PRELIMINARY RESULTS OF A REPLICATIVE STUDY: METATE RE-ROUGHENING, PECKING, OR POUNDING?

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ABSTRACT

This paper discusses the results of a replicative study on the roughening of milling equipment, specifically metates. The intent of the replication was to ascertain if differing results were achieved when various percussor types were used to re-roughen a metate-like surface. Hammerstones prepared by flaking and unmodified cobbles were utilized. The results obtained in the replication were then compared with archaeological specimens in an attempt to determine more information as to the manufacturing and use behaviors associated with milling equipment.

INTRODUCTION

Stone metates or grinding stones have long been a primary food processing tool for many agricultural as well as hunting and gathering societies. Use of these implements to reduce both plant and animal material has been well documented. When a metate is used in conjunction with a mano to grind foodstuffs, sharp edges are sheared off of the metate surface and residues from the material being ground are deposited. This process results in the metate surface becoming increasingly smooth, ineffectual, and in need of maintenance. Rejuvenation of the metate can be achieved through re-roughening of the grinding surface thus extending its usefulness.

Replicative studies involving the manufacture of milling equipment (Pritchard-Parker 1991) sparked discussions concerning possible differences in the type of hammer tool used to manufacture metates versus those used to maintain the milling surface through re-roughening. Both angular-edged hammers and unmodified cobbles have been used in the replicative manufacture of metates (Pritchard-Parker 1991; Schneider et al. 1992). However, it may be possible that the differing tasks of manufacturing and re-roughening of milling equipment would be most efficiently accomplished with tools of different shapes and sizes, depending upon how much mass one is trying to remove and where that mass is located. Where manufacture seeks to remove a relatively large amount of mass, re-roughening seeks to merely mar the grinding surface to such a degree that it becomes useful again. Identifying potential differences in the types of tools used in the manufacture and maintenance of milling implements will contribute to our overall understanding of artifact distributions and their associated behaviors. For example, explanations may be advanced for hammerstones found in behaviorally significant numbers near completed metates or milling activity areas. Additionally, use wear patterns on hammerstones will vary depending upon the way in which they were used. A knapping hammer will reflect glancing rather than direct action fracture whereas a tool used to roughen a grinding surface should reflect a definite fracture pattern, delineating it from other hammer tools. The resultant debitage from such an activity, which may often appear anomalous, may also be diagnostic of the metate re-roughening process.

Ethnographic literature contains vague references to "pecking" stones used in the re-roughening process (Mohr 1954; Lister

1965; Huckell 1986; and others). Pecking, as defined by Turner (1963), is performed with a "sharpened hammerstone". The few descriptions of these stones allude to a modified cobble with sharp edges or points, a sharp broken stone, or a prepared core. No references describing the use of blunt hammerstones for re-roughening were found. However, one account of excavations at Mesa Verde included pictures of recovered "pecking" stones (O'Bryan 1950) that appear to be unmodified cobbles with the cortex and naturally-occurring rounded edges intact. For this reason, it seemed appropriate to suggest that the term "pounding" be adopted (Jeanne Binning, personal communication, 1991) to describe the use of blunt or unmodified hammerstones. While it has been suggested that the rounded or blunt ends of manos could have been used to roughen metate grinding surfaces by Riddell (1960) and others, no replicative work that we know of has addressed this issue.

The goal of this experimental project was to evaluate the results obtained with both angular-edged and naturally rounded or blunt hammerstones when each was used to roughen a simulated metate surface. We focused on the following question: Would rounded-edged hammers be as effective as angular-edged hammers in the metate re-roughening process? We observed the morphology of the dents (Turner 1963) or individual pits resulting from the blows administered with the different tool shapes. In building upon the results of the initial phase of this study, additional variables were considered, including weight of the hammerstone and material of both the hammer and the grinding surface.

PHASED EXPERIMENTS

Phase 1

Methods. In order to control the initial surface characteristics of the simulated metates, 2 slabs of granite and one slab of basalt, obtained from a local monument works, were used. All of the slabs had smooth surfaces cut with a rock saw. The smooth, uniform surfaces allowed the effects of each hammer type to be isolated. The slabs ranged in length from 37 cm to 51 cm and in width from 25.5 cm to 30.5 cm.

