Quaternary International xxx (2016) 1–14

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Use-related or contamination? Residue and use-wear mapping on stone tools used for experimental processing of plants from Southeast Asia

Hermine Xhauflair [a, b, *], Alfred Pawlik [c], Hubert Forestier [a], Thibaud Saos [d], Eusebio Dizon [e], Claire Gaillard [a]

[a] UMR 7194 of the CNRS, Département de Préhistoire, Muséum National d'Histoire Naturelle and Université de Perpignan Via Domitia, Institut de Paléontologie Humaine, 1 rue René Panhard, 75013 Paris, France
[b] McDonald Institute for Archaeological Research, University of Cambridge, Downing Street, Cambridge CB2 3ER, UK
[c] Archaeological Studies Program, University of the Philippines, Diliman, Albert Hall Building, Lakandula Street Corner E. Jacinto Street, Diliman, Quezon City 1101, Philippines
[d] UMR 7194 of the CNRS, Département de Préhistoire, Muséum National d'Histoire Naturelle and Université de Perpignan Via Domitia, Centre Européen de Recherches Préhistoriques de Tautavel, Avenue Léon-Jean Grégory, 66720 Tautavel, France
[e] Division of Archaeology, National Museum of the Philippines, Padre Burgos Drive, City of Manila, Philippines

A R T I C L E I N F O

Article history:
Available online xxx

Keywords:
Experimental plant processing
Residue analysis
Use-wear analysis
Mapping
Contamination

A B S T R A C T

Analysing residues on stone tools can reveal precise information about the activities that were conducted with the lithic tool and is a valuable technique to reconstruct past human behaviours. However, it is often difficult to assess the nature of the relationship between a residue and the artefact on which it is found. It is of great importance, therefore, to determine whether residues are use-related or a result of contamination. Here, we conducted experiments with 99 tool replicas made of red jasper, processed 15 different plant taxa and mapped the distribution of residues against the use-wear traces. Our experiments addressed several questions on the spatial relationship between use-wear and use-related residues on stone tools. In the majority of cases the residues were not spatially associated with use-wear. Therefore, it appears that residues should not necessarily be considered as non-related to use because they are not in close proximity to use-wear. On the other hand, our experiments also showed that the problem of contamination should not be underestimated and can be a serious cause for misinterpreting stone tool functions. Finally, our results showed a variability in residue distribution between tools used to process different plant taxa and revealed that the water content in the contact material has an influence on residue distribution.

1. Introduction

Analysing residues on stone tools can reveal precise information about the activities undertaken with lithic implements and is a useful technique for the reconstruction of past human behaviours (e.g. Bruier, 1976; Fullagar et al., 1996; Barton et al., 1998; Fullagar, 2006; Hardy and Moncel, 2011). Nevertheless, it is often difficult to assess the relationship between a residue and the artefact on which it is found. Indeed, there may be no systematic association between a residue and tool use: the presence of residues may also be related to contamination. They may come from various agents such as the hands of the tool user, the materials which were on the ground when the tool was discarded or in the place where it was stored, the sediments, the wind which brings all sorts of contaminants from the surroundings or even the powder gloves of an analyst (Fullagar, 2006; Wadley and Lombard, 2007; Langejans and Lombard, 2015).

There are several ways to intent determining whether residues are use-related or the result of contamination. A current practice involves the analysis of soil sediments from the same depositional context from which the artefact was discovered to check if they

* Corresponding author. UMR 7194 of the CNRS, Département de Préhistoire, Muséum National d'Histoire Naturelle and Université de Perpignan Via Domitia, Institut de Paléontologie Humaine, 1 rue René Panhard, 75013 Paris, France.

E-mail addresses: hx250@cam.ac.uk, hermine_xhauflair@hotmail.com (H. Xhauflair), afpawlik@upd.edu.ph (A. Pawlik), hubforestier@gmail.com (H. Forestier), saos@cerptautavel.com (T. Saos), drbongdizon@yahoo.com (E. Dizon), gaillacl@mnhn.fr (C. Gaillard).

http://dx.doi.org/10.1016/j.quaint.2016.02.023
1040-6182/

contain similar residues to that documented on the stone tool. If the same residues are present on the stone tool and within the soil, it is possible and perhaps likely that contaminant residues have accumulated on the stone tool from the depositional environment (Fullagar et al., 1996; Hardy and Garufi, 1998; Langejans, 2011; Langejans and Lombard, 2015). The distribution of the residues on a tool and their relationship with use-wear may indicate whether they are related to use (e.g. Barton et al., 1998; Lombard, 2008; Pawlik, 2010, 2012; Pawlik and Thissen, 2011). “Another type of clue is” the distribution of the residues on a tool and their relationship with use-wear “as it” may indicate whether they are related to use “or not”. A concentration of residues on an area that appears likely (based on morphology) to have been the active part (a cutting edge or the tip of a point for instance) would indicate that the residues are use related. Similarly, corresponding use-wear and residue patterns on a tool may also suggest that residues are use-related, while an uneven residue distribution may indicate contamination (Hardy and Garufi, 1998). For instance, a precise mapping of the residue distribution has allowed the identification of the hafted and active zones of lithic implements (Pawlik, 1995, 2012; Lombard, 2008). But are use-related residues frequently stuck or systematically found on the very area that was in contact with the processed material or the one altered by use-wear? Is the localisation of residues a valid argument to establish whether some are use-related or to dismiss them as less valuable for reconstructions of past tool use?

