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IDENTIFY THE LAUNCHED PERCUSSION USE OF LOWER PALAEOLITHIC TOOLS: THE CASE OF SHAPED PIECES IN LIMESTONE AND BASALT

Cyril Viallet[1], Laurence Bourguignon[2], Cyrielle Mathias[1], Pierre Magniez[3], Jérôme Ivorra[4], Jean-Philip Brugal[3]

ABSTRACT
In several Lower Palaeolithic sites of Southeastern France (*i.e.* Bois-de-Riquet, Terra Amata), Heavy-Duty-Tools bear use-wears on their cutting edges. The Techno-Morpho-Functional analysis of these pieces allows to propose a mode of action in launched percussion. This hypothesis was test with specific experimental baseline, dedicated to basalt and limestone. First results show a diagnostic of the launched percussive motion higher for limestone than basalt, for which further developments and experiments still need to be performed.

RÉSUMÉ
Des macro-outils de plusieurs sites du Sud-Est de la France (i.e. Bois-de-Riquet, Terra Amata), portent sur leur tranchant des macro-traces d'utilisation. L'analyse Techno-Morpho-Fonctionnelle de ces pièces permet de proposer un fonctionnement en percussion lancée. Cette hypothèse est testée par la réalisation d'un référentiel expérimental sur du basalte et du calcaire. Les premiers résultats montrent que l'identification d'un fonctionnement en percussion lancée est plus précise pour le calcaire que pour le basalte, pour lequel d'autres expérimentations doivent être effectuées.

Keywords: Lower Palaeolithic, macro-wears, raw materials, launched percussion, experiment.

Mots-clés: *Paléolithique inférieur, macro-usure, matières premières, percussions lancées, experience.*

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Introduction

Gestures in launched percussion are a major component of human activities (Leroi-Gourhan 1943). They are usually employed in activities needing the application of a major force on hard materials. As an example, during the Palaeolithic, bone breakage for marrow extraction might be considered as an example of launched percussion gesture among other technics (Pickering and Egeland, 2006; Galán *et al.* 2009). Furthermore, several works show the use of cleavers, bifaces or even cores or spheroids, in launched percussion on hard or half-hard materials (Claud *et al.* 2010; Mora and De la Torre 2005; Viallet 2016).

However, data linked to these motions and their impacts on lithic tools are poorly documented. Heavy tools (*e.g.* choppers, chopping-tools, picks) are often neglected by traceological analysis, in particular due to their petrographic diversity or the poor degree of preservation. Indeed activities in launched percussion are susceptible to produce large deformations of the cutting edges. These traces are less analysed by traceologists, in despite of their potential in the determination of gestures and tool motion (Tringham *et al.* 1974; Lemorini 2000). Otherwise, existing experimental baselines are mostly dedicated to siliceous material, and thus cannot be transferable for other raw material without an experimental test (Clemente-Conte and Gibaja Bao 2009; Pargeter 2013).

The analysis of the lithic components in basalt and limestone from the US 4 of Bois-de-Riquet (800 ka, France, Bourguignon *et al.* 2016) and Terra Amata (400 ka, France, Lumley 2016), shows several tools bearing macro-wears on their cutting-edges (Viallet 2014). A first comparison with experimental baselines made on flint and quartzite allows to consider the hypothesis of a use in launched percussion. However the validation of this assumption needs the development of a specific experimental programme with basalt and limestone tools, in order to recognise consistently these percussive activities. Preliminary results of this approach constitute the goal of this contribution.

Material and Methods

A set of our experimental baseline is composed by twenty pieces: ten in limestone and ten in basalt. Raw materials employed are strictly the same that those used by the hominins of Bois-de-Riquet and Terra Amata, collected in the local outcrops close to these sites. We have experimentally replicated the same type of tools with the same functional organisation following the Techno-Morpho-Functional analysis (Boëda 2013), previously realised on both sites. At this initial stage, we decide to test two kinds of activities all using launched percus-

sion: bone breakage for marrow extraction process, and to chop fresh wood to produce spear points.

Ten tools (five in basalt, five in limestone) were employed to cut fresh wood in launched percussion (hazel and oak trees). Two pieces (one in basalt and one in limestone) were used for 200 blows, two others for 300 blows and so on for 400, 500 and 600 blows. Simultaneously, ten tools (five in basalt, five in limestone), were used for breaking fresh humerus and femur of domestic suids and bovids. Following the same protocol as for fresh wood, five groups of two pieces in each raw material were used for 10, 30, 60, 90 and 120 blows.

The analysis of macro-wears used a stereomicroscope (Optika SZM – SMD) and the image record with a Canon EOS 550D camera and a Sigma 50mm camera lens. Criteria used for the descriptions on macro-wears correspond to the main characteristics of macro-wears depending of the support (position, repartition), of the side (distribution, overlaps) and of the morphology of the negative of removals and their initiations (Prost 1989; Claud 2008) (fig. 1A).