Three hammerstones were used in the Phase 1 experiment (hammerstones 1, 2, and 3 in Table 1). All 3 hammerstones were quartzite cobbles that had one end flaked to form an angular-edged hammer, and the other end left unmodified (rounded). Using the 2 ends of a single cobble as different tools helped to control for the consistency of the quartzite among the hammerstones. The weights of the hammerstones ranged from 566.9 g to 577.4 g. This weight range was intended to approximate the average weight of archaeological specimens as calculated from the mean weight of a collection of 216 hammerstones recovered from a site, ORA-1070, in Orange County (Mike Macko, personal communication, 1992).

Table 1

Hammer Tool Attribute Summary

#	Material	Original Weight	Final Weight	Shape*	Used on Slab
1	Quartzite	566.9 g	482.0 g	combo	Granite
2	Quartzite	573.5 g	403.2 g	combo	Granite
3	Quartzite	577.4 g	354.3 g	combo	Basalt
4	Rhyolite	763.6 g	481.8 g	angular	Basalt & Granite
5	Quartzite	2365.6 g	1543.6 g	unmod	Basalt
6	Quartzite	1071.4 g	1071.4 g	angular	Weathered Granite
7	Quartzite	1094.1 g	1072.2 g	unmod	Weathered Granite

*combo=combination; unmod=unmodified

In conducting the experiment, each of the slabs was divided into halves. Hammerstones 1 and 2 were used on the granite slabs, with half of each slab being "pecked" with the angular-edged ends of the hammerstones, and the other half of each granite slab being "pounded" with the rounded, unmodified, ends of the hammerstones. Hammerstone 3 was used in the same manner on the basalt slab. The ends of each hammerstone were to be used to strike the simulated metate surface 150 times. In order to evaluate use-attrition of the hammerstones under conditions of pecking and pounding, each hammerstone of known weight was first used for pecking, then the resulting debitage was weighed. Each hammerstone was then used for pounding, and the newly produced debitage was weighed. A final weight of each hammerstone was also recorded.

Results. The dents produced in the surfaces of the basalt and granite slabs by the angular-edged hammerstones were irregularly shaped and had some depth, whereas the blows administered with the unmodified (rounded) tools resulted in elongated marks on the slabs that infrequently broke the surface sufficiently to create a dent. The only difference in dent morphology between the basalt slab and the granite slabs was the somewhat greater depth of dents produced in the granite slabs.

The damage to the angular-edged hammers themselves was reflected in crushed edges and step fractures. The rounded-edged hammerstones tended to develop battered bifacial edges and took on a chopper-like appearance.

An extreme amount of tool loss and early tool failure was experienced with the hammerstones, particularly with the initially unmodified (rounded) tool edges (see Figure 1, hammerstones 1, 2, and 3). 150 blows were administered with the angular ends of all 3 hammerstones, but due to loss and breakage, the unmodified ends of the 3 hammerstones could only be used for 22, 70, and 98 strokes, respectively.

The debitage that was produced by the use-attrition of the angular-edged hammerstones consisted of flakes with crushed and shattered platforms and angular shatter. Debitage from the initially unmodified (rounded) hammerstones was similar to that produced by the angular-edged tools and also included round and oval flakes, often without platforms, that were created by the initial blows. The size of the flakes from the rounded hammerstones tended to be slightly larger than those from the angular-edged tools.

Phase 2

Due to the rates of tool weight loss caused by use-attrition during Phase 1 (Figure 1, hammerstones 1, 2 & 3), it was concluded that the original weights of the experimental hammerstones may have been too low to replicate actual tools used prehistorically. Considering the possibility that a majority of the hammerstones recovered archaeologically may have been expended tools, the average weight of hammerstones during their use-life may have been significantly greater than that recorded for the archaeological specimens. It was also recognized that the material of the hammerstones used in Phase 1 (quartzite) may account for some degree of the use-attrition experienced. It was also desirable to know if hammerstone weight and material accounted for some degree of the use-attrition experienced and if these factors had any effect on the morphology of dents produced in the struck surface.

Methods. To test the effect of hammerstone weight and material on hammerstone use-attrition and dent morphology, 2 hammerstones of greater weights were used, one of which was made of rhyolite. The rhyolite cobble was flaked to form an angular-edged hammerstone weighing 763.6 g (#4 in Table 1), and a quartzite cobble weighing 2365.6 g was left unmodified (rounded; #5 in Table 1). The rhyolite tool was used to strike both the granite and basalt slabs, and the quartzite tool was used to strike the basalt slab. One hundred fifty blows were administered on the basalt slab by each tool, and 50 blows were administered by the rhyolite tool on the granite slab.

