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The Hidden Virtues of Ogallala Quartzite

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ABSTRACT

Knapping Ogallala quartzite proves a difficult task encountered by prehistoric people manufacturing stone tools. Nevertheless, two late Paleoindian sites (34Rm439 and 34Rm602B), and a late prehistoric site (34Rm507) in Roger Mills county, Oklahoma bear witness to this behavior. In addition to knapping, Ogallala quartzite was placed in hearths and possibly heat-treated. To discern prehistoric behavior the authors decided the minimum analytical nodule approach was a valuable tool for examining cultural behavior. To test the accuracy of this approach, a blind test was conducted by both researchers to find the degree of error between lithic analyst and variability of Ogallala quartzite within nodules and between nodules. Experiments of heat-treating, and tossing Ogallala quartzite into a camp fire provides data for determining if Ogallala quartzite was intentionally heat-treated or used for indirect cooking. The results of the following experiments provide a baseline for interpreting human behavior through understanding Ogallala quartzite procurement and use at prehistoric sites..

INTRODUCTION

Modern flint knappers might question the quality of Ogallala quartzite for producing stone tools, but undoubtedly prehistoric groups from Paleoindian through late Archaic periods used Ogallala quartzite for manufacturing their full repertoire of stone tools (Thurmond 1990; Thurmond 1991; Thurmond and Wyckoff 1999). Pete Thurmond's ranch located along the eroding eastern boundary of the Southern High Plains bears witness to several cultural groups manufacturing stone tools from Ogallala quartzite (Figure 1). Current research investigating surface finds from two late Paleoindian sites (34Rm439 and 34Rm602B) and a late Archaic site (34Rm507) located on the Thurmond Ranch are elucidating human behavior through lithic analysis. At all three sites, Ogallala quartzite is the predominate lithic material. After an initial examination of the Ogallala

