A Middle Paleolithic/Pleistocene Stratified Sequence at Coussey/Sionne in the Meuse Alluvial Valley (Vosges, France)

Laurent Delaunay[1], Fréderic Blaser[2,1], Anne Gebhardt[3,1], Nicolas Meyer[1]

1 INRAP

2 UMR 7041, Ethnologie Préhistorique, Maison de l'archéologie et de l'Ethnologie, Nanterre

3 UMR7362-LIVE/CNRS, Université de Strasbourg ; UMR7360-LIEC, Université de Lorraine

ABSTRACT

The stratified Middle Paleolithic site of Coussey in Lorraine (Vosges, France) was discovered in 2014 in trial trenching during rescue archaeology. The site, located at the confluence between the Saonelle and the Meuse rivers, is dominated by the corallian calcareous ledge of the Hauts de Meuse, spreading generally towards the west from the river channel.

The local geological context is characterized by recent alluvial formations and the Woëvre clays. Oxfordian chert deposits rich in chalcedonian concretions are documented in the surrounding hills. Field observations of this sequence, situated at the bottom of the slope, showed more than 2 m of thick loamy clayey colluvium deposits from the mixed alluvial sediment of the flood plain. Solifluction of surrounding slopes occurring in the Late Glacial and Holocene periods allowed the preservation of a 2 m thick pedosedimentological sequence including a humus horizon. The 82 lithic artifacts did not allow a more precise chrono-cultural dating other than Middle Paleolithic. Lithics were the only preserved finds, distributed within several archaeological levels and occurring with varying states of preservation. They were recovered on 2 ha of the 8 ha of the surface surveyed. Paleolithic peoples seem to have benefited from the immediate proximity of good quality Oxfordian chert outcrops (chert of Neuchâteau).

The preservation of these stratified levels from the Pleistocene has made the Coussey site a major discovery from the Lorraine region, filling a gap in our archaeological documentation of northeast France.

RÉSUMÉ

Le site de Coussey en Lorraine a livré plusieurs niveaux archéologiques du Paléolithique moyen. Il a été découvert en 2014 lors d'un diagnostic archéologique. Le site, localisé à la confluence des rivières de la Meuse et de la Saonelle, est dominé par la corniche corallienne calcaire des Hauts de Meuse et s'étale sur la boucle west du lit majeur de la rivière. Le contexte géologique local est caractérisé par des formations alluviales récentes et les argiles de la Woëvre. Des dépôts de silex oxfordiens riches en concrétions calcédonieuses sont mentionnés dans les collines environnantes.

Cite this article: Delaunay, L., F. Blaser, A. Gebhardt, and N. Meyer. 2024. A Middle Paleolithic/Pleistocene Stratified Sequence at Coussey/Sionne in the Meuse Alluvial Valley (Vosges, France). In *The Rhine During the Middle Paleolithic: Boundary or Corridor?*, ed. by H. Koehler, N. J. Conard, H. Floss, A. Lamotte, pp. 183–207. Tübingen: Kerns Verlag. ISBN: 978-3-935751-35-3.

Les observations de terrain de cette séquence, située en pied de versant, montrent plus de deux mètres de dépôts glaiseux argileux recouverts par des sédiments alluviaux. Le démantèlement tardiglaciaire et holocène des versants environnants par solifluxion a permis la préservation d'une séquence pédosédimentologique de deux mètres d'épaisseur qui comprend un horizon humifère. Les 82 artefacts lithiques recueillis ne permettent pas une datation plus précise que « Paléolithique moyen ». Les vestiges lithiques étaient les seuls conservés, répartis au sein de plusieurs niveaux archéologiques, avec différents états de conservation. Ils ont été identifiés sur 2 hectares parmi les 8 explorés. Les hommes du paléolithique semblent avoir profité de la proximité immédiate de gisements de chaille oxfordienne de bonne qualité (chaille of Neuchâteau). La conservation de niveaux pléistocènes stratifiés à Coussey est une découverte majeure pour la Lorraine. Elle comble un vide dans notre documentation archéologique du nord-est de la France.

ZUSAMMENFASSUNG

Die Fundstätte Coussey in Lothringen zeigt mehrere archäologische Schichten aus dem Mittelpaläolithikum. Es wurde 2014 bei einer archäologischen Sondage entdeckt. Der am Zusammenfluss von Maas und Saonelle gelegene Standort wird vom Kalksteinkorallenfelsvorsprung der Hauts de Meuse dominiert und erstreckt sich über die Westschleife des Hauptflussbetts. Der lokale geologische Kontext ist durch rezente Schwemmlandformationen und Woëvre-Tone gekennzeichnet. In den umliegenden Hügeln werden oxfordische Feuersteinvorkommen dokumentiert, die reich an Chalcedonkonkretionen sind.
Feldbeobachtungen dieser am Fuße des Hangs gelegenen Sequenz zeigen mehr als zwei Meter tonige Ablagerungen, die von alluvialen Sedimenten bedeckt sind. Der spätglaziale und holozäne Abbau der umliegenden Hänge durch Solifluktion ermöglichte den Erhalt einer 2-m dicken pedosedimentologischen Abfolge, die einen Humushorizont umfasst. Die 82 gesammelten Steinartefakte erlauben keine genauere Datierung als "Mittelpaläolithikum". Die einzigen erhaltenen Steinartefakte waren auf mehreren archäologischen Ebenen verteilt und hatten unterschiedliche Erhaltungszustände. Sie wurden auf 2 Hektar der 8 erkundeten Hektar identifiziert. Die Menschen des Paläolithikums scheinen von der unmittelbaren Nähe der Lagerstätten hochwertiger Oxford-Chaille (Chaille von Neuchâteau) profitiert zu haben. Die Erhaltung der stratifizierten Schichten des Pleistozäns in Coussey ist eine wichtige Entdeckung für Lothringen. Es füllt eine Lücke in unserer archäologischen Dokumentation Nordostfrankreichs.

INTRODUCTION

In 2014, within the framework of an extension to a quarry located between Sionne and Coussey in the western part of Vosges (Fig. 1), a preventive archaeological assessment was carried out in the area known as "Les Plates Terres" (Meyer 2014). Several phases of activity, spanning the period from the Middle Paleolithic to the present, were revealed within the 11 hectares investigated. The lithic industry is associated with a stratified upper Pleistocene pedo-sedimentary sequence, buried under more than a meter of Holocene colluvial deposits.

Despite their fragmented character, the data constitute a first step in raising awareness of the deficiencies of preventive archaeology in the detection of Paleolithic sites in Lorraine. This discovery should be a sig-

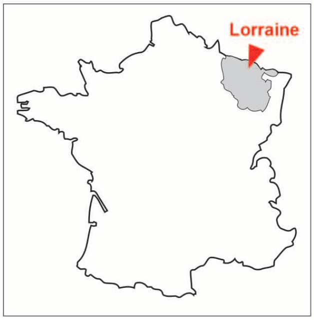
Fig. 1. right
Location of the site on IGN map.

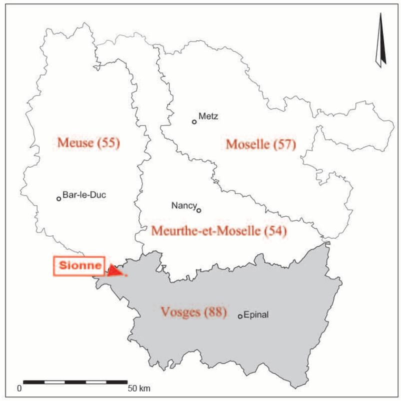
Lorraine, Vosges,
Coussey-Sionne,
Les Plates Terres - phase 3

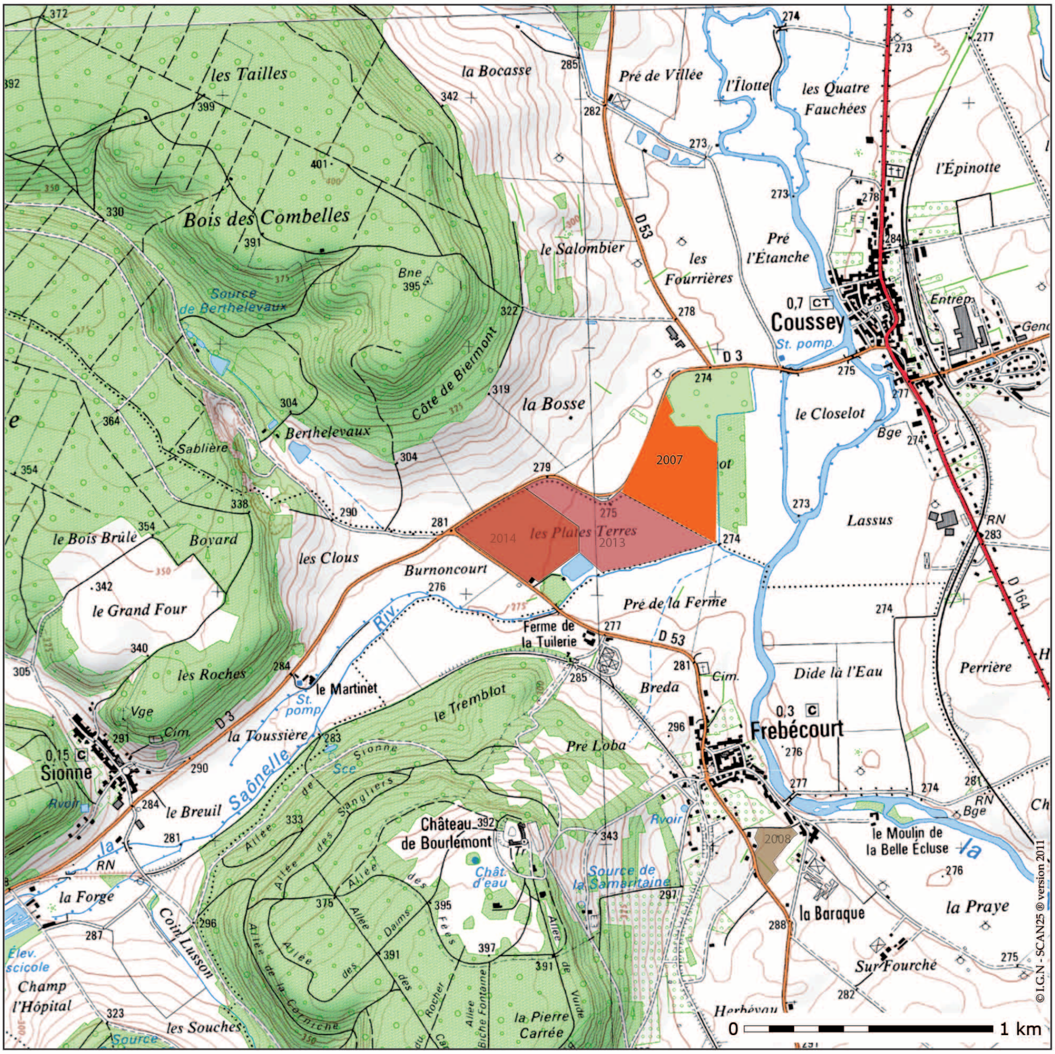
Coord. Géograph. (Greenwich) :
Long : 05°38'49.2"
Lat : 48°24'04.0"

Amplitude Alti (ngf) :
273 - 279 m

Lambert 93 :
X : 897053
Y : 6814528







nificant starting point for improving methodological, stratigraphic and archaeological approaches in this key area. Indeed, Lorraine constitutes a natural crossroads between various regions (Fig. 2): via the Rhine corridor, it is linked to the extensive plains of the north and east, as well as to southern regions. It also allows access westwards, to the heart of the Paris Basin, via the nearby Marne River. This central geographical location means that, even as far back as the Paleolithic, the region witnessed significant population movements.

