to ~30.5 ka uncal BP (34.9 ka cal BP) (Haesaerts et al., 1996; Nigst et al., 2014) and associated with the humiferous horizon SU C2 (Antl-Weiser, 2008; Felgenhauer, 1959; Haesaerts et al., 1996). Its chronostratigraphic position is in the Schwallenbach III Interstadial, which can be correlated to the Malu Galben 11 Interstadial. This would also roughly be the position of the late Aurignacian of Stratzing, Layer 2, dated between 31.8 and 28.4 ka uncal BP (36.2 and 32.6 ka cal BP) (Nigst, 2012), also associated with a humiferous horizon (Neugebauer-Maresch, 2008). We, therefore, seem to have in both the Middle Danube region and the East Carpathian region an overlap of late Aurignacian and early Gravettian (see also Haesaerts et al., 2018). In this context, our new assemblages of SU 9a (Figure 8) in the southern excavation area and SU 9b in the northern excavation area at Mitoc-Malu Galben are of key importance. They will allow a detailed study of the technological behaviour of the late Aurignacian at a time when the same or other groups/populations were already producing Gravettian in the same geographic region. Similarly, this also raises the need to re-evaluate the early Gravettian of Molodova V, Layers 9 and 10, in the future.

7.4 Concluding remarks and future perspectives

In this paper we have presented for the first time (i) an overview of our fieldwork between 2013 and 2016 at Mitoc-Malu Galben, and (ii) the Gravettian assemblages in detail. We have excavated numerous trenches in a number of different areas within the site to get access to several Aurignacian and Gravettian assemblages. The goal was to produce high-resolution samples and start a detailed analysis focusing on technological behaviours and site formation processes.

In this paper we have not dealt in detail with site formation processes, partly because they are - based on the geological work by Haesaerts (2007) - under quite good control, and partly because it is beyond the scope of this paper. However, one focus of our fieldwork between 2013 and 2016 was to collect numerous samples to conduct a set of studies to enhance our understanding of site formation processes, including soil micromorphology, fabric analysis, archaeological particle size analysis, micro-debitage analysis, refitting studies, and taphonomy of the faunal remains. While most of these have never been applied to Mitoc-Malu Galben, taphonomy of the faunal remains was already part of the 1992 to 1995 research (Otte et al. 2007). Most of the above mentioned analyses to study site formation processes are currently conducted by members of our team.

While we have presented basic information on raw material economy and blank production and core exploitation on all larger excavated assemblages, more detailed studies of core exploitation and blank production are in progress and some preliminary information is available (e.g., Branscombe, 2016; Libois, 2017). One focus of these ongoing and future studies will be the bladelet production modes and their relationship to the rest of the blank production but also how they are embedded in technological organisation in general. We have started analysing the small fraction of archaeological objects, i.e. those recovered from wet-sieving. Our preliminary data of this ongoing work shows that the small fraction is dominated by lithics. The analysis of the small fraction material will be of key importance for both technological analysis and aspects of site formation studies. With regard to technological analysis we are focusing on bladelet fragments as well as byproducts of

bladelet production including any crested pieces, core tablets, and fronto-lateral carinated endscraper-core maintenance flakes/chips. This is especially crucial because most of the old excavations (including most of the fieldwork between 1992 and 1995) have not wet-sieved the excavated sediments (Noiret, 2005). With regard to site formation processes the small fraction material is key for archaeological particle size analysis, and a preliminary study looking at some squares of our 2013-2016 fieldwork has been conducted (Murphree, 2017). A more detailed study is in progress. We have reviewed above the appearance of the Gravettian at Mitoc-Malu Galben and in the proximate parts of Eastern and Central Europe, arguing that in both Eastern and Western Europe there is an overlap between the late Aurignacian and the early Gravettian (see also, e.g., Haesaerts et al., 2018). This suggestion needs further testing by detailed technological studies of the late Aurignacian at Mitoc-Malu Galben as well as the early Gravettian at Molodova V. Another key aspect of the Mitoc-Malu Galben Gravettian is that the assemblages are embedded in a long sequence providing high-resolution climatic context for human occupation. One aspect of our future studies will relate to questions of the impact of variation in environmental and climatic conditions for human behaviour and especially landscape use.

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References

- Anghelinu, M., Niță, L., Steguweit, L., 2012. Not that original after all: the chrono-cultural framework of the Upper Paleolithic on the Bistrița Valley (North-Eastern Romania). *Arheologia Moldovei* XXXV, 7-46.
- Anghelinu, M., Niță, L., Murătoareanu, G., 2018. Le Gravettien et l'Épigravettien de l'Est de la Roumanie: une réévaluation. *L'Anthropologie* 122(2), 183-219.

985 Antl-Weiser, W., 2008. Die Frau von W. Die Venus von Willendorf, ihre Zeit und die
 986 Geschichte(n) um ihre Auffindung, Phoibos Verlag, Vienna.
 987 Behrensmeier, A. K., 1978. Taphonomic and ecologic information from bone weathering.
 988 Paleobiology 4(2), 150-162.
 989 Branscombe, T., 2016. Attribute analysis of an Upper Palaeolithic lithic assemblage from
 990 Mitoc-Malu Galben : Is this assemblage "Aurignacian", and if so what does this mean?
 991 Dissertation, University of Cambridge.
 992 Cârciumar, M., Chirica, V., 1987. Découvertes d'art paléolithique sur le territoire de la
 993 Roumanie, in: Chirica, V. (Ed.), La genèse et l'évolution des cultures paléolithiques sur
 994 le territoire de la Roumanie, Actes de la Session scientifique de Iași-Botoșani (22-25
 995 octobre 1985). Iași, pp. 63-71.
 996 Cârciumar, M., Anghelinu, M., Steguweit, L., Nita, L., Fontana, L., Brugère, A., Hambach, U.,
 997 Margarit, M., Dumitrascu, V., Cosac, M., Dumitry, F., Carstina, O., 2006. The upper
 998 palaeolithic site of Poiana Ciresului (Piatra Neamt, north-eastern Romania) - Recent
 999 Results. Archäologisches Korrespondenzblatt 36, 319-331.
 1000 Chernysh, A. P., 1961. The Paleolithic site of Molodova V, AN Ukrainian SSR, Kiev.
 1001 Chirica, V., 1975. Descoperiri paleolitice din așezarea de La Mitoc (jud. Botoșani).
 1002 Arheologia Moldovei VIII, 7-14.
 1003 Chirica, V., 1982. Amuleta-pendantiv de La Mitoc, jud. Botoșani. Studii și Cercetări de Istorie
 1004 veche și Arheologie 33(2), 229-231.
 1005 Chirica, V., 1987. La genèse et l'évolution des cultures du Paléolithique supérieur dans la
 1006 zone du Prut moyen d'après les recherches récentes, in: Chirica, V. (Ed.), La genèse et
 1007 l'évolution des cultures paléolithiques sur le territoire de la Roumanie, Actes de la
 1008 Session scientifique de Iași-Botoșani (22-25 octobre 1985)., pp. 25-40.
 1009 Chirica, V., 1989. The Gravettian in the East of the Romanian Carpathians.
 1010 Chirica, V., 1993. La géochronologie du Gravettien de la Moldavie à la lumière des
 1011 recherches de Mitoc-Malu Galben, in: Actes du XIIe Congrès international des Sciences
 1012 préhistoriques et protohistoriques (Bratislava, 1-7 septembre 1991), volume 2. UISPP,
 1013 Bratislava, pp. 72-75.
 1014 Chirica, V., 1995. Le Paléolithique de la zone du Prut moyen. Memoria Antiquitatis XX, 7-34.
 1015 Chirica, V., 1996. La zone des terrasses du Prut, in: Chirica, V., Borzic, I.A., Chetraru, N.A.
 1016 (Eds.), Gisements du Paléolithique supérieur ancien entre le Dniestr et la Tissa. Helios,
 1017 Iași, pp. 70-94.
 1018 Chirica, V., 2001. Gisements paléolithiques de Mitoc. Le paléolithique supérieur de
 1019 Roumanie à la lumière des découvertes de Mitoc, Helios, Iași.
 1020 Chirica, V., 2007. Historique des recherches paléolithiques en Roumanie et à Mitoc-Malu
 1021 Galben, in: Otte, M., Chirica, V., Haesaerts, P. (Eds.), L'Aurignacien et le Gravettien de
 1022 Mitoc-Malu Galben (Moldavie Roumaine). Université de Liège, Liège, pp. 7-9.
 1023 Chirica, V., Chirica, V.-C., 2017. Le Gisement Paleolithique de Mitoc-Malu Galben. La
 1024 classification du Patrimoine archéologique mobil, Bibliotheca Archaeologica Iassensis
 1025 XXVIII, PIM, Iași.
 1026 Chirica, V., Chirica, V.-C., Bodi, G., 2014. La vallée du Prut moyen - entre Miorcani et
 1027 Ripiceni. Stratigraphie géologique et habitats paléolithiques, PIM, Iași.
 1028 Chirica, V., Vornicu, D.-M., 2015. The Palaeolithic discoveries from Mitoc-Malu Galben
 1029 (Romania). The Aurignacian I and I inferior Layers. Arheologia Moldovei XXXVIII, 201-
 1030 224.

