NEW STUDY AND COMPLEMENTARY ANALYSES ON THE KEILMESSER WITH TRANCHET BLOW FROM THE SITE ABRI DU MUSÉE AT LES EYZIES (DORDOGNE, FRANCE)

Jens Axel Frick[a|b]

a. *Department of Early Prehistory and Quaternary Ecology, Institute of Prehistory, Early History and Medieval Archaeology, Eberhard Karls University of Tübingen, schloss Hohentübingen, Burgsteige 11, DE-72070 Tübingen - jens-axel.frick@ifu.uni-tuebingen.de*
b. *Projet collectif de recherche (PCR) "Le Paléolithique supérieur ancien en Bourgogne méridionale" associated with UMR 6298 ARTeHIS at the Université de Bourgogne, FR-21000 Dijon.*

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ABSTRACT

This contribution summarizes the re-examination carried out in autumn 2018 on the find material of the Abri du Musée site and discusses the results. Initially, the aim of the analyses was to personally examine the already known and published material of the site. In the course of the work, however, it became evident that some units had previously only been processed to a limited extent. Therefore, we consider this work as explicitly intended to complement the analyses of the material carried out by L. Bourguignon in the 1990s. The revision of the archaeological collection led us to increase considerably the amounts of pieces bearing tranchet blow negatives (scars), but also of the related blanks (spalls) produced by this method. This allowed us to go further into the analysis of this specific method of cutting-edge formation.

In addition to the application of metric analyses and working stage analysis to evaluate production processes, the spatial context of the artifacts was investigated. When comparing the finds and results with the analyses of other assemblages from other sites, a picture emerges which shows certain differences in both the production and the matrix selection.

It must be noted that the Keilmesser with tranchet blow, were manufactured exclusively on products (like flakes), regardless of whether they were worked unifacially or bifacially. The production sequences can either be very short (selection, truncation, tranchet blow) or extended to the extreme. In many cases, one surface was completely shaped first (mostly the flatter side) and then the more convex side. This indicates that the tools were produced both ad hoc and in a lengthy manner. The execution of several tranchet blows indicates maintenance processes (remolding) in the same way.

This work is explicitly intended to complement the analyses of the material carried out by L. Bourguignon in the 1990s.

RÉSUMÉ

Nouvelle étude et analyses complémentaires sur le Keilmesser avec coup de tranchet du site de l'abri du Musée aux Eyzies (Dordogne, France).

Cette contribution résume les analyses effectuées en automne 2018 sur le matériel lithique du site de l'Abri du Musée et en discute les résultats. Dans un premier temps, le but des analyses visait à examiner personnellement le matériel déjà connu et publié du site. Au cours des travaux, toutefois, il est apparu évident que certaines unités n'avaient été traitées auparavant que de manière limitée.

Ce travail est explicitement destiné à compléter les analyses du matériel réalisées par L. Bourguignon dans les années 1990.

Ainsi, il nous a été possible d'augmenter le nombre de Keilmesser avec coup de tranchet de n=22 à n=31 (dans l'unité archéologique 3). Si nous incluons également un fragment d'outil avec coup de tranchet, nous obtenons un total de n=32 pièces. En même temps, le nombre de supports de coup de tranchet pourrait être augmenté. Bien que n=61 pièces étaient connues à ce jour, il a été possible d'ajuster la quantité à n=138. Si toutes les découvertes sont additionnées (y compris celles d'autres unités ou de pièces non étiquetées), nous obtenons les artefacts suivants : n=35 pièces avec coup de tranchet et n=143 produits de coup de tranchet.

En plus de l'application des analyses métriques et de l'analyse des étapes opératoires (Working Stage Analysis) pour évaluer les processus de production, le contexte spatial des artefacts a été étudié. En comparant les découvertes et les résultats avec les analyses d'autres assemblages provenant d'autres sites, on obtient une image qui montre certaines différences tant dans la production que dans le choix de la matrice.

Il faut noter que les Keilmesser à coup de tranchet unifacial et bifacial sont fabriqués exclusivement sur les produits du débitage. Jusqu'à présent, ce phénomène n'a pas pu être observé sur aucun autre site avec une série représentative. Les séquences de production peuvent être très courtes (sélection, troncature, coup de tranchet) ou étendues à l'extrême.

Dans la plupart des cas, la face inférieure était façonnée d'abord, puis la face supérieure. Cela indique que les outils ont été produits à la fois de façon ponctuelle et sur une longue période. L'exécution de plusieurs coups de tranchet indique de la même manière les processus de maintenance et de restructuration).

Ce travail est explicitement destiné à compléter les analyses du matériel réalisées par L. Bourguignon dans les années 1990.

MOTS-CLÉS Keilmesser, coup de tranchet, Paléolithique moyen, Prądnik, Prondnik, étude technologique, sud-ouest de la France, unifacial et bifacial.

1 | INTRODUCTION

The Abri du Musée site is of great importance because of its enigmatic lithic finds from the late Middle Paleolithic, which are quite unusual for this region until now. So far, most of the sites with comparable assemblages, especially with tranchet blows, are located further east (Jöris 2003; Urbanowski 2003; Ruebens 2012; Frick 2016; Frick *et al.* 2017b, 2018). The Abri du Musée site has been mapped on maps related to the distribution of tranchet blows since the excavations in the early 1990s, but the site is often considered to be an outlier as it is far outside the main distribution of this phenomenon in Central Europe.

The singular presence of the site is sometimes regarded as a function of migratory movements (Jöris 2003; Baales and Jöris 2018). Alternatively, the skill or knowledge to perform a tranchet blow can be assumed to exist in the collective memory in some way and can be retrieved when necessary (in the terms of the concept reservoir, according to Weißmüller 1995).

With a regional focus on the surrounding sites, further sites can be identified as containing a certain presence of tranchet blows in their assemblages. Since it can be assumed that the main assemblage from the Abri du Musée can be attributed to the Würmian glacial period, five other sites can be envisaged (**fig. 1**). So far, literature has provided clues from Le Moustier (layer G; Gravina 2017), Chez-Pinaud at Jonzac (layer SW-US06-07; Brenet *et al.* 2017), La Rochette at Saint-Léon sur Vézère (layer 8b or 9; Turq 2001), La Grotte Vaufrey (layer 1; Rigaud 1988) or Cantalouette 4 (layer 1; Blaser *et al.* 2012). In these assemblages, however, these are merely individual items. Also, the negative of one piece from Cantalouette 4/1, which was also called tranchet blow, should rather not be addressed as such, because it is orthogonally directed inwards, without leaving a straight, stable cutting edge. The sites mentioned are listed here in order to somewhat weaken the supposed singularity of the Abri du Musée (**fig. 1**).

1.1 | Notes on terminology

The focus of this re-examination is on Keilmesser with tranchet blow (abbreviation used: singular KMTB and plural KMTBs) and corresponding blanks from these tranchet blows (abbreviation used: singular BTB and plural BTBs). We refer here to the technological and historical considerations in Frick *et al.* (2017a, 2017b) and Frick and Herkert (2019), where the tool is defined and the terms are explained in detail.

In a shortened way, a Keilmesser with tranchet blow can be defined as follows: A Keilmesser is an asymmetrically (mainly bifacially worked) backed knife. Its circumferential edge is divided into four clearly distinct sections (as viewed on the top side, the more convex surface): one (at least) cutting edge (a.k.a active edge), a back, a bow and a base (see also Kozłowski 1972 or Jöris 2006). The cutting edge is often two parted and is assumed to be used for different cutting directions (Jöris 2006; Urbanowski 2003). The low angled part with the tranchet blow is assumed to be used for mostly longitudinal cutting-in (for modes such as piercing, slicing or stabbing). In addition, transversal cutting-off (e.g. scraping) can be performed using the other part of the cutting edge. A lateral tranchet blow is a modification in a longitudinal manner on a lateral edge that provides a sharp, straight, stable and low angled

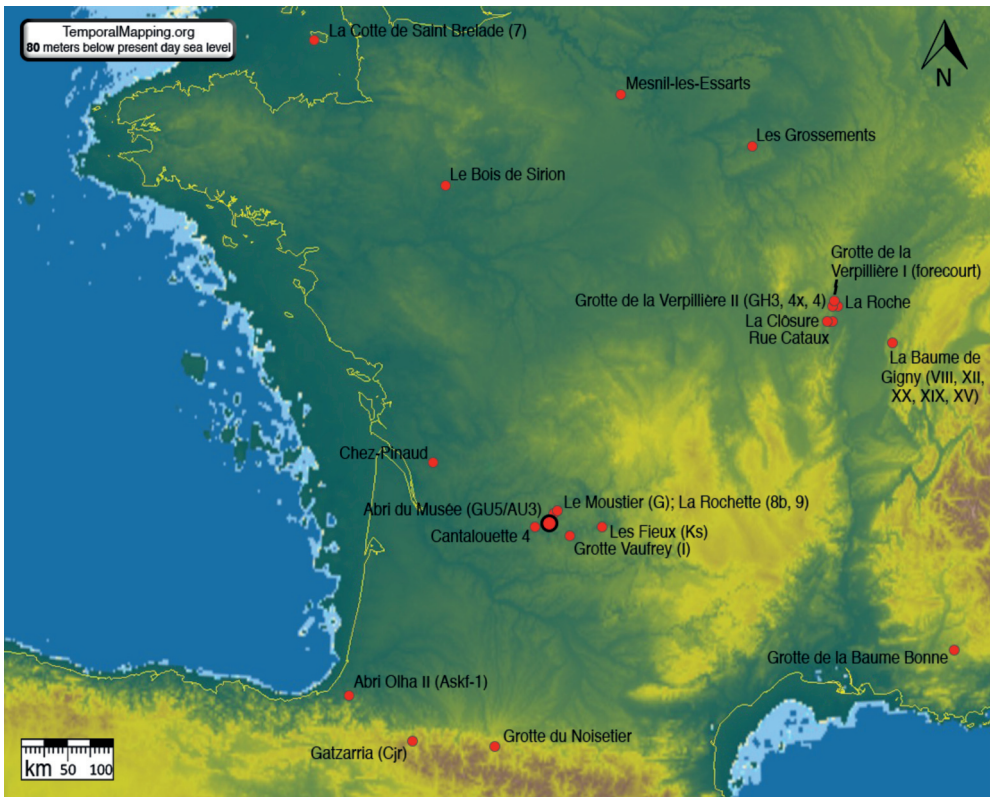


FIGURE 1

Position of the Abri du Musée in Les Eyzies on a map of Western Europe and further sites (layers indicated) with evidence of containing elements that are connected with tranchet blow performance (MIS 5d to early MIS 3). Base map: temporalmapping.org layer in Google Earth Pro, modification and drawings by J. A. Frick.

Position de l'Abri du Musée aux Les Eyzies-de-Tayac sur une carte de l'Europe de l'Ouest et d'autres sites (avec couche) MIS 5d à MIS 3 contenant des éléments liés à la production des coups de tranchet. Fond de carte : couche temporalmapping.org dans Google Earth Pro, modification et dessins par J. A. Frick.

cutting edge. The removed blank (a flake, a blade or a bladelet) is called blank from tranchet blow. This removed blank has a highly distinctive shape, because it possesses a ventral face with two facets (Frick *et al.* 2017 - p. 36, fig. 32 or Frick and Herkert 2019 - p. 13, fig. 7). To shorten it we are talking about tranchet blow here, but always explicitly the lateral tranchet blow is meant.
To avoid terminological confusion, it should be noted that Bourguignon (1992) uses the terms *pièces à coups de tranchet latéral* and *Prondniks* for Keilmesser with *tranchet* blow, and the blanks from tranchet blow are referred to as *chutes de coups de tranchet latéraux*. Our reason for not using the term Prondnik (Pradnik, *Prądnik*, or other spellings) is based on the research history on this term and its changing meaning and spelling, which is summarized in Frick *et al.* (2017a). The French term *coup de tranchet* is the literal translation of the terms *Schneidenschlag* (German) and tranchet blow.

1.2 | Affiliation of the assemblage to techno-complexes, facies or groups

The first publication immediately after the first excavation already depicted one of the pieces with tranchet blow (Detrain *et al.* 1991a - p. 87, fig. 6). However, another piece, a larger biface (Detrain et al. 1991a - p. 86, fig. 5), was presumably decisive for the assignment of the assemblage to the context of the Moustérien de tradition acheuléenne (MTA) of the Late Middle Paleolithic. In the same way, the site of Germolles (now called Grotte de la Verpillière I) was assigned to the MTA (Desbrosse *et al.* 1976). For sites with Prądniks they made a distinction between the Moustérien de tradition acheuléenne and the Moustérien de tradition micoquienne, but without adding any explanation.

This assignment (for Abri du Musée) was later modified slightly. Thus, Bourguignon (1997 - p. 49) speaks of a Micoquian influence *(influence micoquienne)* and Claud (2008 - p. 28) also attests a possible eastern influence from the Micoquian of central Europe. Bourguignon *et al.* (2006a) assigned the assemblage to the MTA. Gouédo (1999 - p. 224 & p. 234) added the site to his Ciemna Group of the Micoquian (which also includes Germolles (VP I) and Buhlen) and concluded that the presence of *Prądniks* in the same chronological period as the *Keilmessergruppen* confirms his interpretation that the tranchet blow is only an economic management process. Jöris (2003) assigned the assemblage of the Abri du Musée to the *Keilmessergruppen* (KMG) B2 and interprets it as an assemblage emerging in this southern region through population movement (see also Baales and Jöris 2018). In a broader sense, the site Abri du Musée was assigned to the context of the pan-European Micoquian (Urbanowski 2003). Often, however, the site is either neutrally assigned to the Middle Paleolithic or Mousterian, whereby it is often pointed out that special elements occur here, which are singular in the region in a certain way (Turq 2000; Bourguignon *et al.* 2006b; Turq *et al.* 2013), or it is assigned to the *Keilmessergruppen* (Baales and Jöris 2018; Jöris 2003; Rosendahl 2004, 2011). In our understanding, *Keilmessergruppen* is an umbrella term that unites the phenomenon that Keilmesser can occur in sites (see Frick Jöris 2003 and Herkert 2019).

1.3 | Excavations in the course of the museum expansion and position

In the course of a forthcoming expansion of the Musée national de Préhistoire in Les Eyzies (MNP), France, several rescue excavations were carried out on the museum

grounds in 1991 and 1993. The entire work, including test pit excavations, regular excavations and evaluations, were divided into five phases, listed below (see also Detrain *et al.* 1994 - p. 1-3; and **table 1**).

The total area to be evaluated for the museum extension was divided into four zones. Two of these zones got their own name, because it was clear that they had potential and had to be excavated after the first test pit excavations. The zone II was given the name Abri du Musée (abbreviated AdM, Museum shelter, **fig. 2** centered) and the zone III was called Abri Casserole (AC, Casserole shelter, **fig. 2** above right). These two areas differ fundamentally in the material of Paleolithic epochs found there. While Abri du Musée is characterized exclusively by a Middle Paleolithic settlement, an Upper Paleolithic sequence (Gravettian, Solutrean and Magdalenian) was found at Abri Casserole (Detrain *et al.* 1991a). Zone II, i.e. the Abri du Musée, is located approximately in the area depicted in **fig. 2** (information through pers. comm. with Luc Detrain, Nov. 27th, 2018 and Feb. 4th, 2019). The site is situated on the museum grounds and at an altitude of 73 m a.s.l. (Roebroeks *et al.* 2009 - p. 32). The following remarks relate exclusively to Abri du Musée.