Results. A similar level of weight loss through use-attrition was experienced with both of the large hammerstones, with the rhyolite specimen (#4) losing 37% of pre-use weight, and the quartzite specimen (#5) loosing 35% of pre-use weight (Table 1 and Figure 2, hammerstones 4 & 5). The larger tools enabled the use of both hands in striking and were therefore more comfortable to use. As in Phase 1, a difference in dent morphology was produced with the angular-edged verses the unmodified (rounded) edged tool. The only distinction in dent morphology noted between the Phase 1 and

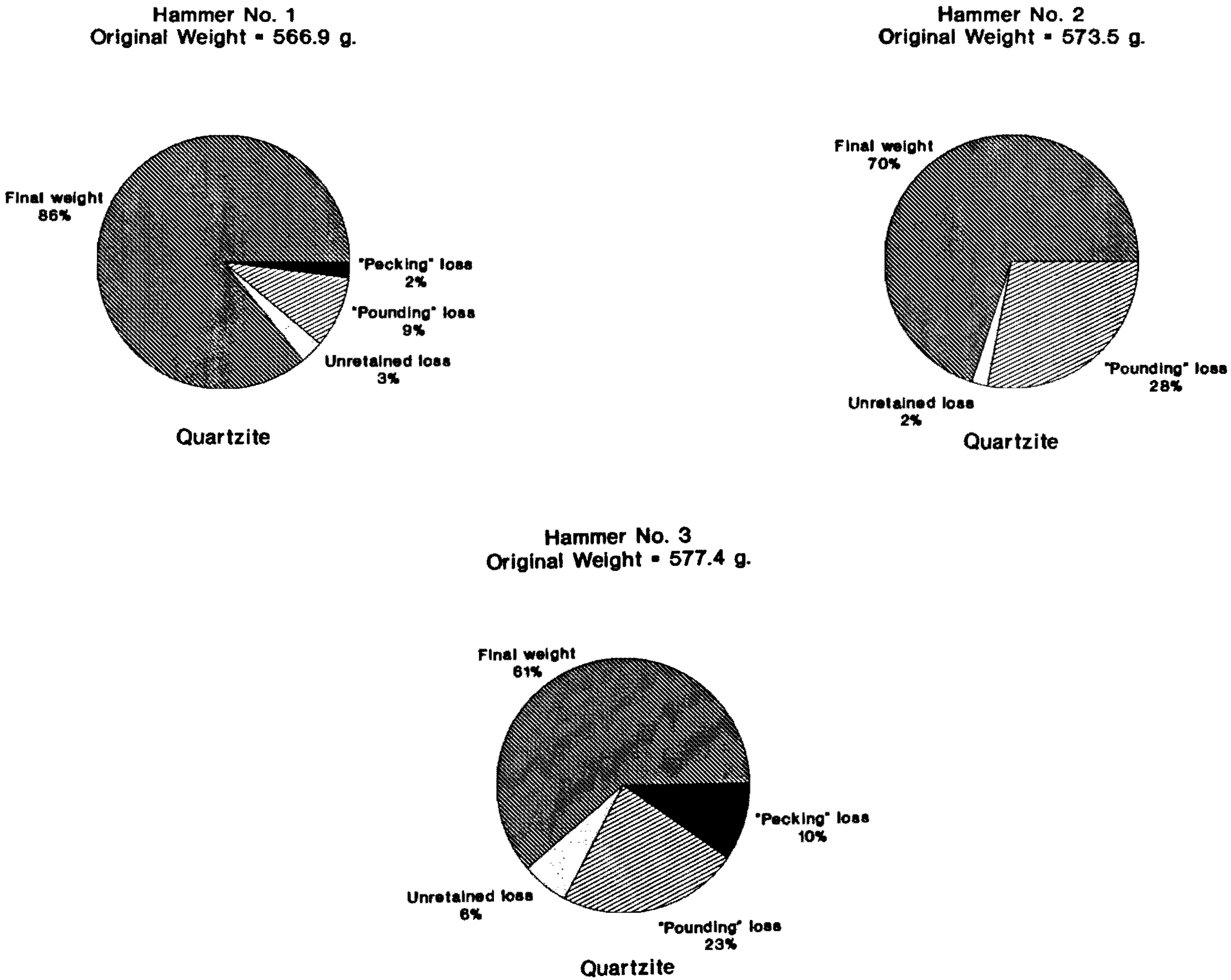


Figure 1. Hammerstone Experiment Phase 1.