- 1031 Chirica, V., Noiret, P., Nigst, P. R., Haesaerts, P., 2014. Mitoc-Malu Galben, Campania 2013.
1032 Cronica cercetărilor arheologice din România XLVIII-a sesiune națională de rapoarte
1033 arheologica, Oradea, 5-7 iunie 2014, Muzeul Țării Crișurilor Oradea, 81-83.
- 1034 Chirica, V., Noiret, P., Nigst, P. R., Haesaerts, P., 2015. Mitoc-Malu Galben, Campania 2014.
1035 Cronica cercetărilor arheologice din România XLIX-a sesiune națională de rapoarte
1036 arheologica, Pitești, 28-30 mai 2015, Muzeul Județean Argeș, 153-156.
- 1037 Chirica, V., Noiret, P., Nigst, P. R., Haesaerts, P., Bodi, G., Vornicu, D.-M., 2017. Mitoc-Malu
1038 Galben, Campania 2016. Cronica Cercetărilor Arheologice Din România a LI-a sesiune
1039 națională de rapoarte arheologice, București, 24-27 mai 2017, 96-97.
- 1040 Chirica, V., Noiret, P., Nigst, P. R., Haesaerts, P., Vornicu, D.-M., Bodi, G., Bosch, M. D.,
1041 Pazan, K., Germain, F., Libois, T., Bruninx, A., Branscombe, T., Ciucalau, D., 2016.
1042 Mitoc-Malu Galben, Campania 2015. Cronica Cercetărilor Arheologice Din România a L-
1043 a sesiune națională de rapoarte arheologica Targu-Jiu, 26 - 28 mai 2016, 62-63.
- 1044 Damblon, F., Haesaerts, P., 2007. Les datations 14C à Mitoc-Malu Galben, in: Otte, M.,
1045 Chirica, V., Haesaerts, P. (Eds.), *L'Aurignacien et le Gravettien de Mitoc-Malu Galben*
1046 (Moldavie Roumaine). Université de Liège, Service de Préhistoire, Liège, pp. 53-65.
- 1047 Damblon, F., Haesaerts, P., van der Plicht, J., 1996. New Datings and Considerations on the
1048 Chronology of Upper Palaeolithic Sites in the Great Eurasiatic Plain. *Préhistoire*
1049 *Européenne* 9, 177-231.
- 1050 Dobosi, V.T., 2000. Bodrogkeresztúr - Henye (NE-Hungary), Upper Palaeolithic Site.
- 1051 Felgenhauer, F., 1959. Willendorf in der Wachau. Monographie der Paläolith-Fundstellen I-
1052 VII, Rohrer, Vienna.
- 1053 Gautier, A., López Bayón, I., 1993. La faune de l'atelier aurignacien de Mitoc Malul Galben
1054 (Moldavie roumaine). *Préhistoire européenne* 3, 77-82.
- 1055 Gavrilov, K. N., Voskresenskaya, E. V., Maschenko, E. N., Douka, K., 2015. East Gravettian
1056 Khotylevo 2 site: Stratigraphy, archaeozoology, and spatial organization of the cultural
1057 layer at the newly explored area of the site. *Quaternary International* 359-360, 335-
1058 346. <https://doi.org/10.1016/j.quaint.2014.08.020>.
- 1059 Goretski, G. I., Tzeitlin, S. M. (Eds.), 1977. The Multilayer Paleolithic Site Korman IV on the
1060 Middle Dniestr. Nauka: Moscow.
- 1061 Haesaerts, P., Borziac, I., Chekha, V. P., Chirica, V., Drozdov, N. I., Koulakovska, L., Orlova, L.
1062 A., Plicht, J. van der, Damblon, F., 2010a. Charcoal and wood remains for radiocarbon
1063 dating Upper Pleistocene loess sequences in Eastern Europe and Central Siberia.
1064 *Palaeogeography, Palaeoclimatology, Palaeoecology* 291(1-2), 106 - 127.
1065 <https://doi.org/10.1016/j.palaeo.2010.03.034>.
- 1066 Haesaerts, P., Borziak, I., Chirica, V., Damblon, F., Koulakovska, L., 2004. Cadre
1067 stratigraphique et chronologique du Gravettien en Europe Centrale, in: Svoboda, J.,
1068 Sedláčková, L. (Eds.), *The Gravettian along the Danube*, Proceedings of the Mikulov
1069 Conference, 20.-21. November, 2002. Institute of Archaeology, AS CR, Brno, pp. 33-56.
- 1070 Haesaerts, P., Borziak, I., Chirica, V., Damblon, F., Koulakovska, L., Van der Plicht, J., 2003.
1071 The East Carpathian Loess Record: A Reference for the Middle and Late Plenigacial
1072 Stratigraphy in Central Europe. *Quaternaire* 14(3), 163-188.
- 1073 Haesaerts, P., Damblon, F., Bachner, M., Trnka, G., 1996. Revised stratigraphy and
1074 chronology of the Willendorf II sequence, Lower Austria. *Archaeologia Austriaca* 80,
1075 25-42.
- 1076 Haesaerts, P., Borziac, I., Chekha, V. P., Chirica, V., Damblon, F., Drozdov, N. I., Orlova, L. A.,
1077 Pirson, S., van der Plicht, J., 2009. Climatic signature and radiocarbon chronology of

1078 Middle and Late Pleniglacial loess from Eurasia: comparison with the marine and
 1079 Greenland records. *Radiocarbon* 51(1), 301-318.
 1080 Haesaerts, P., Gerasimenko, N., Damblon, F., Yurchenko, T., Kulakovska, L., Usik, V., Ridush,
 1081 B., 2020. The Upper Palaeolithic site Doroshivtsi III: A new chronostratigraphic and
 1082 environmental record of the Late Pleniglacial in the regional context of the Middle
 1083 Dniester-Prut loess domain (Western Ukraine). *Quaternary International* 546, 196-215.
 1084 <https://doi.org/10.1016/j.quaint.2019.12.018>.
 1085 Haesaerts, P., 1993. Stratigraphie du gisement paléolithique de Mitoc Malul Galben (District
 1086 de Botoșani, Roumanie): étude préliminaire. *Préhistoire européenne* 3, 67-71.
 1087 Haesaerts, P., 2007. Mitoc-Malu Galben: Cadre stratigraphique et chronologique, in: Otte,
 1088 M., Chirica, V., Haesaerts, P. (Eds.), *L'Aurignacien et le Gravettien de Mitoc-Malu*
 1089 *Galben (Moldavie Roumaine)*. Université de Liège, Service de Préhistoire, Liège, pp. 15-
 1090 41.
 1091 Haesaerts, P., Bachner, M., Borziac, I., Chirica, V., Damblon, F., Drozdov, N., Kulakovska, L.,
 1092 Pirson, S., 2010b. New insight on the environmental background and the chronology of
 1093 the Early Upper Palaeolithic in Central Europe, in: Neugebauer-Maresch, C., Owen, L.
 1094 R. (Eds.), *New Aspects of the Central and Eastern European Upper Palaeolithic -*
 1095 *methods, chronology, technology and subsistence*. Verlag der Österreichischen
 1096 Akademie der Wissenschaften, Vienna, pp. 9-25.
 1097 Haesaerts, P., Damblon, F., Chirica, V., Noiret, P., Nigst, P.R., Kulakovska, L., Usik, V., 2018.
 1098 Données complémentaires relatives au paléoenvironnement et à la
 1099 chronostratigraphie de Mitoc-Malu Galben dans le contexte du Gravettien, in:
 1100 Țurcanu, S., Ursu, C.-E. (Eds.), *Materiality and Identity in Pre- and Protohistoric Europe*
 1101 *- Homage to Cornelia-Magda Lazarovici*. The Bucovina Museum Suceava - Karl A.
 1102 Romstorfer Publishing House, Suceava, pp. 61-74.
 1103 Haesaerts, P., Damblon, F., Gerasimenko, N. P., Stepanchuk, V. N., Cohen, V. Y., Kovalyukh,
 1104 N. N., 2014. Stratigraphy, palaeoenvironment and chronostratigraphic background of
 1105 the Mira succession (Zaporozhiye, central Ukraine), Midway between Carpathians and
 1106 Don, in: Otte, M., Le Brun-Ricalens, F. (Eds.), *Modes de contacts et de déplacements au*
 1107 *paléolithique eurasiatique: actes du Colloque international de la commission 8*
 1108 *(Paléolithique supérieur) de l'UISPP, Université de Liège, 28-31 mai 2012*. Université de
 1109 Liège, Liège, pp. 187-212.
 1110 Ivanova, I. K., Tzeitlin, S. M. (Eds.), 1987. *The Multilayered Paleolithic Site Molodova V: The*
 1111 *Stone Age Men and Environment*. Nauka: Moscow.
 1112 Jardón, P., Collin, F., 1993. Rapport d'étude tracéologique, Mitoc Malul Galben (novembre
 1113 1992). *Préhistoire européenne* 3, 73-75.
 1114 Kulakovska, L., Usik, V., Haesaerts, P., Ridush, B., Uthmeier, T., Hauck, T. C., 2015. Upper
 1115 Paleolithic of Middle Dniester: Doroshivtsi III site. *Quaternary International* 359, 347-
 1116 361. <https://doi.org/10.1016/j.quaint.2014.10.034>.
 1117 Lazarovici, C.-M., Lazarovici, G., Trnka, G., 2018. Flint sources in the Middle Prut area, in:
 1118 Lazarovici, C.-M., Berzovan, A. (Eds.), *Quaestiones Praehistoricae. Studia in Honorem*
 1119 *Vasile Chirica*. Academiei Române & Ed. Istros, București & Brăila, pp. 177-196.
 1120 Lengyel, G., 2015. Lithic raw material procurement at Bodrogkeresztúr-Henye Gravettian
 1121 site, northeast Hungary. *Quaternary International* 359-360, 292-303.
 1122 <https://doi.org/10.1016/j.quaint.2014.07.027>.
 1123 Lengyel, G., 2018. Lithic analysis of the Middle and Late Upper Palaeolithic in Hungary. *Folia*
 1124 *Quaternaria* 2018(2018), 5-157.