Due to its position in the landscape and the content of the assemblage, the site is regarded as a residential camp (Daujeard *et al.* 2011 - p. 95), without this assignment being explained in more detail.
By a main residential camp, we understand a site that was used by the entire group for a longer period of time and on which various activities took place (Bon *et al.* 2011). Although it is not regarded as a reliable indication, it should cause suspicion that at Abri du Musée, no fireplace remains are reported. As Detrain *et al.* (1994 - p. 204) also write: "*Il est délicat d'évoquer, pour l'Abri du Musée, un habitat. En effet, l'absence de vestiges liés à des activités foyères (charbons, os, silex ou galets brûlés) et, donc, liés à l'alimentation, semble un argument relativement fort.*" [It is difficult to evoke for Abri du Musée being a habitat. Indeed, the absence of remains linked to fire activities (charcoal, bone, flint or burnt pebbles) and, therefore, linked to food, seems to be a relatively strong argument]. Rather, they assume that it must be a specialized area of

Phase	Date	Scope
1	1991-01-02 to 1991-05-31	Test pit excavations and determination of the positions of future excavations. Two sensible positions were determined, one with a Middle Paleolithic (Abri du Musée) and the other with a long Upper Paleolithic sequence (Abri Casserole).
2	1991-06-01 to 1991-09-30	Regular excavation on both sites
3	1991-11-01 to 1992-04-01	Evaluation and study of the excavated material from both sites
4	1993-01-18 to 1993-06-18	Additional regular excavation in Abri Casserole
5	1994-02-01 to 1994-03-31	Further evaluations and study of the material from Abri du Musée

TABLE 1

Five phases of the rescue excavation in the course of the forthcoming expansion of the MNP (xxxx-xx-xx = year-month-day).

Cinq phases de fouille de sauvetage dans le cadre de la prochaine extension du MNP (xxxx-xx-xx = année-mois-jour).

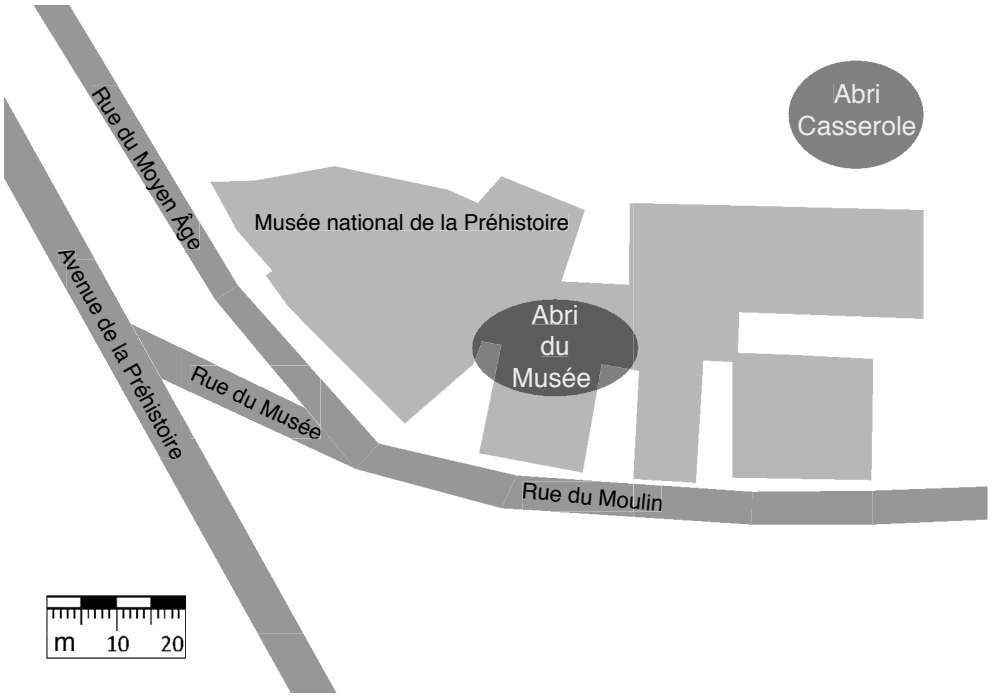


FIGURE 2

Approximate location of both sites on the museum grounds of the MNP. Schematic drawing by J. A. Frick.

Emplacement approximatif des deux sites sur le terrain du musée du MNP. Dessin schématique de J. A. Frick.

a camp elsewhere where meat has been unloaded and cut. We interpret this description of the excavation report as suggesting that it is most likely a butchering site.

1.4 | Stratigraphic evaluation

Within the uncovered stratigraphy, we refer to the material of the *ensemble sédimentaire V* (Geological unit 5, GU 5) which corresponds to *niveau archéologique 3* (Archeological unit 3, AU 3) in the following analyses. AU 3 is located at the base of GU 5 (pers. comm. with Luc Detrain, Nov. 27th, 2018). GU 5 is a fluviatile sediment. On its base are brown-red, quartz and micaceous clayey sands finely bedded towards the shelter but with structures of subsidence (Detrain *et al.* 1996). In addition to these geological and archaeological units, the site includes other units that yielded very low artifact rates. A total of 9 geological units could be separated from each other. The assemblages from AU 1 and 2 are too small to be attributed (Detrain *et al.* 1991a). The position of this GU 5/AU 3 within the stratigraphy is showed in the following **figure 3**.

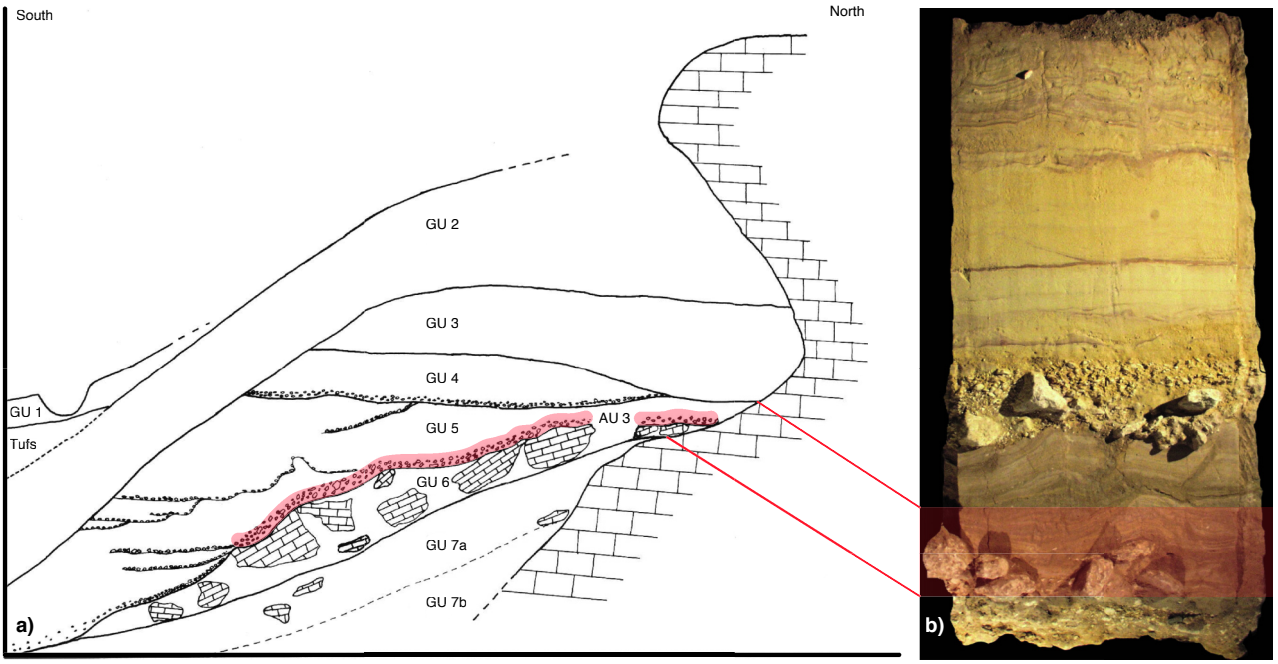
1.5 | Faunal remains

Although the site, including AU 3, contained numerous faunal remains, it was not possible to identify many of the faunal spectrum due to the high degree of fragmentation. Of the total of n=16,621 specimens of all layers, only 3.35% could be identified (Detrain *et al.* 1996). The final excavation report shows that AU 3 is characterized by reindeer and mammoth, followed by red deer, fox, horse and marmot (Detrain *et al.* 1994 - p. 23). The modest size of reindeers indicates very harsh temperatures in either very humid or very dry conditions (Detrain *et al.* 1996 - p. 209).

1.6 | Age determination

The evidence collected so far to narrow down the GU5/AU3 to a probable chronological position was compiled by Detrain *et al.* (1996 - p. 209). Paleomagnetic studies suggest an age between 67 and 60 ka for AU 3 and an age between 46 and 43 ka for the last fluvial deposits above AU 3. The presence of *Mammuthus primigenius* indicates a Würmian age and its common occurrence with *Equus caballus* cf. *germanicus* indicates MIS 5a or 3. However, the presence of the reindeer excludes MIS 5a. When summarizing the data from these different disciplines, a proposed date of AU 3 in the second half of MIS 4 or the beginning of MIS 3 is justified.
This dating has been adopted by some researchers, but others are more conservative as shown in **table 2**. However, it is worth noting that the dating remains open for other researchers.

Basically, all dating approaches are based on the work carried out during the excavations by Detrain and his team in 1991. For the time being, we also want to give priority to the approach of Detrain *et al.* (1996), as it combines the proposals from faunal analysis, paleomagnetism and sedimentology and thus compares them with each other. For a better comparison of the datings these are displayed graphically (**fig. 4**).



— FIGURE 3 —

Schematic stratigraphy of Abri du Musée; a) Schematic stratigraphy of the site, with identification of the find layer AU 3 (Detrain *et al.* 1991a - p. 79, Figure 3, without scale) and b) Molded profile of the site exhibited in the MNP (Author: A. Morala, Realization: Ph. Jugie, Collection: MNP).

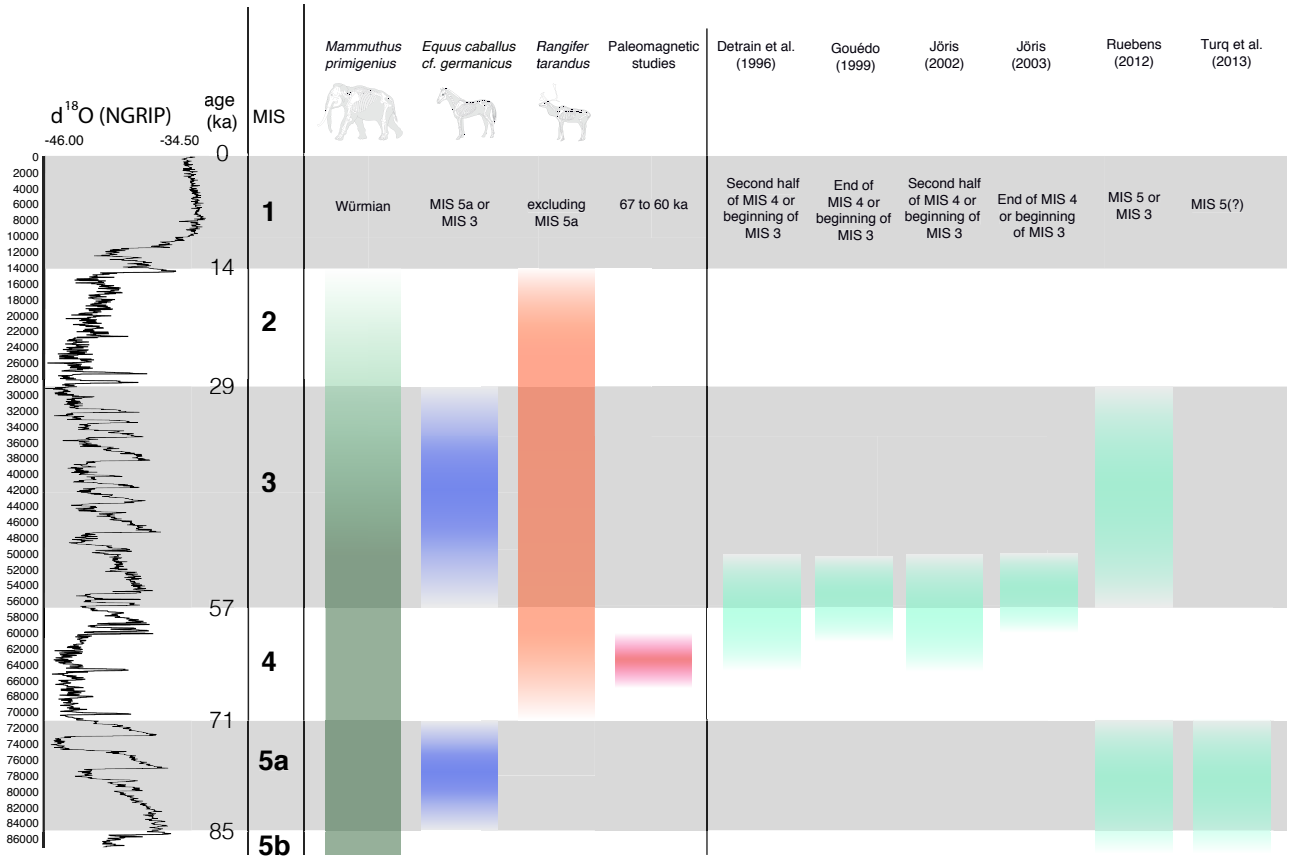
Stratigraphie schématique de l'Abri du Musée ; a) Stratigraphie schématique du site, avec identification du niveau archéologique AU 3 (Detrain et al. *1991a - p. 79, figure 3, sans échelle) et b) Profil moulé du site exposé au MNP (auteur : A. Morala, réalisation : Ph. Jugie, Collection : MNP).*

Suggested Dating	Underlying data source	Author
Second half of MIS 4 or the beginning of MIS 3	Fauna, Paleomagnetism, Sedimentology and Detrain *et al.* (1991a)	Detrain *et al.* (1996 - p. 209)
Second half of MIS 4	Detrain *et al.* (1991a)	Jöris (2002)
End of MIS 4 or beginning of MIS 3	Bourguignon (1992); Detrain *et al.* (1996); Detrain *et al.* (1991a)	Gouédo (1999)
No TL because of absence of burnt material, only paleomagnetic and sedimentological correlations possible	Detrain *et al.* (1991a)	Bourguignon (1992)
MIS 5-3, MIS 5 or MIS 3	Bourguignon (1992); Detrain *et al.* (1991a)	Ruebens (2012)
Undetermined	Coudenneau (2005)	Claud (2008)
>55.8 ± 5 ka BP	Sedimentology	Roebroeks *et al.* (2009)
<90 ka BP	Bourguignon (1994)	Blaser *et al.* (2012)
Chronological position is still discussed	Bourguignon (1992); Gouédo (1999); Jöris (2002)	Rosendahl (2011)
MIS 5(?)	Detrain *et al.* (1996)	Turq *et al.* (2013)

— TABLE 2 —

Collection of dating approaches for GU5/AU 3 of Abri du Musée.