REGIONAL SETTING AND PREVIOUS RESEARCH

In more recent studies the Lorraine region emerges as a virtual desert in terms of Paleolithic settlement. However, a re-examination of old discoveries and numerous past surface collections can throw valuable light on this issue (Janot 1988; Asselin et al., this volume; Figs. 2, 3).

In the Darney area, situated 45 km southeast of Coussey, several sites were discovered between 1971 and 1993 within a 10 km area: Dombasle-devant-Darney, Jésonville, Noncity, Sans-Valois, Provenchères-les-Darney (collective survey work). The eastern part of the Vosges Department is characterized by a lithic industry based on quartzite and quartz; flint is also present but in small quantities (Jannot 1981; Guillaume 1982).

Close to Coussey, numerous surface sites have been recorded in recent years, in particular by Serge Beguinot between 2009 and 2014 (Beguinot 2015; Asselin et al., this volume).

Paleolithic sites with stratigraphical contexts are much rarer with only 6 recorded examples (Guillaume 1988). The closest is the cave site of Jeannüe in Rebeuville, located 10 km from the Coussey site. Other sites are located over 50 kilometers away.

The oldest occupation sites, Vassincourt and Archettes, occur in alluvial contexts and have been assigned to the Riss glaciation by various authors (Bordes 1955; Maubeuge 1961; Guillaume 1982).

Others have been attributed to the Eemien period (Vincey, Guillaume 1988) and the early Würmian (Guillaume 1982; Thévenin 1975). They come from different contexts: sinkholes as in the case of Vincey and Chavelot (Guillaume 1982, 1988), loess deposits sealing terraces (Ludres) and a cave (Rebeuville, Guillaume 1988). The age of these discoveries limits their chronological and cultural interpretation.

This situation prevails in numerous regions but, in places, preventive archaeology has allowed us to rectify this old image of a northern desert subject to extreme weather conditions (Gamble 1986).

In Lorraine, this contribution remains slight, mainly because there is a limited history of research into the Paleolithic period of the region.

The excavation of the protohistoric site of Frébécourt "La Fourche" (Deffressigne 2010), situated 2 km south-southeast of Coussey, is one of only a few sites to have yielded a lithic industry based on raw materials identical to those from the site of "Les Plates Terres." Unfortunately, this determination was made after field work was completed and there was no oppor-

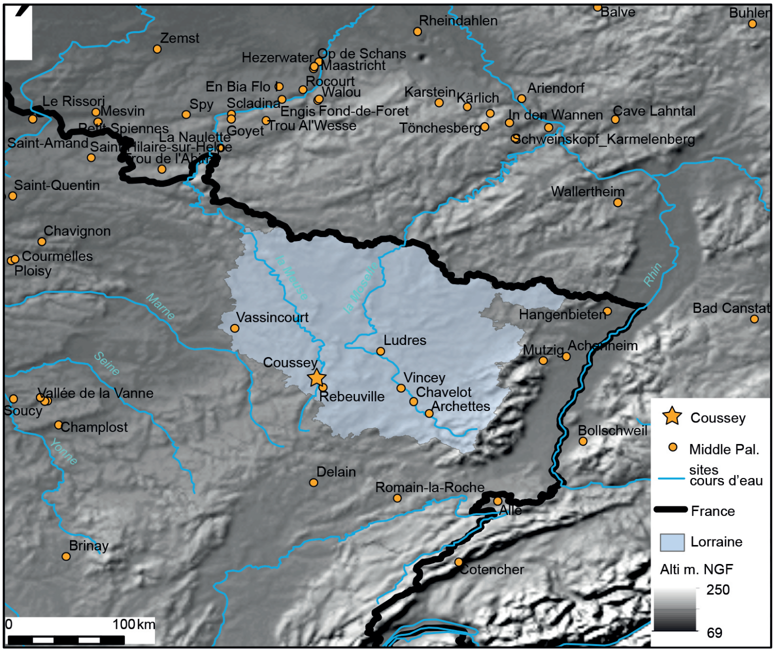


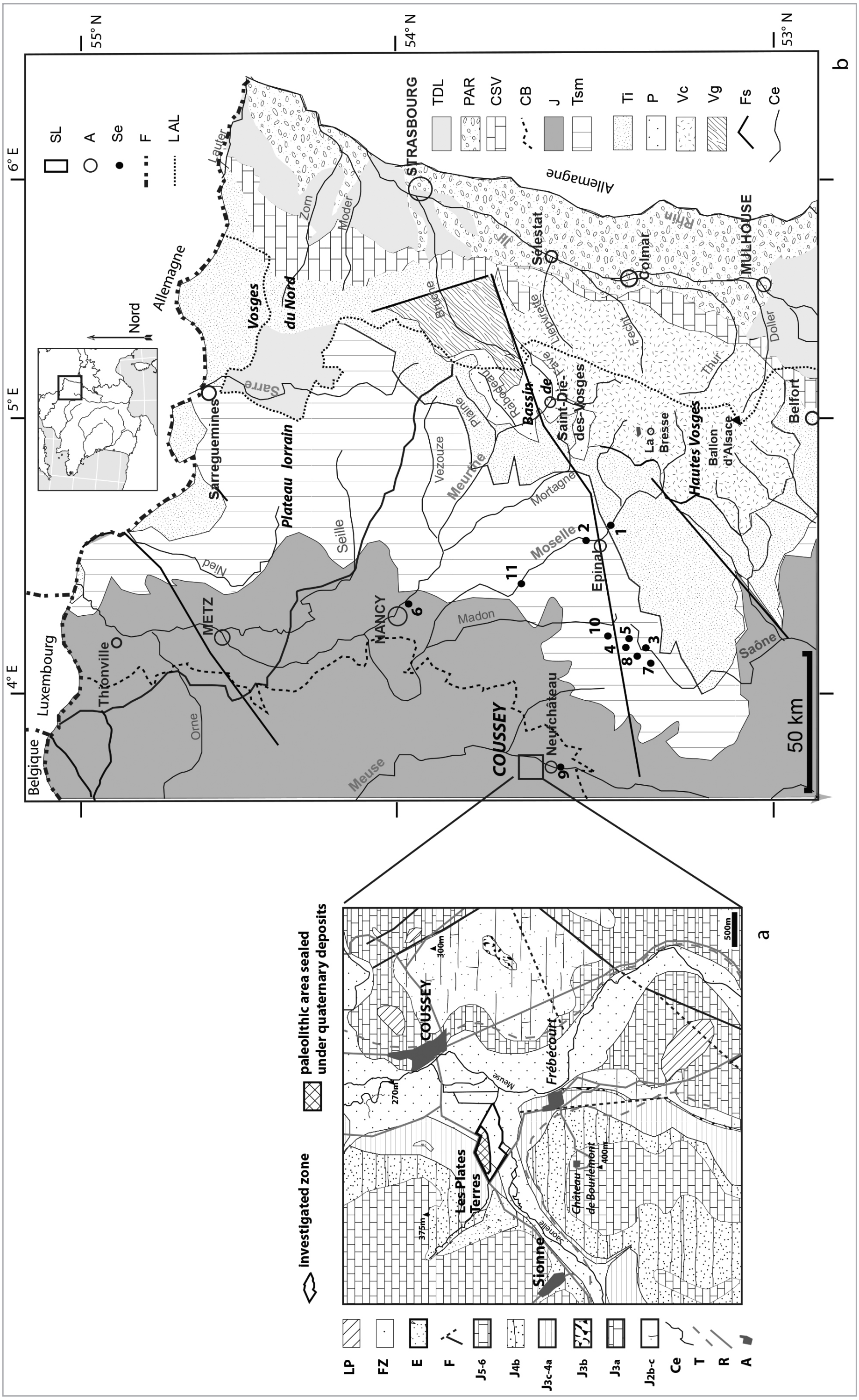
Fig. 2.
Location of the site and archaeological context.

tunity to carry out a new excavation. The material was contained in brown clayey pockets (Chaussé 2010). The context and aim of the excavation (Iron Age), the absence of an associated stratigraphy and the lack of characteristic lithic artifacts prevented the investigators from linking the remains with a specific, cultural facies from the Middle Paleolithic.
Previous diagnostic work carried out close by (Jude 2007; Forelle 2013) unearthed very few lithic artifacts on the alluvial plain.
This context has motivated investigators to pay special attention to the lithic-rich levels here (Meyer 2016) and to establish a specific methodology involving the excavation of deep trenches.

METHODOLOGY

At Coussey, the research was constrained by the process of rescue archaeology: 15 deep trenches, each 25-m long, were dug in areas free of Late Holocene occupation (Fig. 4, top). Five of these followed a downward transect, stretching from the road to the river. The technique of digging discontinuous, 25-m long trenches, separated by 10-m long gaps, and a lack of time meant that no continuous deep transect was excavated; in an alluvial context, this approach made it difficult to correlate the different profiles.