1125 Lengyel, G., Mester, Z., Szolyák, P., 2016. The Late Gravettian and Szeleta Cave, northeast
 1126 Hungary. *Quaternary International* 406, 174-183.
 1127 <https://doi.org/10.1016/j.quaint.2015.09.014>.
 1128 Lengyel, G., Wilczyński, J., 2017. The Gravettian and the Epigravettian chronology in eastern
 1129 central Europe: A comment on Böskén et al. (2017). *Palaeogeography,*
 1130 *Palaeoclimatology, Palaeoecology* <https://doi.org/10.1016/j.palaeo.2017.11.017>.
 1131 Libois, T., 2017. Mitoc – Malu Galben (Roumanie) : Analyse par attributs des ensembles
 1132 lithiques Aurignaciens et Gravettiens issus des fouilles 2013-2016 et intégration des
 1133 données dans une approche comparative multiscalaire. Dissertation, Université de
 1134 Liège.
 1135 Libois, T., Bodi, G., Nigst, P. R., Noiret, P., 2017. Mitoc-Malu Galben (Roumanie): Quelques
 1136 aspects de la technologie lithique Gravettienne, in: Chirica, V., Ichim, C. (Eds.), *Les*
 1137 *Gravettiens: Leur Creation Materielle et Spirituelle*. editura pim, Iasi, pp. 78-105.
 1138 Libois, T., Nigst, P. R., Haesaerts, P., Bosch, M.D., Murphree, W.C., Branscombe, T., Noiret,
 1139 P., 2018. 40 ans des recherches avec Vasile Chirica : Mitoc-Malu Galben, in: Lazarovici,
 1140 C. M., Berzovan, A. (Eds.), *Quaestiones Praehistoricae. Studia in honorem Professoris*
 1141 *Vasile Chirica*. Editura Academiei Române - Editura Istros, Bucarest and Brăila, pp. 53-
 1142 74.
 1143 Lisitsyn, S., 2015. The late Gravettian of Borshevo 5 in the context of the Kostenki-Borshevo
 1144 sites (Don basin, Russia). *Quaternary International* 359-360, 372-383.
 1145 <https://doi.org/10.1016/j.quaint.2014.10.043>.
 1146 López Bayón, I., Gautier, A., 2007. Mitoc Malu-Galben: analyse archéozoologique des
 1147 ateliers de taille, in: Otte, M., Chirica, V., Haesaerts, P. (Eds.), *L'Aurignacien et le*
 1148 *Gravettien de Mitoc-Malu Galben (Moldavie Roumaine)*. Université de Liège, Liège, pp.
 1149 145-166.
 1150 Lyman, R. L., 2008. *Quantitative paleozoology*, Cambridge University Press, Cambridge.
 1151 McPherron, S. P., 2005. Artifact orientations and site formation processes from total station
 1152 proveniences. *Journal of Archaeological Science* 32(7), 1003 - 1014.
 1153 <https://doi.org/10.1016/j.jas.2005.01.015>.
 1154 McPherron, S. P., Dibble, H. L., 2002. *Using Computers in Archaeology: A Practical Guide*,
 1155 McGraw-Hill, Boston.
 1156 McPherron, S. P., 2018. Additional statistical and graphical methods for analyzing site
 1157 formation processes using artifact orientations. *PLoS One* 13(1), e0190195.
 1158 <https://doi.org/10.1371/journal.pone.0190195>.
 1159 Moreau, L., Ciornei, A., Gjesfjeld, E., Filzmoser, P., Gibson, S. A., Day, J., Nigst, P. R., Noiret,
 1160 P., Macleod, R. A., Niță, L., 2019. First Geochemical 'Fingerprinting' of Balkan and Prut
 1161 Flint from Palaeolithic Romania: Potentials, Limitations and Future Directions.
 1162 *Archaeometry* 61(3), 521-538. <https://doi.org/10.1111/arcm.12433>.
 1163 Moreau, L., 2009. Geißenklösterle. Das Gravettien der Schwäbischen Alb im europäischen
 1164 Kontext, Kerns Verlag, Tübingen.
 1165 Moreau, L., 2010. Geißenklösterle. The Swabian Gravettian in its European context. *Quartär*
 1166 57, 79-93.
 1167 Moreau, L., 2012. Le Gravettien ancien d'Europe centrale revisité : mise au point et
 1168 perspectives. *L'Anthropologie* 116(5), 609 - 638.
 1169 <https://doi.org/10.1016/j.anthro.2011.10.002>.

- 1170 Moroşan, N. N., 1938. Le Pléistocène et la Paléolithique de la Roumanie du Nord-Est (les
1171 dépôts géologiques, leur faune, flore et produits d'industrie), Institutului Geologic al
1172 României, Bucureşti.
- 1173 Murphree, W. C., 2017. Examining Site Formation Processes through the Analysis of Small
1174 Fraction Materials. Dissertation, University of Cambridge.
- 1175 Necrasov, O., Ştirbu, M., 1987. Sur les faunes paléolithiques du nord-est de la Roumanie, in:
1176 La genèse et l'évolution des cultures paléolithiques sur le territoire de la Roumanie,
1177 Actes de la Session scientifique de Iaşi–Botoşani (22-25 octobre 1985). Iaşi, pp. 105-
1178 111.
- 1179 Neugebauer-Maresch, C., 2008. Galgenberg-Stratzing/Krems-Rehberg and its 32,000 years
1180 old female statuette. Wissenschaftliche Mitteilungen aus dem Niederösterreichischen
1181 Landesmuseum 19, 119-128.
- 1182 Nigst, P. R., 2012. The Early Upper Palaeolithic of the Middle Danube Region, Leiden
1183 University Press, Leiden.
- 1184 Nigst, P. P., Haesaerts, P., Damblon, F., Frank-Fellner, C., Mallol, C., Viola, B., Götzinger, M.,
1185 Niven, L., Trnka, G., Hublin, J.-J., 2014. Early modern human settlement of Europe
1186 north of the Alps occurred 43,500 years ago in a cold steppe-type environment.
1187 Proceedings of the National Academy of Sciences 111(40), 14394-14399.
1188 <https://doi.org/10.1073/pnas.1412201111>.
- 1189 Nigst, P. R., Bosch, M. D., in press. Exploring diversity of hunter-gatherer behaviour in the
1190 European Mid-Upper Palaeolithic: The Gravettian assemblages of Willendorf II and
1191 Mitoc-Malu Galben as case studies, in: Goutas, N., Salomon, H., Touzé, O., Noiret, P.
1192 (Eds.), North-Western Europe during the Gravettian - Contributions of recent research
1193 to the understanding of the societies and their environment., pp.
- 1194 Nigst, P. R., Libois, T., Branscombe, T., Bosch, M. D., Haesaerts, P., Chirica, V., Noiret, P., in
1195 press. New fieldwork at Mitoc-Malu Galben (Romania): An overview of the 2013 to
1196 2016 excavations, in: Lengyel, G., Wilczyński, J. (Eds.), The Upper Palaeolithic research
1197 in Central and Eastern Europe. Archaeopress, Oxford, pp.
- 1198 Niţu, E. C., Cărciumaru, M., Nicolae, A., Cîrstina, O., Lupu, F. I., Leu, M., 2019. Mobility and
1199 social identity in the Mid Upper Paleolithic: New personal ornaments from Poiana
1200 Cireşului (Piatra Neamţ, Romania). PLoS One 14(4), e0214932.
1201 <https://doi.org/10.1371/journal.pone.0214932>.
- 1202 Noiret, P., 2004. Le Paléolithique supérieur de la Moldavie. L'Anthropologie 108, 425-470.
- 1203 Noiret, P., 2005. Productions lamellaires aurignaciennes à l'est des Carpates, in: Le Brun-
1204 Ricalens, F. (Ed.), Productions lamellaires attribuées à l'Aurignacien. Chaînes
1205 opératoires et perspectives technoculturelles, Actes du Colloque 6.7 du XIVe Congrès
1206 international de l'UISPP (Liège, 2-8 septembre 2001). Musée national d'Histoire et
1207 d'Art, Luxembourg, pp. 439-462.
- 1208 Noiret, P., 2007. Le Gravettien de Moldavie (30 000 - 23 000 BP). Paléo 19, 159-180.
- 1209 Noiret, P., Chirica, V., Haesaerts, P., Vornicu, D.-M., Bodi, G., Branscombe, T., Libois, T.,
1210 Bosch, M. D., Nigst, P. R., 2016. Nouvelles recherches de terrain à Mitoc-Malu Galben
1211 2013-2015, in: Cirica, V., Ichim, C. (Eds.), Les Aurignaciens. Leur création matérielle et
1212 spirituelle. Actes du colloque international de Iasi (28-31 janvier 2016). Editura Cetatea
1213 de Scaun, Targoviste, pp. 13-49.
- 1214 Otte, M., Chirica, V., 1993. Atelier aurignacien à Mitoc Malul Galben (Moldavie roumaine).
1215 Préhistoire européenne 3, 55-66.