Approches de datation pour US5/UA 3 de l'Abri du Musée.



— FIGURE 4 —

Compilation of proposed dating models for GU5/AU 3 of the Abri du Musée. The information on the chronological ranges of animal species and palaeomagnetic studies is given according to Detrain *et al.* (1996). The proposed dates of different authors are shown on the right.

Compilation des modèles de datation proposés pour US5/UA 3 de l'Abri du Musée. Les informations sur les tranches chronologiques des espèces animales et les études paléomagnétiques sont d'après Detrain et al. (1996). Les dates proposées par différents auteurs sont indiquées à droite.

1.7 | Overview of lithic artifacts

The total numbers of the lithic assemblage of the examined unit AU 3 found in the excavation reports (Detrain 1991; Detrain *et al.* 1991-1992a, b; Detrain *et al.* 1994; Detrain *et al.* 1991b) do not correspond to each other, so that an assemblage between 12,000 to 16,000 stone artefacts must be assumed. The assemblage merely has a very small laminar share of about 2 % of the stone artifacts (Blaser *et al.* 2012; Bourguignon 1994). According to Blaser *et al.* (2012 - p. 17, fig. 9), the assemblage contains around 77 % non-Levallois blanks, 19 % Levallois blanks and 4 % cores (according to Bourguignon and Meignen 2010, there are 3.4 % cores). According to the last excavation report on the site, the lithic assemblage GU5/AU3 consists of the components listed in **table 3** (Bourguignon 1994 - p. 38):

	All RM
Raw pieces & tested raw pieces	46
Cortical blanks (cortex >50%)	788
Cortical blanks with a cortical back	487
Cortical blanks (cortex <50%)	445
Normal blanks	1033
Levallois flakes	418
Cortical Levallois flakes	144
Levallois flakes with (natural) back	240
Cores	115
Core fragments	25
Tools	381
Totality of production >2cm	4122
Debris	318
Flakes <2cm	2380
Retouch & resharpening flakes	345
Micro flakes	5701
Pebbles et Hammer stones	52
Total	**12918**

TABLE 3

Lithic assemblage of GU5/AU3 according to Bourguignon (1994 - p. 38).

Industrie lithique de US5/UA3 selon Bourguignon (1994 - p. 38).

A significant part of the lithic objects to be discussed below were already presented by Bourguignon (1992) immediately after the first excavations. Since then, the assemblage has been repeatedly analyzed and/or the collected data have been used in various publications for comparison purposes (e.g. Bourguignon 1994; Coudenneau 2005; Bourguignon *et al.* 2006a & b; Claud 2008; Jöris 2003; Roebroeks *et al.* 2009; Blaser *et al.* 2012; Ruebens 2012; Morala 2011; Turq *et al.* 2013). In the following, we also refer to these publications.

1.8 | Raw material used for lithic artifacts

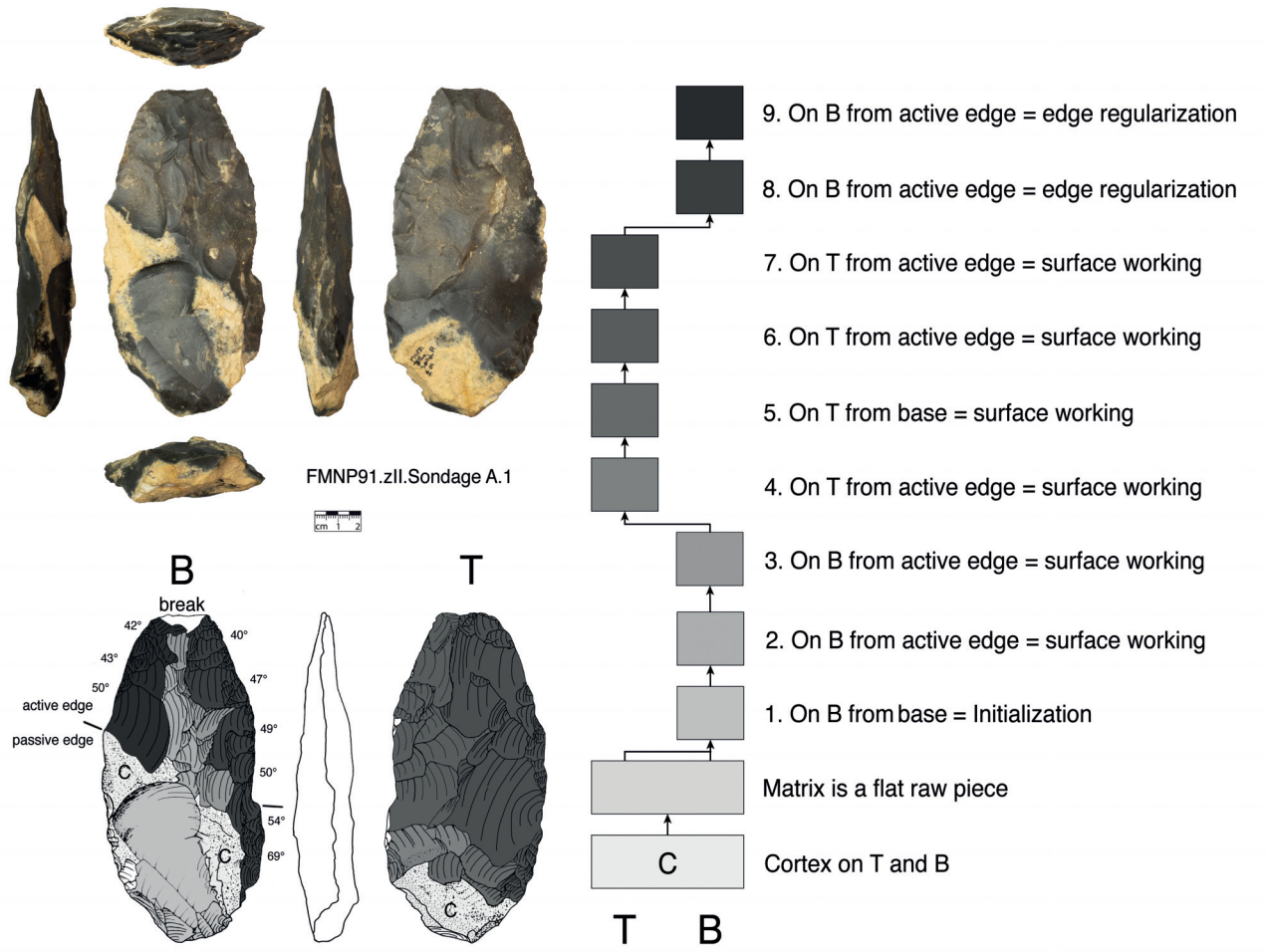
Morala (2011) was able to differentiate a total of n=9 different raw materials (flint and chert Type A to J) in the assemblage using macroscopical and microscopical methods. In contrast, Bourguignon reports n=6 distinguishable raw materials (MP 1 to 6) and, in addition, quartz, quartzite and granite (Detrain *et al.* 1991-1992a) in the final report of the excavation. Morala (2011) distinguished local and imported raw materials, whereby around 91 % of the flint and chert raw material were of local origin. According to Bourguignon's list (1994 - p. 57), n=10 Keilmesser with tranchet blow were made of *silex noir* and n=12 Keilmesser of *silex marron*. According to Bourguignon (1992 - p. 71, Tabl. 1), the flint raw material has a slightly different composition: *Sénonien noir* (n=11); *Sénonien marron* (n=9); *Campanien* (n=1), *Bergeracois* (n=1). The other pieces that were found were also made from one of these raw materials. *Sénonien* and *Campanien* are local raw materials, merely the *Bergeracois* comes from a location of around 40 km to the West (Turq *et al.* 2017).

1.9 | Levallois

The assemblage of AU 3 is characterized mainly by the use of the recurrent unidirectional Levallois method (Bourguignon 1992; 1997 - p. 60), which was quantified in a study by Faivre *et al.* (2017). There, n=4,122 artefacts were investigated from AdM, whereby n=562 Levallois flakes and n=103 Levallois cores where recognized. In addition, n=785 *éclats débordants* and n=6 non-Levallois blades were identified. In addition to Levallois reduction, Ruebens (2012 - p. 189) also attested a discoidal assemblage component. In addition to the production of blanks, Bourguignon *et al.* (2004) also attested a *ramification* (hierarchical branching of lithic concepts) in the assemblage. Levallois blanks were used as matrices for dorsal reduction (formerly called Kostenki reduction, see Klaric *et al.* 2015, for a technological explanation of the Kostenki sharpeing concept) of fine lamellar blanks. In a similar manner, Levallois blanks also served as matrices for the Keilmesser (as discussed later).

1.10 | Bifacial assemblage component

Although the entire lithic industry of layer GU5/ AU3 is characterized and dominated by recurrent unidirectional Levallois reduction, a minor number of bifacial objects is present. The present analysis was able to identify n=28 bifacial objects within the finds. Levallois reduction was also of great importance for the design of these bifacial pieces. N=11 bifacial Keilmesser with and without tranchet blow can be clearly assigned to Levallois reduction.
Interestingly, one of these bifaces is quite large next to the Keilmesser with tranchet blow to be discussed here, which already caused Detrain *et al.* (1991a) to assign the assemblage to the MTA. This biface derives from Sondage A, but was also associated with GU5/AU3. Based on the working stage analysis carried out (**fig. 5**), this biface can also be associated with the Keilmesser. The sequence of the surface working (shaping of the surfaces or *façonnage*) and the resulting edges are kept in the style of the alternating unifacial edge regularization (AUER, *wechselseitig-gleichgerichtete Kantenbearbeitung*, according to Bosinski 1967). A characteristic feature of this production method is that both faces of the two lateral edges were almost completely manufactured in one go. Here, the future bottom side (flatter surface) was shaped first (we are distinguishing between face and side, face refers to the ventral and dorsal face of blanks and side refers to the top side and bottom side of the bifacial objects). Then the top side (more convex surface) was shaped. The last two stages were performed on the bottom side again to regularize the edges. Within



— FIGURE 5 —

Biface (FMNP'91.zII.Sonadge A.1) manufactured according the rules of the AUER. Original drawing from Detrain *et al.* (1991a - p. 86, fig. 5), photographs by E. Nordwald, working stage analysis by J. A. Frick (symbols: T = top side, B = bottom side, C = cortex).

Biface (FMNP'91.zII.Sonadge A.1) fabriqué selon les règles de l'AUER. Dessin original de Detrain et al. (1991a - p. 86, Fig. 5), photographies d'E. Nordwald, analyse des étapes de travail (Working Stage Analysis) par J. A. Frick (symboles : T = surface supérieure, B = surface inférieure, C = cortex).

the working stages per side, the piece was rotated to be able to process the other lateral edge, but never turned or flipped. Bosinski (1967) described this characteristic type of edge regularization as typical for the Micoquian in Central Europe, which was also confirmed years later by Ringer (1983). As the remaining cortex on both faces shows, the piece was made from a flat raw piece. After the stage of the matrix selection, a total of nine further workings stages were carried out (the matrix, Fr. *support* is the selected volume, which can be a (cortical) raw piece (nodule, disc or slab), a frost shard or a detached volume (so called blank, in the shape of a flake or blade)). Finally, after the production of the piece, the tip broke off (linked to its functioning?).

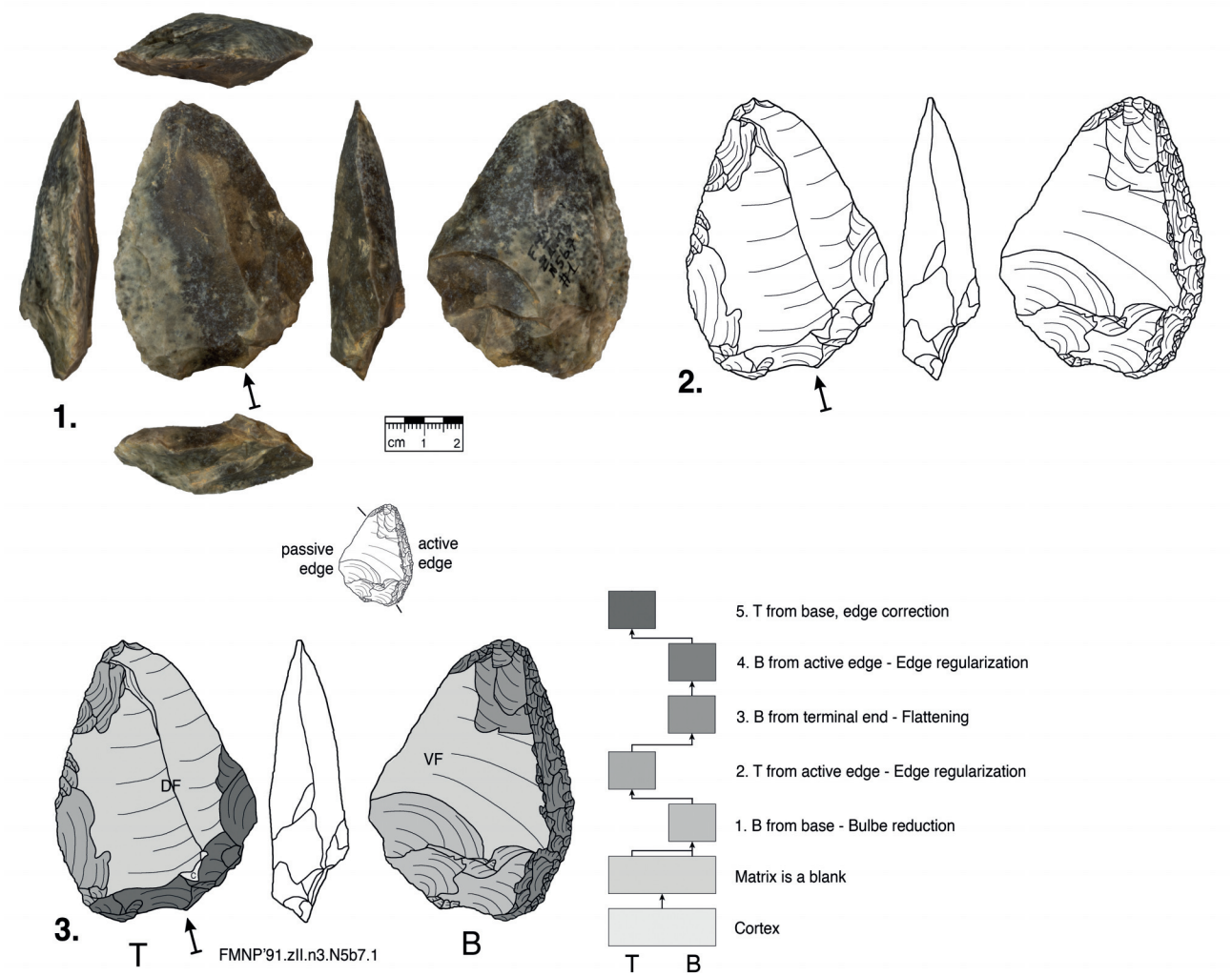
In addition to this biface, there is an example of a bifacially worked object, depicted in **figure 6** (arrows are explained in **table 4**). Although this piece was bifacially worked, only one of the two lateral edges was modified to a working edge by orthogonal retouching. Only one lateral edge and the base were modified, but not the surfaces. This piece also shows that the retouching was carried out in one go. First the dorsal face was retouched, then the piece was turned and the ventral face was retouched. However, the bulb section was also significantly reduced in advance.

