Experimental replication of Australian grinding stone implements

Elspeth Hayes[1], Dries Cnuts[2], Richard Fullagar[1], Colin Pardoe[3], Chris Clarkson[4], Birgitta Stephenson[5]

1 Centre for Archaeological science, University of Wollongong; 2 Service de Préhistoire, University of Liège, Belgium; 3 Bio-Anthropology & Archaeology, Turner, ACT; 4 University of Queensland, St Lucia; 5 In the Groove Analysis, Brisbane

Introduction:

Until recently in Australia, lithic tool-use experiments were dominated by flaked stone with relatively few studies of ground-stone. This poster reports on a workshop, during which tool-use experiments were designed to document the wear traces associated with grinding various materials (n=7), different processing techniques (n=3), and sandstones of different hardness (n=5). The specific variables were selected to build a use-wear and residue reference library applicable to Australian archaeological grinding implements proposed for detailed functional analysis.

Processed material	No. of experiments	No. of tools
Seeds	6	12
Wood	2	2
Bone	3	4
Volcanic stone	3	2
Sandstone	1	2
Haematite	2	2
Ochre	2	2
Total	**19**	**26**

Table 1: Materials processed during experimental workshop

Figure 1a-h: Action shots taken during experiments: a) sharpening wood; b) grinding bone; c-d) pounding bone; e) grating haematite; f) polishing volcanic stone; g) grinding warrego grass seed; h) grinding and pounding acacia seed.

Materials/Methods:

The experimental workshop took place in May, 2013, at Byrangee Academic Retreat, Yadboro. Experimental sandstone grinding implements were used to process organic and inorganic materials, documented ethnographically (Fig. 1). Upper and lower stones were used together to grind or pound seeds and bone; and abrading stones were used to file bone, stone, wood, and haematite. The experimental stones came from five geographic regions in Australia, each associated with the archaeological assemblages proposed for study. Grinding surfaces were examined for wear traces at low magnification using a stereo-microscope and during experimentation using a portable Dino-Lite™ microscope. Use-wear was sampled with polyvinyl siloxane (PVS) peels, which were examined under high magnification using a metallographic microscope. Residues were extracted with two solvents (distilled water and a tri-mixture of acetonitrile, ethanol and water), and subsequently mounted on slides and examined under transmitted light microscopy. The slide preparations were stained to highlight constituent plant and animal tissues.

Processed Material	Processing Method	Starch	Cellulose	Phytoliths	Lignin	Collagen	Bone	Pigment
Bone	Grinding, Pounding		x			x	x	
Haematite	Filing		x					x
Seed	Grinding, Pounding	x	x	x	x			
Stone	Grinding, Filing		x					
Wood	Filing		x		x			

Table 2: Identified residues on the used surface of the grinding stones.

Results:

Use-wear

The hardness/softness of the sandstone and the degree of grain cementation have a strong influence on the development and appearance of use-wear. On the hard sandstone, the processing time affected polish formation. Use-wear patterns were distinctive of the broad categories of processed material (seed, bone, haematite, stone and wood) (Fig. 2-6). Key use-wear features relating to activity and processed material are reflected in the degree of grain rounding and grain levelling, the presence of macroscopic surface striations and the occurrence of micro-fractures, polish and striations observed at high magnification.

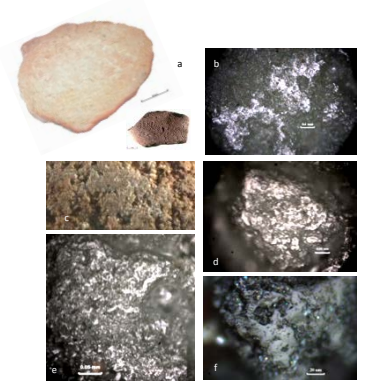

Figure 2a-f: Grinding stones used for seed processing and associated use-wear. Polish is visible on grains at high magnification and appears bright with a reticulated morphology. Grains are highly levelled.

Residues

Residues included collagen and cellulose fibres, starch granules, phytoliths, resins, bone fragments and pigment crystals (Fig. 7). As for use-wear, the residues were also distinctive of the broad categories of processed material. Staining was particularly useful to distinguish plant and animal tissues (Table 2).

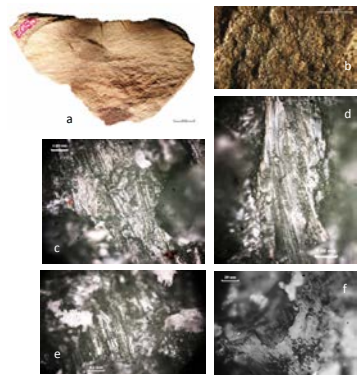

Figure 3a-f: Grinding stone and use-wear following the sharpening of bone. Grains are rounded but not levelled. Polish is smooth with micro-pits, striations are abundant. Micro-fractures are also present (3f).

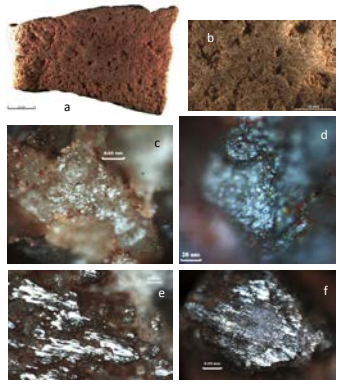

Figure 4a-f: Grinding stone and use-wear associated with grating haematite. Grains are highly levelled and polish appears undulating. Haematite residues are visible even after washing/scrubbing.

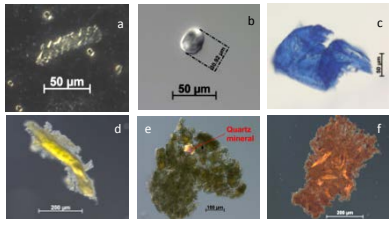

Figure 7a-f: Identified residues on the used surfaces. a) phytolith; b) starch; c) plant tissue stained with Methylene Blue; d) collagen stained with Orange G; e) bone tissue stained with Orange G; f) woody tissue stained with Safranin.

Figure 5a-d: Grinding stone and use-wear associated with the polishing of volcanic stone with added sand. Use-wear is similar to seed grinding stones with a reticulated surface polish and striations. Micro-fractures are more frequent.

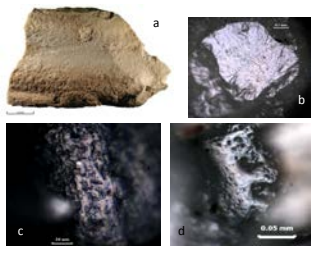

Figure 6a-d: Grinding stone and use-wear associated with sharpening wood. Grains are well rounded but not levelled, polish is reticular and micro-fractures occur.

Conclusions:

The experiments provided insights into the wear formation on sandstones of different hardness and degree of cementation. Stained cellular structures provide a reliable basis for distinguishing the investigated plant and animal tissue subjected to mechanical damage, resulting from grinding and pounding.

The residue and usewear experiments build on previous studies and help form the basis of a systematic and collaborative use-wear and residue reference library for ground-stone tools in Australia. Future experiments will focus on the wider range of plant taxa processed by grinding and documented ethnographically.

Author contribution and acknowledgements:

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