1216 Otte, M., López Bayón, I., Noiret, P., Borziac, I. A., Chirica, V., 1996a. Recherches sur le
 1217 Paléolithique supérieur de la Moldavie. *Bulletin de la Société royale belge*
 1218 *Anthropologie et Préhistoire* 107, 45-80.
 1219 Otte, M., Noiret, P., 2003. L'Europe gravettienne, in: Desbrosse, R., Thévenin, A. (Eds.),
 1220 *Préhistoire de l'Europe. Des origines à l'âge du Bronze*, Actes du 125e Congrès national
 1221 des Sociétés historiques et scientifiques (Lille, 2000). CTHS, Paris, pp. 227-239.
 1222 Otte, M., Noiret, P., Chirica, V., Borziac, I. A., 1996b. Rythme évolutif du Gravettien oriental,
 1223 in: Montet-White, A., Palma di Cesnola, A., Valoch, K. (Eds.), *The Upper Palaeolithic.*
 1224 *Colloquium XII: The Origin of the Gravettian.*, pp. 213-226.
 1225 Otte, M., Chirica, V., Haesaerts, P. (Eds.), 2007. *L'Aurignacien et le Gravettien de Mitoc-*
 1226 *Malu Galben (Moldavie Roumaine)*. Université de Liège: Liège.
 1227 Patefield, W. M., 1981. Algorithm AS 159: An Efficient Method of Generating Random $R \times C$
 1228 Tables with Given Row and Column Totals. *Journal of the Royal Statistical Society.*
 1229 *Series C (Applied Statistics)* 30(1), 91-97. <https://doi.org/10.2307/2346669>.
 1230 R Core Team, 2020. R: A language and environment for statistical computing. R Foundation
 1231 for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
 1232 Rasmussen, S. O., Bigler, M., Blockley, S. P., Blunier, T., Buchardt, S. L., Clausen, H. B.,
 1233 Cvijanovic, I., Dahl-Jensen, D., Johnsen, S. J., Fischer, H., Gkinis, V., Guillevic, M., Hoek,
 1234 W. Z., Lowe, J. J., Pedro, J. B., Popp, T., Seierstad, I. K., Steffensen, J. P., Svensson, A.
 1235 M., Vallenga, P., Vinther, B. M., Walker, M. J.C., Wheatley, J. J., Winstrup, M., 2014. A
 1236 stratigraphic framework for abrupt climatic changes during the Last Glacial period
 1237 based on three synchronized Greenland ice-core records: refining and extending the
 1238 INTIMATE event stratigraphy. *Quaternary Science Reviews* 106, 14-28.
 1239 <https://doi.org/10.1016/j.quascirev.2014.09.007>.
 1240 Reynolds, N., Hicham, T. F. G., Lisitsyn, S. N., Sablin, M. V., Barton, N., 2015. Chronology of
 1241 the European Russian Gravettian: new radiocarbon dating results and interpretation.
 1242 *Quartär* 62, 121-132.
 1243 Salomon, H., 2009. *Les matières colorantes au début du Paléolithique supérieur : sources,*
 1244 *transformations et fonctions*, PhD thesis, Université de Bordeaux I, Bordeaux.
 1245 Schmid, V. C., Bosch, M. D., Brandl, M., Götzinger, M., Nigst, P. R., 2019. Neue Einblicke in
 1246 das Gravettien von Willendorf II. Die Steinartefakte der Grabung 1993. *Archaeologia*
 1247 *Austriaca* Band 103, 11-73. <https://doi.org/10.1553/archaeologia103s11>.
 1248 Simionescu, T., 1987. Nouvelles espèces de gastéropodes dans la terrasse pléistocène du
 1249 Prut de Malu Galben–Mitoc (Départ. de Botoșani), in: Chirica, V. (Ed.), *La genèse et*
 1250 *l'évolution des cultures paléolithiques sur le territoire de la Roumanie*, Actes de la
 1251 Session scientifique de Iași–Botoșani (22-25 octobre 1985). Iași, pp. 113-122.
 1252 Sinitsyn, A. A., 1996. Kostenki 14 (Markina Gora): Data, Problems, and Perspectives.
 1253 *Préhistoire Européenne* 9, 273-313.
 1254 Sinitsyn, A. A., 2010. The Early Upper Palaeolithic of Kostenki: Chronology, Taxonomy, and
 1255 Cultural Affiliations, in: Neugebauer-Maresch, C., Owen, L.R. (Eds.), *New aspects of the*
 1256 *Central and Eastern European Upper Palaeolithic - methods, chronology, technology*
 1257 *and subsistence*. Österreichische Akademie der Wissenschaften, pp. 27-48.
 1258 Sinitsyn, A. A., 2015. Perspectives on the Palaeolithic of Eurasia: Kostenki and related sites,
 1259 in: Sanz, N. (Ed.), *Human Origin Sites and the World Heritage Convention in Eurasia*.
 1260 United Nations Educational, Scientific and Cultural Organization, Paris and Mexico City,
 1261 pp. 163-189.

- Stiner, M. C., Kuhn, S. L., Weiner, S., Bar-Yosef, O., 1995. Differential Burning, Recrystallization, and Fragmentation of Archaeological Bone. *Journal of Archaeological Science* 22(2), 223-237. <https://doi.org/10.1006/jasc.1995.0024>.
- Svoboda, J. A., Klíma, B., Jarosová, L., Škrdl, P., 1999. The Gravettian in Moravia: climate, behaviour and technological complexity, in: Roebroeks, W., Mussi, M., Svoboda, J., Fennema, K. (Eds.), *Hunters of the Golden Age: The Mid Upper Palaeolithic of Eurasia 30,000-20,000 BP*.(31). University of Leiden, pp. 197-217.
- Svoboda, J. A., Sedláčková, L., 2004. The Gravettian along the Danube, *Proceedings of the Mikulov Conference*, 20.-21. November, 2002, Czech Academy of Sciences, Brno.
- Svoboda, J. A., 2007. The gravettian on the middle Danube. *PALEO* 19, 203-220.
- Văleanu, M.-C., 2015. The occurrence of flint in north-eastern Romania in the context of local prehistoric habitations. *Annales d'Université Valahia Targoviste (Section d'Archéologie et d'Histoire)* XVII, 7-50.
- Van Vliet-Lanoë, B., 1985. Frost effects in soils, in: Boardman, J. (Ed.), *Soils and Quaternary landscape evolution*. Wiley, New York, pp. 117-158.
- Wilczyński, J., Goslar, T., Wojtal, P., Oliva, M., Göhlich, U. B., Antl-Weiser, W., Šída, P., Verpoorte, A., Lengyel, G., 2020. New Radiocarbon Dates for the Late Gravettian in Eastern Central Europe. *Radiocarbon* 62(1), 243-259. <https://doi.org/10.1017/rdc.2019.111>.

Figure Captions

Figure 1: Map showing the location of Willendorf II (1), Molodova V (2), Cosautsi (3), Dorochivtsi III (4), and Mitoc-Malu Galben (5). Graphic: Philip R Nigst. Basemap and rivers: HYDRO1K dataset from U.S. Geological Survey Earth Resources Observation and Science (EROS) Center, doi: [10.5066/F77P8WN0](https://doi.org/10.5066/F77P8WN0).

Figure 2: Location of Mitoc-Malu Galben in the Ghireni ravine, close to the main Prut river valley. Graphic: Philip R Nigst. Image from Google Maps [accessed 29 April 2020: <https://www.google.com/maps/place/Mitoc,+Romania/@48.0957495,27.0224763,1151m/data=!3m1!1e3!4m5!3m4!1s0x473362017c791181:0x1957b68eea174124!8m2!3d48.1009863!4d26.9890442>].

Figure 3: Mitoc-Malu Galben: Stratigraphic sequence, radiocarbon dates (in ka uncal BP), occurrence of archaeological assemblages, environmental reconstruction, interstadials, organic matter content. Graphic symbols: 1) loess; 2) loam; 3) silty sand; 4) sand; 5) strong humic horizon; 6) weak humic horizon; 7) yellowish brown bioturbated horizon; 8) krotovinas; 9) bleached horizon (tundra gley); 10) iron staining; 11) frost wedge; 12) Aurignacian; 13) poorly documented Upper Palaeolithic; 14) Gravettian; 14) Late Gravettian; 16) poorly documented Upper Palaeolithic. Abbreviations: ¹⁴C: radiocarbon dates in ka uncal BP; Arch.: archaeology; P: periglacial, with deep frost or permafrost conditions (very cold); A: arctic (cold); SA: subarctic (medium cold); B: boreal; Interst.: interstadials; Org. Mat.: Organic Matter Content. Graphic: Paul Haesaerts.

Figure 4: Mitoc-Malu Galben: Excavation in 1992 (1) and 2013 (2). Photos: Pierre Noiret.

Figure 5: Mitoc-Malu Galben: Map of the site in local coordinate system. Squares shown after Otte et al. (2007). Trenches are colour coded by year: red: 2013, green: 2014, blue: 2015, orange: 2016. GIS & Graphic: Philip R Nigst.

Figure 6: Mitoc-Malu Galben, northern wall of the excavation covering square columns 9 to 4. Graphic symbols: see Figure 3. Graphic: Paul Haesaerts.

Figure 7: Mitoc-Malu Galben, northern area (Trenches 13-A, 14-B, and 16-A): vertical distribution of all piece-plotted archaeological objects (colour-coded by stratigraphic units). GIS & Graphic: Philip R Nigst.

Figure 8: Mitoc-Malu Galben, SU 9a, southern area (Trench 15-A): Selection of bladelets and bladelet fragments. Graphic: Timothée Libois.

Figure 9: Mitoc-Malu Galben, SU 11a, southwestern area (Trenches 14-A, 15-B, and 16-B): Examples of blades (1-5), bladelets (6, 7) and core tablet (8). Graphic: Timothée Libois.

Figure 10: Mitoc-Malu Galben, SU 7a, northern area (Trenches 13-A, 14-B, and 16-A): Examples of blade (1-4) and bladelet (5) fragments. Graphic: Timothée Libois.

1331 Figure 11: Mitoc-Malu Galben, SU 7a, northern area (Trenches 13-A, 14-B, and 16-A):
1332 Examples of blade cores. Graphic: Timothée Libois.

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1334 Figure 12: Mitoc-Malu Galben, SU 6c, northern area (Trenches 13-A, 14-B, and 16-A):
1335 Selected lithic artefacts: 1, 2: cores. 3: core tablet. 4, 5: blades. 6-8: bladelets. Graphic:
1336 Timothée Libois.

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Tables and Table captions

Table 1: Mitoc-Malu Galben excavations 2013 - 2016: List of geological/stratigraphical and archaeological trenches per excavation year.