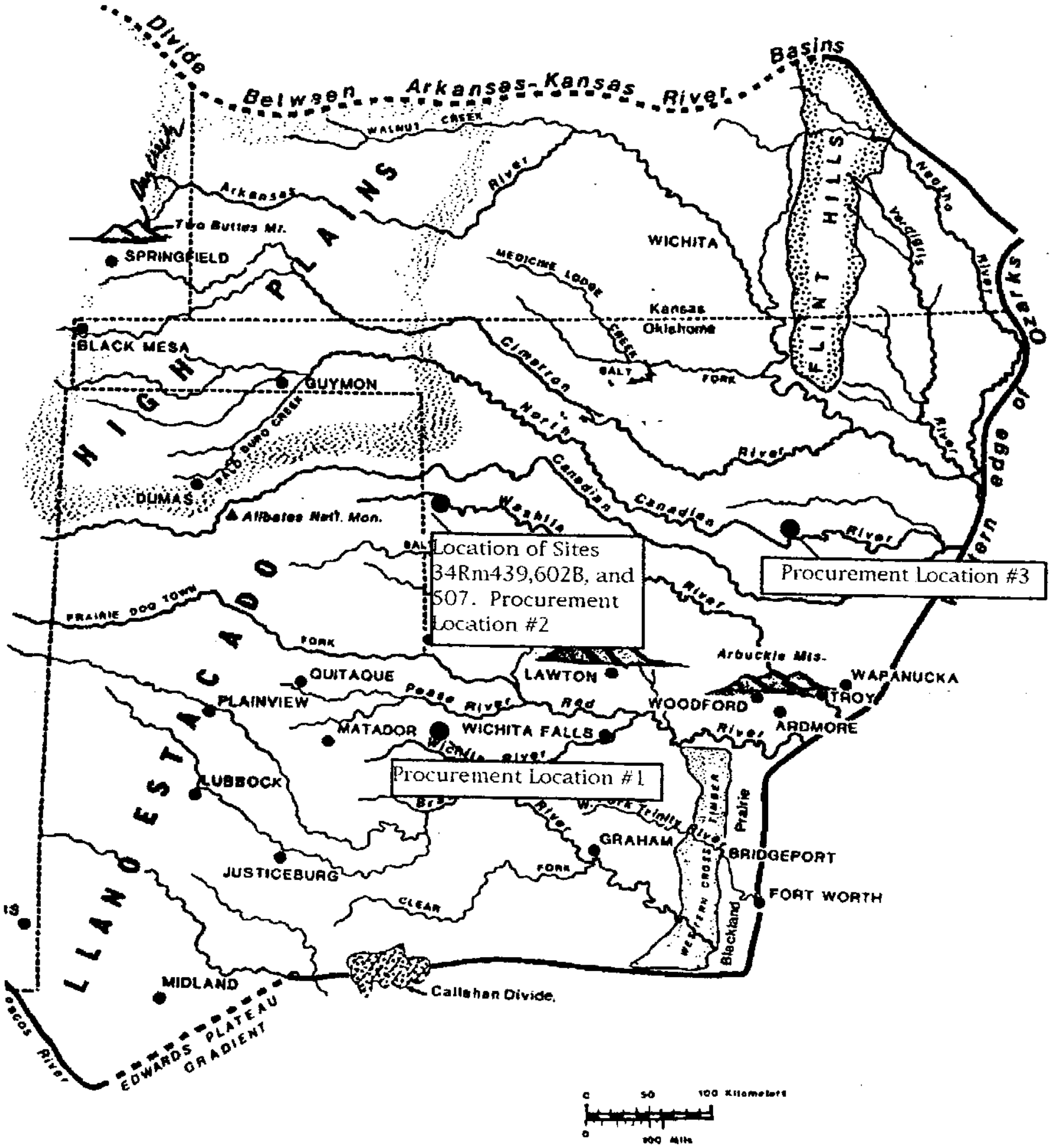

Figure 1. Map displaying Sites Discussed and Ogallala Procurement Locations (Modified from Banks 1990)

quartzite the striking variability between nodules due to differences in grain size, color, luster and inclusions excited both authors of the possibility of employing the minimum analytical nodule approach (Kelly 1985; Larson 1994; Larson 1997) . In addition, a large percentage of the debitage from 34Rm507 contrasts with typical Ogallala quartzite due to it's reddened cortex, and glossy, waxy luster suggesting heat-treatment (Figure 2).

In order to decipher human behavior at these sites a series of experiments were conducted to develop a baseline for relating Ogallala quartzite to human behavior. The following experiment consists of: 1) documenting the degree of difficulty in knapping Ogallala quartzite; 2) the use of the minimum analytical nodule approach for Ogallala quartzite; 3) replicating human behavior by heat-treatment experiments.

OCCURRENCE AND DESCRIPTION OF OGALLALA quartzite

Ogallala gravels derived from the Ogallala formation include quartzites, petrified wood, and various types of cherts that eroded from the Rocky Mountains (Banks 1984; Banks 1990). The gravels are ubiquitous upon terraces across the Central and Southern High plains (Figure 1) (Banks 1984; Banks 1990; Holiday and Welty 1981). Ogallala quartzite cobbles procured for the present study are well-rounded forming a smooth cortex with cortex colors varying from a light tan to dark red (Banks 1984). Grain sizes range from coarse to fine-grained and blue-green, tan, gray, brown, and red are the predominate color sequences with variability in the color that is most pronounced and the mixture of the above colors.

EXPERIMENT METHODOLOGY

Twenty-four Ogallala quartzite cobbles were procured from West Texas (between the towns of Matador and Crowell), 44 from the Thurmond Ranch (Rodger Mills Co, OK), and 22 from Central Oklahoma near the city of Tecumseh (Figure 1).

Flakes were detached while taking note of the degree of difficulty in removing flakes using the "hard" hammer percussion technique with the nodules infrequently resting against a leg and more frequently placed upon the ground (Table 1). Knapping ceased when flakes were no longer removable or a representative sample of both primary and tertiary flakes accumulated.

For the second part of the experiment, flakes from each of the 90 nodules were bagged and entrusted to Sue Richter for coding. From each bag Richter pulled between 0-5 flakes for minimum analytical nodule analysis (MANA) by each author. Each flake was then labeled by Richter representing its procurement location and nodule number.

Degree of Hardness	Number of Hard Hammer Blows
Easy	1-2 Blows
Medium	3-7 Blows
Hard	7 or More Blows

Table 1. Scale for Recording the Degree of Difficulty in Knapping Ogallala quartzite.