When possible, trenching systematically stopped on the top of the gravel layer (Fig. 4a). All of the lithic material was retrieved from the clayey formations. Trench 63/11 (Fig. 4b) was investigated by the removal



a
b
investigated zone
paleolithic area sealed under quaternary deposits
LP
FZ
E
F
J5-6
J4b
J3c-4a
J3b
J3a
J2b-c
Ce
T
R
A
COUSSEY
Frébécourt
Les Plates Terres
Sionne
Château de Bourlémont
Meuse
Vaonelle
375m
400m
270m
300m
500m
55° N
54° N
53° N
4° E
5° E
6° E
SL
A
Se
F
L AL
TDL
PAR
CSV
CB
J
Tsm
Ti
P
Vc
Vg
Fs
Ce
Nord
Belgique
Luxembourg
Allemagne
Thionville
METZ
NANCY
Sarreguemines
Plateau lorrain
Vosges du Nord
STRASBOURG
Selestat
Colmar
MULHOUSE
Belfort
Epinal
Saint-Dié-des-Vosges
Bassin de
Hautes Vosges
Ballon d'Alsace
La Bresse
Neufchâteau
Moselle
Meurthe
Madon
Seille
Nied
Orne
Sarre
Vezouze
Plaine
Rabodeau
Mortagne
Bruche
Zorn
Moder
Lauter
Ill
Rhin
Fecht
Thur
Doller
Lièpvrette
Fave
Saône
50 km
1
2
3
4
5
6
7
8
9
10
11

Fig. 3. left
a: Location of the site of "les Plates Terres" (Coussey /Sionne, Vosges) on the geological map (after Maubeuge 1974). $j_{2b\text{-}c}$: Middle/upper Bathonian compact limestone; j_{3a}: callovian and flaggy Bathonian limestone; j_{3b}: calcareous marl with ferrougeneous oolite; $J_{3c\text{-}4a}$: Woëvre grey-blueish clay; J_{4b}: Oxfordian clayey marl with chert (calcedonic nodules): $J_{5\text{-}6}$: Oxfordian coral limestone; E: soliflucted calcareous debris; FZ: rounded calcareous pebbles and gravel with clay from recent alluvial deposits; LP: clayey/loamy deposits from local calcareous alteration: F: fault; Ce rivers; R: road; T: trackway; A: cities; **b:** location of the site of Coussey and the other sites mentioned in the text superimposed on the geological map of the Grand-Est area (simplified from Lexa-Chomard and Pautrot (2006) and Sell et al.(1998). SL: Sillon lorrain, A, cities, Se: studied sites, F. country border, LAL: Alsace/Lorraine border, TDL: Terraces and loess deposits, PAR: Rhine Alluvial Plain, CB: bajocian steps, J. Jurassic, Tsm: Upper (Keuper) and Middle (muschelkalk) Trias, Ti: lower Trias (Buntsandstein), P: Permian (Grès) Saint-Dié-des-Vosges basin, Vc: Crystalline Vosges basement, Vm: Middle Vosges basement, Fs, Main structural faults, Ce: river. 1; Vincey, 2, Chavelot, 3: Darney, 4: Dombasle-les-Darney, 5: Jésonville, 6: Ludres, 7: Nonville, 8: Provenchère-les-Darney, 9: Rebeuville, 10 Sans Valois, 11: Vincey.

of fine layers, 5 cm in thickness, and a test pit (Fig. 4c), measuring 1 m^2, was excavated in order to evaluate the density of lithics and to understand the local taphonomical processes.

The two most representative reference profiles, "Geol5" and "Carré test" (Fig. 4, 5), were subjected to soil micromorphology analysis. Thin sections, measuring 9 x 6 cm, were created by the Thomas Beckmann Laboratory (Germany) and described following the international terminology (Bullock 1985). Even if the clayey composition of the sediment may render OSL dating too unreliable for this site, three 30-cm long tube samples were taken for OSL dating. One tube was sent for dating to the Silesian University of Technology (Poland), providing an age around 46.3(39) ka. We are now currently awaiting a further extension of the gravel pit in order to have an opportunity to continue our investigations.

GEOMORPHOLOGICAL CONTEXT

The site of Coussey is located in northeastern France, 5 km northwest of Neufchâteau, at the confluence between the Sâonelle and the Meuse rivers, close to the western limit of the Vosges Department (Fig. 3). The investigated zone extends along the river bank and is dominated by the south-facing coral limestone cliff of the Meuse Uplands which dates to the Rauracien period ($J_{5\text{-}6}$). On the surrounding slopes, probable Late Glacial erosion dells are still clearly visible in the landscape.

The local geological context is characterized by recent alluvial formations (calcareous pebbles in a clayey matrix, Fz) and the Woëvre clays ($J_{3c\text{-}4a}$) belonging to the Callovian/Oxfordian transition (Maubeuge 1974). Oxfordian (J_{4b}) chert deposits are rich in chalcedonic concretions. Commonly occurring in the surrounding hills, these nodules may have been used for Middle Paleolithic tool production. This geomorphological context would therefore have benefited Paleolithic human communities. Soliflucted calcareous debris (E) occurs locally in certain small dry valleys which are perpendicular to the principal valleys.

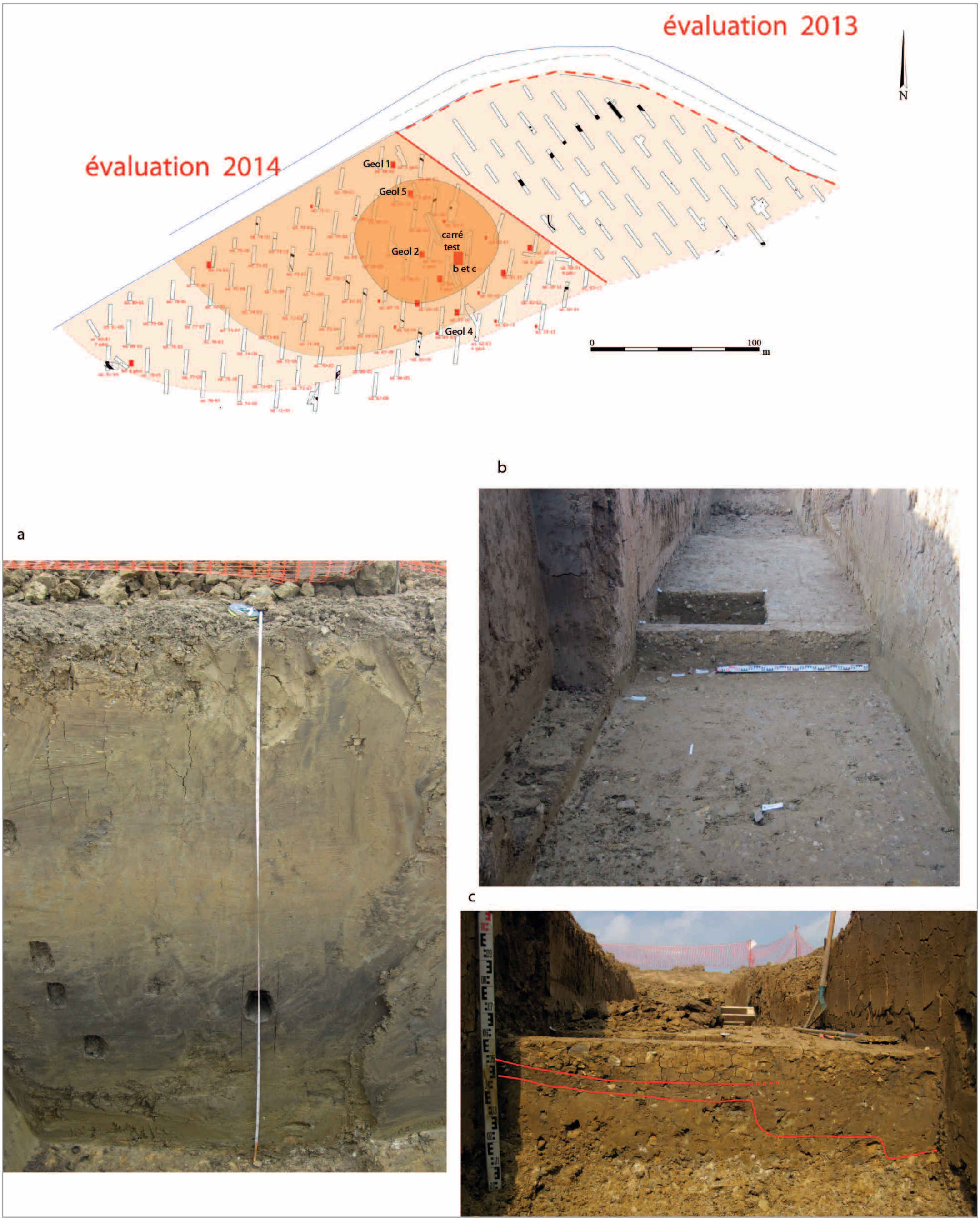


Fig. 4.
Location of the trenches (top), lithic concentration (c) and views of field investigation (a,b).