Excavation year	Archaeological	
	trenches	Geological/stratigraphic trenches
2013	13-A	13-1
		13-2
		13-3
		13-4
		13-5
		13-6
		13-7
		13-8
		13-9
		13-10
		13-11
		13-12
		13-13
2014	14-A	-
	14-B	
2015	15-A	-
	15-B	
2016	16-A	16-1
	16-B	16-2

1347 Table 2: Mitoc-Malu Galben, northern excavation area: archaeological objects per
1348 stratigraphic unit.

SU	bone	charcoal	lithic	ochre	stone	total
5c	0	0	8	0	0	8
6a	1	1	14	0	0	16
6b	0	0	46	0	0	46
6c	14	20	1520	0	8	1562
7a	0	0	642	2	0	644
8a	0	0	2	0	0	2
9a	0	0	1	0	0	1
9b	0	0	204	0	0	204
10a	0	0	1	0	0	1
10b	0	0	2	0	0	2
11b	12	55	41	2	2	112
total	27	76	2481	4	10	2598

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1351 Table 3: Mitoc-Malu Galben, southern excavation area: archaeological objects per
1352 stratigraphic unit.

SU	bone	charcoal	lithic	ochre	stone	total
7b	0	0	1	0	0	1
8b	0	9	20	0	1	30
9a	1	27	404	1	0	433
9b	5	1	2	0	0	8
10b	0	0	2	0	0	2
total	6	37	429	1	1	474

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1355 Table 4: Mitoc-Malu Galben, southwestern excavation area: archaeological objects per
1356 stratigraphic unit.

SU	bone	charcoal	lithic	stone	total
9b	0	0	3	0	3
10a	0	0	11	1	12
10b	1	0	181	10	192
11a	1	3	2599	35	2638
11b	0	0	48	35	83
total	2	3	2842	81	2928

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1360 Table 5: Mitoc-Malu Galben, northeastern excavation area: archaeological objects per
1361 stratigraphic unit.

SU	charcoal	lithic	ochre	total
4a	0	21	0	21
5c	0	1	0	1
6c	2	33	1	36
total	2	55	1	58

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1364 Table 6: Mitoc-Malu Galben, SU 7a und SU 6c: absolute and relative frequencies of
 1365 dataclasses.

dataclass	SU 7a		SU 6c	
	n	%	n	%
< 10 mm Fragment	3	0.47	1	0.07
Blade	21	3.27	144	9.47
Bladelet	16	2.49	71	4.67
Burin spall	1	0.16	6	0.39
Chip	42	6.54	61	4.01
Core	4	0.62	11	0.72
Core maintenance flake	1	0.16	7	0.46
Core shatter	2	0.31	2	0.13
Core tablet	1	0.16	7	0.46
Crested blade	5	0.78	16	1.05
Crested bladelet	-	-	6	0.39
Crested flake	5	0.78	21	1.38
Flake	427	66.51	995	65.46
Shatter	114	17.76	170	11.18
Thermal shatter	-	-	2	0.13
total	642	100.00	1520	100.00

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1369 Table 7: Mitoc-Malu Galben, SU 7a and SU 6c: Count and Weight per raw material group.

RMG	SU 7a				SU 6c			
	count		weight		count		weight	
	n	%	g	%	n	%	g	%
black	359	55.92	2792.94	62.75	1030	67.76	8237.88	74.78
grey	96	14.95	453.13	10.18	205	13.49	1647.24	14.95
grey-translucent	161	25.08	1152.84	25.90	220	14.47	942.34	8.55
n/a	26	4.05	51.73	1.16	65	4.28	188.84	1.71
total	642	100.00	4450.64	100.00	1520	100.00	11016.30	100.00

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1372 Table 8: Mitoc-Malu Galben, SU 7a and SU 6c: Absolute and relative frequencies of cortex
1373 percentage groups for each raw material group.

corte x	SU 7a								SU 6c							
	black		grey		grey- translucent		Total		black		grey		grey- translucent		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0%	22	62.12	6	71.88	83	51.55	37	60.88	724	70.29	17	85.85	14	65.91	104	71.82
	3		9				5				6		5		5	
1- 33%	89	24.79	2	22.92	54	33.54	16	26.79	220	21.36	21	10.24	48	21.82	289	19.86
			2				5									
33- 66%	25	6.96	1	1.04	11	6.83	37	6.01	44	4.27	3	1.46	15	6.82	62	4.26
66- 99%	16	4.46	4	4.17	10	6.21	30	4.87	22	2.14	3	1.46	9	4.09	34	2.34
100%	6	1.67	0	0.00	3	1.86	9	1.46	20	1.94	2	0.98	3	1.36	25	1.72
total	35	100.0	9	100.0	16	100.0	61	100.0	103	100.0	20	100.0	22	100.0	145	100.0
	9	0	6	0	1	0	6	0	0	0	5	0	0	0	5	0

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Table 9: Mitoc-Malu Galben, SU 7a: Absolute and relative frequencies of cortex percentage groups for each dataclass.

	< 10 mm Fragm ent		Blade		Bladele t		Burin spall		Chip		Core		Core mainten ance flake		Core shatte r		Core tablet		Creste d blade		Creste d flake		Flake		Shatter		total	
cor tex	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0%	3	100.00	14	66.67	16	100.00	11	100.00	31	73.81	0	0.00	0	0.00	0	0.00	1	100.00	4	80.00	1	20.00	64	61.83	40	45.45	375	60.88
1-33%	0	0.00	7	33.33	0	0.00	0	0.00	8	19.05	4	100.00	1	100.00	2	100.00	0	0.00	1	20.00	4	80.00	16	27.17	22	25.00	165	26.79
33-66%	0	0.00	0	0.00	0	0.00	0	0.00	2	4.76	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	24	5.62	11	12.50	37	6.01
66-99%	0	0.00	0	0.00	0	0.00	0	0.00	1	2.38	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	17	3.98	12	13.64	30	4.87
100%	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	6	1.41	3	3.41	9	1.46
total	3	100.00	21	100.00	16	100.00	11	100.00	42	100.00	4	100.00	1	100.00	2	100.00	1	100.00	5	100.00	5	100.00	47	100.00	88	100.00	616	100.00

Table 10: Mitoc-Malu Galben, SU 7a: Absolute and relative frequencies of platform types of complete flakes and proximal flake fragments.

	Crested flake	Flake	total	total %
cortical	0	19	19	6.83
dihedral	1	13	14	5.04
faceted	0	3	3	1.08
indeterminable	0	17	17	6.12
joint surface	0	6	6	2.16
linear ridge	0	51	51	18.35
plain	1	108	109	39.21
punctiform	0	30	30	10.79
splittered out	0	29	29	10.43
total	2	276	278	100.00

Table 11: Mitoc-Malu Galben, SU 6c: Absolute and relative frequencies of cortex percentage groups for each dataclass.

cortex	< 10 mm Fragment		Blade		Bladelet		Burin spall		Chip		Core		Core maintenance flake		Core shatter		Core tablet		Crested blade		Crested bladelet		Crested flake		Flake		Shatter		Thermal shatter		total		
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
0-1-3-3-6-6-9-9-10																																1	
		10	1	77		94		10		78		27			50		57		75		83		76		7	71		55			0	71	
		0.	0	.1	6	.3		0.	4	.3		.2		85.		.0		.1	1	.0		.3		1	.1	0	.2	6	.3		0.	4	.8
	%	1	00	8	4	7	7	6	00	7	3	3	7	6	71	1	0	4	4	2	0	5	3	6	9	2	7	7	7	0	00	5	2
					20					15		54			50		42		25		16		23		2	20		20				2	19
		0.	2	.0		5.		0.		.0		.5		14.		.0		.8		.0		.6		.8	0	.5	2	.6		0.	8	.8	
%	0	00	8	0	4	63	0	00	9	0	6	5	1	29	1	0	3	6	4	0	1	7	5	1	2	1	5	6	0	00	9	6	
																															10		
		0.		2.		0.		0.		3.		9.		0.0		0.		0.		0.		0.		0.	4	4.	1	9.		0.	6	4.	
%	0	00	3	14	0	00	0	00	2	33	1	09	0	0	0	00	0	00	0	00	0	00	0	00	4	47	1	09	1	00	2	26	
																															10		
		0.		0.		0.		0.		3.		9.		0.0		0.		0.		0.		0.		0.	1	1.	1	.7		0.	3	2.	
%	0	00	1	71	0	00	0	00	2	33	1	09	0	0	0	00	0	00	0	00	0	00	0	00	7	73	3	4	0	00	4	34	
		0.		0.		0.		0.		0.		0.		0.0		0.		0.		0.		0.		0.	2	2.		4.		0.	2	1.	
%	0	00	0	00	0	00	0	00	0	00	0	00	0	0	0	00	0	00	0	00	0	00	0	00	0	03	5	13	0	00	5	72	

0
%

																												1		
to	10	1	10		10		10		10				10	10		10		10	9	10	1	10		10	4	10				
ta	0.	4	0.	7	0.		0.	6	0.	1	0.		100	0.	0.	1	0.		0.	2	0.	8	0.	2	0.		0.	5	0.	
l	1	00	0	00	1	00	6	00	0	00	1	00	7	.00	2	00	7	00	6	00	6	00	1	00	5	00	1	00	5	00

Table 12: Mitoc-Malu Galben, SU 6c: Absolute and relative frequencies of platform types for flakes, blades and bladelets.

Platform type	Flakes		Blades		Bladelets	
	n	%	n	%	n	%
Chapeau de Gendarme	2	0.28	-	-	-	-
cortical	54	7.52	3	3.00	-	-
dihedral	50	6.96	7	7.00	-	-
faceted	41	5.71	6	6.00	-	-
jointSurface	16	2.23	1	1.00	-	-
linearRidge	90	12.53	17	17.00	7	17.50
plain	273	38.02	44	44.00	10	25.00
punctiform	81	11.28	11	11.00	18	45.00
damaged	62	8.64	9	9.00	3	7.50
indeterminable	49	6.82	2	2.00	2	5.00
total	718	100	100	100.00	40	100.00

Table 13: Mitoc-Malu Galben, SU 6c and SU 7a: absolute and relative frequencies of joint planes on lithic artefacts and shattered pieces.