Langejans (2011) conducted an experiment with used and unused experimental stone tools. She buried some of them and exposed others to potential weathering agencies (e.g. wind, rain, sunlight) to identify possible contaminants and to provide an environment that more closely resembles archaeological conditions. She then recovered the tools and mapped the residues on their surface. Her results showed that, after burying or exposure, the non-used ‘tools’ were indeed ‘randomly’ covered by residues i.e. residues were not concentrated at a particular location. Conversely, used tools showed a higher frequency of residues on the half of their surface that is on the side of the active edge.

In the case of archaeological artefacts, the location of use-wear is often the only clue to know with a rather high probability what part of a tool was the active one. In this article, we question the spatial relationship between use-wear and use-related residues on stone tools: Are they superimposed on each other after tool use? Is a precise correlation between both use-wear and residues on a tool surface a strong argument for the use-related character of residues? Is the case of residues appearing separated from use-wear an argument for contamination?

In addition, we will discuss the variability in residue distribution between tools used to process different rainforest plant taxa from the Philippines.

2. Material and method

2.1. Experiments

We conducted experiments with 99 tools made of red jasper (flakes, choppers and chopping tools) to process 15 different plant taxa: three bamboo genera, *Schizostachyum* cf. *lima*, *Dinochloa luconiae* and *Gigantochloa levis* (shoots); the pandan *Pandanus* cf. *simplex*; three tree species, *Pterospermum diversifolium*, *Albizia acle* and *Alstonia scholaris*; three palms, *Caryota rumphiana*, *Arenga pinnata* and the rattan *Calamus merrillii*; the evergreen herb *Homalomena philippinensis*; the grass *Imperata cylindrica*; the fern *Angiopteris palmiformis*; *Musa* sp., a wild banana tree and the shrub *Donax cannaeformis* (see Table 1 and Xhauflair et al., 2015). The activities took place in the forest of Makiling and on the Diliman campus of the University of the Philippines, Quezon City (both on Luzon Island, Philippines); and in France when the collected plant specimens were dry. All experiments were based on an ethnoarchaeological study that observed plant processing activities of traditional Pala'wan communities in the forested highlands of Palawan Island, Philippines. The aim was to design realistic experiments (Xhauflair et al., 2012; Xhauflair, 2014).

Observations of the processed plants were recorded and included the experimenter's perception of the degree of hardness (1–4), penetrability (1–3) and moisture (1–4) (after Odell, 1980; Odell and Odell-Vereecken, 1980; Rots, 2010 – see Table 1). These observations, however subjective, were conducted by a single person (HX) and allow for consistent estimations of the relative penetrability, hardness and moisture across all the plant taxa processed. Variability within a single taxon is related to the part of the plant that was worked (moisture, hardness and penetrability) and to the direction of the motion to plant fibres (hardness and penetrability). For instance, the inner part of the bamboo vine *Dinochloa luconiae* is quite rich in water although the external part is rather dry. Regarding penetrability and hardness, there is less resistance if plants are processed parallel to their fibres rather than cross-wise or transversal.

In order to avoid contact with other materials, the experimental tools were placed into individual plastic bags immediately after knapping. Prior to the tool-use experiments, tools were briefly taken out of their bags for photography and for observations under low power microscope, before any use. Immediately after the experiment, each tool was placed back in its plastic bag, then wrapped in tissue paper and packed into strong plastic boxes to avoid frictions, movements and shocks during transportation.

Videos of the experiments can be watched on http://plantuseinseasia.net.

2.2. Observation of residues and collecting for reference

The tools were observed under a macroscope (Leica Z16 APO) at the University of Nice (CEPAM laboratory) before cleaning so that residues related to use could be documented in situ and their location recorded. Some of the tools, at least one per plant taxa, were selected for further observations at higher magnifications with a scanning electron microscope working in environmental mode at the *Centre Européen de Recherches Préhistoriques de Tautavel*.

Residues were then collected from the experimental tools for reference, applying the following procedure. The tools were placed inside individual plastic bags filled with demineralized water. These bags were then placed in an ultrasonic tank for 30 min. The water with floating residues was then poured into glass beakers carpeted with a thin film of paraffin wax. The beakers were put to dry inside a botanist oven at a temperature of around 50 °C. When the water had evaporated, residues were adhering to the film of paraffin wax. The latter was removed with tweezers and placed inside plastic tubes filled with alcohol to preserve the residues.

2.3. Mapping

2.3.1. Establishing three types of map per tool

Three maps were created at different stages of analysis for each tool to illustrate the distribution of use-wear and residues on the experimental tools, and to indicate the active zone and the part of the tool that the user was holding. These data were plotted on to photographs of the experimental tools.

On Map 1, we recorded the active or contact part of the tool (i.e. the part which was in contact with the plant material) and the part

Please cite this article in press as: Xhauflair, H., et al., Use-related or contamination? Residue and use-wear mapping on stone tools used for experimental processing of plants from Southeast Asia, Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.02.023