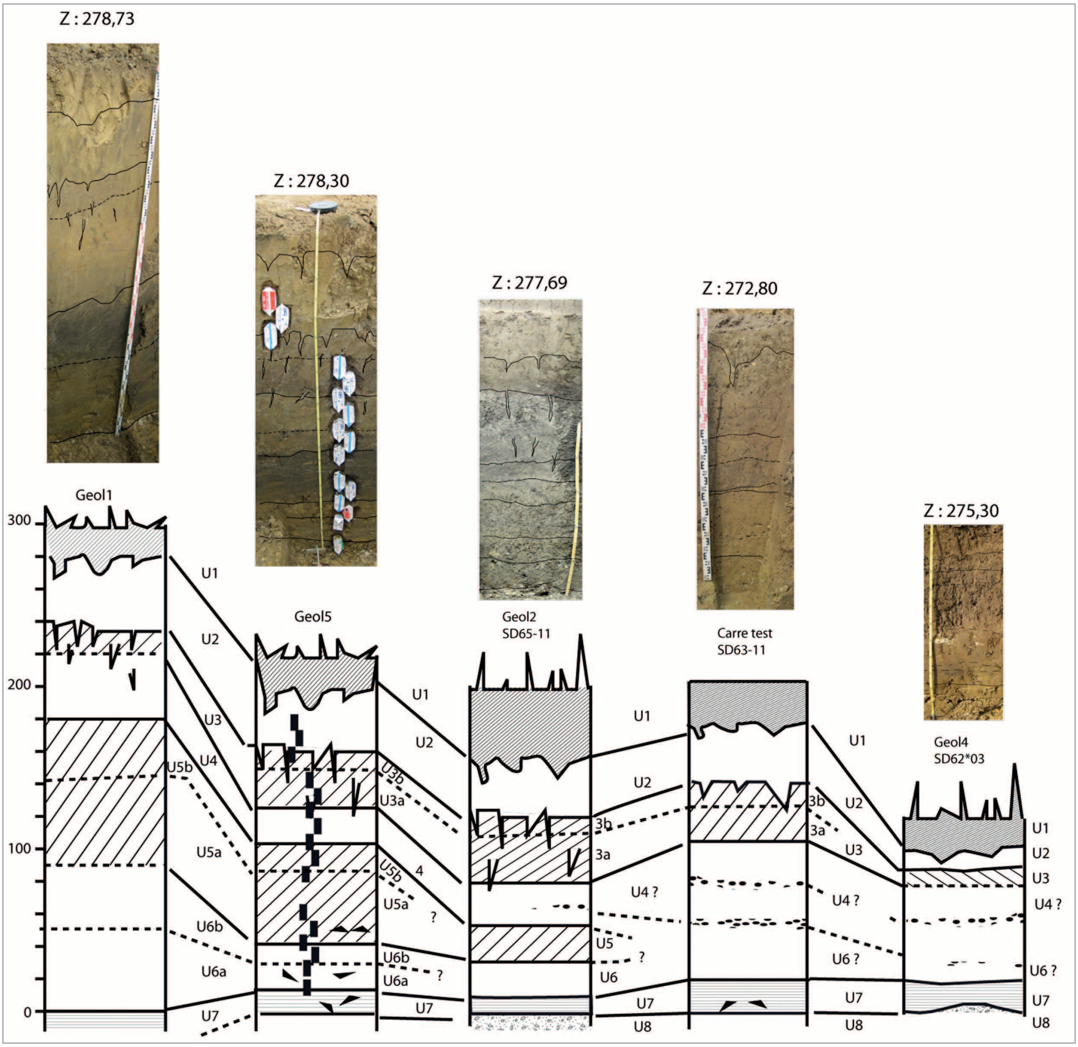


Fig. 5.
Main profiles from the transect.

Observations in the deep trenches reveal late quaternary (Holocene) loamy/clayey slope deposits covering the Middle Paleolithic artifacts. Probably because they are both weathered, these reworked formations are difficult to distinguish from the Woëvre layers, and they were, therefore, not mapped by Maubeuge (1974). Near the slope bottom (Geol5) these deposits are over 2 m in depth, and they become steadily thinner (*Carré test*) before disappearing towards the center of the channel (Figs.4, 5).

THE PEDO-SEDIMENTARY SEQUENCE AT COUSSEY

Main features observed and their interpretation

Five profiles were described along the transect through the main river bed (Fig. 5). On the better developed one (Geol5), blocks of undisturbed sediment were sampled for soil micromorphology analysis and for OSL dating. The main characteristic features observed in the field and under the microscope are grouped, from bottom to top, in Table A1 and illustrated in Figure 6.

All of the sequences show a compact soil microstructure, with cracks that are not very well connected. Mineral compounds are pseudo-angular quarzitic sands and silts with small gravels of chalcedony and decalcified chert. The groundmass is very clayey, reflecting the local Oxfordian marl, with a loamier influence toward the top.

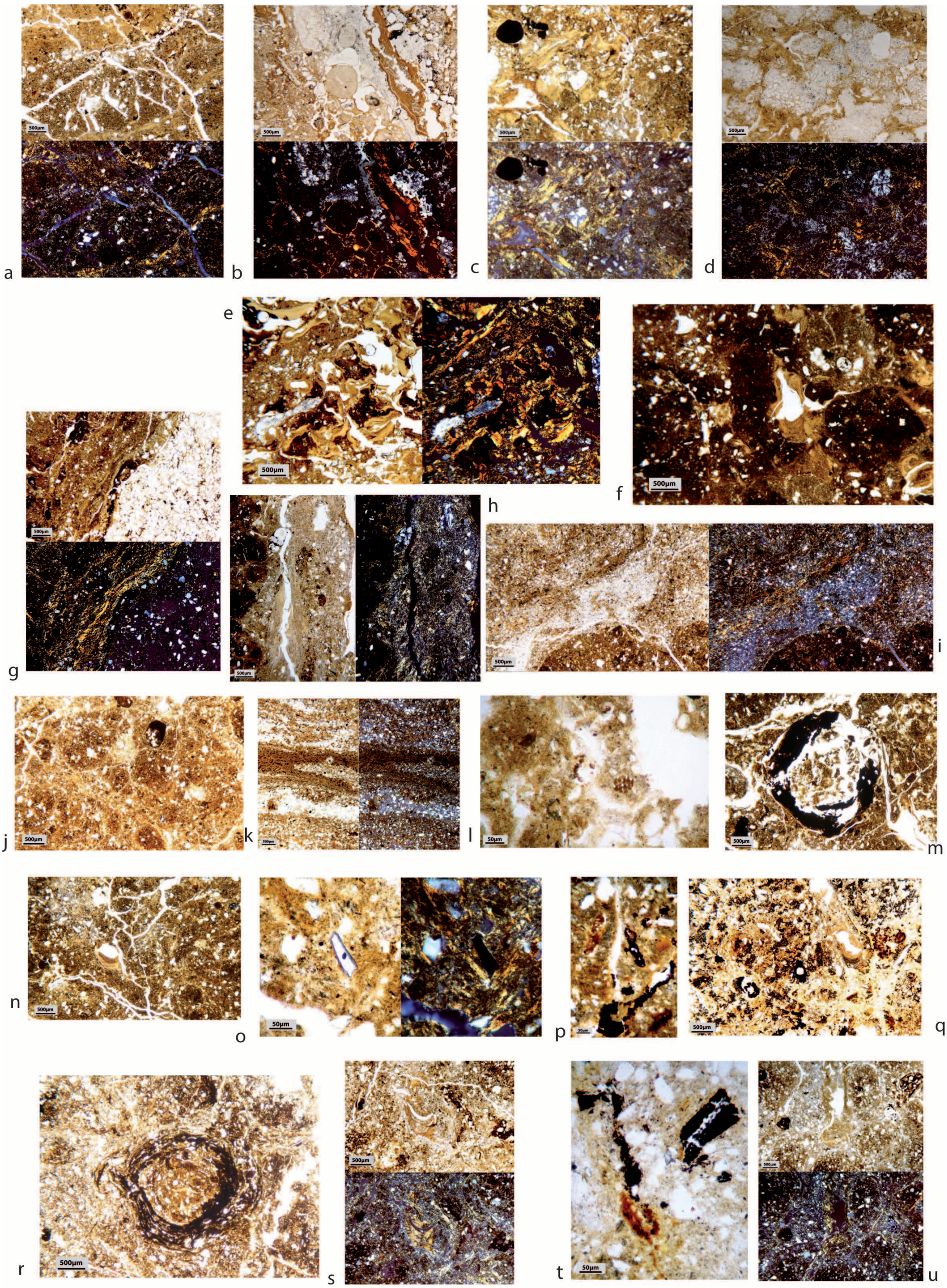
Fig. 6. right
Main soil micromorphological features occurring in the different units.

The base of the profile starts on top of a layer of gravel bound in a clayey sandy matrix (U8): this pattern can be observed at the base of most of the sequences.

On the top of this first layer we find a compact yellowish-grey loamy-clay (U7), measuring about 5 cm in thickness, which includes reworked, weathered and broken lithic artifacts. This homogeneous layer is observed along all of the transects over an area of 1.9 hectares. At the bottom, this unit U7 ($L1_{bottom}$) has a compact microstructure with a well birefringent reticulated groundmass. Pedofeatures include some yellowish limpid clay coatings characteristic of the BT horizon of a luvic sol formation. Locally strongly-bleached groundmass is the result of significant post-depositional weathering of the sediment.

An oxidized yellowish-brown loamy clay (**U6a**, $L1_{top}$, L2) is characterized by the presence of small, blunt, yellowish calcareous pebbles. Chert fragments are weathered. Unbroken, disturbed and weathered Paleolithic chert tools occur within this layer. In this unit, the yellowish limpid clay coatings are slightly disrupted. Ferruginous impregnations are darker, and rounded iron concretions occur more often. The yellowish, slightly disrupted, clay coatings indicate the formation of a BT horizon before post-pedogenetic movement in the sediment. Overlying this last unit is a slightly darker and loamier unit (**U6b**, L3, $L4_{bottom}$) featuring stratified intercalations, and mass-flow silt deposits along with mineral compounds. Iron features (rolled concretions and impregnations) are still abundant. This reveals strong mass movements with a water-saturated and rapid sediment dynamic, as occurs in slope deposits. These levels extend over 2.8 hectares. Towards the flood plain, Layers 6a and 6b become blurred and difficult to follow in the transects (*Carré test,* Geol4, Fig. 4, Fig. 5).