SU	n lithics	n lithics with joint plane	% lithics with joint plane	n shatter	% shatter
6c	1522	164	10.78	170	11.17
7a	642	63	9.81	114	17.76

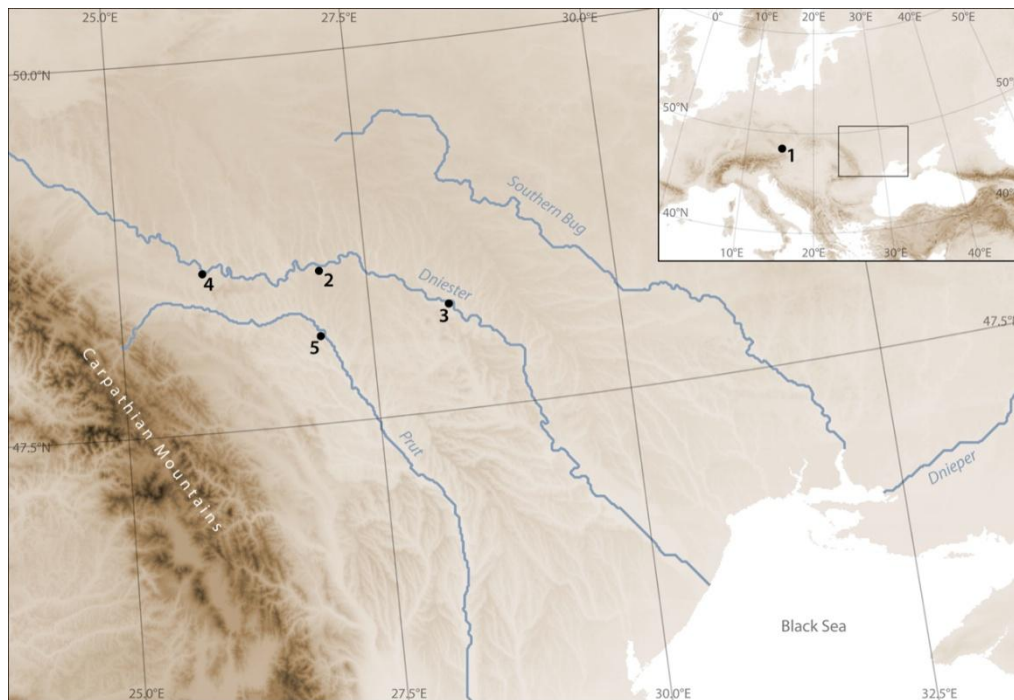


Figure 1



Figure 2

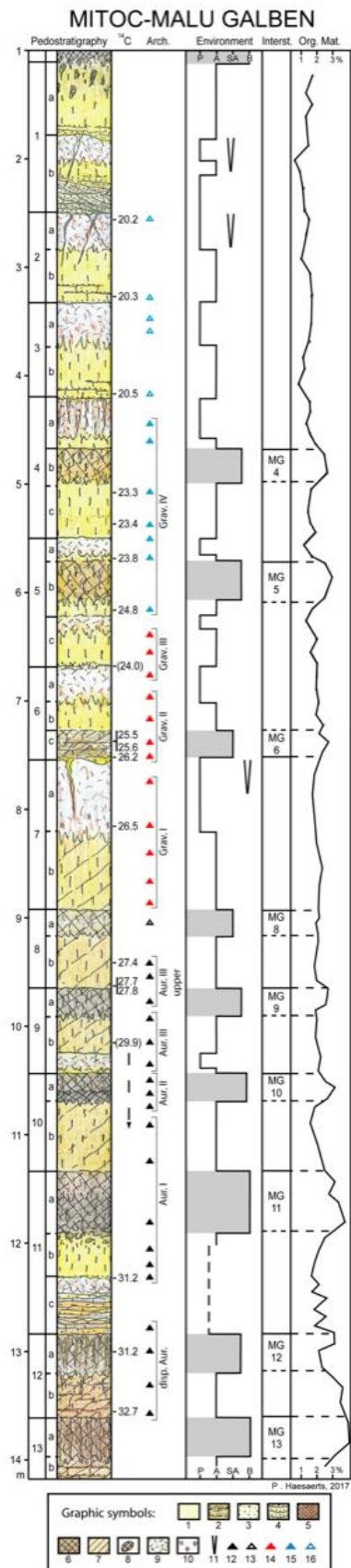


Figure 3



Figure 4

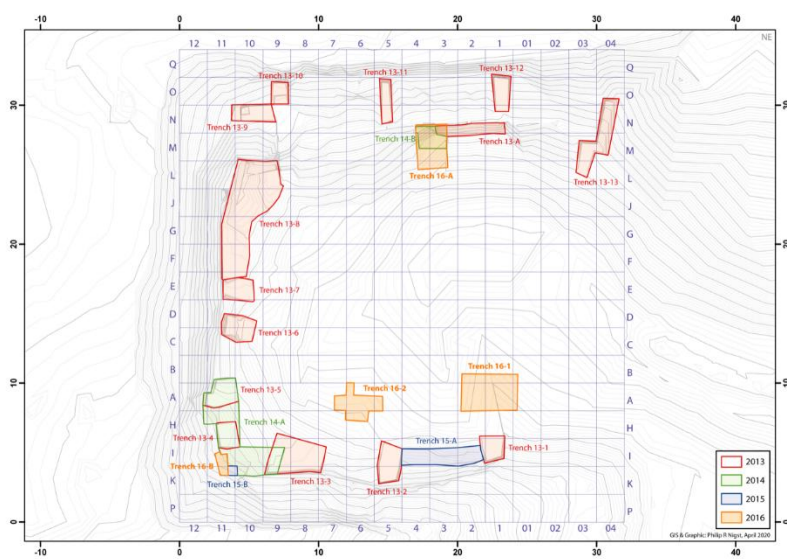


Figure 5

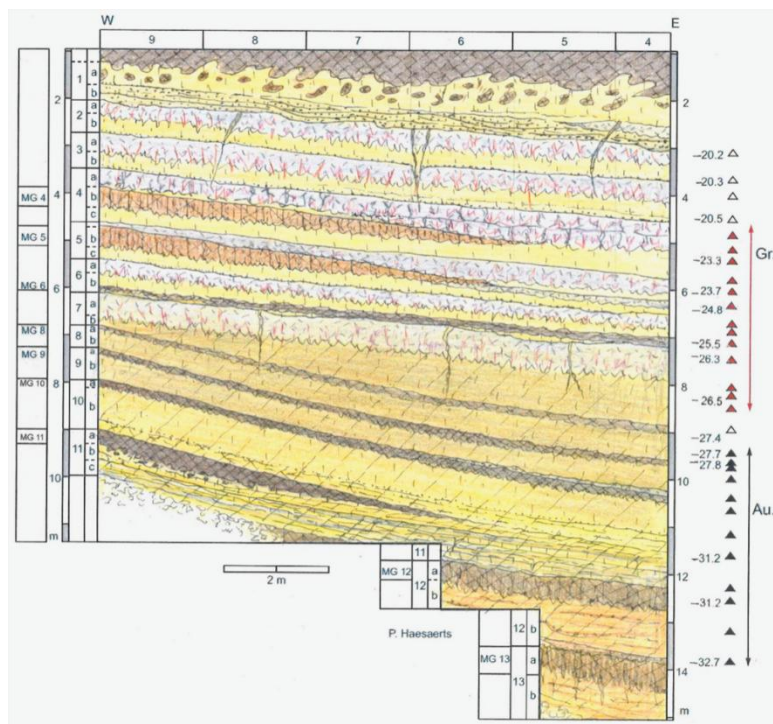


Figure 6

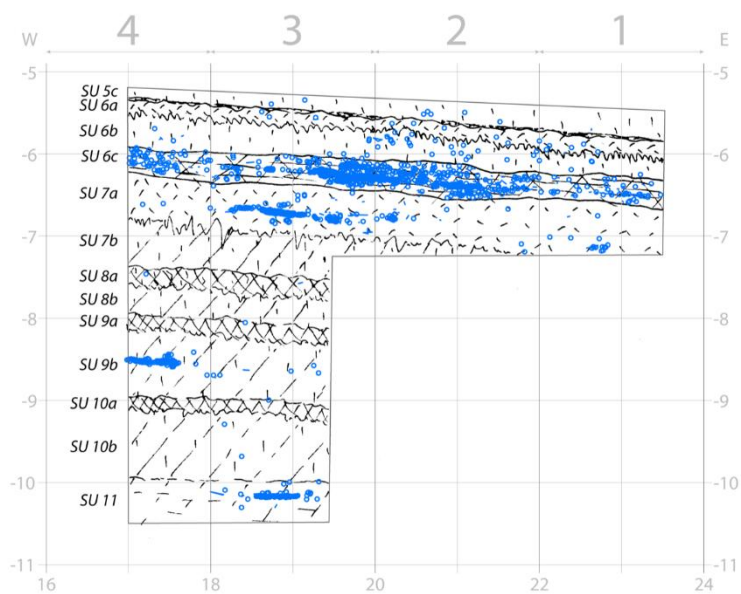


Figure 7