2 | STUDIED ASSEMBLAGE

2.1 | Studied material and terminology

Bourguignon (1992) was able to identify a total of n=22 pieces with tranchet blow and n=61 blanks from tranchet blow from the assemblage of GU5/AU3, where she depicted n=16 pieces with tranchet blow.
The review of the find material from Abri du Musée carried out in October 2018 at the MNP enabled us to significantly expand the known spectrum of pieces with tranchet blow and blanks from tranchet blow. This is due to the fact that we had the opportunity to look through nearly all lithic objects of the relevant find layer, including finds that have hardly been processed to date (obviously previously unprocessed units and finds from water screening).

Our targeted analysis of the finds to identify objects with tranchet blow and corresponding blanks from tranchet blow were able to increase the number considerably.



— FIGURE 6 —

Bifacially worked object (FMNP'91.zII.n3.N5b7.1). Photographs by E. Nordwald, drawings of Figures 6, 9 and 11 to 127.and working stage analysis by J. A. Frick.

Objet travaillé bifacialement (FMNP'91.zII.n3.N5b7.1). Photographies d'E. Nordwald, dessins des figures 6, 9 et 11 à 127.et analyse des étapes de travail (Working Stage Analysis) de J. A. Frick.

Arrow	Meaning
	direction of tranchet blow, origin of the negative present, hard hammer blow
	direction of tranchet blow, origin of the negative not present, hard or soft hammer blow
	direction of blow of the whole piece (if the matrix is a blank), origin of the negative present, hard hammer blow
	direction of blow of the whole piece (if the matrix is a blank), origin of the negative not present, hard or soft hammer blow

— TABLE 4 —

Arrows used in drawings of figures 6, 9 and 11 to 17..

Flèches utilisées dans les dessinsdes figures 6, 9 et 11 à 17..

The analyses presented here essentially included a selection of n=191 pieces. (**table 5**). In total, we were able to increase the number of pieces with tranchet blow from GU5/AU3 to n=32 and the number of blanks from tranchet blow to n=138 (**table 5**). The analyses described below refer exclusively to the find material of the GU5/AU3 (n=182; **table 5**). Only in exceptional cases are further pieces from other units included in the discussion, and these will be explicitly mentioned.

The focus of this lithic analysis is on Keilmesser with tranchet blow and corresponding blanks from tranchet blow. The analysis of the pieces was carried out on the basis of the working stage analysis, which enables predictions about the sequence and succession of production stages (see Jöris 2001; Pastoors 2001; Pastoors *et al.* 2015; Richter 1997). Furthermore, the techno-functional units (Boëda 2001; Lepot 1993; Soriano 2001) of the pieces are determined on the basis of these working stages. Our

Geological and archeological unit Material	GU 5/ AU 3	GU 5 / AU 2-3	Unknown GU/AU	Total
Unifacial Keilmesser without tranchet blow	0	1	0	**1**
Bifacial Keilmesser without tranchet blow	5	0	0	**5**
Unifacial Keilmesser with tranchet blow	16	1	1	**18**
Bifacial Keilmesser with tranchet blow	15	0	1	**16**
Tool tip with tranchet blow	1	0	0	**1**
Almost symmetrical bifacial object	6	0	0	**6**
Blank from tranchet blow	138	4	1	**143**
Preform of bifacial object	1	0	0	**1**
Total	**182**	**6**	**3**	**191**

— TABLE 5 —

Lithic artifacts from Abri du Musée analyzed in this study.

Artefacts lithiques de l'Abri du Musée analysés dans cette étude.

analytical approach corresponds to the analyses in Frick *et al.* (2017b) of the material from Grotte de la Verpillière I, Saône-et-Loire. A detailed description of the technological aspects of tranchet blows can be found in Frick and Herkert (2019).

2.2 | Blank selection for the Keilmesser production

Without exception, all Keilmesser (only the pieces from GU5/AU3, n=31) with tranchet blow were made on blanks (flakes and one blade). In addition to unambiguous Levallois blanks (n=11), other blanks have also been used as matrix for the Keilmesser with tranchet blow, all of which can also be associated to Levallois reduction. In addition to *éclats débordants* (n=4), flakes were also used deriving from surface correction (n=9) and edge correction (n=7).

Unlike some bifaces, which were made from a raw piece (**fig. 5**) or blank (**fig. 6**), the Keilmesser (with or without tranchet blow) show a clear preference for flakes. The dorsal face did not always form the convex surface (top side) of the Keilmesser. Within the n=31 recognized pieces, the ventral face was used as top side six times. There is always a back opposite the cutting edge on Keilmesser (Bosinski 1967; Jöris 2001; Frick *et al.* 2017; Frick & Herkert 2019). If we focus on this back of the pieces, we notice that a cortical back was left on n=16 pieces. On n=7 pieces, the back was shaped more intensively, and on n=8 pieces, the edge was left as it is and only marginally modified. The first processing was done either on the top side or the bottom side (around 50/50).

2.3 | Metrical analysis

When comparing the unifacial KMTBs with the bifacial KMTBs in terms of size (see scatterplot in **figure 7a**), both types are present in very similar dimensions. However, on average unifacial KMTBs tend to be smaller (**fig. 7b**) and lighter (**fig. 7c**) than their bifacial counterparts.

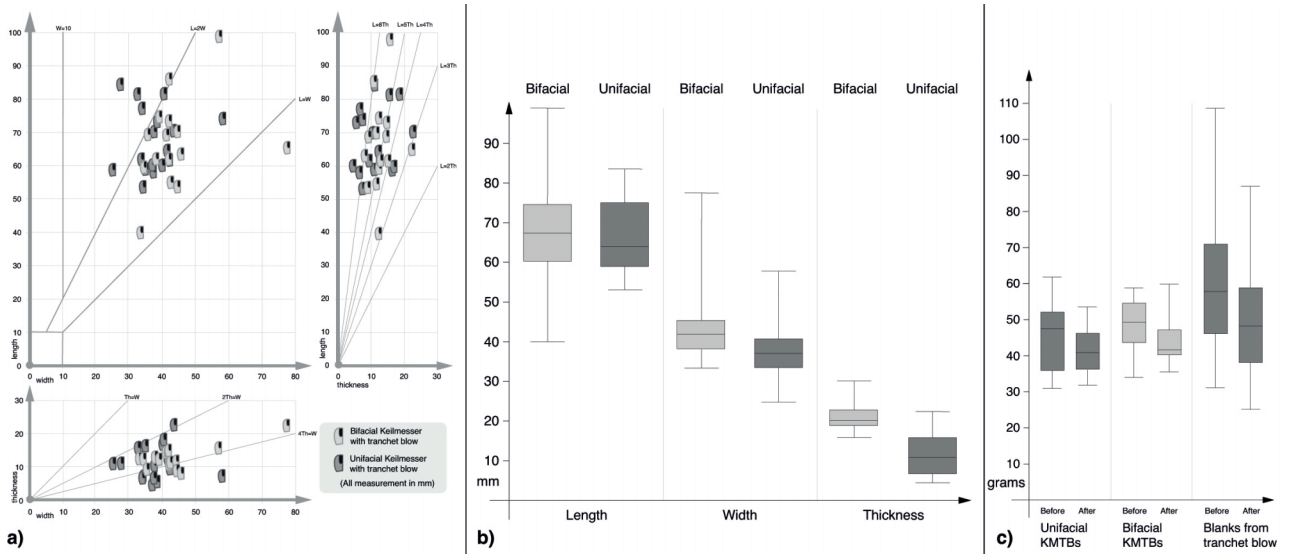
Regarding the laterality of the tranchet blows, the unifacial and bifacial KMTBs, as well as the blanks from tranchet blow, clearly show a substantial preference for right-sided pieces (**fig. 8a**). Likewise, although numerous negatives of tranchet blow were created sometimes, only one negative of tranchet blow can be seen on most pieces (**fig. 8b**).

Very unusual for this site is a piece that has a total of five negatives from tranchet blows. It is a piece with ventrally orthogonal edge retouching that received two respectively three blows from the opposite ends along the same lateral edge (**fig. 9**).

Now, when comparing the angles at the active edges of the KMTBs (edge angle of the active edge where the tranchet blow is situated; measurement is illustrated in Frick *et al.* 2017 - p. 36, fig. 32), we see a certain difference between the bifacial and unifacial pieces. Although the tranchet blow tends to make the angle smaller, the angles of the bifacial pieces are slightly larger than those of the unifacial pieces. The angles measured on the blanks from tranchet blow, before and after the tranchet blow, have a significantly larger value than can be seen on the KMTBs (**fig. 8c**).

This circumstance requires an attempted explanation. As we can see from refittings (see below), the tranchet blow was sometimes repeatedly performed. If the angle of the active edge becomes smaller as a result, this will also become apparent in the blanks from tranchet blow. We therefore interpret the large range of angles in the blanks from tranchet blow as indicative of a successive sharpening of the active edges on site.

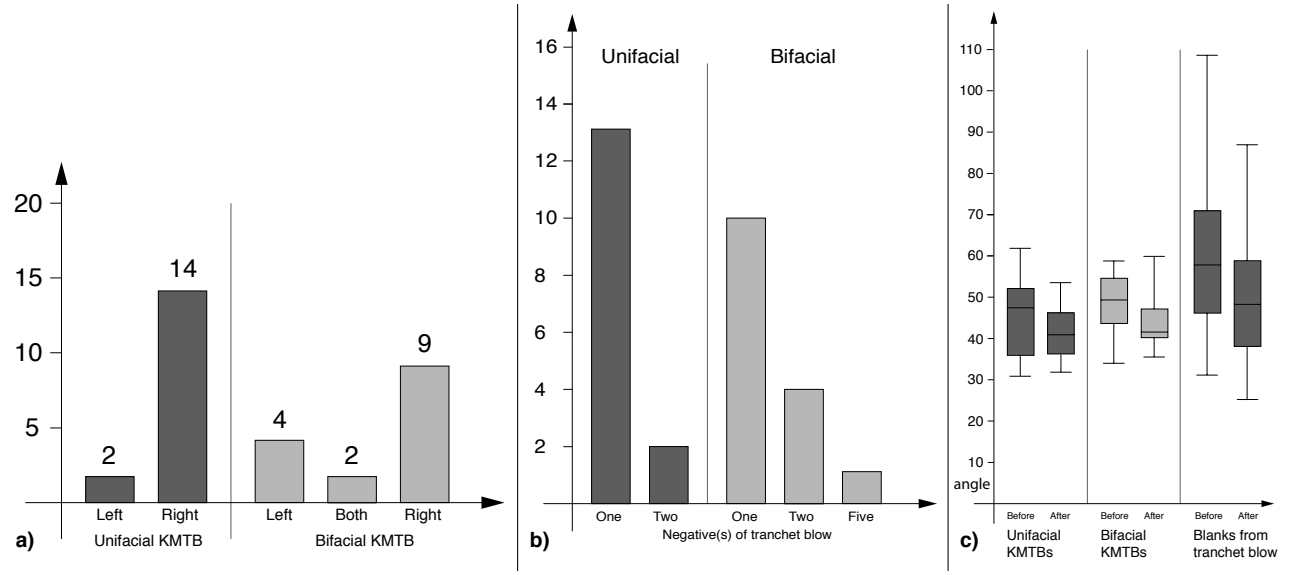
Similar to the KMTBs, the right and left blanks from tranchet blow hardly differ in their dimensions (**fig. 10a**). However, relative to the KMTBS, far more left blanks from tranchet blow are present (see **figure 10b** and compare to **figure 10a**). Also, there are about three times as many primary blanks from tranchet blow as secondary blanks (**fig. 10b**; we designate the first removed blank as primary blank from tranchet blow, the subsequent second blank as secondary, and so on; this is done in accordance with Jöris 2001). The ratio between right and left KMTB is 0.26 (6 left/23 right), but for the blanks from tranchet blow the ratio is 0.66 (55 left /83 right). Similarly, the ratio of secondary and primary blanks from tranchet blow is 0.4 (35 secondary /103 primary). These ratios are indicative of the incompleteness of the assemblage. It is particularly noteworthy that the ratio of right and left pieces is not the same for KMTBS and BTBs.



— FIGURE 7 —

Size and weight comparison of the Keilmesser with tranchet blow; a) scatterplot of length, width and thickness of unifacial and bifacials KMTBs; b) boxplots of length, width and thickness of unifacial and bifacials KMTBs and c) weight comparison of and bifacial KMTBs.

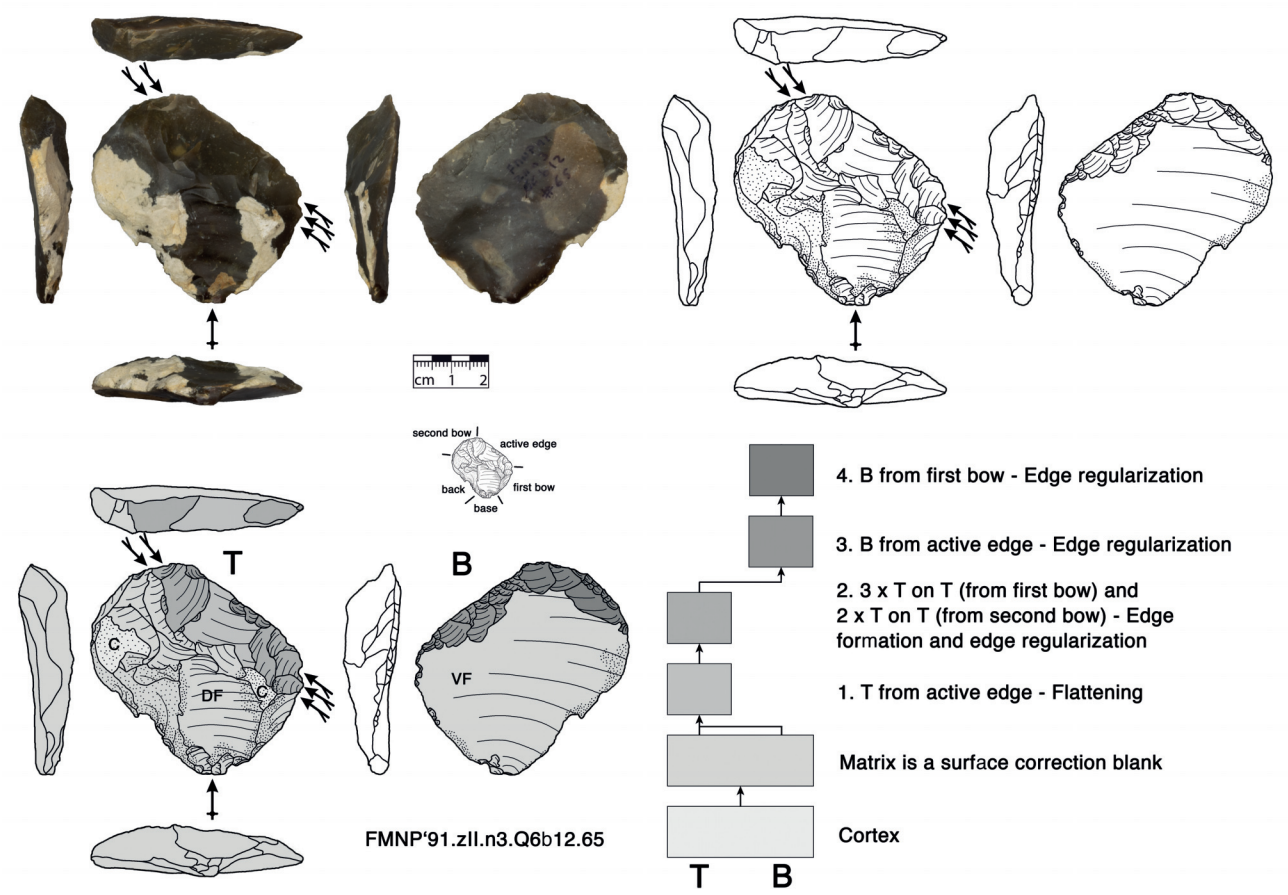
Comparaison métrique et du poids des Keilmesser avec le coup de tranchet ; a) diagramme de dispersion de la longueur, de la largeur et de l'épaisseur des KMTB unifaciales et bifaciales ; b) diagrammes de boxplots de longueur, largeur et épaisseur des KMTB unifaciales et bifaciales et c) comparaison du poids et des KMTBs uni- et bifaciales.