For the heat-treatment and campfire experiments, two flakes from ten fine-grained and ten coarse-grained flakes were detached from cores created from the prior reduction of Ogallala Quartzite from the Thurmond Ranch for MANA (Figure 3). One flake from each core was tossed into a camp fire while the other intentionally heat-treated. By purposefully selecting coarse and fine-grained Ogallala quartzite flakes the effect of heat-treatment on grain size was measured. Five of the coarse-grained and five of the fine-grained cores were also reserved for intentional heat-treatment or tossed into the camp fire.

Similar to Phagan (1970) in a $2ft^3$ pit a fire was allowed to burn for 1.5 hours and created three to four inches of coals. One inch of soil was layered evenly across the coals and Ogallala quartzite flakes and cores were embedded into the soil. Another inch of soil placed upon the Ogallala quartzite served as a buffer for another fire created on top and allowed to burn for four hours. After the fourth hour, eight inches of soil was piled on top of the four to five inches of coals for further cooking and allowing the treated-samples to cool off gradually overnight.

RESULTS

Recording the degree of difficulty is subjective based upon the individual investigator, nevertheless the results are intriguing (Figure 4). Both authors expected and found finer-grained nodules detached flakes easier than coarser-grained nodules. However, the most important variables resulting in successful flake detachments are the initial exterior platform angle and size of the cobble. The size of the cobble is correlated with the initial exterior platform angle. Smaller cobbles are more rounded than larger cobbles resulting in less initial striking platforms less than 90 degrees for detaching flakes.

With other lithic raw material types such as cherts and obsidian, the knapper can detach flakes with an initial exterior platform angle greater than 90 degrees to set up a striking platform. The knapper can accomplish this by holding/resting the cobble against a leg, or by using the bipolar technique. Both of these techniques are

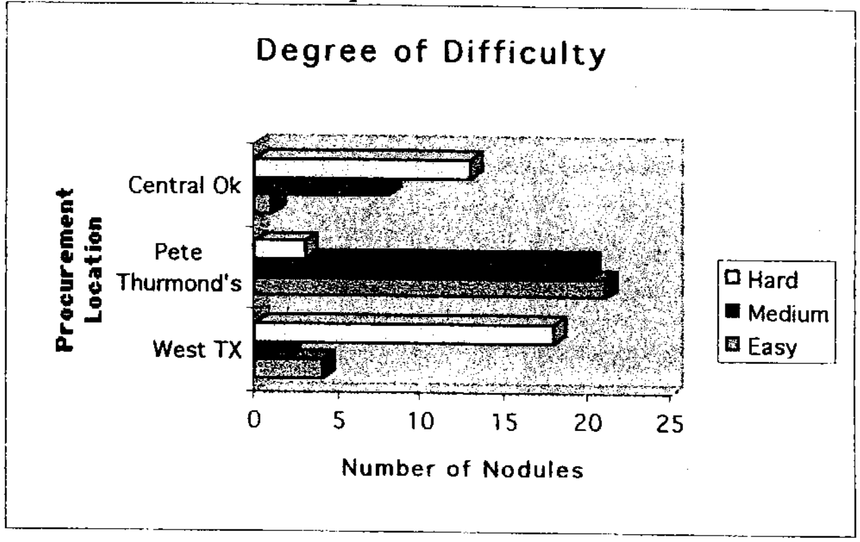

Figure 4. Degree of Difficulty Results

unsatisfactory for detaching flakes from Ogallala quartzite. Detaching flakes from an Ogallala quartzite cobble that is well-rounded by resting it against a leg is almost impossible. By using a cement block as an anvil and striking the cobble numerous times with a steel hammer results in a lot of cursing and eventually unusable pieces of shatter.