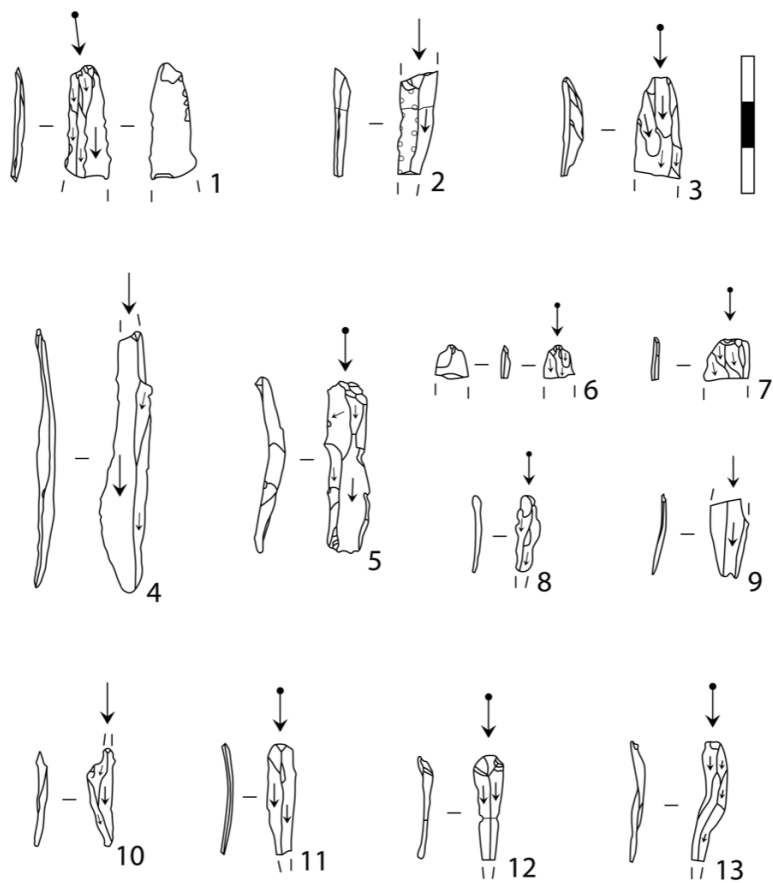


Figure 8

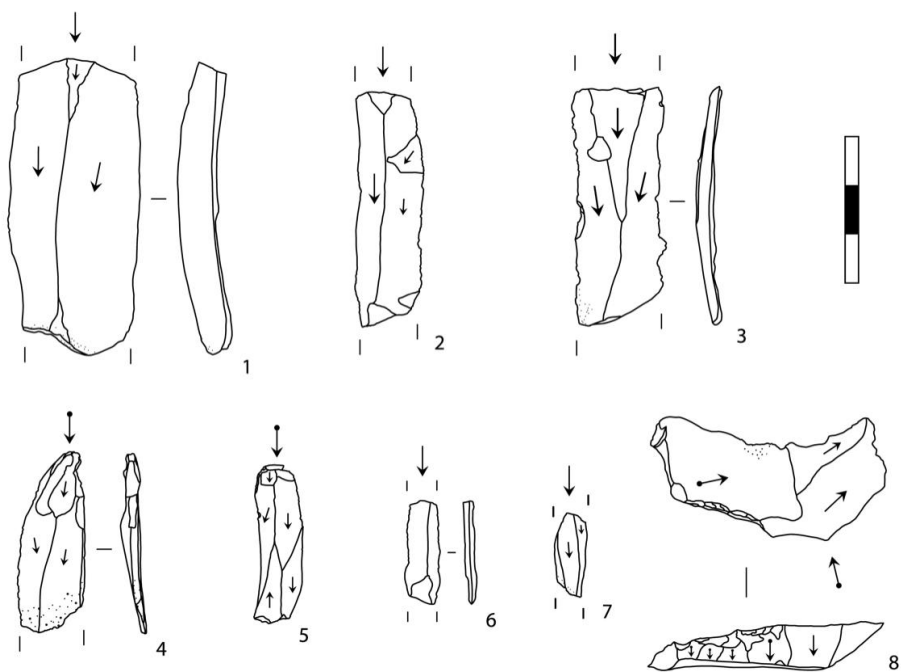


Figure 9

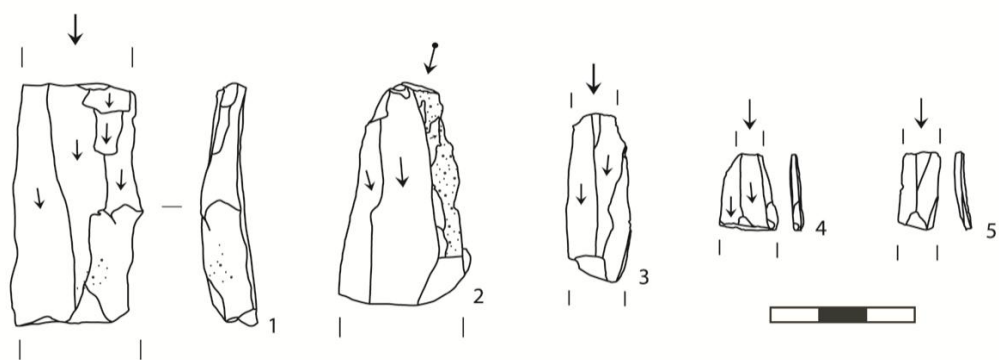


Figure 10

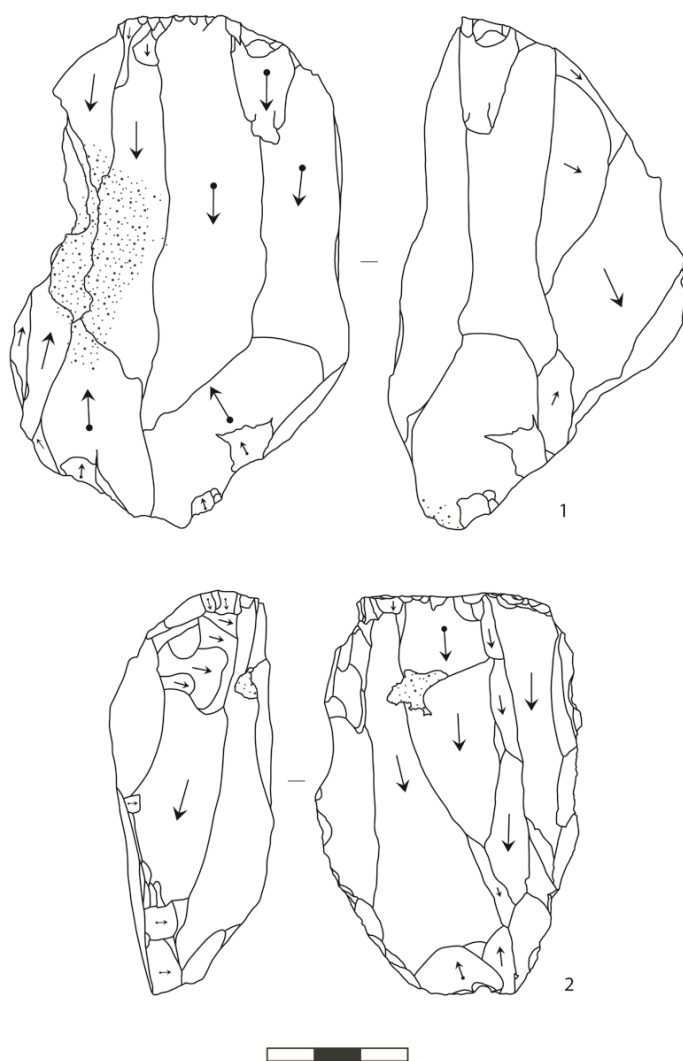


Figure 11

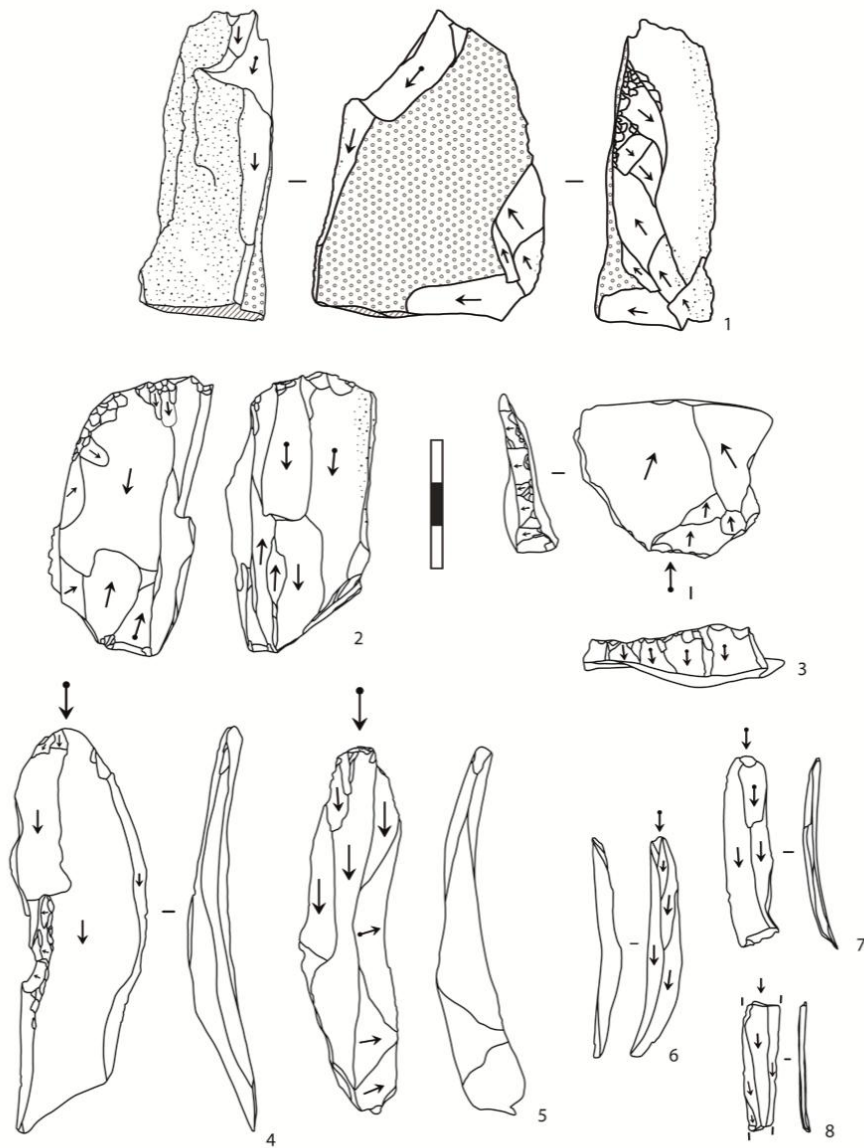


Figure 12

Appendix A – Supplementary Information

The Mid-Upper Palaeolithic (Gravettian) sequence of Mitoc-Malu Galben (Romania): New fieldwork between 2013 and 2016 - preliminary results and perspectives