— FIGURE 8 —

Comparison between Keilmesser and blanks from tranchet blow, a) Laterality; b) Number of Negatives of tranchet blow on Keilmesser with tranchet blow and c) active edge angle before and after the tranchet blow performance.

Comparaison entre Keilmesser et les chutes/éclats de coup de tranchet, a) Latéralité ; b) Nombre de négatifs de coup de tranchet sur Keilmesser avec les négatifs de coup de tranchet et c) angle de bord actif avant et après l'application du coup de tranchet.



— FIGURE 9 —

Bifacial Keilmesser with tranchet blow made from surface correction blank (FMNP'91.zII.n3.Q6b12.65). Photographs by E. Nordwald, drawings by J. A. Frick.

Keilmesser biface avec coup de tranchet sur éclat de correction de surface (FMNP'91.zII.n3.Q6b12.65). Photographies de E. Nordwald, dessins de J. A. Frick.

2.4 | Reduction sequences on KMTBs

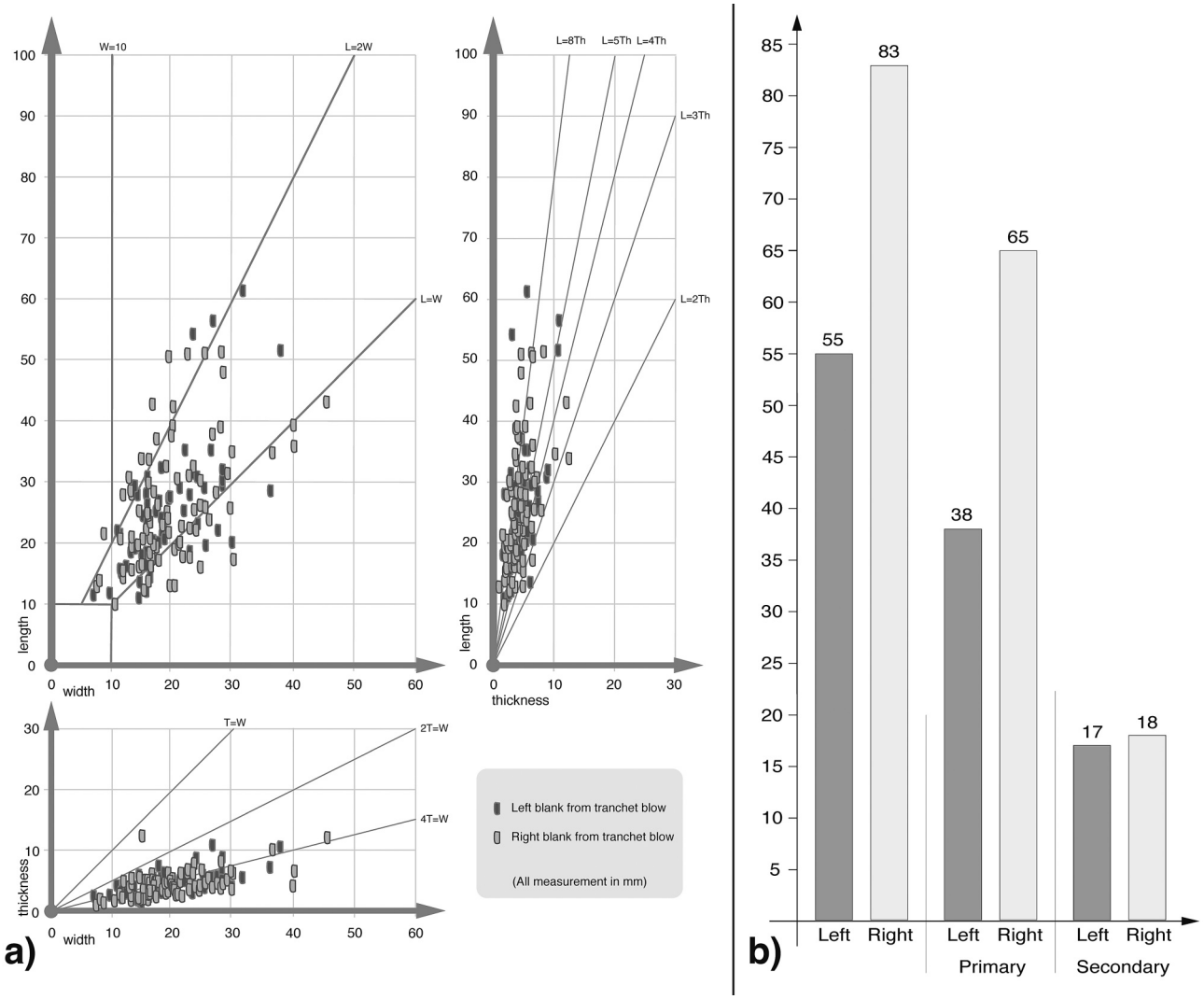
In addition to reduction sequences that could be verified with refittings (**fig. 11 and 12**), reduction sequences detected using working stages analysis alone are presented below.

Some pieces have an extremely short production sequence after the selection of a suitable volume (here the matrix is a blank). There are two examples of how the morphology of the selected blank can already be so close to what is necessary, that a truncation is sometimes not even necessary and the tranchet blow can be created immediately. In **figure 13a**, only a truncation was created before the tranchet blow was performed. On the piece in **figure 13b** it was not even necessary to make a truncation.

Sometimes the production process is quite short, which can be seen very well on unifacial Keilmesser with tranchet blow. In many cases, the modification was limited to the creation of a truncation and performance of the tranchet blow. After the tranchet blow, an edge regularization was sometimes carried out (**fig. 14a and 14b**). This edge regularization can sometimes produce very small negatives that eliminate small irregularities (working stage 3 on **figure 14a.3**). Occasionally, surfaces have to be shaped with a few blows (working stages 1 and 4 on **fig. 14b.3**). Even these extremely short production sequences clearly show that a tranchet blow can only be performed when the specific morphologies of the reduction surface, the striking surface and the corresponding angle are present (see also Frick and Herkert 2019; Frick *et al.* 2017b).

Even on bifacially processed pieces, the morphology given by the blank (dorsal and ventral faces) is used and supplemented by a few negatives, predominantly at the edges. It is noteworthy that the two faces are redesigned relatively independently from each other. In **figure 15**, the bottom side was shaped first with three working stages, then the top side was modified using four working stages.

The independent working of surfaces can also be observed on pieces that have a long production sequence. In the example shown (**fig. 16**), a total of seven working stages were carried out on the bottom side, while the top side was modified with further four working stages. On the basis of the remaining negatives, it seems as if a truncation had been created only for the tranchet blow on the top side. The tranchet blow visible on the bottom side was apparently executed without a truncation that was previously created.



— FIGURE 10 —

Dimension and number of blanks from tranchet blow; a) scatterplot of length, width and thickness and b) Amount of primary, secondary, left and right blanks from tranchet blow.

Dimension et quantité d'éclats de coup de tranchet ; a) diagramme de dispersion de longueur, largeur et épaisseur et b) Quantité d'éclats primaires, secondaires, lateralité de coup de tranchet

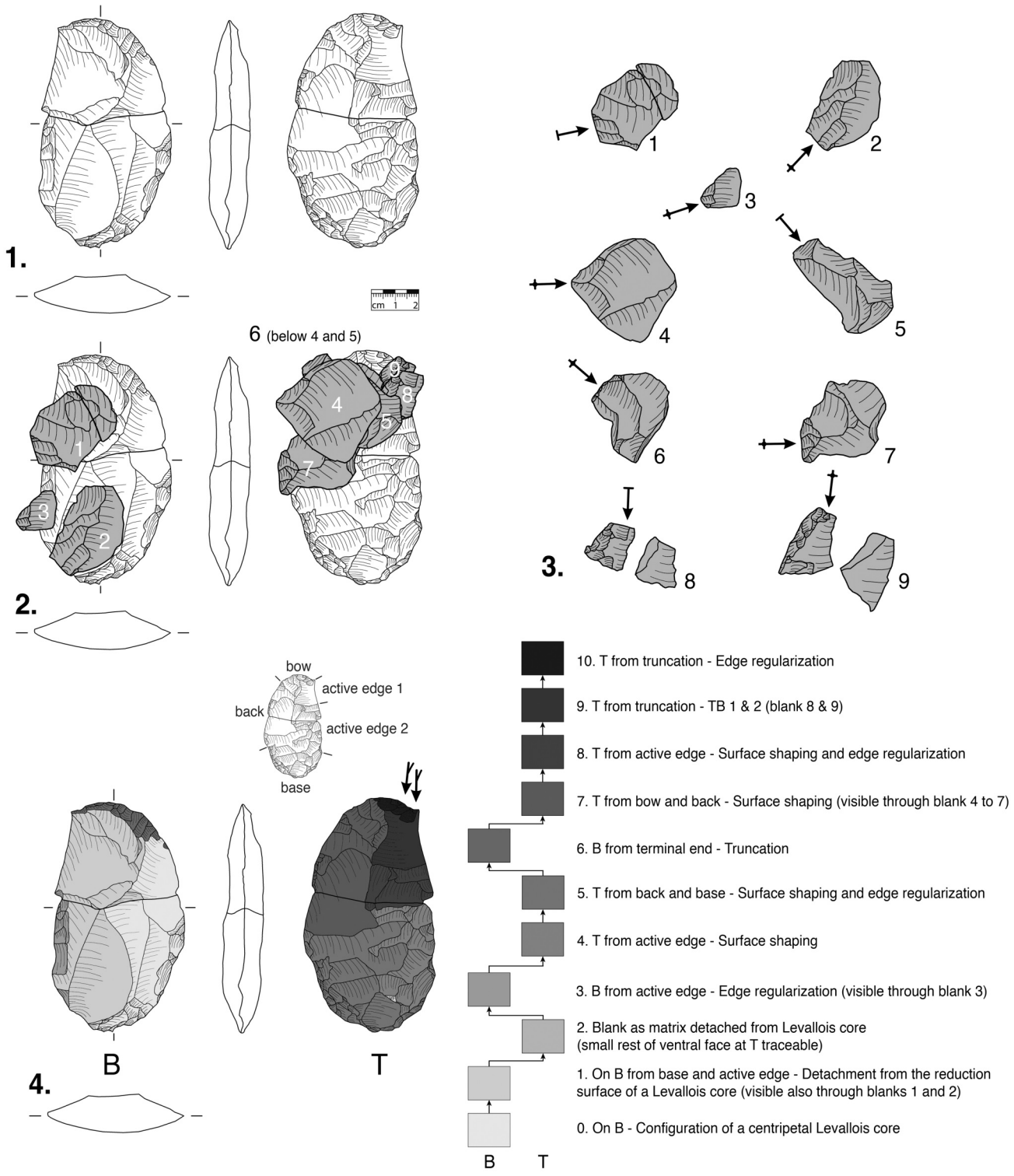
2.5 | Refittings

During the 1990s research, lithic refittings were carried out. In addition to refittings of reduction sequences on cores, blanks could also be refitted to bifacial pieces. We present two of these refittings hereafter. The first shows the reduction sequence of a bifacial Keilmesser with tranchet blow and n=9 corresponding blanks (**fig. 11**). The same piece was depicted in Bourguignon (1992 - p. 81, planche n° 3) with only n=5 corresponding blanks. This refitting allowed us to add notes to the working stage analysis carried out at this KMTB alone very nicely. Luckily, the refitting and the working stage analysis yielded the same results. However, only the refitting can show that two blanks from tranchet blow were removed successively, since the negative of the second tranchet blow removed the previous one completely. In addition, the combination of both methods clearly shows that parts of the surface design were carried out before a large blank as matrix (selected volume) for the Keilmesser was detached.

The second refitting unit also consists of a Keilmesser with tranchet blow and its corresponding blank from tranchet blow. It is easy to see that after the removal of the blank from tranchet blow, further working stages were carried out which reduced the length of the entire piece (**fig. 12**). This sequence was also mapped by Bourguignon (1992 - p. 82, planche n° 4), but we assume a slightly different sequence of working stages. Our working stage analyses suggest that much more of the surface was shaped after the matrix was selected. Otherwise, the two production analyses largely agree with each other.