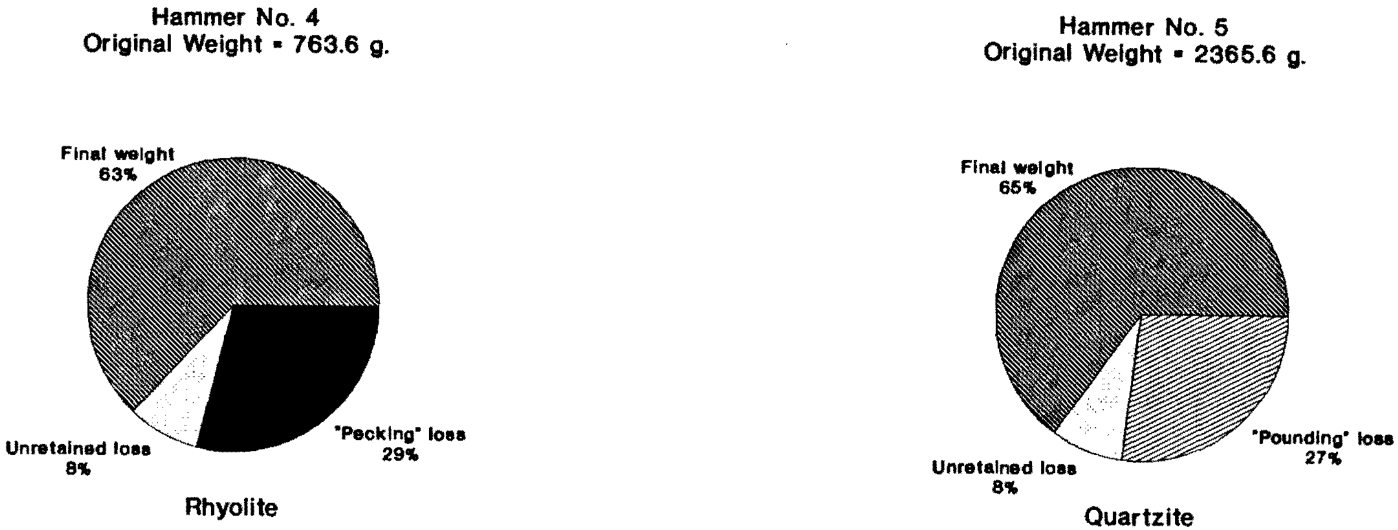


Figure 2. Hammerstone Experiment Phase 2.

Phase 2 experiments was a slight increase in the depth of dents produced when using the heavier hammerstones.

The damage to the angular-edged rhyolite hammerstone consisted of step fractures and edge-crushing, resulting in an object that might typically be classified as a "battered core". Damage to the initially unmodified (rounded) hammerstone resulted in bifacial feathered as well as stepped flake terminations and heavy edge battering. The resulting object closely resembled archaeological "chopper" specimens. As both Phase 1 and Phase 2 experiments produced edge configurations on initially unmodified hammers that are distinctly "chopper" like, the correct identification of such "choppers" as a functional type might sometimes be questioned. The "chopper" tool form may be a by-product of use rather than the result of intentional shaping.

The debitage produced during use of the quartzite hammerstone in Phase 2 was essentially similar to that observed during Phase 1. However, the debitage from the Phase 2 rhyolite hammerstone is much more angular and irregularly shaped than that produced from any of the quartzite hammerstones.

Phase 3

The final phase of the experimental study considered weathering of a grinding-stone surface as a variable that may effect the re-sharpening process. While basin or trough metates would have a fresh surface exposed during the manufacturing stage, initial use of a slab metate often involves the use of a natural slab or flat boulder that has been subjected to deep weathering. Would re-sharpening a weathered stone surface result in the same patterns of dent morphology and hammerstone use-attrition as was observed for the cut slabs used in Phases 1 and 2?