The next dark brownish-black loamy-clay **U5a** ($L4_{top}$ to L7) layer contains *in situ* unweathered lithic artifacts. This layer displayed small polygons, or a 'giraffe skin'-like surface, during surface scraping. It is characterized by the first occurrence of dusty coatings. The presence of abun-


a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p
q
r
s
t
u

Unit	Pedo-sedimentary field observation	TS	Soil Microstructure
1	Loamy clayey organic crumby greyish-brown unit, many small roots and some biogaleries. with rounded millimetric red tiles (0,1 à 1cm), mooved by run off and long term ploughing. Good structural transition with the lower unit. Modern cultivated horizon. COIIILA	/	
2	Loamy clayey yellowish-brown unit, fine roots, homogeneous, quite compact (dry) vertical prismatic structure, rounded millimetric of red tiles (0,1 à 1cm) mooved by run off and long term ploughing. Weak color transition with the lower unit. Structural horizon COIIIS	L16 L15 L14	Compact, unconnected cracks and chambers ; no pedality.
3b	Loamy clayey brownish grey unit, prismatic structure, very fine fresh roots, rounded millimetric of red tiles (0,1 à 1cm) mooved by run off and long term ploughing, start of grey deep cracks. Weak transition of colour with the lower unit. Colluviated COIIA horizon	/	
3a	Clayey-loamy grey unit, prismatic structure, fine fresh roots with rounded millimetric red tiles fragments (0,1 à 1cm) mooved by run off and long term ploughing, grey cracks. Good transition of colour with the lower unit. Horizon COIIA.	L13 L12 L11ht	Compact, unconnected cracks and chambers, no pedality.
4	Clayey-loamy orange-yellowish unit, prismatic structure, rounded millimetric red tiles fragments (0,1 à 1cm) mooved by run off and long term ploughing, basal limit of grey cracks. Weak color transition with the lower unit. Eluvial horizon COIIE?	L11bs L10 L9ht	Compact, unconnected cracks and chambers, no pedality.
5b	Clayey-loamy brownish-grey unit, prismatic structure,rounded milli-metric red tiles fragments. Sharp transition of color with yhe lower unit. Illuvial horizon COIIBT?	L9bs L8	Compact, unconnected craks and chambers, no pedality.
5a	Dark brownish-black loamy-clayey compact unit, crackeled aspect («giraf skin»). Good color limit with the lower unit. Horizon COIA	L7 L6 L5	Compact, weak pedality, layered at the top (Fig2q)
6b	Loamy-clayey yellowish brown unit, prismatic structure, small angu-lar calcareous gravel mooved by surface run-off. Weak limit of color with the next unit. Structural horizon COIs	L4bas L3	Cracks quite well con-nected, weak pedality.
6a	Clayey-loamy yellowish unit, homogeneous vertical compact pris-matic structure with iron and manganese impregnations and some reworked blunt jellowish calcareous gravel and archaeological chert. Gradual textural transition with the lower unit. Middle paleolithic, disturbed	L2 L1ht	compact (Fig2c), vesicular porosity, no birefringence, layered aspect at the top of L1 haut.
7	Alluvial compact yellowisch-grey loamy-clay with calcareous weath-ered and blunt pebbles. In situ archeological chert associated with faunal tooth Middle paleolithic. Date on tooth / C14 ?. Horizon COID	L1 bas	Compact (Fig2b), no pedal-ity, many small unconnected cracks and chamber.
8	Alluvial calcareous rounded gravel in a clayey-sandy matrix.		

Table 1. Pedo-sedimentary and soil micromorphological description.

Soil Compound	Soil Micromorphological features
Quartzitic pseudo-angular sand (10%, 50µm), gravels, chert fragment (2%, 200µm) with dissolution features (Fig.4f), porphyric reticulated groundmass, good birefringence, some quite big charcoal and charred organic matter. Aboundant fresh vegetal fragments (Fig.4df).	Dusty silty coatings and some small limpid clay coatings, sometimes alternating (Fig.4c), some limpid clay coating over the dusty silts(Fig.4a), intercallations (Fig.4g), papules (Fig.4ef), Earthworms galeries, polymerisation artefacts.
Pseudo-angular quartzitic sand (10%, 50µm), gravels, declacified chert fragments (2%, 200µm), porphyric reticulated groundmass, good birefringence, charcoal fragments (Fig3ef).	Reworked marl fragments (Fig3xg), some limpid clay coatings with seldom silty coating (Fig3h), iron imprégnations (Fig3f) and concretions (Fig3e), polymerisation artefacts.
Fine pseudo-angular sand and silt (100-50µm ; 10%) and decalcified chert, calcedony (5%) ; porphyric reticulated groundmass, good birefringence.	Some alternating brown dusty and limpid orange clay coating (Fig3d), rolled iron concretions (Fig3c), localy shearing features, polymerisation artefacts.
Fine pseudo-angular sand and silt (100-50µm ; 5 à 20%) and decalcified chert, calcedony; porphyric reticulated groundmass, good birefringence.	Dusty clay coatings, strong iron impregnation (Fig3b), polymerisation artefacts (Fig3b).
Fine pseudo-angular sand and silt (100-50µm; 5 à 20%) and decalcified chert, calcedony; porphyric reticulated groundmass, good birefringence, aboundant organic fraction: phytolithes (Fig2n), humified/ferruginisied vegetal fragments (Fig2p ; Fig2xr)	Dusty clay coating (Fig2o), iron rolled concretions (Fig2m) and impregnations (Fig2a).
Fine pseudo-angular sand and silt (100-50µm ; 5 à 20%) and decalcified chert, calcedony (Fig2k), calcedony, ; porphyric reticulated groundmass, good birefringence.	Craks filled with flow silt (Fig2li), iron rolled concretions and impregnations.
Fine pseudo-angular sand and silt (100-50µm ; 5 à 20%) and decalcified chert, (Fig2gh), calcedony, porphyric reticulated groundmass (Fig2f), localy no groundmasse.	More or less limpid orange clay coatings along a chert fragment (Fig2d), dusty coating, stratified intercalations (Fig2e), rounded sediment features (Fig2d). Strong ferruginisation, with iron big rolled iconcretions (Fig2j) and linear accumulations (Fig2xd).
Fine pseudo-angular sand and silt (100-50µm ; 5 à 20%), unhomogeneously displayed, some small gravels (quartzite, decalcified chert) ; porphyric clayey reticulated groundmass, excellent birefringence (Fig2a)	Clayey reworked fragments, thick yellowish limpid clay coatings, more or less layered, local strongly bleached zones. Iron concretions.

dant small organic fragments (more or less ferruginized) and phytoliths indicates abundant vegetation, rich in herbaceous plants (steppic soil?). U5a is covered by a greyish loamy clay, denoted **U5b** (L8, $L9_{bottom}$). In this U5b layer, many notable iron features are observed: impregnations, galleries, coatings, but also rolled nodules and iron/humified organic fragments. Well-developed on the edge of the river bed, the dark Layer 5 disappears towards the center of the alluvial plain.

The yellowish clayey loam **U4** ($L9_{top}$ to $L11_{bottom}$) becomes thicker and includes several gravel layers toward the channel center. It corresponds to the basal limit of the grey cracks. Limpid clay coatings are observed, sometimes alternating with dusty ones. Like U5b, unit U4 contains significant iron features (impregnation, coatings) and rolled nodules. Dusty clay and silty coatings are frequently observed when the top soil (in the upper part of the sequence) is exposed by ploughing.

The last layers, **U3** to **U1**, are a clayey loam unit characterized by an abundance of rounded millimetric red tile fragments and dusty clay coatings; the sediment also contains fine charcoal and finely fragmented ferruginized organic matter. The presence of millimetric rounded red tile fragments indicates long-term ploughing of this upper sequence in the Historic Period. In the "*Carré test*" profile, the top of the upper dark grey unit (U3b, Fig. 5) is associated with reworked protohistoric artifacts revealing a marked erosion/colluviation phase. The deep grey cracks in the upper soil sequence (U3b) might be related to a period of significant desiccation of the soil.

Main phases in the evolution of the sequence and relative chronology of the formation of the units

From bottom to top, within this pedo-sedimentary sequence of units (U), we can identify at least nine phases (Fig. 7) of active erosion/sedimentation (S) or stabilization with pedogenesis and soil formation (P):

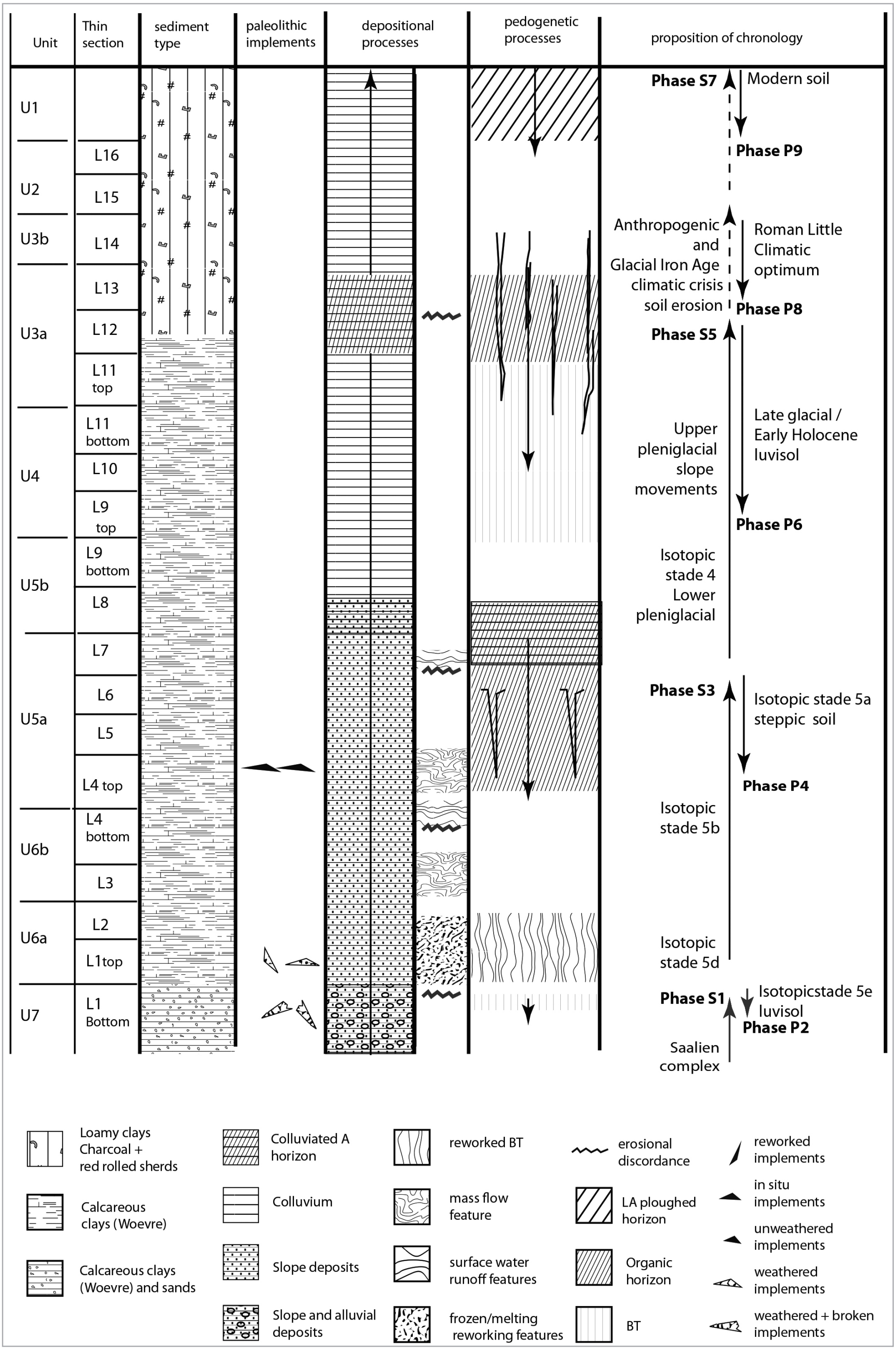
Phase S1 (U7): slope and alluvial sedimentation, deposition of pebbles, sand and Woevre clay. The alluvial dynamics of this phase led to the reworking and breaking of stone implements in the channel.