2.6 | Use-wear analysis by Coudenneau (2006)

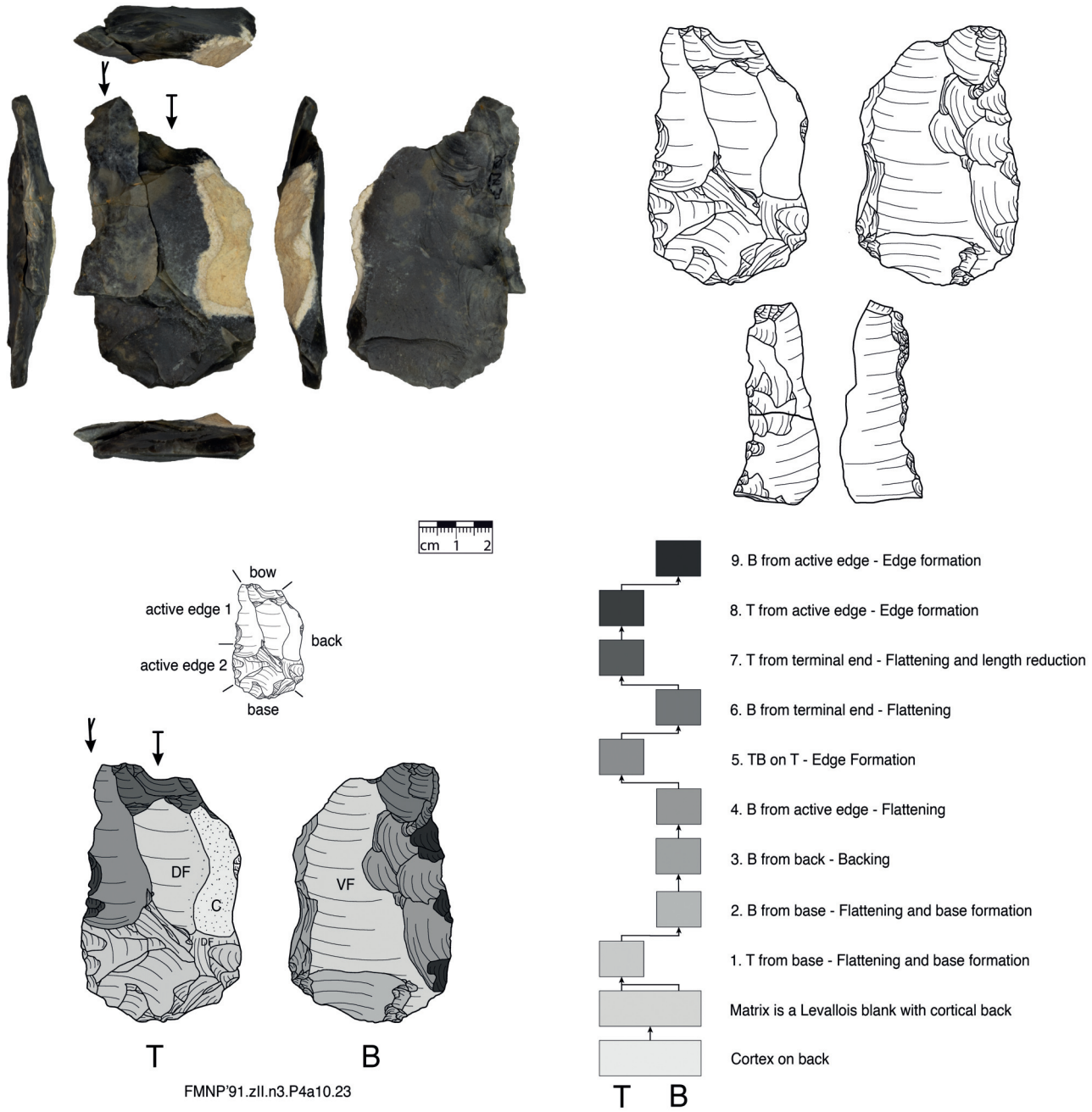
When looking through the material, it was noticeable that most of the pieces from the lithic assemblages were sharp-edged. Fortunately, use-wear analyses were carried out on the material some time ago. During the work carried out by Coudenneau (2005) for her master's thesis,



— FIGURE 11 —

Reductions sequence and refitted blanks on a bifacial Keilmesser with tranchet blows. 1) Drawing of the Keilmesser; 2) Drawing of the Keilmesser with refitted blanks; 3) Blanks; 4) Reduction sequence and techno-functional units. Drawings by J A. Frick.

Séquence de réductions et éclats associés sur un Keilmesser bifacial à coups de tranchet. 1) Dessin du Keilmes-ser ; 2) Dessin du Keilmesser avec éclat associé ; 3) Supports ; 4) Séquence de réduction et unités technofonctionnelles. Dessins de J. A. Frick.



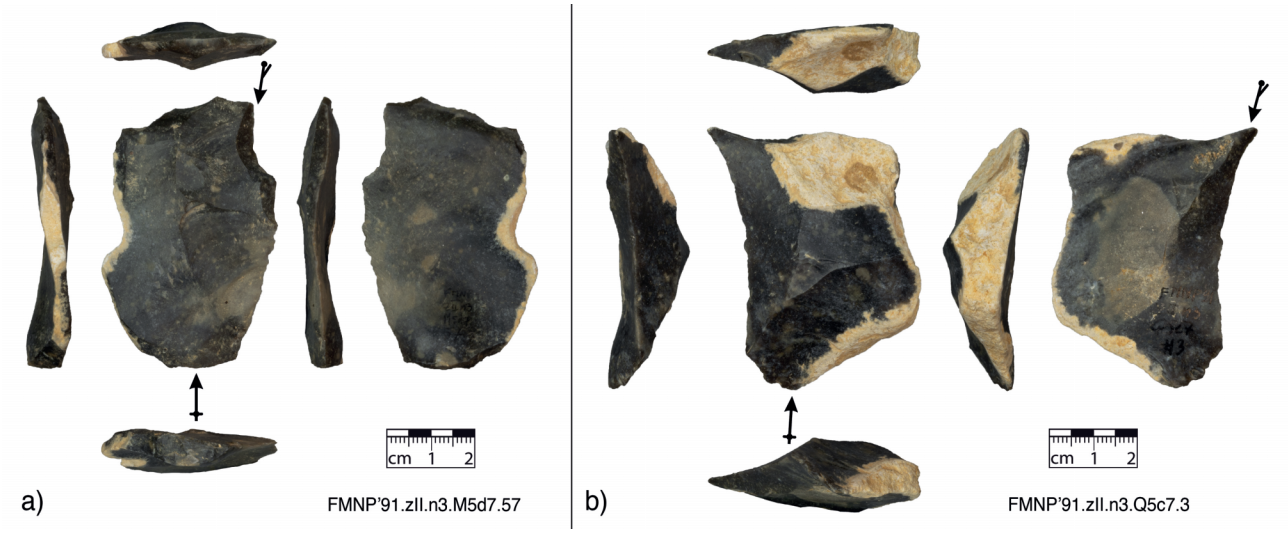
— FIGURE 12 —

Reductions sequence and refitted blanks (FMNP'91.zII.n3.Q4b8.2 & FMNP'91.zII.n3.Q4b9.88) on a bifacial Keilmesser with tranchet blows (FMNP'91.zII.n3.P4a10.23); 1) Photograph of Keilmesser with corresponding blanks; 2) Drawing of the pieces; 3) Reduction sequence and techno-functional units. Photographs by E. Nordwald, drawings by J. A. Frick.

Séquence de réductions et éclats associés (FMNP'91.zII.n3.Q4b8.2 & FMNP'91.zII.n3.Q4b9.88) sur un Keilmesser bifacial à coups de tranchet (FMNP'91.zII.n3.P4a10.23) ; 1) Photo du Keilmesser avec éclat remontage ; 2) dessins des pièces ; 3) séquence de réduction et unités techno-fonctionnelles. Photographies de E. Nordwald, dessins de J. A. Frick.

n=56 pieces were analyzed for use-wear traces. She was able to detect traces of use on a total of n=15 pieces (on n=3 blanks from tranchet blow and on n=12 tools). Within the tools, it was possible to assign n=2 to a transverse movement and n=8 to a longitudinal movement, all of which were performed on medium-hard material. In the examined tools with tranchet blow, traces of use were not only found on the cutting edge modified by the tranchet blow. She detected two different variations (**fig. 17**). First, on a tool with tranchet blow (**fig. 17a**), which shows the longitudinal medium-hard material traces at the expected place. Contrary to this piece, she recognized the use-traces on a Levallois flake with tranchet blow on the lateral edge opposite to the tranchet blow (**fig. 17b**).

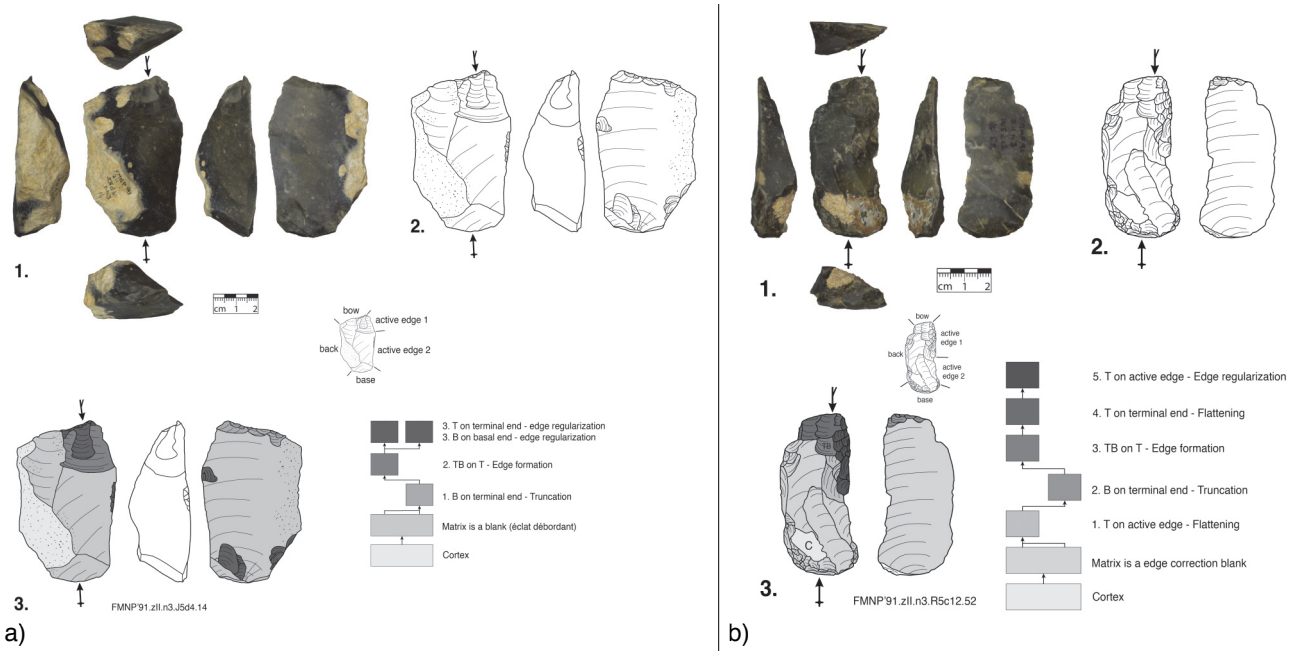
In addition to the pieces with tranchet blow, she also examined blanks from tranchet blow for use-wear traces (Coudenneau 2005 - p. 32, planche 7). It is noteworthy here that the blanks from tranchet blow show traces of use, indicating that the corresponding working edge was used before the detachment. However, there are also blanks from tranchet blow, which were used as tools after being detached. This remarkable circumstance shows that the



— FIGURE 13 —

Unifacial Keilmesser with tranchet blow with extremely short production sequences; a) FMNP'91.zII.n3.M5d7.57 and b) FMNP'91.zII.n3.Q5c7.3. Photographs by E. Nordwald.

Deux Keilmesser unifacials avec coup de tranchet et séquences de production extrêmement courtes ; a) FMNP'91.zII.n3.M5d7.57 et b) FMNP'91.zII.n3.Q5c7.3. Photographies de E. Nordwald.



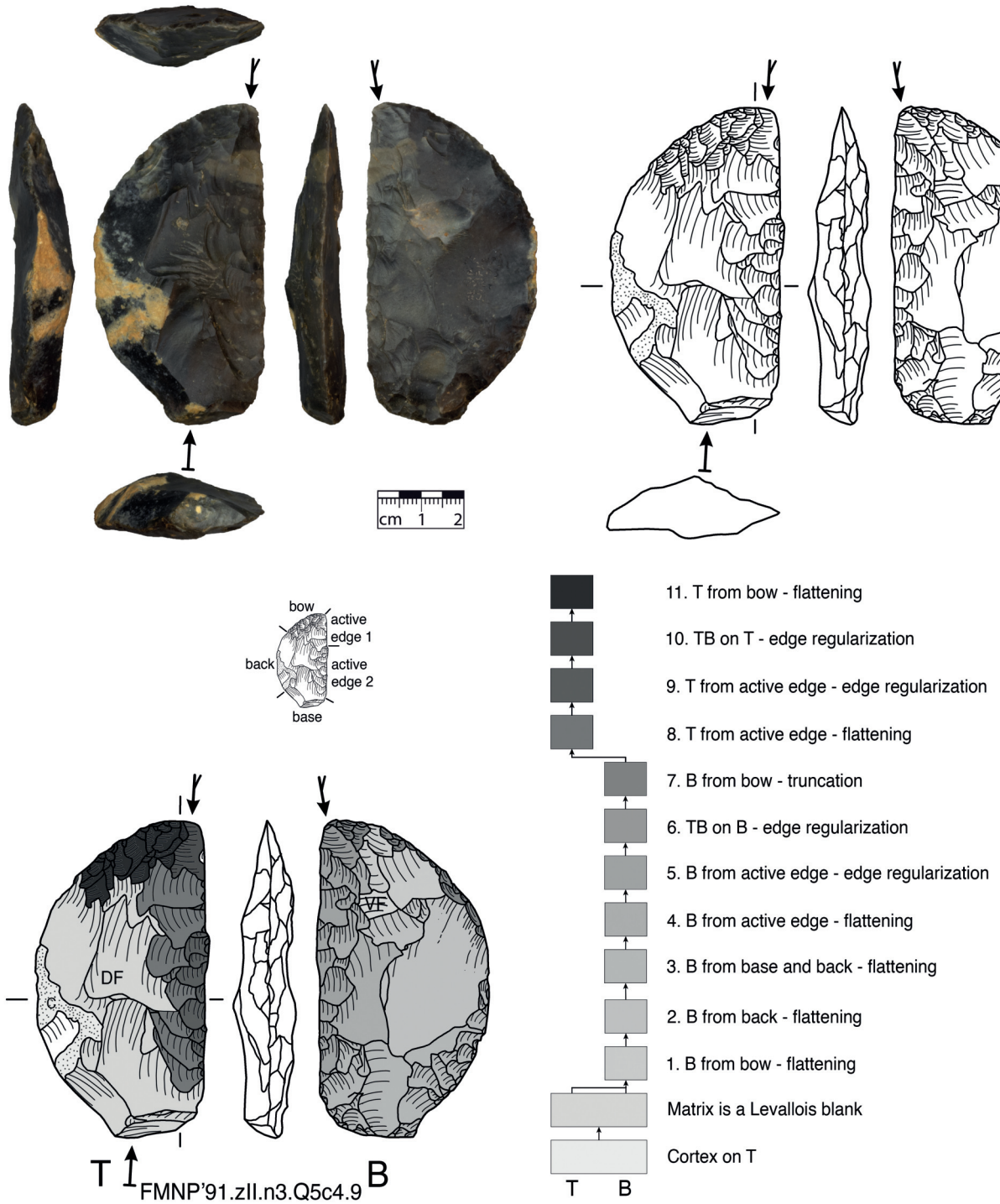
— FIGURE 14 —

Unifacial Keilmesser with tranchet blow; a) FMNP'91.zII.n3.J5d.14 and b) FMNP'91.zII.n3.R5c12.52; 1. Photograph; 2. Plain drawing and 3. Working stage analysis and techno-functional units. Photographs by E. Nordwald. Drawings and working stage analysis by J. A. Frick.

Deux Keilmesser unifacials avec coup de tranchet ; a) FMNP'91.zII.n3.J5d.14 et b) FMNP'91.zII.n3.R5c12.52 ; 1. Photographe ; 2. dessin simple et 3. Séquence de production et unités techno-fonctionnelles. Photographies de E. Nordwald. Dessins et analyse des étapes de travail (Working Stage Analysis) par J. A. Frick.

cutting edge was also used before the blank from tranchet blow was detached and that the blanks from tranchet blow themselves could also be used for cutting purposes.
The size of the blanks from tranchet blow therefore prompts us to consider whether they might have been hafted (maybe like a Magdalenian backed bladelet). In this context, we do not want to make this an assertion, but rather evaluate the position of the use-wear and the specific shape as a possible indication, whereby it is always possible to hold these pieces in one's hand.