Results

Actions on fresh wood caused the development of macro-wears on all of the ten experimental pieces. These traces are scarce with a discontinuous distribution, in particular for basalt (less than 5 traces for each piece) (fig. 1B and table 1), and they are spread on both face in a homogeneous way, especially for limestone (4 out of 5 pieces). Scars show mostly thin termination whereas the initiation is always in flexion. Pieces in basalt always exhibit crushed areas while limestone pieces often present blunts.

Bone breakages in launched percussion induce the development of macro-wears on all tools made in limestone and on four basalt tools. The only cutting edge without traces has an angle higher than 75°; it was shaped only on one side and has a biconvex section. Only three experimental pieces, made in basalt, display less than 5 traces, the others show between 20 and 50 traces on their cutting edges. The position is generally homogenously bifacial (4 out of 9 cases) but some pieces show only unifacial removals (3 out of 9). In this last case, the morphology in section presents an opposition plan/convex, and the traces are preferentially developed on the convex side. However, the distribution is sometime more continuous relating to the higher presence of impacts. Therefore, the repartition is variable. Terminations of scars are most of the time in hinge or in step, and the initiations mostly in flexion and may be cone-like.

These preliminary results allow proposing some first identification criteria related to the motion of the tool which are identical to both raw materials: the

position of use-wear is 63% bifacial and the distribution is 47% alternate and 31% bifacial. Scars are numerous and have generally a large size, especially for tools used for bone working. Nevertheless some characteristics of macro-wears varying according to the raw material: the number of traces is more important on the cutting edges of limestone tools than in basalt ones, because of the difference in hardness of these materials; terminations are mostly thin and in hinge for limestone and in hinge or in step for basalt.

Discussions and Conclusions

One of the main challenges in prehistoric archaeology is to determine the function of lithic artefacts. Identification of tool function is part of our understanding of behaviour and palethnological features of ancient hunter-gatherers societies. In the Lower Palaeolithic, relatively simple heavy tools with cutting edge were used whose function we do not know. From lithic artefact found in early sites such Bois-de-Riquet and Terra Amata where limestone and basalt were used to make tools, we search to discern the function of some of them showing particular scars.

This experimental approach of the gestures of launched percussion operated with limestone and basalt tools yields first interesting results. Macro-wears developing on the working edges of tools are fairly characteristics, especially for limestone tools in which traces are more numerous. From a mechanical point of view, basalt shows a breaking behaviour more plastic than limestone. The transfer of these experimental results to the archaeological basalt materials of Bois-de-Riquet, requires to continue the experiments and to develop specific descriptive criteria, in order to better describe crushing and smoothing processes. However, characteristics of the macro-traces observed for the limestone material seem pertinent to infer a use in launched percussion for some tools of Terra Amata.

More experimental tests would be made in the future in a more various context and more restricted parameters (gesture and strength, type of tools and cutting edge, raw materials), completed with the observations of marks left by the tools on the bones.

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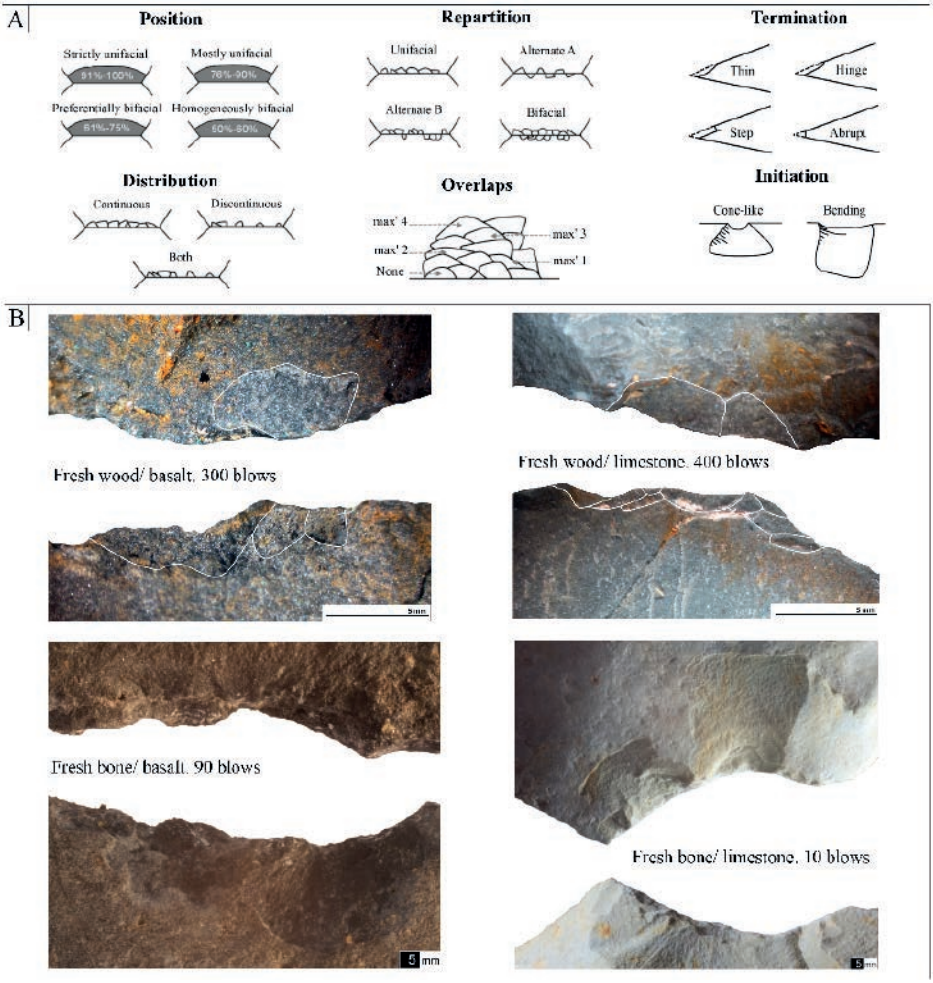