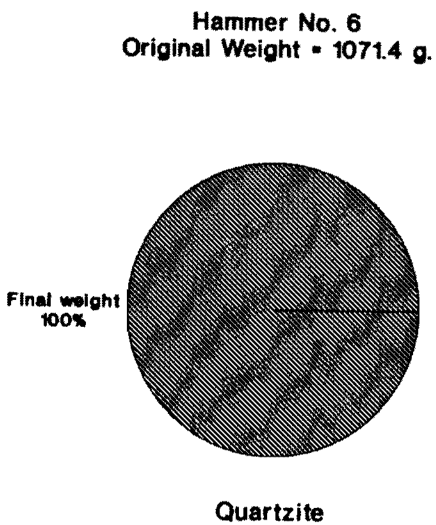
Methods. An unmodified, weathered granite slab was used as the simulated metate surface for the Phase 3 experiment. Two quartzite hammerstones were used: one was an unmodified cobble weighing 1071.4 g (hammerstone #6 in Table 1), and the other was flaked to form an angular-edged tool weighing 1094.1 g (hammerstone #7 in Table 1). In conducting the experiment, the weathered slab was first divided in half, with half of the slab being "pecked" with the angular-edged hammerstone, and the other half being "pounded" with the rounded, unmodified hammerstone. Each hammerstone was used to strike the weathered slab 200 times.

Results. The general shape of the dents produced in the weathered slab were similar to those observed on the cut slabs. However, there was a notable difference between the cut and weathered slabs in the depth of the dents produced. The dents produced in the weathered slab by the angular-edged hammerstone were deeper than those produced in the cut slabs by the angular-edged hammerstones of both the Phase 1 and Phase 2 experiments. In contrast to the oval marks produced by the unmodified (rounded) hammerstone in Phase 1, and the very shallow oval dents produced by the heavier unmodified tool in Phase 2, "pounding" of the weathered slab produced oval shaped dents that were as deep as those produced by the angular-edged tool on the same slab.

Damage to the initially unmodified (rounded) hammerstone was restricted to battering with no measurable weight-loss due to use-attrition (Figure 3, hammerstone #6). The angular-edged hammerstone lost only about 1% of its pre-use weight (Figure 3, hammerstone #7), with damage restricted to a minimal amount of small step fractures, again (as in Phase 2) resulting in an object that might easily be classified as a battered "chopper". The slight amount of debitage produced from the angular-edged hammerstone was essentially similar to the smaller debitage produced from the quartzite hammerstones in Phases 1 and 2.

CONCLUSIONS

The results of the Phase 1 and 2 experiments suggest that an angular-edged hammerstone would have been the most effective tool for re-roughening the grinding surfaces of metates and that "pecking", as referred to in the literature, would have indeed been the method of choice. However, in light of the results of the Phase 3 ex-



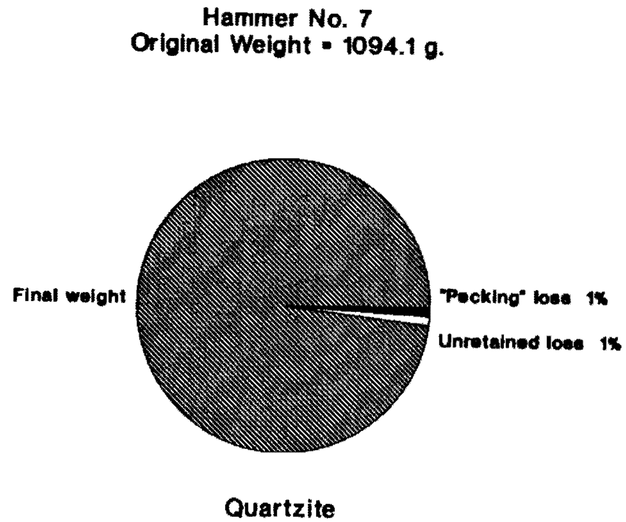


Figure 3. Hammerstone Experiment Phase 3.

periment, these conclusions should be qualified in the case of slab metates made from unquarried, weathered material. In such cases, the use of rounded hammerstones for the roughening process can be considered a viable possibility.

Of particular interest are the effects of the metate re-roughening process on the hammerstones used. We should be aware of the damage patterns produced on hammerstones that have been used in metate rejuvenation and take this into account in our analyses of lithic tools commonly classified as "choppers" and "battered cores". Seemingly anomalous debitage associated with milling activity areas should also be carefully considered as possibly being the result of the metate rejuvenation process. The results of this replicative study have suggested some interesting preliminary interpretations which are being pursued in additional experimental research.

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