Phase P2 (U7): cessation of sedimentary processes, re-centering of the course of the channel, and luvisol (Baize and Jabiol 1992) development on the edge of the channel, with Bt illuviation formation.

Fig. 7. right
Schematic evolution phases in the sequence from Coussey.

Phase S3 (U6a, U6b, U5a): phase of active sedimentary slope erosion with significant surface water abrading the ancient settlements on the slopes and reworking the BT, which accumulated as U6b. Implements carried by the water are trapped at the base of this sequence. It sealed the eroded previous soil surface (P2) which developed on the edges of the river channel.

Phase P4 (U5a, U6b, U6a): development of a humic steppic horizon with *in situ* implements.


Unit
Thin section
sediment type
paleolithic implements
depositional processes
pedogenetic processes
proposition of chronology
U1
U2
U3b
U3a
U4
U5b
U5a
U6b
U6a
U7
L16
L15
L14
L13
L12
L11 top
L11 bottom
L10
L9 top
L9 bottom
L8
L7
L6
L5
L4 top
L4 bottom
L3
L2
L1top
L1 Bottom
Phase S7
Modern soil
Phase P9
Anthropogenic and Glacial Iron Age climatic crisis soil erosion
Roman Little Climatic optimum
Phase P8
Phase S5
Upper pleniglacial slope movements
Late glacial / Early Holocene luvisol
Phase P6
Isotopic stade 4 Lower pleniglacial
Phase S3
Isotopic stade 5a steppic soil
Phase P4
Isotopic stade 5b
Isotopic stade 5d
Phase S1
Isotopicstade 5e luvisol
Phase P2
Saalien complex
Loamy clays Charcoal + red rolled sherds
Calcareous clays (Woevre)
Calcareous clays (Woevre) and sands
Colluviated A horizon
Colluvium
Slope deposits
Slope and alluvial deposits
reworked BT
mass flow feature
surface water runoff features
frozen/melting reworking features
erosional discordance
LA ploughed horizon
Organic horizon
BT
reworked implements
in situ implements
unweathered implements
weathered implements
weathered + broken implements

Phase S5 (U5b, U4, U3a): a new phase of slope erosion, which first abladed the top of the organic horizon (U5a) from the upper parts of the slope and re-deposited it downslope as U5b.

Phase P6 (U3a, U4): new stabilization phase, with luvisol formation (Baize and Jabiol 1992) characterized by BT limpid clay coatings.

Phase S7 (U3b, U2, U1): a new erosional phase producing an inverted colluvial deposition profile. Occurrence of reworked protohistoric artifacts in the U3b. Charcoal, red tile and organic fragments in the U3a top/b horizon indicate long-term cultivation.

Phase P8 (U3b, U3a): formation of an organic horizon, with deep grey cracks in the upper soil sequence (U3b); these cracks may be related to a phase of soil desiccation.

Phase P9 (U1, U2): formation of a modern agricultural horizon.

Discussion

Chronostratigraphic and archaeological interpretations of this first long Middle Paleolithic sequence found in Lorraine are difficult because of the fragmented nature of the data and the lack of dates. Nevertheless, we can propose an initial chronological outline for the main phases (Fig. 7).

During the first stable P2 phase, a soil developed on the edge of the main channel. A few weathered Paleolithic artifacts were found in this level which extends over 2.8 hectares. No *in situ* lithic concentrations were found, but this level contains spots displaying better preservation, meriting careful monitoring during future rescue operations. This P2 phase, featuring slight limpid illuviation, can be correlated to the Rocourt soil formation from the Eemian Isotope Stage 5e (MIS 5.5; Antoine et al. 2016), following the Saalian glacial formation accumulation (S1).

The erosional phase S3 may have reworked the Bettencourt interglacial grey forest soil (isotope stage 5d / MIS 5.4; Antoine et al. 2016) which is only represented in this sequence by a disturbed BT. In this level (between -1.70m and -1.95m), spatial observations revealed locally *in situ* and locally slightly disturbed lithic implements. Because of the discontinuous nature of the test trenches, it was difficult to follow the layers from the edge to the center of the channel. Nevertheless, the disappearance of Layers 6 and 5 from Geol1 to Geol4 (Fig. 5) strongly suggests the formation of erosion gullies (Fig. 5).

The second stable period associated with steppic soil formation P4 (U5a), which features unweathered *in situ* implements and which is dated to the beginning of the Weichselian, can be attributed to Isotope Stage 5a (MIS 5.1; Antoine et al. 2016).

A portion of the lithic industry is well preserved and displays technical homogeneity. Some rare elements evoke the existence of discoïd lithic production, which is more often recorded in the Eemian and in the Middle Pleniglacial (Locht et al. 2015). However, more extensive excavation of these levels will be required to confirm this discoïd production and to date it more precisely.

A Holocene stabilization follows the marked erosion/deposition phase S5. This last could be associated with the Weichselian Lower Pleniglacial erosion phase (MIS4; Antoine et al. 2016) and Late Glacial slope movement. The early Holocene luvisol P6, characterized by its typical BT, starts to develop in the Late Glacial/Early Holocene period.

The last sedimentary phase (S7) probably corresponds to a significant phase of Late Iron Age erosion resulting from the Iron Age Cold Epoch, which is well attested in Lorraine (Gebhardt et al. 2014).

The deep grey cracks in the upper soil sequence (P8) might be related to the Roman soil desiccation phase, recently described in Eastern France (Gebhardt et al. 2014, 2016; 2018).

THE LITHIC INDUSTRY

Nineteen trenches yielded 82 lithic artifacts attributed to the Middle Paleolithic.

Some concentrations were identified (Table 2), one of which was the subject of more extensive excavation. The stratigraphic and altimetric positions of the objects, as well as their state of preservation, reflect different phases of occupation (Fig. 8). Most of the un-weathered materials came from upper layer (U5a) which correspond to a Glacial humiferous soil reported to MIS 3. Weathered artifacts are generally buried deeper, in Layer 7 or 6, but the distinction was not made in the field. They could, therefore, represent one or two levels and belong to a period spanning from the Early Weichselian (MIS 5c) to the Saalian.

The lithic assemblage displays two states of preservation (Table 3). A first group of 40 artifacts is not altered by post-depositional processes. The heart of the material is black in color and often veined with chestnut. The exterior of the blocks is composed of a fine, smooth, neocortical surface.

The second group consists of 42 artifacts which are uniformly brown in color. All of the edges are blunted to the point that it is difficult to identify flake scars. Some of these artifacts are undoubtedly knapped and

Number of artifacts	Sondages
1	4600 - 5102 - 6202 - 4702
2	5409 - 5909 - 6510 - 6604 - 6710 - 6 - 5
3	7601 - 1 - 8
5	6402
6	5811
7	2
15	3
27	6311

Table 2.
Lithic artifacts, distribution by trench.

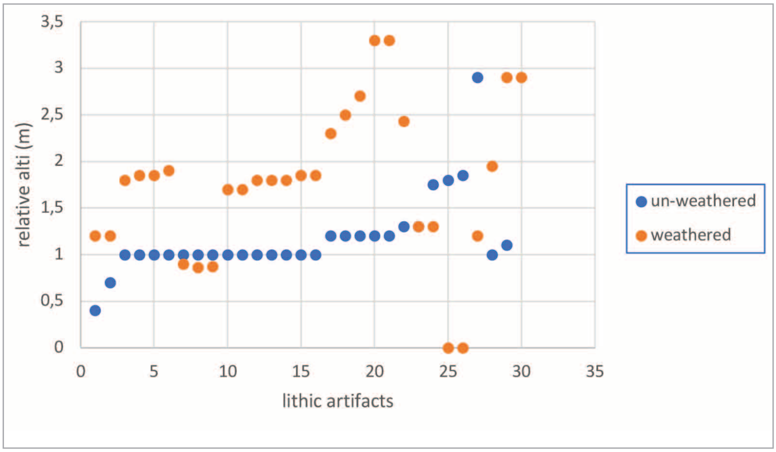


Fig. 8.
Altimetric and surface conservation of the artifacts.

Table 3.
Lithic artifacts, state of preservation by trench.

Sondage	Un-weathered	Weathered	Patina and blunted	Patina and desilicified	Total
4600	1				1
5102			1		1
6202	1				1
SD472			1		1
6604	1				1
5409			2		2
5909			2		2
6510			1	1	2
6710			2		2
5 géol.			2		2
6 géol.			2		2
1 géol.			3		3
8 géol.	3				3
7601	1			2	3
6402	5				5
5811	6				6
2 géol.		3	3	1	7
3 géol.	15				15
6311	7	7	9		23
Total	40	10	28	4	82

retouched, but the origin of others is less clear and they may in fact be natural fragments. Edges often possess alternating retouch, abrupt to semi-abrupt, which evokes the cryo-retouch described elsewhere (Bordes 1963). However, some of these may have been worked beforehand.

These two groups are clearly separated, except in trench 63/11, where they coexist within the same stratigraphic and altimetric level. The artifacts are not altered in the cuttings “Geol3”, 58/11, 64/02 and “Geol8,” while they are patinated in “Geol2.”