Figure 1. A: Description criteria used for the description of macro-wears; B: Photographs of the macro-traces on the working edges in limestone and in basalt of four experimental tools.

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			Description of macro-wears										
Worked material	Pieces	Raw material	Quantity	Position	Repartition	Distribution		Overlaps	Initiation		Termination	Crush	Blunt
						Side A	Side B		Cone-Like	Bending			
Fresh wood	BTA 3	Limestone	<10	Mostly unifacial	Alternate B	Discontinuous	Both	✗	✗	✓	Thin	✗	✓
	BTA 6	Limestone	<10	Homogeneously bifacial	Alternate B	Discontinuous	Discontinuous	✗	✗	✓	Thin	✗	✓
	BTA 9	Limestone	<15	Homogeneously bifacial	Alternate B	Discontinuous	Both	✗	✗	✓	Thin/Hinge	✗	✓
	BTA 12	Limestone	<15	Homogeneously bifacial	Bifacial	Both	Continuous	✗	✗	✓	Hinge	✗	✓
	BTA 13	Limestone	<20	Homogeneously bifacial	Bifacial	Both	Both	Max. 2	✗	✓	Hinge	✗	✓
	Cy.Vi. 25	Basalt	<5	Mostly unifacial	Bifacial	Both	Discontinuous	✗	✗	✓	Hinge	✓	✗
	Je.Iv. 17	Basalt	<5	Homogeneously bifacial	Alternate B	Discontinuous	Discontinuous	✗	✗	✓	Thin/Hinge	✓	✗
	Cy.Vi. 22	Basalt	<5	Preferentially bifacial	Alternate B	Both	Discontinuous	✗	✗	✓	Thin/Hinge	✓	✓
	Cy.Vi. 26	Basalt	<5	Strictly unifacial	Unifacial	Discontinuous	Discontinuous	✗	✗	✓	Thin	✓	✗
	Cy.Vi. 23	Basalt	<5	Mostly unifacial	Alternate B	Discontinuous	Both	✗	✗	✓	Thin/Hinge	✓	✓
Fresh bone	GAB. 03	Limestone	<5	Strictly unifacial	Unifacial	Discontinuous	Discontinuous	✗	✗	✓	Thin	✗	✗
	BMC. 02	Limestone	<20	Strictly unifacial	Unifacial	Discontinuous	Continuous	Max. 3	✗	✓	Hinge	✓	✓
	BTA.11	Limestone	<50	Homogeneously bifacial	Bifacial	Continuous	Continuous	Max. 4	✗	✓	Hinge/Step	✓	✓
	Gu.Os. 1	Limestone	<50	Preferentially bifacial	Alternate B	Both	Continuous	Max. 3	✗	✓	Hinge/Step	✓	✗
	Gu.Os 2	Limestone	<20	Homogeneously bifacial	Bifacial	Continuous	Continuous	Max. 3	✗	✓	Hinge/Step	✓	✗
	Je.Iv. 20	Basalt	Blunt	-	-	-	-	-	-	-	-	✓	✓
	Cy.Vi. 20	Basalt	<30	Homogeneously bifacial	Bifacial	Continuous	Continuous	✗	✗	✓	Hinge/Step	✓	✗
	La.Bo. 65	Basalt	<5	Stictly unifacial	Unifacial	Contunuous	Discontinuous	✗	✗	✓	Hinge	✓	✗
	La.Bo. 20	Basalt	<20	Homogeneously bifacial	Alternate B	Both	Continuous	✗	✗	✓	Hinge/Step	✓	✗
	La.Bo.21	Basalt	<5	Preferentially bifacial	Alternate B	Discontinuous	Discontinuous	✗	✗	✓	Thin	✗	✗

Table 1. Summary table of the results obtained.