It is also important to note that the use traces indicate that the Keilmesser with tranchet blow were used for longitudinal cutting of medium-hard materials. This assessment is in concordance with other interpretations as set out by Jöris (2001, 2006) or Uomini (2006). Claud's (2008 - p. 60) statement that the Keilmesser were used for butchering also points in the same direction.



— FIGURE 15 —

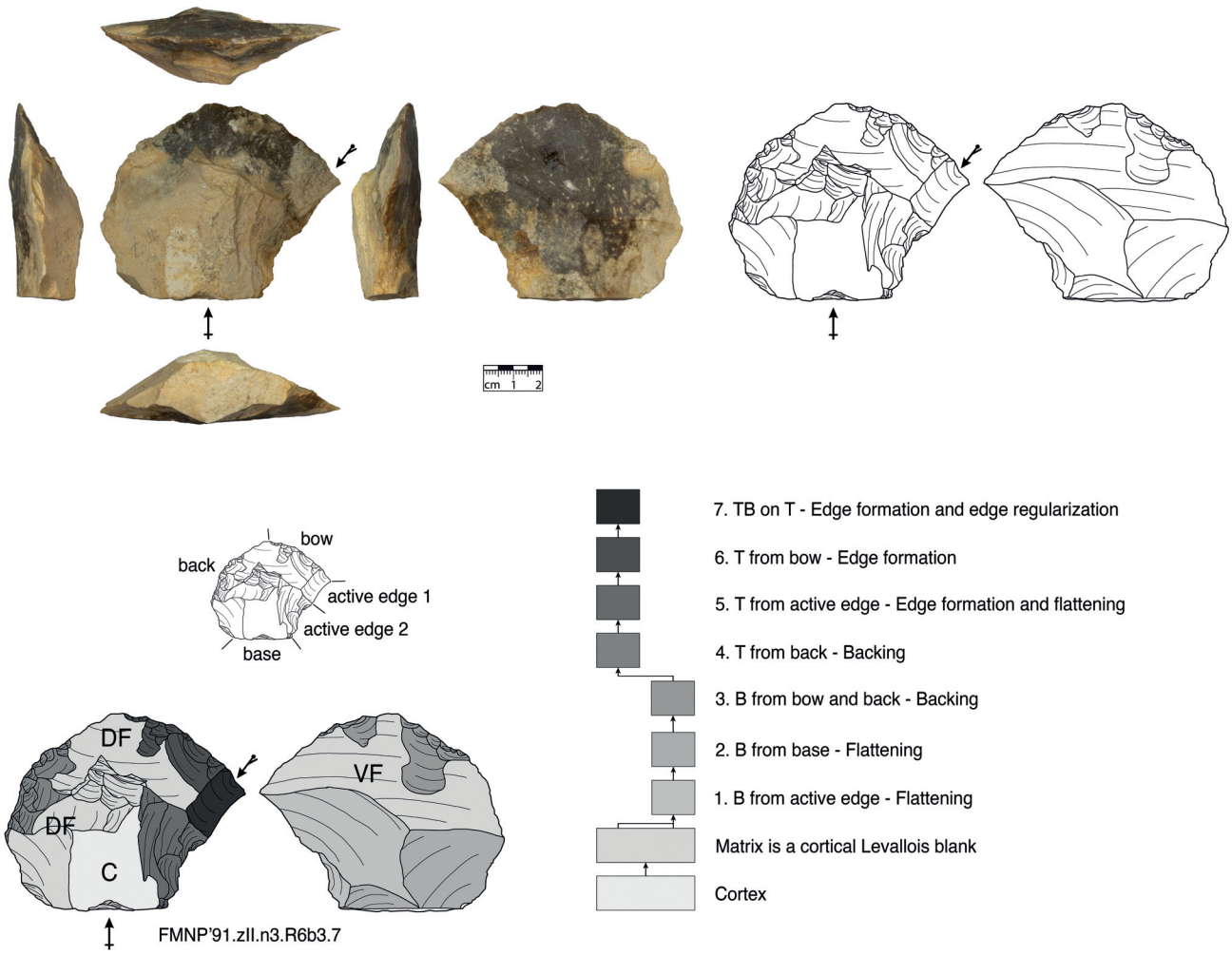
Bifacial Keilmesser with tranchet blow made from Levallois blank (FMNP'91.zII.n3.R6b3.7). Photographs by E. Nordwald, drawings by J. A. Frick.

Keilmesser biface avec coup de tranchet sur éclat de Levallois (FMNP'91.zII.n3.R6b3.7). Photographies de E. Nordwald, dessins de J. A. Frick.

3 | SPATIAL ANALYSIS

3.1 | Intra-site spatiality

The quarter-square-meter labeling of the finds makes it possible to record them spatially and to map them comparatively. The Keilmesser with tranchet blow, as well as the presumably corresponding blanks from tranchet blow, are distributed unevenly in GU5/AU3. The density mappings (kernel density estimation, KDE, R=0.4, 1000 columns and rows) of the finds show different concentrations (**fig. 18 to 20**). It is clearly visible that the blanks from tranchet blow are concentrated more or less in one place (**fig. 18 right**), while the KMTBs show several concentrations (**fig. 18 left**).



— FIGURE 16 —

Bifacial Keilmesser with tranchet blow made from Levallois blank (FMNP'91.zII.n3.Q5c4.9). Photographs by E. Nordwald, drawings by J. A. Frick.

Keilmesser biface avec coup de tranchet sur éclat de Levallois (FMNP'91.zII.n3.Q5c4.9). Photographies de E. Nordwald, dessins de J. A. Frick.

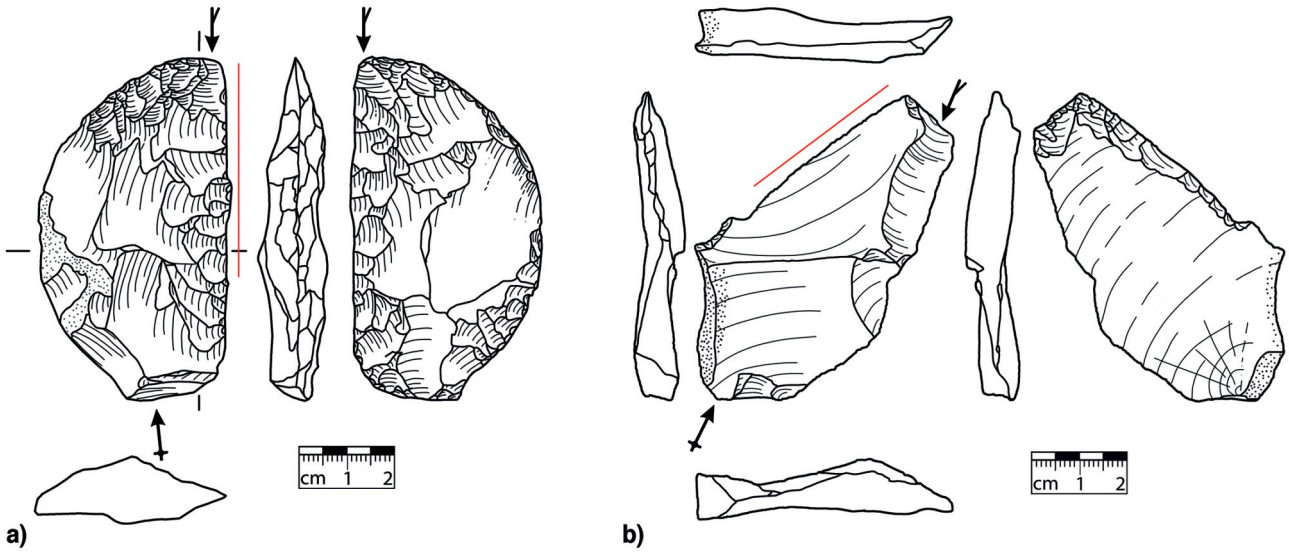
Focusing solely on the KMTBs when looking at the density distribution, different distributions can be seen for the unifacial and bifacial pieces, as well as the right- and left-sided pieces (**fig. 19**). The density distributions of the KMTBs indicate a higher presence of right-sided pieces, which scatter quite widely both bifacially and unifacially (**fig. 19 right**). Left-sided pieces are more likely to be found in the center of the excavation area (**fig. 19 left**), just like the two double-sided pieces (**fig. 19 centered**). Surprisingly, the left-sided KMTBs (if we exclude the two double-sided ones for a moment) are rare, but concentrated in the center of the surface.

Similarly, the blanks from tranchet blow scatter in a similar way, but here the concentrations are slightly shifted to the right compared to the KMTBs. While the left-sided are concentrated in one area (**fig. 20 left**), the right-sided ones are concentrated in two areas (**fig. 20 right**). This is in congruence with the KMTBs, where the right-sided ones are also more scattered than the left-sided ones.

One of the refittings described above (**fig. 11**) is also detailed here in its spatial distribution (**fig. 21**). Some of the pieces have been found about 3m away from each other. Interestingly, the two blanks from tranchet blow were close together spatially, which can indicate that they were removed immediately after each other. Also, the numerous blanks for surface formation were in close proximity to each other (except for one piece). This is seen as a further indication that the shaping of the piece, as well as the detachment of the tranchet blows, was carried out in one go and in one place. However, it is astonishing that the two large fragments of the KMTB were not found close to each other, but about three meters apart. If the two fragments had been used independently, this distribution could be explained. However, no further modifications on the two fragments can be detected, so that their distant position leaves much room for speculation (remote discarding, dragging, sediment movement, etc.).

3.2 | Import and Export

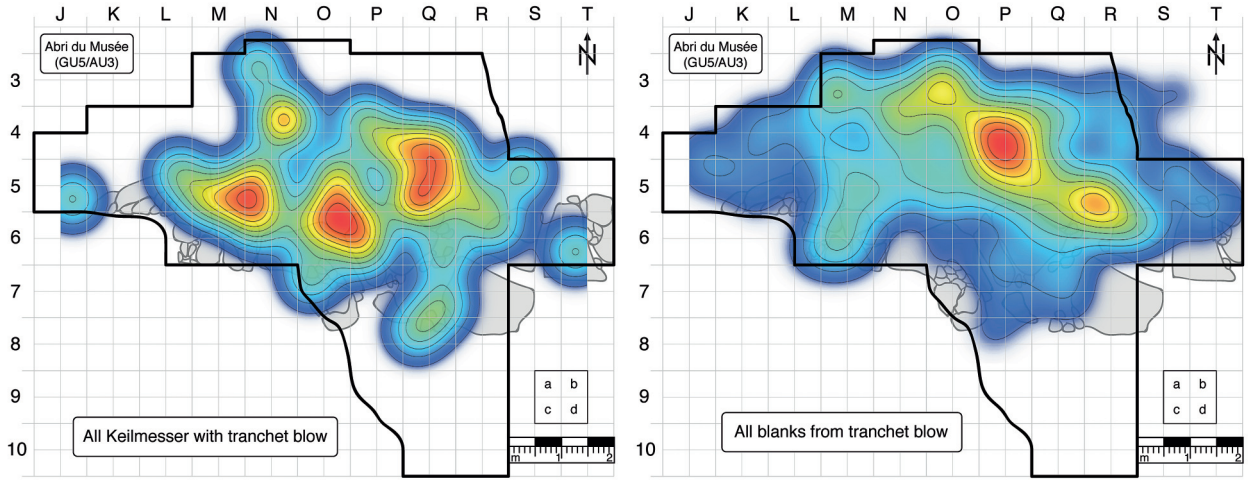
On the n=31 KMTBs identified, only n=50 negative of tranchet blow were detected. This is in stark contrast to the large number of blanks from tranchet blow found (n=138). There are two main possibilities to explain this circumstance. Either numerous KMTBs were exported (brought outside the excavation area) or the existing KMTBs were



— FIGURE 17 —

Pieces with tranchet blow and use-wear; a) bifacial Keilmesser with tranchet blow (FMNP'91.zII.n3.Q5c4.9) and b) Levallois flake with tranchet blow (FMNP'91.zII.n3.Q8a1.1), see also Coudenneau (2005 - p. 30, planche 6). Both artifacts are redrawn by J. A. Frick.

Pièces avec coup de tranchet et traces d'utilisation ; a) Keilmesser bifacial avec coup de tranchet (FMNP'91.zII.n3.n3.Q5c4.9) et b) Éclat Levallois avec coup de tranchet (FMNP'91.zII.n3.Q8a1.1), voir aussi Coudenneau (2005 - p.30, planche 6). Les deux artefacts sont redessinés par J. A. Frick.



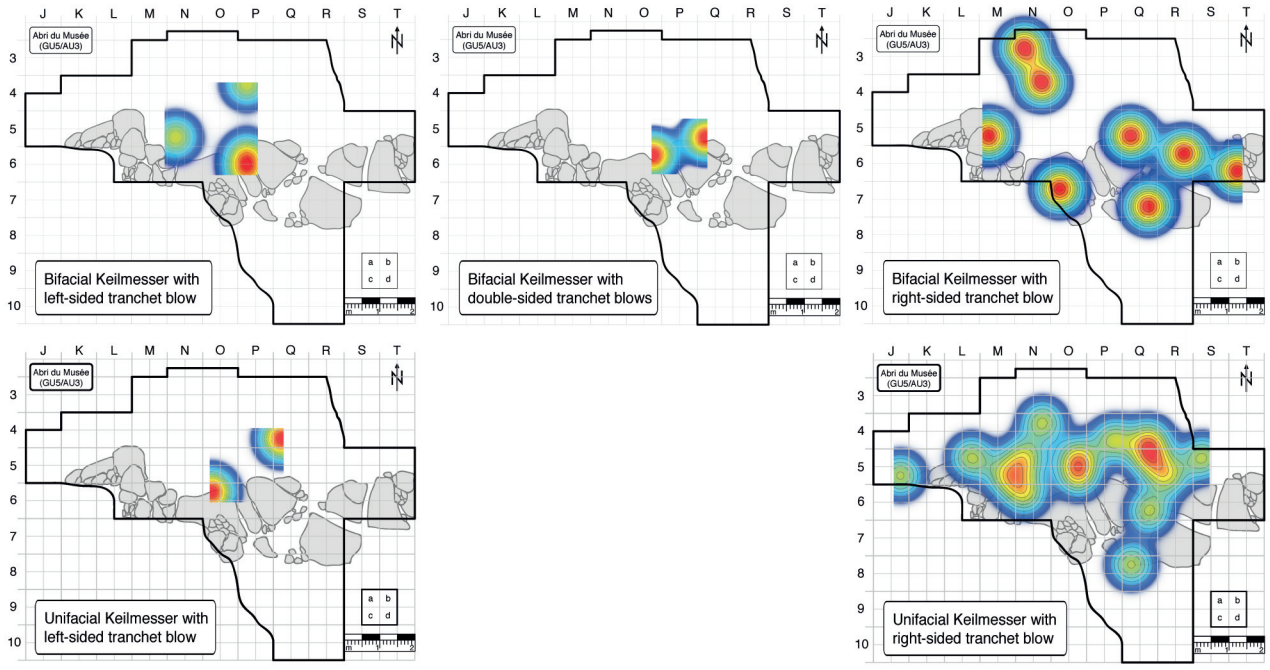
— FIGURE 18 —

Density mapping of the analyzed finds; left) distribution and density of Keilmesser with tranchet blow and right) distribution and density of blanks from tranchet blow. Base map redrawn according to W. O'Yl and Y. Le Grand, in Detrain *et al.* (1991-1992a - p. 28-30, maps) and reproduced by courtesy of L. Detrain.