Raw material

Apart from a single flint flake, all of the artifacts are made of good quality chert; tests indicate that it is a particularly homogeneous material without flaws. As regards percussion marks, impact points are not pronounced, and, in spite of the use of a hard hammer, small lips are sometimes present between the butt and the lower face, misleadingly suggesting the use of a soft hammer.

Typo-technological observation

The un-weathered group

The un-weathered group (Tables 4, 5, 6) includes 40 artifacts originating from nine trenches, five of which yielded more than one piece. This very restricted sample limits the reliability of the study. The composition of the industry (Table 5) cannot be considered as representative, and the rare diagnostic elements need to be treated with caution. Products measure on average 42 mm in length.

The only core present (Fig. 9a) comes from Trench 3, which is the trench that yielded the most artifacts. It testifies to a rather long production sequence organized around at least two surfaces. The first surface exhibits a small number of visible removals. It served as a striking platform for the peripheral exploitation of the second surface, particularly secant removals which indicate discoid production. The clear objective was to obtain pseudo-Levallois points devoid of cortex. Such objects were not found in Trench 3 where products are relatively long, resulting from the initial phases of the production and unipolar methods.

Three pseudo-Levallois points (Fig. 9b, 9c and 9d) were, however, found in other trenches: they are consistent with the discoid core described above. A crested blade (Fig. 9e) was found in Trench 64/02. This type of product generally results from laminar production, but they can also be produced at the intersection of two knapping surfaces in discoid production. The striking platforms are little prepared, as shown by the high proportion of smooth and cortical butts. One object possesses a faceted butt indicating a more elaborate preparation process: it concerns a Levallois point with the same morphological and technological axe (Fig. 9f).

Table 4.
Un-weathered group, lithic artifacts, distribution by trench.

sondage	Total
4600	1
6604	1
7601	1
6202	1
8 géol.	3
6402	5
5811	6
6311	7
3 géol.	15
Total	40

Table 5.
Un-weathered group, lithic artifacts, main typo-technological categories.

sondage	Total
4600	1
6604	1
7601	1
6202	1
8 géol.	3
6402	5
5811	6
6311	7
3 géol.	15
Total	40

Table 6.
Un-weathered group, lithic artifacts, butts.

Butt	Total
cortical	12
flat	16
dihedral	2
punctiform	1
facetted	1
total	34

Only three blanks were retouched, two from Trench 63/11 and one from Trench 8. Only one relates to a "classic" type of tool: a scraper (Fig. 9g). Another possesses partial retouch while the third is a distal fragment. In addition, two blanks, a Levallois point and one other pseudo-Levallois point, display a splintered edge, which may reflect use or natural processes.

The weathered group

As was the case for the un-weathered group, the weakness of the sample again limits our diagnosis of the weathered series.

Cores are more abundant, with four recorded specimens showing various types of approach. One is similar to Levallois production, another is of Clactonian conception, the third shows simple unipolar exploitation (Fig. 10a) while the last cannot be characterized.

Among the flakes recovered, only three could be linked to Levallois production (Fig. 10b and 10c); one example, described above, possesses a faceted butt. Numerous blanks have edges that have been modified by removals, but a significant proportion (19%) seem to be of natural origin; only two are of anthropic origin: a denticulate and one with partial retouch.

Lithic results and regional comparison

The size of the sample, the absence of stratigraphic connections between the trenches, and the unequal quality of the regional data are important factors that limit comparisons.

As regards raw materials, quartz and quartzite predominate in most of the sites in Lorraine. The use of chert as a principal raw material is attested in older contexts such as Vassincourt. At Rebeuville, which is more or less contemporary with the occupation site at Coussey, chert was also favored for flake production. Close examination of Paleolithic artifacts collected at Coussey (Béguinot 2013) and Frébécourt (Allard 2013) also indicates the preferential use of chert.

At Coussey, a core and a small number of artifacts such as pseudo-Levallois points and a crested blade are consistent with discoid production. A single artifact is typologically Levallois, but it could derive from another method. Within the wider region, the sites of Vincey and Chavelot, which are believed to be contemporary, yielded lithic evidence. At these sites, each located about 50 km from Coussey, the majority of the tools are of quartz and quartzite, and a tiny

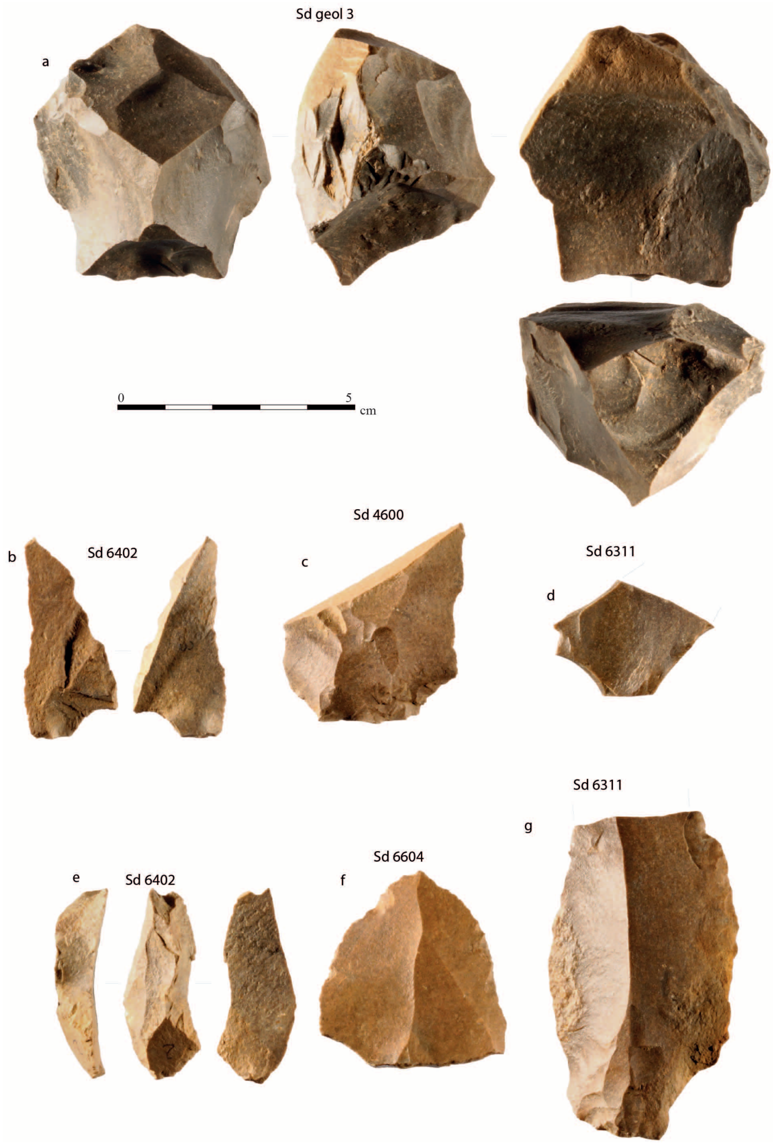


Fig. 9.
Un-weathered artifacts.
a: core; b, c, d: pseudo Levallois points; e: crested blade; f: Levallois point; g: scraper.

proportion, 2 to 5%, are of chert and flint. At Vincey (Guillaume 1988), the presence of Levallois and pseudo-Levallois flakes is noted, but these cannot be connected to a precise method of production.

At Chavelot (Boudias 2005), the cores were classified as Levallois (n=25), discoid (n=14) and indefinite (n=25), but there is a lack of reduction sequence products that would reflect discoid production. At this site, discoid production is interpreted as the outcome of Levallois production.

No comparable element was revealed on close examination of the material from Coussey (Béguinot 2013) and Frébécourt (Allard 2013); at

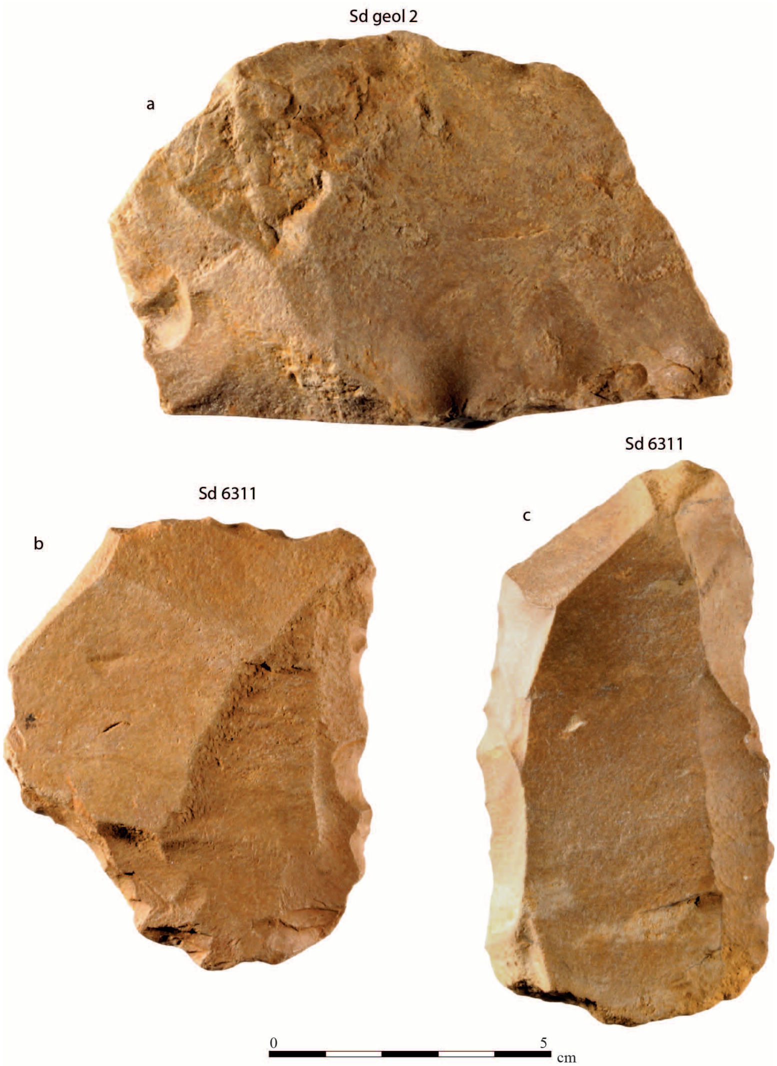


Fig. 10.
Weathered artifacts. a: unipolar core. b, c: preferential flakes.