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Appendix A1: Relocating the previous excavations' square system and height - continuity with the old excavations

A key task of our first excavation season in July 2013 was the relocation of the square system and altitude used by the previous research at the site to help with comparisons between the old collections and our newly generated assemblages. The altitude used as zero by previous fieldworkers at Mitoc-Malu Galben differs between research teams. Between 1978 and 1990 V. Chirica used a different altitude as zero than P. Haesaerts between 1990 and 1995, and the team of M. Otte and P. Noiret between 1992 and 1995. All three altitude systems are mentioned by Otte et al. (2007) in the site monograph. We selected the altitude used by Haesaerts as the preferred system for our fieldwork because of its precise linkage with the stratigraphic, palaeoenvironmental, and chronological record generated by Haesaerts and Damblon. The square system did not change between the various previous excavations/fieldwork.

At the start of our 2013 fieldwork season both the exact position of the square system - consisting of 2 by 2 metres squares labelled with numbers in west-east direction and by letters in south-north direction - and the altitude were relocated by exposing old sections (part of the north and south sections of the site), which still showed marks (drawing lines, wooden datums marking square boundaries and/or altitude, i.e. points of which X-, Y-, and/or Z-coordinates were known) of the last excavations about 18 years earlier. In addition, we used the position of the outline of the interface of the Holocene pits in the upper part of the west section as well as the position of older trenches along the west section to relocate the square boundaries in south-north direction. Through this process we were able to set up a new excavation grid (squares) and height that matches precisely the X- and Y-coordinates by the Chirica/Otte/Noiret-grid and the Z-coordinates by Haesaerts, ensuring compatibility with the information as published in Otte et al. (2007).

During our fieldwork we installed new datums first in 2013 and expanded the system in the subsequent excavation years. Our new datums are normally located at the base or the lower part of the sections of the trenches excavated by our team to ensure longest preservation even if the upperpart of the sections should erode in the future. Our datums are either wooden stakes or metal bolts. Some of the datums installed by our team were removed by us in subsequent years of excavation when extending a trench and excavating down a section. If this was the case we installed new datums at other locations to maintain more or less the same amount of datums.

Appendix A2: Fieldwork: Excavation and documentation methodology

Fieldwork methods have been following the highest standards of Palaeolithic excavations in open-air loess sites, and include stratigraphic excavations taking into consideration the lithostratigraphic boundaries and pedological horizons, 3D piece-plotting of all objects and samples, as well as wet-sieving all excavated sediment (e.g., Nigst et al., 2014). A key feature of our excavation process has been the presence of a Quaternary geologist (P. Haesaerts) during the excavations to ensure detailed stratigraphic analysis of the lithostratigraphic boundaries and pedological horizons as well as a first assessment of site formation processes in the field.

Excavations at Mitoc-Malu Galben have been conducted either horizontally in small areas with good stratigraphic control via vertical sections, or vertically as so-called vertical excavations. In both cases, the goal has been to maximise the stratigraphic control of any excavated sample/material via vertical sections. All sediment excavated by our team has been collected in buckets, which are labelled with unique ID numbers (like finds and samples, see below). Each bucket has a litre-scale on its inside and the litres of sediment to the closest 0.5 litres are recorded in our field database (see below). The sediment has then been wet-sieved using a 1 mm mesh. All content of the sieves has been kept with the exception of recent roots/rootlets and air dried.

All objects and samples are documented with 3D coordinates (X-, Y-, Z-coordinates) in the excavation grid system using totalstations (Leica TCR 805) and field data collectors (Trimble Recon) running a field database and EDM measurement software (EDM Mobile; <http://www.oldstoneage.com/software/edm-mobile.shtml>) (McPherron and Dibble, 2002). The system is identical to the one used by and described in Nigst et al. (2014). All data is stored in a field database (EDM Mobile). All objects > 10 mm are piece-plotted during the excavation process. While most objects are documented by one point at the base of the object, elongated objects (i.e., those twice as long as they are wide) are documented by two points, one at each end of the long-axis. Massive, larger objects (e.g., cores, large chunks/shatter) are documented by six points (each of these points corresponds to the centre of one of the faces of the smallest cuboid in which the object fits). Documenting the long-axis of elongated objects as well as the smallest cuboid in which larger objects fit is key for conducting fabric analysis (analysis of artefact orientations) as a means to study site formation processes (e.g., McPherron, 2005; McPherron, 2018).

Each piece-plotted object/sample is assigned a unique ID number - consisting of the square (e.g., N3) and a running number from 1 to n, resulting in a unique ID (for example, N3-45) - during the recording process. The unique ID number is automatically generated by the EDM Mobile database management software based on the X- and Y-coordinates (square) and the last running ID number in that square saved in the database. All information including raw

measurements by the totalstation (horizontal and vertical angle, measured distance), calculated X-, Y- and Z-coordinates, stratigraphic unit, archaeological layer, object code (lithic, stone, bone, ochre, charcoal, etc.), and the position of the face on which the object rests (for lithics: dorsal or ventral side down) and optional comments are saved in the EDM Mobile database. During data transfer (using the GIS software NewPlot; <http://www.oldstoneage.com/software/Plot.shtml>) (McPherron and Dibble, 2002) this information is added to our site database (MS Access database).

In addition to piece-plotting objects > 10 mm, scatters of artefacts > 10 mm are documented using photos and ground control points, for which X-, Y- and Z-coordinates are recorded using a totalstation and stored in our EDM Mobile field database. This allows us to rectify photos and use them as georeferenced photos in a GIS software for further re-drawings and/or further analyses.

Sections are documented utilizing both photos and drawings. After the sections have been studied by the project geologist (P. Haesaerts) they are drawn at scale 1:10. Stratigraphic units and their litho- and pedostratigraphic boundaries are precisely documented on the drawings and archaeological objects visible in the section are documented on the drawings as well. In addition, we record all sample locations of samples collected from these sections (e.g., palaeoenvironmental and soil micromorphology samples) on the drawings.

Appendix A3: Laboratory work methodology

All data recording for lithic and faunal analyses uses the software E4 (<http://www.oldstoneage.com/software/e4.shtml>) (McPherron and Dibble, 2002) and data is stored as Microsoft Access databases. Analyses are conducted in R 3.6.3 (R Core Team, 2020). We use standard descriptive statistics and relationships between counts of categorical data were tested using Pearson's chi-squared test with Monte Carlo simulation of the p-value (Patefield, 1981) to avoid issues with small sample size and issues related to if one or more expected cell counts would be less than five.

Fauna:

Whenever possible, the faunal remains have been attributed to the species, identifying the skeletal element and the portion of the bone. For NISP (number of identified specimens), all specimens that could be identified for both the species and the element have been taken into account. The MNI (minimum number of individuals) calculations take into account the side, age and size of the specimen (e.g., Lyman, 2008). Description of the specimens includes identification of anthropogenic marks (e.g., traces of cutting and impact of percussion) and animal modifications (e.g., chewing), as well as other attributes such as alterations, burn marks, decalcification and root etching. Weathering stages are classified following Behrensmeyer (1978), burning stages are classified using the system developed by Stiner et al. (1995).

Ochre:

Primary identification of pieces as 'ochre' was realised macroscopically during fieldwork, mostly based on colour and texture. These items were then examined under binocular microscope to confirm their identification, get insights on their composition, and look for anthropogenic modifications (Salomon, 2009).

Lithic artefacts:

Lithic analysis is based on attribute and refitting analysis. Attribute analysis uses the variables defined and described in Nigst (2012), consisting of qualitative and quantitative

attributes. All lithic pieces are assigned to a technological class, each associated to specific attributes. Blanks' categories of attributes include measurements (e.g., length, width, thickness, weight, exterior platform angle, platform width, platform thickness/depth, etc), production attributes (e.g., platform type, presence/absence of bulb, lip, etc.), morphology (e.g., profile, distal shape, etc.), dorsal scar pattern, and retouch description. Cores' attributes include measurements (length, width, etc.), core type, surfaces management, and organization of blank production. A total of 60 individual attributes are defined and used, all technological classes included. All measurements (e.g., length, etc.) are recorded with a digital caliper in mm with two decimal precision. Weight is recorded in g with a scale with 2 decimal precision; artefacts from 100g are recorded with no decimal. Exterior platform angles are recorded using a goniometer with a resolution of 2 degrees. Refitting analysis, following standard approaches (e.g., Cahen and Keeley, 1980; Cahen, 1987; Czesla et al., 1990), was applied to a selection of specific samples.

With regard to raw material, all lithic artefacts are attributed to a raw material group based on macroscopic criteria. We have used three raw material groups in this preliminary assessment of raw materials: 'black', 'grey', and 'grey-translucent'. All of them are of rather good quality and can be attributed to varieties of the so-called 'Prut flint'.