Répartition de densité des trouvailles analysées ; à gauche) répartition et densité des Keilmesser avec coup de tranchet et à droite) répartition et densité des blancs de coup de tranchet. Carte de base redessinée selon W. O'Yl et Y. Le Grand, dans Detrain et al. (1991-1992a - p. 28-30, cartes) et reproduite avec la permission de L. Detrain..

reworked in such a way that the actual number of negatives is no longer visible. A combination of both aspects can be assumed at the site. An indication for the second aspect is provided by one of the refittings discussed (**fig. 11**). The blank from tranchet blow, that was detached first, left no traces on the artifact. It is only visible on the secondary blank from tranchet blow that a blank from tranchet blow was removed before.

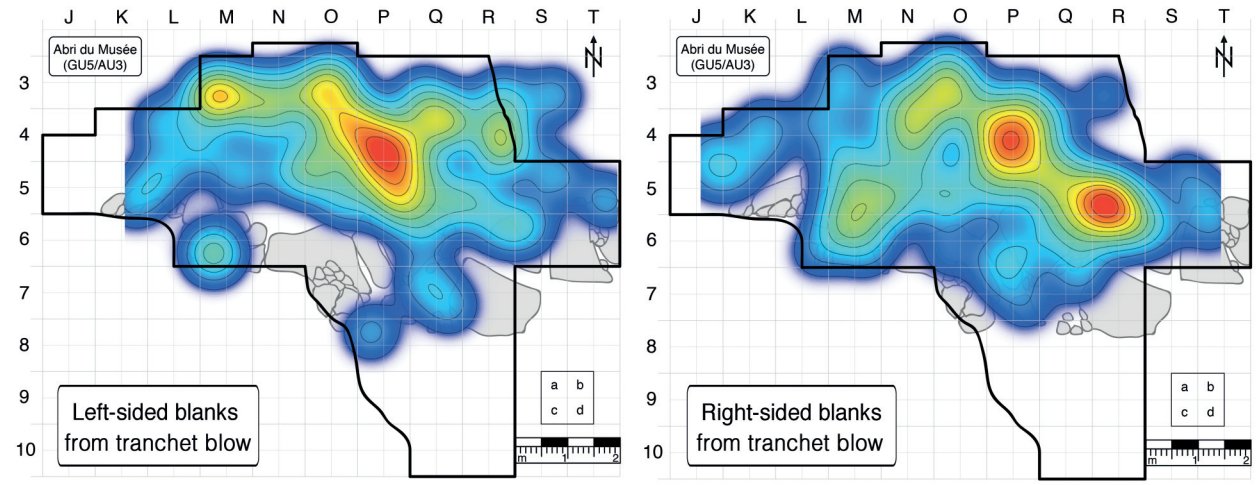
If we look at the import into the site, the literature provides us with further information. Bourguignon *et al.* (2006b - p. 79, fig. 2) could determine imported products from the surrounding (<5 km) and the local (5-20 km) territory and suggested partial operating sequences (**table 6**):
Based on this information, we can assume that neither exploited cores nor blanks of the façonnage were imported, but that configured cores or marginally



— FIGURE 19 —

Density mapping of the analyzed finds; left) distribution and density of bifacial and unifacial Keilmesser with left-sided tranchet blow; centered) distribution and density of bifacial and unifacial Keilmesser with right-sided tranchet blow and right) distribution and density of bifacial Keilmesser with double-sided tranchet blows. Base map redrawn according to W. O'Yl and Y. Le Grand, in Detrain *et al.* (1991-1992a - p. 28-30, maps) and reproduced by courtesy of L. Detrain.

Répartition de la densité des trouvailles analysées ; à gauche) répartition et densité du Keilmesser bifacial et unifacial avec coup de tranchet gauche ; au centre) répartition et densité de Keilmesser bifacials et unifacials avec coup de tranchet droit et à droite) distribution et densité du Keilmesser bifacial avec coups de tranchet double-face. Carte de base redessinée selon W. O'Yl et Y. Le Grand, dans Detrain et al. (1991-1992a - p. 28-30, cartes) et reproduite avec la permission de L. Detrain.



— FIGURE 20 —

Density mapping of the analyzed finds; left) distribution and density of left-sided blanks from tranchet blow and right) distribution and density of right-sided blanks from tranchet blow. Base map redrawn according to W. O'Yl and Y. Le Grand, in Detrain *et al.* (1991-1992a - p. 28-30, maps) and reproduced by courtesy of L. Detrain.

Répartition de la densité des trouvailles analysées ; à gauche) répartition et densité des blancs du côté gauche du coup de tranchet et à droite) répartition et densité des éclats de coup de tranchet. Carte de base redessinée selon W. O'Yl et Y. Le Grand, dans Detrain et al. *(1991-1992a - p. 28-30, cartes) et reproduite avec la permission de L. Detrain.*

processed bifaces were imported, which were then processed further or reduced on site (it is also possible that certain activities took place off-site). The presence of a certain amount of fine debris suggests that numerous activities took place on site. The known refittings of Keilmesser with tranchet blow and corresponding blanks clearly show that the tranchet blow performance, at least in some cases, must have taken place on site.

"On-the-spot reduction of blocks was not the dominant activity." (Turq *et al.* 2013 - p. 647) on the site of Abri du Musée. This assumption suggests that the raw material

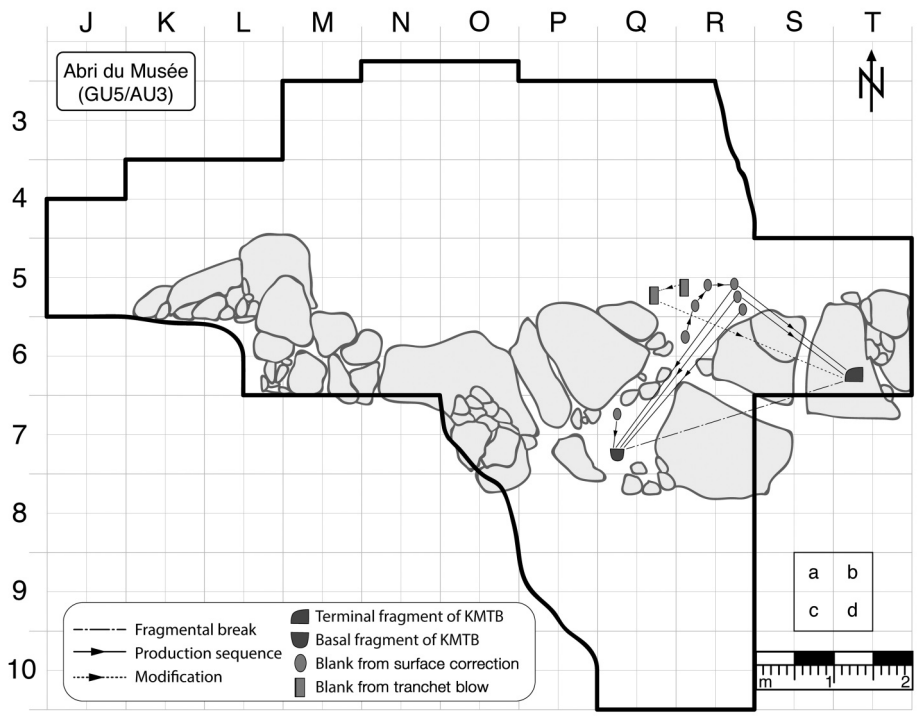


FIGURE 21

Mapping of refitted finds (which were depicted in fig.11). Base map redrawn according to W. O'Yl and Y. Le Grand, in Detrain *et al.* (1991-1992a - p. 28-30, maps) and reproduced by courtesy of L. Detrain.

Répartition des remontages (qui ont été illustré dans la figure 11). Carte de base redessinée selon W. O'Yl et Y. Le Grand, dans Detrain et al. (1991-1992a - p. 28-30, cartes) et reproduite avec la permission de L. Detrain.

blocks (cortical and non-cortical raw pieces) were initialized or even configured elsewhere to such an extent that they could then be reduced on-site, which was described by Turq *et al.* (2013) as the fragmented character of Middle Paleolithic stone tool technology. Likewise, we can assume that numerous products (blanks and blanks modified into tools) were also imported into the site.

4 | SUMMARY AND CONCLUSION

After our review of the finds from the Abri du Musée using the criteria published in Frick *et al.* 2017 and Frick and Herkert 2019, we are suggesting that there are additional artifacts that can be associated with the tranchet blow phenomenon. All artifacts previously published by Bourguignon (1992) could be confirmed. Most of the additional pieces come from previously only slightly processed volumes. Due to this increase in finds, it was both advisable and necessary to present the material that had already been published in detail again.

On some pieces a slightly altered production sequence could be determined (**fig. 11 to 16**). Since almost every piece had a square meter and quarter square meter label, spatial distribution analyses could also be carried out (**fig. 18 to 21**).
The find material of layer GU5/AU3 of the Abri du Musée site discussed here shows an interesting fragmented character (Turq *et al.* 2013). Refittings make it particularly clear which parts of the *chaîne opératoire* (transformation section according to Weißmüller 1995) are represented at a site. With regard to Keilmesser with tranchet blow, the refittings (**fig. 11 and 12**) clearly show that a large part of the work was carried out on-site. The piece in **fig. 11** even shows that the blank that was used as matrix for the Keilmesser was already produced on-site, since there are verifiable working stages before the detachment of the matrix. However, it seems that blocks that have already been decorticalized were brought in, which were then further processed on-site. Likewise, Keilmesser with tranchet blow were presumably exported from the site, since far more blanks from tranchet blow can be found than negatives on the Keilmesser with tranchet blow and the secondary blanks from tranchet blow. The fact that the Keilmesser with tranchet blow (whether bifacial or unifacial) are made on blanks (the selected matrixces were blanks) without exception also points in the same direction.
To our present knowledge, it seems as if the Keilmesser with tranchet blow assemblage from the Abri du Musée not only has the peculiarity that it is spatially quite isolated to date, but also the fact that all Keilmesser with tranchet blow were manufactured without exception from blanks. When considering other sites with this phenomenon, Keilmesser were evidently made from a huge variety of matrices (**table 7**). Taking the example from Sablière Seuron at the Mont du Beuvry in Béthune, Pas-de-Calais, France, we can clearly see this variety of matrices (Marcy 1991; Urbanowski 2003). There, the n=12 pieces with tranchet blow were made from blanks, cores, frost shard, raw pieces and one unknown matrix. This can similarly be seen in the material from the Grotte de la Verpillière I, where the pieces were made on blanks, raw pieces and frost shards (Frick *et al.* 2017b). Even in Buhlen, both blanks and raw pieces were used for the production of Keilmesser with tranchet blow ("Prądnik-Geräte"). The bifacial Keilmesser (referred to by Jöris as Keilmesser) were made exclusively from raw pieces, whereas the (mostly) unifacial Keilmesser (referred to by Jöris as "Prądnik-Schaber") were made exclusively from blanks (Jöris 2001).

Choosing the right matrix for Keilmesser is not only a matter of the available raw material. If we look at the material from the Abri du Musée, we will notice that bifaces are made on blanks as well as on flat raw pieces (discs, **fig. 5 and 6**), but the Keilmesser are made exclusively on blanks (**fig. 11 to 16**).

Imported products	Surrounding territory (5-20 km)	Local territory (<5 km)
Predetermined flakes	yes	yes
Configured or exploited cores	yes	yes
Blanks from the façonnage	yes	no
Bifaces	no	yes

— TABLE 6 —

Imported products, according to Bourguignon et al. (2006b - p. 79, fig. 2).

Pièces importées, selon Bourguignon et al. (2006b - p. 79, fig. 2)

The assumption of the excavation report (Detrain *et al.* 1994) that the assemblage GU5/AU3 is the remains of a butchering site can also be supported by the presence of the Keilmesser. As Coudenneau (2005) explains, the Keilmesser with tranchet blow were mainly used for longitudinal cutting of medium-hard materials, an activity likely to be performed at a butchering site.
So far, the site and its assemblage are unique in southwest France. According to the current state of research, similar assemblages can be found several hundred kilometers further east (sites of the Côte chalonnaise, Frick 2016; Frick and Herkert 2019), but there are isolated indications for the presence of the technology of the tranchet blow in other sites in the vicinity of the Abri du Musée, which require the same consideration.

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Site	Layer	Blank	Core	Frost shard	Raw piece	Unknown	Total of pieces with TB	Number of blanks from TB	Total of TB elements
Abri du Musée in Les Eyzies, Dordogne, France	GU5/AU3	31	0	0	0	0	31	138	**169**
Sablière Seuron at the Mont du Beuvry in Béthune, Pas-de-Calais, France	Unknown	7	1	2	1	1	12	0	**12**
Grotte de la Verpillière I in Germolles, Saône-et-Loire, France	Surface collection, mixed layer (GH 1), inside the abri (GH 18) and forecourt (GH 44 to 46)	35	0	6	3	0	44	55	**99**
Oberer Fundplatz in Buhlen, in Edertal, district Waldeck-Frankenberg, Hesse, Germany[1]	IIIb	47	0	0	158	0	205	1533	**1738**
Ciemna	CO5	24	0	0	27	0	51	unknown	**51**

— TABLE 7 —

Matrices of pieces with tranchet blow from different sites; data taken from own analyses (Abri du Musée, Grotte de la Verpillière I) and literature: Sablière Seuron (Marcy 1991; Urbanowski 2003), Buhlen (Jöris 2001) and Ciemna (Sudoł 2013). 1 The number of pieces with tranchet blow is a little higher here, the number in the table indicates the Keilmesser with tranchet blow, which can be assumed to have been made from raw pieces (Jöris 2001 - p. 33 & p. 52). In addition, there are n=4 Halbkeile, n=2 Fäustel, n=1 Micoquian biface and n=3 Faustkeilblätter, each with a tranchet blow, but the matrix could not be identified.

Matrices de pièces avec coup de tranchet de différents sites ; données issues de nos propres analyses (Abri du Musée, Grotte de la Verpillière I) et de la littérature: Sablière Seuron (Marcy 1991 ; Urbanowski 2003), Buhlen (Jöris 2001) et Ciemna (Sudoł 2013). 1 Ici, le nombre de pièces avec coup de tranchet est un peu plus élevé ; la quantité indiquée dans le tableau montre les Keilmesser avec coup de tranchet, qui peuvent être supposés avoir été faits à partir de pièces brutes (Jöris 2001 - p. 33 & p. 52). De plus, il y a n=4 Halbkeile, n=2 Fäustel, n=1 Biface micoquien et n=3 Faustkeilblätter, chacun avec un coup de tranchet, mais dont la matrice n'a pu être identifiée.

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