A prehistoric person manufacturing usable stone tools from Ogallala quartzite will find differences in procurement locations for easier flake detachment. At the Thurmond, ranch a higher percentage of easy and medium difficulty nodules were recorded compared to the other procurement locations (Figure 4). Aside from mere coincidence or an act of the lithic gods, gravels by nature should contain a random assemblage of fine-coarse grained Ogallala quartzites. The Thurmond ranch may be a better procurement location due to large quanity of Ogallala quartzite nodules, resulting in a wider selection, and therefore larger sized nodules with an initial exterior platform angle less than 90 degrees. On average for all three procurement locations, a prehistoric person will find fine-grained large nodules with initial exterior platform angles less than 90 degrees 29% of the time (Figure 4). Thirty-three percent of the time the nodules will be more coarse-grained and have fewer initial exterior platform angles less than 90 degrees. Thirty-eight percent of the time, the cobbles will be smaller without initial exterior platform angles less than 90 degrees.

MANA Test

For the MANA test each author employed similar separating strategies without conferring with each other in organizing the flakes into nodules. Flakes with comparable grain size and color were first distinguished and placed into nodules together. Cortex, and inclusions were not as diagnostic as grain size or color, but were characteristic for some nodules. Although comparable techniques for separating flakes into nodules were employed there is discrepancy between the two authors' results (Figure 5).

The first author's tendency in sorting flakes into nodules was to split flakes into more nodules, compared to the second author's preference for lumping together flakes into less nodules. As a result being too discriminatory or lacking in the ability to discern color and grain size variation accurately, the first author spent three hours separating a total of 169 flakes from 53 nodules into 63 (Figure 5). The second author in hare-like fashion, separated the same flakes into 49 nodules in 1.5 hours.

To measure the accuracy of each author for placing a given flake into the proper nodule, a point was counted for each flake properly correlated with another flake from the same nodule, or if a nodule with a single flake was properly identified. The first author's 56% accuracy rate is lower than the second author's 62% in correlating two or more flakes within the same nodule. In contrast, the first author perfectly correlated flakes within 14 nodules while the second author scored perfectly on eight nodules.

The results indicate variability in the accuracy of estimating the number of minimum analytical nodules, and placing flakes within their correct nodules. A highly subjective exercise, it is difficult to define standardized criteria for more objectivity. To eliminate a portion of the variability, it is suggested that one or more analysts with similar blind tests scores conduct the MANA. The two authors results are comparable, but after more extensive MANA of Ogallala quartzite the scores will exhibit

less variability and possibly increase.
A 56%-62% accuracy level for using the minimum analytical nodule approach to Ogallala quartzite will lead to interpretative errors in demarcating expedient versus curative types of behavior within nodules. For example, if one nodule contains biface thinning flakes and the biface is placed into another minimum analytical nodule than the first nodule suggests a curative type behavior which is in error.

This accuracy level allows a fairly accurate determination of the

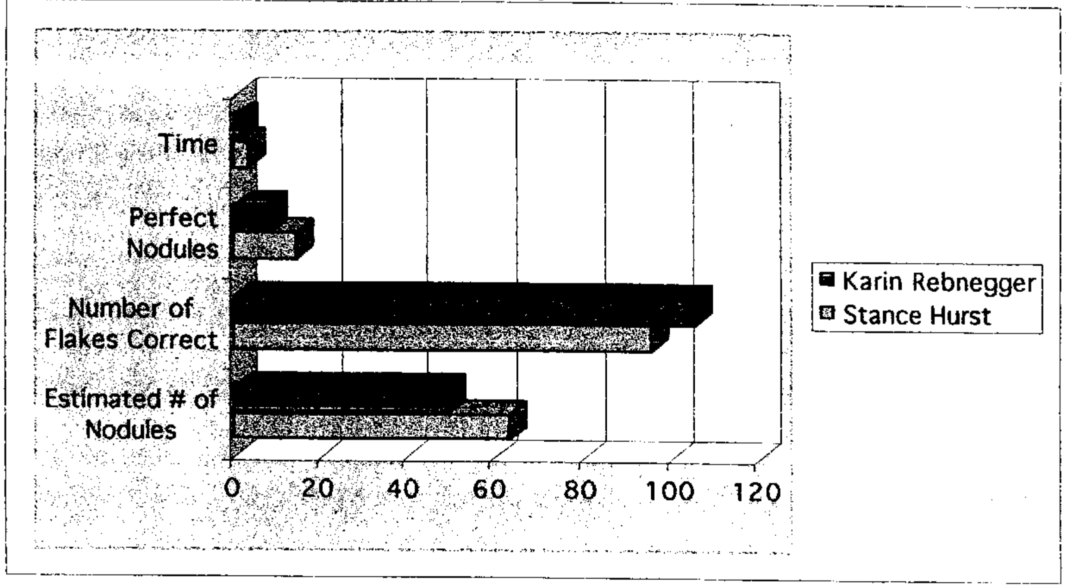

Figure 5. Variability between Analyst in the MANA

number of minimum analytical nodules present at the site, and the kinds of activities represented at the site. However, this accuracy level is not high enough for understanding expedient and curative behavior with Ogallala quartzite.