Coussey, long flake production is recorded, and at Frébécourt, there is evidence for Levallois production where butts are regularly faceted.

On a larger scale, discoid products, though rarely dominant, are present in northern France at the beginning of the Weichselian Glaciation (Locht 2015), as for example at Mutzig (Koehler et al. 2016).

They seem to occur more exclusively during more recent phases of the Middle Pleniglacial, as at Beauvais (Locht 2004) and Ormesson (Bodu 2013), or during the Eemian, as at Caours (Antoine 2006).

CONCLUSION

The discovery of the Paleolithic site of Coussey is very important as it fills a lacuna in a key geographical context at the eastern extremity of the Paris Basin, at the crossroads between the Rhine Region and Northern Europe. Its place in the regional Paleolithic context, however, remains difficult to ascertain because of the incomplete character of the data. OSL data indicate an age of 46.3 ka, which needs to be confirmed by further investigations. Above all else, this discovery raises questions about current research strategies. The Paleolithic wasteland of Lorraine, as it is presented in most recent studies, seems to correspond, in fact, to methodological shortcomings in the identification of human occupation within a rescue context. These deficiencies can be rectified by an increased awareness, among all of the actors involved, of the need to coordinate the various rescue interventions. In this context, diagnosis is the first stage at which action can be taken. The excavation of multiple deep trenches allows us to identify the sedimentary potential by period and, quite often, reveals Paleolithic occupations. It is then possible to consider the Paleolithic occupation, its presence or the reasons for its absence; these reasons can be anthropological (desertification) or natural (erosion). The dating of the sedimentary contexts and the human occupations provides a reliable geomorphological and archaeological framework which permits us to develop predictive approaches.

This first stage of the diagnosis must lead to excavations in order to refine our reading of the chronology, technology and the spatial organization of the groups. It will then be possible to estimate the place of the Lorraine region at the crossroad between several cultural zones in the Paleolithic.

LITERATURE

Allard, P. 2013. L'industrie lithique de Frébécourt. In *Frébécourt, Vosges, La Fourche. Une occupation rurale des âges du fer et du Ier Moyen Âge*, ed. by S. Defréssigne, M. Prévot, and Y. Ferraresso, pp. 54–63. Rapport de fouille. Inrap GEN.

Antoine, P., S. Coutard, G. Guerin, L. Deschodt, E. Goval, J.-L. Locht, and C. Paris. 2016. Upper Pleistocene Loess-palaeosol records from Northern France in the European context: Environemental background and dating of the Middle Palaeolithic. *Quaternary International* 411: 4–24.

Antoine, P., N. Limondin-Lozouet, P. Auguste, J.-L. Locht, B. Galheb, J.-L. Reyss, É. Escudé, P. Carbonel, N. Mercier, J.-J. Bahain, C. Falguere, and P. Voinchet. 2006. Le tuf de Caours (Somme, France): mise en évidence d'une séquence éémienne et d'un site paléolithique associé. *Quaternaire* 17/4: 281–320.

Beguinot, S. 2013. Le paléolithique. In *Coussey et Sionne, Vosges, Launot et Longues Royes, Phase 2*, ed. by L. Forelle, pp. 183–187. Rapport de diagnostic, Inrap GEN.

Beguinot, S. 2015. Utilisation de la chaille oxfordienne de la région de Neufchâteau au cours de la préhistoire. *Résumés des journées archéologiques de Lorraine, Bussang, octobre 2015, ADRAL*, pp. 25–27.

Bodu, P., H. Salomon, M. Leroyer, H. G. Naton, J. Lacarrière, and M. Dessoles. 2013. An open-air site from the recent middle Palaeolithic in the Paris Basin (France): Les Bossats at Ormesson (Seine-et-Marne). *Quaternary International* 331: 39–59.

Bordes, F. 1963. Le Moustérien à denticulés, *Arheološki vestnik, Ljubljana* t. XIII-XIV, pp. 43–49.

Bordes, F. 1955. L'Acheuléen moyen de Vassincourt (Meuse) et la question de l'Acheuléen "froid." *Bulletin de la Société préhistorique de France* 52 (3-4): 157–162.

Boudias, J-B. 2005. La production lithique sur le site paléolithique moyen de Chavelot-Clair-Bois (Vosges), Données récentes sur les modalités de peuplement en Europe au Paléolithique inférieur et moyen. Rennes, Université de Rennes 1, 22-25 septembre 2003.

Bullock, P., N. Fedoroff, A. Jongerius, G. Stoops, T. Tursina, and U. Babel. 1985. *Handbook for soil thin section description*. Waine Research Publication.

Chaussé, C. 2010. Éléments de diagnostic chronostratigraphique. In Frébécourt, Vosges, La Fourche Une occupation rurale des âges du Fer et du Ier Moyen-Âge. *Rapport de fouilles*, ed. by S. Defréssigne, M. Prévot, and Y. Ferraresso, pp. 52–54. Inrap GEN.

Defressigne, S., M. Prévot, and Y. Ferraresso (ed.). 2010. Frébécourt, Vosges, La Fourche Une occupation rurale des âges du Fer et du Ier Moyen-Âge. *Rapport de fouilles*. Inrap GEN.

Forelle, L. 2013. Coussey et Sionne, Vosges, Launot et Longues Royes, Phase 2. *Rapport de diagnostic*. Inrap GEN.

Gamble, C. 1986. *The Palaeolithic Societies of Europe*. Cambridge: Cambridge University Press.

Gebhardt, A., A. Champougny, and P. Wuscher. 2018. Assèchement et dégradation des sols durant le Subatlantique: un niveau repère antique dans l'Est de la France (Lorraine, Alsace)? *Archéosciences* 42(2): 77–94.

Gebhardt, A., V. Vincent Robin, K. Boulanger, J.-M. Blaising, and A. Nuesslin. 2017. Variabilité et extension spatiale de sécheresse(s) au cours du début de l'Antiquité dans le Grand Est de la France. Apport des archives du sol aux données narratives connues. *Adaptation et résilience aux sécheresses: Perspectives historiques en Europe et alentours*, ed. by C. De Jong and A. Metzger, Actes du colloque, Université de Strasbourg, 1-2 juin 2017.

Gebhardt, A., S. Occhietti, and K. Fechner. 2014. Grandes phases de pédogenèse, d'érosion et d'anthropisation des sols au cours de la seconde moitié de l'Holocène en Lorraine (France). *Archéosciences* 38: 7–29.

Guillaume, C. 1988. Le gisement du Paléolithique moyen de Vincey Haut de Beloup. *Société d'Histoire et d'Archéologie de la Lorraine* 1988: 105-111. Les Cahier Lorrains 2.

Guillaume, C. 1982. Les gisements du Paléolithique inférieur et moyen de Lorraine. *Bulletin de l'Association française pour l'étude du quaternaire* 19 (2-3): 135–146.

Janot, A. 1988. Paléolithique inférieur et moyen de Lorraine, originalité des industries à quartzites. *Bulletin de la Société préhistorique française* 85 (10-12): 291–303.

Janot, A. 1981. Ludres (54), "Bois Chauvemont". Essai de chronologie des industries paléolithiques à quartzites de la région sud de Nancy (Meurthe-et-Moselle). *Bulletin de la Société préhistorique française* 78 (10-12): 306–316.

Jude, R. 2007. *Coussey-Sionne (Vosges) "Les Plates Terres" phase 1*. Rapport de diagnostic. Inrap.

Koehler, H., F. Wegmüller, J. Detrey, S. Diemer, T. Hauck, C. Pümpin, P. Rentzel, N. Sévêque, E. Stoetzel, P. Wuscher, P. Auguste, H. Bocherens, M. Lutz, and F. Preusser. 2016. Fouilles de plusieurs occupations du Paléolithique moyen à Mutzig-Rain (Alsace): premiers résultats. *Bulletin de la Société préhistorique française* 113 (3): 429–474.

Lexa-Chomard, A., and C. Pautrot. 2006. *Géologie et Géographie de la Lorraine*. Metz: Éditions Serpenoise.

Locht J.-L., S. Coutard, and V. Deloze V. 2016. Stratigraphie, taphonomie et industries lithiques du gisement paleolithique moyen de Cuvilly. *Revue Archéologique de Picardie* 1-2: 5–39.

Locht, J-L., D. Hérisson, E. Goval, D. Cliquet, B. Huet, S. Coutard, P. Antoine, and P. Feray. 2015. Timescales, space and culture during the Middle Palaeolithic in north-western France. *Quaternary International* 411: 129–148.

Locht, J-L. 2004. *Le gisement paléolithique moyen de Beauvais. Contribution aux modalités de subsistance des chasseurs de rennes du Paléolithique moyen*. Thèse de doctorat de l'Université des Sciences et Technologies de Lille.

Maubeuge, P. L. 1974. *Neufchâteau, carte géologique de la France au 1/50 000 XXXII-17*. BRGM.

Maubeuge, P. L. 1961. Le gisement paléontologique et préhistorique acheuléen de Vassincourt (Meuse). *Bulletin de l'Académie et de la Société lorraines des sciences*: pp. 166–173.

Meyer, N. (ed.) 2014. *Sionne Les Plates Terres: Coussey et Sionne, Vosges, Launot et Longues Royes: Projet de gravière* Société Paul Calin phase 3: rapport de diagnostic. Inrap.

Occhietti, S., A. Gebhardt, P. Ruffaldi, G. Allenet de Ribemont, and A. V. Walter-Simonnet. 2020. Unité fluviatile à échardes volcaniques d'un interstade à Bétula/Pinus antérieur à 53ka (début du MIS3) et optimum glaciaire pendant le MIS4 au nord des Vosges Centrales. *Quaternaire* 31 (1): 1–17.

Paque, A. 1943. Co-existence d'Elephas antiquus et d'E. primigenius dans les alluvions anciennes du plateau de Vassincourt (Meuse). *CRSS Société Géologique de France* 11-12: 133–135.

Sell, Y., J.-P. Berchtold, H. Callot, M. Hoff, J.-C. Gall, and J.-M. Walter. 1998. *L'Alsace et les Vosges*. La bibliothèque du naturaliste, Delachaux et Niestlé.

Thévenin, A. 1975. Informations archéologiques. *Gallia Préhistoire* 18: 563–581.