The 56%-62% level of accuracy is improved by sites with discrete spatial activity areas (Larson 1994). At such sites with a limited number of nodules reduced to specific areas increases the accuracy level of the MANA. Refitting is another a valuable check in determining the accuracy of the MANA, with a high frequency of refits within nodules confirming the accuracy of the MANA.

In using any type of subjective approach to lithic technology, it is important to find the degree of error and variability on the part of investigator(s) and the technique. An understanding of the degree of error helps structure the types of inferences possible in interpreting the archaeological record.

Heat Alteration Experiment Results

Unlike cherts and confirming Phagan's (1970) and Hanckel's (1985) results, the authors observed no macro changes in Ogallala quartzite after heat-treatment (Ahler 1982; Crabtree 1964) (Domanski 1992) (Mandeville 1973). Failure to replicate the waxy glossy appearance of lithic artifacts from 34Rm507 indicates the authors heat-treatment technique is in error or the waxy glossy appearance of the lithic artifacts are not due to heat-treatment. None of the Ogallala quartzite nodules and subsequent debitage from all three procurement locations exhibit the glossy waxy appearance characteristic of heat-treatment. If natural processes were the culprit for producing the glossy waxy appearance, then different sides of the artifacts should exhibit differences in the degree of waxiness and glossiness or all of the debitage from 34Rm507 should be similar in the degree of waxiness and glossiness. Both authors agree that a different heat-treatment technique was employed and future experiments are planned to understand this technique for further elucidation of human behavior. Additional planned heat-treatment experiments include: cooking the same Ogallala quartzite debitage involved in the first experiment replicating the exact technique to discern if multiple heat-treatments are necessary in producing pronounced changes. A lithic technology class under the direction of Dr. Don Wyckoff found a pit lined with stone slabs compared to pit without produced far more visible alterations in cooking chert. Another pit will be lined with stone slabs to trap heat and distribute it more efficiently and for longer periods of time.

The Ogallala quartzite tossed directly into the campfire began to explode potlid flakes and fracture into FCR/shatter after a half hour and became a dangerous affair to approach within one meter of the the fire after a hour. The fire burned for four hours and then was put out and allowed to cool overnight. Screening the hearth area with a 1/4" mesh the authors found a total of 13 flakes, 122 potlid flakes, 80 FCR, and 95 shatter from the original 20 flakes and 10 cores. This debitage is distinctive and characterized by a reddened cortex, gray and black color, and numerous potlid flakes detached from exposed surfaces. Prehistoric people heating quartzite for indirect cooking may have found it necessary to remove the nodules between 30 minutes to 45 minutes after placing them into the fire. Ogallala quartzite left unattended in the fire results in numerous and distinctive shatter, FCR, and potlid flakes detached in a circular fashion within one meter from the fire (Figure 6). If this type of pattern is found in the archaeological record, then the hearth was left unattended after placing Ogallala quartzite into the fire, limiting human activity around the hearth at that time.

CONCLUSION

Elucidation of human behavior through experimentation results in a greater understanding of the static archaeological record. Blind tests conducted upon subjective types of lithic analysis such as use-wear or MANA leads to a better understanding of the investigators accuracy and the types of inferences reliably drawn from the archaeological record (Newcomer 1986) (Newcomer and Keeley 1979) (Odell 1980) (Odell 1985).

Both authors regard these experiments as a decoding mechanism for interpreting the archaeological record and providing new insights into prehistoric human behavior (Schiffer 1972). Further experimentation with Ogallala quartzite will reveal other types of human behavior adding to the hidden virtues of Ogallala quartzite.

Acknowledgments

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